Nantucket Memorial Airport Master Plan Update

CHAPTER 2 – AIRFIELD INVENTORY

–FINAL DRAFT–

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CHAPTER 2 – AIRFIELD INVENTORY

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Chapter 2 - Airfield Inventory

2.0 Introduction

The initial step in the preparation of Nantucket Memorial Airport's (ACK's) Master Plan is the collection of current information, including relevant information from the previous Airport Master Plan[1] and other studies. This chapter details the existing conditions at ACK. The Airport's existing facilities are comprised of **airside facilities** (runways, taxiways, aircraft parking aprons, NAVAIDS), and **landside facilities** (passenger terminal, auto parking lot, Fixed Based Operator (FBO), Aircraft Rescue and Fire Fighting (ARFF), the Air Traffic Control Tower, hangars, and fuel farm). In addition, local airspace, FAA design criteria, land use, zoning and environmental issues are discussed within this chapter. A detailed analysis of existing facilities, both airside and landside, serves as the basis for future planning recommendations.

2.1 Background

Located on the Island of Nantucket, ACK is the second busiest airport in Massachusetts, after Logan International Airport, during the months of July and August[2] as it is a popular destination for seasonal tourist traffic. The airport is owned by the Town of Nantucket and operated by the Nantucket Memorial Airport Commission. The Commission is an appointed agency under the Nantucket Board of Selectmen and operates the airport under its independent self-sustaining Enterprise Fund. The Commission has undertaken this Airport Master Plan Update to assess the current and future aviation safety and operational needs for improving the airport's landside and airside facilities.

ACK is classified within the National Plan of Integrated Airport Systems (NPIAS) as a "Primary" airport. A "Primary" airport is defined as a public use airport that receives scheduled airline passenger service, enplaning 10,000 or more passengers per year. ACK is a public use facility (i.e. does not require prior permission to take off or land) with over 170,000 enplanements.

Due to the Island's popularity as a summer resort destination, the airport experiences significant seasonal changes in the fleet of visiting aircraft. In discussions with the airport operations staff, the GA/corporate jet fleet utilizing ACK has evolved to larger, wider-wingspan corporate jets that occupy larger areas of ramp space. During peak summer weekends, especially during the Airport's busiest months of July and August, there is limited ramp space available, leading to narrow taxilanes and limited maneuvering areas for aircraft.

In addition, there have also been significant changes in the aviation industry, both nationally and regionally. The data pertinent to these changes is discussed in the following sections.

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[1] Nantucket Airport Master Plan - 1999

[2] Town of Nantucket. (2013) *Nantucket Facts*. Retrieved from http://www.nantucket-ma.gov/Pages/NantucketMA_Visitor/nantucketfacts.pdf

2.2 Airport Location/Regional Demographics

ACK is located on Nantucket Island, 25 miles south of Cape Cod, MA. The Island's isolated location and local demographics lend uniqueness to its aviation activity that is fundamentally different than at most other mainland airports. Unlike mainland airports, it is not the local area's year-round population, employment, or income that drives aviation activity; instead it is driven primarily by second home owners and seasonal visitors. A review of local demographics provides insight to the Island's prosperity, as derived from its year-round residents and seasonal visitors; all of whom arrive only either by air or by boat.

2.2.1 Local Demographics

In terms of its population, income and employment, Nantucket is unique in many respects:

- Nantucket is predominantly a summer resort where the population between June-September escalates to approx. 50,000, which is almost five times greater than the year round population of 10,240.
- 75% of all visitors arrive by ferry; the remainder arrives by air.
- 37% of all employment on the island is in the service/hospitality industry.
- There are a high percentage of second-home owners, and Nantucket has the highest median property value in the state.
- Nantucket has among the highest per capita and household income in Massachusetts.
- Construction represents the second highest employment sector on the Island, however, many construction and service sector employees 'commute' by air and boat from Hyannis.

The last two factors in particular have a direct impact on corporate aviation activity, which fluctuates in relation to those economic indicators. The advent of fractional ownership of corporate aircraft has further stimulated demand for corporate aircraft use at ACK.

A detailed discussion of the Islands' population, income and employment data from the 2012 Nantucket Regional Transportation Plan, authored by the Nantucket Planning and Economic Development Commission (NPEDC) is provided in the following sections.

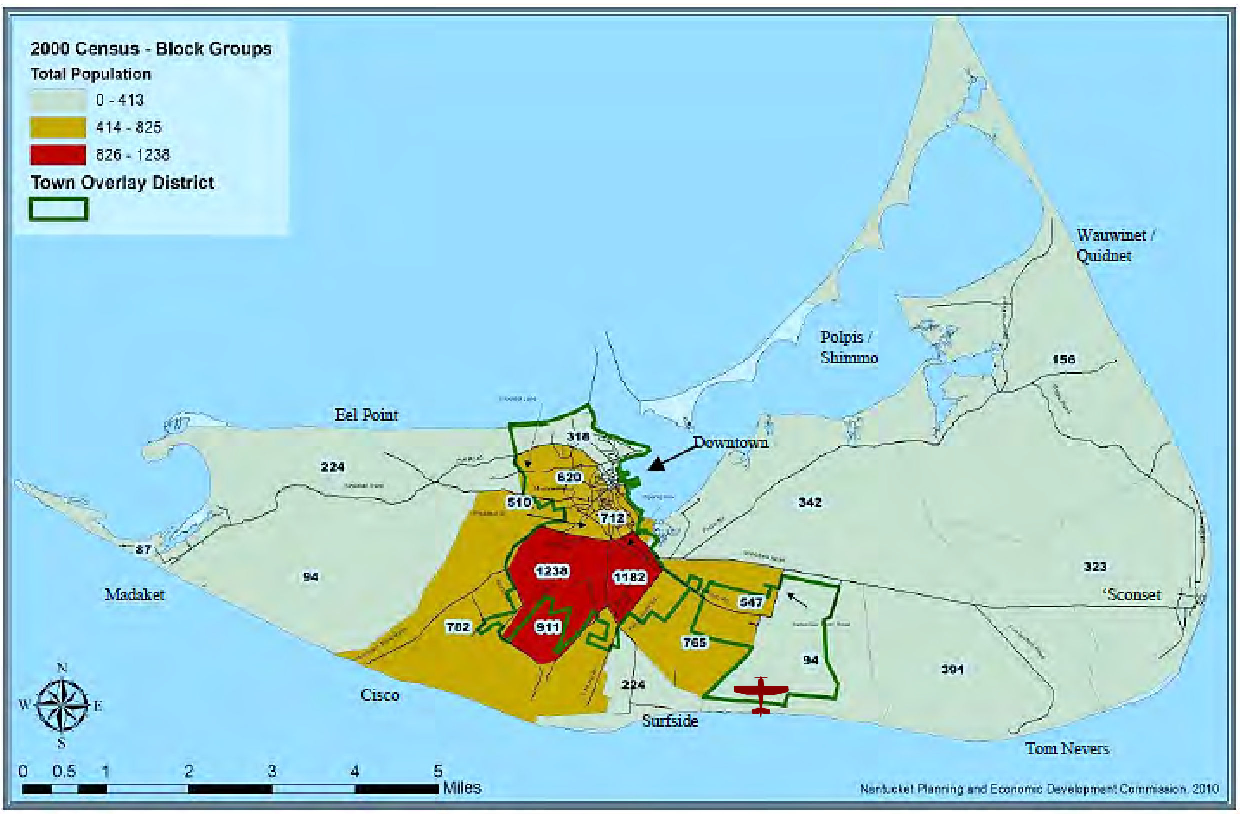
2.2.2 Population

Population data can be used to gauge a location's propensity to attract additional residents and businesses, which may increase the need for additional transportation services such as aviation. Conversely, a declining population is less likely to demand transportation services. Population density is also reviewed to determine current and future land use for areas that surround the airport.

Population indicators such as distribution and density were reviewed from a report prepared by the NPEDC which used US census data from the year 2000 as a base year. The NPEDC extrapolated future estimates from the census data to update total projected year-round resident population growth.

Figure 2-1 shows a map of the year round population distribution throughout the Island and population density in proximity to the airport. The locations marked in red notate the highest population concentration, which are located in the central portion of the island. According to the NPEDC, this central core of the Island contains approximately 35% of the year-round residents occupying about 4% of the total land area.

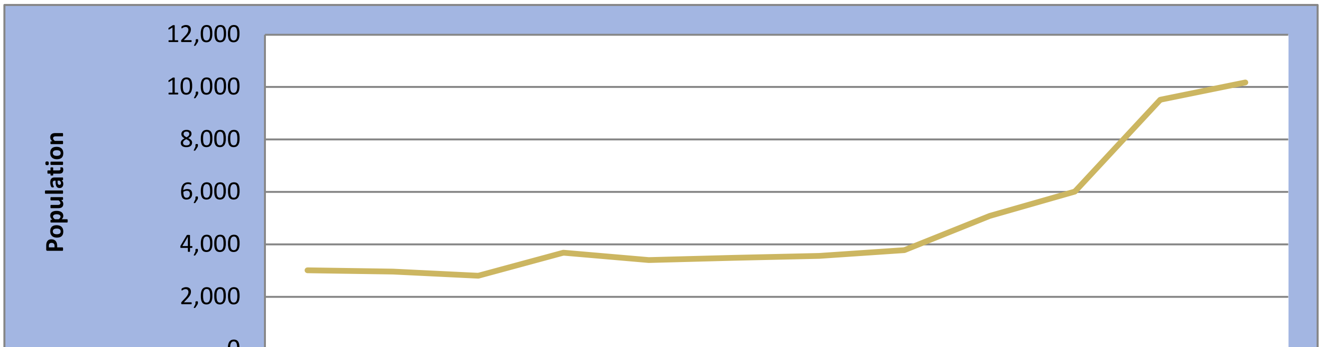
Figure 2-1 Nantucket Total Population per Acre (2000 Census)



Source: 2012 Nantucket Regional Transportation Plan

Figure 2-2 on the following page illustrates the increasing population of year-round residents on the island. The NPEDC further notes: "According to the US Census figures, there were 3,774 residents in 1970, and by 2000 this figure had grown to 9,520. The estimated 2008 population grew about 18% since 2000 to over 11,000."

Figure 2-2 Population by Year (US Census)



	1900	1910	1920	1930	1940	1950	1960	1970	1980	1990	2000	2010
POPULATION	3,006	2,962	2,797	3,678	3,401	3,484	3,559	3,774	5,087	6,012	9,520	10,172

Source: 2012 Nantucket Regional Transportation Plan

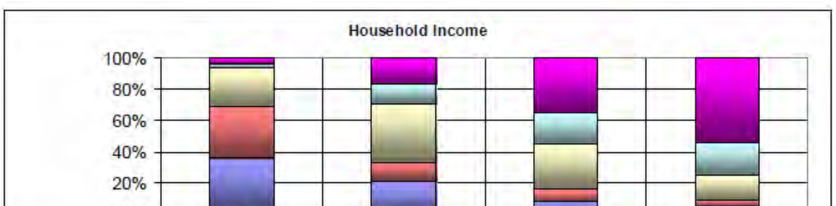
An increasing population could lead to additional demand for air travel. Additionally, existing land use controls need to be evaluated to ensure compatible development near the airport.

2.2.3 Income

A review of median income for residents on Nantucket illustrates the shift in population and likelihood of available discretionary income for alternative modes of transportation, such as travel by airline and corporate jets. This echoes the recent trend cited by Airport Operations staff that visitors/residents are arriving on larger aircraft than in years past.

Figures 2-3 and 2-4 illustrate the local income levels and the mean and median income for Nantucket residents. The NPEDC noted that, "Most residents now earn over $75,000 with the mean income actually surpassing the median income level in 1999, meaning those of the higher income began earning significantly more than most year round employees."

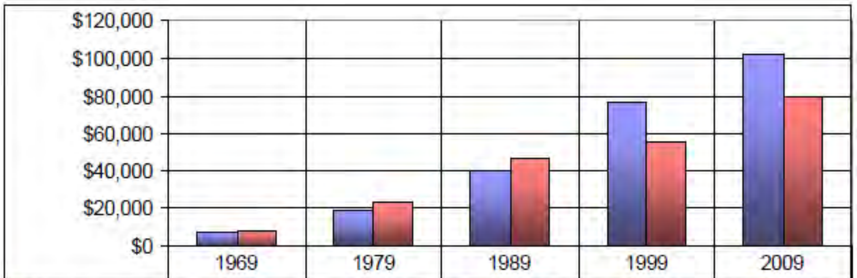
Figure 2-3 Nantucket Island Household Income Levels (US Census)



	1979	1989	1999	2009
Over $75,000	81	382	1,307	2,269
$50,000 to $74,999	49	282	736	833
$25,000 to $49,999	547	879	1,061	683
$15,000 to $24,999	702	260	282	167
Less than $15,000	782	482	315	212

Source: 2012 Nantucket Regional Transportation Plan

Figure 2-4 Mean/Median Household Income (US Census)



	1969	1979	1989	1999	2009
Mean Income	$7,064	$19,012	$40,331	$76,214	$102,243
Median Income	$7,872	$23,071	$46,606	$55,522	$79,431

Source: 2012 Nantucket Regional Transportation Plan

2.2.4 Employment

The seasonality of the ACK economy is evident in the employment demographics that were reviewed as part of this master plan update. The seasonal fluctuation of the labor force suggests that most of the jobs on the island are either (a) held by workers who do not live on Nantucket year-round or (b) held by Nantucket residents who enter and leave the labor force on a seasonal basis.

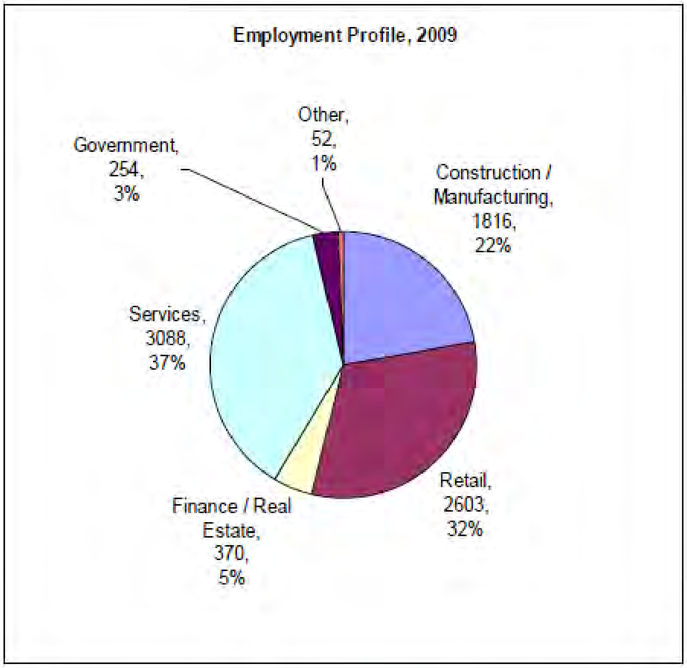
Employment peaks during the warmer summer months as shown in the employment profile, which is heavily weighted towards hospitality, retail and construction services. **Figure 2-5 and 2-6** on the following page depicts an economy supported by the influx of second home owners and tourists.

Figure 2-5 Monthly Employment Trends, 2009 (Bureau of Labor Statistics)

	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Employed	5,465	5,400	5,513	6,215	7,318	9,407	10,958	10,849	8,905	7,584	6,467	

Source: 2012 Nantucket Regional Transportation Plan

Figure 2-6 Employment profile, 2009 (Bureau of Labor Statistics)



Source: 2012 Nantucket Regional Transportation Plan

Also refer to Chapter 4 for further discussion on demographics.

2.3 Aviation Activity

This section describes the 2012 levels of based aircraft and aircraft operations at ACK. The purpose of this section is to provide an overview of historical and current aviation activity that will be used as a base for the forecasting and facility requirements within this update.

Aviation activity is measured primarily in terms of aircraft operations (considered either a takeoff or landing) as well as by passenger enplanements (passengers boarding a departing commercial flight). ACK accommodates a wide variety of activity and users, from scheduled airlines to on-demand charters and air taxis, to small general aviation airplanes, larger corporate jets, and occasional military traffic.

Nantucket is a unique air travel market, driven by unique demographic and geographic characteristics. It is a small island that has among the highest percentage of second home owners, along with the highest average housing prices in the country. As a result, the air service market (which includes scheduled air carriers, and on-demand air taxis) is more directly affected by national and international economic developments and financial industry trends.

Since Nantucket is an island, there are only two means of access to the Island; either by air or water. Scheduled ferry and air service serves the majority of travelers to/from the Island. Privately owned boats and airplanes provide the remaining transportation options. Recent trends with high speed ferry service, and its implications for Nantucket's commuter air service to Hyannis, are discussed in Chapter 4.

There is an FAA operated Air Traffic Control (ATC) tower at ACK. The ATC tower operates daily from 6 AM to 9 PM off season (October-May). During the summer months (June-September), the ATC tower remains open until 10 PM. The hours are adjusted seasonally to coincide with the changes that occur as a result of seasonal peak and off-peak traffic. The FAA control tower personnel maintain aviation activity records at Nantucket Airport, which are compiled and uploaded to FAA's Air Traffic Activity Data System (ATADS) web site[3]. ATC staff estimate that the number aircraft operations that occur when the control tower is closed equal no more than 5% of the counted operations. FAA controllers count aircraft operations (takeoffs and landings) and classify them into the following categories:

- **Air Carrier (AC)** - An aircraft with a 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. (Note: JetBlue, United, Delta, and US Airways Express are classified as air carriers because they operate regional jets, including the E-190 and CRJ-200, and turboprops such as the Dash 8).

- **Air Taxi (AT)** - An aircraft designed to have a maximum seating capacity less than 60 seats or a maximum payload capacity of 18,000 pounds or less carrying passengers or cargo for hire or compensation. (Note: Cape Air, Nantucket Airlines, and Island Airlines are classified as air taxi because they operate Cessna 402 and Caravans. In addition, a variety of general aviation aircraft from single-engine pistons up to corporate jets operate as Air Taxi under Federal Aviation Regulation Part 135. When they use an FAA-designated air taxi call-sign they are counted by air traffic control as an air taxi operation. These can include turboprops such as the Pilatus PC-12 and larger corporate jets such as the Cessna Citation 10 and Gulfstream 650, or smaller single engine pistons, such as the Cirrus SR-20.)

- **General Aviation (GA)** - Takeoffs and landings of all civil aircraft, except those classified as air carriers or air taxis. Usually small single or twin-engine piston planes, such as Cessna 172's, 182's, and Beech Bonanzas or Barons.

- **Local operations** - are those operations performed by aircraft that remain in the local traffic pattern, execute simulated instrument approaches or low passes at the airport, and the operations to or from the airport and a designated practice area within a 20−mile radius of the tower.

- **Itinerant operations** - are operations performed by an aircraft that lands at an airport, arriving from outside the airport area, or departs an airport and leaves the airport area.

- **Military** - aircraft operated by all branches of the military, as well as the National Guard, Reserve, and U.S. Coast Guard.

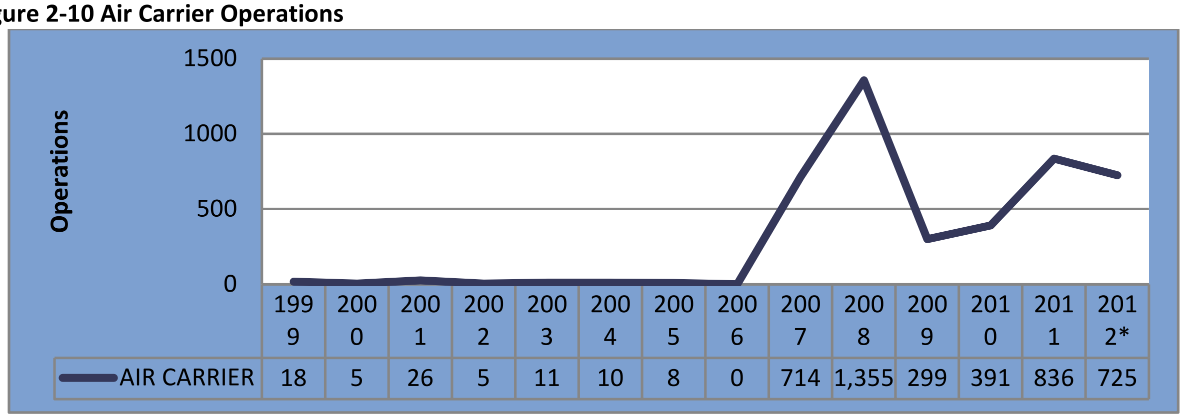
[3] Source: https://aspm.faa.gov/opsnet/sys/Airport.asp

2.3.1 Air Carrier Operations

Air carrier service is strictly seasonal at ACK and provided by regional airlines utilizing longer haul, turbine-powered aircraft which fly longer hauls and include JetBlue, United Airlines, Delta Airlines, and US Airways (now merged with American Airlines). As noted above, FAA air traffic controllers distinguish between air carrier and air taxi aircraft operations. Air carrier aircraft are defined by the FAA as more than 60 seats and capable of carrying more than 18,000 lbs. of payload. That includes regional jets such as the CRJ-200 (flown by American Airlines), ERJ-190 (flown by JetBlue), as well as larger turboprops such as the DHC Dash-8/Q-300.

There had been a substantial increase in air carrier operations in the years 2006-2008. During 2008 to 2009 air carrier operations declined by 77%. However, from 2009 to 2013, air carrier operations have gained back nearly half the loss, increasing by 47% to 793 operations in 2013 (see **Figure 2-10**).

