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Greenwood Lake Airport Master Plan Update

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**Greenwood Lake Airport
Master Plan Update
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Greenwood Lake Airport

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1. Airport Inventory

The initial step in the master planning process is to inventory the physical, operational, and functional characteristics of the airport and its immediate environs. The inventory information presented in this section provides the basis for evaluating existing facilities at Greenwood Lake Airport (4N1) (Airport) and subsequently determining future facility needs. The information includes the location of the Airport, a brief overview of the Airport's history, the existing airport facilities, and land use.

1.1 Background

1.1.1 Airport Location

4N1 is located in Passaic County, New Jersey, and lies within the jurisdictional border of West Milford. The Airport is located 47 miles northwest of New York City, 50 miles northwest of Newark Liberty International Airport, 45 miles northwest of LaGuardia Airport, and 54 miles northwest of John F. Kennedy International Airport. The published geodetic location of 4N1 is 41° 07'42.2" N, 74° 20'47.5" W, at an elevation of 790.1 feet above mean sea level (AMSL). The Airport encompasses approximately 150 acres. **Figure 1-1** illustrates the location of 4N1.

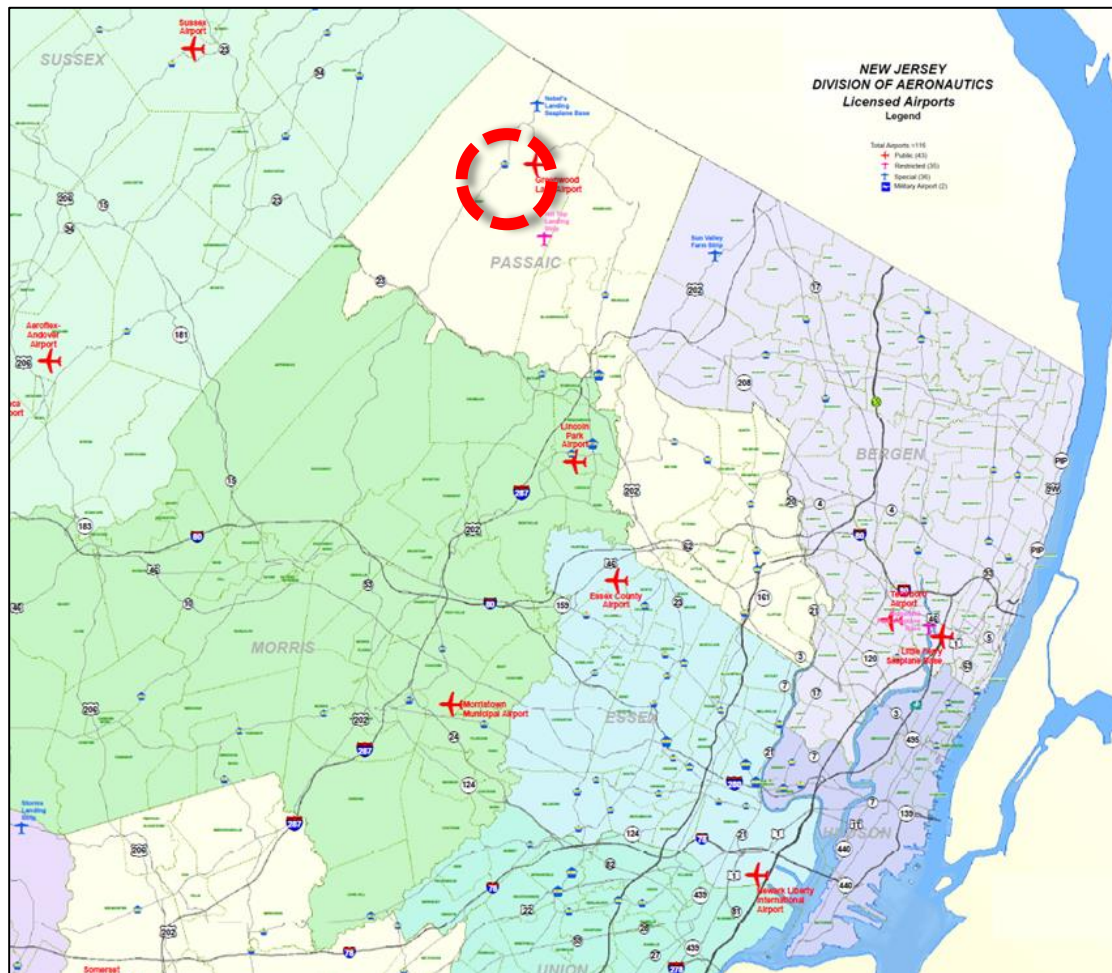


Figure 1-1. Location Map

Source: NJDOT, Division of Aeronautics, National Transportation Atlas Database, July 2016.

1.1.2 Airport History

A small airport located in the heart of the New Jersey Highlands Region, 4N1 first opened in 1960 as a public-use airport.

The Airport rose to fame when 'Jungle Habitat', a Warner Brothers-owned theme park, opened adjacent to the east side of the Airport. The theme park opened in the summer of 1972 and had 500,000 paid visitors by November of its first year. In 1976, the theme park faced opposition from local residents against expansion and closed down. While the park was operating, the Airport was temporarily renamed to 'Nairobi Airport' to complement the theme of Jungle Habitat.

A key piece of the Airport's history is the Lockheed Constellation ('Connie'), a vintage plane purchased by Frank Lembo Enterprises located at the main terminal building of the Airport. The plane operated as a restaurant and lounge from 1977 to 1981. Over the years, changes were made to the interior of the plane, and it is now connected to the banquet hall on the second floor of the main terminal building. The plane now primarily serves as a pilot lounge and an event space.

In 1995, the owners of the Airport, Frank Lembo Enterprises, approached West Milford Township regarding the sale of the Airport. The township was interested in purchasing the Airport initially and commissioned a study about the benefits and issues of acquiring the Airport. In 2002, NJDOT acquired the Airport from Frank Lembo Enterprises to develop and enhance its infrastructure as part of a greater ongoing effort to preserve and improve the existing airports in the state.

In recent years, funding has been provided through the Federal Aviation Administration's (FAA) State Block Grant Program and the State of New Jersey. This has supported pavement rehabilitation and the installation of new fuel tanks. Most recently, funding has been allocated for the installation of a new airport beacon, replacement of the existing wind cone, and installation of a segmented circle. Additional projects being considered for federal funding include the installation of new Light Emitting Diode (LED) lighting for the runway and taxiway system, a new airfield lighting vault, and installation of a new Precision Approach Path Indicator (PAPI) for Runway 24.

Figure 1-2 shows the timeline of the major milestones at 4N1.

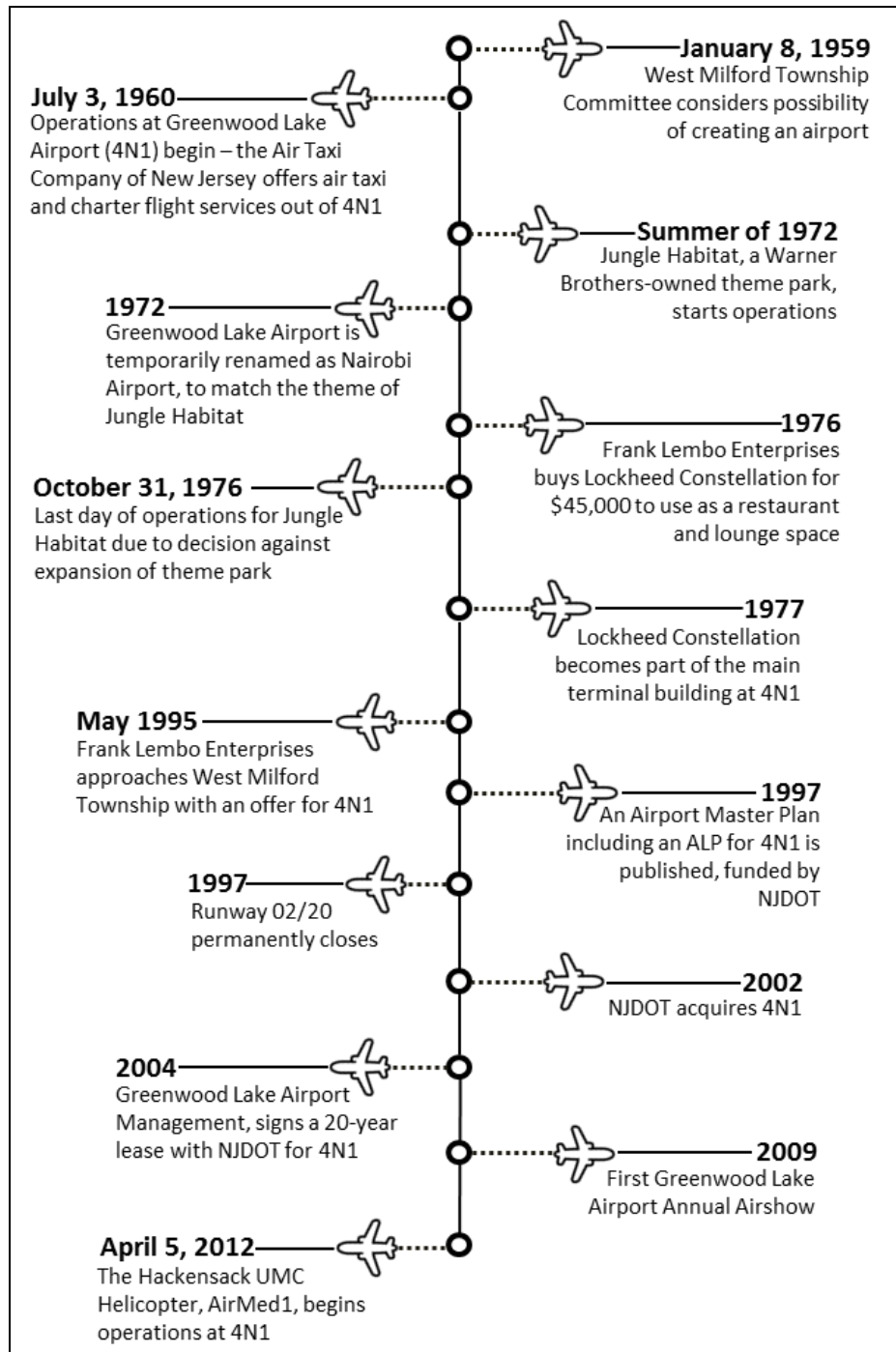


Figure 1-2. Timeline of Major Milestones at 4N1

1.1.3 Airport's Role

4N1 is owned by the State of New Jersey Department of Transportation (NJDOT) Division of Aeronautics, and is managed and operated by Greenwood Lake Airport Management. It is a public-use airport

classified by the FAA as a General Aviation (GA) Local Airport. GA airports are those designated by the FAA in the National Plan of Integrated Airport Systems (NPIAS) that do not have scheduled service or have less than 2,500 annual passenger boardings. GA Local airports supplement communities by providing access to primarily intrastate and some interstate markets. According to the 2012 *General Aviation Airports: A National Asset*, the criteria used to define the local airports category requires that the Airport have at least 10 annual instrument operations and 15 based aircraft, or at least 2,500 annual passenger enplanements.

As outlined in the NJDOT's 2007 *State Airport System Plan*, NJDOT categorizes airports as either Core airports or Core Candidate airports. NJDOT acquires, preserves, and rehabilitates the Core airports because of their vital importance and contribution to the State's airport system. NJDOT further classifies the Core system airports into four functional levels: Scheduled Service, Advanced Service, General Service, and Basic Service airports. 4N1 is a Core airport and is classified as a General Service airport, which are those designated by NJDOT that are intended to support smaller corporate aircraft and the operation of GA aircraft for a variety of uses, including business, pleasure, and training.

GA airports serve important societal needs and often provide critical support functions for the public. GA airports provide connections to the larger aviation system, uniting communities, businesses, and people, while also providing access to their respective geographies.

The Hackensack University Medical Center (UMC), one of the busiest medical centers in the state of New Jersey, has offices and personnel at 4N1 in case of emergencies. UMC operates the AirMed1 helicopter that provides vital transport services not only for Hackensack UMC patients, but also to their affiliate hospitals. In its first year, the AirMed1 flew 145 missions, 25 of which were local in West Milford.

Other on-field services available at 4N1 include flight training, aircraft rental, air tours, fueling, hangar and tie-down rentals, car rentals, airframe and power plant maintenance, among other functions. 4N1 also provides important access for aerial power line and construction support service companies which serve local and regional communities.

Since 2009, the Airport has gathered thousands of visitors to attend its popular annual air show. The Greenwood Lake Air Show is one of the largest events in West Milford and the surrounding region.

4N1 also plays a key role in alleviating congestion caused by small planes at Teterboro Airport and Morristown Airport, which are located roughly 25 miles away from 4N1. 4N1 operates from 08:00 to 17:00.

1.2 Existing Airport Facilities

The following paragraphs describe the existing facilities at 4N1. **Figure 1-3** provides an overview of the existing airport facilities.

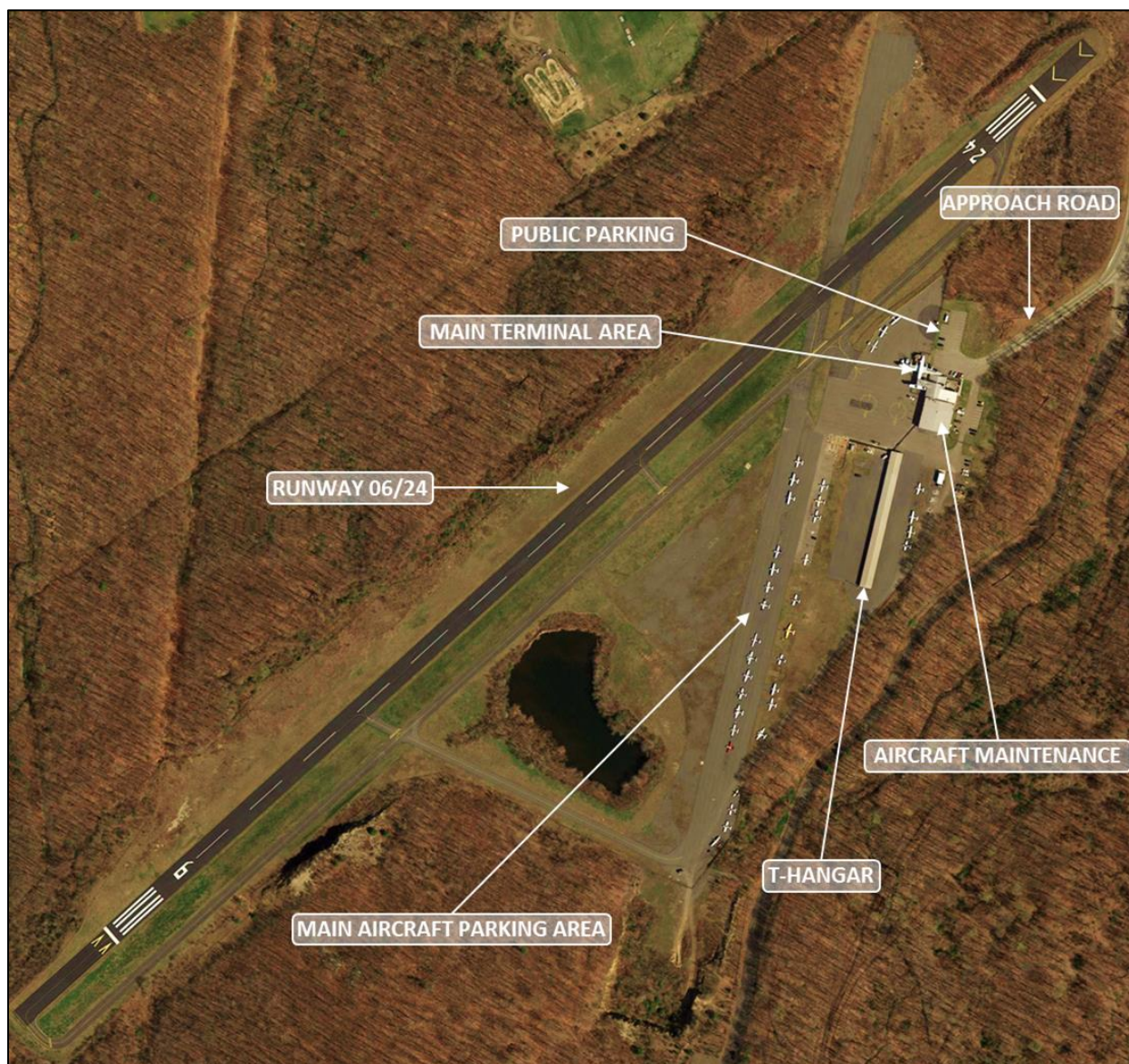


Figure 1-3. Overview of the Airport Facilities

Basemap Source: Google Earth

1.2.1 Airfield and Airspace

Runway

4N1 has a single northeast-southwest Runway 06/24, measuring 3,471 feet in length and 60 feet in width. **Table 1-1** summarizes the airport facilities and runway data.

Runway 06/24 is paved and marked for non-precision approach with centerline, runway designation, threshold, fixed distance, and holding position markings on intersecting taxiways.

The Runway Design Code (RDC) determines the FAA design standards that apply to each runway and will be referenced to evaluate the existing runway design. The FAA classifies the RDC as a combination of the runway's Aircraft Approach Category (AAC), Airport Design Group (ADG), and the Visibility Minimums, or Runway Visual Range (RVR). The RDC for Runway 06/24 is currently B-I-5000. Runway 06/24 is designed to accommodate aircraft as large as a Beech Baron 58 on a regular basis.

The Approach Reference Code (APRC) and Departure Reference Code (DPRC) describe the current operational capability of a runway without the use of special procedures. The APRC is a function of the separation between the centerlines of the runway and parallel taxiway as well as the visibility minimums associated with the approach procedures. Both of these reference codes are determined solely on the amount of separation between the centerlines of a runway and parallel taxiway. The lowest separation distance between runway to taxiway centerlines applicable to the APRC and DPRC is 150 feet or greater. The APRC is B/I (S) 5000 and the DPRC is B/I.

The Main Aircraft Parking Area occupies pavement that was previously utilized for Runway 2/20. This runway was permanently closed in 1997.

Taxiway

4N1 has a partial parallel taxiway identified as Taxiway A for Runway 06/24, measuring 25 feet in width, with six entrances/exits connecting to the runway. The separation distance between the partial taxiway centerline and the runway centerline is approximately 130 feet. The partial parallel taxiway connects to Runway 06/24 before the Runway 24 end, requiring departing Runway 24 aircraft to enter the runway, taxi to the runway end and conduct a 180-degree turn if the aircraft requires full runway length.

The Airport also has two apron taxiways connecting the aprons to the partial parallel Taxiway identified as Taxiways A3 and A4. The taxiway connector at the east end of the main apron is approximately 60 feet wide and connects the main apron to the partial parallel taxiway. The taxiway connector at the west end of the main apron is approximately 25 feet wide and connects the main apron to the Taxiway A.

Airport Reference Code

The FAA classifies airports for design purposes based on their associated Airport Reference Code (ARC). The ARC consists of two aircraft characteristics that govern the dimensions of airfield facilities and the associated design surfaces. The first component of the ARC is a letter that references the aircraft approach category; which indicates the approach speed of the aircraft that the runway is designed to accommodate. The second component of the ARC is a roman numeral that references the Airplane Design Group (ADG), which indicates the aircraft wingspan and tail height a runway is designed to accommodate.

Currently, the Airport is classified as a B-I airport for small aircraft, (commonly written out as "B-I(S)") or aircraft with a maximum certificated takeoff weight of 12,500 pounds. B-I design standards relate to aircraft with an approach speed of 91 knots to 120 knots, tail height of less than 20 feet, and wingspan of less than 49 feet.

With reference to the FAA Advisory Circular (AC) 150/5300-13A, the minimum runway width for B-I small aircraft runways with not lower than 1-mile approach visibility minimums are 60 feet with 10-foot shoulders of paved surface or suitable soil. Runway 06/24 is 60 feet wide but does not have shoulders. Per the standards, the minimum taxiway width is 25 feet with 10 feet shoulders. The separation standard for runway centerline to parallel taxiway centerline is 150 feet.

Runway and Taxiway Pavement

The airfield pavement comprised of asphalt is currently in good condition.

Table 1-1. Existing Airport Facilities and Runway Data

Description	Airport Data	
Airport Reference Code ⁽¹⁾	B-I(S) ¹	
Airport Reference Point ⁽²⁾		
Airport Latitude	41° 07'42.17" N	
Airport Longitude	74° 20'47.51" W	
Airport Elevation (MSL) ⁽²⁾	789.6'	
Acreage ⁽²⁾	±150	
Airport Navigational Aids ⁽³⁾	GPS, VOR (off-airport)	
Miscellaneous Facilities ⁽²⁾	Rotating Beacon, Wind Cone (lighted)	
Description	Runway Data	
	Runway 06	Runway 24
Runway Category ⁽¹⁾	B-I(S) ¹	
Runway Length ⁽²⁾	3,471'	
Runway Width ⁽²⁾	60'	
Pavement Type ⁽²⁾	Asphalt	
Runway Heading ⁽¹⁾	061 magnetic/048 true	241 magnetic/228 true
Runway End Coordinate ⁽²⁾		
Latitude	41°07'30.6581" N	41°07'53.6822" N
Longitude	74°21'04.3220" W	74°20'30.7005" W
Runway End Elevation (MSL) ⁽²⁾	789.3'	789.4'
Effective Gradient ⁽¹⁾	0.003%	0.003%
Approach Visibility Minimums (AGL) ⁽³⁾	Ceiling 1,340' Visibility 1 statute mile	Ceiling 1,160' Visibility 1 statute mile
Runway Lighting Type ⁽²⁾	MIRL	MIRL
Runway Marking Type ⁽²⁾	Non-Precision	Non-Precision
14 CFR FAR Part 77 Approach Category ^{(2) (3)}	Non-Precision (A) 20:1	Non-Precision (A) 20:1
Visual NAVAIDs ⁽²⁾	None	PAPI (2 Left) (3.50 degrees glide path angle)

Abbreviations: GPS – Global Positioning System

VOR – Very High Frequency Omni-directional Range Finder

NDB – Non-Directional Beacon

MIRL – Medium Intensity Runway Lights

PAPI – Precision Approach Path Indicator

NAVAID – Navigational Aid

Note: (1) The existing runway, taxiways, and separation between runway and taxiway do not meet the ADG I standard.

Sources: (1) Greenwood Lake Airport, Airport Layout Plan

(2) Airport Master Record, FAA's Aeronautical Information Services, Effective date April 27, 2017

(3) Instrument Approach Procedures, FAA, date April 27, 2017

Airspace and Air Traffic Control

4N1 operates in Class G, uncontrolled airspace from the surface to 700 feet AGL. From 700 feet above ground level (AGL) to 18,000 feet MSL, the surrounding airspace is identified as Class E airspace. The surrounding airspace is generally congested, as 4N1 is located approximately 7 NM from New York's Class B Airspace. Although Class E and Class G airspace have no requirements for aircraft equipment, 4N1 is located in a Mode C area, which requires any aircraft flying within 30 nautical miles (nm) of Class B airspace to be equipped with a Mode C altitude encoding transponder. **Figure 1-4** shows the Visual Flight Rules (VFR) Terminal Area Chart for New York and **Figure 1-5** shows the Instrument Flight Rules (IFR) Low Altitude Enroute Aeronautical Chart for the area around 4N1.

The New York Air Route Traffic Control Center (ARTCC) provides radar services to high altitude aircraft operating on IFR flight plans. The New York Approach and Departure Control provides radar sequencing and separation to aircraft landing and/or departing 4N1 since there is no airport traffic control tower (ATCT) on the field. The Automated Flight Service Station (AFSS) is provided at Millville Airport.

The traffic pattern at 4N1 is standard (left-hand turns) for Runway 24 and non-standard (right-hand turns) for Runway 06. The traffic pattern altitude is established at 1,791 feet MSL.

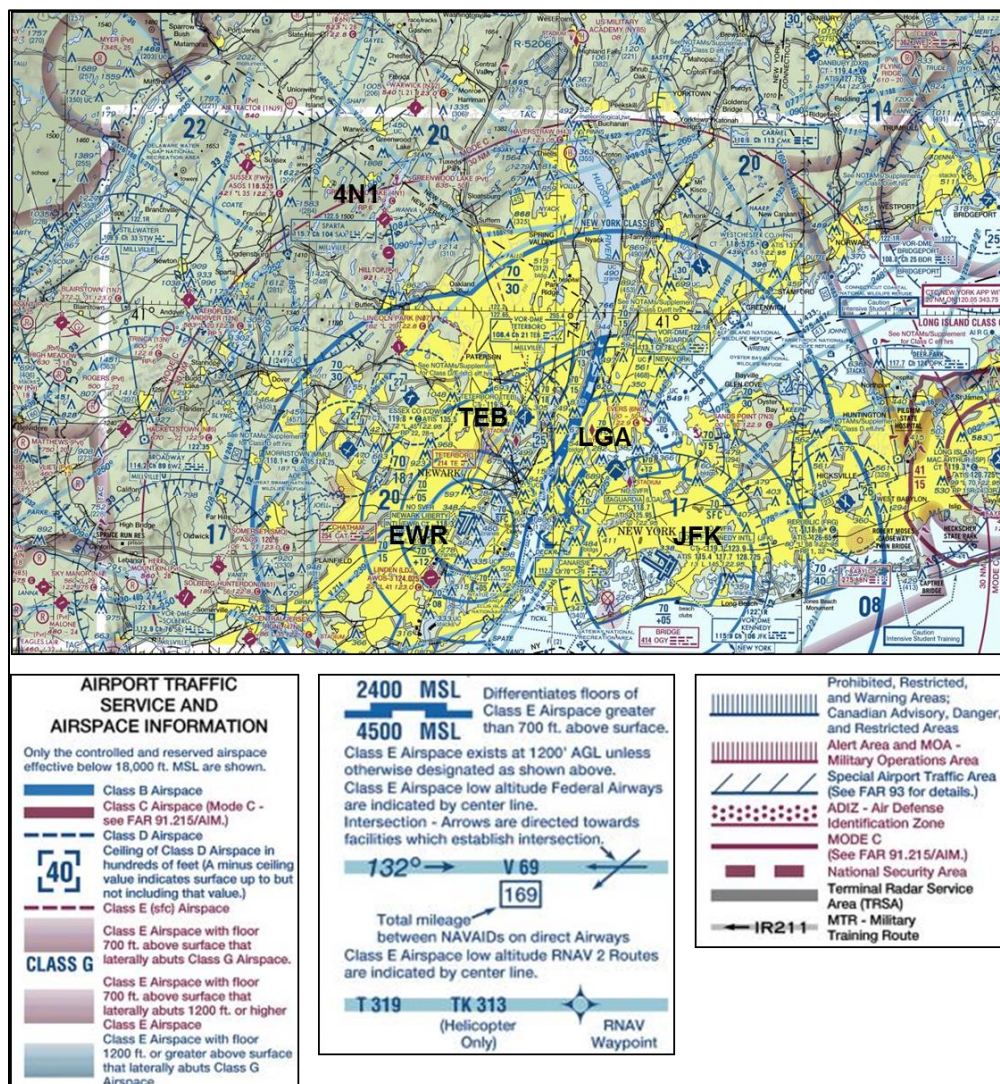


Figure 1-4. New York Sectional Chart, date April 27, 2017

Source: NJDOT, Bureau of Transportation Statistics, National Transportation Atlas Database, 2003.

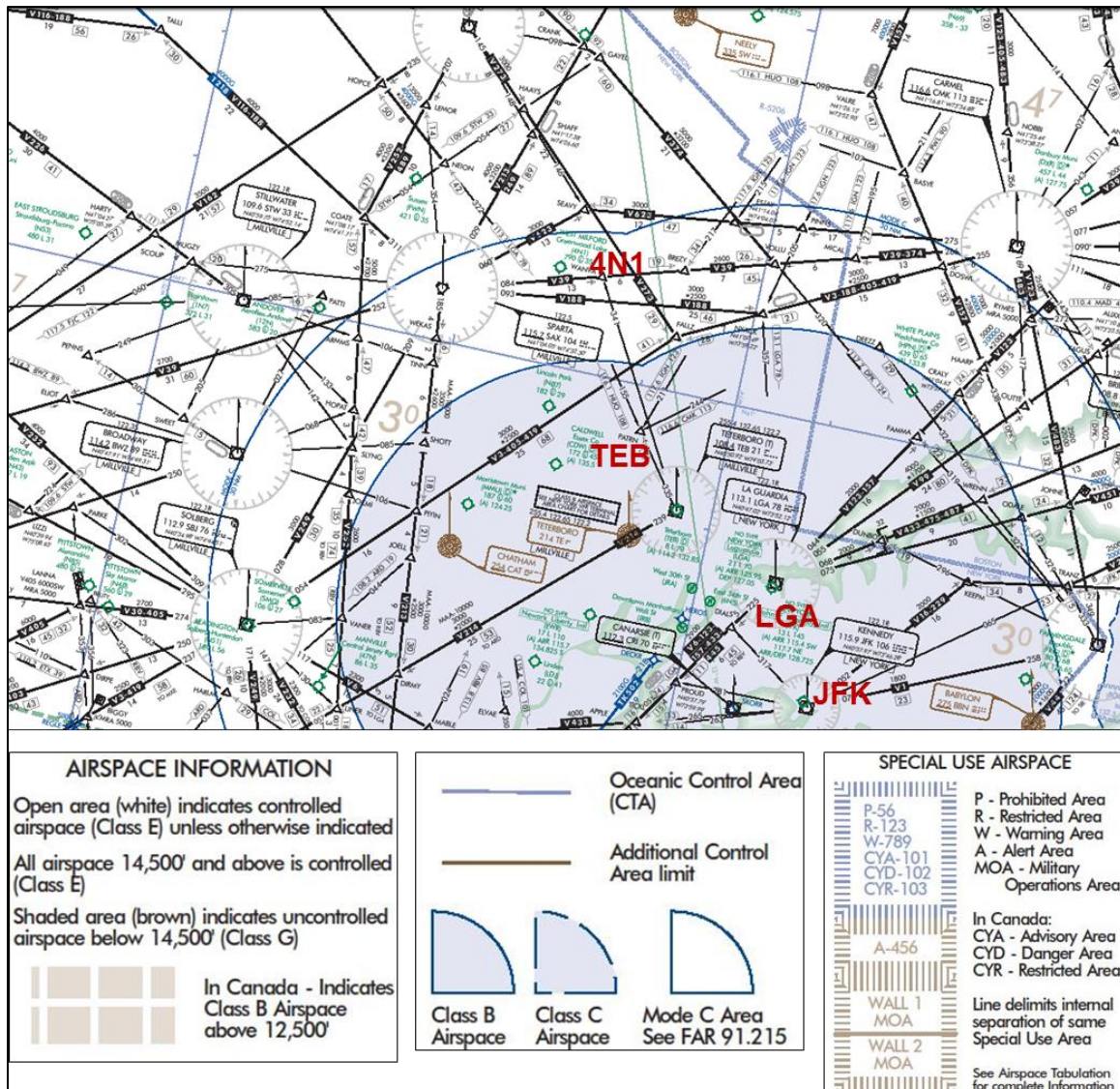


Figure 1-5. IFR Low Altitude Enroute Aeronautical Chart, date April 27, 2017

Source: NJDOT, Bureau of Transportation Statistics, National Transportation Atlas Database, 2003.

Navigational and Lighting Aids

The navigational and lighting aids associated with 4N1 are described below and summarized in **Table 1-1**. The location of each of the navigational and lighting aids at 4N1 is shown in **Figure 1-6**.



Figure 1-6. Navigational and Lighting Aids at 4N1

Basemap Source: Google Earth.

Within a 30 nautical mile radius of 4N1, there are six very high frequency omni-directional range (VOR) stations, and two non-directional beacons (NDB).

A VOR is a navigational aid that transmits radio signals in all directions from a central station. It is the most widely used navigational aid and the primary enroute facility on which the airway system is established. **Table 1-2** is a listing of the VORs and their location with respect to 4N1.

An NDB is a navigational aid that transmits low or medium frequency radio signals whereby the pilot of an aircraft can determine his/her bearing and “home” in on the station. The NDBs in the area within 30 nautical mile radius of 4N1 are given in **Table 1-3**.

4N1 has two published non-precision instrument approach procedures, which are an RNAV(GPS) approach to Runway 06 and an RNAV(GPS) approach to Runway 24. The RNAV(GPS) approach procedures include both the LP (lateral precision) procedure, which is a Wide Area Augmentation System (WAAS) procedure with accurate lateral guidance but no vertical guidance; and the LNAV (lateral navigation) procedure, which is the basic Global Positioning System (GPS) approach procedure with only lateral guidance. The approach minimums by aircraft category are shown in **Table 1-4**.

Runway 06/24 has medium intensity runway lights (MIRL) and a precision approach path indicator (PAPI) for Runway 24 as visual aids to guide the pilot's approach.

Table 1-2. VOR Locations within 30 Nautical Miles of 4N1

VOR Identifier	Distance from 4N1 (nautical miles)	Radial (in degrees)
Sparta	9.4	078
Huguenot	20.2	158
Teterboro	21.2	334
Stillwater	24.9	082
Broadway	29.3	058
La Guardia	29.9	326

Source: New York Sectional Chart, date April 27, 2017.

Table 1-3. NDB Locations within 30 Nautical Miles of 4N1

NDB Identifier	Distance from 4N1 (nautical miles)	Heading (in degrees)
Chatham	23.6	022
Stanwyck	27.6	222

Source: Nearby Radio Navigation Aids, <http://www.airnav.com/airport/4N1>, date April 27, 2012.

Table 1-4. Instrument Approach Summaries

Type of Instrument Approach and Runway	Approach Category Mean Sea Level (MSL) – Above Ground Level (AGL) / statute miles			
	A	B	C	D
RNAV (GPS) – Runway 06			N/A	N/A
LP MDA	1340 ft MSL – 550 ft AGL/1 mile	1340 ft MSL – 550 ft AGL/1 mile		
LNAV MDA	1540 ft MSL – 750 ft AGL/1 mile	1540 ft MSL – 750 ft AGL/1¼ mile		
Circling	1600 ft MSL – 810 ft AGL/1 mile	1600 ft MSL – 810 ft AGL/1¼ mile		
RNAV (GPS) – Runway 24			N/A	N/A
LP MDA	1160 ft MSL – 370 ft AGL/1 mile	1160 ft MSL – 370 ft AGL/1 mile		
LNAV MDA	1560 ft MSL – 771 ft AGL/1 mile	1560 ft MSL – 771 ft AGL/1¼ mile		
Circling	1600 ft MSL – 810 ft AGL/1 mile	1600 ft MSL – 810 ft AGL/1¼ mile		
SUSSEX ALTIMETER SETTING MINIMUMS				
RNAV (GPS) – Runway 06			N/A	N/A
LP MDA	1420 ft MSL – 630 ft AGL/1 mile	1420 ft MSL – 630 ft AGL/1 mile		
LNAV MDA	1580 ft MSL – 790 ft AGL/1 mile	1580 ft MSL – 790 ft AGL/1¼ mile		
Circling	1700 ft MSL – 910 ft AGL/1¼ mile	1700 ft MSL – 910 ft AGL/1¼ mile		
RNAV (GPS) – Runway 24			N/A	N/A
LP MDA	1240 ft MSL – 450 ft AGL/1 mile	1240 ft MSL – 450 ft AGL/1 mile		
LNAV MDA	1640 ft MSL – 851 ft AGL/1 mile	1640 ft MSL – 851 ft AGL/1¼ mile		
Circling	1700 ft MSL – 910 ft AGL/1¼ mile	1700 ft MSL – 910 ft AGL/1¼ mile		

Abbreviations: RNAV – Area Navigation; LP – Lateral Precision; LNAV – Lateral Navigation; MDA – Minimum Descent Altitude

Source: Instrument Approach Procedures, FAA, October 8, 2020 – November 5, 2020.

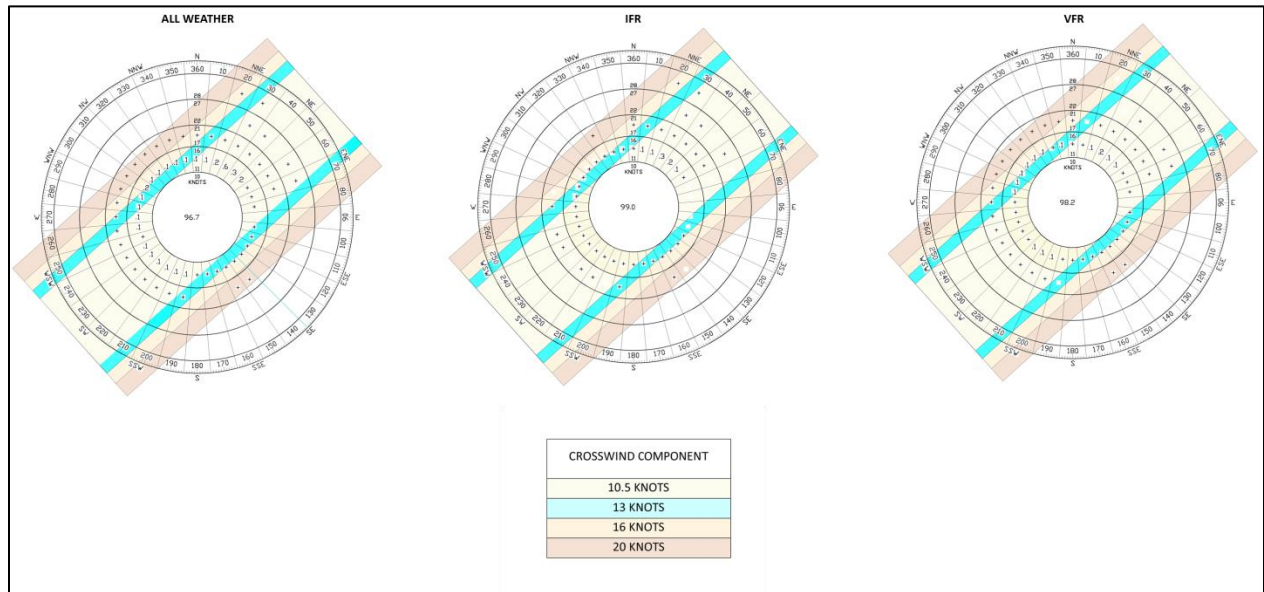


Figure 1-7. Wind Rose Diagrams (All Weather, IFR, VFR)

Meteorological Conditions

The climatic environment of an airport site influences the operational characteristics of the aircraft as well as airfield facility requirements. For example, cloud ceiling and visibility conditions affect airport capacity because aircraft spacing usually increases as these conditions deteriorate. In addition, annual temperature is useful in recommending runway specifications and associated lengths.

The closest National Oceanic and Atmospheric Administration (NOAA) meteorological station is at Sussex Airport, which is approximately 13 nautical miles from Greenwood Lake Airport. Two meteorological stations have served 4N1 since 2000. Information about the meteorological stations is presented in **Table 1-5**. The meteorological data from the National Climatic Data Centre (NCDC) for this station include data for extreme maximum temperature, mean maximum temperature, extreme minimum temperature and mean minimum temperature. The later station installed in 2008 is an automated airport weather station with an Automated Surface Observing System (ASOS).

Based on the analysis for these two meteorological stations at 4N1 for the period from 2005 to 2015, the mean maximum temperature of the hottest month is 84.36°F and the mean minimum temperature of the coldest month is 39.26°F. The analysis is summarized in **Table 1-6**.

Wind data for 4N1 from 2007 to 2016 was analyzed and was determined that the predominant winds in the area are from the west ranging from southwest to northwest. Wind coverage for the present runway orientation is presented in **Table 1-7** and **Figure 1-7** presents wind rose diagrams. Weather observations are provided according to the three conditions as described below:

- All weather observations include all recordings throughout the study period regardless of cloud ceiling and visibility.
- Visual flight rules (VFR) observations are included when the visibility was at least 1 statute mile and distance from clouds is clear per the specifications for Class G airspace in 14 CFR §91.155.
- Instrument flight rules (IFR) observations are included when visibility and cloud distance do not satisfy the requirement for VFR.

Table 1-5. Meteorological Stations Near 4N1

Station Name	Equipment	Elevation	Location	Period of Record
Sussex Airport, NJ US ⁽¹⁾	ASOS Sonic Anemometer, 3-second	128.3 m (421 feet)	LAT 41.20028 ° LONG -74.62306 °	Sep 24, 2008 to Present
Sussex Airport, NJ US ⁽¹⁾	ASOS Cup Anemometer, 5-second	128.3 m (421 feet)	LAT 41.20028 ° LONG -74.62306 °	Oct 25, 2000 to Sept 24, 2008

Abbreviations: ASOS – Automated Surface Observing System

Note: (1) The closest available station to 4N1 with substantial data.

Source: National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Centre, Station at Sussex Airport, NJ.

Table 1-6. Mean Maximum and Minimum Temperatures

Description	Year											Average
	2005	2006	2007	2008	2009	2010	2011	2012	2013 ⁽³⁾	2014	2015 ⁽³⁾	
Extreme Max. Temperature Occurrence (Month) ⁽¹⁾	Aug	Jul	Jul	Jul	Aug	Jul	Jul	Jul	Jul	Jul	Jul	Jul
Mean Max. Temperature (°F)	84	85	82	85	81	87	86	86	—	84	—	84.36
Extreme Min. Temperature Occurrence (Month) ⁽²⁾	Jan	Dec	Mar	Jan	Jan	Feb	Feb	Feb	—	Jan	—	Jan
Mean Min. Temperature (°F)	38.3	39.0	38.2	39.5	38.3	40.8	38.9	38.9	—	40.2	—	41.9

Notes: (1) The extreme maximum temperatures (occurrence) month is obtained from the day the maximum temperature occurred in that particular month.