Figure 2-10 Air Carrier Operations



Source: FAA Air Traffic Activity Data (ATADS)

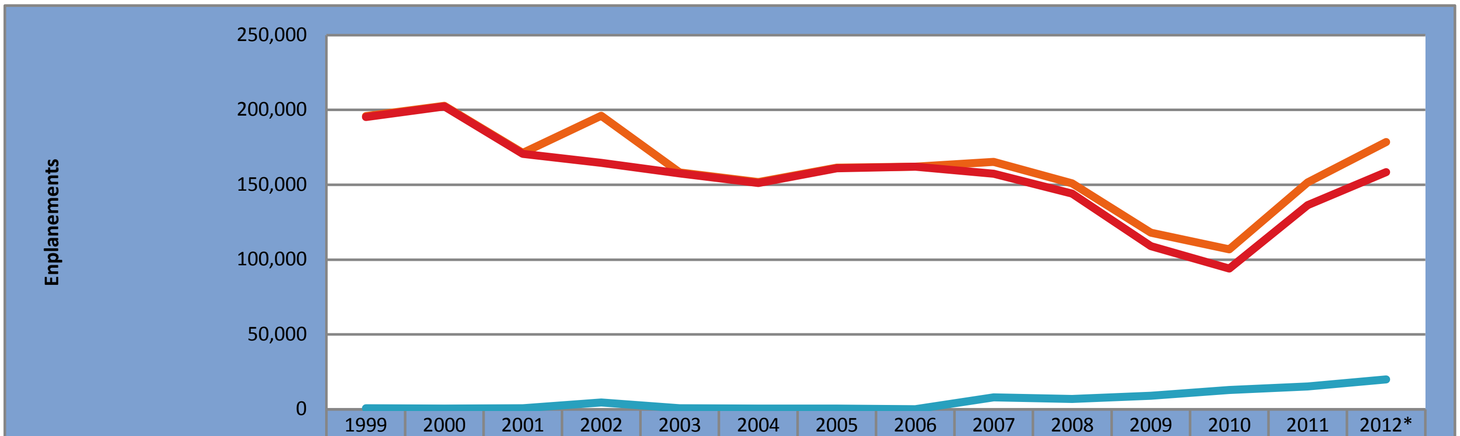
Air Carrier Enplanements (Peak Period)

ACK experiences a very strong peak season in passenger enplanements, which typically lasts for four months from June to September coinciding with peak summer tourist season. Between 2001 and 2013 peak season operations consistently generated between 46% - 49% of total annual activity, which is one of the strongest seasonal peaks of any airport in the U.S.

Peak month is typically July or August, and peak month activity shows similar trends – it has consistently represented 14.1% of total annual operations.

Overall, total enplanements have been increasing steadily since 2009, which reflect the increased amount of air carrier activity at ACK. Since August 2011, peak month screened air carrier enplanements have increased by more than 25%, which have implications for the airlines' potentially using larger aircraft. **Figure 2-11** illustrates the recent gains in total annual enplanements, including the air carrier segment, which reflects growing the peak summer seasonal market at ACK.

Figure 2-11 Total Enplanements



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
TOTAL ENPLANEMENTS	195,839	202,812	171,264	196,085	158,145	151,766	161,410	161,981	165,254	150,870	118,019	106,807	151,665	178,512
TOTAL AIR CARRIER	676	570	603	4,473	661	561	432	1	7,950	6,873	9,122	12,879	15,257	20,015
TOTAL COMMUTER	195,163	202,242	170,661	164,612	157,484	151,205	160,978	161,980	157,304	143,997	108,897	93,928	136,408	158,497

Source: FAA Air Traffic Activity Data (ATADS)
*Numbers for 2012 considered estimated

A major component of Nantucket's enplanements are the year-round commuters who utilize the very high-frequency, short-haul, year-round service provided by Cape Air, Island Airlines, and Nantucket Airlines (owned by Cape Air), with piston-engine Cessna 402s. Island Air has recently introduced turbine-engine Cessna Caravans. ACK's primary commuter markets are HYA and BOS, although Cape Air also flies to EWB, MVY, PVD, and White Plains, NY.

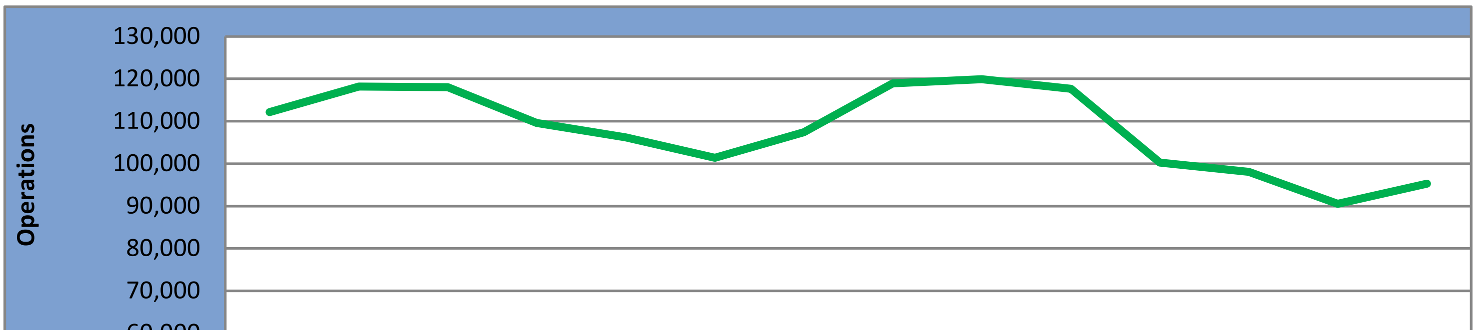
Typical commuter passengers include those who reside in the metro areas of Hyannis, Boston, Providence, and New Bedford, as well as those passengers who drive to those locations from throughout New England, New York, and New Jersey, to connect with a flight to ACK. Cape Air has an interline agreement with JetBlue at Boston Logan Airport and both use Terminal C. As a result, some of Cape Air's passengers connect with Jet Blue for flights beyond Boston and New York. Jet Blue now flies a seasonal flight between BOS and ACK utilizing E-190 aircraft. Chapter 4 discusses the potential for Jet Blue to operate the E-190 at 85% load factors on the BOS-ACK route. However, because Cape Air is a privately held company, the actual number of Cape Air passengers connecting with Jet Blue or other carriers for destinations beyond Boston, cannot be quantified. This potential "beyond Boston" market from Nantucket is analyzed further in Chapter 4, Air Service Trends.

2.3.2 Air Taxi Operations

Distinct from the passenger enplanement statistics are the airport's flight operations counts. These counts of aircraft types are tabulated by FAA Air Traffic Control, which combines certain "air carrier" aircraft types with "commuter" aircraft and on-demand air charter aircraft into "air taxi" operations. This combined "air taxi" category mixes year-round Part 135 air taxi and on-call charter operations that operate a variety of aircraft to nearby destinations on the mainland. In addition to Cape Air's Cessna 402's, larger equipment operated by airlines such as US Airways (now American Airlines) which operate the CRJ-200 regional jet, are also categorized by the FAA as "Air Taxi" operations. It is apparent in reviewing the FAA's operations data that Air Taxi operations at ACK generate the greatest amount of air traffic, as discussed below.

Air taxis generated 119,876 operations in 2007 and 95,244 operations in 2012. **Figure 2-9**, shows that although air taxi operations had declined between CY 2007 and 2011, they had begun to increase by 5% between 2011 and 2012, and still represent the majority of commercial operations at ACK.

Figure 2-9 Total Air Taxi Operations



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
AIR TAXI	112,149	118,190	118,035	109,559	106,183	101,396	107,386	118,935	119,876	117,667	100,218	98,090	90,515	95,244

Source: FAA Air Traffic Activity Data (ATADS)

Airplanes used by on-demand/air taxi operators such as Executive Jet, NetJets, or Citation Shares, are typically the same type of corporate jets and turboprops used by other companies and individuals for non-commercial (FAR Part 91) operations. Non-commercial operations are counted by ATC as General Aviation (GA), and they use their designated N number for their call sign (e.g. "N1317U").

The recent increase in air taxi operations is due to several factors, including a rebound from the recession of 2008-2010 which leads to an increase in high-end passengers desiring expedited, private service. As the economic situation improves, growth is anticipated to continue in both air taxi and charter service passengers (see **Chapter 5, *Aviation Activity Forecasts***).

2.3.3 General Aviation - Local Operations

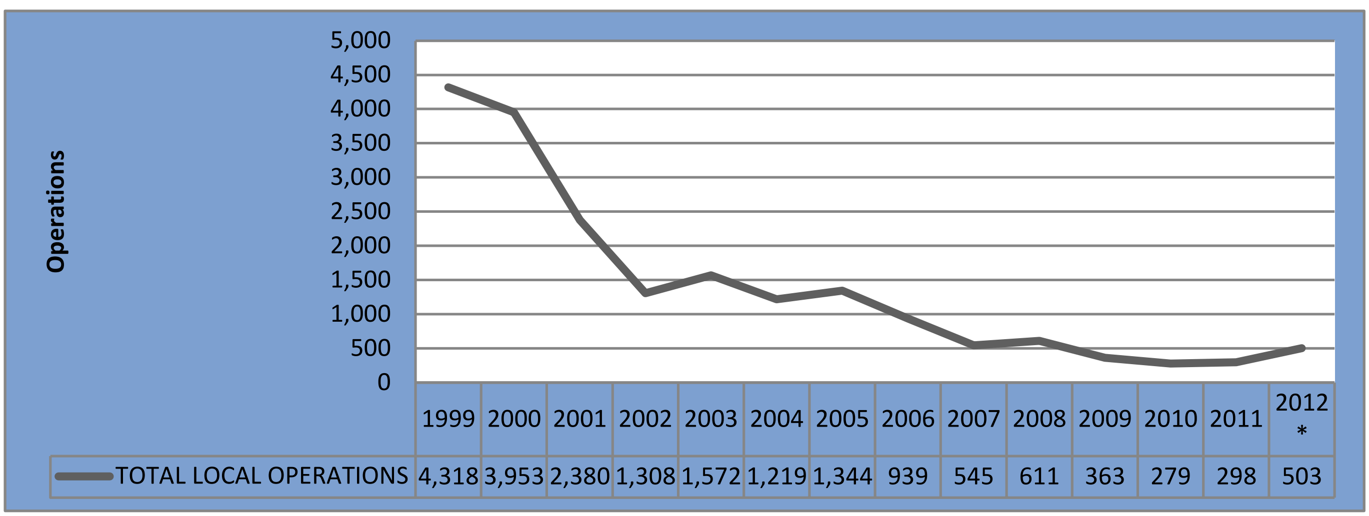
General Aviation (GA) activity is made up of local and itinerant operations, and encompasses a broad spectrum of civilian aircraft types and use. The aircraft range in size from the smaller single engine piston types, such as a Cessna 172, up to the largest corporate jets such as the Gulfstream 650. All types of GA operate at Nantucket, although as described below in Section 2.5.1.5, the mix and size of Nantucket's GA fleet is changing.

Local General Aviation aircraft operations, which are primarily training flights (e.g. touch-and-go activity), declined by almost 90% from 1999 to 2012, and in CY 2012 generated only 339 operations, less than one half of one percent of total operations. Prior to 2013, there was no flight school based at Nantucket. However, a new organization, Nantucket Flyers Association, is developing an aviation curriculum at the High School with support from local pilots so it is anticipated that training activity will increase. Military aircraft activity generated less than one half of one percent of total operations. **Figure 2-7** depicts the changes in local airport operations by year for aircraft based at ACK. The amount of based aircraft at ACK has declined by 49% since 1999. The overall total local operations have steadily since 1999 (by 88.4%).

A number of factors contributed to the decline in activity, including:

- The economic recession of 2008-2011;
- Decline in based aircraft due to increasing cost of ownership;
- Lack of flight schools based at ACK, and flight instructors from other airports on the Massachusetts mainland do not typically authorize their students to fly over Nantucket Sound to do touch and goes at ACK;
- Summer traffic at ACK is often too heavy to accommodate touch and go's;
- The weather on ACK changes rapidly, including fog/wind, which is challenging for students doing touch and go's (IFR conditions approximately 22.9% in 2013);
- Limited amounts of military traffic;
- Higher fuel prices.

Figure 2-7 Total Local Operations



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012 *
TOTAL LOCAL OPERATIONS	4,318	3,953	2,380	1,308	1,572	1,219	1,344	939	545	611	363	279	298	503

Source: FAA Air Traffic Activity Data (ATADS)

2.3.4 GA Itinerant Operations

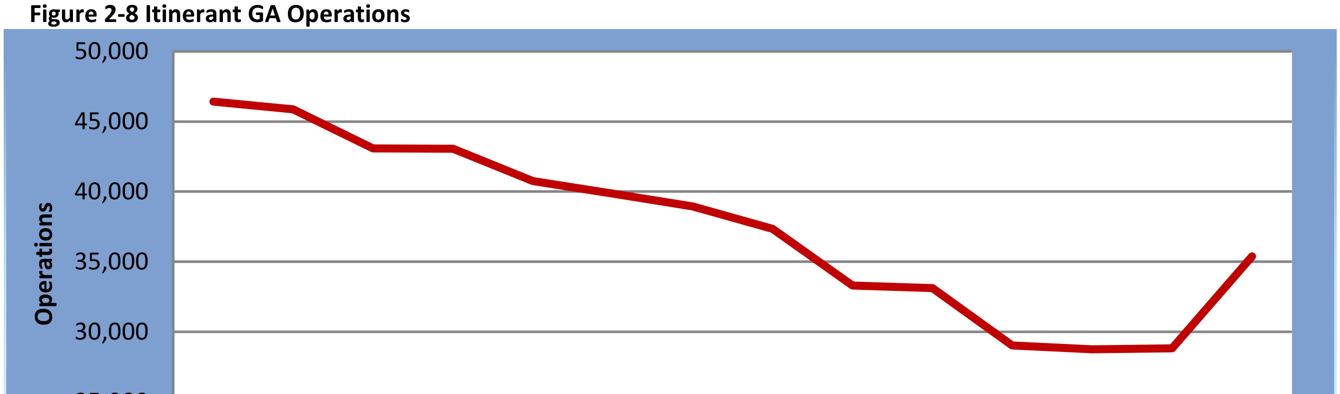
Itinerant, or transient, General Aviation activity is comprised of a variety of types of aircraft, as well as origins and destinations. Piston-engine aircraft generally serve short haul markets from ACK, primarily the New England states and New York/New Jersey. Turboprops and business jets also connect ACK and New England, but also regularly fly non-stop between ACK and Florida, California, Canada, the Caribbean, and Europe, based on flight track data compiled by Flight Aware and Passur.

Corporate aircraft activity largely serves second home owners, which is a mature market on Nantucket. Because there is limited land available for new development, and land and housing prices are among the highest in the country, there is no significant growth anticipated in second home development on the Island. Also, corporate aviation activity declined on both the regional and national level between 2008 and 2010, and remained relatively flat between 2010 and 2012. Recent trends in corporate aircraft activity at ACK indicate that the average size of aircraft utilizing ACK are getting larger, but the number of aircraft and operations is not increasing.

Figure 2-8 shows the trends in itinerant (aircraft not based at ACK) airport operations by year. Overall, GA operations as a percent of total operations had declined between the years 1999-2011. However, the data shows a 3% increase for the years 2011-2012, potentially due to the rebound in the economy and the corresponding increase in discretionary income for pilots.

It is the second homeowners that primarily generate the corporate/turbine GA traffic, followed by short-term island visitors at ACK. National trends and talks with ACK Operations staff have indicated an increase in the use of larger aircraft such as the Gulfstream G-550, G-650, Falcon 2000, and Challenger 5000 and 7000, which all have wingspans reaching 100'.

Figure 2-8 Itinerant GA Operations



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012*
GA	46,416	45,870	43,092	43,062	40,755	39,856	38,954	37,345	33,303	33,124	29,025	28,770	28,833	35,393

Source: FAA Air Traffic Activity Data (ATADS)

2.4 Airport Design Standards

As an airport that receives federal funding (FAA Grants), ACK must ensure that it meets the obligations within the grant assurances to the extent practicable. To this end, the FAA has prescribed Advisory Circular which outlines airport design standards. Airport design standards are based on the wingspan and approach speed of a type or grouping of aircraft that conduct a minimum of 500 operations (takeoffs and landings) per year at an airport. These aircraft are referred to as the critical design aircraft.

2.4.1 Runway Design Code (RDC)

The FAA divides aircraft into Airplane Design Group (ADG) and Approach Categories, shown below in ***Tables 2-2 and 2-3***, which when combined determine the appropriate Runway Design Code (RDC) ***Table 2-4***. This creates separate RDC's for each of Nantucket's three runways.

Table 2-2 Airplane Design Group

Group #	Tail Height (ft)	Wingspan (ft)
I	<20	<49
II	20- <30	49 - <79
III	30 -<45	79 - <118
IV	45 - <60	118 - <171
V	60 - <66	171 - <214
I	66 - <80	214 - <262

Table 2-3 Aircraft Approach Categories

Category	Speed
A	Speed less than 91 knots
B	Speed 91 knots or more but less than 121 knots
C	Speed 121 knots or more but less than 141 knots
D	Speed 141 knots or more but less than 166 knots
E	Speed 166 knots or more

Table 2-4 Runway Design Code

	Runway 6-24	Runway 15-33	Runway 12-30
RDC	C-III	B-II	A-I (small)

Source: FAA AC 150/5300-13A

As noted previously, the average size of corporate aircraft has been increasing steadily, and there are more than 500 operations annually by large jets as a collective group. Having a 6,303' long runway (Runway 6-24) allows the capacity to handle faster, larger aircraft, such as the E-190 and B-737, in nearly all weather conditions.

2.4.2 Critical Design Aircraft

Each runway at ACK has unique operational characteristics which serve different operational needs and aircraft. For example, Runway 6-24 is considered the airports primary runway and is capable of serving the approach and departure needs under most weather conditions, by the largest aircraft typically operating at ACK which has been identified as the E-190, flown by Jet Blue. ACK Operations personnel have provided airport operations data from Passur, (a flight tracking software) which indicates that the largest grouping of aircraft with over 500 operations at ACK fall within Group III (Wingspan 79'-<118').

Runway 15-33, although shorter, is capable of serving aircraft in poor weather, to a lesser extent and typically serves aircraft ranging in size from a Cessna 402 and to a Piper Malibu. A third runway at ACK, Runway 12-30, is the shortest runway and typically serves smaller aircraft with lower approach speeds such as a Cessna 310, Piper Saratoga and other smaller aircraft when the wind conditions favor approach/departures in easterly/westerly wind direction. Air taxi C-402's will also use Runway 30 for arrivals when there are operational restrictions on the use of Runway 15-33 or high winds out of the west-northwest.

Table 2-1 (below) identifies the critical design aircraft for each runway at ACK.

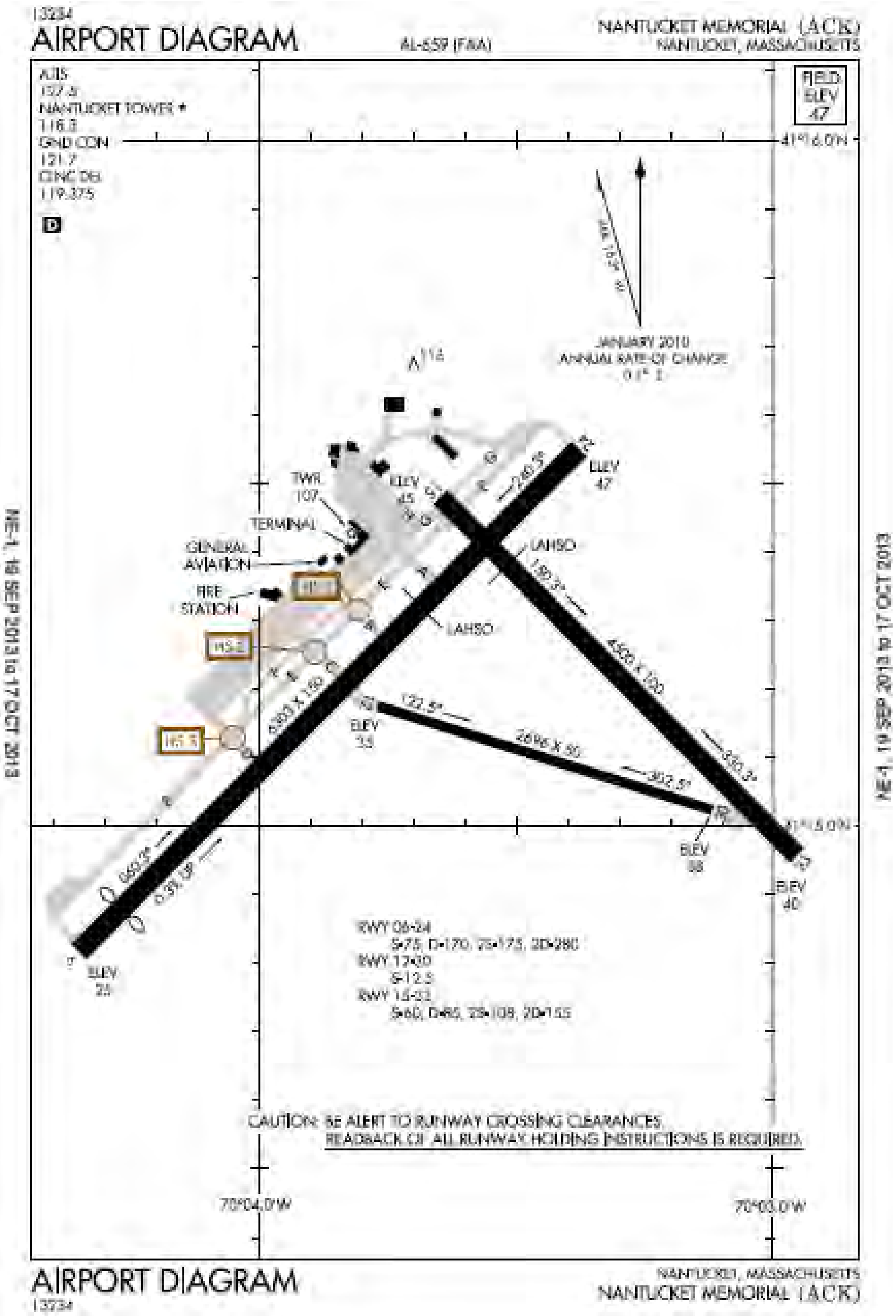
Table 2-1 Critical Design Aircraft
Nantucket Memorial Airport

	Runway 6-24 & Taxiways A, B, C, D, E, F, G, H, J	Runway 15-33	Runway 12-30
Critical Design Aircraft	Gulfstream 650 Embraer 190	Beech King Air 90, Cessna 402, Piper Malibu	Beech Baron 58, Cessna 310, Piper Saratoga, etc.

2.4.3 Runways

Runway 6-24 is ACK's primary runway at 6,303 feet long. Runway 15-33 is the crosswind runway and is 4,500 feet long, and Runway 12-30, which is sometimes operated as a taxiway, is a visual-only runway and is 2,696 ft. long. Runway 12-30 serves small GA aircraft and occasional Cessna 402 air taxi traffic. Runway 6-24 is designated a Design Group C-III runway, while Runway 15-33 is a Group B-II (with Group III capabilities) and the smaller Runway 12-30, is a Group A-I. **Figure 2-9** shows the official airport diagram from the FAA and it provides a general overview of the facilities at ACK. Runway data for each runway is shown in **Table 2-5,** and on page 2-17.

Figure 2-9 FAA Airport Diagram for ACK



Source: FAA

Table 2-5 Nantucket Memorial Runway Data Table	Runway 6-24	Runway 15-33	Runway 12-30
Magnetic Bearing	N 44°43'47" W	S 45°16'258" E	N 73°05'43" W
RDC	C-III	B-II	A-I SM*
Length	6303'	4500'	2696'
Width	150'	100'	50'
Pavement Type/Condition	Asphalt/Good	Asphalt/Good	Asphalt/Excellent
Effective Gradient (%)	.3/-.3	-.1/.1	.1/-.1
Displaced Threshold	537.5' (06)	-	-
Pavement Strength S D T	75 170 280	60 85 155	12 - -
Approach Visibility Minimums	(06) ILS (200-3/4) RNAV/GPS- (200-3/4) LPV (24) ILS (200-1/2) RNAV/GPS- (200-1/2) LPV	(15) RNAV/GPS (300-1) LPV (33) RNAV/GPS (300-1) LPV	(12) VISUAL (30) VISUAL
RW Marking	(6-24) PRECISION	(15) VISUAL (33) NON-PRECISION	(12-30) VISUAL
Navigational Aids	(06) ILS/LOC/DME (24) ILS/ VOR/NDB	-	-
Visual Aids	(06) MALSF/PAPI-R/HIRL/CL (24) SSALR/PAPI-L/HIRL/CL/TDZ	(15) REIL/MIRL (33) PAPI-L/REIL/MIRL	(12-30) VISUAL
Runway Lighting	(06-24) HIRL, CL TDZ (24)	(15-33) MIRL	-
Part 77 Runway Category	(06-24)(OTHER THAN UTILITY) PRECISION	(15) VISUAL (OTHER THAN UTILITY) (33) NON-PRECISION	(12-30) (UTILITY) VISUAL
Part 77 Approach Surfaces	34:1 50:1(10,000')/ 40:1(40,000')	(15-33) 34:1	(12-30) 20:1
RSA Dimensions WIDTH LENGTH Beyond RW End	500' 1000'	150' 300'	120' 240'
ROFA Dimensions WIDTH LENGTH Beyond RW End	800' 1000'	500' 300'	250' 240'
RPZ Dimensions INNER W OUTERW LENGTH DIST. Beyond RW End	1000' (06) 1510' (24) 1750' (06) 1700' (24)2500' 200'	500' 700' 1000' 200'	250' 450' 1000' 200'
ROFZ Dimensions WIDTH LENGTH Beyond RW End	400' 200'	400' 200'	120' 200'

*SM= Propeller driven aircraft weighing less than 12,500lbs. ***Source: FAA Advisory Circular 150/5300-13A, Airport Design***

2.4.4 Airport Capacity

The FAA uses demand-capacity calculations as the primary basis for identifying airport facility requirements. Each component of the airport has its own unique demand – capacity level, and under ideal conditions each component of the airport should be operating below capacity. The airport facilities were categorized and assessed with regard to demand-capacity under the following categories:

Airside

- Runways / taxiways
- Parking aprons
- Hangar storage
- Fuel storage and dispensing capacity

Landside

- Terminal building
- Auto parking
- Access roads

Airspace and ATC

- Arrivals and departures
- Instrument approach minimums

When demand for one component of the airport, such as the runway/taxiway system, for example, exceeds available capacity, then delays occur which often spread to other parts of the airport. For example, aircraft departing for New York metro airports can be delayed due to ATC constraints or weather conditions and may have to hold on the ground at Nantucket. While they are holding they occupy space on the parking aprons, or on taxiways or run-up aprons. This can affect other aircraft arriving and departing ACK. In addition, air carrier delays can mean additional passengers in the terminal building hold rooms and security areas.

FAA Advisory Circular (AC) 150/5060-5, *Airport Capacity & Delay* is used to calculate annual operational capacity as well as hourly operational capacity under visual (VFR) and instrument (IFR) conditions. The AC identifies the operational capacity of the runway and taxiway system based on the configuration and use of the runways, assumptions about the exit taxiways available (i.e. runway occupancy time), the percent of training operations, and the type of aircraft using the airport. The FAA's capacity estimates reflect the maximum number of operations that can be conducted at the airport within a given time period. When activity at airports approaches the calculated capacity limit, delays increase exponentially.

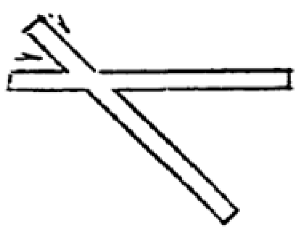
Several computer models such as FAA's Airport and Airspace Delay Simulation Model (SIMMOD[4]), and Jeppesen's Total Airport and Airspace Modeler (TAAM[5]) simulate specific airport operations and

[4] http://www.tc.faa.gov/acb300/aasw.asp

calculate detailed arrival and departure delays, as well as identify specific locations where the delays occur. However, the models are designed for large hub airports, are complex to run, and are intended for complex airfield configurations and airspace structures, which is not the case at ACK.

For ACK, the closest airfield and runway use configuration identified in the AC is shown below. Based on the type of aircraft and operational characteristics of ACK, the FAA calculates that the annual operational capacity of the airport is approximately 230,000 annual operations, 98 hourly operations during visual (VFR) conditions, and 59 hourly operations during instrument (IFR) conditions. An operation is either one takeoff or one landing.

Table 2-6 Annual Operational Activity

Runway-use Configuration	Mix Index % (C+3D)	Hourly Capacity Ops/Hr VFR	IFR	Annual Service Volume Ops/Yr
	0 to 20	98	59	230,000
	21 to 50	77	57	200,000
	51 to 80	77	56	215,000
	81 to 120	76	59	225,000
	121 to 180	72	60	265,000

Source: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*

In calendar year 2012, ACK recorded almost 133,000 operations, which is approximately 58% of its maximum estimated operational capacity. This does not however, consider local factors (as discussed below) or taxiway/apron capacity or airspace issues.

Strong Seasonal Peak

As noted in Chapter 4, ACK experiences one of the highest seasonal peaks in aircraft operations of any airport in the U.S., with almost 50% of all operations (almost 66,000 operations) conducted within a four month period. The peak month saw 14.3% of total annual activity, or 19,000 operations. That results in an estimated average day/peak hour demand level of 633 average day/95 peak hour operations. According to Airport Operations and ATC staff, these peak hour activity levels can exceed the airport's operational capacity during holiday summer weekends in good weather conditions, such as July 4th and Labor Day. When that occurs, delays on the taxiway system and overcrowding on the GA South Apron can occur, which can necessitate the closure of Runway 15-33 in order to accommodate the overflow GA parking.

Added to the demand-capacity challenge is Nantucket's highly variable summer weather pattern. Fog can frequently roll in off the ocean and cover the airport (often starting at the south end of the airport at Runway 6 and moving rapidly north), and the airport can go from good VFR to low IFR in a matter of

[5] http://ww1.jeppesen.com/industry-solutions/aviation/government/total-airspace-airport-modeler.jsp

minutes. Similarly, afternoon thunderstorms in New York or Washington, DC, can create ATC Ground Stops for flights departing ACK. When that happens, operational delays can increase while aircraft wait for ATC clearances, causing ground delays and taxiway congestion.

Based on an analysis of historical METAR (Meteorological Terminal Aviation Routine Weather Report) data provided by the Iowa State University of Science and Technology[6], it was determined that in 2013 (from January 1, 2013-December 30, 2013) there were a total of 12,162 METAR reports (weather reports were taken up to 2 times an hour). Of those, there were a total of 2,785 reports that met the criteria for IMC (Instrument Meteorological Conditions), which are weather conditions where visibility is less than 3 mi. This equates to ACK observing IMC conditions 22.9% of the time in 2013, meaning the airport could experience fog in the morning and/or haze and fog during the evening hours. Approximately half of the days in 2013 reported IMC. The following table (**Table 2-7**) depicts the breakdown of IMC over the course of 2013 at ACK.

Table 2-7 ACK Weather Conditions Summary – 2013		
Visibility	METAR Entries	Percentage of Total
¼ mi.	705	5.8%
½ mi.	413	3.4%
¾ mi.	265	2.2%
1 mi.	232	1.9%
1 ¼ mi.	141	1.2%
1 ½ mi.	172	1.4%
1 ¾ mi.	200	1.6%
2 mi.	383	3.15%
2 ½ mi.	274	2.25%
Total	**2,785**	**22.9%**

An option to reduce airfield congestion during these weather delays may include minor expansion of the aircraft holding/run-up pads, or inclusion of short by-pass taxiways at the Runway 6-24 ends, where aircraft can wait for ATC clearances while allowing other aircraft to arrive and depart freely. These and other options are analyzed in Chapter 6 of this Master Plan.

To design and build a runway /taxiway system that can accommodate peak hour operations during holiday summer weekends without delays can result in underutilized facilities for most of the remainder of the year. While significant investment in new runway extensions or full-length parallel taxiways may not be warranted to address delays, the FAA's Airport Design Standards, AC 150-5300-13A, Table 3-4,

[6] http://mesonet.agron.iastate.edu/request/download.phtml?network=MA_ASOS

does recommend a parallel taxiway for non-precision runways to enhance operational safety, such as on Nantucket's Runway 33. The need for such an improvement is discussed further in Chapter 6.

2.5 Airport Facilities

Airport facilities are sorted into two categories: airside and landside facilities. Airside facilities include runways, taxiways, airfield lights, and navigational facilities. Landside facilities include terminals, FBOs, hangars, fuel farms and other supporting facilities. These two groups of facilities are described below.

2.5.1 Airside

The airside facilities are discussed in the following sections.

2.5.1.2 Navigation, Lighting and Communication Aids

Airport navigational aids provide a means for aircraft to safely navigate to the airport and/or specific runway ends in various weather conditions. At ACK, Runways 6-24 and 15-33 are equipped to provide nearly all weather access through the use of various navigational aids, while Runway 12-30 is used only for visual (good weather) operations.

Runway 24 is equipped with an ILS/DME (Instrument Landing System/Distance Measuring Equipment) precision instrument approach which is supported by ground based equipment such as: localizer and glide slope, Simplified Short Approach Lighting System (SSALR), Runway Alignment Indicator Lights (RAIL), Touchdown Zone Lighting (TDZL), Centerline Lights (CL), a Precision Approach Path Indicator (PAPI) four-light box on the left side of the runway and High Intensity Runway Lights (HIRL). The NAVAIDS support properly equipped aircraft in landing with visibility minimums of a 200' ceiling and ½ mile visibility. This enables instrument-rated pilots flying properly equipped aircraft to descend to a 200' AGL minimum altitude in visibilities down to a ½ mile, while flying the ILS approach.

Runway 6 has an ILS/DME instrument approach which utilizes a glide slope and localizer, a Medium Intensity Approach Light System with Sequenced Flashers (MALSF), a Precision Approach Path Indicator (PAPI) on the left side of the runway, Centerline Lights (CL) and High Intensity Runway Lights (HIRL). These NAVAIDS support an ILS/LOC approach with minimums of 200' ceiling and ¾ mile visibility. Runway 6 has a usable landing length of 5,766 beyond its displaced threshold. It has a Land and Hold Short Operations (LAHSO) distance of 4,316' to the hold short prior to Runway 15-33. LAHSO is used by Air Traffic Control to increase and maintain system capacity by having aircraft hold short of any intersecting runway, taxiways or predetermined point after landing.

Runway 15-33 is 4,500 feet long and is equipped with Medium Intensity Runway Lights (MIRL) and Runway End Identifier Lights (REIL), while the Runway 33 end has a PAPI located on the left and has an RNAV (GPS) approach with a 380' ceiling and 1 mile visibility minimum. Runway 33 has a Land and Hold Short Operation (LAHSO) distance of 3,673 feet to hold short of Runway 6-24. LAHSO is used for C-402 landings, as well as smaller corporate and GA aircraft. Aircraft holding short on an active runway limit the use of that runway by any following aircraft, which must wait for the first aircraft to clear before they can land. In the case of Runway 33, this limits the full benefit of the over-water noise mitigation landing route.

Runway 12-30 is used only as a daytime, visual-use runway with a 12,500 lb. aircraft weight restriction. It is 2,696’ long and 50’ wide and is frequently used by ATC to land small GA traffic while turbine aircraft are using Runway 24. As noted above, it is used when Runway 33 is closed or during high west winds.

The Automatic Terminal Information System (ATIS) is a continuous broadcast of recorded aeronautical information regarding activity in the terminal area of the airport. Such information includes weather information, runways in use, and other information pertinent to pilots such as Notices to Airman (NOTAMS). The ATIS information is available on the frequency 127.5. When the air traffic control tower is closed, the common traffic advisory frequency (CTAF) is available on 118.3, and used for air-to-air communication between pilots.

2.5.1.3 Safety Areas

Airport safety areas are designed to protect arriving/departing aircraft and persons/property on the ground in the event an aircraft exits the runway unexpectedly. Safety areas are designed to represent different safety assurances at all airports. The following definitions provided by the FAA describe the various safety areas located about the runways at ACK. The dimensions for each safety area are provided in **Table *2*-5, *Runway Data Table***.

Runway Safety Area (RSA) - an area surrounding the runway that is prepared or suitable for reducing the risk or damage to aircraft in the event of an overshoot, undershoot, or excursion from the runway. This area typically houses the space for emergency vehicles and equipment in support of an aircraft when needed. ACK’s runway ends meet the FAA RSA standards.

Runway Object Free Area (OFA) - a two-dimensional ground area surrounding the runway which must be clear of parked aircraft and objects other than those whose location is fixed by function.

Runway Protection Zone (RPZ) - an area on the ground used to enhance the protection of people and objects near the runway approach. It is the inner portion of the FAR part 77 approach surface to the runway, (discussed in **Section 2.6, *Airspace***).

Runway Obstacle Free Zone (OFZ) - a defined volume of air-space centered above the runway which supports the transition between ground and airborne operations.

Precision Obstacle Free Zone (POFZ) – a volume of airspace above an area beginning at the threshold at the threshold elevation and centered on the extended runway centerline, which when in effect neither the tail nor fuselage may infringe on the POFZ.

2.5.1.4 Taxiways

Taxiways provide aircraft with a means of accessing the runway(s) from the terminal area. Airport taxiways are required to meet certain design standards based on the largest aircraft expected to use the taxiways, which for ACK is a Group III aircraft. The taxiway design standards are noted in **Table 2-8,** below. The current taxiway system meets FAA design standards, with the exception noted below.

Table 2-8 Taxiway Design Standards	
Standard	**Dimension (ft)**
Taxiway Width (based on Taxiway Design Group 3 utilizing an E-190/ Gulfstream 650.	50
Taxiway Safety Area	118
Taxiway Object Free Area	186
Taxiway Centerline to Fixed or Movable Object	93
Wingtip Clearance	34
Taxiway Centerline to Parallel Taxiway Centerline	152

The separation between parallel Taxiways 'E' and 'F' and 'E' and 'G' is 125', which is less than the current FAA criteria for RDC III aircraft of 152'. This means that ground controllers have to avoid taxiing two Group III wingspan aircraft in opposite directions on those Taxiways. This can be an issue when two larger aircraft, such as JetBlue E-190's, are operating at the same time on the opposing taxiways, as shown in **Figure 2-10**.

Figure 2-10 – Opposing Group III (E-190) aircraft on ACK Taxiways E and G

Source: Jacobs, 2014

All Taxiways (A, B, C, D, E, F, G, H, and J) utilize the Gulfstream G-650/Global Express and air carrier (Jet Blue) E-190 as the Group C-III critical design aircraft. The taxiway width for all taxiways is 50' which meets FAA standards for Group C-III aircraft.

Runway 6-24 has a full parallel taxiway identified as Taxiway 'E' and four exit taxiways (A, B, C, D), as well as stub taxiways at each threshold on Runway 6-24. ATC staff has expressed an interest in providing an additional exit taxiway at the Runway 6 end. Runway 15-33 intersects Runway 6-24 and Taxiways E and G, which serve as a means of egress at the Runway 15 end. That configuration can create Hold Short situations for aircraft arriving on Runway 33 which increases runway occupancy time. Runway 15-33 is not served by a full-length parallel taxiway, although Runway 12-30 is used as Taxiway 'C' between the apron area and the Runway 33 end, and the runway intersects Taxiways 'E' and 'G' on the North end. C-402 operators have requested an alternative exit taxiway from Runway 33 through the infield to cross Runway 6-24 at Taxiway A to improve access the Terminal Ramp. Concepts consistent with guidance within FAA AC 150-5300-13A, Table 3-4, will be evaluated in Chapter 7 – Alternative Improvement Concepts.

2.5.1.5 Aircraft Parking Aprons/Tiedowns

Aircraft parking/tiedown areas are divided into several areas at ACK as follows: The Terminal Parking Apron, Secure North Ramp and South Apron. Aircraft parking is quantified in terms of based aircraft and transient parking, which have different requirements. Parking demand was further analyzed in terms of tiedowns (based and transient) and hangar storage. Air carrier parking demand was examined separately as part of the North Apron Secure Ramp.

North Apron/Secure Ramp

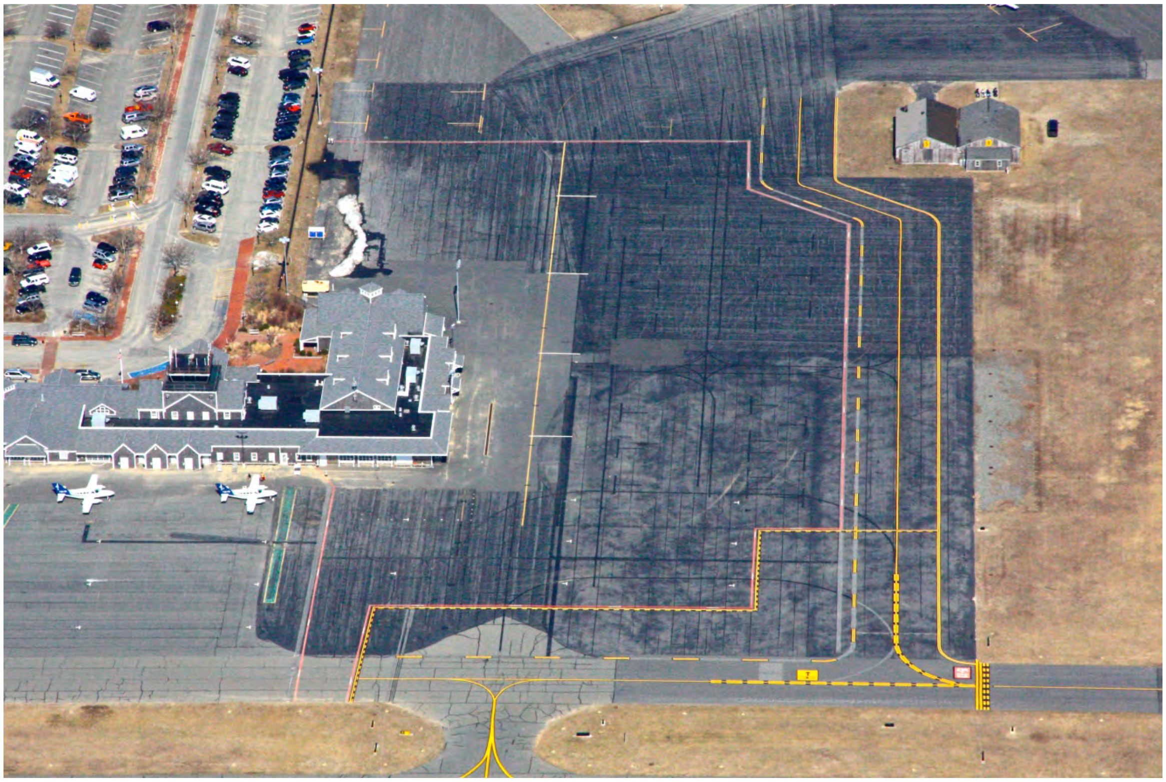
The North Apron, referred to as the "secure ramp", is used primarily by the major airlines during the summer season, flying regional jets and turboprops to major hub airports which require TSA screening of passengers and bags. Their service runs approximately four to five months per year, with Jet Blue currently (2014) operating May-October.

Figure 2-11 – North Apron Air Carrier Parking

There are no passenger loading bridges, so all enplanements and deplanements are at ground level (**Fig. 2-11**). Mobile stairs and ramps are used for regional jets and turboprops, and the Cessna 402's and Caravans used by Cape Air, Nantucket and Island Airlines have stairs built into the airplane access doors.

During the peak summer season, the secure ramp accommodates regional jets and turboprops operated by Jet Blue, Delta, United, and US Airways (now American). Only Jet Blue operates their own regional aircraft, the other three carriers (Delta, United, US Airways) use regional airline partners including Air Wisconsin, Pinnacle, and Republic. The North Apron is shown within the red pavement markings in **Figure 2-12**, below.