(2) The extreme minimum temperatures (occurrence) month is obtained from the day the minimum temperature occurred in that particular month.

(3) No data available from 2013 and 2015.

Source: National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Centre, Station at Sussex Airport, NJ for 2005 to 2015.

Table 1-7. Wind Coverage for Runway 06/24

Weather Conditions	Crosswind Components			
	10.5 Knots	13 Knots	16 Knots	20 Knots
All Weather Wind Coverage	99.12%	99.57%	99.96%	100%
VFR Wind Coverage	99.37%	99.69%	99.97%	100%
IFR Wind Coverage	99.61%	99.96%	100%	100%

Source: National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Centre, Station at FWN from 2007 to 2016.

1.2.2 Terminal Area and Aircraft Parking Aprons

An overview of the existing terminal area and related facilities at 4N1 are depicted in Figure 1-8.

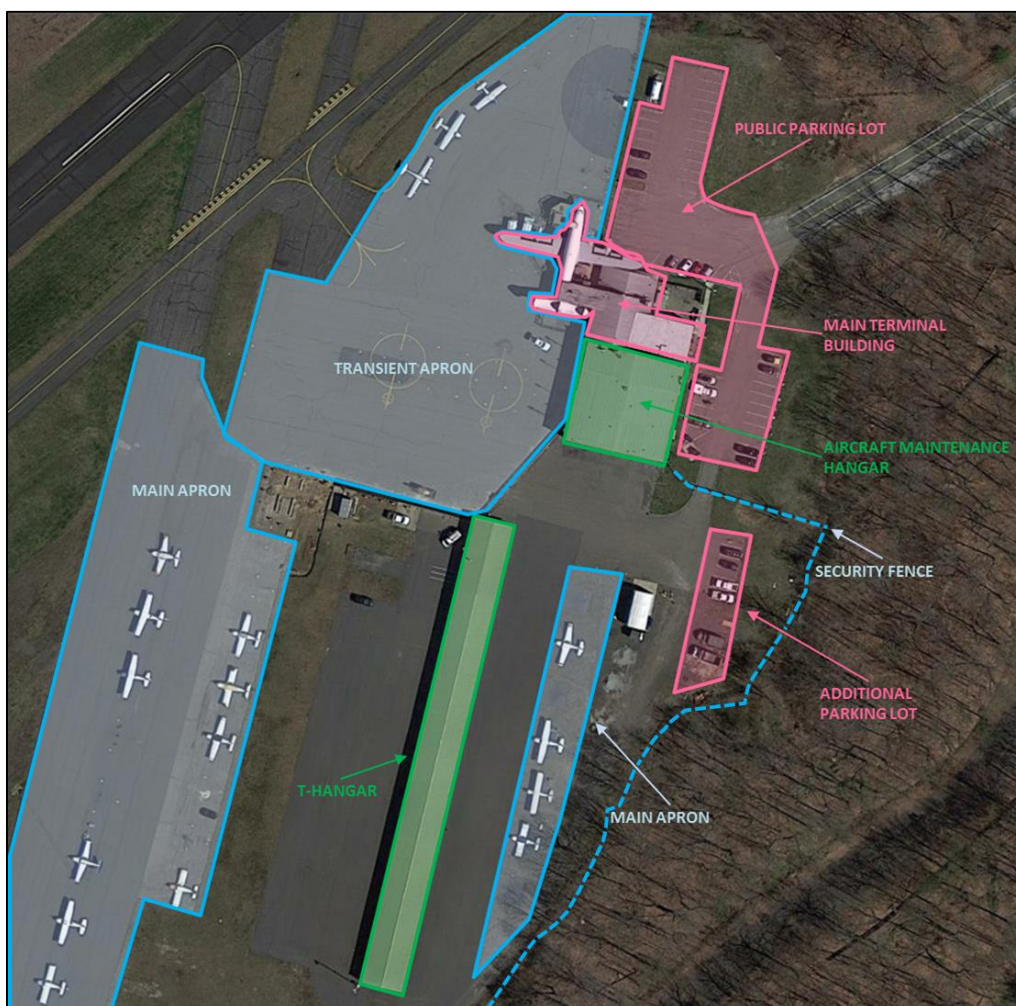


Figure 1-8. Terminal Area and Related Facilities

Basemap Source: Google Earth

Terminal Area

Figure 1-9 shows the existing main terminal building and related facilities.



Figure 1-9. Main Terminal Building and Related Facilities

Basemap Source: Google Earth

The terminal area is located along the east side of the Airport. As shown in **Figure 1-9**, 4N1 has a two-story terminal building (the main terminal building) of 4,460 square feet that includes several offices including aircraft maintenance services, a flight school, a lounge for pilots and passengers, a restaurant, a banquet hall, rental car service and restrooms. **Figure 1-10** shows the exterior of the main terminal building and the connected Lockheed Constellation.



Figure 1-10. Main Terminal Building and Lockheed Constellation

The Airport operator/fixed base operator (FBO) is operated by Northeast Aero Services who also owns the flight school, Sky Training LLC. Their office is located on the first floor of the main terminal building. The second floor of the main terminal building has a banquet hall that is primarily used for events and parties, and is connected to the old Lockheed Constellation that sits by the west side of the main terminal building. **Figure 1-11** shows the interior of the Lockheed Constellation.



Figure 1-11. Interior of the Lockheed Constellation

On the north side of the main terminal building is a paved public parking lot with 26 vehicular parking spaces (including two accessible parking spaces) and 16 parking spaces in the overflow lot, as shown in **Figure 1-9**. Access to the public parking lot is through Airport Road.

On the east side of the main terminal building is the Hackensack UMC office; UMC operates the AirMed1 helicopter, providing transport services for Hackensack UMC patients and for affiliate hospitals.

The airside restricted area is located on the southeast side of the main terminal building and has several parking spaces for Airport personnel and users.

Hangars

The aircraft maintenance hangar is attached to the south side of the main terminal building, as shown in **Figure 1-8**. The maintenance hangar, operated by Northeast Aero Services, provides aircraft maintenance services and can accommodate up to six ADG II aircrafts (assuming two are on lifts).

Figure 1-12 shows the interior of the aircraft maintenance hangar.



Figure 1-12. Exterior and Interior of the Aircraft Maintenance Hangar

The T-hangar is located south of the aircraft maintenance hangar, as shown in **Figure 1-8**. The hangar is a 13,350 square-foot structure built approximately in 1970. The spaces are rented on a month-to-month

basis. The building is of steel frame structure with ribbed metal paneled walls. The interior floors are concrete with a basic electrical package for each individual unit. The doors are manually operated and provide a 42-foot opening for each bay. There are 12 T-hangar spaces in total. **Figure 1-13** shows the exterior and interior of the T-hangar.



Figure 1-13. Exterior and Interior of the T-Hangar

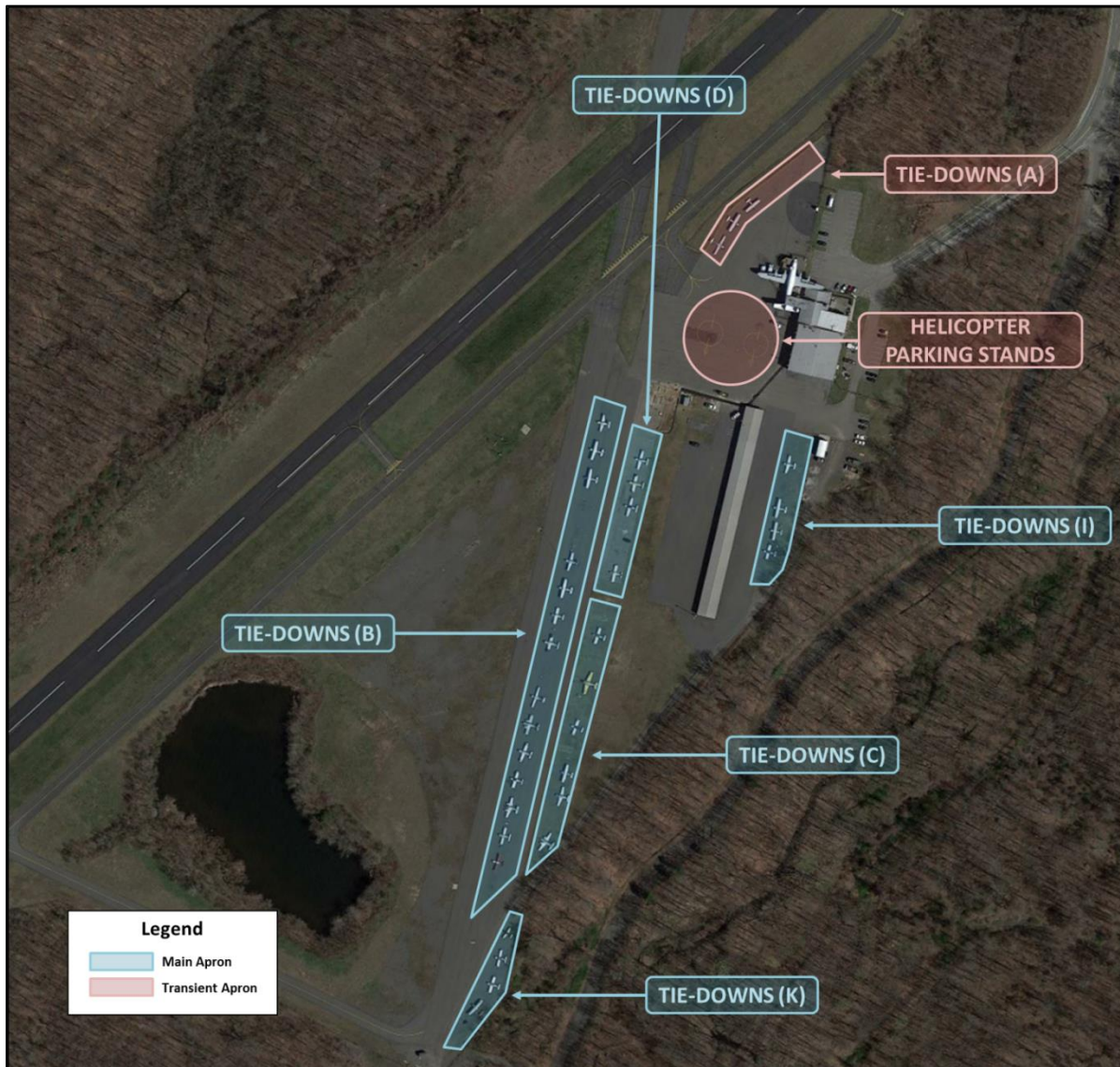


Figure 1-14. Based Aircraft Parking Areas and Transient Apron

Based Aircraft Parking Areas

Parking areas for aircraft based at the Airport include the main apron and other tie-down areas. The location of each of these areas is shown in **Figure 1-14**.

The main apron is the area to the west of the T-hangar which includes aircraft tie-down spaces on both hard-top paved areas and grass areas. The main apron covers an area of approximately 3.97 acres with around 45 tie-down aircraft parking spots designed to fit planes no larger than a Beech King Air B100. The areas of the paved (hard-top) and grass aircraft parking areas are 3.43 acres and 0.54 acres respectively. **Table 1-8** summarizes the type and number of based aircraft parking areas at 4N1.

The main apron is connected to the parallel taxiway and the runway through two connecting taxiways.

The portion of old Runway 02/20, north of Runway 06/24, receives limited use with airport equipment and unused aircraft occupying this area.

Transient Apron

To the north and west of the main terminal building are parking areas for transient aircraft. The transient apron has an area of approximately 1.78 acres and has tie down locations for up to six ADG-I aircraft.

There are also two helicopter stands in the transient apron area, west of the main terminal building, one of which is used primarily by the Hackensack UMC. **Figure 1-14** shows the location of the helicopter parking stands and **Figure 1-15** shows a photograph of this area.



Figure 1-15. Helicopter Parking Stands

Table 1-8. Based Aircraft Parking Areas and Transient Apron

Category	Tie-Down Area	Number of Parking Spots	Hard Top or Grass
Main Apron	Tie-Down B	17 Spots	Hard Top
Main Apron	Tie-Down C	12 Spots	Grass
Main Apron	Tie-Down D	4 Spots	Hard Top
Main Apron	Tie-Down I	7 Spots	Hard Top
Main Apron	Tie-Down K	5 Spots	Hard Top
Transient Apron	Tie-Down A	6 Spots	Hard Top
Transient Apron	Helicopter Parking Stand	2 Spots	Hard Top

1.2.3 Support Facilities

Fuel Storage Facilities

Fuel service for Jet A fuel (Jet A) and 100 low lead aviation gasoline (100LL Avgas) is operated and managed by the Airport.

4N1 has recently completed construction on two 6,000-gallon fuel tanks that store 100LL and Jet A fuel. 4N1 owns two fuel trucks, circa 1991. One of them accommodates 100LL with a capacity of 1,200 gallons, and the other accommodates Jet A with a capacity of 2,200 gallons. The Jet A fuel tank was installed to support the Hackensack UMC EC-135 helicopter (model year 1991), which operates one to two times per day. **Figure 1-16** shows the two fuel trucks on the left and the two newly constructed fuel tanks on the right, and **Figure 1-17** shows the change in location of the fuel tanks. The newly constructed fuel tanks are located west of the T-hangar and just north of the based aircraft parking areas.



Figure 1-16. Fuel Trucks and Fuel Tanks

Aircraft Rescue and Fire Fighting



Figure 1-17. Location of Fuel Tanks

4N1 uses the West Milford Fire Department for aircraft rescue and firefighting (ARFF) services and any other emergency response activities. The closest response facility is Greenwood Lake Fire Department located on Route 511 roughly one mile from the Airport.

Ground Support Equipment

Below is a list of ground support equipment (GSE) at the Airport.

- Three power tugs owned by Northeast Aero Services.
- One front-end loader with a snowplow, owned by NJDOT, is available for snow removal. It is stored in a fabric tent adjacent to the main hangar, as shown in **Figure 1-18**.

The Airport does not use de-icing fluid on the runway or taxiway, and occasionally uses urea on ramp areas. Snow removal operations are completed using 4N1's snow bucket attachment.



Figure 1-18. Front-end Loader Snowplow

1.2.4 Airport Access

Access Roads

Direct access to 4N1 is provided via Airport Road, which leads to the entrance of the Airport to the north. The Airport is easily accessible through Marshall Hill Road, or County Road 696, which has become the township's main business strip, and the county highway County Route 511, as shown in **Figure 1-19**.

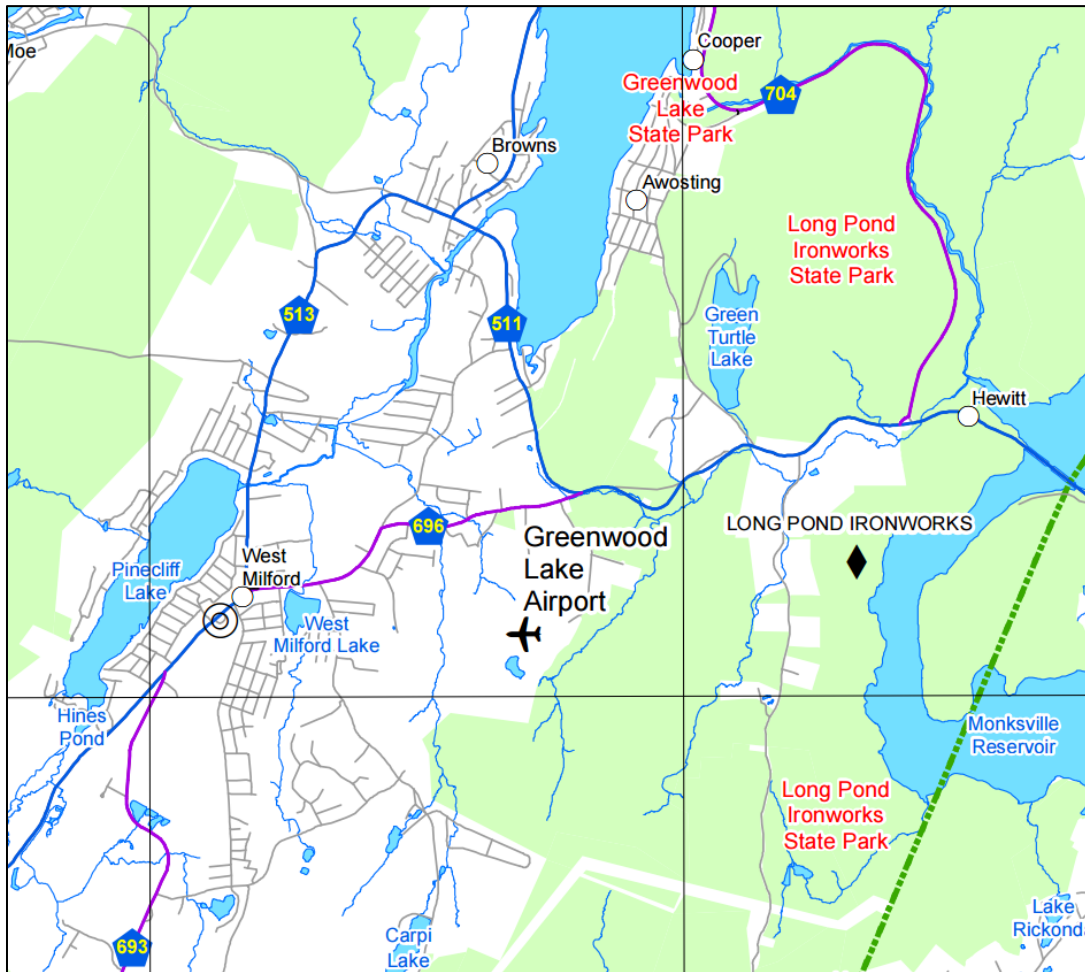


Figure 1-19. Access Roads to 4N1

Source: NJDOT, Bureau of Information Management and Technology Planning GIS, Passaic County Map.

Public Transit

No mass transit options connect directly with the Airport. However, NJ Transit provides access via bus routes 196 and 197 which originate from the Port Authority Bus terminal in Manhattan and provide service to/from Manhattan to Northwestern New Jersey communities. Uber, Lyft and taxi services are available at the Airport.

1.2.5 Utilities

The Airport is provided with potable water, sewer, telephone, internet connection, electricity, and natural gas.

A detention basin, as shown in **Figure 1-20**, is located adjacent to the main apron area. Drains are located within the grassy areas adjacent to the runway and taxiways which connect to this detention basin.

The Airport has no back-up generator and the Airport operator indicates that the existing electrical system is older and in need of an upgrade. Electrical power enters the Airport at the eastern side of the main terminal building through which power is routed to the airfield. The Airport is unaware of any records of hazardous waste contamination at the Airport.



Figure 1-20. Stormwater Detention Basin and Milling Area

Basemap Source: Google Earth

1.2.6 Security

The Airport has no “through-the-fence” operations, which means that independent entities or operators of aeronautical services and aircraft owners not located on airport property are not permitted to access the public landing area. The Airport is surrounded by an 8-foot high security fence with barbed wire, as shown in **Figure 1-21**. The only location of the fence that is lower than 8 feet is along the end of Runway 6. The lower fence height provides less of a barrier to wildlife. Additionally, the Airport has a CCTV system installed to monitor the activities in the Airport. This system is not currently operational.



Figure 1-21. Airport Security Fence

Basemap Source: Google Earth.

1.3 Existing Land Use Data

1.3.1 Existing On-Airport Land Use

Existing on-airport land uses that are within the airport property line are depicted in **Figure 1-22**. The functional designations are defined below and the approximate acreages are summarized in **Table 1-9**.

- **Airfield** – all of the associated aircraft movement areas to the airfield, including the runway, taxiway, main apron, and transient apron.
- **Terminal/Industrial** – passenger terminal building and other related landside facilities, including the curbside, public parking, industrial-related businesses, and their associated facilities.
- **General Aviation** – corporate-use facilities, fixed-based operator (FBO) and aircraft services, and private hangar parking; including hangars and associated vehicle parking.
- **Aircraft Maintenance** – facilities dedicated to aircraft maintenance and repair activities, such as the aircraft maintenance hangar.
- **Other/Unpaved** – Other general areas, including but not limited to other properties, open space and unpaved areas within the airport property line.

Table 1-9. Existing On-Airport Land Use

Function designation	Area (acres)	Percentage of Total
Airfield	40.0	26.7%
Terminal/Industrial	0.8	0.5%
General Aviation	0.4	0.3%
Aircraft Maintenance	0.2	0.1%
Other/Unpaved	108.6	72.4%
Total	150.0	100.0%

Just to the west of the main apron is a ground area covered with milling, as shown on **Figure 1-20**. Storm drainage connected to the detention basin is also located within this area. Plans had begun to convert this area for aircraft parking/hangars in the late 1990's but N.J. Highland Act environmental requirements have since stalled development of this portion of the airport.

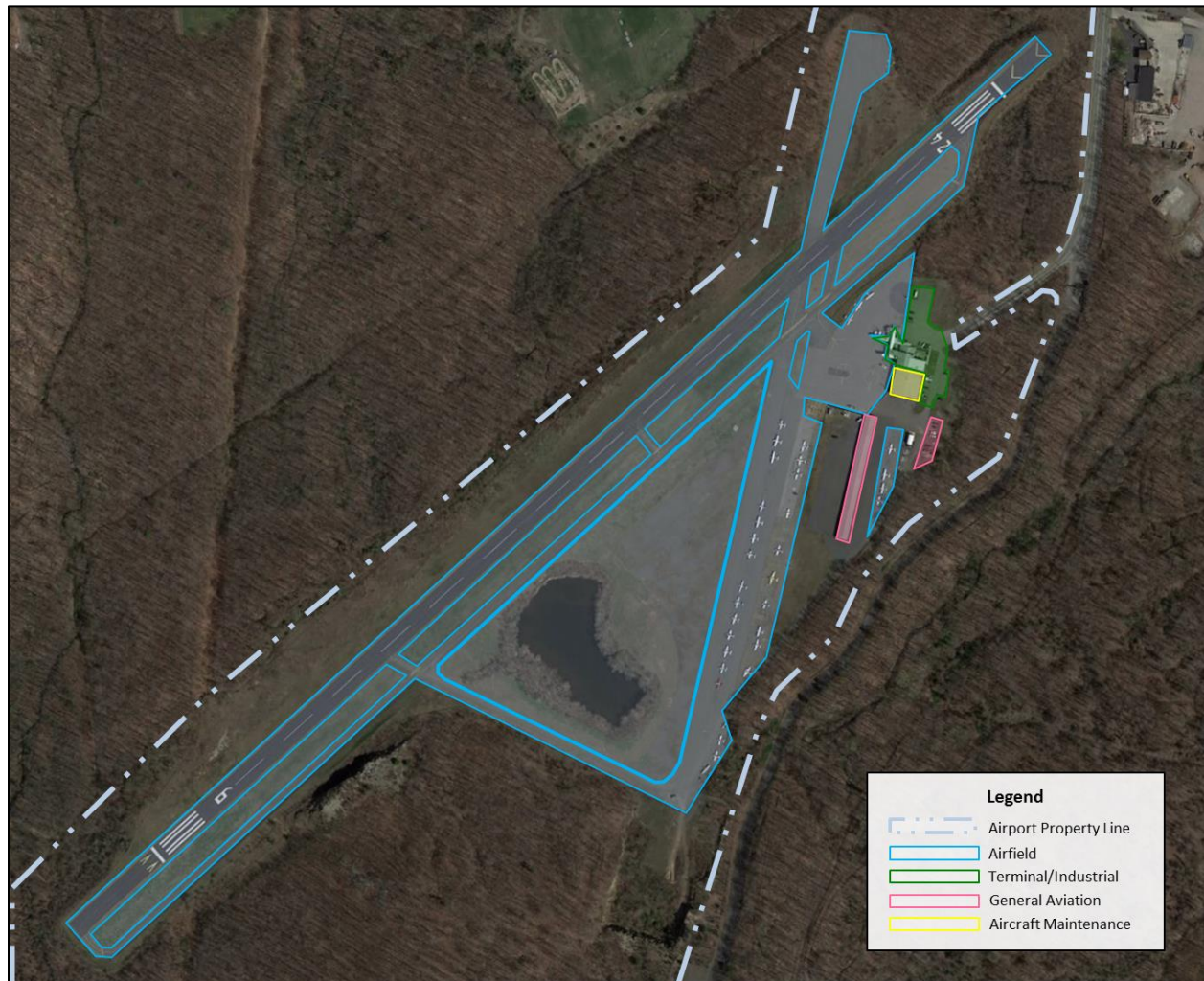


Figure 1-22. Existing On-Airport Land Use

Basemap Source: Google Earth.

1.3.2 Existing Off-Airport Land Use

Figure 1-23 depicts the generalized existing land uses that surround the Airport. The existing land uses that surround the Airport, and are in close proximity to the airport hazard zone (AHZ), include light manufacturing and industrial (LMI), community commercial (CC), higher density residential (R1), low and very low density residential (R-3, R-4), and senior congregate care (SCC) areas.

The majority of the area immediately surrounding the Airport is fairly undeveloped. To the northeast of the Airport, there are a few manufacturing companies that are located off of Airport Road, such as Skytop Recycling, West Milford Recycling-Garbage Center, and Awisco, which is a safety equipment supplying company. Morsetown Brook, a fresh water stream, is immediately west of the airport, and further west of that residential neighborhoods populate the landscape. Other establishments in this area, located off of Marshall Hill Road, include the West Milford Animal Shelter Society, West Milford Fire Department, and Marshall Hill Elementary School. To the southwest of the airport there is a sizable retirement community, The Chelsea at Bald Eagle, which house 463 condominium units, 39 townhomes, and a full service assisted living facility. Commercial establishments, such as restaurants, pharmacies, and shopping facilities are in close proximity to the retirement community.

As the Airport lies in the heart of the New Jersey Highlands, much of the surrounding region is a popular tourist destination offering an abundance of outdoor recreational activities. Immediately to the east of the

The Airport is one mile south of the popular Greenwood Lake, a nine-mile lake half in the state of New York and half in the state of New Jersey. During peak season, locals and vacationers can be seen boating, swimming, fishing, and relaxing at the lake. Smaller lakes, forests, and wildlife recreation areas can also be found in the region, offering miles of hiking and hunting trails.



The general land use/land cover pattern on and surrounding the Airport is depicted in the NJDEP Land Use/Land Cover Map, shown in **Figure 1-24**. The NJDEP Land Use/Land Cover was most recently updated in 2012 and is based on a visual interpretation of color infrared aerial photography. Through this process, distinct land use/land cover types are classified and delineated as GIS polygons.

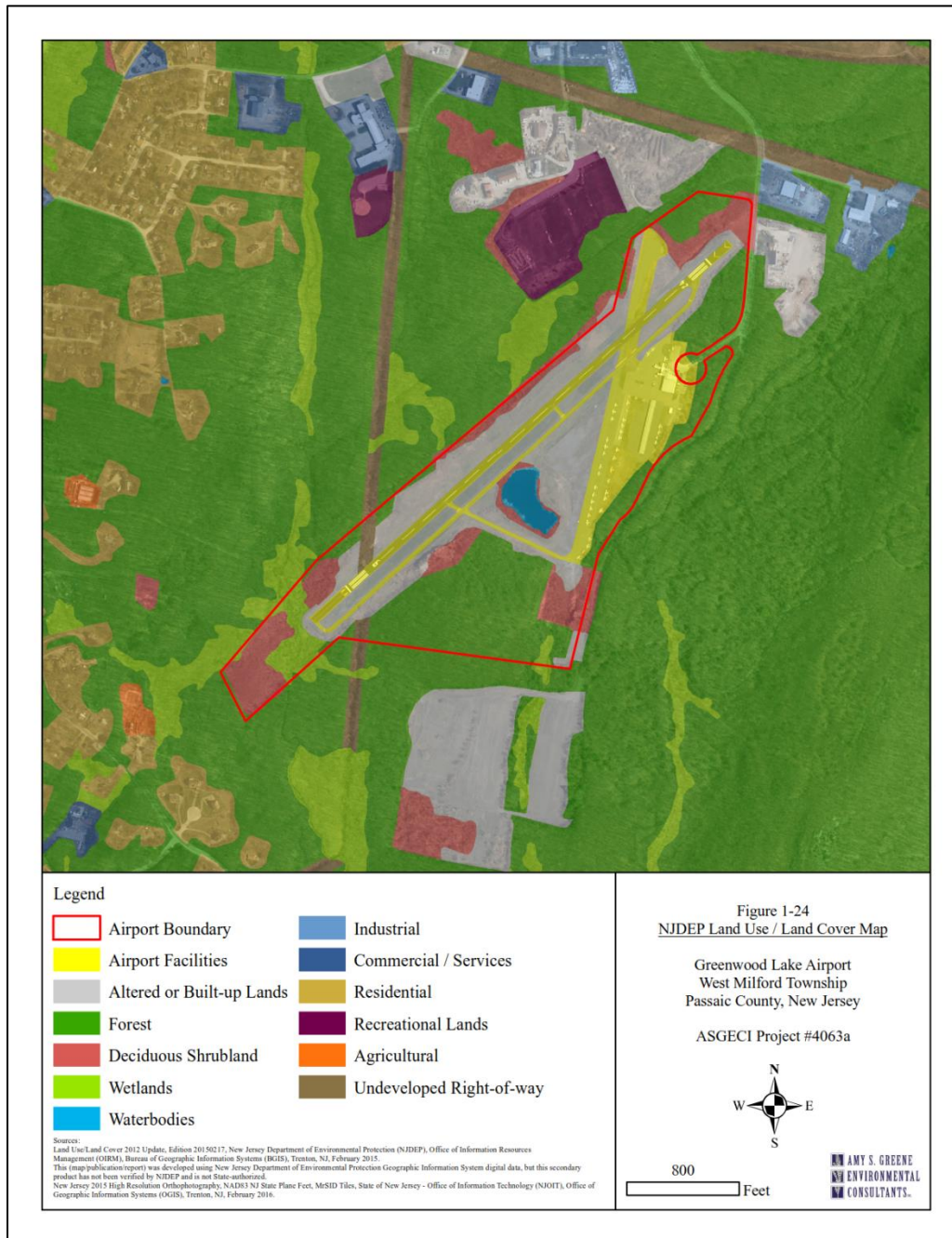


Figure 1-24. NJDEP Land Use/Land Cover Map

Existing land use in the vicinity of the Airport includes a mix of forested land, low and very low density residential, and scattered commercial and industrial establishments. Within West Milford Township, the majority of the area immediately surrounding the Airport is undeveloped, most of which consists of forested land and State open space. Immediately to the east of the airport is forested land that was previously occupied by Jungle Habitat in the 1970's, and is now part of Long Pond Ironworks State Park. Long Pond Ironworks State Park, once an industrious ironworking community, has been converted to approximately 7,000 acres of protected forested land by the state of New Jersey. Additionally, Green Acres properties, open space lands that are protected by the New Jersey Department of Environmental Protection Green Acres Program, are located adjacent to the airport. Several freshwater streams are located on or immediately adjacent to the Airport. Morsetown Brook traverses the Airport at the approach end of Runway 6, which flows north until eventually discharging to Belcher Creek. An Unnamed Tributary

to Hewitt Brook is located along the southeastern boundary of the Airport, which flows northeast to the Wanaque River. Numerous lakes and reservoirs also dot the surrounding landscape, which include Pinecliff Lake to the west, Greenwood Lake to the north, Monksville Reservoir to the east, Wanaque Reservoir to the southeast, and Carpi Lake to the south (see **Figure 1-25**, USGS Topographic Map).

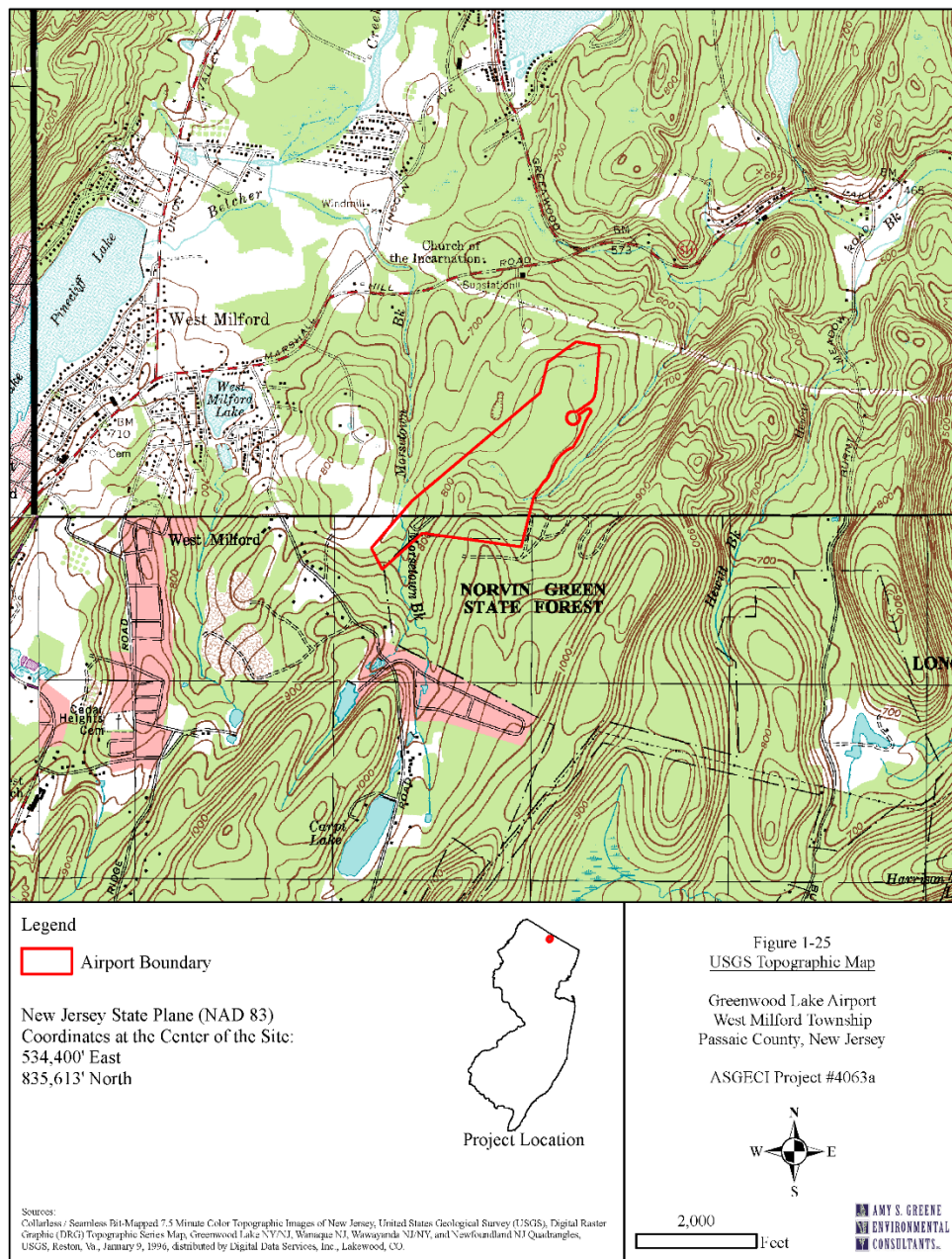


Figure 1-25. USGS Topographic Map

As the Airport lies in the heart of the New Jersey Highlands, much of the surrounding region is a popular tourist destination offering an abundance of outdoor recreational activities. During peak season, locals and vacationers can be seen boating, swimming, fishing, and relaxing at the various lakes, and hunting biking, and hiking on the miles of surrounding wildlife recreation areas and trails.

Low density residential development occupies areas to the north-northwest, west, and southwest. The Chelsea at Bald Eagle, a large retirement community consisting of 463 condominium units, 39 townhomes, and a full service assisted living facility, is situated to the southwest. A variety of businesses, such as restaurants, pharmacies, and shopping centers, are also located in close proximity to the

retirement community. Several manufacturing companies are located to the northeast along Airport Road, including Skytop Recycling, West Milford Recycling-Garbage Center, and Awisco, a safety equipment supply company. Other establishments and institutions in the vicinity of the Airport include the Marshall Hill Elementary School, West Milford Fire Department, West Milford Animal Shelter Society, Organic Waste Solutions, and Hydraulic Manifolds USA, all of which are located north-northwest of the Airport along Marshall Hill Road.

1.3.3 Land Use Considerations

1.3.3.1 State of New Jersey, Air Safety and Zoning Act of 1983

Chapter 62 of the New Jersey Administrative Code, Air Safety and Zoning, identifies minimum standards that airport operators must comply with in order to ensure safety for land use adjacent to airports. Municipalities in the State of New Jersey are required to implement and maintain land use ordinances in accordance with the provisions of Chapter 62. The control of aeronautical hazards within the Air Safety and Zoning Act are primarily through local zoning regulations, and many municipalities adopt more stringent standards for control of these areas under the Municipal Land Use Law. The act requires that an Airport Safety Zone be established for each runway, and each Airport Safety Zone must have a Runway Subzone, two Runway End Subzones, and two Clear Zones. These zones establish minimum standards for the control of airport and aeronautical hazards.

West Milford Township has set standards for an Airport Hazard Zone (AHZ) in compliance with the Air Safety and Zoning Act of 1983. The Township has adopted stricter standards that only permits residences of at least four acres in size compared to the State law that permits residences of three acres or greater within the AHZ. The Chelsea at Bald Eagle, a retirement community located southwest of the airport, is exempt from the Air Safety and Zoning Act and West Milford Township air safety regulations.

1.3.3.2 4N1 Airport Hazard Zone Land Use

According to the Township of West Milford's Chapter 500, Article III, § 500-22 Airport Hazard Zone, the following land uses are permitted within the AHZ:

- Residential single-family dwelling units
- Open space
- Agriculture
- Airports

Land uses within the AHZ at 4N1 include light manufacturing and industrial (LMI), special economic district (SED), very low density residential (R-4), community commercial (CC), senior congregate care (SCC) and moderate density residential (R-2).

The purpose of the SED is to create a unique living and working environment, encouraging economic development of mixed uses in a setting which will preserve environmentally sensitive land areas and offer development reflective of surrounding land uses, specifically the airport in particular, and promote compatibility between these uses. While a mix of uses is permitted, nonresidential uses are to make up the majority of this zone. The following land uses are permitted within the SED: industrial and light manufacturing, executive and administrative offices, research laboratories and testing facilities, multifamily and single-family residential dwelling units, and bed-and-breakfasts.

1.3.3.3 State of New Jersey, Highlands Water Protection and Planning Act

The Highlands Water Protection and Planning Act ("Highlands Act") is a New Jersey state law signed in August 2004 by the Highlands Task Force, which was created through an Executive Order in 2003. The Highlands Act serves to preserve open space and protect the State's environment, including natural resources such as water and forested lands. The Act categorizes the Highlands Region into two areas:

The Highlands Preservation Area and the Highlands Planning Area and requires all types of major development in the Highlands Preservation Area to conform to the Highlands Regional Master Plan (RMP). The Highlands RMP became effective in September 2008 and provides a basis for municipalities to align their land use plans with the provisions of the Highlands RMP. Conformance with the Highlands RMP is required for all municipalities within Highlands Preservation Areas and is voluntary for municipalities with Highlands Planning Areas.

Figure 1-26 is a map of the New Jersey Highlands Preservation and Planning Areas in and surrounding West Milford Township. As shown in **Figure 1-26**, the Township of West Milford is located within the Highlands Preservation Area.

As required by the Highlands Act, the Township of West Milford completed the 'Basic' Highlands Plan Conformance process, which included reviewing and modifying draft versions of the new Highlands Preservation Area Master Plan Element, Preservation Area Land Use Regulations, and Highlands Environmental Resources Inventory. The following key reports have been reviewed and modified to support the Township's efforts to continue the Highlands Plan Conformance process:

- 2003 Revision of West Milford Open Space Plan
- 2008 Open Space Greenway and Prioritization Plan
- 2010 Highlands Environmental Resource Inventory for the Township of West Milford
- 2012 Township of West Milford's Highlands Preservation Area Master Plan Element
- 2013 Periodic Reexamination Report of the Master Plan and Development Regulations

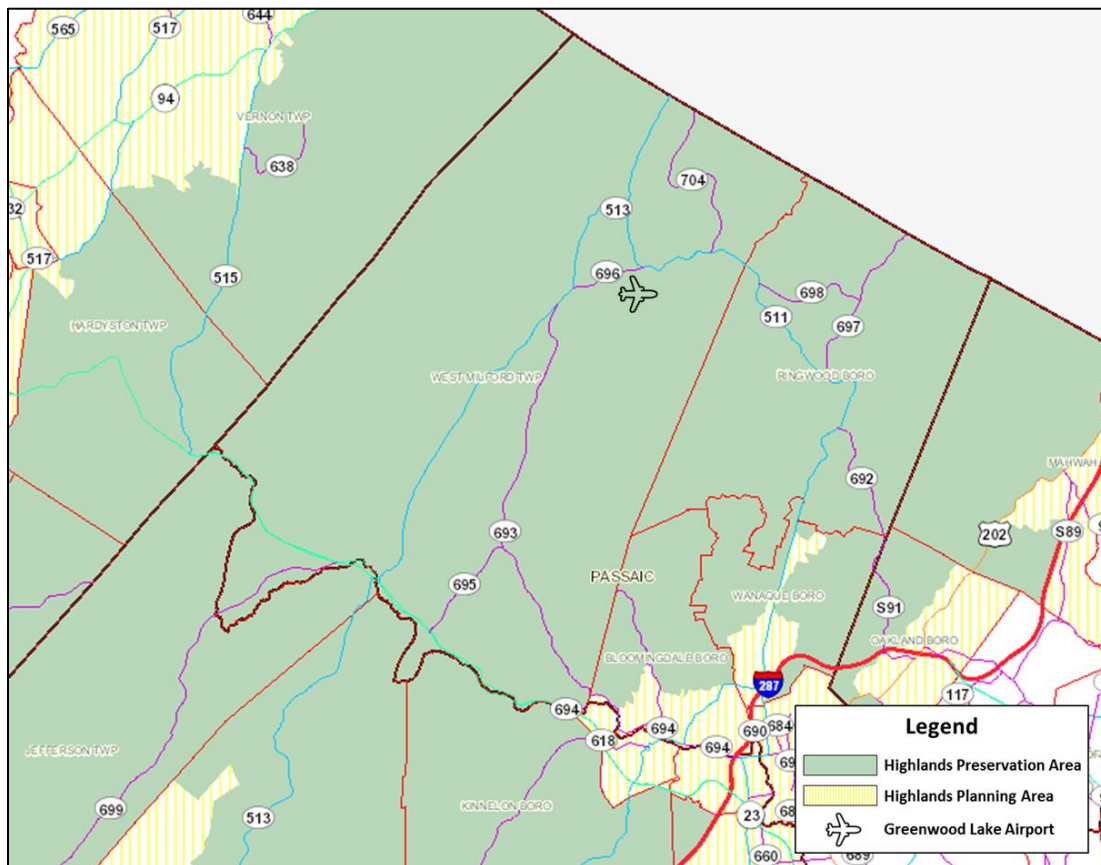


Figure 1-26. New Jersey Highlands Preservation and Planning Areas

Source: NJ-GeoWeb 3.0, State of New Jersey Department of Environmental Protection, Bureau of GIS, August 1, 2017.