Figure 2-12 – North Apron/Secure Air Carrier Parking Area



Source: Jacobs, 2014

The types of aircraft that are currently used to provide air carrier service to JFK, Boston, Washington Regan, and Newark from ACK's North Apron include:

- Embraer ERJ-190 (Jet Blue)
- Canadair CRJ-200 (US Airways/American)
- Embraer ERJ-135, 140, and 145 (Delta)
- Bombardier DH-8-Q400 (United)

It should be noted that the type of equipment used by major airlines and their regional partners to serve Nantucket has changed over time, and will likely continue to change in the future. Each carrier typically provides two flights per day to Nantucket throughout the summer season, although the daily schedule changes. As a result, the North Apron can accommodate as many as 4 to 5 regional aircraft at the same time, depending on the scheduling. Delays to/ from hub airports due to weather and mechanical issues can result in more aircraft parked on the North Apron.

As discussed in more detail in Chapter 4, major airlines are switching their 50-seat regional jets and turboprops to larger 70 to 100 seat regional aircraft. As a result, it is likely that aircraft such the Bombardier DH-8-200, DH-8-300 and the CRJ-200 could be replaced by larger jets, which would require more apron space for parking. Also, if any additional service were provided by new airlines during the summer season, that could cause further congestion on the North Apron, particularly during peak periods. It should also be noted that Cape Air's Cessna 402's use a portion of the North Ramp for flights to Boston and Providence.

Terminal Ramp

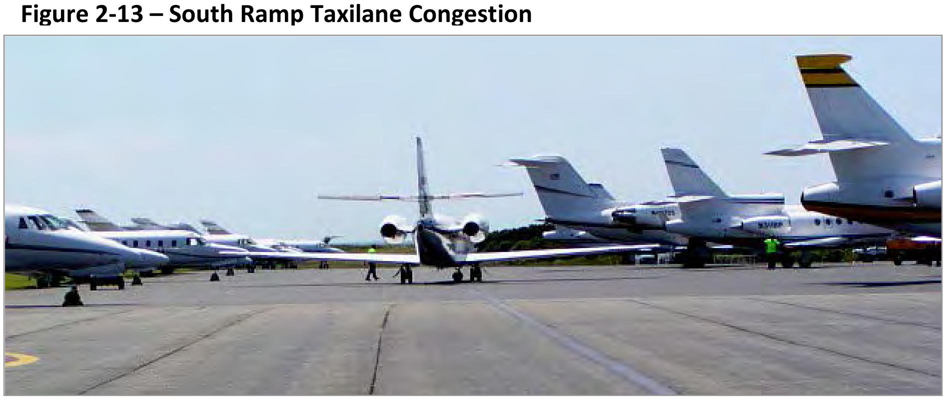
The non-secure portion of the terminal ramp is used primarily by Cape Air and Nantucket Airlines, as well as Island Air, for their shuttle services to Hyannis, New Bedford, and Martha's Vineyard, as well as White Plains, NY. The predominant aircraft used is the Cessna 402, although Island Air is also operating Cessna 208 Caravan turboprops. Both the 402s and Caravans have 9 passenger seats, although the Caravan (wingspan: 52', length: 41') is a significantly larger aircraft than the 402 (wingspan: 44', length: 36'). The three carriers operate a high-frequency, short-haul network, and as a result have short turnaround times at Nantucket, particularly during the peak summer season. With relatively small passenger and cargo capacity, the aircraft can be offloaded and reloaded in a short time. As a result, their average turn-around and apron parking time is less than that for the larger regional jets and turboprops. However, during peak periods there are typically more Cessna 402s parked on the non-secure ramp, and occasionally on the secure ramp, than regional jets and turboprops, and during peak periods both ramps can be saturated.

If Cape Air and Nantucket Airlines were to replace their Cessna 402s with Cessna Caravans (see Chapter 4 for added discussion), they would have the same passenger capacity and would, therefore, operate about the same number of flights to provide the same seat capacity. However, the Caravan would occupy more apron space due to its wider wingspan, and would thereby cause more congestion on the apron, particularly during peak periods.

South Apron

The seasonal aviation volume for corporate jets, particularly flights by newer and larger wingspan jets, has a significant impact on airport operations, facility requirements, and apron space during the peak summer season. **Figure 2-13** illustrates the congestion on the South Ramp taxilane at ACK as witnessed during the peak summer period. Discussions with ACK operations staff revealed that operations by larger aircraft such as the G-550 and -650 have increased necessitating the need for wider taxilanes, more maneuvering room and more transient aircraft parking space.

Figure 2-13 – South Ramp Taxilane Congestion



Source: Jacobs, 2014

The South Apron was designed to accommodate 120 parking positions for GA single and light twin-engine piston aircraft. The parking spaces are accessed by two taxilanes within the apron which enable the aircraft to move in and out of their spaces (see **Figure 2-14**). The taxilanes were designed for the 45.9 foot wingspan of a twin-engine piston Beech C-90, plus 15-foot clearance, to pass along the center rows of spaces, which provided nested, tail-to-tail parking for smaller piston aircraft.

Figure 2-14 – South Apron nested parking for smaller GA aircraft

Source: Jacobs, 2014

ACK's South Apron is divided into two operational areas (see **Fig. 2-15**). The northerly portion is a 224,000 square foot area that is used as a short-term (transient) GA parking apron and the southerly 252,000 square foot portion is used for long-term GA parking. These areas are located immediately adjacent to the Airport Administration/OPS building and ARFF fire station.

An additional 44 GA parking spaces had been located on the paved apron north of the Passenger Terminal Building. These 44 North Apron GA spaces were eliminated, but not replaced, during the expansion of the passenger terminal building in 2010. This loss of GA parking was required to comply with TSA security mandates for moving screened passengers from the secure hold rooms out to the waiting aircraft. The 44 spaces that were lost from the North Apron were not replaced, leaving the original 120 spaces on the South Apron and adding to the GA parking congestion. The available capacity has been further eroded by the increasing wingspan of new corporate jets, which occupy more ramp space and displace more of the smaller aircraft.

Changing Fleet

ACK handles a wide range of GA and corporate aircraft. The recent trend has seen an increasing number of large and very large private jet aircraft (wingspan greater than 90 feet) and a reduction in the number of small, single engine piston GA aircraft. The large jets can only be accommodated on Nantucket's South Apron transient parking area. The taxilanes between the rows of parked jets are narrow for the wider wingspans of the new, larger corporate jets, such as the

Figure 2- 15 – South Apron – Two Parking Areas

Source: Jacobs, 2014

Bombardier Global Express (93'- 6") and Gulfstream V (98'- 6"). The displacement of GA parking from the North Ramp, combined with the wider wingspans of newer private jets and the very tight operating areas on the existing South Ramp, has created operational safety concerns due to constricted maneuvering space (see **Figure 2-16**).

Figure 2-16 – Constricted Taxilane Width – South Ramp

Source: Jacobs, 2014

During the 1990's, the mix of aircraft using ACK started to change when many of the twin-engine piston aircraft began to be replaced with private jets. This trend accelerated during the last decade, when many Island property owners and visitors began arriving in larger private jets, each one of which occupies an area equal to two or three of the smaller spaces. The Airport is able to park only 8 to 9 of these larger jets where 22+ of the smaller piston planes could typically park in the nested center rows. This displaces the smaller planes and causes safety concerns with the wider wingspans of the bigger jets taxiing on the apron. The jets must move through the apron's taxilanes designed for the 46-foot wingspans of the smaller aircraft. The taxilanes are too narrow to safely accommodate the new jets' broader wingspans which range from 93.5 feet for the Global Express to 99.7 feet for the Gulfstream 650. This creates operational hazards and safety issues for wingtip strikes with parked aircraft, as seen above in **Figure 2-16**.

ACK's FBO staff keep a daily log of aircraft which park on the apron for use in invoicing parking fees to the larger corporate and charter jet traffic. ACK parking records for the peak week of July 4th 2010 show that the average day/peak week apron parking was about 150 aircraft per day, including many multiple-day layovers. The percentage breakdown by size and type of aircraft in ACK's current fleet mix are as follows:

- Group I – Small GA Piston Aircraft (Cessna, Piper, Beech single engine) = 40%
- Group II – GA Piston Twins (Beech Kingair 100+) = 10%
- Group II – Small GA Jets (Citations, Hawker 850) = 45%
- Group III – Large GA Jets (Global Express, Gulfstream V) = 5%

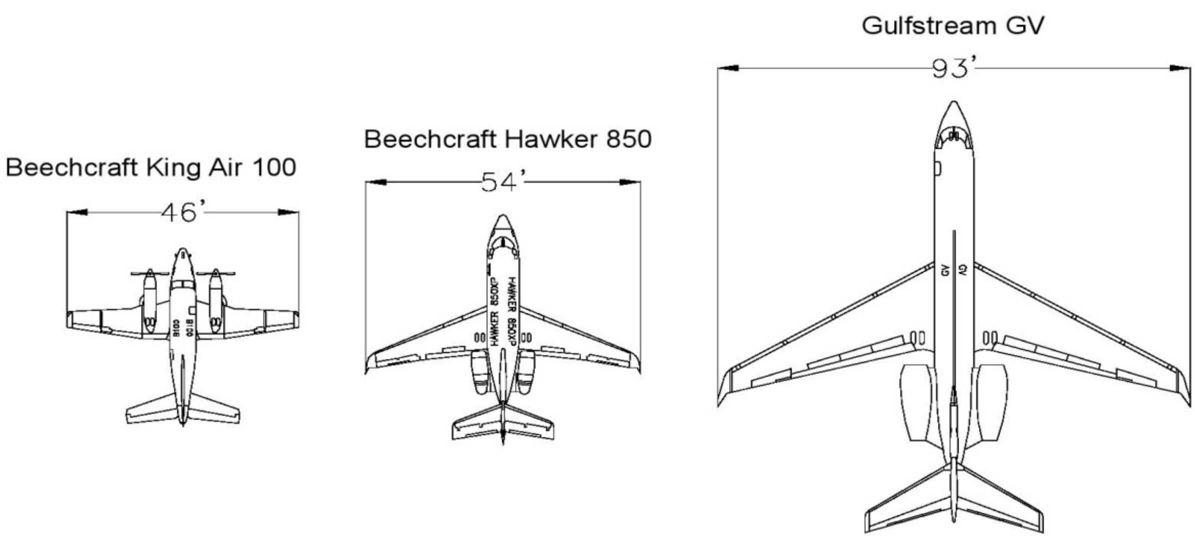
Applying the average percentages for the current fleet mix to the average peak day demand of 150 parked aircraft, yields the following distribution of South Apron aircraft spaces:

- Group I – Small GA Piston Aircraft (Cessna, Piper, Beech single engine) = 60 spaces
- Group II – GA Piston Twins (Beech King Air 100+) = 15 spaces
- Group II – Small GA Jets (Citations, Hawker 850) = 68 spaces
- Group III – Large GA Jets (Global Express, Gulfstream 550/650) = 7 spaces

The wingspans of the current fleet break down as follows:

- Group I – Small GA Piston Aircraft (Cessna, Piper, Beech single engine) = 36 feet
- Group II – GA Piston Twins (Beech King Air 100+) = 46 feet
- Group II – Small GA Jets (Citations, Hawker 850) = 54.5 feet
- Group III – Large GA Jets (Global Express, Gulfstream 550/650) = 93.5/99.7 feet

The variations in size of the three larger aircraft types are illustrated below:



Group I **Group II** **Group III**

These larger private GA jets are displacing the smaller GA fleet from the South Apron's short term and long term parking areas, due to the size of their wingspans. As noted previously, ACK is able to park only eight corporate jets where twenty-two of the smaller GA planes had parked. This reduces the capacity of the South Apron and limits the airport's ability to handle the total demand for paved parking spaces on peak weekends. This condition is illustrated in **Figure 2-17**, on the following page.

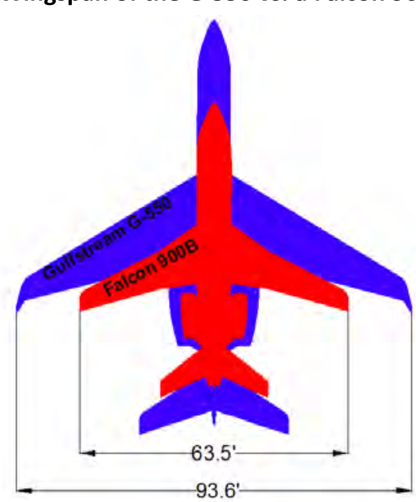
Figure 2-17 South Apron parking showing 8 corporate jets displacing 22 smaller aircraft

Source: Jacobs, 2014

The fleet mix required parking for 7 large and 68 small jets, 15 twins, and 60 smaller piston aircraft. The larger jet aircraft and small piston aircraft, as shown above, create dissimilar spatial and operational requirements that are not accommodated within the South Apron's existing layout. The narrow space and proximity of small aircraft, especially those parked or passing to the rear of the jets creates jet blast issues for the smaller planes, as well as for airport personnel working on the apron.

Figure 2-18 at right, illustrates (to scale) the difference in wingspans between typical corporate aircraft (Gulfstream 550 - 93.67' wingspan and the Falcon 900B - 63.5' wingspan) that operate at ACK. During some peak season weekends, ACK has had to close Runway 15-33 to accommodate overflow parking and make room for the jet fleet. While these conditions occur during the peak summer season, the physical configuration of the existing apron and the design requirements created by FAA Design Standards, create an operational safety issue that must be addressed.

Figure 2-18 – The Growing GA Jet Fleet: Wingspan of the G-550 vs. a Falcon 900B



Aircraft Tiedowns

There are 24 aircraft based year round at ACK. Of the 24, 14 are single engine airplanes, 10 are multi-engine airplanes. An additional number of turf tiedowns are rented to seasonal tenants. The majority of single-engine aircraft are on tiedowns, while the majority of multi-engine aircraft are stored in hangars.

A 270,000 sq. ft. of turf adjacent to the paved South Apron has historically been used for overflow parking up to 54 light piston aircraft in three rows of 18 each. An additional equivalent area of graded turf, extending further south along Runway 6 toward the beach, is also used for parking up to 50 additional light GA aircraft during peak summer weekends (see **Figure 2-19**).

Figure 2-19 – Turf parking provides 100 spaces for small aircraft

Source: Jacobs

The turf area has been graded, stabilized and partially irrigated to support the weight of light piston aircraft weighing less than 2,500 pounds. Jets do not operate on grass because, at 8,000 to 90,000+ pounds, they are too heavy for the turf to support their weight. In addition, their jet turbine engines are prone to the ingestion of foreign matter (grass and small stones), which can cause safety risks from engine failures.

2.5.1.6 Fuel Farm

ACK's aviation fuel farm facility is located adjacent to the new administration building. The fuel farm was built in 1993 and requires annual maintenance and overhaul of key components. The Airport is the sole provider of aviation fuel. The fuel farm contains storage for both jet fuel (Jet-A) and aviation gasoline (100 LL Avgas). The Jet-A storage consists of four 25,000 gallon above ground tanks placed in raised saddles within a partially sunken concrete pad surrounded by a 6'8" containment wall. Appropriate leak detection and overfill warning sensors are provided.

The entire Jet-A tank containment area is fitted with an open steel rack structure that supports a fire suppression foam spray system, fed by a remote foam pump house. Immediately northeast of the Jet-A tanks is a loading rack for the airport's mobile fuel trucks. This raised loading rack is fitted with an open steel grating and a concrete containment pit for potential fuel spills, plus a fire-suppression rack enclosure.

Figure 2-20 shows the four Jet-A storage tanks and adjacent refueler truck loading rack, plus the connections to the foam pump house. A Jet-A refueler truck is parked on the loading rack. In addition to the Jet-A tanks, the airport also maintains three 20,000 gallon underground storage tanks for 100 LL Avgas which are located adjacent to and just south of the refueler rack. These three underground Avgas tanks are also fitted with appropriate leak detection and overfill warning sensors

Figure 2-20 – ACK Fuel Farm

Source: Jacobs, 2014

The airport's summertime mobile fuel truck fleet consists of three 5,000 gallon Jet-A refueler trucks (two of which are retained for winter operations) and two 5,000 gallon Avgas refueler trucks that are operated year-round. The refueler trucks are parked adjacent to the fuel farm, on paved pads at the edge of the South Terminal Apron, as seen above.

2.5.1.7 Weather Services

The airport's Automated Surface Observation System (ASOS) provides pilots with current local weather observations. The ASOS is able to measure and report elements such as variable cloud height, precipitation type, intensity, accumulation, and beginning and ending times. The ASOS is also capable of measuring wind shifts and peak winds. **Figure 2-21** is of the ASOS at ACK. The weather information at ACK can be obtained by calling (508) 325-6082.

Figure 2-21 – ACK ASOS

Source: Jacobs, 2014

2.5.1.8 Pavement Condition

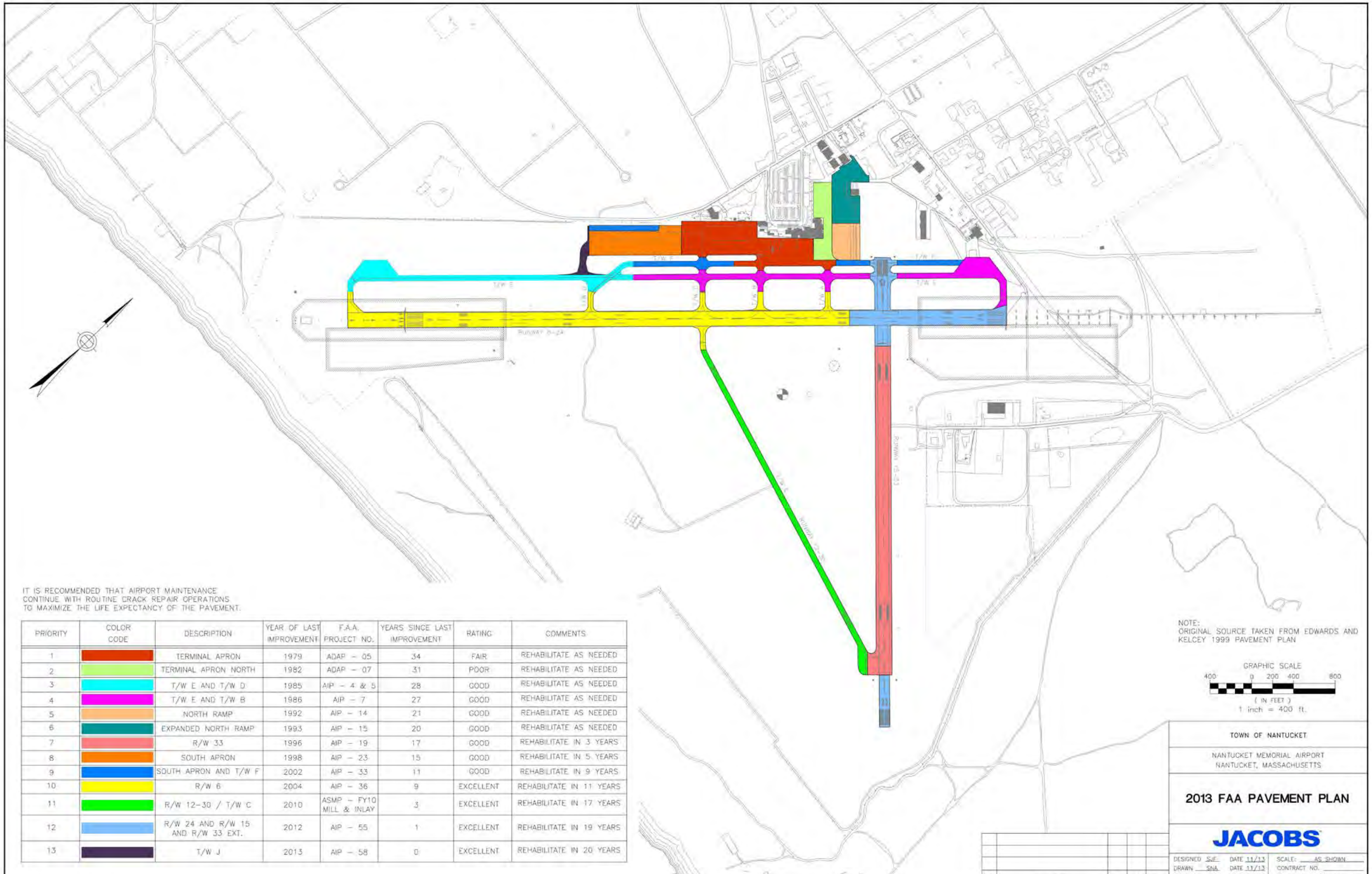
Airfield pavement is evaluated on a regular basis to determine its condition and identify any maintenance needs, or requirements for major rehabilitation or replacement priorities.

In 2013, a pavement condition assessment was completed as required by the FAA. It was determined that the majority of the pavement at ACK is in good to excellent condition as shown on **Figure 2-22.** It was expected that a portion of the North Apron, which was last improved in 1993, would need to be rehabilitated by 2014, based upon FAA's 20-year pavement life expectancy. According to the Mass DOT Pavement Condition Index (PCI), last updated in March 2013, the majority of pavement (Runways 6-24, 15-33, and 12-30, South Apron, portions of Taxiway 'F') would require preventative maintenance. The Terminal Apron required major rehabilitation. The North Apron along with the remaining taxiways would require rehabilitation (**Figure 2-23** shows the MassDOT PCI ratings).

In early 2014, MassDOT Aeronautics contributed a significant improvement to extend the life of all of Nantucket's runway, taxiway and aprons by crack sealing all airfield pavements. This important maintenance improvement extended the life of all pavements by five to seven years beyond those reported in the 2013 pavement condition assessments by FAA and MassDOT. Therefore, 5 to 7 years should be added to the expected life of all pavements shown on **Figures 2-22 and 2-23.**

However, despite the recent crack sealing, summertime operations by JetBlue E-190's have caused rutting and pavement deterioration on the air carrier North Apron. Installation of Portland cement hardstands may be warranted to address this problem.