As shown in **Figure 1-26**, Greenwood Lake Airport is situated entirely within the Highlands Preservation Area. As such, any development on the Airport must comply with the Highlands Water Protection and Planning Act Rules at N.J.A.C. 7:38, including the Preservation Area Standards set forth in N.J.A.C. 7:38-3. In addition to the regulated areas and natural resources evaluated by the New Jersey Department of Environmental Protection (NJDEP), Division of Land Use Regulation, the following environmental resources would be evaluated as part of a Highlands Preservation Area Approval:

- Highlands open waters, including all springs, streams (including intermittent streams), wetlands, and bodies of surface waters, whether natural or artificial (excluding swimming pools);
- Flood hazard areas;
- Upland forest areas;
- Steep slopes;
- Historic and archaeological areas;
- Rare, threatened or endangered plant and animal species (including State Endangered, Threatened and Special Concern species);
- Unique or irreplaceable land types (such as vernal habitats); and
- Existing scenic attributes.

These resources, also known as Highlands resource areas, merit special protection pursuant N.J.S.A. 13:20-23b. See **Chapter 5 Implementation Plan and Financial Analysis** for additional information regarding the need for and timing of additional Highlands studies and associated approvals.

1.3.3.4 Historic Resources

Historic properties include pre-historic and historic archeological sites, historic districts, buildings, structures, objects, and the historic environment in which they exist. Within the State of New Jersey, the State Historic Preservation Office (SHPO) is responsible for maintaining a register of State Historic Resources, which includes those resources also listed on the National Register of Historic Resources. In addition, mentioned in Section 1.3.3 above, historic and archaeologic areas are considered Highlands Resource areas that warrant special protection under the *Highlands Water Protection and Planning Act Rules* (N.J.A.C. 7:38-3.10).

According to NJDEP SHPO historic resources mapping, there are no known archeological or historical sites or districts in the immediate vicinity of the Airport. The nearest historic property, identified as the Wallisch Homestead [ID #2058; Certification of Eligibility (COE) September 13, 2012], is located approximately 3,600 feet northwest of the Airport property. The location of the Wallisch Homestead, as well as other mapped historic properties and districts, is illustrated on the Historic Resources Map (see **Figure 1-27**).

See **Chapter 5 Implementation Plan and Financial Analysis** for additional information regarding the need for and timing of additional historic, archaeological, and architectural studies and associated approvals.

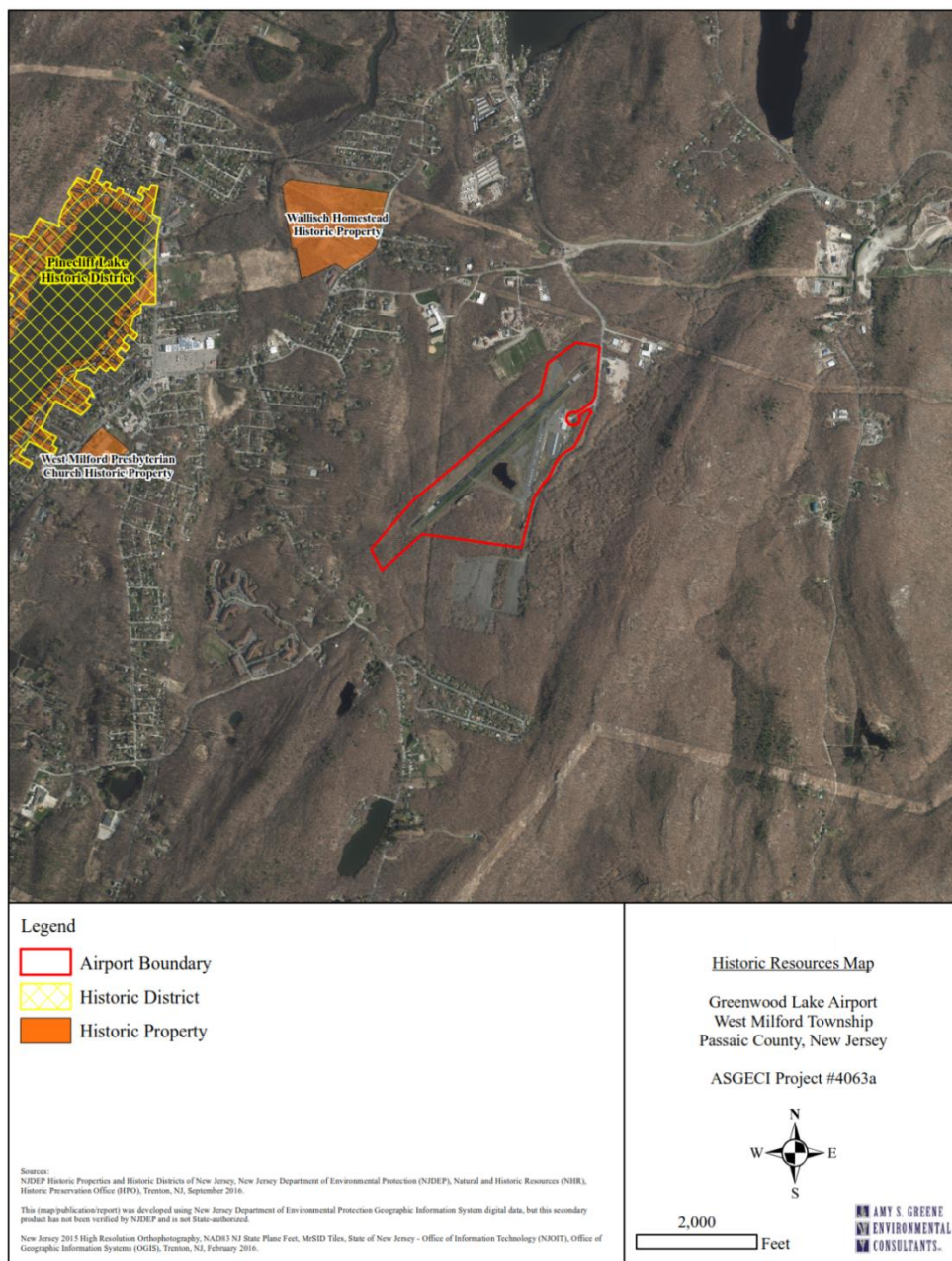


Figure 1-27. Historic Resources Map

1.3.3.5 Wetlands

The NJDEP regulates activities in wetlands and their adjacent transition areas under the New Jersey *Freshwater Wetlands Protection Act* (N.J.S.A. 13:9B-1 et seq.), which defines a wetland as:

“An area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.”

Wetlands serve many important ecological and quality of life functions. They minimize flooding by absorbing water during storm events and releasing it slowly over time. They also improve water quality by filtering sediments, absorbing nutrients and pollutants, and reducing them to their elemental forms. Wetlands provide habitat for many species of wildlife including Federal and State-listed endangered

and/or threatened species and in turn enhance recreational experiences, such as canoeing, fishing, and birdwatching.

The general distribution of freshwater wetlands on and in the vicinity of the Airport is depicted on Figure 1-28 (NJDEP Wetlands and Streams Map) and Figure 1-29 (NWI Wetlands and Streams Map). The National Wetland Inventory (NWI) was developed by the US Fish & Wildlife Service (USFWS) in 1974 for the purpose of conducting a nationwide inventory of wetlands. NWI maps identify and classify wetland and deep-water habitats based on an interpretation of aerial photography. The NWI was established to aid in wetland conservation efforts. The NJDEP wetlands mapping was first developed in 1986 and is based on interpretations of aerial photographs that were integrated with other sources, including hydric soils, USGS flood prone areas, land use/land cover, and 1906 atlas sheet geology. The extent of wetlands as depicted is intended to be used as a general planning tool. The specific location, extent, and resource value classification of wetlands is subject to site-specific field delineations. The presence, absence, extent, and resource value classification of wetlands are subject to verification by the NJDEP Division of Land Use Regulation.

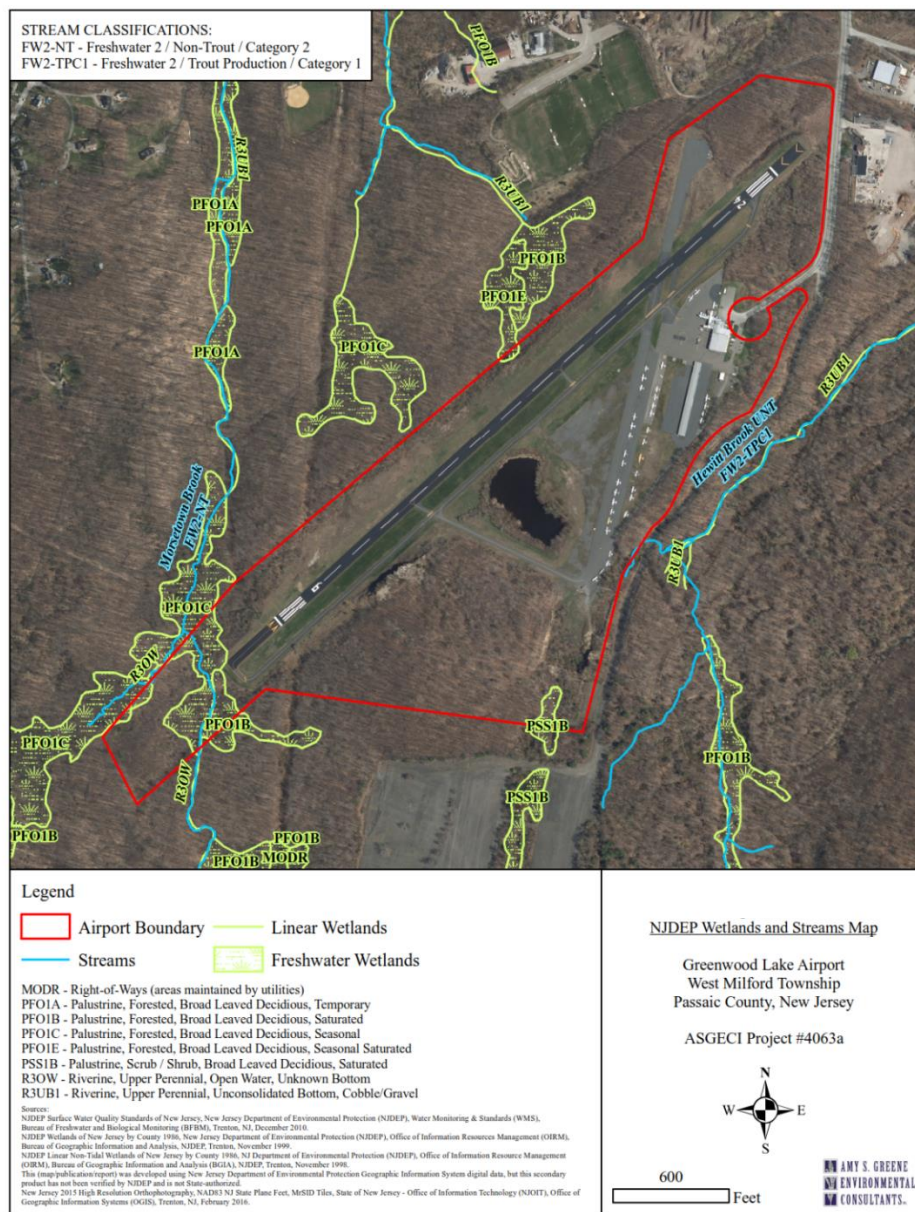


Figure 1-28. NJDEP Wetlands and Streams Map

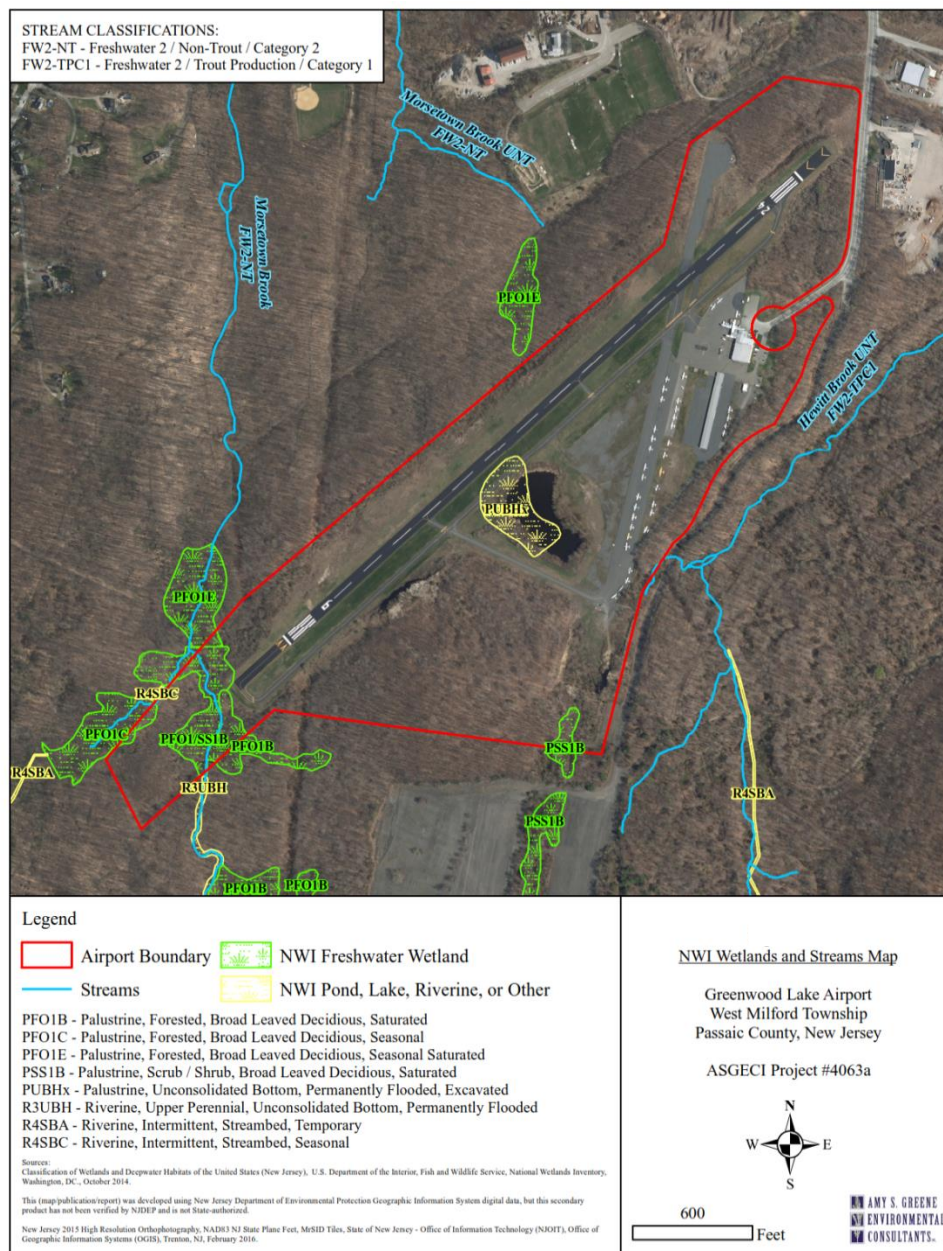


Figure 1-29. NWI Wetlands and Streams Map

The NJDEP maps illustrate several potential wetland areas within or adjacent to the Airport, which are generally associated with Morsetown Brook and its tributaries or Hewitt Brook and its tributaries. Palustrine forested wetlands (PFO1A, B, and C), modified wetlands in maintained right-of-ways (MODR), and riverine, upper perennial, open water (R3OW) associated with Morsetown Brook are mapped within and adjacent to the southwestern portion of the Airport. Palustrine forested wetlands (PFO1B, C, and E) are also mapped along the northern Airport boundary, which appear to drain to a tributary to Morsetown Brook. Riverine, upper perennial, unconsolidated bottom wetlands (R3UB1) and Palustrine forested wetlands (PFO1B) associated with an unnamed tributary to Hewitt Brook are mapped along the southeastern boundary of the Airport. Palustrine scrub-shrub wetlands (PSS1B) are also mapped along the southcentral portion of the Airport.

The NWI mapping appears similar to the NJDEP wetlands map; however, the NJDEP identifies additional mapped wetlands associated with Morsetown Brook, Hewitt Brook, and their tributaries. Additionally, the NWI mapping identifies the centrally-located, manmade waterbody as Palustrine, unconsolidated bottom, permanent, excavated (PUBHx), whereas the NJDEP does not map this feature.

In 2016, a wetlands delineation was conducted for areas within 150-feet of the proposed Airfield Rehabilitation Project in order to identify the presence or absence of State open waters, freshwater wetlands, and wetland transition area. The wetlands delineation was conducted in accordance with the methodology outlined in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (Federal Interagency Committee on Wetland Delineation, 1989). Use of this methodology is required by the NJDEP, Division of Land Use Regulation in accordance with the *Freshwater Wetlands Protection Act Rules*. The location and extent of wetlands is established using a three-parameter approach: 1) dominance of hydrophytic vegetation, 2) presence of hydric soils, and 3) evidence of long-term wetland hydrology.

The results of the on-site wetlands investigation determined that the extent of wetlands is greater than that mapped by the NJDEP, see **Figure 1-30**, Wetland Delineation Map (Partial). Forested wetlands were identified and delineated along both ends of Runway 6-24, as well as along the north side of the runway. Palustrine scrub-shrub wetlands were identified around the centrally-located manmade waterbody, which is situated along the south side of Taxiway A. Lastly, a manmade emergent wetland ditch was identified along Taxiway A. Further investigation is required to identify any additional wetland areas that may be present on the Airport property.

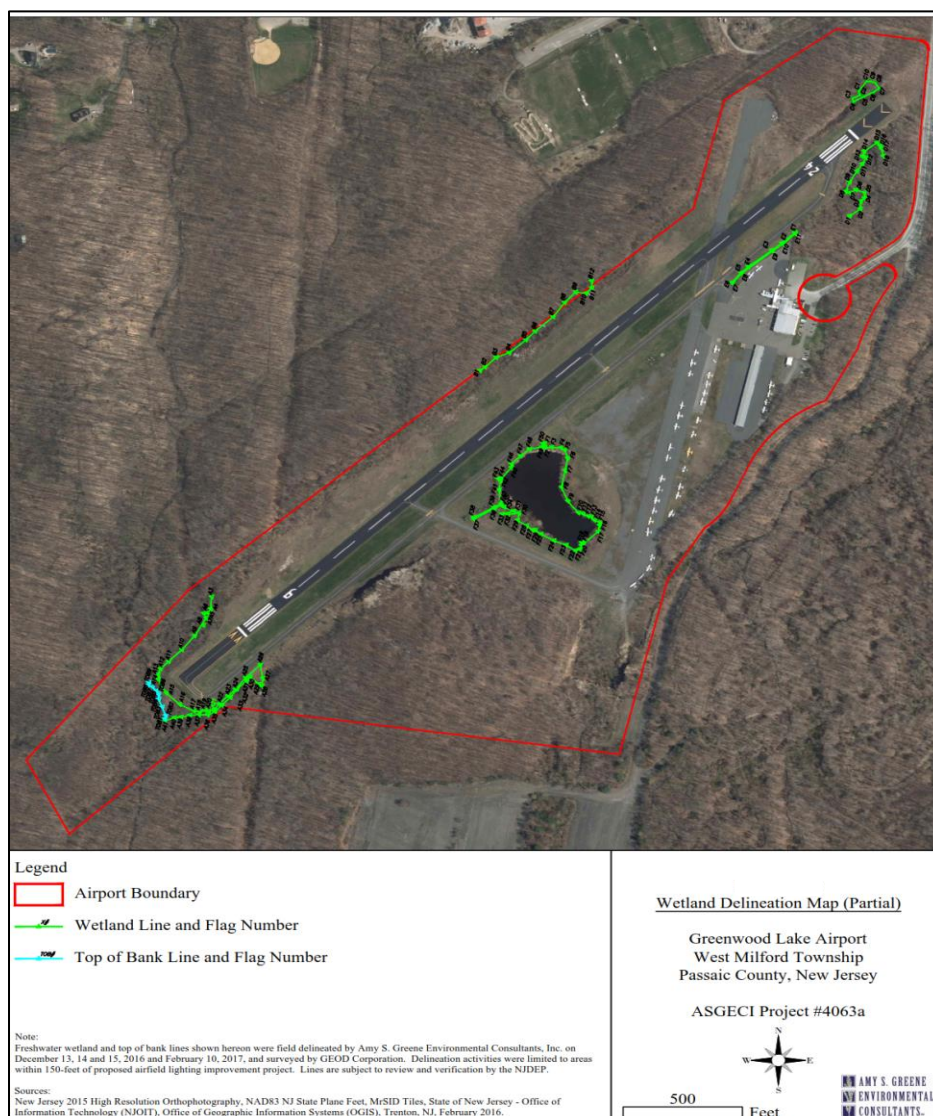


Figure 1-30. Wetland Delineation Map (Partial)

Wetlands are classified according to their resource value as determined by the New Jersey *Freshwater Wetlands Protection Act Rules*. Wetlands associated with FW1 or FW2 trout-production waters or their

tributaries, or documented habitat for endangered or threatened species, are classified as exceptional resource value wetlands and have a 150-foot transition area. Ordinary resource value wetlands are ditches, swales (linear topographic depressions, either naturally occurring or of human construction and generally 50 feet wide or narrower), detention basins, and certain isolated wetlands (less than 5,000 square feet and surrounded by more than 50% developed land). Ordinary resource value wetlands do not have a transition area. All other wetlands are intermediate resource value and have a 50-foot transition area.

According to NJDEP Landscape Project Mapping (see **Figure 1-31**, NJDEP Landscape Project Map), the Airport property has records of the following species: barred owl (*Strix varia*, State Threatened), Northern long-eared bat (*Myotis septentrionalis*, Federally Threatened), timber rattlesnake (*Crotalus horridus horridus*, State Endangered), red-shouldered hawk [*Buteo lineatus*, State Endangered (breeding)], bobcat (*Lynx rufus*, State Endangered), Northern goshawk (*Accipiter gentilis*, State Endangered), and wood turtle (*Glyptemys insculpta*, State Threatened), as well as a variety of Special Concern Species (see Section 1.3.8, **Table 1-10** below for a full list of rare, threatened and endangered species).

Due to the extensive presence of threatened and endangered species habitat and trout production waters on and in the vicinity of the Airport property, a majority of on-site wetlands would be anticipated to be classified by NJDEP as exceptional resource value wetlands with a standard 150-foot transition area. This determination is based on the fact that the delineated wetlands drain directly or indirectly to trout production waters and/or are present or documented habitat for threatened or endangered species, as reported by NJDEP Landscape Project (v.3.3). The exception to the exceptional resource value classification would involve certain manmade features, such as manmade wetland ditches or swales. The resource value classification of the manmade, emergent wetland ditch (Wetland E) is questionable due to its potential connection to trout production waters. The presence, absence, extent, and resource value classification of wetlands are subject to review and verification by the NJDEP Division of Land Use Regulation.

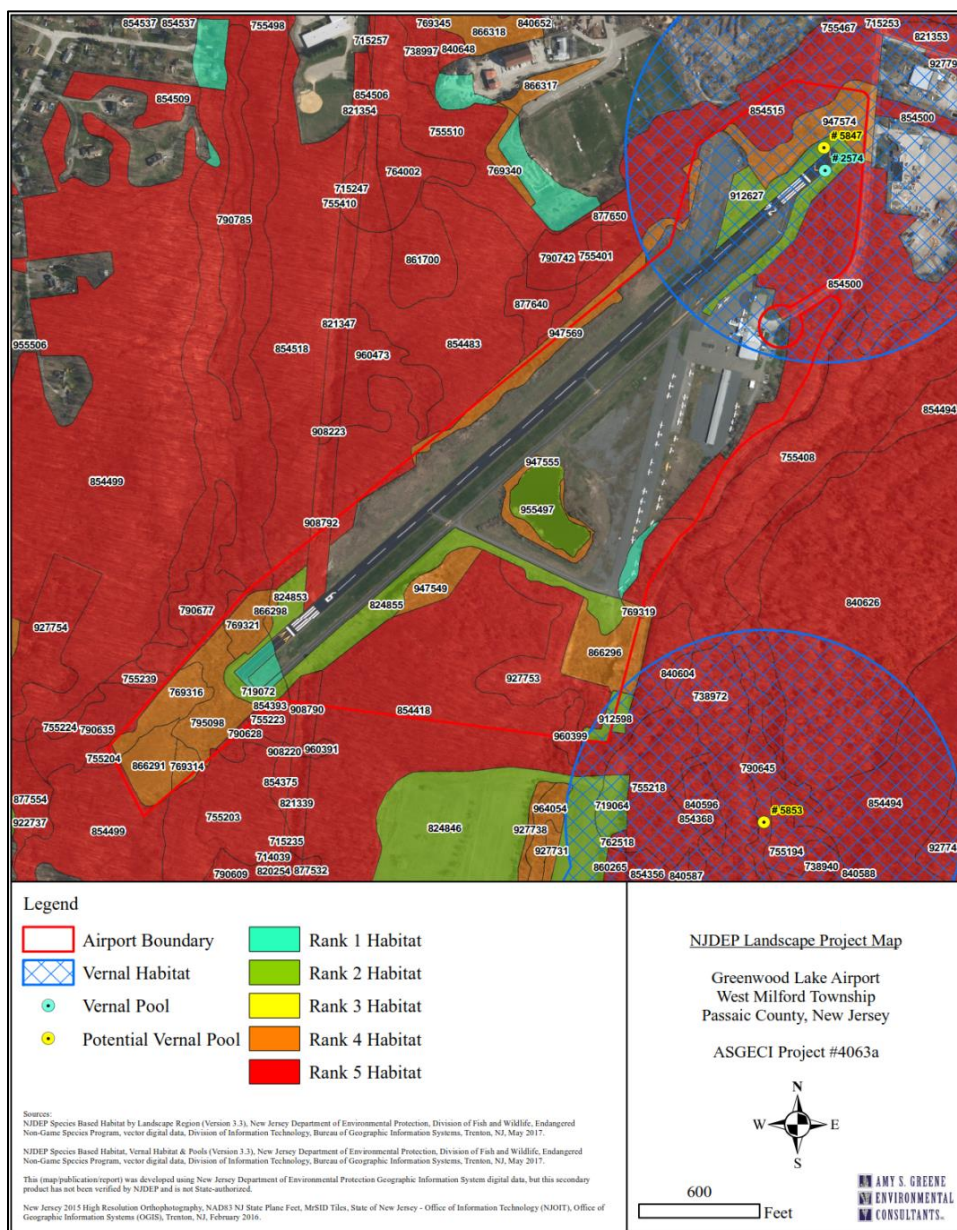


Figure 1-31. NJDEP Landscape Project Map

Lastly, as mentioned in [Section 1.3.3](#) above, wetlands are considered “Highlands open waters” and are therefore Highlands Resource areas that warrant special protection under the *Highlands Water Protection and Planning Act Rules* (N.J.A.C. 7:38-3.6).

See **Chapter 5 Implementation Plan and Financial Analysis** for additional information regarding the need for additional investigations, surveys, and associated freshwater wetlands permit approvals.

1.3.3.6 Vernal Habitat

Vernal habitats are ephemeral wetlands that contain standing water for a portion of the year (usually winter and spring seasons) and are generally free of standing water for a portion of the year, and as a result, do not support fish populations. Vernal habitats are biologically important due to the variety of species that are dependent upon the unique conditions for their survival, particularly several species of frogs and salamanders. Some species are completely dependent on these habitats for reproduction (obligate species), while others may use vernal habitats, other wetlands, or open waters (facultative species). Vernal pools provide habitat that is essential for breeding success of the species that are

adapted to them. The surrounding uplands provide critical habitat for the adult life cycle of many of the vernal habitat dependent species. Vernal habitats are often isolated wetland features, but they also occur as basins within floodplains and within larger wetland complexes that are not isolated.

NJDEP uses four basic criteria to determine if a wetland is a certified vernal habitat. A wetland certified by the State as a vernal habitat must:

1. Occur in a confined basin depression without a permanent flowing outlet;
2. Feature evidence of breeding by one or more species of fauna adapted to reproduce in ephemeral aquatic conditions (see N.J.A.C. 7:7A, Appendix 1);
3. Maintain ponded water for at least two (2) continuous months between March and September of a normal rainfall year; and
4. Be free of fish throughout the year, or dry up at some time during the year.

The NJDEP's Landscape Project, which is accessible through NJDEP NJ-GeoWeb, provides mapping of potential and confirmed vernal habitats throughout the State. NJ-GeoWeb identified the presence of one (1) confirmed (Vernal Pool ID #2574) and one (1) potential vernal pool (Vernal Pool ID #5847), as well as their associated vernal habitat (Vernal Pool Habitat ID #3146), on the Airport property, specifically at the northeast end of Runway 6-24 (see **Figure 1-31**, NJDEP Landscape Project Map, in [Section 1.3.5 Wetlands](#) above). Additionally, two (2) confirmed vernal pools and four (4) potential vernal pools are mapped to the south of the Airport property. The vernal habitat (Vernal Pool Habitat ID #3140) associated with the northernmost potential vernal pool (Vernal Pool ID #5853) extends into the southern portion of the Airport property.

Although the presence of a vernal pool will not affect the wetland resource value classification of wetland, the presence of vernal habitat limits the availability and use of certain general permits under the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A). Please note, a formal vernal habitat survey has not been conducted.

Lastly, as mentioned in [Section 1.3.6](#) above, vernal pools are considered "unique or irreplaceable land types" and are therefore Highlands Resource areas that warrant special protection under the *Highlands Water Protection and Planning Act Rules* (N.J.A.C. 7:38-3.12).

See **Chapter 5 Implementation Plan and Financial Analysis** for additional information regarding the need for additional surveys and associated approvals.

1.3.3.7 Floodplains

The NJDEP regulates activities in regulated waters, flood hazard areas, and riparian zones under the *Flood Hazard Area Control Act (FHACA) Rules* (N.J.A.C. 7:13 *et seq.*). "Regulated waters" include all streams and drainage features with an upstream drainage basin area of more than 50 acres, and streams with a drainage area less than 50 acres provided they meet certain criteria. The NJDEP does not regulate a segment of water that has a drainage area of less than 50 acres, provided one or more applies:

- The water has no discernable channel;
- The water is confined within a lawfully existing, manmade conveyance structure or drainage feature, such as a pipe, culvert, ditch, channel, or basin; and
- The water is not connected to a regulated water by a channel or pipe, such as an isolated pond or depression that has no outlet.

In addition, as mentioned in [Section 1.3.3.7](#) above, flood hazard areas are considered Highlands Resource areas that warrant special protection under the *Highlands Water Protection and Planning Act Rules* (N.J.A.C. 7:38-3.7).

A flood hazard area exists along all regulated waters that have a drainage area of 50 acres or more. The flood hazard area is defined as the land and space above that land, which lies below the flood hazard area design flood. The area of the flood hazard area design flood is defined as a flood equal to the 100-

year flood plus an additional amount of water in fluvial areas to account for possible future increases in flows due to development or other factors. The flood hazard area design flood elevation is determined using a flood that is no less than 125 percent of the peak flow and volume of a 100-year flood.

The flood hazard area includes both the floodway and flood fringe. The floodway is the channel and inner portions of the floodplain adjoining the channel which are reasonably required to carry and discharge the regulatory flood. The floodway is subject to high velocity flows during flooding events and development within a floodway is highly restricted. The flood fringe is the portion of the floodplain contiguous with the floodway. The flood fringe experiences flooding, but is inundated to a lesser degree than the floodway. Delineated flood hazard areas have been established and officially adopted by the State of New Jersey for certain watercourses. Flood profiles, mapping, and corresponding computer models for delineated watercourses may be obtained from the NJDEP.

The Flood Insurance Program, administered by the Federal Emergency Management Agency (FEMA), has also prepared mapping and classifies floodplain areas in a manner similar to the State of New Jersey. Within the FHACA Rules (N.J.A.C. 7:13-3), NJDEP has established methodologies and circumstances for using FEMA floodplain mapping for determining the flood hazard area for FHACA permit applications.

FEMA's Preliminary Digital Flood Insurance Rate Map (DFIRM; dated January 2015) and the NJDEP Delineation of Floodway and Flood Hazard Areas Map (Undated) indicate that the southwestern portion of Airport property contains floodway and flood fringe associated with Morsetown Brook. Refer to **Figure 1-32**, FEMA Floodplain Map, and **Figure 1-33**, NJDEP Flood Hazard Area Map, for details.



Figure 1-32. FEMA Floodplain Map

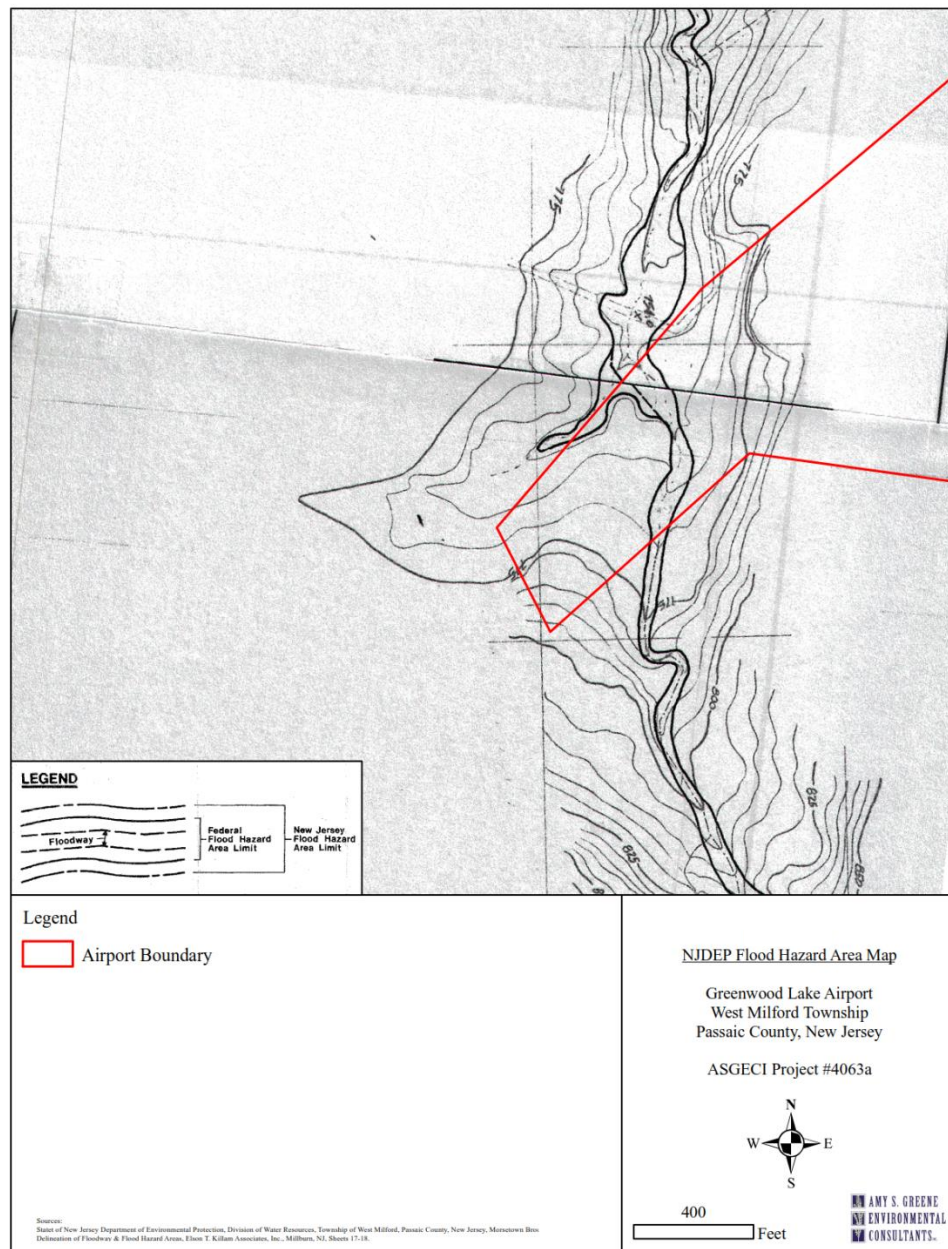


Figure 1-33. NJDEP Flood Hazard Area Map

Regulated waters, such as Morsetown and Hewitt Brooks, are also subject to buffer areas called “riparian zones.” A “riparian zone” is the land and vegetation within and adjacent to both sides of a regulated water. The width of a riparian zone may be 50, 150, or 300 feet, depending upon the stream’s association with certain environmental characteristics, as follows:

- For Category 1 (C1) streams and upstream waters within the same HUC-14 subwatershed, the riparian zone is 300 feet.
- The following regulated waters are assigned a 150-foot riparian zone:
 - Trout production water and all upstream waters including tributaries.
 - Any trout maintenance water and all upstream waters including tributaries within one mile of the trout maintenance water as measured along the length of the regulated water.
 - Any segment of a water flowing through an area that contains a threatened or endangered

species, and/or present or documented habitat for those species, which is critically dependent on the regulated water for survival, and all upstream waters (including tributaries) within one mile of such habitat as measured along the length of the regulated water.

- The riparian zone for all remaining regulated waters is 50 feet.

Greenwood Lake Airport falls within two (2) subwatersheds: Belcher Creek (Pinecliff Lake and below) and Wanaque River/Greenwood Lake (above Monks gage). The west side of the Airport drains to Morsetown Brook and two unnamed tributaries, which drain to Belcher Creek and eventually to the Wanaque River. Morsetown Brook and its tributaries are classified as Freshwater 2, Non-Trout (FW2-NT) and Category 2 (C2); however, these streams are located upstream of Trout Production (TP) Waters and have present or documented habitat for wood turtle (*Glyptemys insculpta*), a State threatened species that is critically dependent on regulated waters for survival. Therefore, the anticipated riparian zone of Morsetown Brook and its tributaries is 150 feet from the top-of-bank.

The east side of the Airport drains to Hewitt Brook and its unnamed tributary, which drain to the Wanaque River. Hewitt Brook and its tributary are classified as FW2, TP and C1; therefore, the riparian zone associated with Hewitt Brook and its tributaries is anticipated to be 300 feet from the top-of-bank.

The Flood Insurance Program, administered by FEMA, has also prepared mapping and classifies floodplain areas in a manner similar to the State of New Jersey. Within the FHACA Rules (N.J.A.C. 7:13-3), NJDEP has established methodologies and circumstances for using FEMA floodplain mapping for determining the flood hazard area for FHACA permit applications.

See **Chapter 5 Implementation Plan and Financial Analysis** for additional information regarding the need for additional studies, analyses, and associated approvals.

1.3.3.8 Biotic Communities and Rare, Threatened & Endangered Species

Biotic Communities

In an environment or habitat, different types of plants and animals exist in close association and show interdependence. A biotic community is a common environment consisting of an actively interacting group of a number of different populations of several species.

Greenwood Lake Airport contains a variety of natural areas, including forested wetlands associated with Morsetown Brook, Hewitt Brook, and their tributaries; mixed hardwood upland forest; and scrub-shrub wetlands surrounding the centrally-located, manmade waterbody. These areas provide habitat for numerous species of mammals, birds, reptiles, and amphibians, as well as small fish and other aquatic species within the streams themselves. The remainder of the Airport consists of regularly maintained lawns and impervious surfaces, such as taxiways, runways, and buildings.

Rare, Threatened & Endangered Species

Endangered species are those whose prospects for survival in New Jersey (State-listed), or nationally (Federally-listed), are in immediate danger because of a loss or change in habitat, over-exploitation, predation, competition, disease, disturbance or contamination. Assistance is needed to prevent future extinction. Threatened species are those that may become endangered in New Jersey (State-listed) or nationally (Federally-listed) if conditions surrounding them begin or continue to deteriorate.

The USFWS protects Federally-listed endangered and threatened wildlife and plant species and their habitat under the 1973 *Endangered Species Act*. Under Section 7 of this Act, Federal agencies are required to consult with the USFWS to ensure that the actions they authorize, fund, or carry out will not jeopardize the existence of any species listed under the Act, or destroy or adversely modify designated critical habitat of any listed species. In the event that proposed actions are determined to jeopardize a listed species, the USFWS must offer reasonable alternatives that will meet the goals of the proposed action without jeopardizing the listed species.

The State of New Jersey has its own *Endangered Species Act*, known as the *Endangered and Nongame Species Conservation Act* (N.J.S.A. 23:2A-13 *et seq.*), which resulted in the listing of State endangered animal species (N.J.A.C. 7:25-4:13) and a Nongame Species list, including threatened species (N.J.A.C. 7:25 4.179(a)). As part of this Act, all New Jersey animals appearing on the Federal list are also included on this State list. Endangered plants in New Jersey have been identified in accordance with the *Endangered Plant Species List Act* (N.J.S.A. 13:1B-15.151 *et seq.*). See **Chapter 5 Implementation Plan and Financial Analysis** for additional information on Section 7 of the *Endangered Species Act*.

State listed endangered and threatened wildlife species that are dependent upon wetlands can have increased protection to their wetland habitat under the *Freshwater Wetlands Protection Act Rules* (N.J.A.C. 7:7A). Federally listed plant species are also afforded protection under this Act. A freshwater wetland that is habitat for an endangered or threatened species is considered to be an exceptional resource value wetland with a standard transition area width of 150 feet (N.J.A.C. 7:7A-2.4(b)2). The New Jersey FHACA (N.J.A.C. 7:13) Rules also provide for protection by providing a 150-foot regulated riparian zone for certain water-dependent State-listed endangered and threatened animal and plant species habitats. See **Chapter 5 Implementation Plan and Financial Analysis** for additional information regarding permitting considerations.

The New Jersey Natural Heritage Program (NHP) of the Office of Natural Lands Management maintains the Natural Heritage Database for occurrences of rare wildlife species, including endangered and threatened species, or wildlife habitat within the State of New Jersey. The NHP also utilizes the New Jersey Landscape Project Habitat mapping to identify rare wildlife species or wildlife habitat within the State (see **Figure 1-31**, NJDEP Landscape Project Map, in Section 1.3.3.5 Wetlands above). The New Jersey Landscape Project habitat patches are assigned a Rank of 1 through 5, based on the status of the species present, as follows:

Rank 5:	Presence of one or more Federally-listed threatened or endangered species.
Rank 4:	Presence of one or more State-listed endangered species.
Rank 3:	Presence of one or more State-listed threatened species.
Rank 2:	Presence of one or more non-listed State priority species.
Rank 1:	Habitat patches with minimum habitat specific suitability size requirement for threatened or endangered or priority species, but do not intersect with any confirmed occurrence.

Database searches were conducted by the NHP to ascertain whether State or Federally-listed threatened or endangered species, critical habitat, or rare natural communities have been recorded for the area within one mile of the site as per the *Endangered and Nongame Species Conservation Act* (N.J.S.A. 23:2A-1 *et seq.*) and the *Endangered Species Act of 1973* (16 U.S.C. 1531 *et seq.*), respectively.

As stated in a letter, dated December 13, 2017, neither the NHP database nor the Landscape Project (v3.3) has records of any rare plants, ecological communities, Natural Heritage Priority Sites, or rare wildlife species or wildlife habitat based on NJDEP Landscape Project stream habitat files. The NHP does, however, have records of the following rare wildlife species or wildlife habitat on the site:

- Barred owl (*Strix varia*, State Threatened) – Breeding and Non-Breeding Sightings
- Blue-headed vireo (*Vireo solitarius*, State Special Concern) – Breeding Sighting
- Bobcat (*Lynx rufus*, State Endangered) – Live Individual Sighting, On Road, Physical Evidence
- Cooper's hawk [*Accipiter cooperii*, State Special Concern (breeding)] – Breeding Sighting
- Eastern box turtle (*Terrapene carolina carolina*, State Special Concern) – Occupied Habitat
- Golden-winged warbler [*Vermivora chrysoptera*, State Endangered (breeding)] – Breeding Sighting
- Great blue heron [*Ardea herodias*, State Special Concern (breeding)] – Foraging
- Hooded warbler [*Wilsonia citrina*, State Special Concern (breeding)] – Breeding Sighting
- Northern copperhead (*Agkistrodon contortrix mokasen*, State Special Concern) – Occupied Habitat

- Northern goshawk [*Accipiter gentilis*, State Endangered (breeding)] – Breeding Sighting
- Northern long-eared bat (*Myotis septentrionalis*, Federally Threatened) – Active Season Sighting, Hibernaculum
- Red-shouldered hawk [*Buteo lineatus*, State Endangered (breeding)] – Breeding and Non-Breeding Sightings
- Timber rattlesnake (*Crotalus horridus horridus*, State Endangered) – Occupied Habitat
- Veery [*Catharus fuscescens*, State Special Concern (breeding)] – Breeding Sighting
- Whip-poor-will [*Caprimulgus vociferus*, State Special Concern (breeding)] – Breeding Sighting
- Wood thrush [*Hylocichla mustelina*, State Special Concern (breeding)] – Breeding Sighting
- Wood turtle (*Glyptemys insculpta*, State Threatened) – Occupied Habitat
- Worm-eating warbler [*Helmitheros vermivorum*, State Special Concern (breeding)] – Breeding Sighting

Additionally, the NHP has records of two (2) vernal habitat areas (Vernal Pool Habitat ID #s 3140 and 3146) and three (3) invertebrates, including Henry's elfin (*Callophrys henrii*, State Rank S3/S4), long dash (*Polites mystic*, State Rank S3), and Edwards' hairstreak (*Satyrium edwardsii*, State Rank S3), on the site. The aforementioned State ranking system was developed by The Nature Conservancy (1982: Chapter 4, 4.1-1 through 4.4.1.3-3) for use in identifying elements of natural diversity. Each element is ranked according to its state rarity and is used to prioritize conservation work. According to this ranking system, S3 is defined as "rare in the state". This rank includes elements that are widely distributed in the state, but occur in small (sometimes abundant) populations, acreage, or elements with restricted distribution. Elements in this rank are not yet imperiled in state, but may soon be if current trends continue. Elements ranked as S4 are "apparently secure in state, with many occurrences."

The same records were identified in the vicinity of the site; however, the NHP also identified Cerulean warbler (*Dendroica cerulean*, State Special Concern; Breeding Sighting) within the immediate vicinity of the site based on a search of Landscape Project 3.3 Species Based Patches.

In addition, the NHP also has the following records within one (1) mile of the site:

- Bald eagle [*Haliaeetus leucocephalus*, State Endangered (breeding) and State Threatened (non-breeding)] – Foraging, Nest, Wintering
- Barred owl – Breeding Sighting, Non-Breeding Sighting
- Blue-headed vireo – Breeding Sighting
- Broad-winged hawk (*Buteo platypterus*, State Special Concern) – Breeding Sighting
- Bobcat – Live Individual Sighting, On Road, Physical Evidence
- Cerulean warbler – Breeding Sighting
- Cooper's hawk – Breeding Sighting
- Eastern box turtle – Occupied Habitat
- Golden-winged warbler – Breeding Sighting
- Great blue heron – Foraging, Nesting Colony
- Hooded warbler – Breeding Sighting
- Northern copperhead – Occupied Habitat
- Northern goshawk – Breeding Sighting
- Northern long-eared bat – Active Season Sighting, Hibernaculum

- Red-shouldered hawk – Nest, Breeding and Non-Breeding Sightings
- Timber rattlesnake – Occupied Habitat
- Veery – Breeding Sighting
- Whip-poor-will – Breeding Sighting
- Wood thrush – Breeding Sighting
- Wood turtle – Occupied Habitat
- Yellow-breasted chat (*Icteria virens*, State Special Concern) – Breeding Sighting

Additionally, the NHP identifies five (5) vernal habitat areas (Vernal Pool Habitat ID #s 3128, 3140, 3146, 3148 and 3150), one (1) potential vernal habitat area (Vernal Pool Habitat ID #2459), and three (3) invertebrates, including Henry's elfin, long dash, and Edwards' hairstreak, within one (1) mile of the Site.

The NHP does not have any records for rare plant species occurrences covered by the FHACA or Natural Heritage Priority Sites within one mile of the project site.

The wood turtle is critically dependent on regulated waters for survival.

Refer to **Figure 1-31**, NJDEP Landscape Project Map, in Section 1.3.3.5 Wetlands above.

The USFWS Information Planning and Conservation (IPaC) system was utilized to determine the potential presence of Federally-listed species or critical habitats within the Airport property. Based on the Official Species List, dated December 7, 2017, the USFWS did not identify critical habitats within the project area; however, the list did identify the following Federally-listed species as species to be considered in an effects analysis:

- Bog turtle (*Glyptemys {Clemmys} muhlenbergii*, Federally Threatened)
- Indiana bat (*Myotis sodalis*, Federally Endangered)
- Northern long-eared bat (*Myotis septentrionalis*, Federally Threatened)
- Small-whorled pogonia (*Isotria medeoloides*, Federally Threatened)

No other threatened or endangered species protected by the *Endangered Species Act* were identified by the Official Species List. Refer to **Appendix A**, Agency Correspondence, for a copy of the USFWS Official Species List.

Rare, threatened or endangered plant and animal species are considered Highlands Resources that warrant special protection under the *Highlands Water Protection and Planning Act Rules* (N.J.A.C. 7:38-3.11). "Rare species" are defined as wildlife species that are not endangered or threatened species, but are considered by the NJDEP to be Species of Special Concern or those that are ranked S1 (critically imperiled in New Jersey because of extreme rarity), S2 (imperiled in New Jersey because of rarity), S3 (rare in New Jersey), G1 (critically imperiled globally), G2 (imperiled globally because of rarity), or G3 (globally very rare and local throughout its range or found locally in a restricted range) in the Natural Heritage Database. Rare species also includes Plant Species of Concern listed pursuant to N.J.A.C. 7:5C-3.1. A Highlands Conservation Rank index was developed for those species whose survival in New Jersey is highly dependent upon Highlands Region habitats. The following are the Highlands Conservation Ranks that were used:

- **Critically Significant** – if habitats in the Highlands Region were lost, that species would not exist in the State.
- **Significant** – Highlands Region habitats play a significant role for that species' existence in the State.
- **Low Significance** – Highland Region habitats do not play an important role for that species' existence in the State.

Refer to **Table 1-10** below for a comprehensive list of rare, threatened and endangered species identified on or in the immediate vicinity of the Airport property. **Table 1-10** also provides the federal and State status, as well as Highlands Rank.

See **Chapter 5 Implementation Plan and Financial Analysis** for information on the need for and timing of additional studies, surveys, and associated approvals.

**Table 1-10. Rare, Threatened and Endangered Species Documented On
or in the Immediate Vicinity of Greenwood Lake Airport (4N1)**

Common Name	Scientific Name	Status	Highlands Rank	Record Source
Barred Owl	<i>Strix varia</i>	ST	S	Landscape Project, NHP
Blue-Headed Vireo	<i>Vireo solitarius</i>	SC (breeding)	-	Landscape Project, NHP
Bobcat	<i>Lynx rufus</i>	SE	CS	Landscape Project, NHP
Bog Turtle	<i>Glyptemys {Clemmys} muhlenbergii</i>	FT	CS	USFWS
Cerulean Warbler	<i>Dendroica cerulea</i>	SC	CS	NHP
Cooper's Hawk	<i>Accipiter cooperii</i>	SC (breeding)	LS	Landscape Project, NHP
Eastern Box Turtle	<i>Terrapene carolina carolina</i>	SC	LS	Landscape Project, NHP
Edwards' Hairstreak	<i>Satyrium edwardsii</i>	-	-	NHP
Golden-Winged Warbler	<i>Vermivora chrysoptera</i>	SE (breeding)	CS	Landscape Project, NHP
Great Blue Heron	<i>Ardea herodias</i>	SC (breeding)	LS	Landscape Project, NHP
Henry's Elfin	<i>Callophrys henrici</i>	-	-	NHP
Hooded Warbler	<i>Wilsonia citrina</i>	SC (breeding)	-	Landscape Project, NHP
Indiana Bat	<i>Myotis sodalis</i>	SE, FE	CS	USFWS
Long Dash	<i>Polites mystic</i>	-	-	NHP
Northern Copperhead	<i>Agkistrodon contortrix mokasen</i>	SC	CS	Landscape Project, NHP
Northern Goshawk	<i>Accipiter gentilis</i>	SE (breeding)	CS	Landscape Project, NHP
Northern Long-Eared Bat	<i>Myotis septentrionalis</i>	FT	-	Landscape Project, NHP, USFWS
Red-Shouldered Hawk	<i>Buteo lineatus</i>	SE (breeding)	CS	Landscape Project, NHP
Small Whorled Pogonia	<i>Isotria medeoloides</i>	FT	-	USFWS
Timber Rattlesnake	<i>Crotalus horridus horridus</i>	SE	CS	Landscape Project, NHP
Veery	<i>Catharus fuscescens</i>	SC (breeding)	S	Landscape Project, NHP
Whip-Poor-Will	<i>Caprimulgus vociferus</i>	SC (breeding)	-	Landscape Project, NHP
Wood Thrush	<i>Hylocichla mustelina</i>	SC (breeding)	-	Landscape Project, NHP
Wood Turtle	<i>Glyptemys insculpta</i>	ST	CS	Landscape Project, NHP
Worm-Eating Warbler	<i>Helmitheros vermivorum</i>	SC (breeding)	CS	Landscape Project, NHP

Notes:

- SC** – State Special Concern

ST – State Threatened

SE – State Endangered

FT – Federally Threatened

FE – Federally Endangered
- FT** – Federally Threatened

CS – Critically Significant

LS – Low Significant

S - Significant

Landscape Project – New Jersey Department of Environmental Protection Landscape Project Mapping, Version 3.3, 2017.

NHP – New Jersey Department of Environmental Protection Natural Heritage Program letter, dated December 13, 2017.

USFWS – US Fish & Wildlife Service Official Species List, dated December 7, 2017.

Highlands Rank – Highlands Ecosystem Management Technical Report, dated 2008

1.3.3.9 Section 4(f) Lands

The U.S. Department of Transportation requires that transportation projects shall not use or take any publicly owned land from a public park, recreational area, wildlife or waterfowl refuge, or land of a historic site unless there is no feasible and prudent alternative and planning to minimize harm to the property has been incorporated. The term historic site includes prehistoric and historic districts, sites, buildings, structures, or objects listed in or eligible for that National Register of Historic Places. Historic sites may also include places of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria.

A review of available mapping identified the following publicly owned land adjacent to or in the vicinity of the Airport property (see **Figure 1-34**, Section 4(f) Map):

- Block 6002, Lot 18.01
 - Owner: West Milford Township (Green Acres Program Parcel)
 - Lot Size: Approx. 111 Acres
 - Location: Adjacent (West)
- Block 6002, Lot 33
 - Owner: NJDEP
 - Lot Size: Approx. 769 Acres
 - Location: Adjacent (East)
- Block 6002, Lot 28.02
 - Owner: West Milford Township (Green Acres Program Parcel)
 - Lot Size: Approx. 13 Acres
 - Location: Approx. 225 Feet Northwest
- Block 6002, Lot 26
 - Owner: NJDEP
 - Lot Size: Approx. 3 Acres
 - Location: Approx. 1,350 Feet Northwest
- Block 6002, Lot 38
 - Owner: NJDEP
 - Lot Size: Approx. 21 Acres
 - Location: Approx. 1,675 Feet Northeast
- Block 3801, Lot 1
 - Owner: State of New Jersey, Division of Parks & Forestry
 - Lot Size: Approx. 226 Acres
 - Location: Approx. 1,725 Feet North
- Block 3801, Lot 10
 - Owner: NJDEP
 - Lot Size: 28 Acres
 - Location: Approx. 2,250 Feet Northeast

- Block 4501, Lot 4
 - Owner: State of New Jersey, Division of Fish & Game
 - Lot Size: Approx. 908 Acres
 - Location: Approx. 4,425 Feet Northeast

Lastly, the Wallisch Homestead Historic Property (ID #2058), located at 65 Lincoln Road, is located approximately 3,700 feet northwest of the Airport property. Refer to [Section 1.3.3.4](#) above and **Figure 1-27** for additional historic sites located in the vicinity of the Airport.

See **Chapter 5 Implementation Plan and Financial Analysis** for information on the need for and timing of additional survey and approvals associated with Section 4(f) properties.

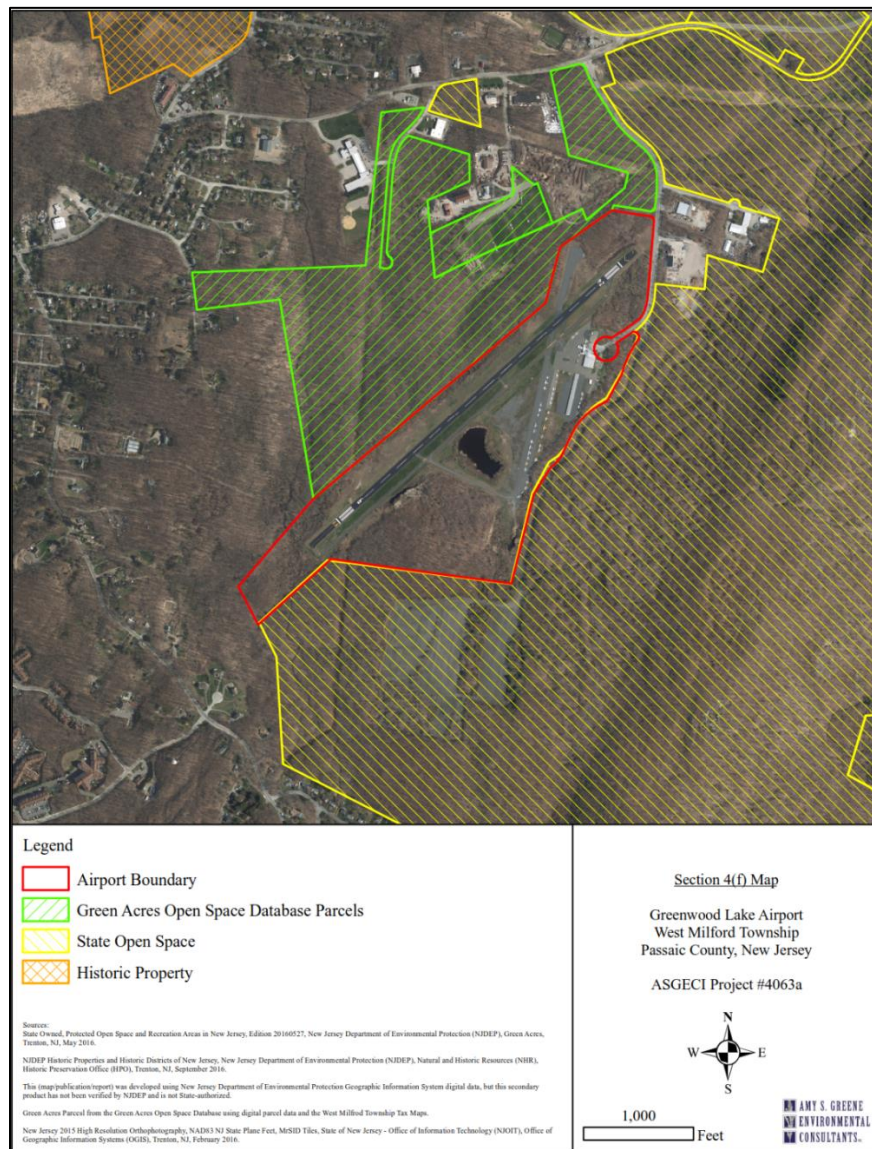


Figure 1-34. Section 4(f) Map

1.3.4 Air Quality

The NJDEP Bureau of Air Quality provides air quality monitoring at various locations across the State. Certain locations provide air quality monitoring for six (6) specific air pollutants, known as criteria pollutants, including ozone (O₃), sulfur dioxide (SO₂), nitrogen dioxide (NO₂), particulate matter (PM), lead

(Pb), and carbon monoxide (CO); however, these are often situated near urban centers. These pollutants are used as indicators of air quality and for which National Ambient Air Quality Standards (NAAQS) have been established. In addition to monitoring criteria pollutants, the NJDEP also measures “non-criteria pollutants,” or pollutants that do not have health-based NAAQS, at certain stations throughout the State.

The nearest air quality monitoring stations include the Ramapo Monitoring Site, located at Ramapo Mountain State Forest in Wanaque, and the Paterson Monitoring Site, located at the City of Paterson Board of Health in Paterson.

The Ramapo Monitoring Site provides air quality monitoring for Ozone; however, monitoring only occurs during the “Ozone season” of April 1 through October 31. In 2016, the 1-hour daily maximum concentration was 0.103 parts per million (ppm) and the highest daily maximum concentration was 0.079 ppm. USEPA lowered the ozone standard from 0.075 ppm to 0.070 ppm in 2016.

The Paterson Monitoring Site provides air quality monitoring for fine particulate matter, known as PM_{2.5}. In 2016, the annual mean concentration of PM_{2.5} was 7.39 micrograms per cubic meter (µg/m³) and the highest 24-hour concentration was 21.0 µg/m³. The annual standard for PM_{2.5} is 12.0 µg/m³ and the 24-hour standard is 35 µg/m³; therefore, PM_{2.5} was not exceeded at this station in 2016.

The air monitoring data is also used to characterize the general air quality in New Jersey. Descriptor ratings, ranging from “Good” to “Very Unhealthy,” have been established to provide a general system of rating the regional air quality. The NAAQS is given a numerical Air Quality Index (AQI) rating. The results of air monitoring for pollutants measured at the stations were compared to the National Ambient Air Quality Standards. An index value was given for the level of Air Quality. The Index Level ranges from 0-500. Zero to 50 is considered good air quality; 51-100 is considered moderate air quality; 101-150 is considered unhealthy for sensitive groups (children, elderly and individuals with health conditions); 151-200 is considered unhealthy, 201-300 is considered very unhealthy and 301 to 500 is considered hazardous. The NAAQS is equal to a value of 100. Any value above 100 is considered to be exceeding the NAAQS.

The 2016 Air Quality Index Summary for New Jersey indicates there were 156 “Good” days, 183 were “Moderate,” 25 were rated “Unhealthy for Sensitive Groups,” and 2 were considered “Unhealthy.” None were rated “Very Unhealthy.” Throughout the State, ozone was the most common criteria pollutant exceeding standards. In general, the air quality in New Jersey has improved significantly since the passage of the Clean Air Act in 1970. New Jersey is now in compliance with all NAAQS Standards for criteria pollutants, except for ozone.

The full NJDEP Bureau of Air Monitoring 2016 Air Quality Report; real time monitoring station data; multiple studies/reports concerning pollutants and air toxics, can be reviewed at NJDEP Bureau of Air Monitoring website at <http://www.njaqinow.net/Default.ltr.aspx>.

1.3.5 Obstructions Analysis

The FAA institutes regulations, policies, and procedures for protecting airspace around airports and requires the evaluation of objects that may pose hazardous to operating aircraft. Both manmade and natural objects such as trees, buildings, and powerlines located on or near airport property have the potential to penetrate the Approach and/or Departure Surfaces of aircraft, which may limit an airport's operational capability. The FAA has determined that the mitigation of objects, both natural and manmade, that penetrate flight procedure obstacle clearance surfaces is crucial to airport safety, efficiency, and utility.

In 2016, NJDOT conducted an aeronautical survey of 4N1 in accordance with FAA AC 150/5300-18B requirements. Obstacle penetrations to the 20:1 Approach Surfaces, 40:1 Departure Surfaces, Primary Surface, and Transitional Surfaces were identified, including the type, category, location of obstacles, and any unique topographical or environmental conditions that have been identified at each airport. Based on this analysis, a summary of next steps for obstruction mitigation at the Airport was developed. Recommendations were primarily focused on the 20:1 Approach Surface, given the FAA's mandate to mitigate such obstacles.

The aeronautical survey found that the majority of the obstacles at both Runway Ends 06 and 24 are natural objects, including trees and bushes, and some are manmade objects, including buildings and poles. It was recommended that the airport operator focuses mitigation efforts on tree clearing at the Runway 24 end, as there are only 26 obstacles that fall within the 20:1 Approach Surface. At the Runway 06 end, 241 obstacles fall within the 20:1 Approach surface. Given the number of obstacles identified at the Runway 06 end, the elevation of a hill 2,000 feet from the Runway 06 end, and the number of manmade obstacles and different property owners, the Runway 24 end was judged as having a greater probability of success in clearing the obstacles.

2. Aviation Activity Forecasts

AECOM has been engaged by the New Jersey Department of transportation (NJDOT) Bureau of Aeronautics (BOA) to provide the Airport Master Plan Update for Greenwood Lake Airport (“4N1” or “the Airport”) in accordance with FAA guidelines.

Under the Airport Master Plan Update Task, the AECOM Team prepared unconstrained aviation activity forecasts. This Technical Report documents the background information, methodology, and findings of the forecasting and analysis, and is the forecast chapter of the Airport Master Plan report.

The Aviation Activity Forecasts Chapter includes the following sections:

- Section 2.2 Airport Service Area, defines the catchment area around 4N1. It establishes the framework for analyzing the aviation demand.
- Section 2.3 General Aviation in the Region and the U.S., describes the national general aviation activity, regional pilot populations, and aircraft shipments in the U.S.
- Section 2.4 Economic Basis for General Aviation Demand, identifies the economic drivers for aviation demand and trends of aviation fuel prices. It provides the economic parameters for the forecast models.
- Section 2.5 Historical General Aviation Demand, describes the historical industry trends, based aircraft, annual general aviation operations, and the general aviation communities at 4N1. It provides the historical background and baseline conditions for the forecast development and analysis.
- Section 2.6 General Aviation Demand Forecasts, provides the general aviation demand forecasts for based aircraft, and annual operations. It also identifies the critical aircraft.
- Section 2.7 Summary, reviews the aviation demand forecasts for 2021, 2026, and 2036.

4N1 is classified as a local general aviation airport under the Federal Aviation Administration (FAA) National Plan of Integrated Airport Systems (NPIAS), 2021-2025. The airport service area for a general aviation airport is considered to cover areas located within an approximately 60-minute drive time area as shown in **Figure 2-1**. In addition, it will also be impacted by the composition of airports in the region. Taking into consideration the distribution of the based aircraft registrants' locations as shown in **Figure 2-2**, a high percentage of based aircraft are registered in Passaic, Bergen, Morris, Sussex, Rockland, and Westchester Counties. It is anticipated that the majority of the general aviation users at 4N1 are from Passaic and surrounding counties. The airport service area for 4N1 would include counties located within a 60-minute drive time area, and where multiple aircraft owners have selected 4N1 to park their aircraft. Although no existing aircraft owners from Essex County base their aircraft at 4N1 in 2016, it is within the 30- to 60-minute drive time area and is included in the airport service area for analyzing the regional demand surrounding the airport. The 8-county airport service area is summarized in **Table 2-1**.



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2-2

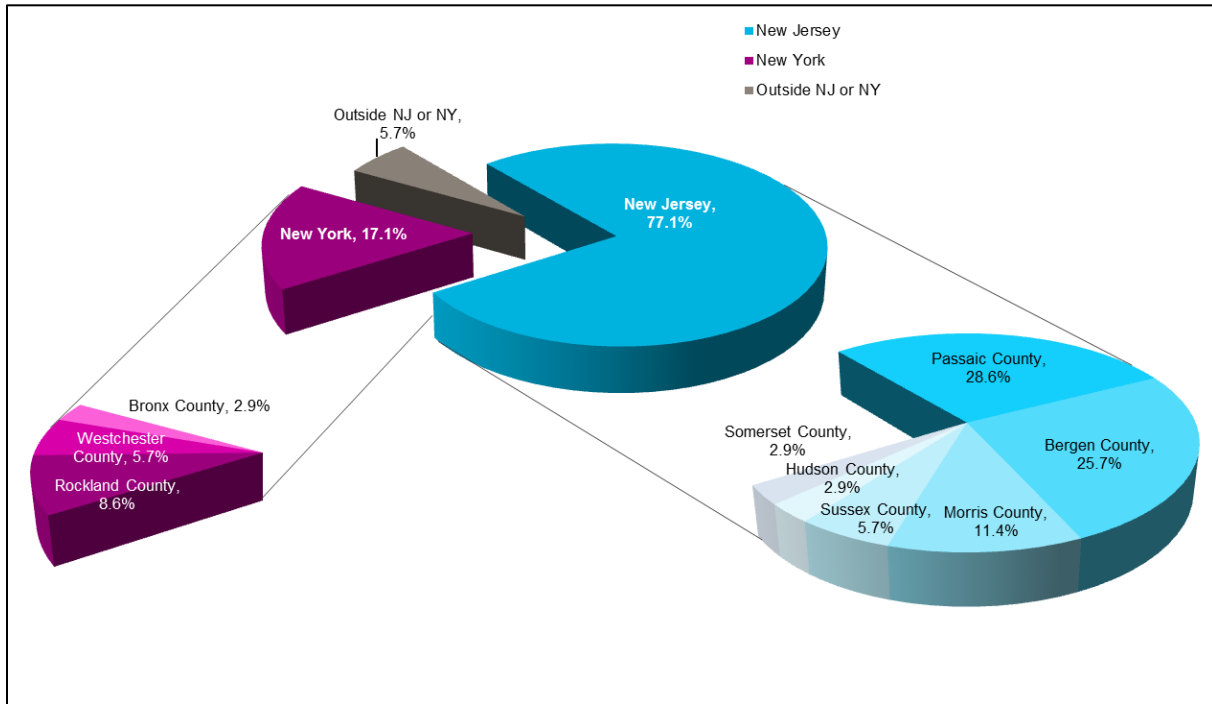


Figure 2-2. Locations of Registered Owners of 4N1 Based Aircraft

Source: Aircraft registration (N-number) records obtained from Greenwood Lake Airport Tenants Report December 2016. AECOM analysis.

Table 2-1. Counties within the Airport Service Area

County	State
Passaic County	New Jersey
Bergen County	New Jersey
Morris County	New Jersey
Sussex County	New Jersey
Essex County	New Jersey
Orange County	New York
Rockland County	New York
Westchester County	New York

2.2 General Aviation in the Region and in the U.S.

2.2.1 Composition of General Aviation Activity

General aviation (GA) includes a wide range of flying activities, such as flight training, personal and recreational, business and corporate, on-demand charter, aerial work (observation, firefighting, agricultural), sightseeing, air medical, and other purposes.

The FAA conducts annual surveys of general aviation activities, which classifies general aviation activity into twelve different categories. **Table 2-2** summarizes the relevant information from the FAA General Aviation Survey 2015.¹

Table 2-2. General Aviation Activity in the U.S. 2015

Aircraft Use	Primary Use Active Aircraft	Actual Use Hours Flown (thousand hours)	Percentage of total hours	Average Hours Flown per Active Aircraft
Personal ¹	139,700	7,438	36.1%	53.2
Business ²	15,887	1,839	8.9%	115.7
Corporate ³	11,276	2,384	11.6%	211.4
Instructional ⁴	15,667	4,648	22.6%	296.7
Aerial Application ⁵	3,303	941	4.6%	285.0
Aerial Observation ⁶	5,477	1,412	6.9%	257.7
Aerial Other ⁷	870	178	0.9%	205.1
External Load ⁸	321	176	0.9%	549.4
Other Work ⁹	1,272	241	1.2%	189.3
Sightseeing ¹⁰	1,164	162	0.8%	138.8
Air Medical ¹¹	516	77	0.4%	149.3
Other ¹²	5,674	1,080	5.2%	190.4
Total GA	201,127	20,576	100.0%	102.3

Source: FAA General Aviation Activity Survey 2015. AECOM Analysis.

- Note:
1. Flying for personal reasons (includes recreational, excludes business transportation)
 2. Individual or group use for, or in the furtherance of, a business (without a paid flight crew)
 3. Individual or group business transportation with a paid flight crew (include fractional ownership)
 4. Flying under the supervision of a flight instructor, including student pilot solo
 5. Include application in agriculture and forestry, e.g. crop and timber production, fertilizer and pesticide application
 6. Aerial mapping/photography, patrol, search and rescue, hunting, traffic advisory, surveillance, etc.
 7. Public health sprayings, cloud seeding, fire fighting, etc.
 8. Operation under FAR Part 133, rotorcraft external load operations, e.g. helicopter hoist, hauling logs, etc.
 9. Construction work (exclude FAR Part 135) parachuting, aerial advertising, towing gliders, etc.
 10. Commercial sight-seeing conducted under FAR Part 91
 11. Air ambulance services, rescue, human organ transportation, emergency medical services (excludes FAR Part 135)
 12. Positioning flights, proficiency flights, training, ferrying, sales demos, etc.

The FAA GA Activity Survey 2015 shows the average number of hours flown per year by aircraft used for different purposes. Since each aircraft may be used for multiple purposes, the average shown is not strictly the average flight hours for aircraft primarily used for each purpose. Instead, it gives an indication for those aircraft that are in fact used mainly for a single purpose and provides the relative differences in average use across different purposes. It also provides an indication of the changes over time as FAA has conducted this survey for over 20 years.

¹ The FAA General Aviation Activity Survey includes Part 135 activities. Since there is no air taxi operations recorded at 4N1, survey results for Part 135 activities are not included in this report.

Although the FAA GA Activity Survey 2015 provides only national statistics, it is likely that the general characteristics are consistent while some indicators may be unique to 4N1. Later sections will reveal more analyses on the characteristics specific to the region and 4N1.

2.3 Pilot Population

Private and student pilots are the key components of GA communities. There has been a decline in the number of private pilots (-4.52 percent per year) in the combined New Jersey and New York region, while the number of student pilots remains steady (0.10 percent per year). The changes in pilot population in New Jersey and New York generally follow the national trend, but with a slower growth in student pilots and a slightly greater reduction in private pilots as compared to the national average. **Figure 2-3** and **Figure 2-4** present the changes in active² private, and student pilot population in New Jersey, New York, combined New Jersey and New York, and the national totals since 2006.

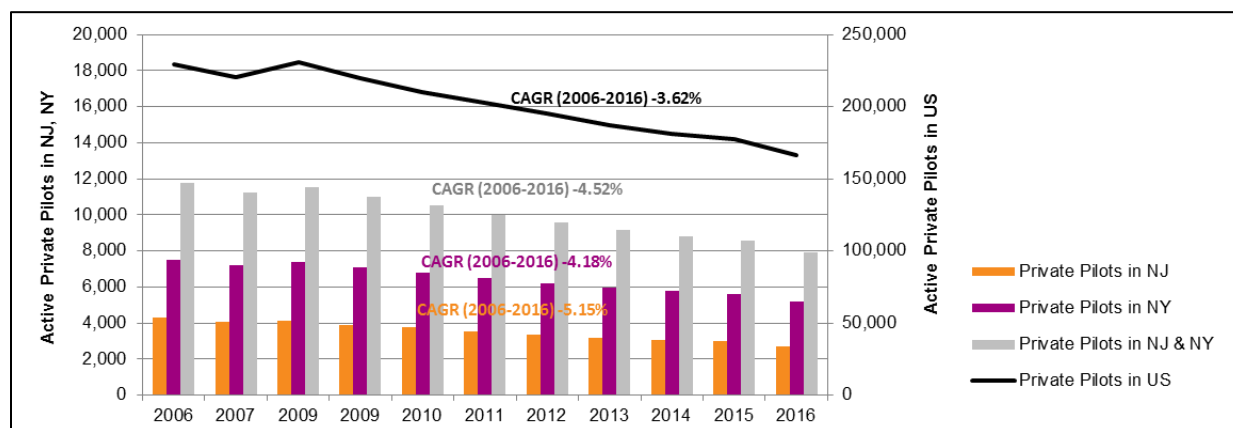


Figure 2-3. Private Pilot Populations in New Jersey, New York, and the U.S. (2006 to 2016)

Source: FAA Airmen Registration Data 2006 to 2016. AECOM analysis.

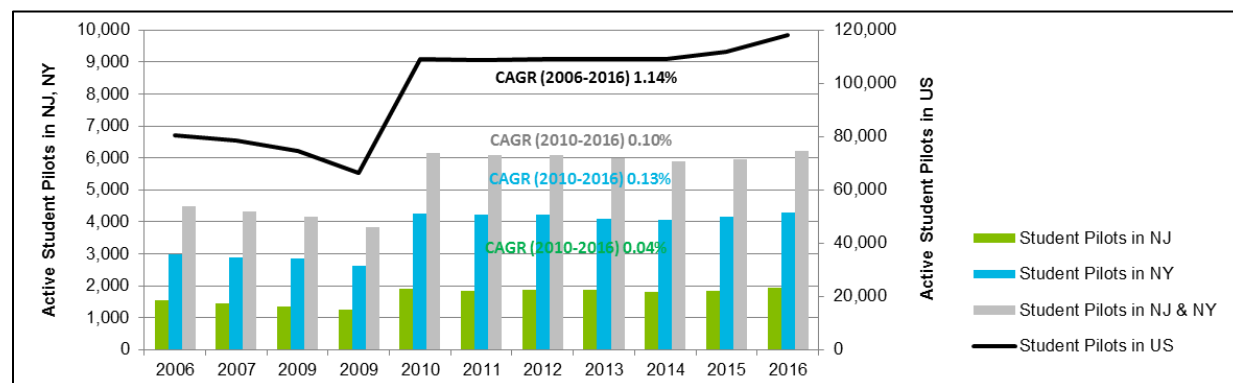


Figure 2-4. Student Pilot Populations in New Jersey, New York, and the U.S. (2006 to 2016)

Source: FAA Airmen Registration Data 2006 to 2016. AECOM analysis.

Note: In July 2010, the FAA issued a rule that increased the duration of validity for student pilot certificates for pilots under the age of 40 from 36 to 60 months. This resulted in the sudden increase in active student pilots at the end of 2009. Hence, only the compound annual growth rates (CAGR) from 2010 to 2016 are shown.

Figure 2-5 shows the percentage share of New Jersey and New York pilots over the pilot population in the U.S. There have been slow declines in the percentage share of private pilots (from 5.14 percent to

² Active pilots are defined as airmen holding a pilot certificate and a valid medical certificate where required (student pilots only require a medical certificate for solo flight, glider and balloon/recreation pilots do not require a medical certificate, and sport pilots do not require a medical certificate if they hold a valid driver's license).

4.75 percent), and student pilots (from 5.60 percent to 5.26 percent) in New Jersey and New York over the past decade.

Figure 2-6 summarizes the private and student pilot population in Passaic County and the surrounding Bergen, Morris, Sussex, Essex, Orange, Rockland, and Westchester Counties in 2016 and 2017.³ It indicates both the private and student populations decline in the airport service area around 4N1.

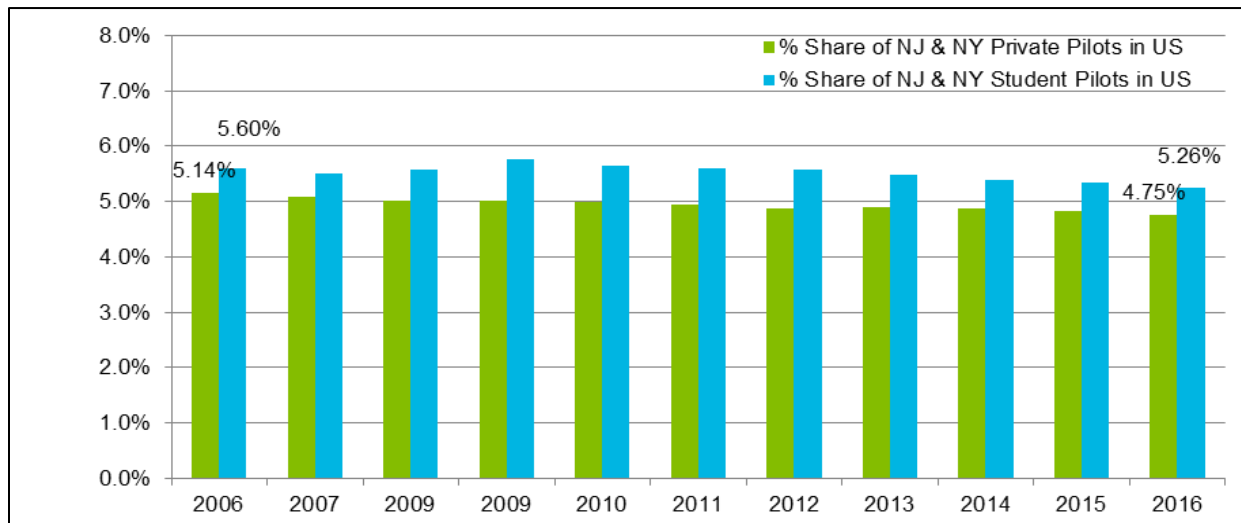


Figure 2-5. Percentage Share of Private and Student Pilots in New Jersey and New York over Totals in the U.S. (2006 to 2016)

Source: FAA Airmen Registration Data 2006 to 2016. AECOM analysis.