Figure 2-22 - 2013 FAA Pavement Plan

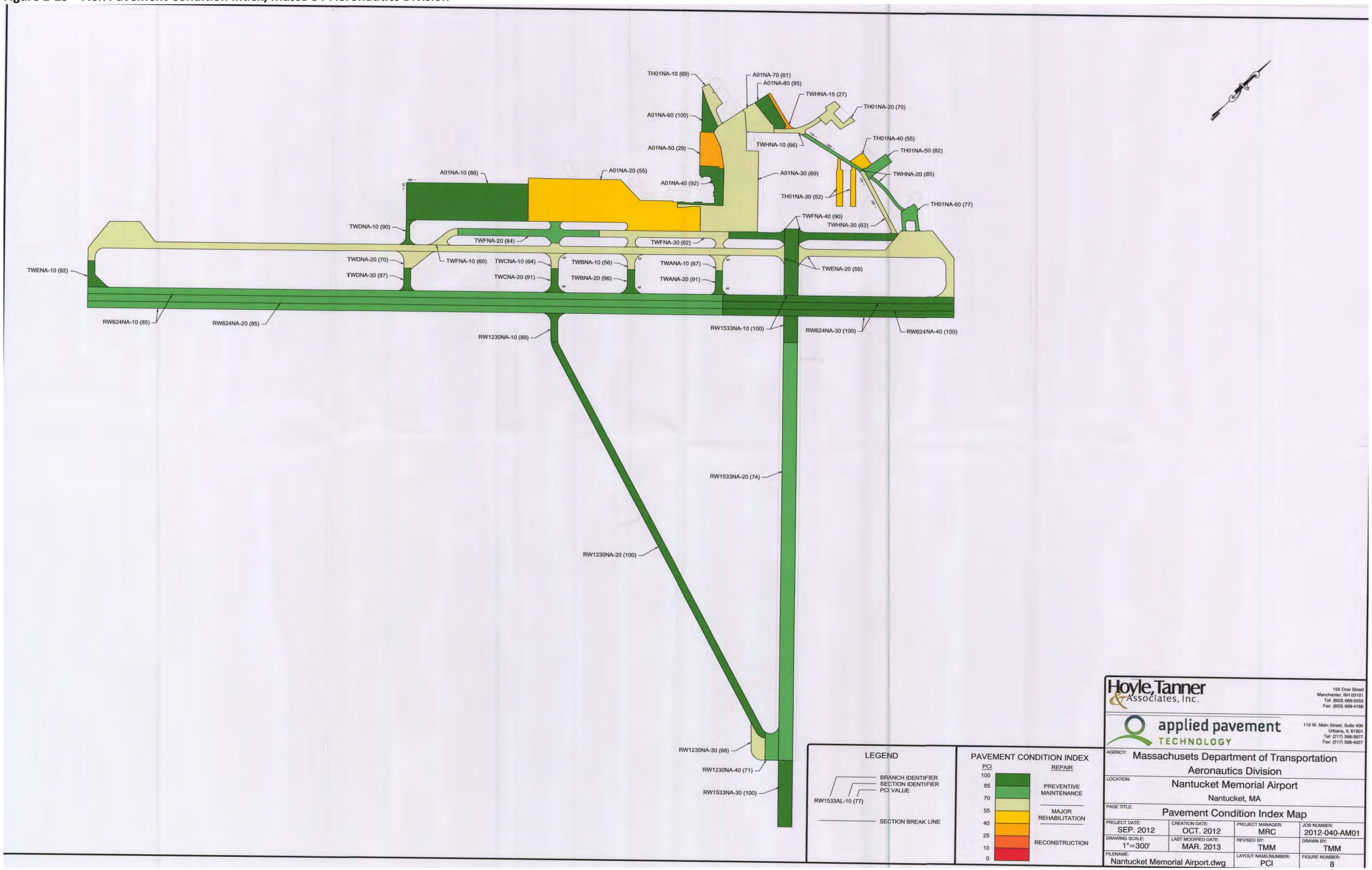


IT IS RECOMMENDED THAT AIRPORT MAINTENANCE CONTINUE WITH ROUTINE CRACK REPAIR OPERATIONS TO MAXIMIZE THE LIFE EXPECTANCY OF THE PAVEMENT.

PRIORITY	COLOR CODE	DESCRIPTION	YEAR OF LAST IMPROVEMENT	F.A.A. PROJECT NO.	YEARS SINCE LAST IMPROVEMENT	RATING	COMMENTS
1		TERMINAL APRON	1979	ADAP – 05	34	FAIR	REHABILITATE AS NEEDED
2		TERMINAL APRON NORTH	1982	ADAP – 07	31	POOR	REHABILITATE AS NEEDED
3		T/W E AND T/W D	1985	AIP – 4 & 5	28	GOOD	REHABILITATE AS NEEDED
4		T/W E AND T/W B	1986	AIP – 7	27	GOOD	REHABILITATE AS NEEDED
5		NORTH RAMP	1992	AIP – 14	21	GOOD	REHABILITATE AS NEEDED
6		EXPANDED NORTH RAMP	1993	AIP – 15	20	GOOD	REHABILITATE AS NEEDED
7		R/W 33	1996	AIP – 19	17	GOOD	REHABILITATE IN 3 YEARS
8		SOUTH APRON	1998	AIP – 23	15	GOOD	REHABILITATE IN 5 YEARS
9		SOUTH APRON AND T/W F	2002	AIP – 33	11	GOOD	REHABILITATE IN 9 YEARS
10		R/W 6	2004	AIP – 36	9	EXCELLENT	REHABILITATE IN 11 YEARS
11		R/W 12-30 / T/W C	2010	ASMP – FY10 MILL & INLAY	3	EXCELLENT	REHABILITATE IN 17 YEARS
12		R/W 24 AND R/W 15 AND R/W 33 EXT.	2012	AIP – 55	1	EXCELLENT	REHABILITATE IN 19 YEARS
13		T/W J	2013	AIP – 58	0	EXCELLENT	REHABILITATE IN 20 YEARS

Jacobs - O:\INFRASTRUCTURE\AIRPORTS\ACK\001 GENERAL\2013 PAVEMENT PLAN\Pavement plan.dwg November 12, 2013

Figure 2-23 – ACK Pavement Condition Index, MassDOT Aeronautics Division



2.5.2 Landside Facilities

The landside facilities at ACK consist of those structures and support elements that are not directly associated with the aircraft movement areas (airside). Examples of landside facilities include structures adjoining the airfield such as the Snow Removal Equipment Storage and Maintenance building, the Airport Rescue and Fire Fighting Building (ARFF), the airport Terminal building, Air Traffic Control Tower (ATCT), and the automobile parking lot. These existing landside facilities are described in more detail in the following sections.

2.5.2.1 Snow Removal Equipment (SRE) /Storage and Maintenance Building

In 2000, the Airport constructed the Snow Removal Equipment (SRE) storage and maintenance building at the "Bunker Area" (see **Figure 2-24**, right). The 105'x240' also contains the Nantucket Regional Transit Authority (NRTA) bus garage and maintenance facility, which occupies approximately 7,875 SF of floor space at the north end of the building.

Figure 2-24 – SRE Maintenance Garage

Source: Jacobs

The airport's Maintenance and equipment storage activities are crowded into the remaining 17,325 SF, which houses multiple functions, including the main work shop, vehicle maintenance bays, parts and materials storage, work benches, electrical room, sand storage, OSHA hazmat wash station, staff training room, staff break room, kitchen, locker room, wash rooms and rest rooms, as well as staff offices. There are vehicle storage bays for the airport's dump trucks, snow plows, sweepers, front end loaders, grader and pickup trucks, which are all stored here. During the winter months, the equipment used during summer airfield maintenance, FBO operations and airline ramp Ground Support activities are stored in a seasonal storage tent located off the Runway 24 end and adjacent to the Delta Parcel. Airport Maintenance staff noted that it would be advantageous to the airport to have enough space for all equipment to be stored within this single facility, instead of scattered in temporary tent structures. Two additional pieces of SRE equipment are expected to be added in coming years. A centralized permanent storage location would enable pre and post season maintenance to be performed more efficiently.

FAA and airport standards generally call for the phased replacement of airport vehicles on a five year cycle, with heavy equipment on an eight year cycle. Vehicle requirements are considered at such time based on specific operational requirements, airport activity levels, and airport size. FAA AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*, specifies the spatial requirements for SRE. According to the AC, ACK is classified as a very large airport as it has >1,000,000 SF of total paved runway, with a total of 1,530,250 SF of total paved runway. Due to an increase in activity and size of aircraft operating at ACK, the equipment needs of the airport will also require additional consideration. It has been noted that a sand storage building would be beneficial as well. A listing of current SRE and airfield maintenance equipment is provided in **Table 2-9**, below.

Table 2-9 Airport SRE/Airfield Maintenance Equipment

Equipment	Year	Size (SF Area)
Freightliner Sweeper @ 8'x24'	2006	192 SF
Crafco Crack sealer @ 6'x12'	2010	72 SF
John Deere 772G Grader @ 15'x42' (with Wing Plow*)	2010	630 SF
John Deere XUV 620i Gator @ 8'x25'	2010	200 SF
John Deere 5095M Tractor @ 11'x25'	2008	275 SF
John Deere 5520 Tractor @ 19x25'	2003	225 SF
John Deere 5100 Tractor @ 10'x35' (with Mower*)	2014	350 SF
John Deere 724K Loader and plow @ 20'x51'	2014	1020 SF
John Deere 724J Loader 22'x42' (with Plow and Bucket*)	2003	924 SF
John Deere 644E Loader @ 19'x37' (with Plow and Bucket*)	1988	703 SF
Oshkosh Snowblower and Broom @ 20'x55'	2001	1100 SF
John Deere 319E Skidsteer @ 8'x46' (with attachments*)	2013	368 SF
Sterling L850 Dump Truck 11'x50' (with Plow & Sander*)	2004	550 SF
Ford L-8000 Dump Truck @ 11'x50' (with Plow & Sander*)	1994	550 SF
Ford F250 Pickup @ 8'x24' (with Plow*)	2008	192 SF
Ford F550 @ 9'x36' (with Plow*)	2004	324 SF
Ford F350 @ 8'x24' (with Plow*)	2005	192 SF
Ford F-250 Pickup @ 8'x24' (with Plow*)	1999	192 SF
Hummer Utility Vehicle @ 8'x18'	2002	144 SF
Ford E-350 Bus @ 9'x23'	2001	207 SF
JLG 600s Man Lift @ 8'x37'	2006	296 SF
JLG 2320 Scissor Lift @ 4'x8'	2009	32 SF
Eager Beaver Utility Trailer @ 8'x32'	2001	256 SF
Hudson Utility Trailer @ 8'x31'	1997	248 SF
Baldor Light Carts @ 6'x14' (x2)	-	168 SF
Lighted "X's" for Pavement Closures (stackable) @ 8'x15'	-	120 SF
Air Compressor on Trailer @ 6'x10'	-	60 SF
Portable Deicer Trailer @ 8'x12'	-	96 SF
John Deere Z Tracmowers @ 7'x10' (x3)	-	210 SF
• Includes SF for plows and attachments		
Total Snow Removal and Airfield Maintenance Equipment SF Requirement *		**9,896 SF**

The storage conditions in the SRE Maintenance Building are shown in **Figure 2-25**, on the following page. During the warmer months, ACK utilizes a temporary tent structure across the airport from the main SRE building to store the airfield SRE equipment (see **Figure 2-26)**. Due to a lack of storage area in the SRE Building, ACK stores the 22' and 19' plow, two 11' plows, and three 8' pickup truck plows, along with two 6 yard sanders and one 3 yard sander in the tent during the summer. During the winter, the airfield mowing equipment is stored here.

Figure 2-25 – SRE Storage Conditions

Source: Nantucket, 2014

Figure 2-26 – SRE Temporary Tent Storage Structure

Source: Jacobs, 2014

There is a separate, smaller, 542 SF two-bay wood frame garage located adjacent the South Ramp that is used by the Airport's Operations staff to store the GSE equipment that is used to support GA aircraft parking and passenger movement on the South Ramp (see **Figure 2-27**).

Figure 2-27 – Two-Bay Garage, ACK Operations GSE Equipment Storage, South Ramp

Source: Jacobs, 2014

The Airport owns a variety of FBO/GSE equipment that is stored in and scattered around the two-bay garage. This GSE equipment is listed in **Table 2-10** (below). Operations staff noted that it would be advantageous to have enough space for all equipment to be stored in one location.

Table 2-10 Airport FBO/GSE Equipment	Size (SF Area)
3 Golf Carts : (1) 2 Seat @ 5’ x 12’ and (2) Limos @ 5’ x 16’	220 SF
2 Tugs @ 6’ x 14’	168 SF
2 GPU (+1)* @ 5’ x 6’	90 SF
2 Lektro Tugs (+1)* 2 @ 8’x16’ + 1 @ 10’x20’	456 SF
3 Chargers @ 2’ x 3’	18 SF
12 Luggage Trailers @ 3’ x 5’	180 SF
1 Lavatory Cart @ 4’ x 5’	20 SF
1 Luggage Cart- Tow Behind @ 5’ x 12’	60 SF
1 Flat Tire Dolly @ 3’ x 12’	36 SF
1 Fueling Stairs @ 4’ x 6’ x 10’	24 SF
1 Pre-Heater- Aerotech Model BT-400-46 @ 5’ x 7’	35 SF
(Should Have SPCC Spill Vacuum @ 8 ’x 6’)	(48 SF)
1 Tow Behind Deicer @ 12’ x12’ x 10’	144 SF
2 Small Mowers/self-propelled JD’s @ 5’ x 6’	30 SF
1 Snow Blower @ 3’ x 5’	15 SF
2 Passenger Busses @ 10’ x 30’	600 SF
1 Hazmat Bus	300 SF
Total GSE Equipment SF Requirement	**2,444 SF**

* Indicates future equipment

2.5.2.2 Airport Rescue and Fire Fighting Building (ARFF)

The Airport Rescue and Fire Fighting building (ARFF) opened in 2012. The building is located adjacent to the South Apron and west of the Terminal Building. The ARFF building is pictured in **Figure 2-28**.

Figure 2-28 – ACK ARFF Building and ARFF Truck

Source: Jacobs

The building is sized to meet ARFF Index B (based on the function of the largest passenger aircraft that operates at ACK) criteria for large airports. It features three bays for the fire trucks and emergency vehicles; Bay #1 is a wash bay, Bay #2 and Bay #3 are dedicated for first response. The first floor provides space for gear storage and a dining/ready area with a kitchen.

There are locations for gear wash, personnel decontamination and first aid equipment. Lockers for both men and women are available, along with restroom facilities. There is housing for dry chemicals and foam. There are two stairway locations and an elevator for accessing the second floor.

On the second floor, there is an exercise room with two treadmills, two bikes and weights. There is an office and telecom room. There is one bathroom and one janitor closet. The electrical and mechanical rooms are also located on the second floor. There is also a training room that can hold approximately 25 people for staff meetings. There are two locations of stairs and an elevator for accessing the second floor. Recent HVAC leakage problems have created flooding issues which should be rectified.

2.5.2.3 Terminal Building

Figure 2-29 – ACK Terminal Addition

Source: Jacobs

The previous Master Plan had focused on the spatial needs for a new terminal building. After several years of extensive community review, thorough environmental permitting, rigorous refinement of architectural designs, and detailed construction reviews, ACK successfully completed its new terminal renovation and expansion in time for the 2009 summer passenger season. **Figure 2-29** shows the terminal's renovation with the secure holdroom and bag claim addition.

The renovation added 18,000SF to the existing terminal building, expanding it to a total of 30,000SF. This reconstruction and addition was done primarily to accommodate the growth in passenger enplanements at ACK and to comply with TSA security screening requirements. The entire construction project for the terminal was a green initiative, and meets the U.S. Green Building Council's LEED (Leadership in Energy and Environmental Design) Silver Certification standards. The building, however, does have deficiencies with its passenger hold room and TSA screening room sizes, as well as IT system issues, which should be addressed (see Chapter 6). The completed terminal building renovation is shown in **Figure 2-30**.

Figure 2-30 – View of the Terminal Expansion from the North Apron

Source: Jacobs, 2013

In addition, the 2009 terminal renovations added new bag screening facilities, secure hold rooms for departing passengers, a secure arrivals area, bag claim facilities, TSA offices, and improved airline operation spaces. The existing passenger ticket lobby was renovated and the non-secure passenger arrival and departure lobbies were improved. Restroom facilities were upgraded and the restaurant was completely remodeled and brought up to code. The public area, including TSA screening, increased from 6,960 SF to a total of 23,300 SF, fully two-thirds of which was new construction space. Approximately 5,250 SF of renovated and expanded space is leased to the airlines. The restaurant leases 2,650 SF and the remaining 2,000 SF is dedicated to Airport Security, telecom, electrical, generator and mechanical space.

A spatial analysis of the terminal building was conducted in **Chapter 6**, including airline ticketing counters, lobby space, passenger screening facilities and a secure hold room, to identify any deficiencies that should be addressed as part of this Master Plan. Discussions were held with the Airport Security Coordinator to identify areas of concern. Jacobs was provided with the typical peak summer day aircraft parking configuration and ramp utilization for airline flights that require screening of passengers.

It was noted that, due to competitive airline scheduling, demand increases between the hours of 10:30am and 2pm for the limited amount of ramp and secure hold room space as several aircraft arrive/depart in close sequence to one another throughout that time frame. This places high demand for space within the terminal hold room as deplaned passengers compete for space with departing passengers. ACK receives service from JetBlue (100-seat Embraer Regional Jet ERJ-190's), Delta (operating ERJ's/Canadair Regional Jets with 50 passenger seats), United (operating Dash 300's with 38 passenger seats), USAirways/American Airlines (operating CRJ-200's with 50 passenger seats), and Cape Air (operating Cessna 402's with 9 passenger seats). Passengers arriving at the terminal to board a flight are often faced with long security screening lines as the single hold room nears capacity. The secure hold room is approximately 34' x 56' in size which equates to roughly 1,900SF of space. The

International Building Code (IBC) allots 16SF per person. Therefore, according to the IBC, the secure hold room should be able to accommodate 126 passengers. During peak summer periods the airport can have several flights departing/arriving at once. Two flights can easily necessitate demand for well over the 126 passenger capacity of the existing secure hold room. The spatial requirements of the secure hold room and the ability to accommodate existing and future passenger screening demand will be analyzed in **Chapter 6** of this study.

2.5.2.4 Air Traffic Control Tower (ATCT)

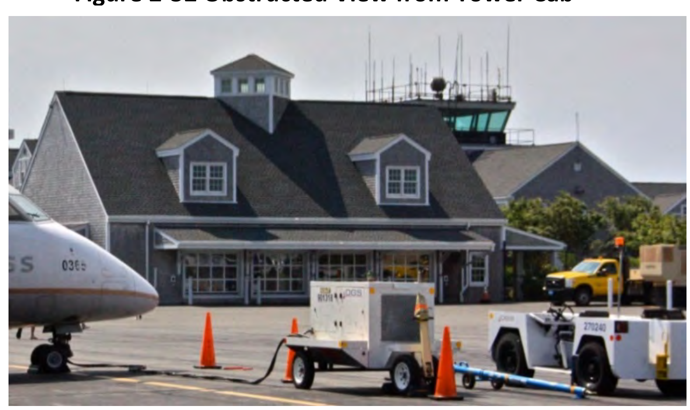
Nantucket's Air Traffic Control Tower (ATCT) is located within the passenger terminal building, on the northeast corner of the building, as shown in **Figure 2-31.** ACK leases the ATCT building to the FAA, where the Air Traffic Controllers provide separation between aircraft operating within Nantucket's 5-mile Airport Traffic Area (ATA). The FAA tower personnel also control all aircraft, ground vehicles, and personnel movement on the airport's runways and taxiways. The building supports fifteen Air Traffic Control staff. There can be a maximum of six Air Traffic Controllers in the tower cab at any given time. Currently there are 9 Certified and 1 Developmental Air Traffic Controllers that work at the ATCT.

Figure 2-31 Nantucket ATCT

Source: Jacobs, 2014

The existing tower cab is approximately 2,500 SF in floor area (50' x 50'). The cab itself is mounted on top of a three-story building, the entry-level floor consisting of the terminal building. The second and third floors are used by FAA personnel and consist of approximately 3,025 SF per floor, with a subtotal of 6,050 square feet on the second and third floors, plus the cab's 2,500 SF floor space, for a total of 8,550 SF floor space. The cab eye height is 81 feet above Mean Sea Level (MSL), while the total height of the structure including antennas and the airport beacon is 107 feet MSL. These elevations are shown on the Nantucket Airport Obstruction Chart, OC 659, published November 1988. The FAR Part 77 transitional surface (designed to provide aircraft operations in the vicinity of airports, clear from objects) is 90 feet MSL at the location of the Control Tower. The current ATCT, at 107 MSL, penetrates this FAR Part 77 transitional surface by 17 feet.

Figure 2-32 Obstructed View from Tower Cab



Source: Jacobs. 2014

Discussions with the ATCT Staff have indicated that the recent expansion of the passenger terminal building has caused a line of sight issue from the tower cab resulting in an partially obstructed view of the non-movement area of the secure terminal apron (North Apron), where air carrier jets park at their gates (shown to the right in **Figure 2-32***)*. In addition to line of sight issues, locating an aircraft at the departure end of Runway 33 can be a challenge, even with binoculars due to the height limitations of the control tower.

The controllers also mentioned that there would be a tangible benefit from having a high-speed turn off near the departure end of Runway 24, a VGSI (Visual Glide Slope Indicator), and ASDE-X (Airport Surface Detection Equipment-Model X). While the NAVAID components would benefit the controllers at ACK, these upgrades are not yet scheduled or confirmed.