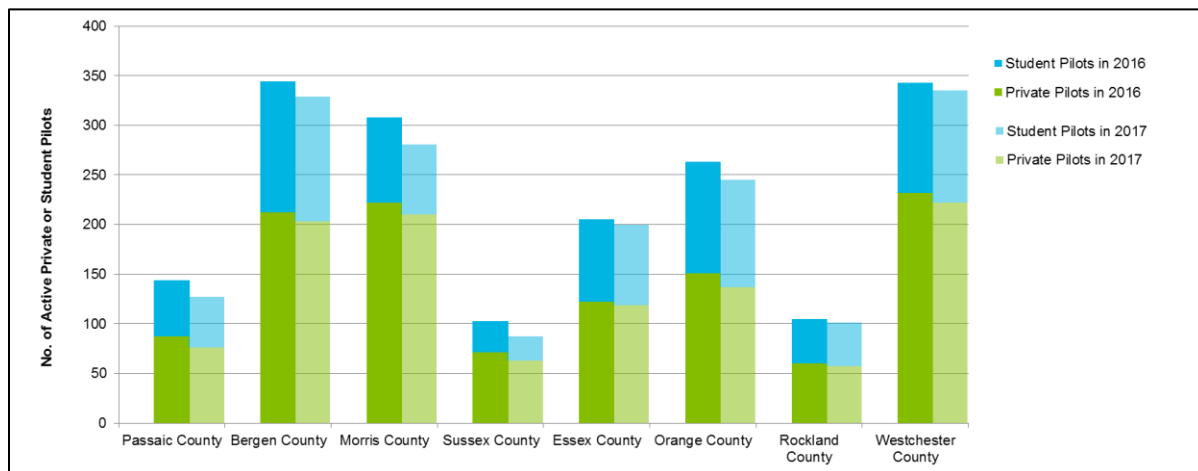


Figure 2-6. Active Private and Student Pilots in the Eight-County Area

Source: 2016 and 2017 data are based on FAA Airmen Registration (November 1, 2016. July 1, 2017). AECOM Analysis.

Note: Data include the active pilot population with registered address.

When we compare the number of private and student pilots per 10,000 population (pilot density) for different areas, the pilot density in the eight-county area is below the statewide average in New Jersey and New York, which is also below the pilot density in the U.S. **Figure 2-7** illustrates the pilot densities for different areas in 2016.

³ The data are based on our analysis of the FAA airman registration data (November 1, 2016 and July 1, 2017). The data include approximately 70 percent of the pilots who grant permission to FAA to share their details, such as address, in the FAA airman registration database.

Unlike areas in California where pilot density has been recovering in recent years, the historic trends of private and student pilots in the area surrounding 4N1 are trailing the national average. There may be multiple contributing factors to the decline, such as the increased cost of flying and the increased cost of living, which results in less discretionary dollars for flying, more hobby options than flying, aging GA facilities, and a less vibrant GA community.

It is anticipated that the private and student pilot population trend in the area will remain stagnant relative to the national forecast pilot population.

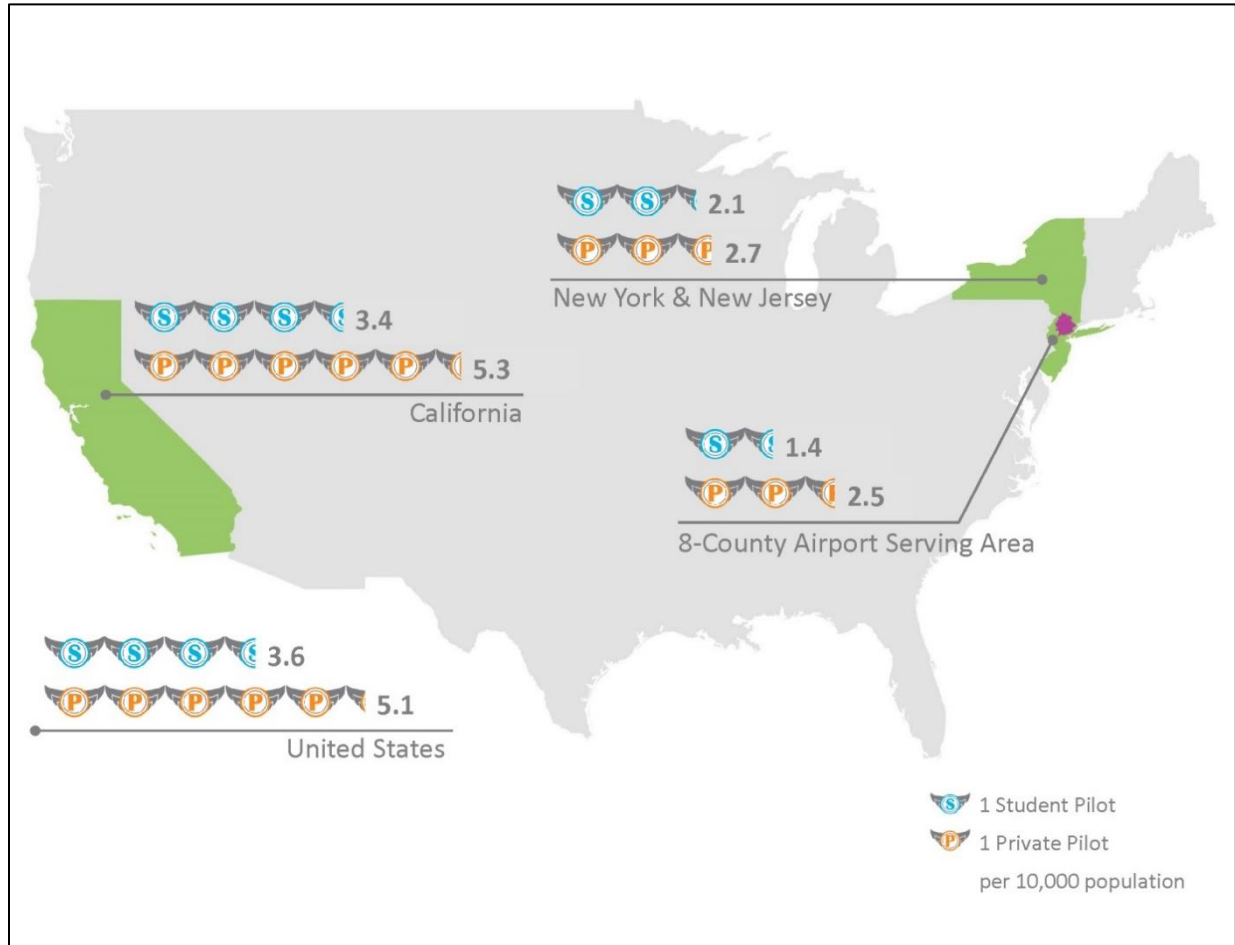


Figure 2-7. Active Private and Student Pilot per 10,000 Populations

Source: FAA Airmen Registration Data 2016. Socioeconomic data from the State Profile of New York and New Jersey, Woods & Pools Economics. AECOM analysis.

2.4 General Aviation Aircraft Shipment

Figure 2-8 shows the trend in U.S.-manufactured GA aircraft shipments, total billings, and average billings per aircraft since the 80's. The number of aircraft exported is excluded from the analysis. After the financial crisis in 2008 (recession from December 2007 to June 2009), shipments of new aircraft have been increasing gradually from 645 in 2010 to over a thousand units in 2016 (CAGR 8.7 percent per year). The increases in shipments are mostly for turboprop and business jet aircraft.

Figure 2-8 also shows the total value and average value per aircraft shipment. Although the number of GA aircraft manufactured declined significantly in the past three decades, the average value per aircraft shipment has increased. This implies that the composition of the future aircraft fleet will change as the number of older, less expensive aircraft declines, and as they are replaced by newer, more expensive aircraft.

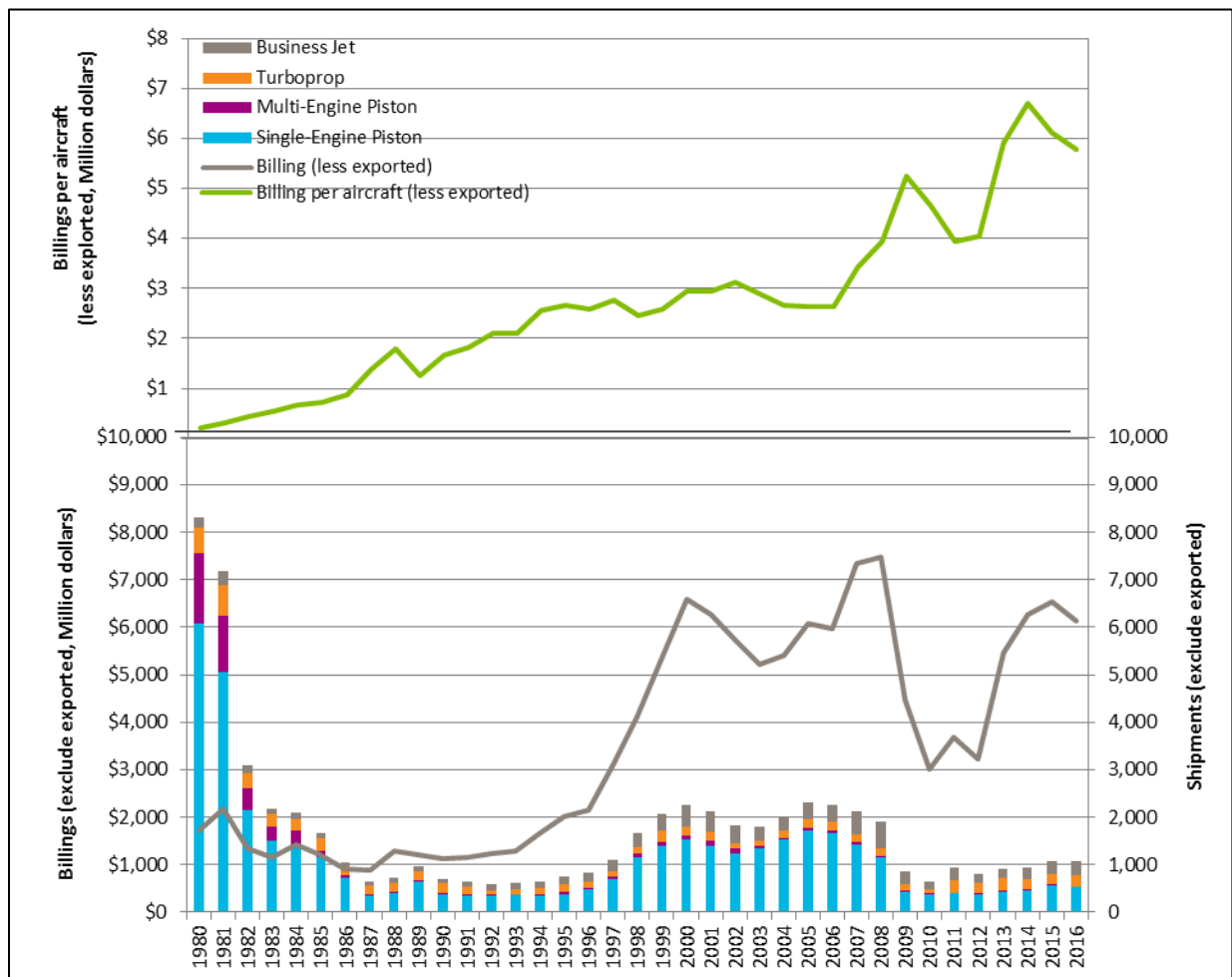


Figure 2-8. U.S.-Manufactured General Aviation Airplane Shipments by Type (Exclude Exported)

Source: GAMA. AECOM Analysis.

Figure 2-9 presents the total shipments of aircraft to North America. The difference between total shipments and the U.S.-manufactured aircraft (exclude exported) are the estimated shipments imported (may include small amount of shipments to Canada). Shipments of aircraft to North America increase from 957 units in 2010 to 1,455 units in 2016 (CAGR 7.2 percent per year).

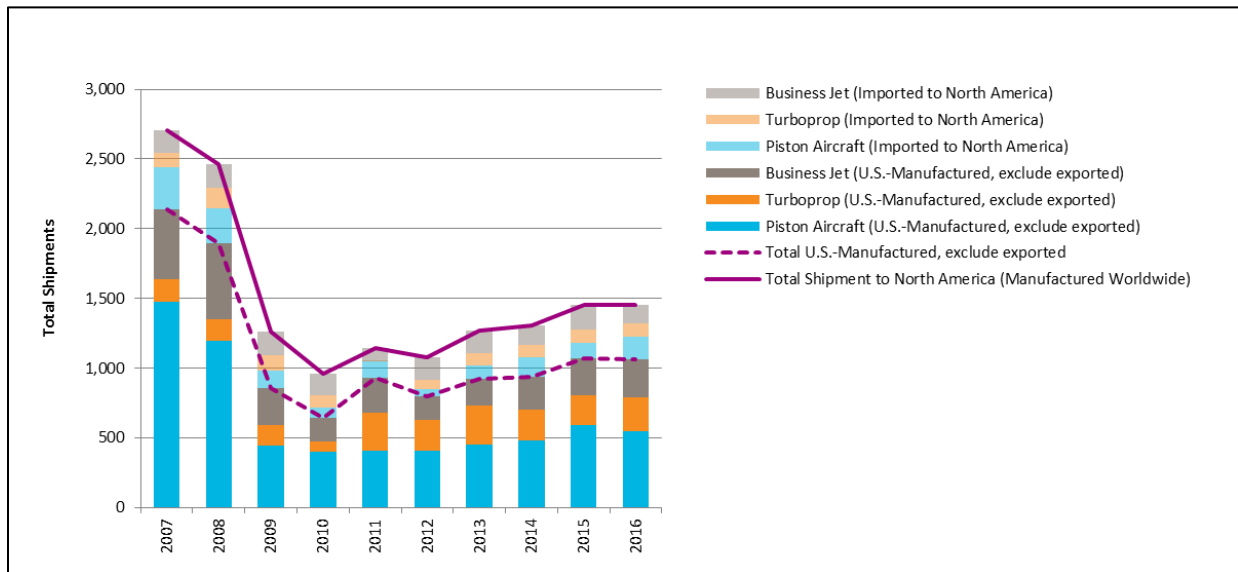


Figure 2-9. Domestic and Imported Shipments to North America by Type

Source: GAMA. AECOM Analysis.



Greenwood Lake Airport. AECOM July, 2017.

2.5 Economic Basis for General Aviation Demand

2.5.1 Statewide and Regional Economy

New Jersey and New York States have a productive economy. Their gross domestic product (GDP) in 2016 ranked at the eighth, and the third in the U.S., respectively. The two states experienced steady and modest growth in the recent five years after the economic downturn between late 2007 and mid-2009.

Figure 2-10 compares the real GDP growth rate of the combined New Jersey and New York area and the 8-county airport service area to the U.S. The GDP growth rates in the airport service area generally fell behind the national and statewide growth for most of the years in the last decade.

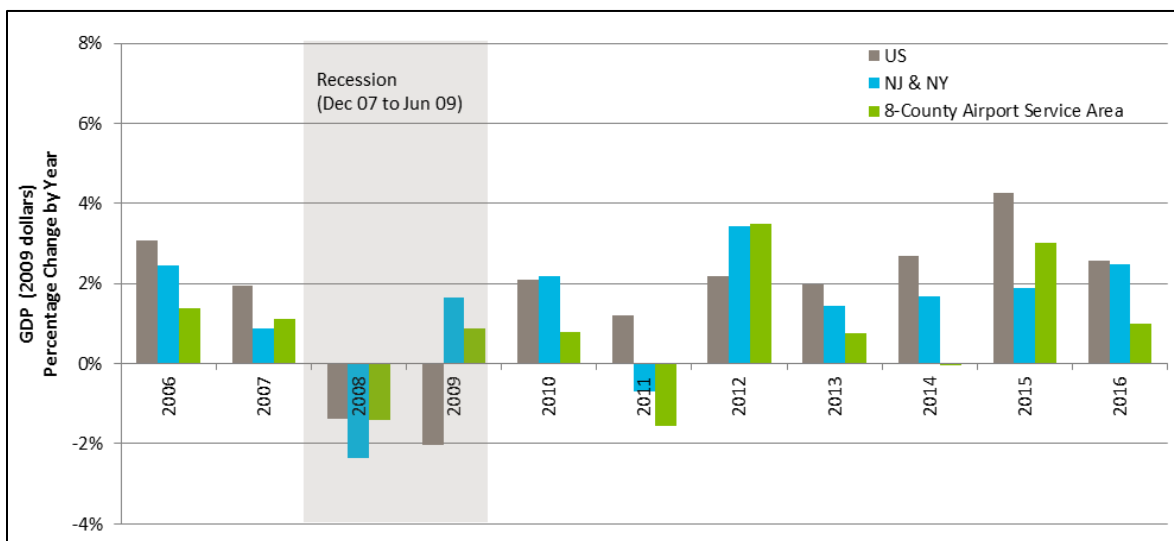


Figure 2-10. Real GDP Percentage Change by Year (U.S., NJ & NY, and 8-County Area)

Source: Woods & Pool Economics 2017 State Profile for New York and New Jersey. AECOM analysis

The per capita personal income growth rates in the 8-county airport service area also lagged behind the national and statewide averages for most of the years in the last decade as shown in **Figure 2-11**.

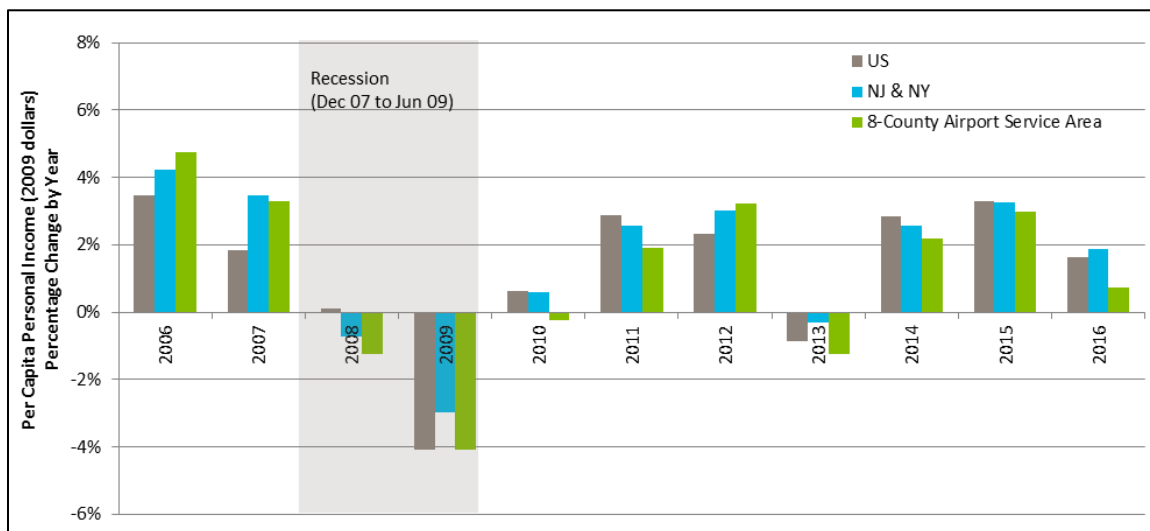


Figure 2-11. Per Capita Personal Income Percentage Change by Year (U.S., NJ & NY, and 8-County Area)

Source: Woods & Pool Economics 2017 State Profile for New York and New Jersey. AECOM analysis.

Figure 2-12 shows the historical growth rates of non-farm employment in the U.S., combined New Jersey and New York States, and the 8-county airport service area. It also indicates that recovery within the 8-county area is generally behind the national and statewide growth.

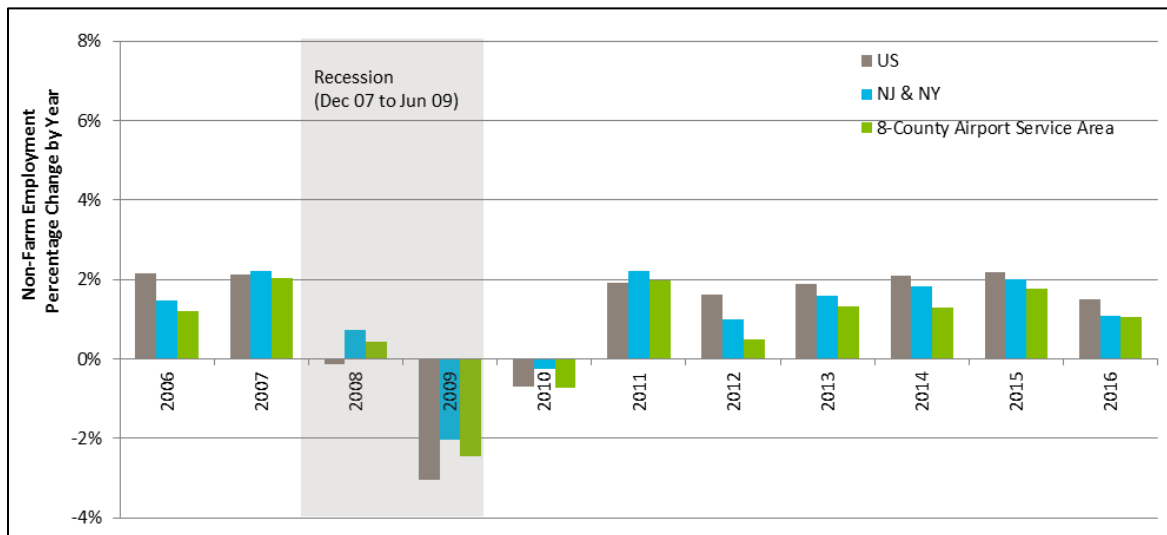


Figure 2-12. Non-Farm Employment Percentage Change by Year (U.S., NJ & NY, and 8-County Area)

Source: Woods & Pool Economics 2017 State Profile for New York and New Jersey. AECOM analysis.

The outlook in the region is forecast to have relative slow, steady growth over the next two decades and is expected to remain below the national average.⁴

Table 2-3 summarizes the historical and projected GDP, per capita income, and non-farm employment, in the U.S., combined New Jersey and New York States, and the 8-county airport service area from 2006 to 2036. The compound annual growth rates (CAGR) for the historical and forecast periods are also given in **Table 2-3**. Both historical and forecast growth rates for the 8-County area are more conservative than the statewide or national growth rates.

Table 2-3. GDP, Per Capita Income, and Non-Farm Employment for the U.S., combined New Jersey and New York States, and 8-County Area

Year	GDP (in millions of 2009 dollars)			Per Capita Personal Income (in 2009 dollars)			Total Non-farm Employment (thousands)		
	U.S.	NJ & NY	8-County	U.S.	NJ & NY	8-County	U.S.	NJ & NY	8-County
Historical									
2000	12,293,614	1,439,416	234,263	36,833	44,762	54,835	162,329	15,111	2,494
2005	14,106,895	1,589,600	260,835	38,916	46,250	57,336	169,902	15,592	2,594
2010	14,618,132	1,666,274	268,021	39,622	48,344	58,637	170,399	15,914	2,605
2015	16,501,908	1,798,330	283,306	43,924	53,928	64,098	187,553	17,335	2,788
Forecast									
2016	16,923,958	1,842,959	286,115	44,637	54,937	64,555	190,368	17,523	2,817
2021	18,825,583	2,030,165	309,750	48,082	59,360	69,686	204,280	18,501	2,968
2026	20,850,396	2,227,960	334,444	51,660	64,038	75,041	218,348	19,502	3,121

⁴ Woods & Pool Economics 2017 State Profile for New York and New Jersey.

Year	GDP (in millions of 2009 dollars)			Per Capita Personal Income (in 2009 dollars)			Total Non-farm Employment (thousands)		
	U.S.	NJ & NY	8-County	U.S.	NJ & NY	8-County	U.S.	NJ & NY	8-County
2036	25,183,071	2,639,497	383,554	58,005	72,526	84,997	245,434	21,351	3,397
Historical CAGR									
2000-2015 (15-Year)	1.98%	1.50%	1.28%	1.18%	1.25%	1.05%	0.97%	0.92%	0.75%
2005-2015 (10-Year)	1.58%	1.24%	0.83%	1.22%	1.55%	1.12%	0.99%	1.07%	0.72%
2010-2015 (5-Year)	2.45%	1.54%	1.12%	2.08%	2.21%	1.80%	1.94%	1.73%	1.37%
Forecast CAGR									
2016-2021 (5-Year)	2.15%	1.95%	1.60%	1.50%	1.56%	1.54%	1.42%	1.09%	1.05%
2016-2026 (10-Year)	2.11%	1.92%	1.57%	1.47%	1.54%	1.52%	1.38%	1.08%	1.03%
2016-2036 (20-Year)	2.01%	1.81%	1.48%	1.32%	1.40%	1.38%	1.28%	0.99%	0.94%

Source: Woods & Poole Economics 2017 State Profile for New York and New Jersey. AECOM analysis.

Note: CAGR – Compound annual growth rate.

In summary, the economic outlook for the area surrounding 4N1 is conservative. The regional economy is growing slower than the nation. The projected socio-economic characteristics in the 8-county area are considered in the GA demand forecast model presented in the subsequent section.



Fuel Trucks at Greenwood Lake Airport. AECOM May, 2017.

2.6 Fuel Price

Fluctuations and overall trends in the cost of aviation fuel is an important factor affecting the aviation industry since it directly impacts the operating expenses and thus the demand. Fuel prices are particularly sensitive to worldwide economic uncertainty and political instability. Beginning in 2003, fuel prices increased as a result of the Iraq War, political instability in some oil-producing countries, the rapidly growing economies of China, India, and other developing countries, and others. By mid-2008, crude oil prices and average fuel prices were more than three times higher than they were in 2003. In the second half of 2008 when the recession was approaching its peak, fuel demand decreased worldwide and prices followed. During the initial recovery stage in 2009, prices began to get back to a relatively steady cost between \$100 and \$120 per barrel of crude oil as depicted in **Figure 2-13**. However, as demand slowed, domestic supplies increased, and alternative energy sources became more available, crude oil price dropped to below \$50 per barrel in January 2015, hit \$30 per barrel in January 2016, and stayed around \$44 per barrel in 2016. Kerosene-type jet fuel prices have also dropped since late 2014 and followed the crude oil price trend as shown in **Figure 2-13**. However, the aviation gasoline prices stayed at \$4.50 per gallon and above.⁵

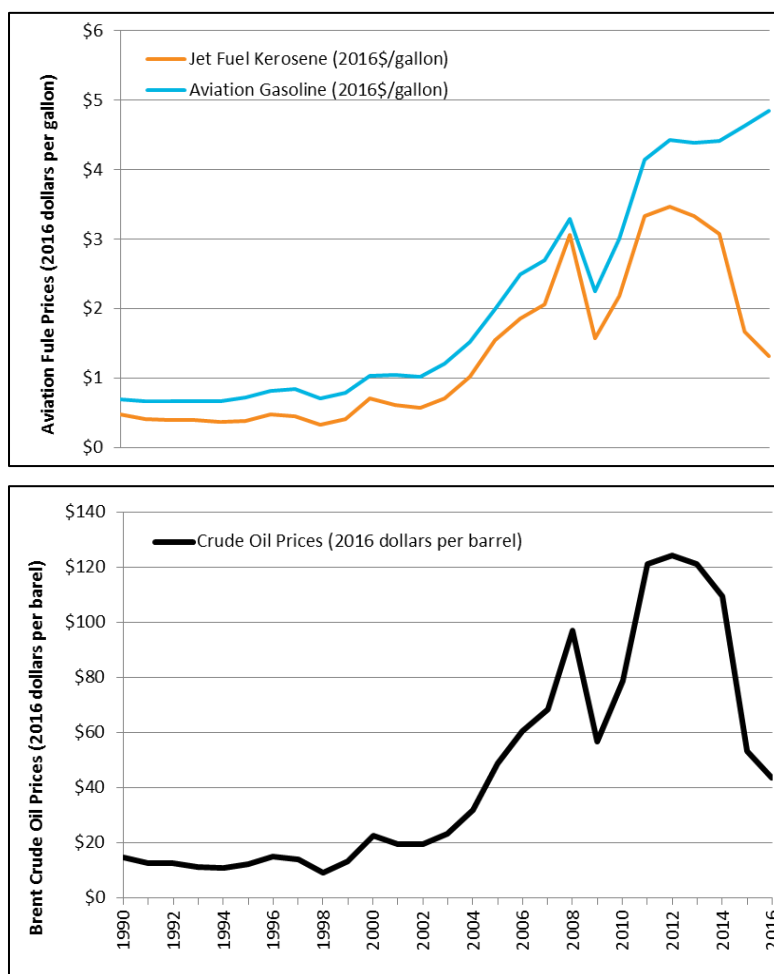


Figure 2-13. Historical Crude Oil and Aviation Fuel Prices (1990 to 2015)

Source: U.S. Energy Information Administration (USEIA). Bureau of Transportation Statistic.

⁵ Brent crude oil prices are based on the release dated July 26, 2017 from the U.S. Energy Information Administration (USEIA). Historical aviation gasoline and jet fuel prices are based on data from the Bureau of Transportation Statistics (BTS), the USEIA, and Globalair.com.

Aviation fuel sales by fixed base operators (FBOs) at general aviation airports are typically higher than the fuel prices to end users as reported by the U.S. Energy Information Administration (USEIA) or Bureau of Transportation Statistics (BTS) because of the handling and operating costs. The average fuel prices for 100LL aviation gasoline and Jet A fuel at 4N1 are summarized in **Table 2-4**. Although fuel prices at 4N1 are slightly higher than those shown in **Figure 2-13**, they generally followed the global trend when the price dropped in 2009 and then increased from 2009 to 2012/2013. Both Jet A and 100LL prices at 4N1 dropped after 2013, but the recent price in 2017 indicates a rise to above \$4.80 per gallons.

Table 2-4. Average Fuel Prices at 4N1 (Dollars/Gallon)

Year	100LL	Jet A
2007	\$4.12	N/A
2008	\$4.98	N/A
2009	\$3.88	N/A
2010	\$4.65	\$3.93
2011	\$5.32	\$5.75
2012	\$6.47	\$5.54
2013	\$6.35	\$5.58
2014	\$5.97	\$5.50
2015	\$4.95	\$5.02
2016	\$4.76	\$4.69
	100LL	Jet A
	Full Service	Self Service
Sep, 2017	\$5.39	\$4.99
		Full Service
		\$4.89

Source: Fuel Report from 2007 to 2016 provided by 4N1. 2017 fuel prices are from GlobalAir.com and AirNav.com, accessed September 3 & 12, 2017. AECOM analysis.

Note: N/A – Not available.

Analysts hold different views regarding how oil and aviation fuel prices may change in the future. Reference case forecasts project fuel prices out into the future based on current market conditions, exchange rates, technology advancement in oil extraction, and other possible factors which may affect the supply and demand of crude oil. In order to consider future uncertainties, organizations such as the USEIA develop both high and low oil price forecasts in addition to a reference case. **Table 2-5** summarizes the long-term projected annual growth rates of crude oil prices, aviation jet fuel, and gasoline fuel prices by the USEIA, including the reference as well as the high and low oil price cases. The FAA Aerospace Forecast FY2017-2037 projects jet fuel prices for air carriers will increase by 3.3 percent which falls within the projections by the USEIA's reference and low oil price cases as shown in **Table 2-5**.

Table 2-5. Forecast Annual Growth Rates for Fuel Prices

Authority (Period) Type of Product	Forecast CAGR		
	Low Oil Price Case	Reference Case	High Oil Price Case
USEIA (2016 to 2040) Brent Crude Oil	-0.03%	3.92%	7.12%
USEIA (2016 to 2040) Jet Fuel	-0.07%	3.47%	6.43%
USEIA (2016 to 2040) Gasoline	-0.42%	1.68%	1.68%
FAA Aerospace Forecast (2016 to 2037) Jet Fuel		3.3%	

Source: USEIA Annual Energy Outlook 2017. FAA Aerospace Forecast FY2017-2037. AECOM analysis.

2.7 Historical General Aviation Demand

2.7.1 Historical Industry Trends

Understanding of the past trends provides an insight on expectations of the future activity levels. General aviation activity grew to peak levels in the 70s, accompanied by high manufacture rates of new general aviation aircraft until it was set back by high fuel costs and concerns on liability issues with increasing insurance costs and aircraft accidents with aged aircraft at the end of the decade. General aviation activity levels slowly recovered during the 80s. However, during the early 90s, with the Gulf war and economic downturn, activity levels declined. The General Aviation Revitalization Act (GARA) was passed by Congress in 1994. The new legislation limited the liability of aircraft manufacturers to accidents involving their aircraft and aircraft parts to less than eighteen years after delivery. The enactment of GARA resulted in an increase in aircraft production. During the same period, an increase in fractional ownership programs, benefiting from co-ownership tax treatment, stimulated demand for general aviation aircraft. The next drop in general aviation activity during the early 2000s is most likely due to the burst of the dotcom bubble in 2001, and the September 11 attacks. General aviation activities continued to decline with the rising fuel prices until another economic downturn that began in December 2007. In the most recent two to three years, nationwide general aviation activity stabilized when fuel prices returned to those experienced during the early 2000s and the economy was recovering. Some airports in the U.S. have shown an increase in general aviation demand, especially in business aviation. General aviation aircraft shipments have grown since 2012, especially for high value aircraft. However, there are also general aviation airports with stagnant activities.

2.7.2 Based Aircraft in the 8-County Airport Service Area

Historical based aircraft records for the comparable airports within the 8-county airport service area were obtained from FAA Terminal Area Forecast (TAF) (January 2017), and Form 5010-1 Airport Master Record to investigate the regional demand in the area surrounding 4N1. The airports included in the study are given in **Table 2-6. Figure 2-14** summarizes the total number of based single engine aircraft, multi-engine aircraft, and helicopter in these eight airports.⁶ The based aircraft demands in the area declined from over 1,400 aircraft in 2000 to below 700 aircraft in 2016.

Table 2-6. Airports in the 8-County Airport Service Area

Airport	LOCID	Role	Category	County, State	Remarks
Greenwood Lake Airport	4N1	Local	GA	Passaic County, NJ	
Sussex Airport	FWN	Unclassified	Reliever	Sussex County, NJ	Most competitive against 4N1
Lincoln Park Airport	N07	Regional	Reliever	Morris County, NJ	
Teterboro Airport	TEB	National	Reliever	Bergen County, NJ	Attract higher performance aircraft
Morristown Municipal Airport	MMU	National	Non primary	Morris County, NJ	
Essex County Airport	CDW	Regional	Reliever	Essex, NJ	
Warwick Municipal Airport	N72	Local	GA	Orange County, NY	
Randall Airport	06N	Unclassified	Reliever	Orange County, NY	

Source: FAA NPIAS, 2021-2025. Definition of roles and categories refer to NPIAS.

⁶ Based jet aircraft and other aircraft such as ultralight aircraft and gliders are excluded in the total number of based aircraft to match with the characteristics of 4N1. 06N has a high numbers of based ultralight aircraft (4) and gliders (19) while other seven airports have none, except one at 4N1. Jet aircraft are based mostly at TEB and MMU in addition to a few at CDW only. It is anticipated that the future based aircraft growth will follow similar type of aircraft composition as existing conditions.

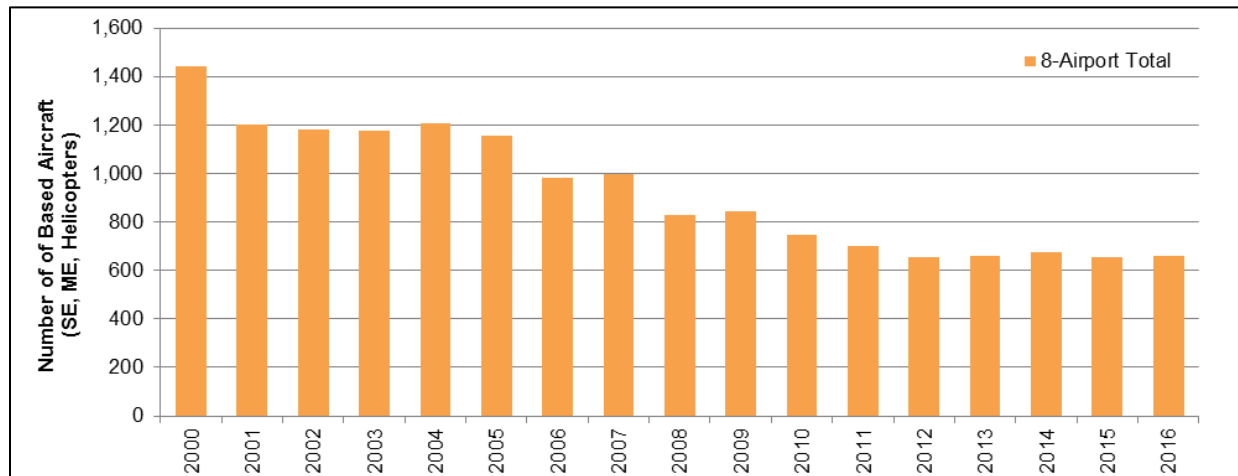


Figure 2-14. Total Number of Based Aircraft in the 8-County Airport Service Area

Source: FAA TAF (January 2017). Note: SE – Single engine aircraft, ME – Multi-engine aircraft.

2.7.3 Based Aircraft at 4N1

Historical based aircraft records at 4N1 were collected from multiple sources, including:

- Airport's Rental Records, December 2012 to December 2016.
- FAA Form 5010-1 Airport Master Record, 12-month period ending March 29, 2010.
- New Jersey State Airport System Plan (NJSASP), 2007.
- Greenwood Lake Airport, Facility Requirement Report, Final Report, 1997.
- FAA TAF, January 2017.

Figure 2-15 illustrates the historic trend for the based aircraft counts at 4N1 from the above sources. Since the Airport's Rental Records provide the most recent and detailed information on the based aircraft by type, and the records are consistent with the based aircraft information in Form 5010-1, these two data records are considered to be the actual historical based aircraft numbers at 4N1 from 2010 to 2016. **Table 2-7** summarizes the existing based aircraft by type at 4N1 based on the Airport's Rental Records and the Form 5010-1 record.

In summary, the total number of based aircraft at 4N1 declined from 62 aircraft in 2010 to 46 aircraft in 2016. Most of the based aircraft are single engine piston aircraft, which dropped from 56 aircraft to 41 aircraft. Multi-engine piston aircraft dropped from 4 aircraft to 3 aircraft.

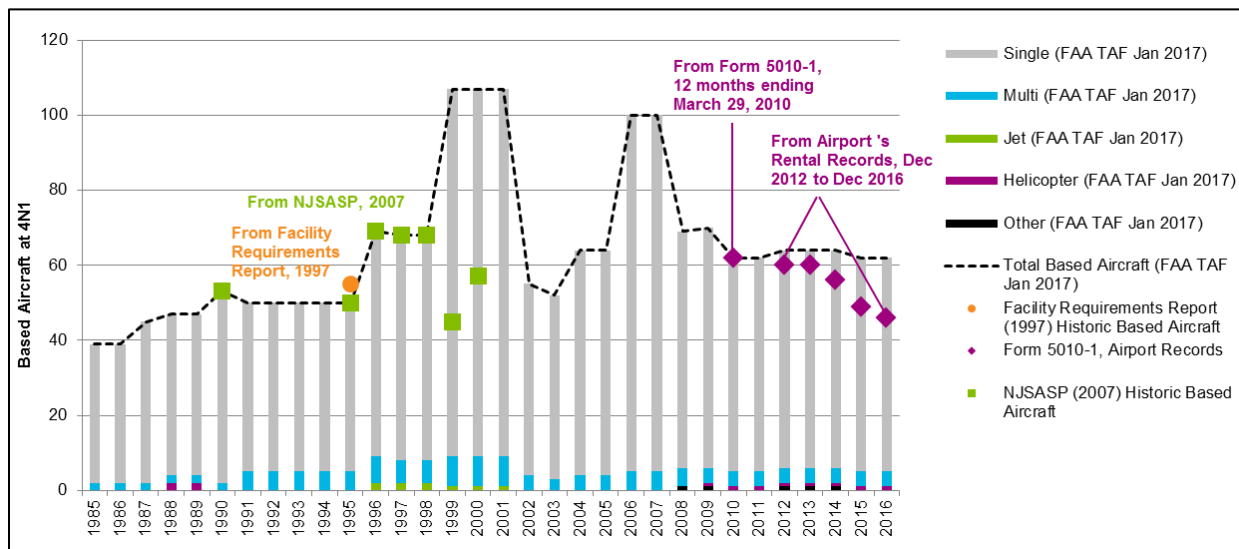


Figure 2-15. Percentage Share of Based Aircraft in the 8-County Airport Service Area

Source: FAA TAF (January 2017). NJSASP 2007. 4N1 Facility Requirement Report 1997. FAA Form 5010-1. Airport's Rental Records 2012 to 2016.

Table 2-7. Historical Based Aircraft by Type from the Airport's Rental Records and FAA Form 5010-1 Airport Master Record

Year	Single Engine	Multi-Engine	Jet	Helicopter	Other	Total
2010	56	4	0	1	1	62
2011*	55	4	0	1	1	61
2012	54	4	0	2	1	60
2013	55	3	0	2	0	60
2014	50	5	0	1	0	56
2015	44	3	0	1	1	49
2016	41	3	0	1	1	46
CAGR						
2010 to 2016	-5.06%	-4.68%	N/A	0.00%	0.00%	-4.85%

Source: Based aircraft counts are from the FAA Form 5010-1 Airport Master Record and Rental Records provided by the Airport. One helicopter is added in the counts from the Airport Rental Records for the helicopter from Hackensack University Medical Center's (UMC) AirMed 1. AECOM analysis.

Note: N/A - not available. CAGR - Compound annual growth rate. * 2011 records are estimated from 2010 and 2012 records.

Although the based aircraft numbers at 4N1 dropped in recent years, the market share of based aircraft in the airport service region was generally steady and maintained between 7 percent and 10 percent in the past decade. **Figure 2-16** presents the estimated percentage share of based aircraft at each of the eight airports over the total counts in the airport service area.