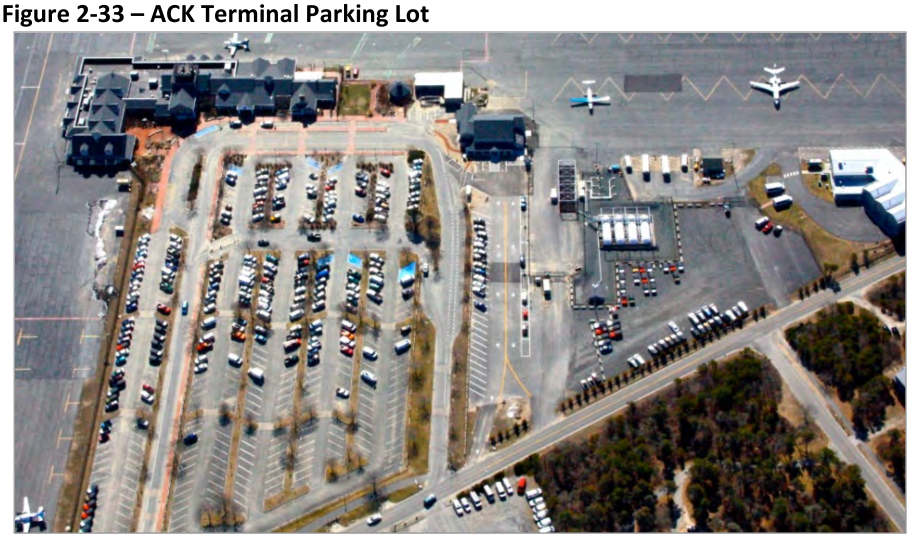
As a result of the 9/11 attacks, the FAA had required that Control Towers not be co-located within public passenger terminal buildings due to a perceived security threat to the federal ATC system. In response to this security mandate, the FAA conducted two successive tower siting and risk assessment studies for ACK at the FAA's Airport Facilities Terminal Instrumentation Laboratory (AFTIL) in Atlantic City. Based on available funding and a reduced level of security concern with passenger terminals, the FAA planned to rehabilitate Nantucket's ATCT in its current location and at its present height. The Tower rehabilitation was conducted under a program separate from the Master Plan and was initiated during the late spring of 2014. However, FAA's funding enabled only a partial "Phase 1" rehab, which leaves the remaining "Phase 2" work to be completed with Airport funds under a future CIP project.

2.5.2.5 Automobile Parking/ Traffic

ACK maintains a paved main parking lot adjacent the passenger terminal for short and long-term auto parking. The main auto parking lot has 292 spaces (226 long-term and 66 short-term) and 80 rental car spaces **(Figure 2-33)**. The FAA occupies 11 additional spaces, plus 4 inside the main parking lot. There are 19 curbside spaces and 8 additional cab queuing spaces. A separate secure lot serves the FBO/ Administration Building with 27 employee spaces, 4 short-term and handicapped spaces, plus 10 spaces for FBO customers.

The Airport also has a stabilized gravel parking lot which provides overflow parking for 120 rental cars, plus space for visitors to the Airport's ARFF Station. Traffic Counts at the main parking lot entrances and at Old South Road show that automobile traffic volumes have decreased by approximately 4% to 5% since 2002 (see **Appendix 2-1 -** Traffic Analysis).

Figure 2-33 – ACK Terminal Parking Lot



Source: Jacobs, 2014

2.6 Airspace

The airspace surrounding ACK was described in great detail in the 2010 ALP Update Report prepared by Jacobs and is provided below.

The airspace surrounding Nantucket Airport is part of the National Airspace System (NAS) which consists of various classifications of airspace regulated by the FAA. Airspace classification is necessary to ensure the safety of all aircraft utilizing public airspace during periods of inclement weather, with the primary function of airspace classification being the separation of instrument flight rules (IFR) traffic from each other, as well as from visual flight rules (VFR) traffic. Pilots flying in controlled airspace are subject to air traffic control (ATC) requirements and must either follow VFR or IFR regulations. These regulations, which include combinations of operating rules, aircraft equipment, and pilot certification, vary depending on the class of airspace and are described in Federal Aviation Regulation (FAR) Part 71.

The five-mile ring of "Class D" airspace encircling Nantucket Airport and extending to 2,500 above the airport surface is controlled by the FAA Air Traffic Control specialists who staff the Nantucket Control Tower. This area is depicted as the smaller, segmented circle centered on Nantucket Island, as shown in **Figure 2-34.**

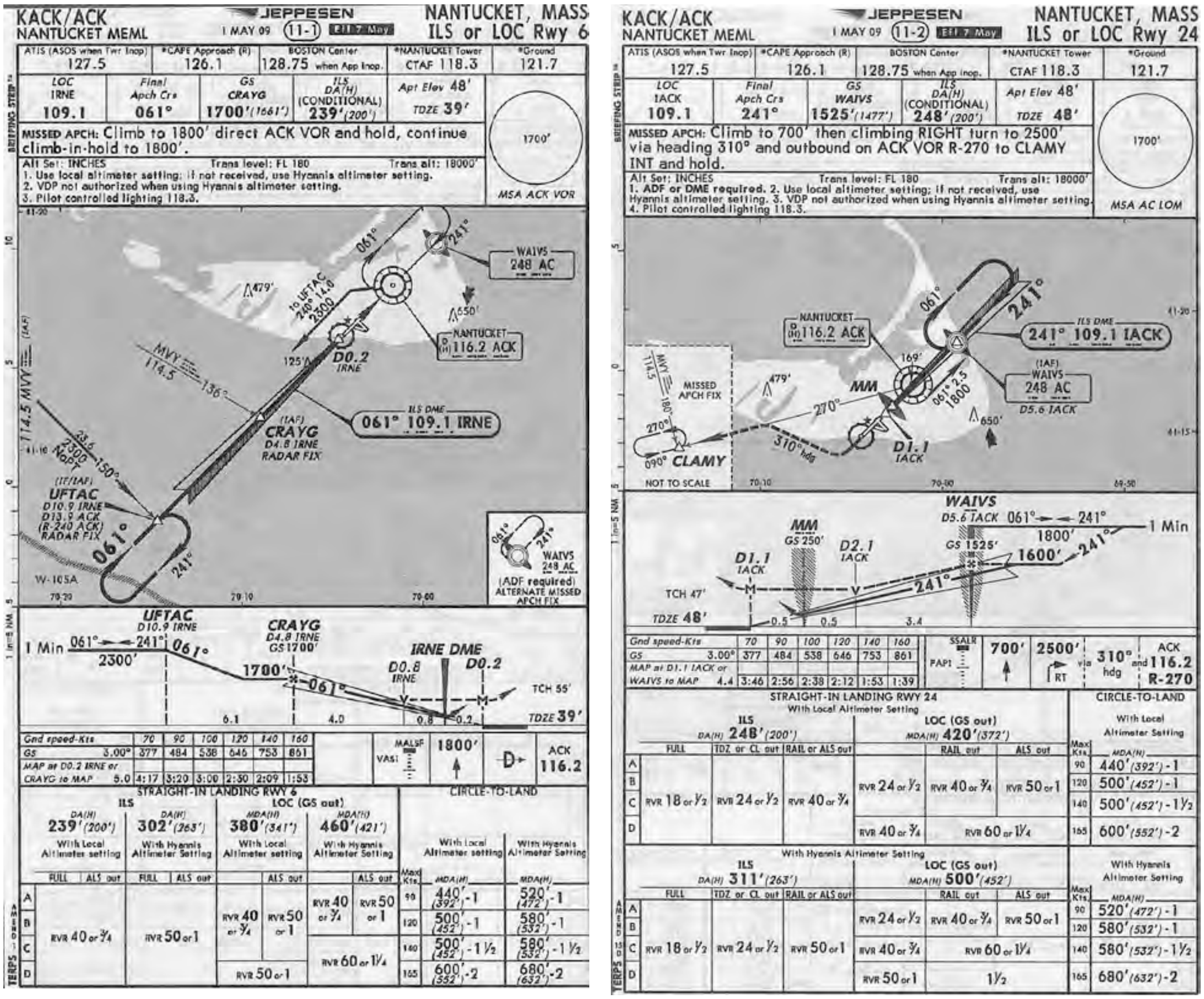
Arriving aircraft must contact the Tower prior to entering this 5-mile ring of airspace in order to establish radio communications. This enables ATC to provide separation with other aircraft and clearance for aircraft to land on specific runways. IFR aircraft are provided with ATC separation services down to a transition altitude of 700 feet AGL within the magenta-toned areas, shown to the right.

Figure 2-34 – NY Sectional Aeronautical Chart (Nantucket Sound Area)

Source: FAA

Aircraft departing Nantucket on instrument flight plans must contact the Tower for delivery of their flight routing instructions and departure clearances prior to any movement on the ramps. All departing aircraft must contact Nantucket Tower's local ground control to obtain taxi instructions to the active runway for takeoff. Outside the 5-mile ring, aircraft on an IFR flight plan are controlled by ATC staff at Cape Approach who provide separation services and sequence aircraft for arrivals to and departures from Nantucket. Cape Approach can provide overwater flight following services during visual flight conditions for VFR aircraft transiting to and from Cape Cod out to Nantucket.

Figure 2-35 – Instrument Approach Plates – ACK ILS Rwy 6 & Rwy 24 (NOT for Aerial Navigation)



Source: Jeppesen

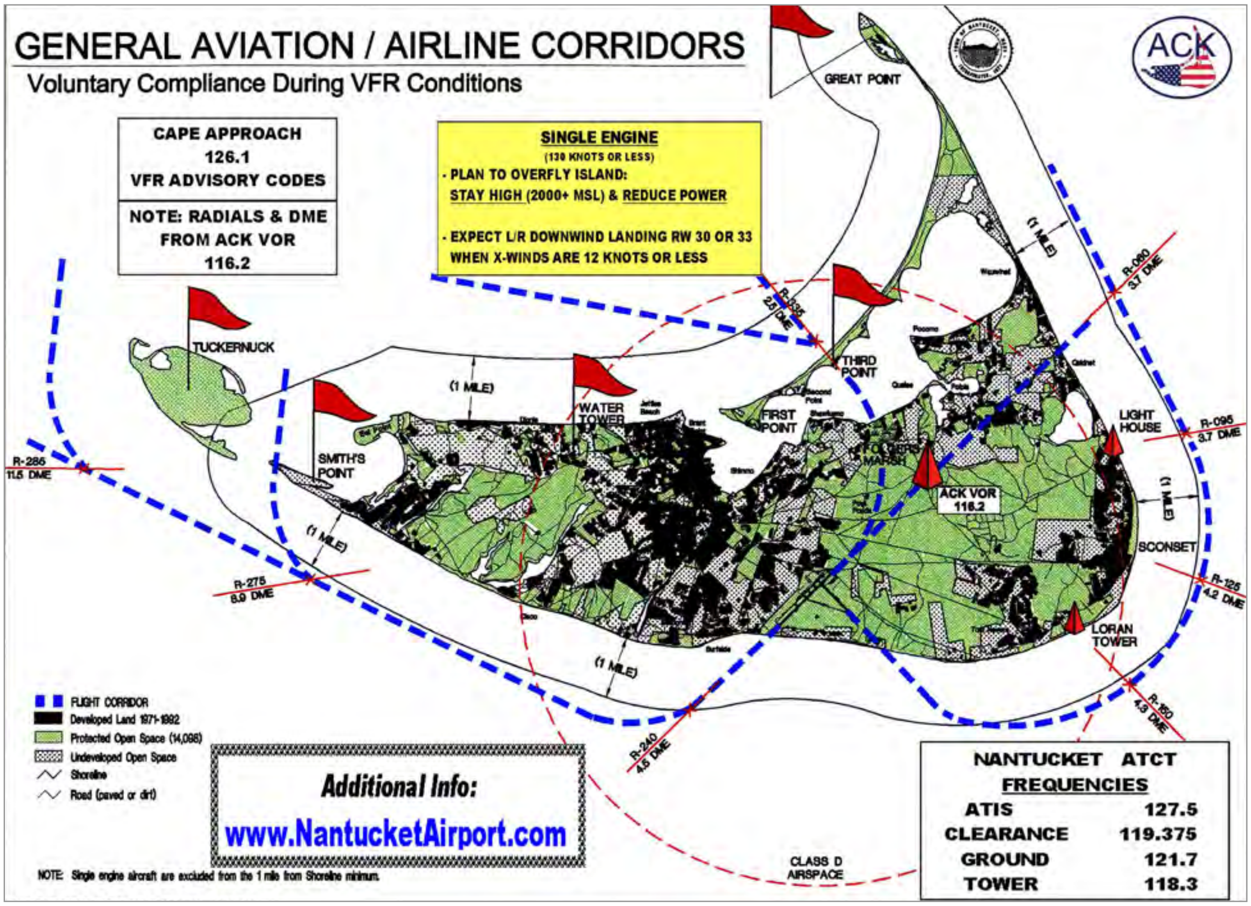
There are currently nine separate precision and non-precision approach procedures available to IFR traffic landing at Nantucket Airport. Examples of two of these procedures are shown above in **Figure 2-35**. These are the approach plates for the ILS to Runway 6 and the ILS to Runway 24. The appropriate radio contact frequencies, approach course, altitude and location of the initial approach fix, minimum decision altitude (239′ for Runway 6 ILS) and touchdown zone elevation (39′ for Runway 6) are supplemented with a map and profile of the procedure. Once the pilot intercepts the Localizer signal, the aircraft is turned to keep the vertical needle centered on the ILS instrument. This gets the airplane aligned with the runway (on a 061 degree heading). The pilot then adjusts the altitude to cross the initial approach fix (CRAYG) at 1700 feet and 4 miles out, at which point the 3 degree glide slope is intercepted and the descent is begun to the runway.

A standard speed, heading, and rate of descent are maintained to the decision altitude of 239 feet. At that minimum height, the runway approach lights should be in view and the pilot may proceed to a visual landing. If at 200 feet above the runway the approach lights are not visible, the pilot must pull up and fly the missed approach procedure which is noted on the approach plate. The Runway 24 ILS has a similar procedure, but a slightly higher “minimum” because that end of the runway is slightly higher. However, because the approach lights to Runway 24 extend further and have the sequenced flashing “rabbit” lights, the minimum visibility range, such as in fog, is 1800 feet for Runway 24 ILS approaches, whereas it is 4,000 feet for Runway 6. These are specified in the lower left of the approach plates as an RVR note. The Runway 24 ILS “minimums” of 200 feet AGL and 1800 feet RVR are the lowest available at Nantucket and represent typical ILS “Cat I” minimums at most regional, short haul, non-hub airports. These minimums are important, since they establish a very high level of aeronautical access for properly-trained pilots operating properly-equipped aircraft during fog and poor weather conditions at Nantucket.

During periods of good VFR weather, Nantucket frequently attracts high volumes of GA traffic and summer visitors. The visitors (“day-trippers”) often fly over on one of the commuter airlines (Cape Air and Island Airlines), which operate nine-passenger Cessna 402 aircraft. The volume of C-402’s, GA traffic, and corporate jets can reach very high levels on peak summer weekends. This high level of aircraft activity had created concentrations of noise impacts due to FAA’s standard air traffic patterns that directed air traffic over high-density populated areas of the Island. The Nantucket Memorial Airport Commission conducted a FAR Part 150 Noise Abatement Study with the support of the FAA. The process involved the analysis of modified VFR flight tracks to avoid populated areas. New studies were conducted by aviation flight safety experts, with participation by the commuter airlines and private aircraft operators, involvement of interested and impacted civic parties, and meetings and deliberations by the Airport Commission. Out of this cooperative process in 1987 came volunteer flight paths to reduce noise levels on the ground. Subsequent new VFR noise abatement air routes, adopted in 1971 and updated more recently, have helped to reduce the noise impact of aircraft operations on the island and on its residents.

The current VFR noise abatement routes are shown in **Figure 2-36** on the following page.

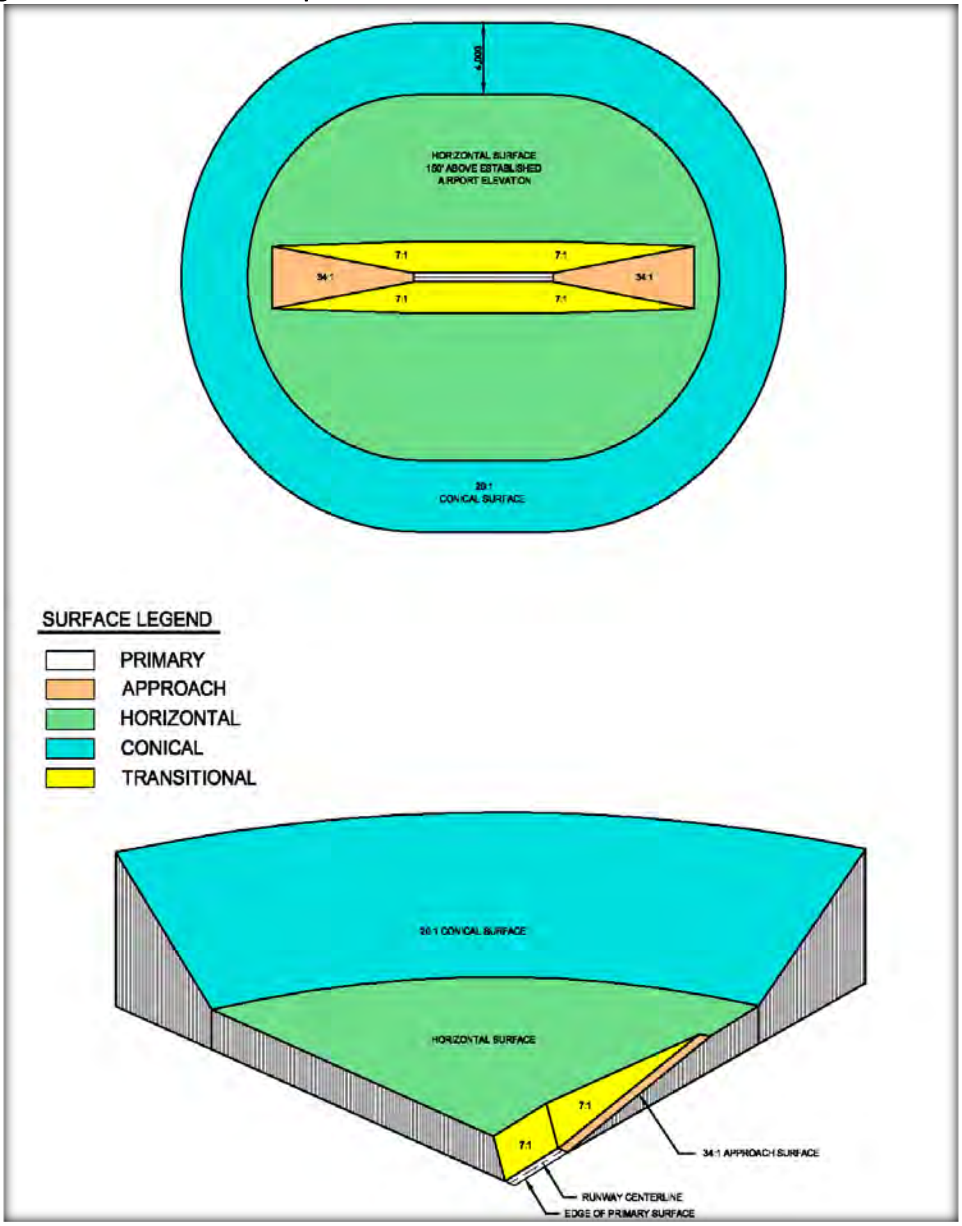
Figure 2-36 VFR Noise Abatement Routes



Source: Nantucket Memorial Airport

The airspace around Nantucket's runways is also protected by imaginary surfaces that FAA manages through its Part 77 and TERPS designation process. The TERPS, or Terminal Instrument Procedure surfaces, slope up and out from the runway ends and protect the airspace below the glide paths for the various ILS and non-precision approaches. The FAA also checks instrument departure surfaces, as well, for clearance of obstacles during takeoff. Lower still, in terms of airspace protection, are FAA's Part 77 surfaces. Similar to the TERPS surfaces, these "troughs" of airspace slope up and out from the runway ends up to a flat horizontal surface that overlies the entire airport at 150 feet above the ground. These surfaces, which are typical for all civilian airports are shown in **Figure 2-37** on the following page.

Figure 2-37 – FAR Part 77 Airspace Surfaces



Source: FAA

The individual FAR Part 77 Airspace Surfaces are illustrated in **Figure 2-37** (above) are described in the following paragraphs: The primary, approach, transitional, horizontal and conical surfaces identified in FAR Part 77 are applied to each runway based upon the type of approach procedure available for that runway and the specific FAR Part 77 runway category criteria. A visual/utility runway such as Runway 12-30 is a runway that is intended for use by propeller driven aircraft of 12,500 pounds or less maximum gross weight. A non-precision instrument runway such as Runway 15-33 is a runway with an approved or planned straight-in non-precision (RNAV or GPS/LPV) instrument procedure that has no existing or planned precision instrument approach. A precision instrument runway such as Runway 6-24 is a runway with an approved straight-in precision (ILS) instrument procedure.

PRIMARY SURFACE

The primary surface is a flat imaginary surface that extends along the length and width of the runway and 200 feet beyond each end of the runway. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline. The width is 1,000 feet for precision runways such as Runway 6-24, 500 feet for non-precision runways with visibility minimums greater than ¾ mile (Runway 15-33) and 250 feet for visual runways serving only small GA aircraft (Runway 12-30). The purpose is to establish a “safety zone” along the runway within which no large structures or objects can be located to reduce chances of collisions by aircraft.

APPROACH SURFACE

The approach surface is a surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. An approach surface is applied to each end of the runway based upon the type of approach for that runway, with gradients of 20:1, 34:1 or 50:1. The inner edge of the surface is the same width as the primary surface. It expands uniformly to a width corresponding to the FAR Part 77 runway classification criteria. The purpose is to prevent construction of buildings, towers or growth of tall trees that would obstruct aircraft on approach to the runway.

TRANSITIONAL SURFACE

The transitional surfaces extend outward and upward at right angles along the edges of the runway centerlines from the sides of the primary and approach surfaces at a slope of 7:1 up to elevation of the horizontal surface. The transitional surfaces create the sides of the “troughs” of airspace that slope up and out along the edges of the runways, protecting aircraft from obstructions long the sides of their flight path.

HORIZONTAL SURFACE

The horizontal surface protects the maneuvering of aircraft over and in the vicinity of an airport. The horizontal surface is a flat plane established 150 feet above the airport elevation. At Nantucket the highest elevation runway elevation is 48 feet MSL, which sets the horizontal surface at 198MSL. The outer edges of the horizontal surface are constructed by arcs of specified radius from the center of each end of the primary surface of each runway. The radius of each arc is 5,000 feet for runways designated as utility or visual and 10,000 feet for all other runways. The shape and extent of Nantucket’s horizontal surface, as well as each of its Part 77 surfaces, is illustrated on the next page (**Figure 2-38**).