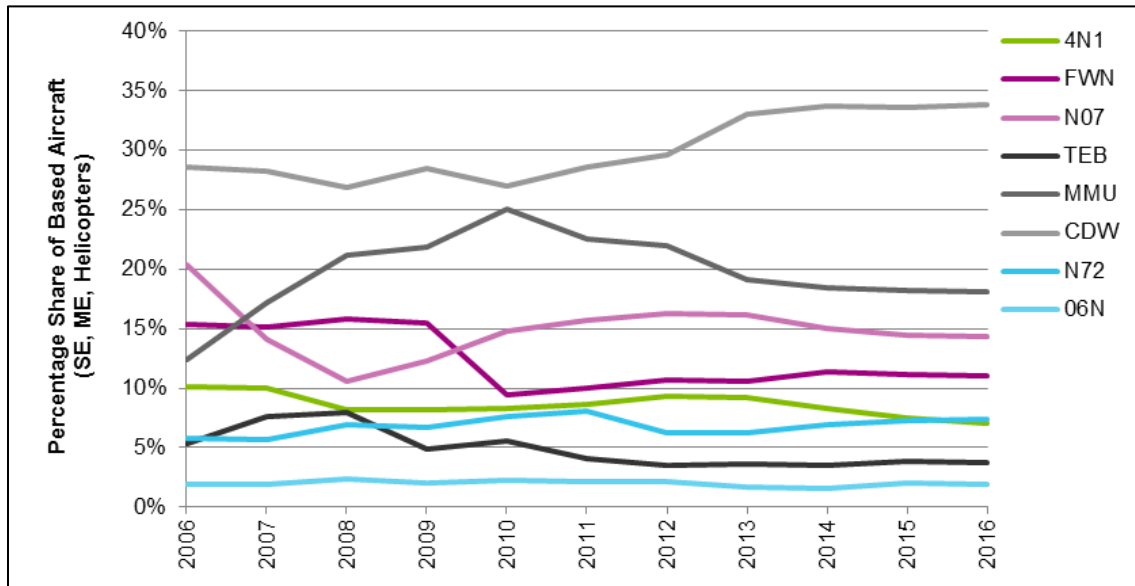


Figure 2-16. Percentage Share of Based Aircraft in the 8-County Airport Service Area

Source: FAA TAF (January 2017). FAA Form 5010-1 Airport Master Record and Rental Records provided by the Airport.

2.8 General Aviation Operations

Historical GA operations were collected from the following sources:

- Airport's Invisible Intelligence Data, February 2016 to July 2017.
- FAA Form 5010-1 Airport Master Record, 12-month period ending March 29, 2010.
- New Jersey State Airport System Plan (NJSASP), 2007.
- Greenwood Lake Airport, Facility Requirement Report, Final Report, 1997.
- FAA TAF, January 2017.

Figure 2-15 illustrates the historic trend for the GA annual operations at 4N1 from the above sources. It is noted that the Airport's Invisible Intelligence data only provides counts since February 2016 and the data show some inconsistencies between months. There may be some missing counts from Invisible Intelligence and this may underestimate the actual activity levels at the airport. The Invisible Intelligence Data are summarized in **Appendix B** for reference. The annual GA operations from FAA TAF (January 2017), which are consistent with the FAA Form 5010-1 record, are adopted as the existing activity levels at 4N1. **Table 2-8** summarizes the historical annual operations at 4N1.

In summary, the total annual GA operations at 4N1 declined from over 32,000 operations in 2000 to approximately 18,000 operations in 2016. The decline in itinerant GA operations is greater than the local GA operations. The decline in 2009 and 2010 are the potential impacts of the recession lasting from December 2007 to June 2009. The economic recovery in the area surrounding 4N1 is relatedly slow as compared to the nation. Nevertheless, GA activity levels are generally steady in the most recent five years.

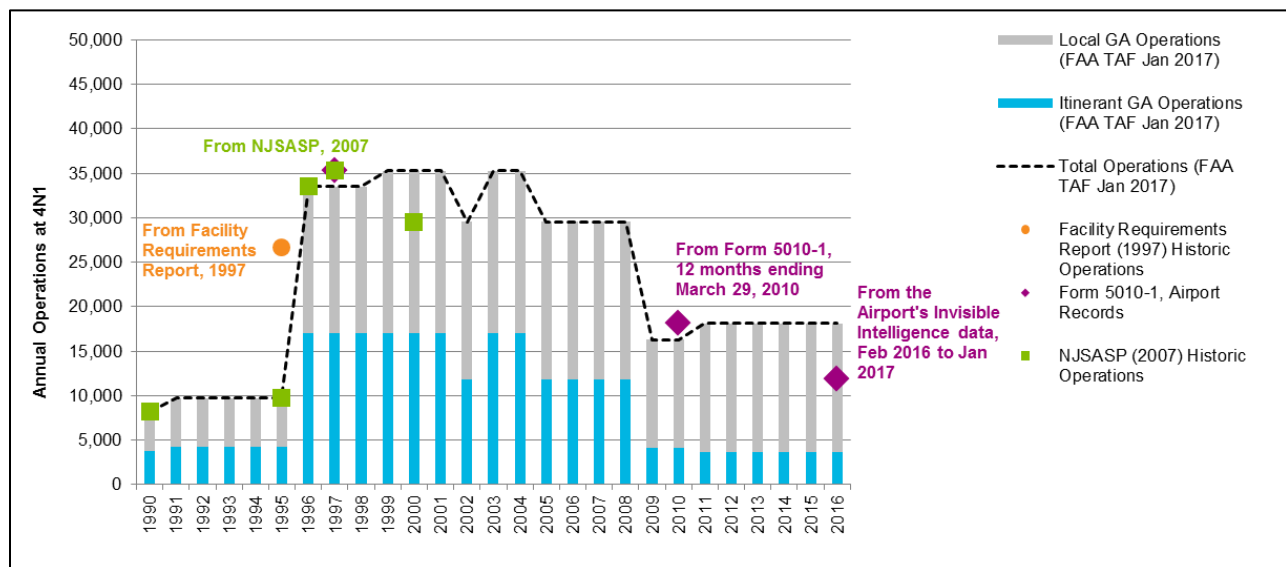


Figure 2-17. Historical General Aviation Operations at 4N1

Source: FAA TAF (January 2017). NJSASP 2007. 4N1 Facility Requirement Report 1997. FAA Form 5010-1. Airport's Invisible Intelligence Data Feb 2016 to Jan 2017.

Table 2-8. Historical General Aviation Operations at 4N1

Year	Itinerant General Aviation	Local General Aviation	Total
2000	17,000	18,244	35,244
2001	17,000	18,244	35,244
2002	11,809	17,714	29,523
2003	17,000	18,244	35,244
2004	17,000	18,244	35,244
2005	11,809	17,714	29,523
2006	11,809	17,714	29,523
2007	11,809	17,714	29,523
2008	11,809	17,714	29,523
2009	4,067	12,202	16,269
2010	4,067	12,202	16,269
2011	3,620	14,479	18,099
2012	3,620	14,479	18,099
2013	3,620	14,479	18,099
2014	3,620	14,479	18,099
2015	3,620	14,479	18,099
2016*	3,620	14,479	18,099
CAGR			
2000-2016	-9.21%	-1.43%	-4.08%
2010-2016	-1.92%	2.89%	1.79%

Source: FAA TAF (January 2017).

Note: * 2016 annual operations are estimated under FAA TAF (January 2017).

2.9 Existing General Aviation Communities at 4N1

The existing characteristics of the GA communities and stakeholders at the airport provide relevant information for the aviation demand forecast analysis. This section summarizes the key findings.

The general aviation activities at the Airport are supported by the fixed base operator (FBO), Northeast Aero Services, who also owns the flight school, Sky Training. The services available at 4N1 include aircraft ground handling, aviation fuel (self-service 100LL, full service 100LL, and Jet A), aircraft parking (ramp or tie-downs), hangar facilities, passenger terminal and lounge, aircraft maintenance, flight training, aircraft rental, rental cars, and car parking, etc.

The flight school, Sky Training, has three single-engine aircraft based at 4N1. Flight training generates a portion of aviation activities at the airport. Flight training used to account for a large proportion of the general aviation operations at smaller airports like 4N1 because it involves a large number of takeoffs and landings. With the decline in the number of active pilots since the 80's, this segment of general aviation activity has become a smaller proportion of overall activity.

Hackensack University Medical Center's (UMC) AirMed 1 has offices located in 4N1. They have a helicopter, EC-135, stationed on the main ramp adjacent to the hangar. Air medical activities contribute to a portion of the aviation demands at 4N1.

Haverfield Aviation is the provider of aerial power line inspection and construction support services. Its corporate headquarters is located in Gettysburg, Pennsylvania, and they used to have an operational base at 4N1⁷. Its aviation activities at 4N1 have declined since 2015 after terminating their lease at 4N1.

With reference to the fuel sales record in 2016, there is a new user, Downstown Aero, flying for aerial work at 4N1. Downstown Aero provides services such as crop spraying, aerial firefighting (SEATs), mosquito spraying, gypsy moth spraying, aerial land restoration/reforestation, seeding, oil spill control, aerial surveys, etc.

Other than showing newcomers at the airport, historic fuel sales also indicate the relative activity levels of the GA community. **Figure 2-18** summarizes the percentage share of fuel sales by customers in 2016. It shows Hackensack UMC and the flight school consumed most of the fuel at the airport in 2016, hence they are probably the most active stakeholders at the airport. **Figure 2-19** shows the changes of fuel sales by customers in the recent four years (2013 to 2016). It shows increases in activities from the Greenwood Lake Air Show and Downstown Aero, and decreases from Haverfield Aviation, and the flight school.

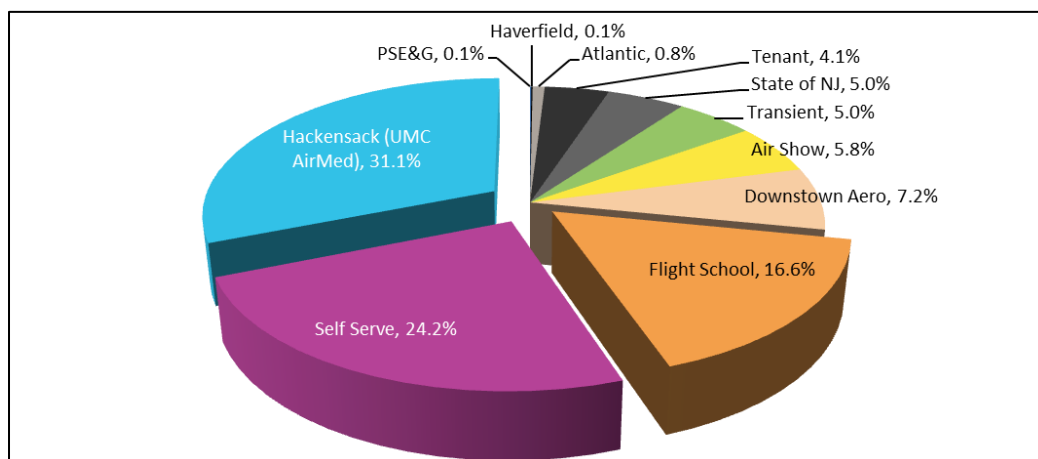


Figure 2-18. Percentage Share of Fuel Sales (by Dollars) at 4N1 in 2016

Source: Fuel Report from 2007 to 2016 provided by 4N1. AECOM analysis.

⁷ Airport's Rental Records indicate Haverfield Aviation was a tenant from December 2013 to March 2014.

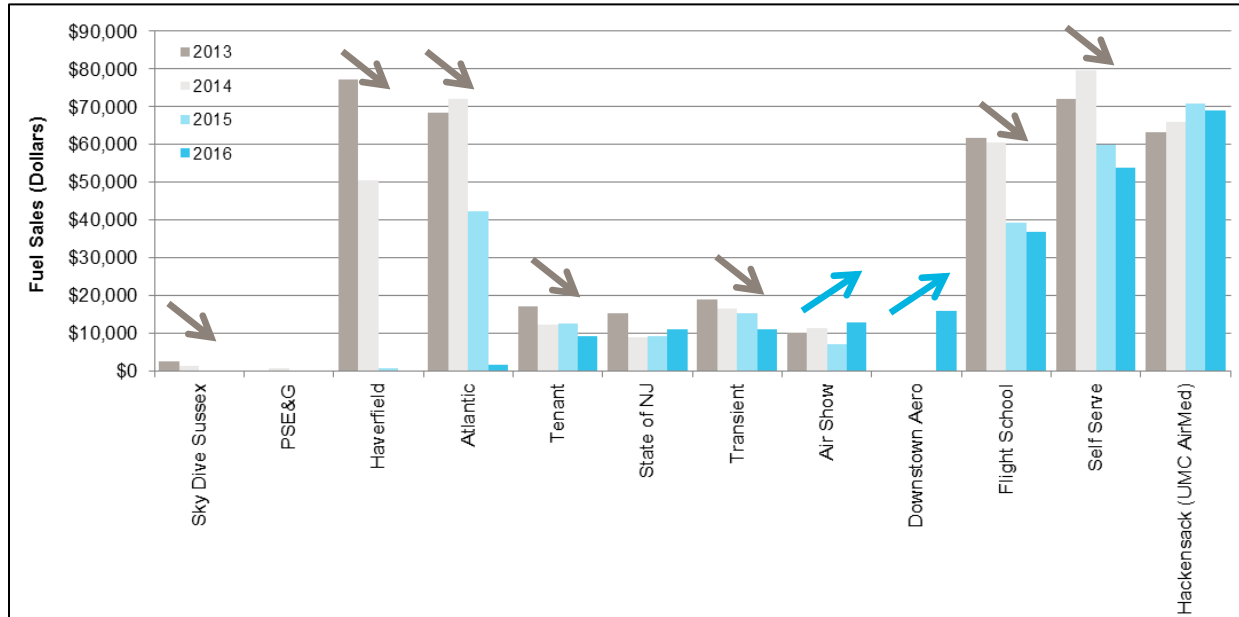


Figure 2-19. Fuel Sales (by Dollars) by Customers at 4N1 from 2013 to 2016

Source: Fuel Report from 2007 to 2016 provided by 4N1. AECOM analysis.

The Greenwood Lake Air Show is an annual event hosted at 4N1 in summer since 2013. It typically lasts over one weekend from Friday to Sunday. The event attracts visiting aircraft and revitalizes the general aviation community.

The based aircraft owners at 4N1 are mostly individuals. Less than half of the based aircraft are owned by a corporation or partnership. **Figure 2-20** shows the percentage split of different ownership at 4N1 in 2016. In addition to the fact that Greenwood Lake is a vacation destination, flying to 4N1 for personal and recreational activities is anticipated to be more than flying for business and corporation purposes. There may be some growth momentum driven by the business and corporate activities following the nationwide growing trend. However, because there are no based turboprop or jet aircraft, and no air taxi operations (on-demand flight activity operated under FAR Part 135) recorded at 4N1, the potential growth is anticipated to be less than national averages.

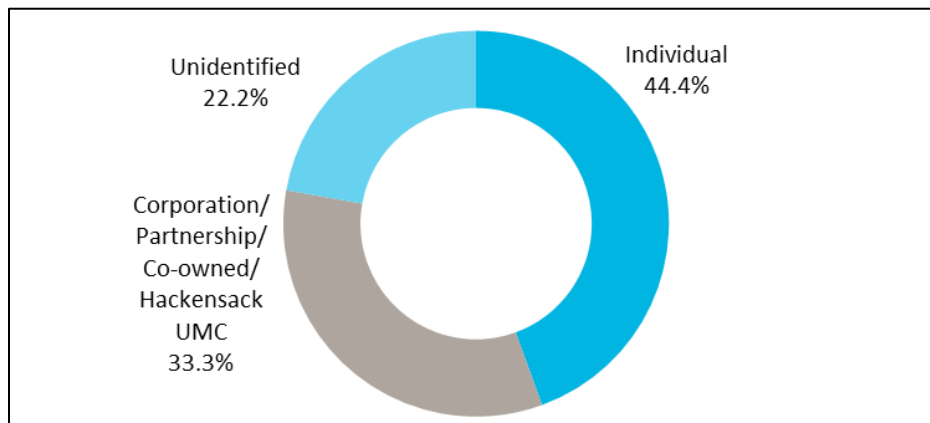


Figure 2-20. Ownership of Based Aircraft at 4N1 in 2016

Source: N-numbers from Airport's Rental Records. AECOM analysis.

2.10 General Aviation Demand Forecasts

2.10.1 Based Aircraft

2.10.1.1 Forecasting Methodology

The forecasts for based aircraft at 4N1 include both top-down and bottom-up approaches:

- The top-down approach estimates the total regional demand for based aircraft in the airport service area based on historic activities, fuel prices, pilot populations, socio-economic factors, and the projections from FAA TAF. The future based aircraft fleet is then allocated to 4N1 based on the historic share of based aircraft at 4N1.
- The bottom-up approach projects the based aircraft at 4N1 by type based on growth rates predicted nationally by FAA and GAMA, and regionally by NJSASP.

The results of both approaches are compared and consolidated into a recommended baseline scenario, a high case scenario, and a low case scenario. Findings are then compared with the FAA TAF based aircraft forecasts for 4N1.

2.10.1.2 Based Aircraft Projections for the Airport Service Area

The future regional demand for based aircraft in the airport service area is estimated by regression analysis that related aviation demand (dependent variables), such as based aircraft numbers, to key parameters (independent variables) such as fuel prices, income, population, and employment. Correlations between historic based aircraft numbers and socioeconomic data are analyzed to find the highest relationship between the dependent and independent variables. The forecast of future based aircraft in the area is then derived from the regression model incorporating forecast socioeconomic data to 2036.

Multiple regression analyses on historic data in the last decade from 2006 to 2016 demonstrated a strong correlation of regional based aircraft numbers to aviation gasoline price, statewide private pilot population, and local socioeconomic factors in the 8-county area, including GDP, per capita personal income, and non-farm employment. The coefficient of determination (R^2) is 0.94 which signifies a high percentage of variation in the dependent variables that are explained by the independent variables.

The projected range of future based aircraft numbers in the airport service area are estimated as described below:

- Regional demand model: Based on the forecast economic growth represented by GDP, per capita personal income, non-farm employment in the area⁸, fuel prices projected by the USEIA Annual Energy Outlook 2017, and a modest growth on pilot population (0.5 percent).
- FAA TAF model: Adopted the total based single engine aircraft, multi-engine aircraft, and based helicopter forecasts from FAA TAF (January 2017) at the eight airports within the airport service region.

Figure 2-21 presents the projected range of future based aircraft numbers in the airport service area, including the results of the regression model, and correlation with the historic records. It is estimated that the number of based aircraft in the airport service area will be between 444 and 753 aircraft by 2036.

Supplementary information on the regression model is provided in **Appendix C**.

⁸ Woods & Poole Economics 2017 State Profile for New York and New Jersey. AECOM analysis for the 8-county area.

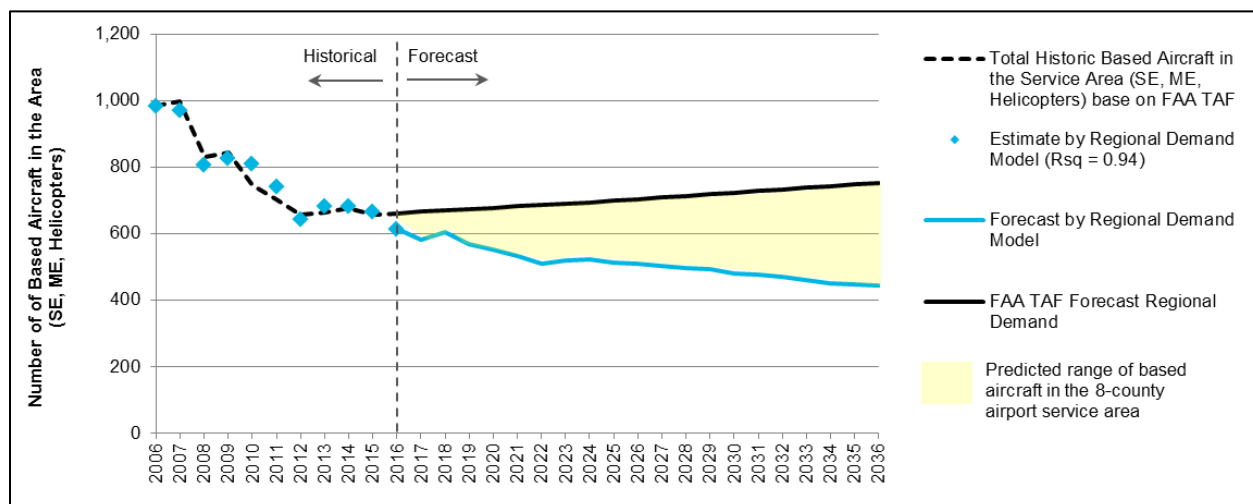


Figure 2-21. Forecast Based Aircraft in Airport Service Area

2.10.1.3 Based Aircraft Projections for 4N1

Top Down Approach

The forecast based aircraft demands at 4N1 are obtained by distributing the total demand of the airport service region as shown in **Figure 2-21** based on historical share. The range of market share at 4N1 was between 7 and 10 percent in the last decade. Assuming 4N1 will maintain its existing competitiveness with other airports in the airport service region, an 8.5 percent share is assumed for the distribution of regional demand to 4N1 over the 20-year planning horizon. Two cases are developed for the top down approach:

- Case 1 assumes average historical market share at 4N1 with the regional demand projected from the regression model.
- Case 2 assumes average historical market share at 4N1 with the regional demand projected by FAA TAF (January 2017).

Bottom Up Approach

Table 2-9 summarizes the projected CAGR for different types of aircraft by FAA Aerospace Forecast 2017-2037, GAMA 2017 Industry Outlook, FAA TAF for 4N1, and NJSASP 2007. The forecast based aircraft demands at 4N1 are estimated by adopting the growth rates assumed in the two cases below to the existing based aircraft numbers in 2016:

- Case 3 (Low Growth Case) assumes fixed wing piston aircraft will shrink over the forecast period following the national trend predicted by the FAA Aerospace Forecast. The proposed annual growth rates are given in **Table 2-9**.
- Case 4 (High Growth Case) assumes fixed wing piston aircraft will reach the growth rates estimated by NJSASP by 2020 and continues with similar growth rates to 2036. It represents an optimistic scenario at 4N1. The proposed annual growth rates are given in **Table 2-9**.

The outcomes of the four cases from both the top down and bottom up approaches are depicted in **Figure 2-22**.

Table 2-9. Projected Based Aircraft Growth Rate by Type

Source	Fixed Wing Piston			Helicopter		Total	Total Based Aircraft
	Single Engine	Multi-Engine	Total	Piston	Turbine		
Historic CAGR (2010 to 2015)							
FAA Aerospace Forecast 2017-2037	-1.73%	-3.57%	-1.91%	-1.74%	2.80%	0.79%	-1.22%
GAMA 2017 Industry Outlook	N/A	N/A	--1.91%	-1.74%	2.08%	0.79%	-1.22%
NJSASP Forecast for 4N1	1.60%	1.55%	1.60%	N/A	N/A	N/A	1.55%
Forecast CAGR (2010 to 2020)							
NJSASP Forecast for 4N1	1.60%	1.55%	1.60%	N/A	N/A	N/A	1.55%
Forecast CAGR (2015 to 2025)							
FAA Aerospace Forecast 2017-2037	-0.85%	-0.33%	-0.80%	1.30%	1.79%	1.64%	-0.01%
GAMA 2017 Industry Outlook	N/A	N/A	-0.93%	2.22%	-0.95%	0.21%	-0.30%
FAA TAF For 4N1	0.00%	N/A*	N/A	N/A	N/A	0.00%	0.00%
Bottom Up Approach Assumed CAGR (2016 to 2036)							
Case 3 (Low Growth Case)	-0.85%	-0.33%	-0.80%	N/A	N/A	0.00%	-0.77%
Case 4 (High Growth Case)	1.60%	1.55%	1.60%	N/A	N/A	0.00%	1.53%

Note: * FAA TAF and historic Form 5010-1 for SNA report multi-engine aircraft only, which include multi-engine propeller-driven aircraft either reciprocal engine or turboprop.

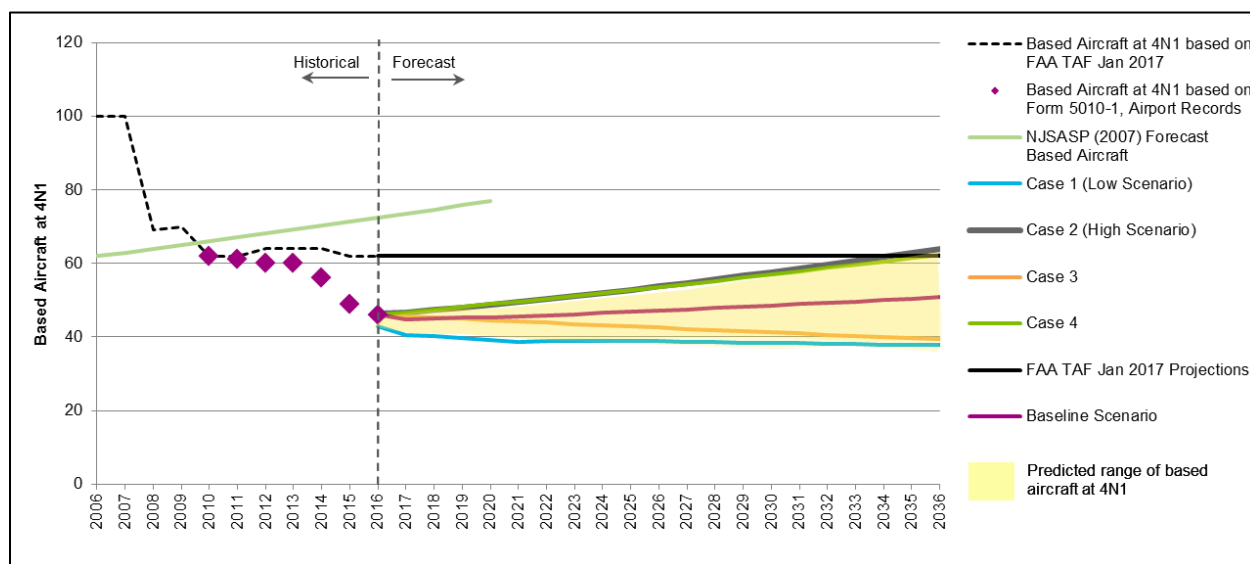


Figure 2-22. Forecast Based Aircraft Demands at 4N1

By comparing the outcome of the four cases as shown in **Figure 2-22**, it is estimated that forecast based aircraft at 4N1 will range from the lower bound of approximately 38 units to the upper bound of 64 units by

2036. The recommended baseline moderate growth scenario will be the mean of four cases with approximately 51 based aircraft by 2036.

Table 2-10 summarizes the baseline, low, and high scenarios for forecast based aircraft by type.

The baseline forecast based aircraft demands are lower than the FAA TAF (January 2017) projections by -25.8 percent in 5-year (i.e. exceed 10 percent), and -24.2 percent in 10-year (i.e. exceed 15 percent). It is mainly due to the discrepancy on the existing numbers of based aircraft in the base year 2016. The airport rental record indicates there are 46 based aircraft at 4N1, but the FAA TAF estimated 62 based aircraft in 2016. The difference in the base year 2016 is -25.8 percent already. If the FAA TAF updates their model with the actual numbers of based aircraft at 4N1 in 2016 to 46 units, the difference between the forecast baseline scenario and FAA TAF projections will be within 10 percent in 5-year and within 15 percent in the 10-year planning horizon.

Table 2-10. SNA Forecast Based Aircraft by Type

Year	Single Engine	Multi-Engine	Helicopter	Other	Total Based Aircraft	Percentage difference from FAA TAF
2016	41	3	1	1	46	-25.8%
Baseline Scenario						
2021	41	3	1	1	46	-25.8%
2026	42	3	1	1	47	-24.2%
2036	46	3	1	1	51	-17.7%
Low Scenario						
2021	35	2	1	1	39	-37.1%
2026	35	2	1	1	39	-37.1%
2036	34	2	1	1	38	-38.7%
High Scenario						
2021	45	3	1	1	50	-19.4%
2026	48	4	1	1	54	-12.9%
2036	57	4	2	1	64	3.2%
FAA TAF (January 2017)						
2016 Estimate	57	4	1	0	62	
2021	57	4	1	0	62	
2026	57	4	1	0	62	
2036	57	4	1	0	62	

Note: Numbers may not add up due to rounding.

2.11 General Aviation Operations

The forecast for general aviation operations at 4N1 is based on the estimated number of operations per based aircraft by type of aircraft, ownership, and usage. The assumptions in the model are listed below.

- The average number of hours flown and number of landings by different types of active aircraft for different usage reference the FAA General Aviation Activity Survey 2015 and are adjusted to the characteristics of 4N1. It is generally assumed that based aircraft owned by individuals tend to fly mostly for personal use while corporation owned aircraft are used mostly for business, flight

instruction, and sightseeing. The activity levels for based aircraft that are co-owned or owned by partnership or government are higher than those owned by individuals. **Table 2-11** summarizes the estimated average number of landings per based aircraft assumed in the model.

- The FAA Aerospace Forecast 2017 to 2037 projects that the total general aviation hours flown by single engine and multi engine piston aircraft will decrease at -0.9 percent and -0.1 percent per annum, respectively. Since the decline in hours flown is minimal and it will be further reduced when hours flown are converted to average landings per aircraft, our model assumes the activity levels per based aircraft are similar to the existing level given in **Table 2-11**.

Table 2-11. Estimated Average Annual Landings per Based Aircraft

Type of Aircraft / Ownership	Average Landings per Aircraft
General Aviation Use	
Single Engine Piston	
Individual	140
Corporation	190
Co-Owned	190
Partnership	190
Multi Engine Piston	160
Rotorcraft Piston	190
Other (Lighter-than-air)	50

Source: FAA General Aviation Activity Survey 2015. AECOM Analysis.

- The model assumes 90 percent of the total operations flown by a based general aviation aircraft in each year are local operations.⁹ For the remaining 10 percent itinerant operations, approximately 40 percent of them are either departures or arrivals at 4N1.
- The proportion between transient and based aircraft operations is estimated to be approximately 25 to 75 percent. Approximately 40 percent of the transient operations at 4N1 are local operations and the remaining 60 percent are itinerant operations. This assumption takes into account the visiting aircraft for the Air Show which generates some local operations other than itinerant operations.
- With the above assumptions, the model maintains an overall 80 percent local GA operations, and 20 percent itinerant GA operations, which is consistent with the existing characteristics at 4N1.

Forecast annual general aviation operations for the baseline, low, and high scenarios are given in **Figure 2-23**. **Table 2-12** summarizes the corresponding share of local and itinerant general aviation operations. Comparison with FAA TAF is given in both **Figure 2-23** and **Table 2-12**. The forecast annual operations at 4N1 are similar to the FAA TAF projections in the five-year forecast period (i.e. within 10 percent difference), and 2.1 percent higher in the ten-year forecast period (i.e. within 15 percent difference).

⁹ Local operations mean operations performed by aircraft which operate in the local traffic pattern or within the sight of the airport; are known to be departing for, or arriving from flight in local practice areas located within a 20-mile radius of the airport; or execute simulated instrument approaches or low passes at the airport. Airport operations other than local operations are itinerant operations.

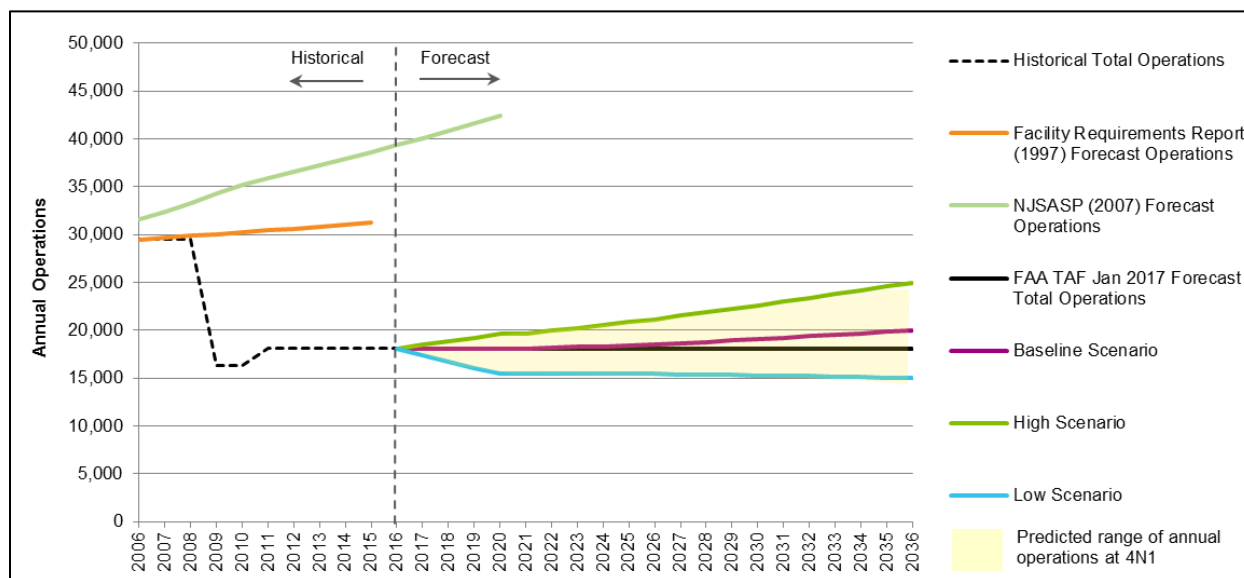


Figure 2-23. Forecast Total General Aviation and Air Taxi Operations

Table 2-12. Forecast General Aviation Operations

Year	Itinerant GA	Local GA	Total GA	Percentage difference from FAA TAF
2016	3,620	14,479	18,099	0.0%
Baseline Scenario				
2021	3,600	14,500	18,100	0.0%
2026	3,700	14,800	18,500	2.1%
2036	4,000	16,000	20,000	10.6%
Low Scenario				
2021	3,100	12,300	15,400	-14.8%
2026	3,100	12,300	15,400	-14.8%
2036	3,100	12,000	15,100	-16.9%
High Scenario				
2021	3,900	15,700	19,600	8.5%
2026	4,200	17,000	21,200	16.9%
2036	4,900	20,100	25,000	38.0%
FAA TAF				
2016 Estimate	3,620	14,479	18,099	
2021	3,620	14,479	18,099	
2026	3,620	14,479	18,099	
2036	3,620	14,479	18,099	

Note: Numbers may not add up due to rounding.

2.12 Critical Aircraft

FAA Advisory Circular (AC) No. 150/5000-17, Critical Aircraft and Regular Use Determination, provides guidance on the determination of critical aircraft (also known as design aircraft) in the conduct of facility planning studies. It defines critical aircraft as the most demanding aircraft type, or group of aircraft with similar characteristics, that make regular use of the airport. Regular use is 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations.

FAA AC 150/5300-13A Change 1, Airport Design, recommends that the critical aircraft for the purposes of airport geometric design should be a composite aircraft representing a collection of aircraft classified by the following three parameters: Aircraft Approach Category (AAC), Airplane Design Group (ADG), and Taxiway Design Group (TDG). The recommended critical aircraft at 4N1 is given as a group of aircraft represented by AAC, ADG, and TDG as defined in FAA AC 150/53-13A.

In order to determine the most demanding group of aircraft that make regular use at 4N1, the characteristics of the multi-engine-based aircraft are evaluated. **Table 2-13** summarizes the based multi-engine aircraft at 4N1 in December 2014, 2015, and 2016, and provides the characteristics of each model with classification by AAC, ADG, and TDG.

Table 2-13. Multi-Engine Aircraft Based at 4N1 in December 2014, 2015, and 2016

Aircraft Model	No. of Based Aircraft	AAC	ADG	TDG	MTOW (lbs)	Wingspan (feet)	Tail Height (feet)	V _{REF} / Approach Speed (knots)
December 2014								
Piper PA-23-250 Aztec	1	A/B	I	1A	5,200	37.17	10.33	N/A
Beechcraft Baron 58 *	2	B	I	1A	5,500	37.83	9.75	96
Piper Twin Comanche	1	A/B	I	1A	3,600	36.0	8.17	N/A
December 2015 & 2016								
Piper PA-23-250 Aztec	1	A/B	I	1A	5,200	37.17	10.33	N/A
Beechcraft Baron 58 *	2	B	I	1A	5,500	37.83	9.75	96

Source: FAA Aircraft Characteristics (September 2017). Appendix 1 of FAA AC 150/5300-13A, Airport Design. Aircraft Manufacturer's technical specifications.

Note: Beechcraft Baron 55 is classified as AAC-A while Beechcraft Baron 56, 58, and G58 are classified as AAC-B. It is assumed that the two Barons at the airport are 58. MTOW – Maximum takeoff weight. VREF – Reference landing speed.

The most demanding based aircraft is identified as the Beechcraft Baron twin-engine (piston) aircraft, which is classified as B-I-1A (representing AAC-ADG-TDG) aircraft. The other two common multi-engine models at 4N1 are the Piper Aztec and Twin Comanche. Although the approach speed for these two aircraft models are not available, they are either classified as AAC A or B. Hence, the most demanding group of aircraft is still under the B-I-1A category.

There is no available operations count by aircraft make and model for the most recent 12-month period at 4N1 as required by AC 150/5000-17. Nevertheless, there are three multi-engine aircraft based at 4N1 in 2015 and 2016, and the operations generated from these based aircraft and visiting multi-engine aircraft are estimated to be over 500 operations as summarized in **Table 2-14**.

Table 2-14. Forecast General Aviation Operations by Multi-Engine Aircraft

Year	Annual GA Operations by Multi-Engine Aircraft (B-I-1A Group of Aircraft)
2016 Estimate	900
Baseline Scenario	
2021	900
2026	930
2036	1,000
Low Scenario	
2021	980
2026	1,060
2036	1,260
High Scenario	
2021	770
2026	770
2036	750

Note: Numbers are rounded to the nearest 10 operations.

In summary, the recommended existing and forecast critical aircraft group is:

- **AAC – B** (Approach speed 91 knots or more but less than 121 knots)
- **ADG – I** (Wingspan less than 49 feet, tail height less than 20 feet)
- **TDG – 1A** (Cockpit to main gear less than 20 feet, and main gear width less than 15 feet)



Multi-Engine Aircraft at Greenwood Lake Airport. AECOM May, 2017.

2.13 Summary

Table 2-15 summarizes the recommended baseline scenario for the general aviation demand forecast for 2021, 2026, and 2036.

Table 2-15. Summary of Aviation Activity Forecasts (Baseline Scenario)

Based Aircraft Forecast

Year	Single Engine	Multi-Engine	Helicopter	Other	Total Based Aircraft	Percentage difference from FAA TAF
2016	41	3	1	1	46	-25.8%
Forecast						
2021	41	3	1	1	46	-25.8%
2026	42	3	1	1	47	-24.2%
2036	46	3	1	1	51	-17.7%
CAGR						
2016-2021 (5-year)	0.00%	0.00%	0.00%	0.00%	0.00%	
2016-2025 (10-year)	0.24%	0.00%	0.00%	0.00%	0.22%	
2016-2036 (20-year)	0.58%	0.00%	0.00%	0.00%	0.52%	

Annual Operation Forecast

Year	Itinerant GA	Local GA	Total GA	Percentage difference from FAA TAF
2016	3,620	14,479	18,099	0.0%
Forecast				
2021	3,600	14,500	18,100	0.0%
2026	3,700	14,800	18,500	2.1%
2036	4,000	16,000	20,000	10.6%
CAGR				
2016-2021 (5-year)	0.00%	0.00%	0.00%	
2016-2025 (10-year)	0.19%	0.21%	0.21%	
2016-2036 (20-year)	0.45%	0.52%	0.50%	

Note: Numbers may not add up due to rounding. CAGR – Compound annual growth rate.

3. Facility Requirements

3.1 Introduction

The facility requirements section of this Master Plan identifies potential issues associated with existing facilities by applying Federal Aviation Administration (FAA), industry, and site specific planning parameters to existing and forecast demand.

3.2 Airfield

The airfield facility requirements include an assessment of runway operational capacity as well as the overall design of the runways and taxiways based on the B-I(S) design category.

3.2.1 Airfield Capacity Analysis

The airfield capacity analysis evaluates the ability of Runway 06/24 to accommodate the forecast demand. The guidance documents used for this analysis are listed below:

- FAA Advisory Circular (AC) 150/5060-5, Airport Capacity and Delay
- FAA-RD-74-124, Techniques for Determining Airport Airside Capacity and Delay
- Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP) Report 79, Evaluating Airfield Capacity

Airfield capacity is defined as the number of aircraft operations an airport can conduct during a specified period of time under various operating conditions. **Annual capacity (Annual Service Volume)** and **hourly capacity (throughput capacity)** are the two common measures used by the FAA to evaluate an airfield's operational capabilities.

The runway capacity at 4N1 is determined by various factors including runway use configurations, aircraft fleet mix, runway Exit (E) factor, and Touch and Go (T) factor.

Based on historical weather data, **Figure 3-1** illustrates the runway use configurations for four different meteorological conditions based on visibility and wind direction. The possibility for each condition to occur is represented as a percentage.

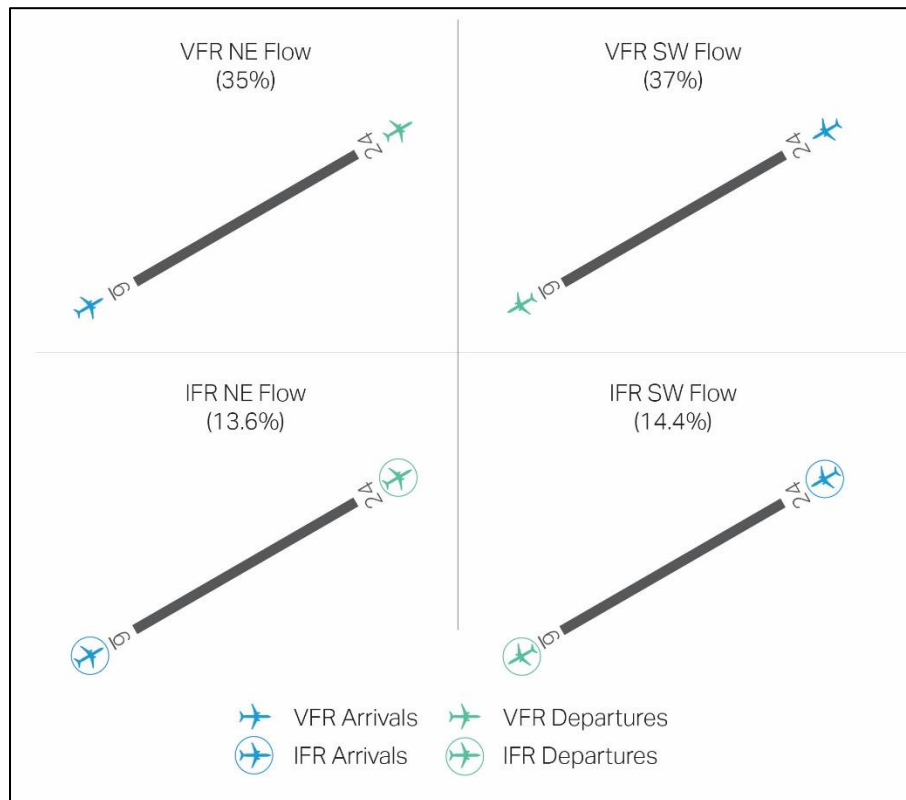


Figure 3-1. Runway Use Configuration

Data Source: NCDL Climate Data Online, Surface Hourly Data for the Sussex Airport Weather Station, January 2006 - May 2017; AECOM Analysis.

This analysis used the National Climatic Data Center (NCDC) Climate Data Online for Sussex Airport Weather Station from January 2006 - May 2017. This dataset includes 145,328 records throughout the study period.

- Visual Flight Rules (VFR) observations (104,640 records) include those when the visibility was at least three statute miles and cloud ceiling was at least 1,000 feet Above Ground Level (AGL).
- Instrument Flight Rules (IFR) observations (40,687 records) include those when visibility and cloud distance do not satisfy the requirements for VFR.

The operational flow is determined based on wind direction. Among the 145,328 records:

- 27,499 of the records had wind blowing from the northeast, and thus required a northeast flow of traffic,
- 31,724 had wind blowing from the southwest, and thus required a southwest flow of traffic, and
- 86,104 had calm air (wind speed of zero) or variable wind (unsteady direction). The analysis assumes either runway end could be used under such conditions.

The FAA Air Traffic Control Handbook (Order 7110.65) applies wake turbulence procedures for aircraft operations based on the weight of preceding aircraft. **Table 3-1** identifies the four classes of aircraft according to their Maximum Takeoff Weight (MTOW) and number of engines. The aircraft mix index indicates the relative percentage of operations conducted by each of four classes of aircraft. However, the FAA's methodology only incorporates Class C and Class D aircraft to determine airfield capacity via the following formula:

$$\text{Mix Index} = C + 3D$$

Table 3-1. Aircraft Classifications

Aircraft Class	Maximum Takeoff Weight (lbs)	Number of Engines	Wake Turbulence Classification
A	12,500 or less	Single	Small (S)
B	12,500 or less	Multi	Small (S)
C	12,500 – 300,000	Multi	Large (L)
D	Over 300,000	Multi	Heavy (H) / B757

Since Runway 06/24 is only utilized by small GA aircraft weighing 12,500 pounds or less (A and/or B), the aircraft mix index for 4N1 is zero.

The Exit (E) factor refers to the number and location of exit taxiways. An inadequate amount or location of exit taxiways can increase the amount of time an aircraft is on the runway during an arrival (known as runway occupancy time). In such cases, subsequent operations (arrivals and/or departures) can be delayed while waiting for the aircraft to fully exit the runway.

The FAA provides this factor based on the aircraft mix index, percentage of arrivals, and the number of exits within a given range. An exit factor is applied to each runway use configuration and ranges from 94 percent to 99 percent at 4N1.

Based on an estimate provided by the airport operators, the touch and go operations at 4N1 account for less than 10 percent of the total operations. According to the FAA guidance, the Touch & Go factor (T) is assumed to be 1.04 for VFR conditions and one for IFR conditions¹⁰.

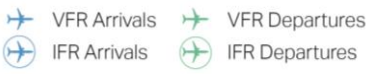
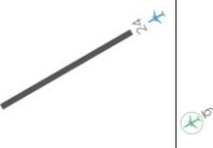
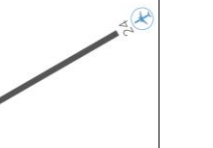
The FAA recommends planning for airfield enhancements when annual operations reach 60 percent of the Annual Service Volume (ASV) and implementing the enhancements when annual operations approach 80 percent of ASV. Based on **Figure 2-1** in the FAA AC 150/5060-5, *Airport Capacity and Delay*, the ASV for a single runway with Mix Index at zero is 230,000 operations per year¹¹.

The weighted hourly capacities for each runway use configuration were evaluated by applying runway utilization percentages for each meteorological condition, as summarized in **Table 3-2**.

¹⁰ Figure 2-3 and Figure 2-43, FAA-RD-74-124, Techniques for Determining Airport Airside Capacity and Delay

¹¹ An alternative method to estimate ASV is to multiply the weighted average hourly capacities (Cw) by the daily demand (D) and hourly demand (H) ratios. Due to the lack of daily and hourly operations data at 4N1, this method can only be adopted when and if such data become available.

Table 3-2. Summary of Airfield Capacity Analysis

4N1: Hourly Capacity Estimates				
Capacity Element	NE Flow		SW Flow	
	VFR NE Flow	IFR NE Flow	VFR SW Flow	IFR SW Flow
	Rwy 6	Rwy 6	Rwy 24	Rwy 24
Runway Configurations 				
Weather Conditions	35.0%	13.6%	37.0%	14.4%
Aircraft Mix Index (C+3D)	0			
Arrival %	Sensitivity Test 1	40%		
	Sensitivity Test 2	50%		
	Sensitivity Test 3	60%		
Touch & Go Factor (T)	1.04	1	1.04	1
Exit Range (feet)	2000 - 4000	2000 - 4000	2000 - 4000	2000 - 4000
No. of Exits (N) within range	2	2	2	2
Exit Factor (E)	0.94	0.99	0.94	0.99
C*	Sensitivity Test 1	110	62	110
	Sensitivity Test 2	105	70	105
	Sensitivity Test 3	100	52	100
C* x T x E	Sensitivity Test 1	107.5	61.4	107.5
	Sensitivity Test 2	102.6	69.3	102.6
	Sensitivity Test 3	97.8	51.5	97.8
Weighted Hourly Capacity (Cw)	Sensitivity Test 1	37.6	8.3	39.8
	Sensitivity Test 2	35.9	9.4	38.0
	Sensitivity Test 3	34.2	7.0	36.2
Total Hourly Capacity	Sensitivity Test 1	95		
	Sensitivity Test 2	93		
	Sensitivity Test 3	85		

Notes:

- 1) Per FAA guidance in AC 150/5060-5 based on Hourly Capacity Base (C*) x Exit Factor (E) x Touch and Go Factor (T)
- 2) Cw = Hourly Capacity Base (C*) x % of Weather Conditions
- 3) Total Hourly Capacity is the sum of Weighted Hourly Capacity (Cw) for each configuration
- 4) Touch & Go factor is conservatively assumed at 1.

Based on these factors, the estimated hourly capacity for 4N1 ranges from 85 to 95 operations.

As summarized in **Table 3-3**, the existing annual demand operations (18,099) is only 7.9 percent of the ASV. The forecast annual operations will not exceed 10 percent of ASV; therefore, the runway capacity of 4N1 is satisfactory for the foreseeable future.

Table 3-3. Annual Demand / Annual Service Volume (ASV)

Year		Annual Operations	ASV	Annual Demand/ASV
Forecast	2016	18,099	230,000	7.9%
	2021	18,100		7.9%
	2026	18,500		8.0%
	2036	20,000		8.7%

3.2.2 Runway System

Runways are the fundamental component supporting air transportation at any airport. The runway system is a combination of the structural pavement used for takeoffs and landings, shoulders, blast pads, safety areas, protection zones, and obstruction identification surfaces. The following evaluates the existing runway system and future requirements for each component.

3.2.2.1 Number of Runways

The required number of runways at an airport is based on the annual and hourly capacity of the airfield as well as the prevailing wind conditions.

As noted in [Section 3.2.1](#), the annual capacity of Runway 06/24 is adequate to accommodate the projected demand throughout the planning horizon. According to the FAA AC 150/5300-13A, *Airport Design*, the desirable wind coverage for an airport is 95 percent based on the total number of weather observations during the record period, typically 10 consecutive years. As indicated on **Figure 1-7**, Wind Rose Diagrams, and **Table 1-7**, Wind Coverage for Runway 06/24, the single-runway configuration at 4N1 satisfies the FAA's recommended 95 percent wind coverage for aircraft with allowable crosswind components at 10.5 knots, 13 knots, 16 knots and 20 knots in All-Weather, VFR and IFR conditions.

Given the adequate airfield capacity and wind coverage, a new runway is not required for 4N1.

3.2.2.2 Runway Length Requirements

The operating length of a runway is its most important functional element. The length of the primary runway should support the most demanding aircraft operating at the Maximum Takeoff Weight (MTOW) required to reach its furthest destination, otherwise known as the stage length. The required runway length is determined based on the guidelines provided in FAA Advisory Circular 150/5325-4B, *Runway Length Requirements for Airport Design*.

Since most of the aircraft regularly operating at 4N1 have a MTOW less than 12,500 pounds, the recommended runway length was calculated using the guidelines provided in Chapter 2 of FAA AC 150/5325-4B.

Runway takeoff length requirements are a factor of airport elevation, temperature, number of passenger seats, and approach speed, whereas higher values for each will increase the takeoff length due to aircraft performance characteristics. Conditions specific to 4N1 include:

- 789.6 feet airport elevation
- 83.67 degrees (Fahrenheit) mean maximum temperature of hottest month
- 95 percent of fleet¹² (applies to airports that are primarily intended to serve medium size population)

Based on Chapter 2 of FAA AC 150/5325-4B, airports with the conditions above require a runway length of 3,100 feet for aircraft with fewer than 10 passenger seats¹³, and a length of 4,200 feet for aircraft with 10 or more passenger seats¹⁴. The majority of, if not all, the aircraft that regularly operate at 4N1 have fewer than 10 passenger seats.

In addition to this analysis, the airplane flight manuals and specifications from manufacturers were also analyzed for a fleet mix specific to 4N1. The fleet mix for this analysis accounts for both existing B-I and A-I aircraft operating at 4N1 and future B-I and A-I aircraft that could potentially operate at 4N1. The fleet mix consists of an array of representative aircraft and is not intended to be exhaustive. The representative aircraft were selected based on multiple information sources, including:

¹² A special designation delineated in Chapter 2, FAA AC 150/5325-4B

¹³ Figure 2-1, Chapter 2, FAA AC 150/5325-4B

¹⁴ Figure 2-2, Chapter 2, FAA AC 150/5325-4B

- Airport's Rental Records, December 2012 to December 2016.
- FAA Aircraft Characteristics Database under Appendix 1 of the AC 150/5300-13A¹⁵ was examined to identify suitable B-I and A-I aircraft. The database provides basic characteristics for common aircraft, categorized by aircraft manufacturer and Runway Design Code (RDC).
- The 2016 and 2017 Plane Buyer's Guide for single-engine and twin-engine piston aircraft¹⁶, provided by the Plane & Pilot Magazine, were also reviewed to determine the most popular aircraft of 2017 and aircraft ownership trends, including aircraft that are no longer being manufactured.

Figure 3-2 illustrates the takeoff length required for the selected fleet mix as specified by the manufacturers. The required takeoff length for each aircraft is compared with the Takeoff Run Available (TORA) for Runway 06/24. TORA is the distance declared suitable for an aircraft to accelerate from brake release to lift-off, plus additional safety factors. Refer to Section 3.2.2.4 Declared Distances, for more information on TORA and other declared distances.

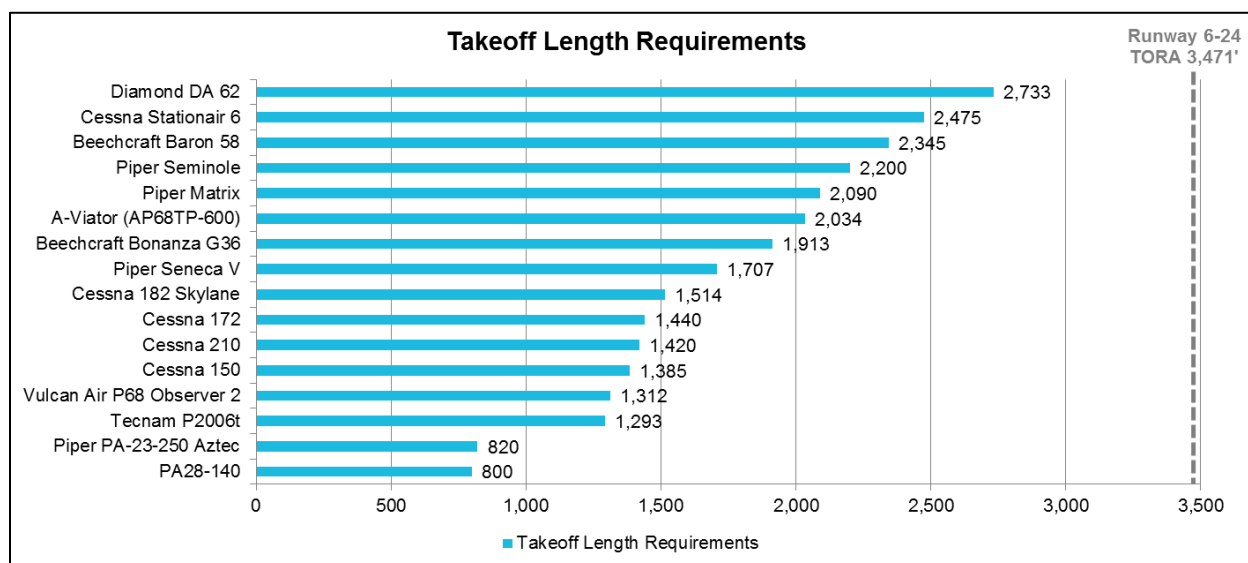


Figure 3-2. Takeoff Length Required for the Representative Fleet Mix at 4N1

Sources: Aircraft manufacturers' specifications.

As shown on **Figure 3-2**, Runway 06/24 has adequate length to support the representative fleet mix at 4N1. While a runway extension is not required for existing and anticipated operations, it is recommended that the airport preserve the ability to maximize the length of Runway 06/24 in the event there is an increase in long-range markets served from 4N1.

Runway Landing Length Required by Future Fleet Mix

As illustrated in **Figure 3-3**, landing length requirements were researched for the representative fleet mix and compared to the Landing Distance Available (LDA) for Runway 06/24. Refer to Section 3.2.2.4 Declared Distances for more information on LDA and other declared distances. For a conservative analysis, an additional 15 percent of length is added for each aircraft to estimate the landing length required for a wet runway.

¹⁵ Last updated in September 2017 by the FAA, retrieved from https://www.faa.gov/airports/engineering/aircraft_char_database/

¹⁶ Published in January 2017. retrieved from <http://www.planeandpilotmag.com/article/plane-pilot-buyers-guide-piston-twins/#.WfOhdlUrLq5>, <http://www.planeandpilotmag.com/article/single-engine-piston-planes/#.WfOhnVUrLq5>

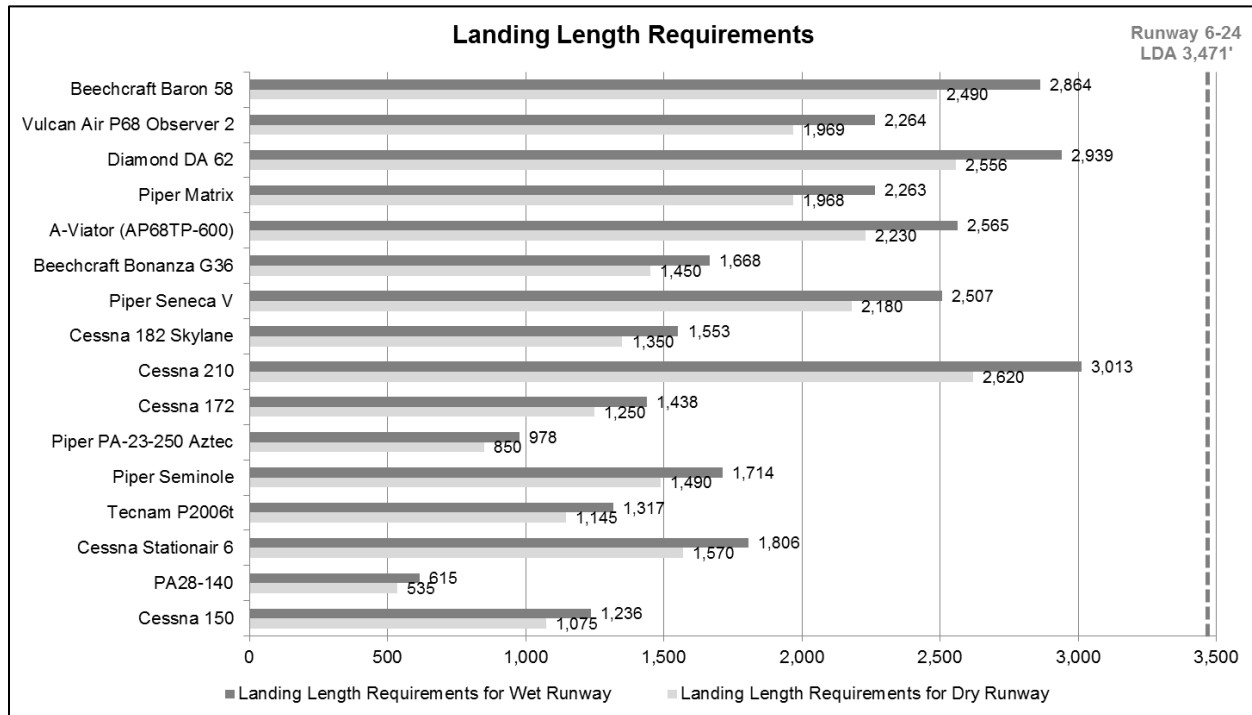


Figure 3-3. Landing Length Required for the Representative Fleet Mix at 4N1

Sources: Aircraft manufacturers' specifications.

Runway 06/24 has adequate landing length for the representative fleet mix under both dry and wet conditions.

The maximum range of each aircraft in the representative fleet mix was collected from the manufacturers' specifications and is depicted on **Figure 3-4**. Aircraft in the representative fleet mix have varying ranges from approximately 300 to 1,500 Nautical Miles (NM). **Figure 3-5** illustrates the regions covered by this range.

Since aircraft are loaded with an amount of fuel based on the destination, the stage length of an individual flight affects the weight of the aircraft at takeoff, which in turn impacts the required runway length. For instance, for a Beechcraft Baron 58 with one passenger to reach its maximum range of approximately 1,480 NM, it must carry a full fuel load and take off at its maximum takeoff weight (MTOW), requiring a takeoff length of at least 2,345 feet. If the same aircraft with the same passenger only needs to reach a destination within 500 NM, the fuel load could be reduced which results in a lower takeoff weight and the corresponding runway takeoff length required is therefore shorter than 2,345 feet.

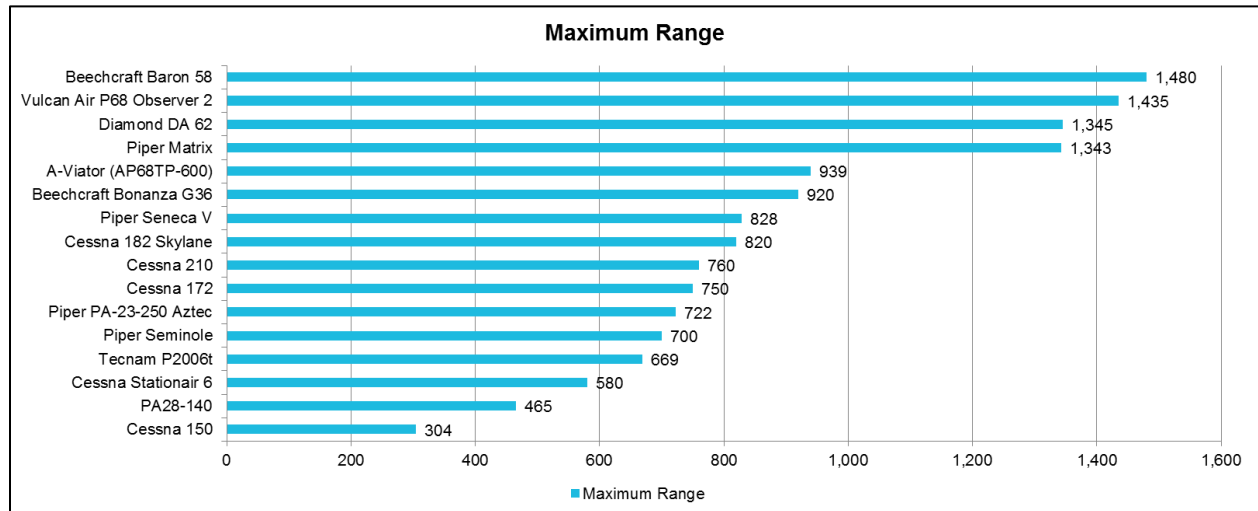


Figure 3-4. Maximum Range for the Representative Fleet Mix at 4N1

Sources: Aircraft manufacturers' specifications.

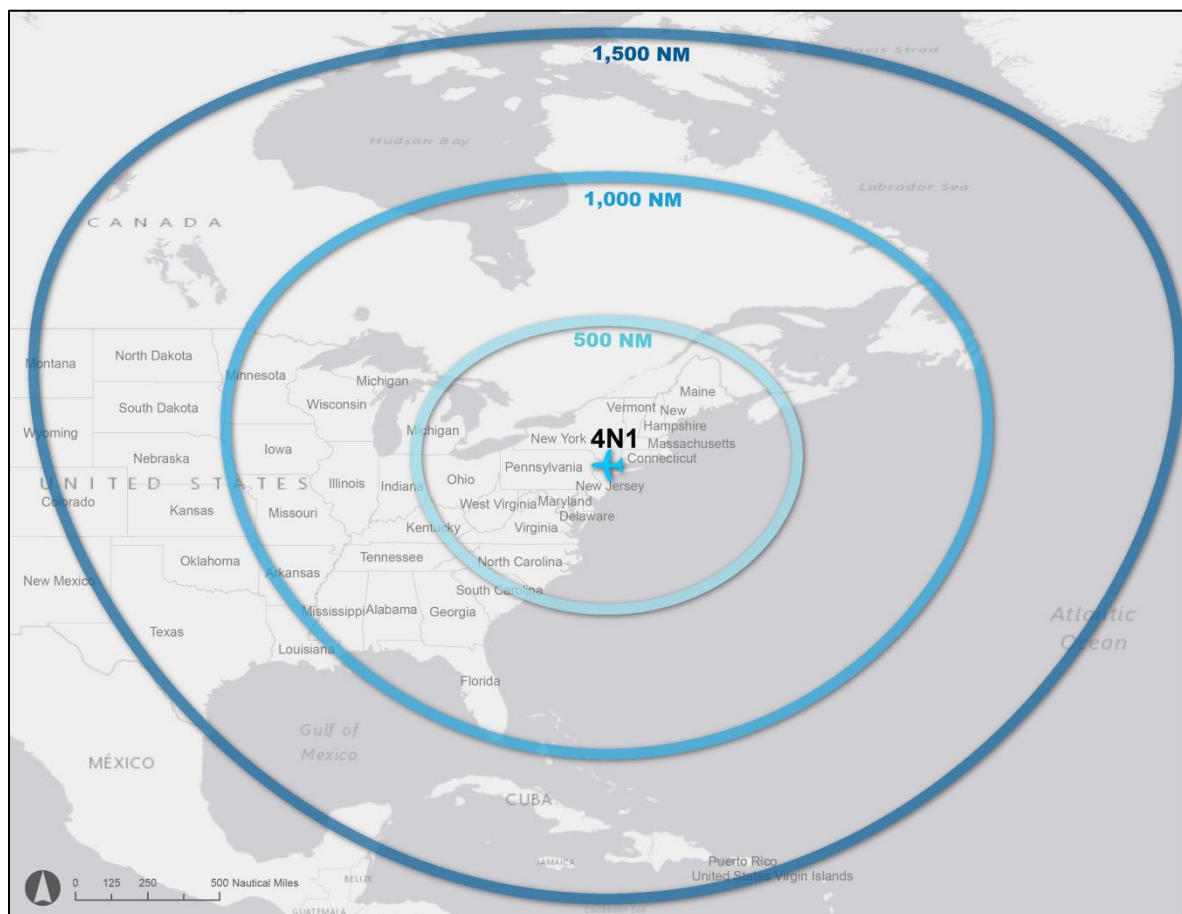


Figure 3-5. Stage Lengths from 4N1

3.2.2.3 Runway Geometry and Safety

The geometry of an airfield is subject to FAA airport design standards which provide for safe operations and consistency among the nation's airports. **Figure 3-6** illustrates existing non-standard conditions at 4N1 which are discussed in the following sections and summarized in **Table 3-4**.

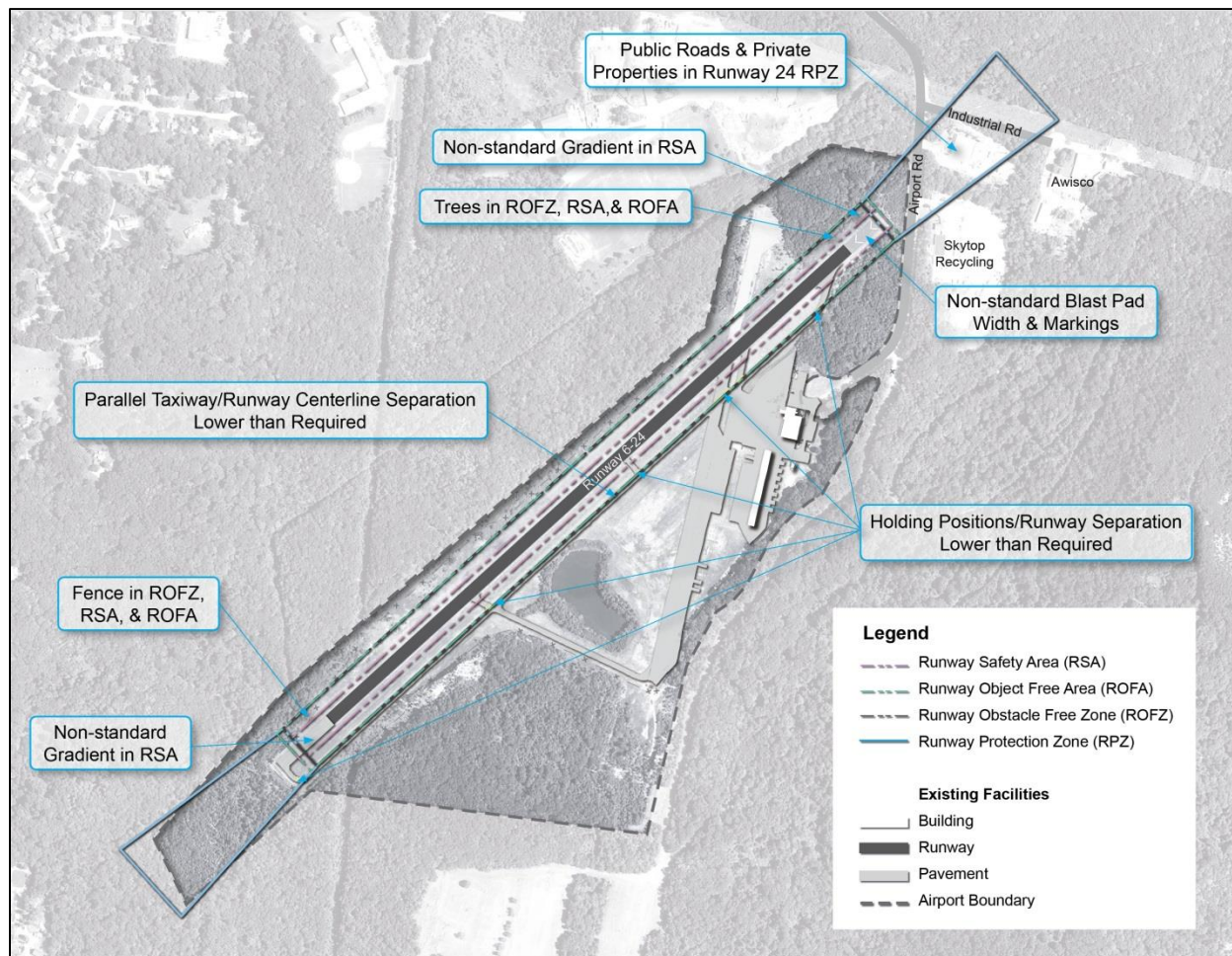


Figure 3-6. Existing Non-Standard Conditions for Runway 06/24 at 4N1

Runway geometry standards include runway length and width, runway shoulder width, and blast pad dimensions. These features are based on the Airplane Design Group (ADG) of the design aircraft and are intended to provide a sufficient amount of stabilized surface for safe operations. Based on the existing and future critical aircraft, Runway 06/24 should be designed based on ADG-I standards.

The existing runway width adheres to the applicable standards. FAA recommends providing stabilized surfaces as shoulders for ADG-I runways¹⁷. Surfaces such as turf, aggregate-turf, soil cement, lime, or bituminous stabilized soil could help reduce the possibility of soil erosion and engine ingestion of foreign objects. In addition to providing protection from jet blast, shoulders must be able to support the occasional passage of the most demanding aircraft as well as the emergency and maintenance vehicles under dry conditions. Runway 06/24 has 10-foot-wide turf shoulders on both sides.

The FAA requires runway blast pads to protect against jet blast and propeller wash. Since none of the representative fleet mix at 4N1 is jet or propeller aircraft, blast pads are not required for these aircraft. However, to allow for future operational flexibility to accommodate jet or propeller aircraft, blast pads of 80

¹⁷ Section 304, FAA AC 150/5300-13A

feet in width and 60 feet in length could be provided at both runway ends. Currently, Runway 06 does not have a blast pad, and the blast pad of Runway 24 is 20 feet less than the standard width.

The chevron markings for the Runway 24 blast pad are non-standard. As shown on **Figure 3-7**, FAA requires 50-foot chevron spacing for blast pad less than 250 feet in length. Also, the first full chevron should start at the runway threshold. However, the chevron spacing at 4N1 is 100 feet, and the first full chevron does not start at the runway threshold.

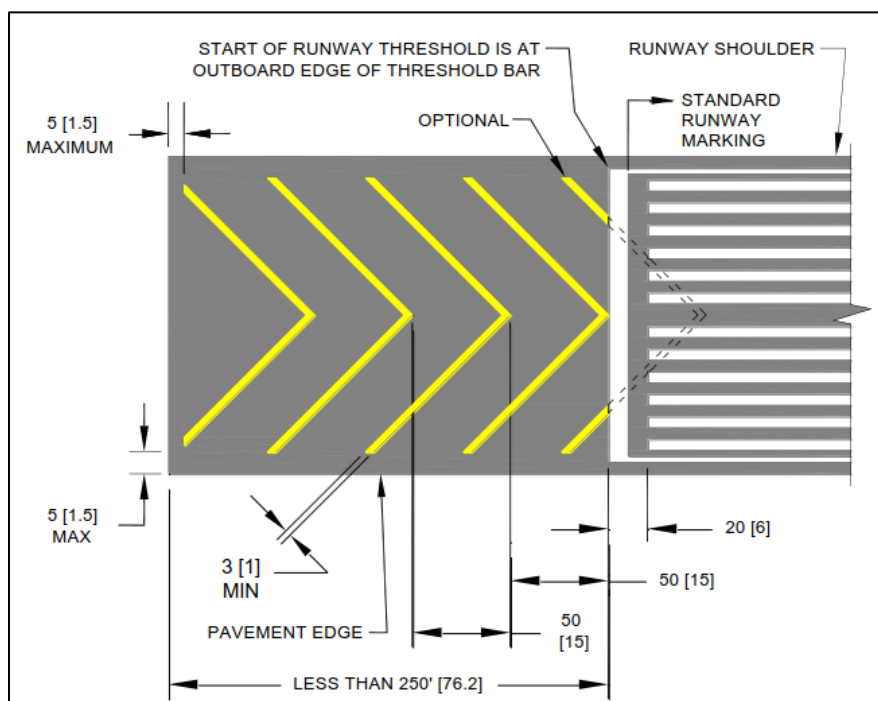


Figure 3-7. FAA Standards for Blast Pads Markings

Source: FAA AC 150/5340-1L, Figure A-9.

Runway separation standards are intended to provide sufficient separation between aircraft operating on a runway and other aircraft and/or vehicles on the airfield, including parallel runways, parallel taxiways, and aircraft parking aprons. There is no parallel runway at 4N1, but the parallel taxiway separation from Runway 06/24 is 20 feet less than the FAA required separation. Due to the reduced taxiway separation, the holding positions separation from the runway centerline is also less than standard. Aircraft parking areas are in compliance with the FAA standard (125 feet from runway).

The Runway Safety Area (RSA) functions as a safety buffer in the rare event when an aircraft undershoots, overruns, or veers off the runway. Per FAA standards, the RSA must be free of all objects except those that must be located in the RSA because of their function, such as navigational aids. Public roads, airport service roads, Instrument Landing System (ILS) localizers, and other objects not frangible-mounted and fixed by function are not allowed within an RSA. Trees and a security fence exist within the Runway 06/24 RSA and should be removed.

The FAA has set specific longitudinal and traverse requirements¹⁸ for the surface gradient within the RSA to prevent the ground from sloping up to obstruct any applicable approach surface. Meanwhile, the downward grade should also be limited otherwise it compromises the ability for an overrunning aircraft to stop within the RSA.

For the first 200 feet of the RSA beyond runway ends, the allowable longitudinal grade is zero percent to three percent downward from the ends. Both runway ends satisfy this requirement. The allowable traverse grade for Approach Categories A and B is 1.5 percent to five percent downward. However, the

¹⁸ Section 313, d, FAA AC 150/5300-13A

existing traverse grade is as high as 23 percent downward for Runway 24 and 13 percent downward for Runway 06.

For the remaining RSA beyond 200 feet, the maximum allowable longitudinal grade is five percent downward from the ends, and the RSA terminates at 240 feet beyond the runway ends. The RSA at Runway 06 end satisfies this requirement. However, the grade in the corner areas of the RSA at Runway 24 end is as high as 25 percent downward.

Therefore, to meet the FAA requirements for surface gradients within RSA, earthwork would be required to bring the ground gradients up to standards.

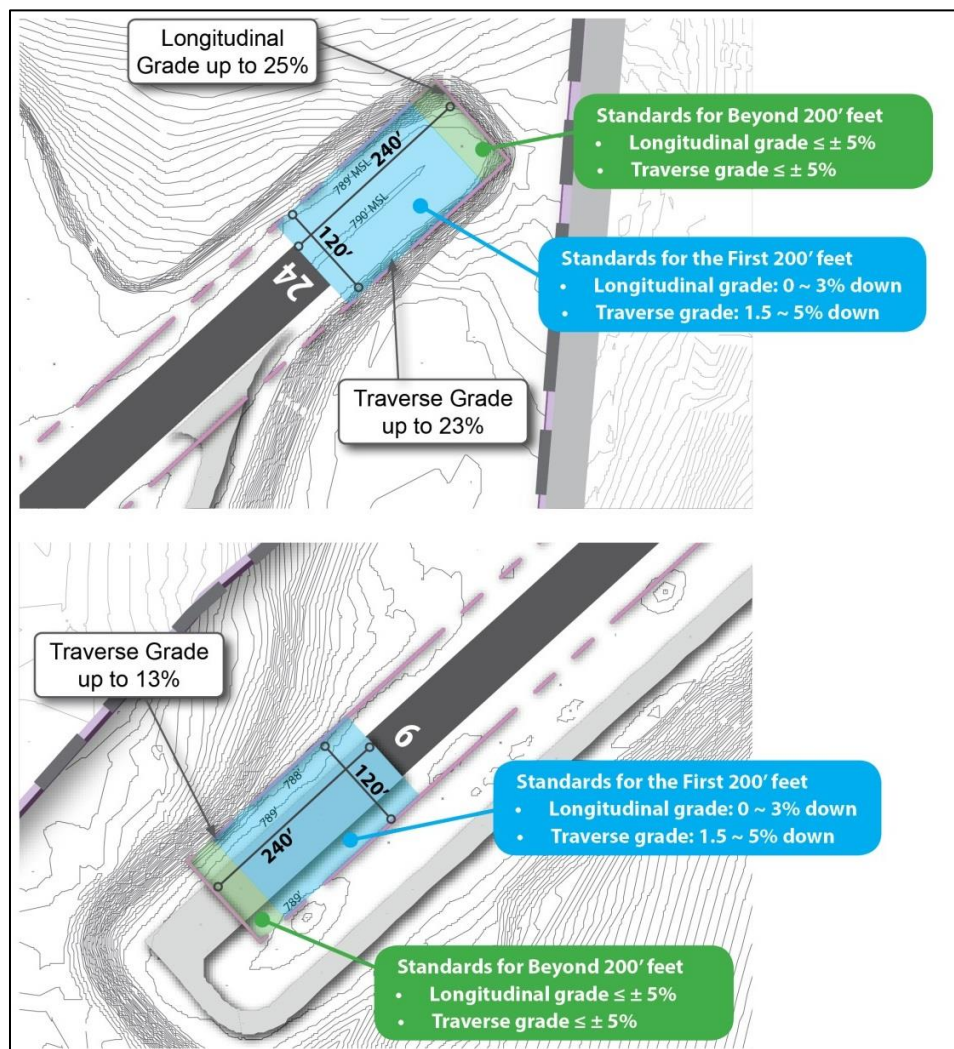


Figure 3-8. Existing Non-Standard Surface Gradient Conditions within RSA

The Runway Object Free Area (ROFA) further enhances the safety of aircraft operations by providing additional clearances from objects non-essential to air navigation or aircraft movements on the taxiway system. The ROFA is an extension of the RSA and must be cleared of above-ground objects protruding above the nearest point of the RSA. Frangible Navigational Aids (also known as NAVAIDS) that are fixed by function are allowed in ROFA, such as the Precision Approach Path Indicator (PAPI).

Trees and the security fence exist within the Runway 06/24 ROFA and should be removed.

The Runway Obstacle Free Zone (OFZ) provides clearance protection for aircraft landing or taking off from the runway as well as missed approaches. The OFZ must be clear of all objects (including aircraft), except for frangible NAVAIDs that are fixed by function.

Trees and security the fence exist within the Runway 06/24 ROFZ and should be removed.

The Runway Protection Zone (RPZ) is a trapezoidal area at each runway end and/or threshold. The main purpose of RPZ is to protect people and property on the ground. The FAA recommends airports gain an interest in RPZs, such as fee title, lease, or avigation easement. While it is desirable to keep the entire RPZ clear of all above-ground objects, RPZs should be maintained clear of all incompatible activities at a minimum. Per the FAA, permissible land uses within RPZs include:

- Farming
- Irrigation channels
- Airport service roads
- Underground facilities
- Unstaffed NAVAIDs and facilities (only if fixed by function)

The FAA also recommends airports coordinate with the Airports District Office (ADO) to remove or mitigate the risk of any existing incompatible land uses in the RPZ as practical, including public roads. The RPZ includes both an Approach RPZ (ARPZ) and a Departure RPZ (DRPZ). The ARPZ is located 200 feet from the runway threshold. The DRPZ begins 200 feet beyond the runway end, or the far end of the TORA if it is not the same as the runway end. The location and size of the ARPZ and DRPZ are the same for Runway 06/24 because there is no displaced threshold.

The Runway 24 RPZ is penetrated by Airport Road and properties not owned by the New Jersey Department of Transportation (NJDOT). It is recommended the Airport acquire the properties within the RPZ, which includes properties owned by the New Jersey Department of Environmental Protection (NJDEP), the Township of Milford, and private entities. When property acquisition is not attainable, an avigation easement should be obtained to avoid construction of incompatible structures within the RPZs. Avigation easement is a legally binding document in which the property owner grants to the Airport unobstructed use and passage of all types of aircraft in and through the airspace, at any height or altitude above the surface of the parcel(s).

As for the public roads, if possible, the Airport should work with the NJDOT to reroute them clear of the RPZs in the long run to the extent practicable. Alternatively, declared distances could be utilized to clear the RPZs from the incompatible land uses, but this approach compromises the usable runway lengths and therefore is usually not recommended as the first choice. More details about declared distances are discussed in [Section 3.2.2.4](#). Alternatively, avigation easement can also be obtained for public roads within RPZs to avoid structures incompatible with air navigation.