CONICAL SURFACE

The conical surface extends outward and upward from the periphery of the horizontal surface at a slope of 20:1 for a horizontal distance of 4,000 feet. This creates the outer edges of the “pie plate” of imaginary Part 77 airspace surfaces that overlie Nantucket Airport.

Figure 2-38 – FAR Part 77 Surfaces – Nantucket Memorial Airport

Source: Jacobs

2.7 Airport Management and Operation

Nantucket Memorial Airport is owned by the Town of Nantucket. The responsibility for its operation lies with a five-member Airport Commission which is appointed by the Board of Selectmen. A full-time Airport Manager and technical staff are employed to operate the Airport on a day-to-day basis. Airport staff positions include the Airport Manager, Office Manager, Training/Compliance Officer, Operations Superintendent/ARFF, Operations Superintendent/FBO, Airport Maintenance Superintendent, Business Manager, Environmental Coordinator, Terminal and Security Coordinator, Assistant to the Security Coordinator, Finance Assistant, Operations Supervisor, Administrative Assistant and Receptionist. These positions are provided by the Town and County of Nantucket. There are a total of 33 year-round staff positions. This increases by an additional 19 seasonal employees during the summer, for a seasonal total of 51 employees. Most of this seasonal increase is in the Operations staff, which adds 11 summer personnel. FBO staff increases from 3 to 6, and Security increases from 2 to 5 staff. An ongoing concern is the availability of seasonal housing for summer employees. The Airport maintains the Thompson House, which sleeps 8 in three bedrooms. With 19 incoming staff, however, seasonal housing is a critical concern. With escalating annual rental costs, this housing situation will become more critical each year.

2.8 Fixed Base Operator (FBO)

ACK is the Fixed Base Operator (FBO) servicing based and transient aircraft. This includes aircraft fueling, parking, tie down and/or hangar storage (for transient aircraft), as well as providing pilot lounge and flight planning facilities. The airport Operations staff is responsible for line service, which includes parking aircraft and pumping 100 LL and Jet-A fuel. FBO staff monitors the UNICOM frequency, processes invoices for fuel and collects parking fees. In FY13, the Airport FBO pumped 1,164,958 gallons of Jet A and 116,007 gallons of AvGas. The FBO offices are located in the new Administration/FBO building adjacent the GA South Ramp. **Figure 2-39** shows the new FBO and Airport Administration building.

Figure 2-39- New FBO/Admin Building

Source: Jacobs, 2014

2.9 Airport Tenants

Airport tenants include a mix of terminal concessions, aircraft hangar owners, airlines and businesses located at the airport. Each one is described below.

- Airlines – There are several airlines that service ACK from a variety of airports. Seasonal airlines between June-September include JetBlue, United, Delta and US Airways (American Airlines). Year-round airline service is provided by Cape Air, Island Airlines, and Nantucket Airlines. Airline service and frequency of flights is subject to change, season to season.
- Rental Cars – ACK services three auto rental companies within the terminal building provided by Hertz, Nantucket Island Rent-a-Car, and Windmill Auto, all offering rental options ranging from small, midsize, and SUV vehicles. Car rental counters are located within the air taxi arrival lobby. ACK also offers seasonal shuttle service and year-round taxi services available island wide.
- Restaurant – Crosswinds Restaurant and Bar, located on the west side of ACK Terminal, serves breakfast, lunch, and dinner Monday-Sunday. The restaurant is approximately 2,700 SF and was renovated in 2009. It is open year-round and is a popular with local clientele during the off-season.
- Gift Shop – ACK's gift shop is located centrally within the terminal west of the ticketing lobby. The gift shop is approximately 544 SF including storage space.

2.9.1 Hangars

Hangar storage provides better security for the aircraft, typically lowers insurance rates, and on Nantucket, protects the airplane against the ocean's salt air. The airport's hangars are clustered around the approach end to Runway 15, north of the Passenger Terminal Building. The Airport's familiar "Nantucket" hangar, shown in **Figure 2-40**, is used for storage of four to six small GA aircraft.

Figure 2-40 – Nantucket GA Hangar Area

Source: Jacobs, 2013

There are six conventional storage hangars (capable of storing multiple aircraft) and a 10 unit T-hangar located at ACK (see **Figure 2-41**). However, the hangars are privately owned, so the owners control how many and which airplanes are stored in each. The previous Master Plan indicated that any excess capacity may not be available for future based aircraft. As a result, future based aircraft that require hangar storage will require additional hangars to be constructed.

In addition, the previous Master Plan noted that the existing hangars are too small to accommodate large corporate jets such as the G-V, the Global Express, Falcon 7X, etc. In previous years, a few corporate jet owners had expressed interest in constructing new hangars to house their jets for the summer season. While this interest has waned with the recent economic downturn, the potential to set aside areas for future large hangar land leases should be a consideration for potential revenue generation.

Figure 2-41 – GA Hangar #9

Source: Jacobs, 2013

2.10 Land Use and Zoning

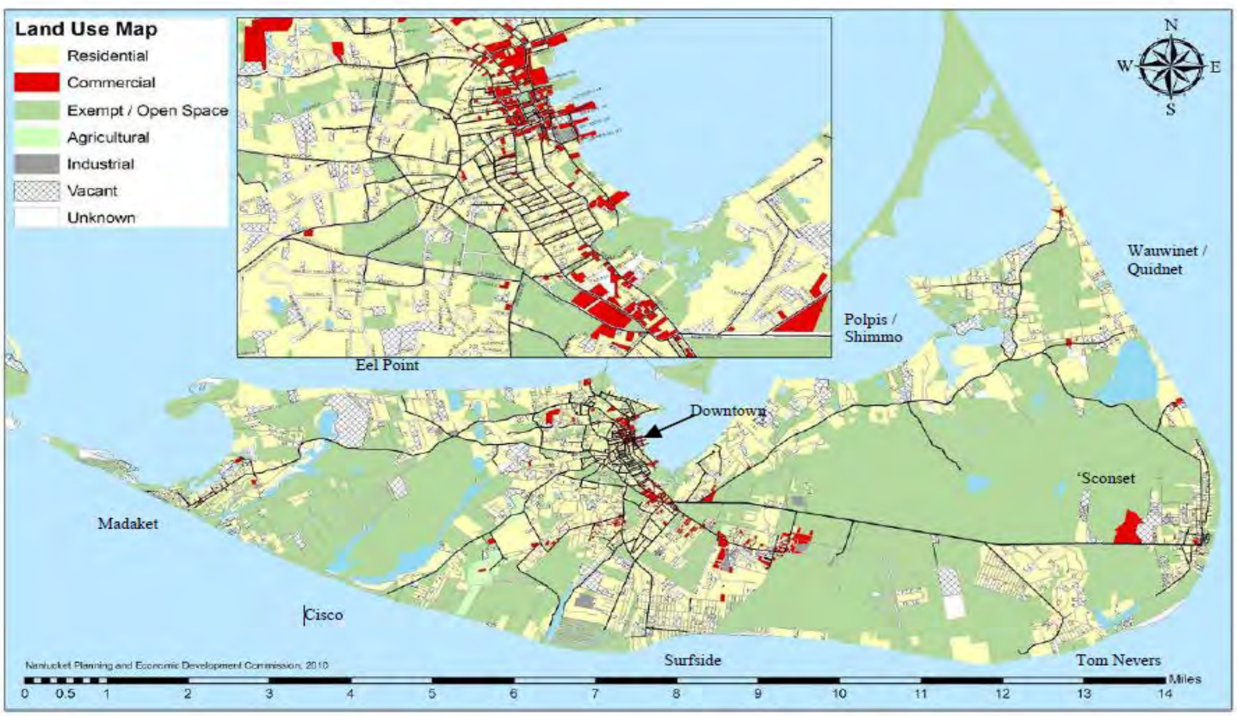
The permitted uses of land adjacent to an airport can have a profound effect on the type of aeronautical activity seen at the airport. High density residential areas, landfills, and libraries all tend to be incompatible with most types of aviation activity. Also, vegetative and man-made objects with extensive vertical development can have substantial adverse impacts on airport aeronautical accessibility if they are found to penetrate any of the protected airspace surfaces described previously in Section 1.6, *Airspace.*

The following section contains land use and zoning information that is located in the 2012 Nantucket Regional Transportation Plan, provided by the Nantucket Planning and Economic Development Commission and the Town of Nantucket.

2.10.1 Land Use

Nantucket Island is made up of approximately 30,000 acres of land. The majority of the land on the island is Exempt/Open Space which is conservation and/or government owned, and this land is classified by the Town of Nantucket as "limited use". The next significant amount of land is considered residential. The Commission states that "the high demand for housing, particularly for seasonal vacation homes, has meant that Nantucket continues to face intensive development pressure." **Figure 2-42** depicts the various land use concentrations at Nantucket.

Figure 2-42 Nantucket Land Use Map (2010)



Source: 2012 Nantucket Regional Transportation Plan

2.10.2 Local Zoning/ Land Development

The Town of Nantucket's zoning code is used to control the density of island wide development. The zoning code specifies minimum lot size, frontage, and defines usage specific to each zoning classification. The airport is zoned as Commercial Industrial (CI) and is bordered by Limited Use General 3 (LUG-3) with minimum 120,000 SF lot sizes to the east and south. LUG-3 supports low density residential development. To the west is a mix of low to medium residential districts (LUG-2 with 80,000 SF lots; LUG-1 with 40,000 SF; and R-20 at 20,000 SF). North of the airport is High Density Residential R-5, plus RC-2 at 5,000 SF). There are also two areas of CI Commercial 15,000 SF immediately to the north, as shown of **Figure 2-43**. It would be advantageous to extend the CI zone to the corner of Airport Road (see Chapter 6). **Table 2-11** on the following page serves as a guide to the Town's zoning classifications and land use densities.

Figure 2-43 Local Zoning Map Surrounding ACK

Source: Town of Nantucket; GIS Mapsheet

Table 2-11 Nantucket Island Land Use Zones

Land Use Zones Surrounding Nantucket Memorial Airport				
ZONING	**MIN. LOT SIZE (in Sq. Ft)**	**FRONTAGE**	**FRONT YARD SETBACK**	**GROUND COVER RATIO**
Low Density Residential				
Limited Use General 2 **(LUG-2)**	80,000’	150 ft	35 ft.	4%
Limited Use General 3 **(LUG-3)**	120,000’	200 ft.	35 ft.	3%
Medium Density Residential				
Limited Use General 1 **(LUG-1)**	40,000’	100 ft.	35 ft.	7%
Residential 40 **(R-40)**	40,000’	75 ft.	30 ft.	10%
Residential 20 **(R-20)**	20,000’	75 ft.	30 ft.	12.5%
High Density Residential				
Residential 5 **(R-5)**	5,000’	50 ft.	10 ft.	40%
High Density Commercial/Mixed Use				
Residential Commercial **(RC)**	5,000’	40 ft.	None	50%
Residential Commercial 2 **(RC-2)**	5,000’	40 ft.	10 ft.	50%
Commercial Industrial **(CI)**	15,000’	75 ft.	20 ft.	50%

Source: Town of Nantucket Code; Zoning

The areas immediately surrounding the airport have seen steady development over the past several decades for residential, commercial and light industrial uses. The Nantucket Planning and Economic Development Commission described the island-wide extent of these areas in the 2012 Nantucket Regional Transportation Plan:

Residential
There are 7,978 acres devoted to residential development on the Island, which is 26.3% of the total acreage on the island. Considering that only about 31% of the island is developed, residential use accounts for 88.2% of this developed land.

Commercial
There are 313.6 acres, or 1% of the island, zoned for commercial activities. Presently, the commercial land is concentrated primarily in downtown Nantucket and the center of the Island, known as the "Mid-Island", with some commercial and light industrial uses running along a transportation network spine from the Milestone Rotary (intersection of Old South Road, Lower Orange Street, Sparks Avenue and Milestone Road) east along both sides of Old South Road to the Airport. The commercial zone also extends from the Rotary northwest along Sparks Avenue and Pleasant Street. The local commercial uses consist of retail and service-oriented businesses, some of which are seasonal and located in the downtown core district. Minor commercial uses also include workshops and construction-related businesses, many of which are based out of homes.

Light Industrial
Light industrial uses are only a small portion of Nantucket's developed land area. Nantucket's light industrial land uses are the utilities and power generation facilities and several construction related non-manufacturing industries such as asphalt production, grading and excavation. A number of the Island's light industrial, construction and storage facilities are located along Old South Road and the area surrounding the Nantucket Memorial Airport. An industrially zoned area is located off of Bunker Road immediately east of the airport's Runway 24 approach path and adjacent the airport's "Bunker Area" (see **Figure 2-44**, below).

Figure 2-44 – Commercial Industrial Development Abutting the Bunker Area

Source: Jacobs, 2014

Immediately north of the Runway 24 end, and opposite the Bunker Area, the former Coffin Pit has been filled-in and converted to a new subdivision (see **Figure 2-45,** below).

Figure 2-45 – Development in Coffin Pit Abutting Runway 24 (view looking north)

Source: Jacobs, 2014

Immediately north of the Runway 6 end, a series of residential lots have been developed directly adjacent to the airport's security fence (see **Figure 2-46,** below):

Figure 2-46 – Residential Development Abutting Runway 6 (view looking south)

Source: Jacobs, 2014

Immediately south of the Runway 6 end, a new residence has been constructed directly abutting the airport boundary and adjacent the Runway 6 flight path (see **Figure 2-47,** below). This area along South Beach and Madequecham Valley Road is zoned for 120,000 SF lots (IE: 3 acres) which supports low density residential development. However, the return on investment in high-value waterfront land leads to the development of any parcel that can be made available. At present, there are no mechanisms in the Town's Zoning Bylaw, Building Code or Subdivision Code to address land development that may be incompatible with on-going aviation operations and uses (see **Chapter 3, Appendix 3-1**).

Figure 2-47 - Beachfront Residential Development Immediately South of Runway 6

Source: Jacobs, 2014

APPENDIX 2-1

TRAFFIC ANALYSIS REPORT

Nantucket Airport
Traffic Analysis Report

Nantucket, MA

January 17, 2014

SUBMITTED BY:

Jacobs
343 Congress Street
Boston, Massachusetts 02210

JACOBS

Introduction

This traffic impact study for the Nantucket memorial Airport examines current (2013) traffic volumes and operating conditions and compares them to historical (2002) traffic volumes and operating conditions along roadways providing access to the Nantucket Memorial Airport. Crash data at the study area intersections has been obtained from the MassDOT for the years 2009 to 2011 and is summarized in this report.

Existing Conditions

Existing roadway and traffic conditions were determined for the project study area. The project site with respect to the local roadway system is shown in Figure 1. The existing conditions analysis is based on traffic counts and field conditions. Information collected regarding roadway geometric conditions, traffic control, traffic volumes and peak period traffic operations are described below.

Study Area

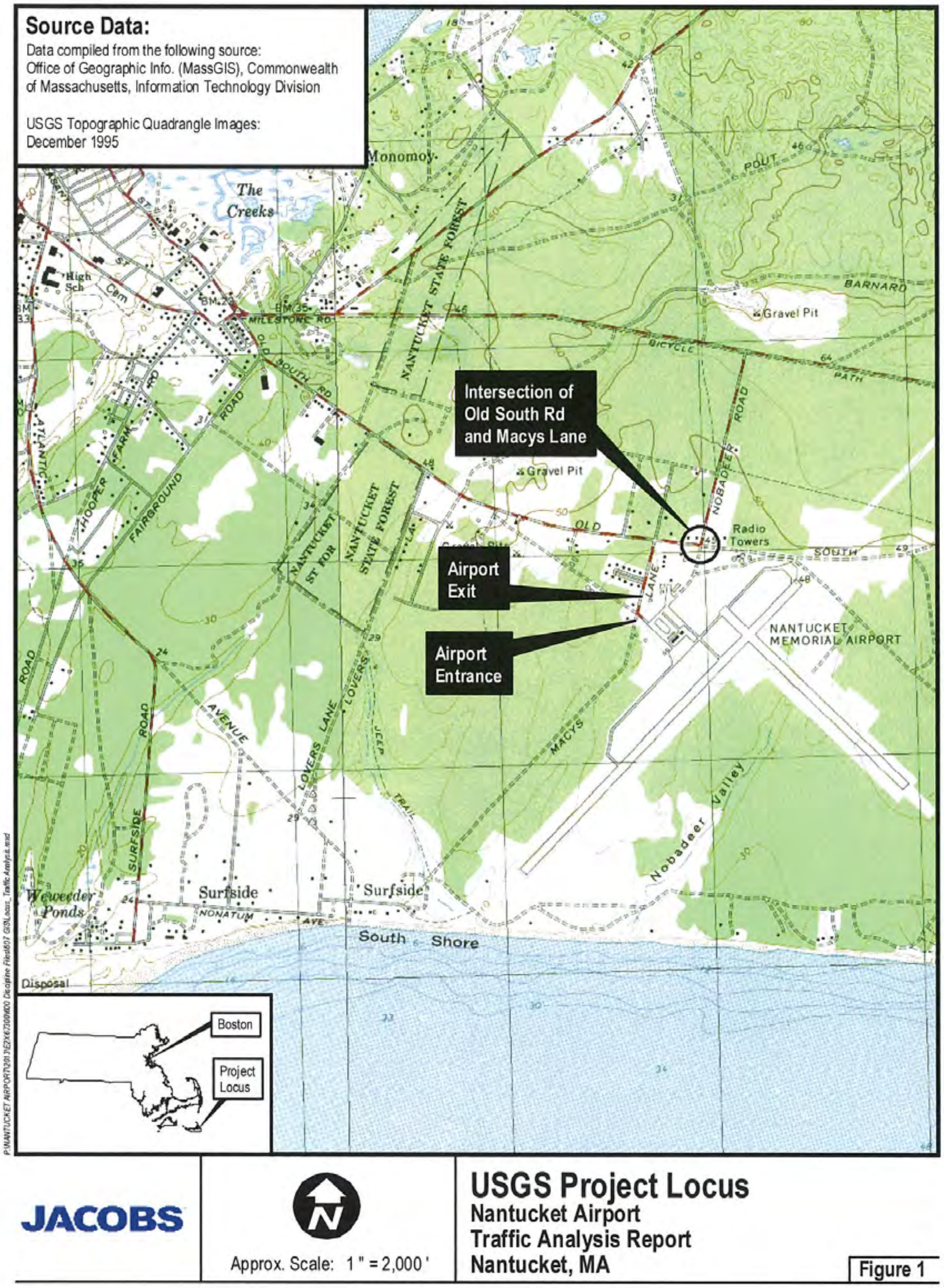
The study area for the traffic study includes the critical intersections and roadways providing access to the Airport. The study area evaluated within this report includes Macy Lane, and Old South Road. Specifically, the study area includes the following intersections:

- Airport Entrance at Macy lane
- Airport Exit at Macy lane
- Old South Road at Macy Lane

Roadway Network

Macy Lane is a two lane north south collector type road with no shoulders that provides access to Old South road to the north of the airport and Nobadeer Beach to the south of the airport. It is the only public vehicular access route to the airport. Posted speed is 30 mph. Land use along Macy Lane is primarily commercial/industrial around the airport and large lot residential to the south of the airport.

Old South Road is an east west collector type road that intersects with Macy Lane approximately 1000 feet north of the airport driveways. It is a two-lane road that forms a rotary at the intersection of Milestone Road 1.8 miles to the west. Land use is primarily light commercial with single family residential to the north of the road. Speed limit on the road is 35 mph.


Source Data:
Data compiled from the following source:
Office of Geographic Info. (MassGIS), Commonwealth of Massachusetts, Information Technology Division
USGS Topographic Quadrangle Images:
December 1995
Intersection of Old South Rd and Macys Lane
Airport Exit
Airport Entrance
NANTUCKET MEMORIAL AIRPORT
Boston
Project Locus
JACOBS
Approx. Scale: 1" = 2,000'
USGS Project Locus
Nantucket Airport
Traffic Analysis Report
Nantucket, MA
Figure 1

Intersections

Airport Driveways at Macy Lane

The main airport access road provides one-way circular flow around the main parking lot as shown in Figure 2. There are two driveways along Macy Lane; the one to the south is used as the entrance, and the one to the north is used as the exit. Each driveway has one lane. Employee parking has a separate entrance/exit on Macy Lane, located opposite the main airport entrance.

Macy Lane at Old South Road

The intersection of Macy Lane and Old South Road is a four-way intersection with STOP sign control on all approaches. This intersection is proximate to the airport, which is located approximately 1,000 feet south on Macy Lane. Each approach of the intersection accommodates one genera-purpose lane serving all turning movements. Pavement markings are clearly delineated with double yellow center lines on the north, east and west approaches to the intersection. Cross walks are located on the north and east approaches. This intersection previously operated under two-way stop control on the Macy Street approaches. The intersection is shown in Figure 3.

Motor Vehicle Crash Data

Motor vehicle crash information for the study area intersections was provided by the MassDOT Highway Division Safety management/traffic Operations Unit for the most recent three-year period available (2009 through 2011 inclusive) in order to examine motor vehicle crash trends occurring within the study area. No crashes were reported at either of the Airport Entrance and Airport Exit driveways at Macy Lane and one crash was reported in 2009 and 2011 at the Macy Lane/Old South Road intersection. Both crashes were property damage only, occurred during daylight and clear conditions. One crash was a rear-end and the other was a side-swipe crash. Based on two crashes over a three year period, there is no identifiable trend of motor vehicle crashes taking place.

Traffic Volumes

Base traffic conditions within the study area were developed by collecting automatic traffic recorder (ATR) and manual turning movement (TMC) counts at the study locations during the peak summer months. ATR counts were collected at the airport entrance and airport exit for a 4 day period from Friday August 30, 2013 to Monday September 2, 2013. A TMC was conducted at the intersection of Macy Lane and Old South Road from 9:00 AM to 11:00 AM and 4:00 PM to 8:00 PM on Friday, August 30, 3013. The typical morning peak hour was not used in this analysis because activity at the airport is low during that time period. Previous counts were taken in these areas in 2002.

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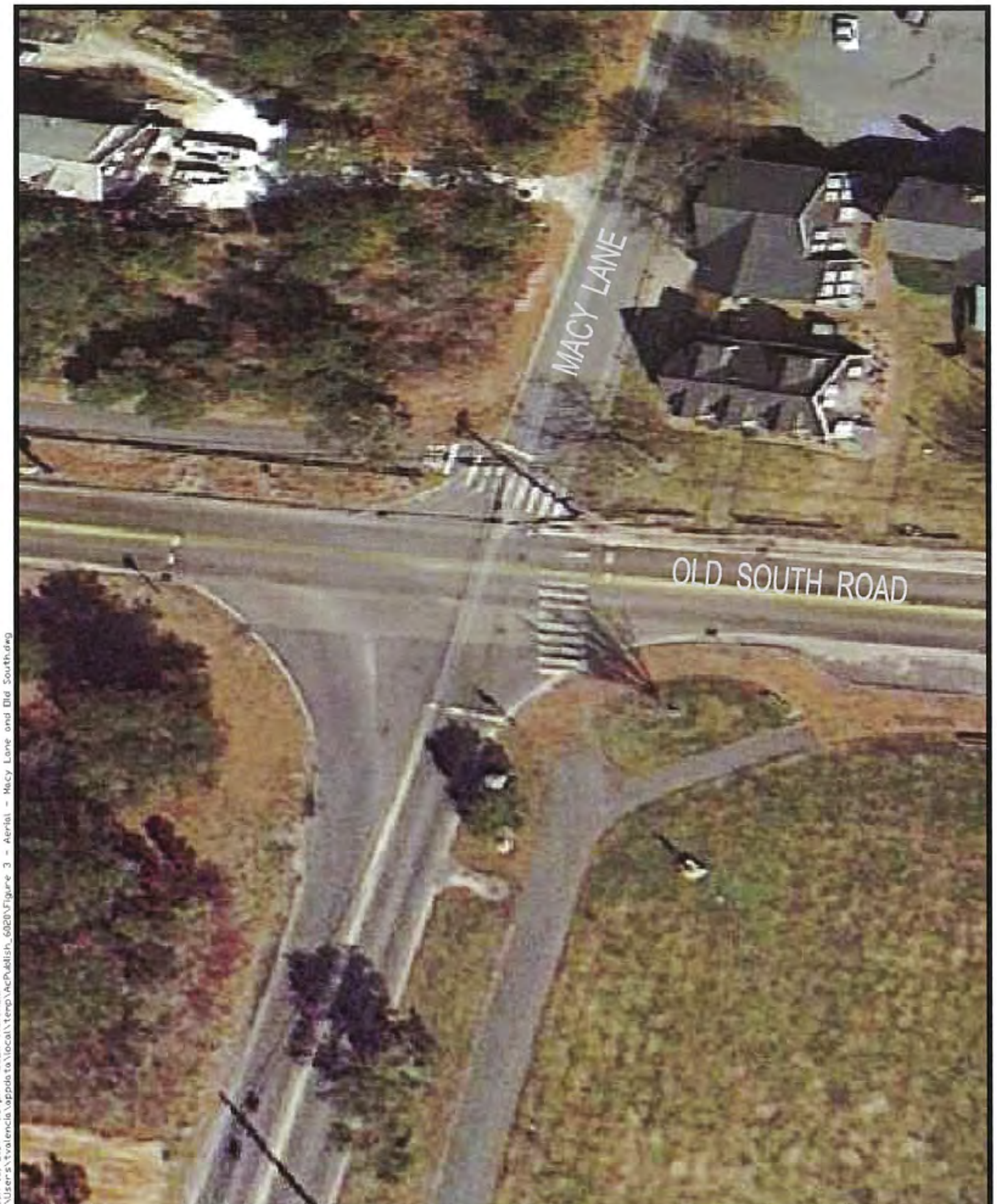
Approx. Scale: NTS

AIRPORT DRIVEWAYS
Nantucket Airport
Traffic Analysis Report
Nantucket, MA

Figure 2



JACOBS

Approx. Scale: NTS

MACY LANE AT OLD SOUTH ROAD
Nantucket Airport
Traffic Analysis Report
Nantucket, MA

Figure 3

Seasonal traffic is significantly higher during the summer months due to tourist activity on the island, therefore, in order to provide peak existing summertime conditions, the observed traffic volumes were used with no adjustment.

Figure 4 shows the 2013 Peak Hour Traffic Turning Movements and Table 1 below shows the 2002 and 2013 hourly and daily traffic volumes as well as the percent change over the two time periods.

Table 1 - Traffic Volumes:

Midday

Location	Direction	2002 Midday Peak Hour	2013 Midday Peak Hour	% Change Per Year
Airport Entrance	Eastbound	207	251	1.77%
	Total	207	251	
Airport Exit	Westbound	245	239	-0.23%
	Total	245	239	
Macy Lane	Northbound	309	284	-0.76%
(North of Airport)	Southbound	317	241	-2.46%
	Total	626	525	-1.59%
Old South Road	Eastbound	596	352	-4.67%
(West of Macy Lane)	Westbound	626	372	-4.62%
	Total	1,222	724	-4.65%

PM Peak

Location	Direction	2002 PM Peak Hour	2013 PM Peak Hour	% Change Per Year
Airport Entrance	Eastbound	195	130	-3.62%
	Total	195	130	
Airport Exit	Westbound	213	146	-3.38%
	Total	213	146	
Macy Lane	Northbound	275	234	-1.46%
(North of Airport)	Southbound	323	260	-1.95%
	Total	598	494	-1.72%
Old South Road	Eastbound	603	410	-3.45%
(West of Macy Lane)	Westbound	597	404	-3.49%
	Total	1,200	814	-3.47%

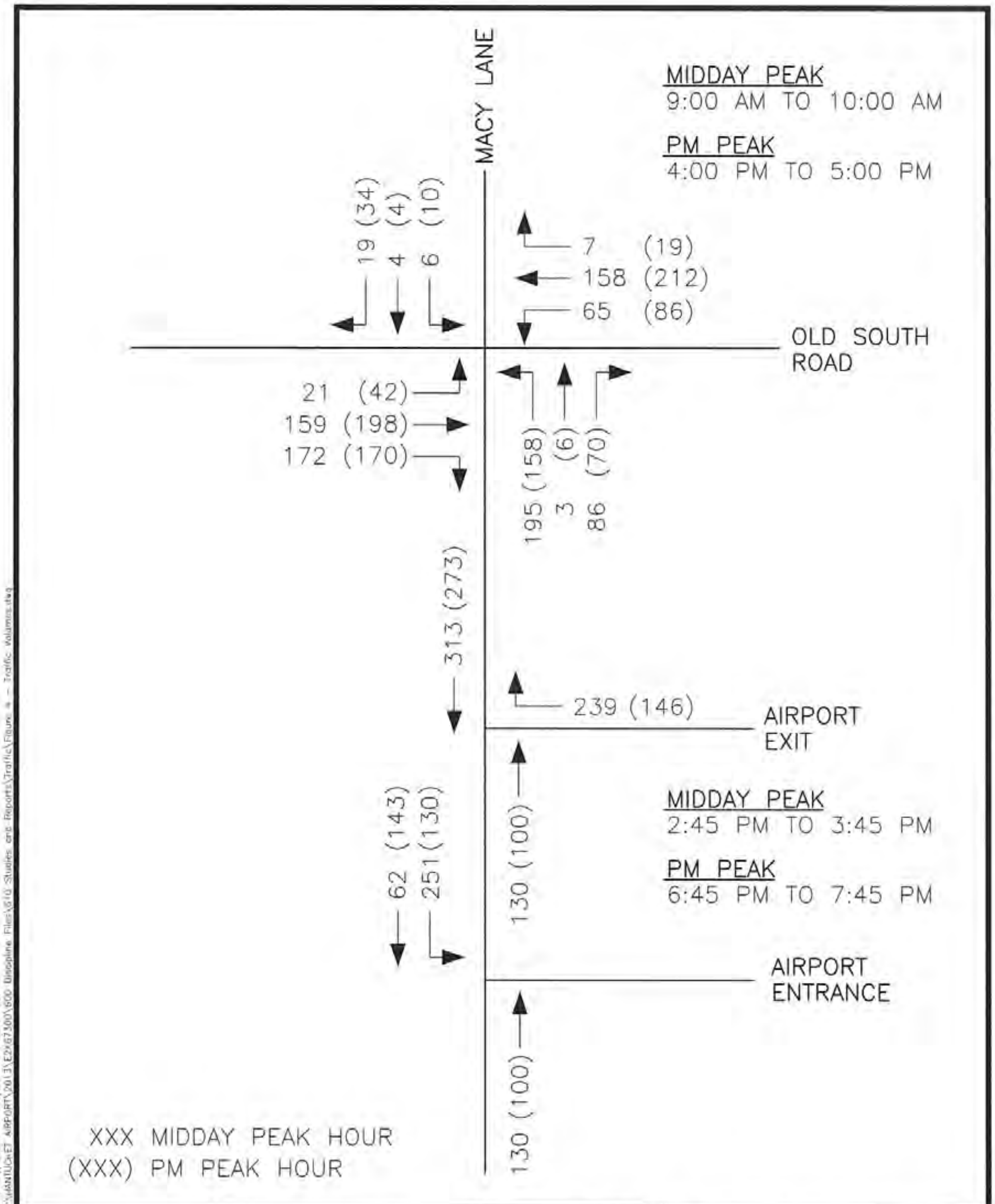
Daily

Location	Direction	2002 Daily	2013 Daily	% Change Per Year
Airport Entrance	Eastbound	2,881	2,261	-2.18%
	Total	2,881	2,261	
Airport Exit	Westbound	3,399	2,303	-3.48%
		3,399	2,303	
Macy Lane	Northbound	4,205	2,840	-3.51%
(North of Airport)	Southbound	4,122	2,410	-4.76%
	Total	8,327	5,250	-4.11%
Old South Road	Eastbound	7,829	4,100	-5.71%
(West of Macy Lane)	Westbound	7,601	4,040	-5.58%
	Total	15,430	8,140	-5.65%

Source: 2002 volumes: Traffic Impact Study Nantucket Memorial Airport
2013 volumes: Airport Entrance and Exit from 2013 Automatic Traffic Recorder Counts (ATR), Macy Lane and Old South Road 2013 Turning Movement Counts (TMC), 2013 Daily volumes for 2013 Macy Lane and Old South Road determined by assuming k factor of 10% of peak hour.

Traffic Operations

Existing peak summer traffic operations in the traffic study area were assessed from both a quantitative and qualitative perspective for the midday and PM peak hours. The qualitative analysis is based on field observations made during peak traffic periods, while the quantitative analysis is based on calculated intersection operating levels of service as described in greater detail below.



JACOBS

Approx. Scale: NTS

2013 EXISTING PEAK HOUR VOLUMES

Nantucket Airport
Traffic Analysis Report
Nantucket, MA

Figure 4

Level of Service Criteria

Level of Service (LOS) is a term used to describe the quality of the traffic flow on a roadway at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway facility capacity to travel demand. Operating levels of service are reported on a scale of A to F, with Level of Service A representing the best operating conditions and Level of Service F representing the worst operating conditions. Level of Service A represents free-flow conditions with little or no traffic delays, while Level of Service F represents a forced-flow condition with long delays and traffic demands routinely exceeding roadway capacity.

Roadway operating levels of service are calculated following procedures defined in the 2010 Highway Capacity Manual, published by the Transportation Research Board. Delay criteria for unsignalized intersections are calculated for the side street or minor street approach and for left turns from the major street. The specific criteria applied per 2000 Highway Capacity Manual are summarized in table xxx2.

Table 2
Level of Service Criteria (Unsignalized Intersections)

Level of Service	Delay (Sec./Veh.)
A	<10
B	10 to 15
C	15 to 25
D	25 to 35
E	35 to 50
F	>50

Intersection Operating Conditions (Summer Peak)

Procedures described in the 2010 Highway Capacity Manual (HCM) were used to determine existing peak summer operating levels of service at the study area intersections. Analysis results are based on data collected during peak summer conditions. The results, based on the traffic volume and roadway conditions presented, indicate that all locations operate at an acceptable level of service. The airport driveways operate at LOS A while the intersection of Macy Lane and Old South road operates at LOS B or C depending on the approach. While the change from two-way to four-way stop control has decreased delay on the Macy Lane approaches, it has increased delay on the Old South Road approaches. Tables 3 & 4 indicates the current level of service and the existing level of service from 2002.

Table 3 Existing Peak Summer Level of Service Summary – Midday Peak Hour

		2002			2013		
Location	Movement	V/C	Delay	LOS	V/C	Delay	LOS
Macy Lane at Old South Road	Old South Road EB Left-Thru-Right	0.01	7.7	A	0.617	17.2	C
	Old South Road WB Left-Thru-Right	0.06	8.2	A	0.495	15	B
	Macy Lane NB Left-Thru-Right	0.79	42.5	E	0.621	18.2	C
	Macy Lane SB Left-Thru-Right	0.08	12.1	B	0.08	10.1	B
Macy Lane at Airport Entrance	Macy Lane SB Left-Thru	N/A	N/A	N/A	0.095	7.7	A
Macy Lane at Airport Exit	Airport Exit WB Left - Right	N/A	N/A	N/A	0.289	10.6	B

Table 4 Existing Peak Summer Level of Service Summary – PM Peak Hour

		2002			2013		
Location	Movement	V/C	Delay	LOS	V/C	Delay	LOS
Macy Lane at Old South Road	Old South Road EB Left-Thru-Right	0.03	7.8	A	0.621	17	C
	Old South Road WB Left-Thru-Right	0.09	8.4	A	0.565	15.8	C
	Macy Lane NB Left-Thru-Right	0.95	77	F	0.472	14.4	B
	Macy Lane SB Left-Thru-Right	0.07	13.1	B	0.107	10.2	B
Macy Lane at Airport Entrance	Macy Lane SB Left - Thru	N/A	N/A	N/A	0.095	7.7	A
Macy Lane at Airport Exit	Airport Exit WB Left - Right	N/A	N/A	N/A	0.17	9.6	A

N/A = Not available, Airport Entrance SB analyzed with exclusive left lane to determine effect of left turning vehicles on the approach.

Conclusions

Jacobs (formerly Edwards and Kelcey) recommended the implementation of a four-way stop sign at the Macy Lane/Old South Road intersection in the 2002 Traffic and Transportation Infrastructure Report. The four-way stop has been implemented and the future 2007 capacity analysis results from the report closely match the current 2013 traffic level of service and delays. Traffic volumes since 2002 have decreased as much as to 4.65% per year on each approach since 2002. The study area intersections are capable of handling increased traffic volumes as originally projected in the 2002 report.

Capacity Analysis

HCM 2010 AWSC
3: Macy Lane & Old South Rd 12/24/2013

Intersection	
Intersection Delay, s/veh	16.7
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	21	159	172	65	158	7	195	3	86	6	4	19
Peak Hour Factor	0.88	0.88	0.88	0.79	0.79	0.79	0.75	0.75	0.75	0.66	0.66	0.66
Heavy Vehicles, %	5	5	5	10	10	10	2	2	2	3	3	3
Mvmt Flow	24	181	195	82	200	9	260	4	115	9	6	29
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	17.2	15	18.2	10.1
HCM LOS	C	B	C	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	69%	6%	28%	21%
Vol Thru, %	1%	45%	69%	14%
Vol Right, %	30%	49%	3%	66%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	284	352	230	29
LT Vol	3	159	158	4
Through Vol	86	172	7	19
RT Vol	195	21	65	6
Lane Flow Rate	379	400	291	44
Geometry Grp	1	1	1	1
Degree of Util (X)	0.62	0.615	0.492	0.08
Departure Headway (Hd)	5.898	5.537	6.087	6.547
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	610	648	588	551
Service Time	3.979	3.621	4.18	4.547
HCM Lane V/C Ratio	0.621	0.617	0.495	0.08
HCM Control Delay	18.2	17.2	15	10.1
HCM Lane LOS	C	C	B	B
HCM 95th-tile Q	4.3	4.2	2.7	0.3

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
8: Macy Lane & Airport Entrance 12/24/2013

Intersection						
Intersection Delay, s/veh	4.6					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	0	130	1	251	62
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	141	1	273	67

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	755	142	0	0	142	0
Stage 1	142	-	-	-	-	-
Stage 2	613	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	376	906	-	-	1441	-
Stage 1	885	-	-	-	-	-
Stage 2	541	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	302	906	-	-	1441	-
Mov Capacity-2 Maneuver	302	-	-	-	-	-
Stage 1	885	-	-	-	-	-
Stage 2	434	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	6.5
HCM LOS	A		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	0	1441	-
HCM Lane V/C Ratio	-	-	+	0.189	-
HCM Control Delay (s)	-	-	0	8.081	0
HCM Lane LOS			A	A	A
HCM 95th %tile Q(veh)	-	-	+	0.697	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
6: Macy Lane & Airport Exit 12/24/2013

Intersection	
Intersection Delay, s/veh	3.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	1	239	130	0	0	313
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	260	141	0	0	340

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	481	141	0	0	141	0
Stage 1	141	-	-	-	-	-
Stage 2	340	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	544	907	-	-	1442	-
Stage 1	886	-	-	-	-	-
Stage 2	721	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	544	907	-	-	1442	-
Mov Capacity-2 Maneuver	544	-	-	-	-	-
Stage 1	886	-	-	-	-	-
Stage 2	721	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	10.6	0	0
HCM LOS	B		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	904	1442	-
HCM Lane V/C Ratio	-	-	0.289	-	-
HCM Control Delay (s)	-	-	10.6	0	-
HCM Lane LOS			B	A	
HCM 95th %tile Q(veh)	-	-	1.199	0	-

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

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Synchro 8 Report
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HCM 2010 AWSC
3: Macy Lane & Old South Rd 12/24/2013

Intersection	
Intersection Delay, s/veh	15.6
Intersection LOS	C

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	42	198	170	86	212	19	158	6	70	10	4	34
Peak Hour Factor	0.99	0.99	0.99	0.89	0.89	0.89	0.84	0.84	0.84	0.80	0.80	0.80
Heavy Vehicles, %	4	4	4	2	2	2	1	1	1	4	4	4
Mvmt Flow	42	200	172	97	238	21	188	7	83	12	5	42
Number of Lanes	0	1	0	0	1	0	0	1	0	0	1	0

Approach	EB	WB	NB	SB
Opposing Approach	WB	EB	SB	NB
Opposing Lanes	1	1	1	1
Conflicting Approach Left	SB	NB	EB	WB
Conflicting Lanes Left	1	1	1	1
Conflicting Approach Right	NB	SB	WB	EB
Conflicting Lanes Right	1	1	1	1
HCM Control Delay	17	15.8	14.4	10.2
HCM LOS	C	C	B	B

Lane	NBLn1	EBLn1	WBLn1	SBLn1
Vol Left, %	68%	10%	27%	21%
Vol Thru, %	3%	48%	67%	8%
Vol Right, %	30%	41%	6%	71%
Sign Control	Stop	Stop	Stop	Stop
Traffic Vol by Lane	234	410	317	48
LT Vol	6	198	212	4
Through Vol	70	170	19	34
RT Vol	158	42	86	10
Lane Flow Rate	279	414	356	60
Geometry Grp	1	1	1	1
Degree of Util (X)	0.468	0.62	0.561	0.107
Departure Headway (Hd)	6.042	5.387	5.666	6.438
Convergence, Y/N	Yes	Yes	Yes	Yes
Cap	591	667	630	560
Service Time	4.127	3.464	3.747	4.438
HCM Lane V/C Ratio	0.472	0.621	0.565	0.107
HCM Control Delay	14.4	17	15.8	10.2
HCM Lane LOS	B	C	C	B
HCM 95th-tile Q	2.5	4.3	3.5	0.4

Notes

~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
8: Macy Lane & Airport Entrance 12/24/2013

Intersection	
Intersection Delay, s/veh	2.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	0	100	1	130	143
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	-	0	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	109	1	141	155

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	547	109	0	0	110	0
Stage 1	109	-	-	-	-	-
Stage 2	438	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	498	945	-	-	1480	-
Stage 1	916	-	-	-	-	-
Stage 2	651	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	446	945	-	-	1480	-
Mov Capacity-2 Maneuver	446	-	-	-	-	-
Stage 1	916	-	-	-	-	-
Stage 2	583	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	3.7
HCM LOS	A		

Minor Lane / Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	0	1480	-
HCM Lane V/C Ratio	-	-	+	0.095	-
HCM Control Delay (s)	-	-	0	7.689	0
HCM Lane LOS			A	A	A
HCM 95th %tile Q(veh)	-	-	+	0.316	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined

HCM 2010 TWSC
6: Macy Lane & Airport Exit 12/24/2013

Intersection	
Intersection Delay, s/veh	2.7

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	1	146	100	0	0	273
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	None	-	None
Storage Length	0	-	-	-	-	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	1	159	109	0	0	297

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	406	109	0	0	109	0
Stage 1	109	-	-	-	-	-
Stage 2	297	-	-	-	-	-
Follow-up Headway	3.518	3.318	-	-	2.218	-
Pot Capacity-1 Maneuver	601	945	-	-	1481	-
Stage 1	916	-	-	-	-	-
Stage 2	754	-	-	-	-	-
Time blocked-Platoon, %			-	-		-
Mov Capacity-1 Maneuver	601	945	-	-	1481	-
Mov Capacity-2 Maneuver	601	-	-	-	-	-
Stage 1	916	-	-	-	-	-
Stage 2	754	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	9.6	0	0
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	941	1481	-
HCM Lane V/C Ratio	-	-	0.17	-	-
HCM Control Delay (s)	-	-	9.6	0	-
HCM Lane LOS			A	A	
HCM 95th %tile Q(veh)	-	-	0.61	0	-

Notes
~ : Volume Exceeds Capacity; $: Delay Exceeds 300 Seconds; Error : Computation Not Defined