Table 3-4. FAA Runway Design Standards

Item	B–I Small Aircraft Standards	06	24	Requirements
Visibility Minimums	Not Lower Than 1 Mile	Not Lower Than 1 Mile	Not Lower Than 1 Mile	
Runway Geometry				
Runway Design Code (RDC)	B–I–5000			
Runway Width	60 feet	60 feet	60 feet	None
Shoulder Width	10 feet	10 feet	10 feet	
Blast Pad Width	80 feet	0 feet	60 feet	Optional: Add blast pad for Rwy 06; Add 20 feet width for Rwy 24
Blast Pad Length	60 feet	0 feet	190 feet	Optional: Add blast pad for Rwy 06
Runway Separation				
Parallel Taxiway/Taxilane Centerline	150 feet	130 feet	130 feet	Add 20 feet
Holding Position	125 feet	106 feet – 116 feet	116 feet – 120 feet	Add 5 – 19 feet
Aircraft Parking Area	125 feet	n/a	180 feet	None
Runway Safety Area (RSA)				
Length Beyond Departure End	240 feet	240 feet	240 feet	Trees should be removed; Earthwork needed to meet gradient requirements.
Length Prior to Threshold	240 feet	240 feet	240 feet	
Width	120 feet	120 feet	120 feet	
Runway Object Free Area (ROFA)				
Length Beyond Runway End	240 feet	240 feet	240 feet	Trees should be removed
Length Prior to Threshold	240 feet	240 feet	240 feet	
Width	250 feet	250 feet	250 feet	
Runway Obstacle Free Zone (ROFZ)				
Length	200 feet	200 feet	200 feet	Trees should be removed
Width	250 feet	250 feet	250 feet	
Approach Runway Protection Zone (ARPZ)				
Length	1000 feet	1000 feet	1000 feet	Public road and properties within the Rwy 24 RPZ should be mitigated
Inner Width	250 feet	250 feet	250 feet	
Outer Width	450 feet	450 feet	450 feet	
Departure Runway Protection Zone (DPRZ)				
Length	1000 feet	1000 feet	1000 feet	Public road and properties within the Rwy 24 RPZ should be mitigated
Inner Width	250 feet	250 feet	250 feet	
Outer Width	450 feet	450 feet	450 feet	

Notes:

- (1) Deficiencies are denoted in
- red text**
- .

In addition to the FAA runway safety standards, New Jersey also has specific requirements for the runways in the state. The NJDOT instituted the Air Safety and Zoning Act of 1983¹⁹ which establishes zoning and land use regulations in the vicinity of airports in order to control aeronautical hazards. The Act mandates that each runway establishes an Airport Safety Zone, which consists of a Runway Subzone, two Runway End Subzones, and two Clear Zones. **Table 3-5** specifies the dimensional requirements of the three components of the Airport Safety Zone. **Figure 3-9** provides an illustration.

Furthermore, West Milford Township has set standards for an Airport Hazard Zone in compliance with the Air Safety and Zoning Act of 1983, as shown in **Figure 1-23**. The dimensional requirements of West Milford's Airport Hazard Zone are the same as the State's Airport Safety Zone. However, The Township has adopted stricter standards that only permits residences of at least four acres in size in the Airport Hazard Zone, compared to the State law that permits residences of three acres or greater within the Airport Safety Zone.

Table 3-6 lists the permitted land uses in the Township's Airport Hazard Zone.

Table 3-5. Airport Safety Zone Components

	Location	Width	Length
Runway Subzone	Same centreline and length as the runway.	2,350 feet	Physical length of the runway ¹
Runway End Subzones	At either end of the Runway Subzone	2,350 feet at the edge of Runway Subzone; 850 feet at the end	3,000 feet
Clear Zones	Within the Runway End Subzone	Inner width: 250 feet; Outer width: 450 feet	1,000 feet

Source:

- (1) N.J.A.C. §16:62-3.3 through N.J.A.C. §16:62-3.5

Notes:

- (1) If the physical end of a runway is closer than 200 feet from the property or easement line of the airport, as measured along the runway's extended centerline, then the end of the RUNWAY SUBZONE shall be defined by a line drawn perpendicular to the runway centerline at a point 200 feet inside of the airport property or easement line. In this case, a portion of the runway will extend beyond the bounds of the RUNWAY SUBZONE.

¹⁹ [N.J.A.C. 16:62](#)



Figure 3-9. Airport Safety Zones and Incompatible Land Uses

Table 3-6. Airport Hazard Zone Permitted Land Uses

Permitted Land Uses
• Residential single-family dwelling units which are situated on a lot at least four acres in size and not located in a clear zone; • Open space; • Agricultural; • Airport;

Runway 06 End

There are 15 parcels located within the Runway 06 Airport Safety Zone that are incompatible with the Air Safety and Zoning Act and not one of permitted land uses, as outlined in **Table 3-6**. All of these parcels fall within the Runway End Subzone. There are no incompatible land uses within the Runway 06 Clear Zone.

The majority of the incompatible parcels are residential single-family dwelling units which are smaller than three acres in size and are thus prohibited by the Air Safety and Zoning Act. However, two of the single-family dwelling units in the Runway End Subzone on Moresstown Road are greater than three acres in size, but less than four acres in size. These parcels are prohibited by the Township's Airport Hazard Zone and are thus included on the list of incompatible parcels.

There are also four condominiums located on 161-164 Richmond Road. Pursuant to the N.J.A.C.16:62-7.2(b)1, two of the multi-family townhouse dwellings on Richmond Road are exempt from the requirements of the Air Safety and Zoning Act.

Runway 24 End

Two buildings in violation of the Air Safety and Zoning Act fall within the Clear Zone on the Runway 24 end and are not one of the permitted land uses, as outlined in **Table 3-6**. One is a recycling center owned by Gagliano Comp, L.L.C; the other is a parcel of unknown land use which appears to be industrial based on aerial image.

3.2.2.4 Declared Distances

The FAA allows the use of declared distances to identify maximum distances available for arrivals and departures in situations where the full physical length of the runway cannot be made available. Declared distances are typically utilized to obtain additional runway safety and/or object free area, mitigate unacceptable land uses within a runway protection zone, provide obstacle clearance, or mitigate environmental concerns. However, the FAA does not require an airport to reduce the length of a runway or declare its length to be less than the actual pavement length to meet runway safety area standards if there is an adverse operational impact to the airport.

The four declared distances include the Takeoff Run Available (TORA), Takeoff Distance Available (TODA), Landing Distance Available (LDA), and Accelerate Stop Distance Available (ASDA).

Table 3-7 summarizes the key elements of each declared distance. **Table 3-8** identifies the existing declared distances at 4N1. As discussed previously in Section 3.2.2.3, the Runway 24 Departure and Approach RPZs could be displaced to provide clearance from the public road. However, this displacement (as shown on **Figure 3-10**) reduces the LDA and TORA by 1,040 feet. TODA and ASDA are not impacted. Such reduction would limit the runway's flexibility of supporting takeoffs and landings of certain aircraft models and thus have a significant adverse operational impact to the airport. Therefore, revising declared distances is not a top recommended approach for RPZ clearance.

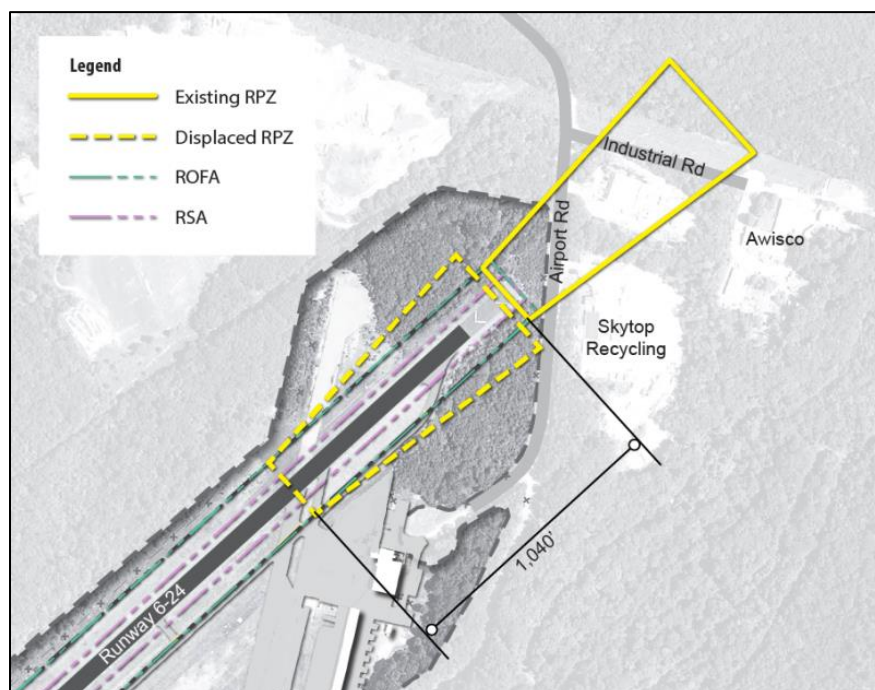


Figure 3-10. Displacement of RPZ for Clearance from Public Roads

Table 3-7. FAA Declared Distances

Declared Distance	Definition	Limitation	Reduction Reasons
TORA (Takeoff Run Available)	Distance to accelerate from brake release to lift-off plus safety factors	Must not exceed the length of the runway or TODA	Mitigate incompatible land uses and environmental effects
TODA (Takeoff Distance Available)	Distance to accelerate from brake release past lift-off to start of takeoff climb plus safety factors	Must not exceed the length of the runway plus clearway	Mitigate 40:1 Instrument Departure Surface penetrations
LDA (Landing Distance Available)	Distance from threshold to complete the approach, touchdown, and decelerate to stop plus safety factors	Must not exceed the length of the runway	Provide the standard ROFA and/or approach RSA, satisfy approach surface requirements, mitigate incompatible land uses in approach RPZ and environmental effects
ASDA (Accelerate Stop Distance Available)	Distance available to accelerate from brake release to takeoff speed and then decelerate to a stop plus safety factors	Must not exceed the length of the runway plus stopway	Provide standard ROFA and/or approach and departure RSA

Table 3-8. Existing and Revised Declared Distances

Runway		Declared Distances (in feet)							
		TORA		TODA		ASDA		LDA	
ID	Length	Existing	Revised	Existing	Revised	Existing	Revised	Existing	Revised
06	3,471	3,471	2,431	3,471	3,471	3,471	3,471	3,471	2,431
24	3,471	3,471	2,431	3,471	3,471	3,471	3,471	3,471	2,431

3.2.2.5 Runway End Siting and Airspace Protection

Runway ends and thresholds are established based on the requirements in Chapter 3 of the FAA AC 150/5300-13A. Runway 06/24 is a utility runway with non-precision approach procedure. Utility runway means that the runway was constructed to be used by propeller driven aircraft of 12,500 lbs. maximum gross weight and less²⁰. Non-precision approach refers to straight-in instrument approach procedure that provides course guidance with or without vertical path guidance, with visibility minimums not lower than $\frac{3}{4}$ mile (4000 RVR)²¹. **Table 3-9** documents the runway parameters that are associated with approach procedures.

²⁰ 14 CFR Part 77, Safe, Efficient Use, and Preservation of the Navigable Airspace

²¹ FAA Advisory Circular 150/5300-13A

Table 3-9. Runway Parameters Associated with Approach Procedures

	Runway 06	Runway 24
Elevations		
Threshold Elevation ¹	789.3' MSL	789.4' MSL
Runway End Elevation ¹	789.3' MSL	789.4' MSL
Touchdown Zone Elevation (TDZE) ²	789.5' MSL	789.6' MSL
Approach Parameters		
Threshold Crossing Height (TCH) ²	Not Available	44' AGL
Glide Path Angle (GPA) ²	Not Available	3 degrees
Approach Minimum ²	1 mile	1 mile

Sources:

- (1) FAA 5010 Airport Master Records and Reports
 (2) RNAV approach plates for Runway 06 and 24 ends, dated Oct 12, 2017

Table 3-10 compares the standards required for such runways to the existing conditions of Runway 06/24. The non-standard conditions are highlighted in **red** text. **The runway must meet the standards specified in Table 3-10 to protect the airspace needed for the instrument approach procedure.**

Table 3-10. Standards for Instrument Approach Procedures

	Requirements For A(NP) Runways ³	Runway 06	Runway 24
Approach Category ¹	A(NP)	A(NP)	A(NP)
Instrument Approach Procedures ²	Required	RNAV (GPS)	RNAV (GPS)
Displaced Threshold	No requirement	None	None
Runway Markings ¹	Non-precision	Non-precision	Non-precision
Runway Edge Lights ¹	MIRL/LIRL	MIRL	MIRL
Parallel Taxiway	Recommended	Yes	Yes
Minimum Runway Length	3,200 ft	Longer than 3,200 ft	Longer than 3,200 ft
Approach Lights ¹	Recommended	None	2-light PAPI on left (3.5 degrees glide path)
Threshold Siting Criteria to Be Met ⁴	20:1 TSS ₁ Surface Clear	20:1 TSS with obstructions	20:1 TSS with obstructions

Notes:

- (1) Threshold Siting Surfaces (TSS)

Sources:

- (3) FAA 5010 Airport Master Records and Reports
 (4) RNAV approach plates for Runway 06 and 24 ends, dated Oct 12, 2017
 (5) FAA Advisory Circular 150/5300-13, Table 3-4
 (6) 4N1 Obstruction Evaluation Study, AECOM, January 2017

In addition to protecting the instrument approach procedure, the 40:1 Departure Surface should be clear of obstacles as well. When it is not possible to keep the Departure Surface clear of obstacles, any obstacles must be evaluated through the Obstruction Evaluation/Airport Airspace Analysis (OE/AAA) process²².

In January 2017, NJDOT commissioned an Obstacle Evaluation study for 4N1, which focuses on the 20:1 TSS Surface and 40:1 Departure Surface. **Table 3-11** provides a summary of the findings from the study.

²² FAA AC 150/5300-13A, Section 303.a.(4).(b)

Table 3-11. 4N1 Obstruction Evaluation

Obstacle Counts	Runway 06		Runway 24	
	Threshold Siting Surface (20:1)	Departure Surface (40:1)	Threshold Siting Surface (20:1)	Departure Surface (40:1)
Trees/Bushes	229	1,198	23	67
Buildings/Water Towers	5	49	0	0
Poles/Powerlines	7	29	3	4
Total	241	1,276	26	71

Because of penetrations to the 20:1 TSS at both runway ends, nighttime approaches to the Airport are restricted.

3.2.2.6 Runway Pavement Design Strength and Condition

Based on the 2014 Pavement Condition Index (PCI) report published by the NJDOT, the runway and most of the taxiway pavement is in “satisfactory” condition. The based aircraft apron is in “fair” condition, but the transient aircraft apron is in “poor” condition. The 2017 Capital Improvement Plan (CIP) for 4N1 schedules pavement rehabilitation projects for both the transient apron and the based aircraft apron.

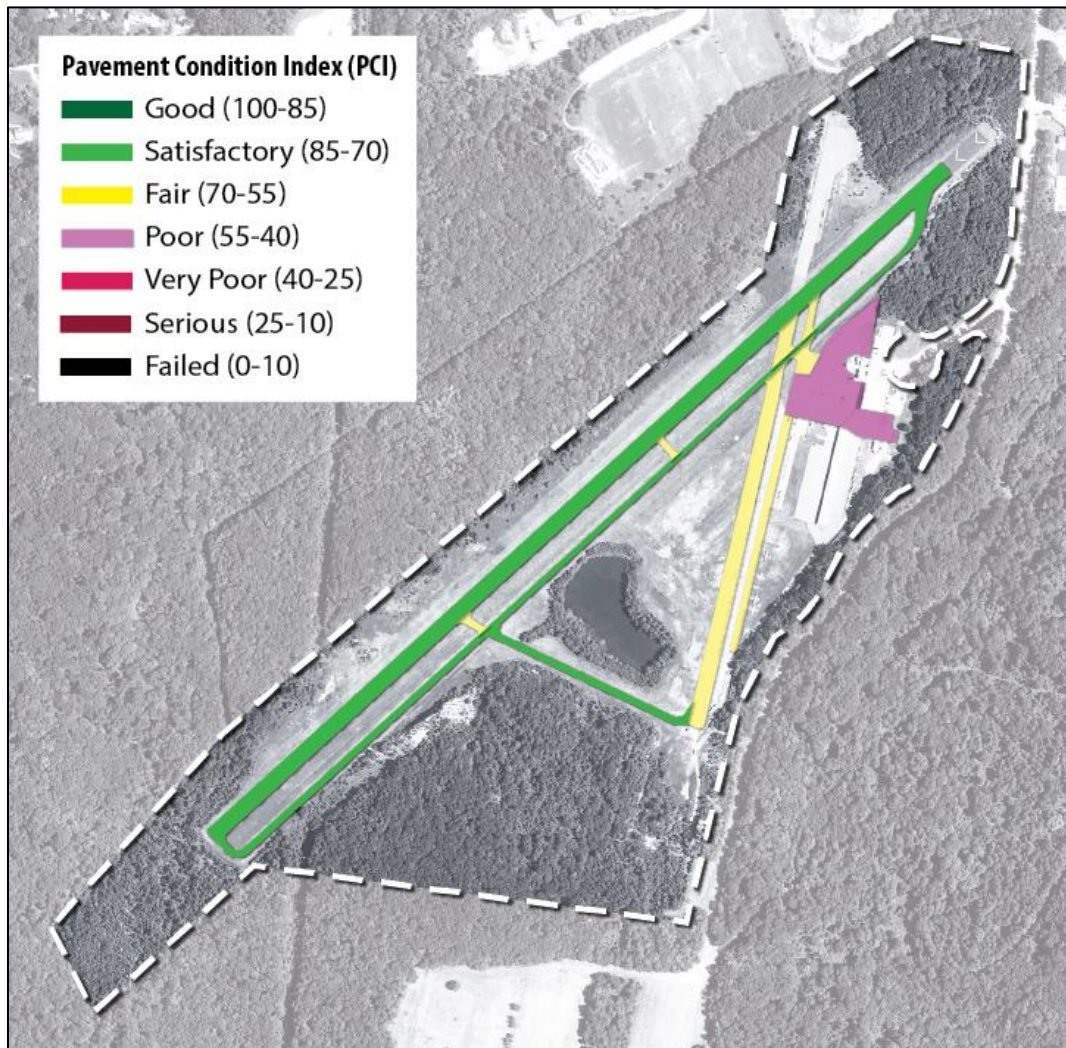


Figure 3-11. Pavement Condition

Source: 2014 Pavement Condition Index (PCI) Report, NJDOT, May 2015

3.2.3 Taxiway System

The taxiway system of an airport provides for safe and efficient movement of aircraft between the runways, terminal area, and general aviation facilities. The following section evaluates the taxiways in terms of design standards and operational efficiency from a runway exit perspective.

3.2.3.1 Taxiway Design

Taxiway design standards are based on the Airplane Design Group (ADG) and Taxiway Design Group (TDG) of the aircraft frequently using the taxiways. ADG affects the protection areas, separation standards, and wingtip clearances. TDG determines the width, main-gear safety margin, and shoulder width. As discussed in [Section 2.12 Critical Aircraft](#), the existing and forecast critical aircraft group is B-I(S). The applicable design requirements for this critical aircraft group are summarized in [Table 3-12](#).

An evaluation of the existing taxiway system revealed the non-standard conditions identified on [Figure 3-12](#) and [Table 3-12](#). In addition, none of the taxiways at 4N1 are named. It is recommended that the taxiways be named according to [Figure 3-12](#). The proposed taxiway naming system is utilized in the

following sections of this report. In addition, it is recommended that trees be removed from the Taxiway Object Free Area (TOFA) to meet FAA standards.

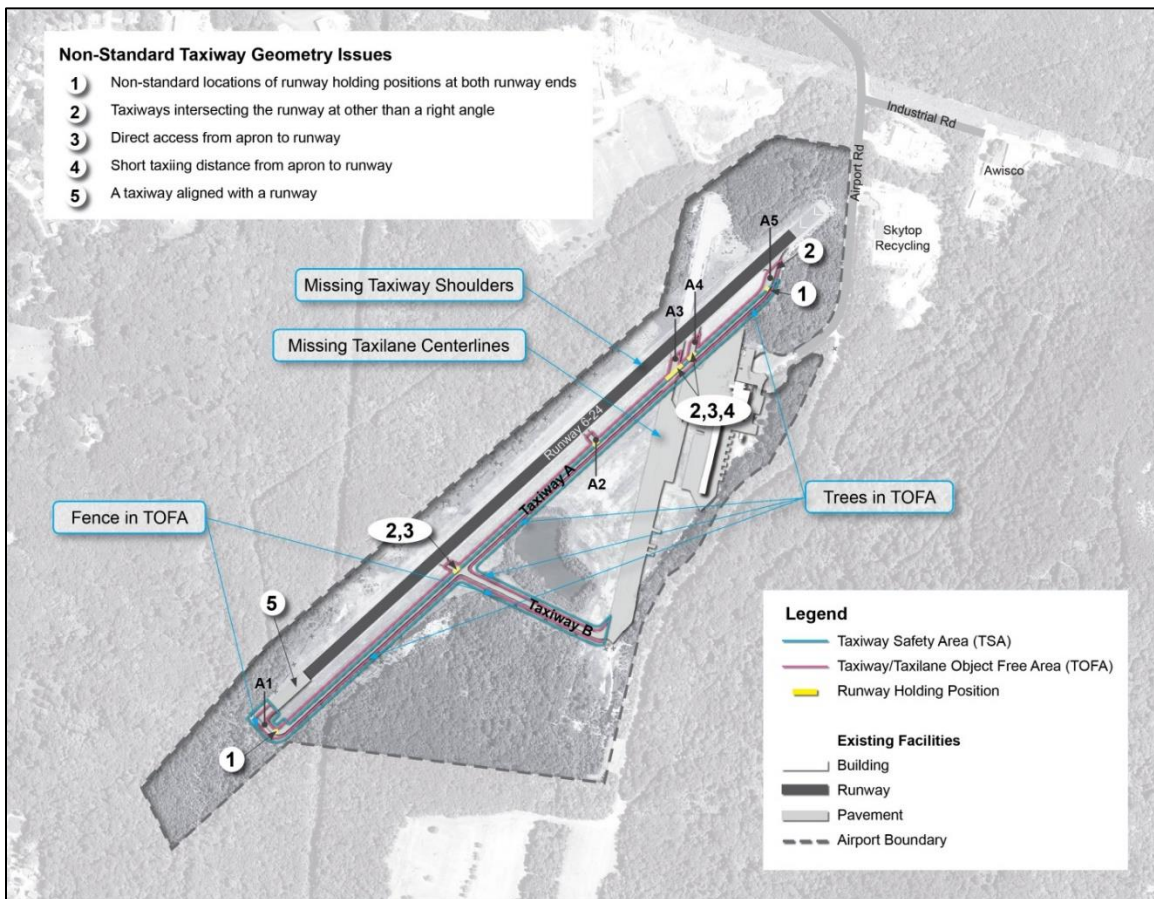


Figure 3-12. Existing Non-Standard Conditions for Taxiways at 4N1

Table 3-12. Taxiway/Taxilane Design Standards

Item	ADG I	Non-Standard Condition
Protection		
Taxiway Safety Area	49 feet	None
Taxiway Object Free Area	89 feet	Fence & Trees within TOFA
Taxilane OFA	79 feet	None
Taxiway Separation		
Parallel Centerline	70 feet	None
Fixed or Movable Object	44.5 feet	Fence & Trees
Taxilane Separation		
Parallel Centerline	64 feet	Taxilane centerline markings missing
Fixed or Movable Object	39.5 feet	
Wingtip Clearance		
Taxiway Wingtip Clearance	20 feet	None
Taxilane Wingtip Clearance	15 feet	None
Item	TDG 1A	
Taxiway Width	25 feet	None
Taxiway Edge Safety Margin	5 feet	None

Taxiway Shoulder Width	10 feet	None
------------------------	---------	------

3.2.3.2 Taxiway Configurations

The FAA design standards in AC 150/5300-13A (Change 1) include guidance regarding taxiway configurations, particularly points of intersection with a runway. A review of the existing taxiway configuration at 4N1 revealed approximately five intersections that do not adhere to the standards.

As indicated on **Figure 3-12**, the non-standard taxiway geometry issues at 4N1 include:

1. Non-standard locations of runway holding positions at both runway ends
2. Taxiways intersecting the runway at other than a right angle
3. Direct access from apron to runway
4. Short taxiing distance from apron to runway
5. A taxiway aligned with a runway

It is recommended that the implementation plan includes the elimination of these non-standard taxiway configurations.

3.2.3.3 Exit Taxiways

While the runway at 4N1 can accommodate the aircraft fleet mix based on landing length requirements, the location of the exit taxiways can have a significant impact on the capacity of the runway system.

FAA AC 150/5300-13A provides exit taxiway cumulative utilization percentages based on exit taxiway location and aircraft size. **Table 3-13** shows the percentages of the small aircraft of 12,500 lbs or less (both single engine and twin engine) that could decelerate sufficiently to use specific exit taxiways under wet and dry runway conditions. For instance, Taxiway A3 (approximately 2,612 feet from the Runway 06 threshold) can be used by 84 percent of small single-engine aircraft to exit on a wet runway and 99 percent on a dry runway respectively; Taxiway B, which is very close to Runway 06 could only be used by four percent and six percent of small single-engine aircraft for exit respectively under wet and dry conditions.

Table 3-13. Exit Taxiways Cumulative Utilization Percentages

Exit Taxiway	Distance from Threshold (ft)	Wet Runways		Dry Runways	
		Right Angled Exits		Right Angled Exits	
		Small, Single Engine	Small, Twin Engine	Small, Single Engine	Small, Twin Engine
Approach Traffic on Runway 06					
Taxiway B	926	4%	0%	6%	0%
Taxiway A2	1,958	60%	0%	84%	1%
Taxiway A3	2,612	84%	1%	99%	10%
Taxiway A5	3,276	96%	10%	100%	39%
Approach Traffic on Runway 24					
Taxiway A2	1,510	23%	0%	39%	0%
Taxiway B	2,542	84%	1%	99%	10%
Taxiway A1	3,800	99%	41%	100%	39%

Notes:

- (1) The percentages are estimated based on Table 4-13 in FAA AC 150/5300-13A.

It is important to note that while Runway 06/24 and its associated exit taxiing distances are not long enough to support the majority of the small, twin-engine fleet available in the industry, they are adequate to support the representative fleet mix at 4N1. **Figure 3-13** depicts the locations of the exit taxiways along Runway 06/24 relative to the landing length requirements for the 4N1 fleet mix. The traffic light color scheme indicates an aircraft's relative ability to utilize the exits and includes the following:

- Red indicates the distance an aircraft cannot exit the runway due to its speed at that point,
- Yellow indicates a distance an aircraft can potentially exit the runway depending on deceleration rate, which varies based on weather conditions and airline or pilot operational procedures, and
- Green indicates a distance that the aircraft can exit the runway with conservative deceleration rates.

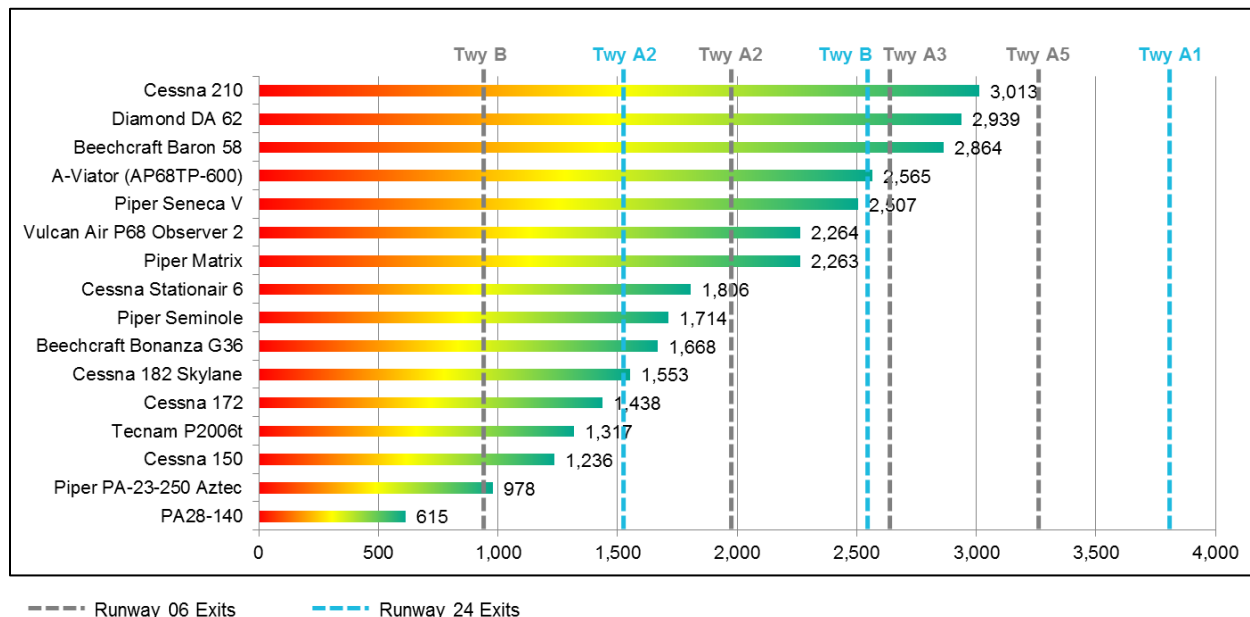


Figure 3-13. Runway 06/24 Taxiway Exit Locations

Sources: Aircraft manufacturers' specifications.

As indicated on **Figure 3-13**, most of the representative fleet mix could decelerate adequately to exit from Taxiways A3 and A5 when landing on Runway 06, and from Taxiways B and A1 when landing on Runway 24. When reconfiguring the non-standard taxiway geometries, it is important to retain exit taxiways at appropriate locations.

3.2.4 Navigational Aids

Greenwood Lake Airport has two "RNAV (GPS)" (Area Navigation and Global Positioning System) non-precision approaches with Lateral Navigation (LNAV), Lateral Precision (LP), and circling Minimum Descent Altitudes (MDAs). LP approaches provide the lowest possible MDA at airports where obstructions and/or infrastructure prevent an LPV procedure.

The Wide Area Augmentation System (WAAS) is a navigation system comprised of satellites and ground stations that improve the accuracy of GPS and offers an opportunity for airports to gain Instrument Landing System (ILS)-like approach capability without the purchase or installation of any ground-based navigation equipment at the airport. Localizer Performance with Vertical Guidance (or LPV) approaches are WAAS-enabled vertically guided approach procedures that can provide minimums as low as 200 feet. The FAA plans to publish 300 WAAS approach procedures per year to provide service to all qualifying instrument runways within the U.S. National Airspace System (NAS). Should 4N1 be interested in adding one or two LPVs, the Airport could work with the FAA to determine if this type of approach can be accommodated. Additional land acquisition, obstacle clearing, and/or upgrading the runway markings may

be needed. Once the scope of the infrastructure needs is understood, the feasibility of its implementation, along with options for funding, is to be further discussed.

While the Airport may be well served with instrument approaches, it does not currently have onsite weather equipment/capabilities. According to the FAA's Surface Weather Observation Stations (ASOS/AWOS) website²³, the closest weather reporting station, an Automated Surface Observing System (ASOS), is at Sussex Airport (FWN), 13.2 NM to the west. No other stations are found within at least a 50 NM radius of 4N1.

The installation of a weather reporting station at the Airport, whether an Automated Weather Observing System (AWOS), an Automated Weather Sensor System (AWSS) or an ASOS, is recommended. Controllers issue Special VFR and IFR clearances based on pilot request, known traffic, and reported weather when they are available. At non-towered airports, pilots determine the current airport weather from ASOS/AWSS/AWOS. In addition, pilots in Class E airspace (Class E starts at 700 AGL at 4N1) must be alert for changing weather conditions which may affect the status of the airspace from IFR/VFR. Without proper onsite weather equipment, pilots may choose to not fly into 4N1. The unpredictability of not knowing the weather conditions upon arrival discourages a pilot from flying in. If not able to successfully land at the planned airport, the need to fly to their alternate will completely change their arrival plans (meeting location, arrival time, ground transportation arrangement, etc.). While 13 miles between 4N1 and FWN may not seem like a significant distance, the weather could be drastically different at both. While one airport may be surrounded by a rain cell, the other may have clear skies. In addition, while FWN's weather information should be available from the air within 25 nautical miles of FWN, it may not be accessible from the ground at 4N1 via aircraft frequency.

3.2.5 Summary

In summary, the following improvements should be provided to the airfield at 4N1 to meet FAA standards and accommodate future demand.

Runway Improvements

- Standardizing the parallel taxiway separation from runway centerline if possible
- Standardizing the holding positions separation from runway centerline if possible
- Removing trees from the ROFZ, RSA, and ROFA
- Providing standard surface gradients within RSA
- Providing mitigation for properties and public roadways within RPZs
- Providing mitigation for the obstructions to the Runway 24 20:1 Threshold Siting Surfaces (TSS)
- Optional:
 - Adding a blast pad to Runway 06
 - Widening the blast pad of Runway 24 to 80 feet and standardizing the chevron markings

Taxiway Improvements

- Reconfiguring non-standard taxiway geometries
- Providing taxiway naming
- Relocating the security fence from the TOFA **along future taxiway B**
- Removing trees within the TOFA
- Providing taxilane markings if possible

²³ Source: Federal Aviation Administration (2016, December 16). *Surface Weather Observation Stations (ASOS/AWOS)*. Retrieved on November 13, 2017, from https://www.faa.gov/air_traffic/weather/asos/?state=NJ

Navigational Aids Improvements

- Optional:
 - Investigate the feasibility of adding a WAAS approach
 - Installing a weather reporting station at the Airport (AWOS/AWSS/ASOS)

3.3 General Aviation

This section reviews the capacity of General Aviation (GA) infrastructure to accommodate existing and forecasted demand. The GA facilities analyzed in this section include tie-down parking, hangars, and a GA terminal. The facility requirements utilize FAA design standards, industry standard planning factors, and site specific conditions. FAA design standards and industry standard planning factors were referenced from the following guidance:

- FAA Advisory Circular 150/5300-13A (Change 1), *Airport Design*
- TRB ACRP Report 113: Guidebook on General Aviation Facility Planning

GA aircraft are typically categorized into two groups – based aircraft and transient aircraft. Based aircraft are aircraft normally stored at a particular airport, requiring a parking position on either the apron or inside of a hangar. The tenants (pilots, aircraft owners, and/or aircraft operators) elect between the two parking options after considering availability, price, geographic location, weather, the aircraft (type, size, condition, age, needs, etc.), and their needs (maintenance, storage of parts, usage, etc.) among other things. Transient aircraft do not rent parking positions at 4N1 and only use the airport for takeoff and landing purposes.

The aircraft apron typically requires the largest area of a GA facility because it provides adequate aircraft parking positions, clearance from other fixed and/or movable objects, and access to/from different areas of the airfield. Three types of hangars are typically provided at GA airports: T-hangars, box (or corporate) hangars, and conventional (or community) hangars, in that order from smallest to largest.

In addition, some airports also offer shaded structures (also known as shaded shelters or shaded covers). These are basic, open-ended structures that provide a roof and sometimes side walls to shield aircraft from the sun and other weather elements. They can be made of steel or fabric. There is one aircraft per shaded spot even if part of a long structure of shaded spots.

Taxilanes are usually provided for access between taxiways and aircraft parking positions. Lower taxiing speeds on taxilanes allow for reduced standards for safety areas and Object Free Areas (OFAs). Currently, none of the taxilanes are marked at 4N1.

3.3.1 Tie-Down Parking

Aircraft that are not stored in a hangar utilize an open-air aircraft parking apron. Both based aircraft and transient aircraft could use the tie-down parking positions on the apron. Also, helicopters are parked on the apron at 4N1.

3.3.1.1 Based Aircraft Tie-Down Parking Requirements

Based aircraft parking aprons normally have lower activity but a higher density as aircraft are parked for longer periods of time. According to [Section 1.2.2](#), Terminal Area and Aircraft Parking Aprons, the Airport has 45 tie-down parking positions for based aircraft. According to rental records, 78 percent of the tie-down spots are currently occupied. **Table 3-14** provides more occupation details for each tie-down area.

Table 3-14. Tie-Down Parking for Based Aircraft

Tie-Down Area	Total Tie-Down Spots	Occupied Tie-Down Spots ²	Empty Tie-Down Spots ²	Pavement Type	Taxilane Access
B	17	16	1	Paved	Dual
C	12 ¹	7	5	Grass	Single
D	4	3	1	Paved	Single
I	7	5	2	Paved	Single
K	5	4	1	Paved	Single
Total	45	35	10	--	--

Notes:

- (1) According to the Airport operator, only three to five out of twelve spots are currently in good condition (due to moisture, winter weather, grass length, etc.) to be rented.
- (2) Empty tie-down spots as of December 2016.

Sources:

- (1) Greenwood Lake Airport's Tie-Down Diagram.
- (2) Greenwood Lake Airport's Rental Records.
- (3) AECOM Analysis.

All tie-downs have three hooks on the ground to enable aircraft to be secured to the ground; however, the Airport does not provide straps or any cable attachment to connect the based aircraft to the hooks. The pilots or aircraft owners are responsible for providing them.

Limited hangar capacity translates to additional demand on the parking apron. However, without sufficient apron capacity, the apron will become constrained as the based aircraft grow at 4N1. Therefore, adequate sizing of the parking apron is required to maximize efficiency.

The first element in determining the adequate size of an aircraft parking apron is to identify the number of required aircraft positions. **Chapter 2 Aviation Activity Forecasts**, projects 51 based aircraft by 2036. The recommendation based on discussion with the Airport sponsor is for 50 percent of those aircraft to be stored indoor. Therefore, the remaining 50 percent of aircraft, which amounts to 26, are expected to be parked on the apron. Since the available based aircraft tie-down positions are 45, the Airport has sufficient positions for accommodating the 26 based aircraft.

The second element in identifying an adequate aircraft parking apron is to determine the type of aircraft that will utilize the facilities. Given the critical aircraft Beechcraft Baron 58, the size of the aircraft parking apron should be at least based on ADG-I taxilane design standards as summarized in **Table 3-15**.

Table 3-15. FAA Design Standards for ADG I

Items	ADG I Requirement (in feet)	Deficiency
Taxiway/Taxilane Safety Area (TSA)	49	--
Taxilane Object Free Area (OFA)	79	Does not meet FAA standards
Taxilane Centerline to Fixed or Movable Object	39.5	Does not meet FAA standards
Taxilane Wingtip Clearance	15	Does not meet FAA standards

Data Source: FAA Advisory Circular 150/150-13A, Airport Design.

The existing number of tie-down positions is sufficient to accommodate the current and forecasted based aircraft. However, according to ACRP Report 113, the main apron depth for two single rows of tie-downs

with a single taxilane in between (as delineated by existing tie-down areas B, C, and D) should be at least 145 feet, composed of two, 33 foot parking areas plus an ADG-I, 79-foot taxilane OFA in between, as illustrated on **Figure 3-14**. The existing parking apron depth varies between the paved and grass row but overall the depth is less than 145 feet. Therefore, although there is sufficient number of parking positions on the tie-down apron to accommodate the forecasted number of based aircraft, the apron still requires reconfiguration to meet safety standards.

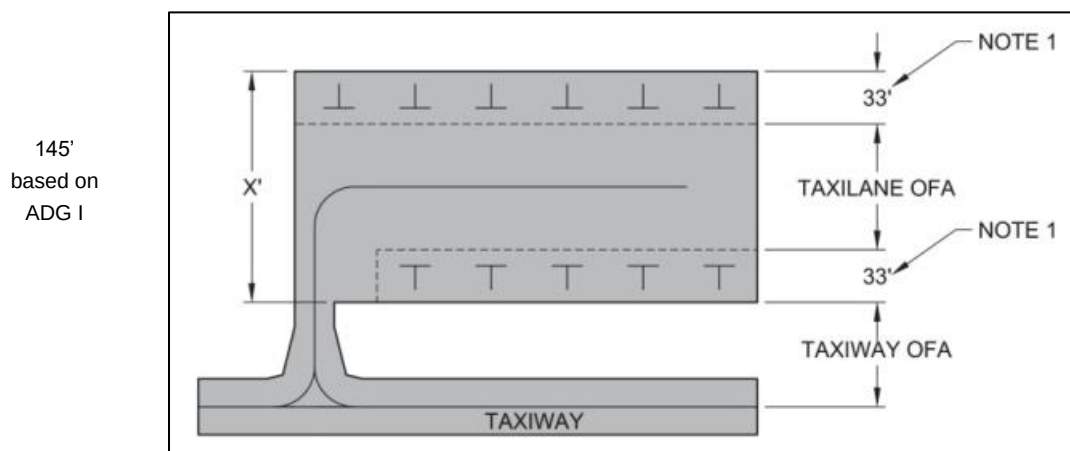


Figure 3-14. Depth for Tie-Down Aprons

Sources:

- (1) Transportation Research Board (2016, October 20). Guidebook on General Aviation Facility Planning. Retrieved on November 6, 2017, from <http://www.trb.org/ACRP/Blurbs/171315.aspx>
- (2) AECOM Analysis.

It is also recommended that the Airport marks the taxilanes to avoid any confusion to the pilots entering or exiting the tie-down area and to ensure proper clearance is maintained between aircraft and fixed and moveable objects.

3.3.1.2 Transient Aircraft Tie-Down Parking Requirements

Transient aprons are utilized by aircraft that are only at the airport on a short-term basis and usually have higher activity and turnover but lower density. Transient aprons are best located near GA terminal buildings.

Section 1.2.2 Terminal Area and Aircraft Parking Aprons, identifies the transient aircraft parking area as the apron area immediately adjacent to and to the west of the terminal building and the Constellation aircraft. It also states that the area is approximately 1.78 acres and has tie-down locations for up to six ADG-I aircraft in addition to two helicopter pads. All six transient tie-downs have three hooks on the ground and straps to enable aircraft to be tied down and secured to the ground. The Airport operator indicated that the six transient spots are often occupied.

In addition, the Airport operator also indicated that larger transient aircraft, such as King Air or Pilatus, are sometimes parked across the field, on the decommissioned runway (as indicated by **Figure 3-15**) due to lack of ADG-II parking space in the apron area. They are normally tugged across the field to and from the overflow transient parking area.

The decommissioned runway is also utilized for an airshow each year sponsored by Greenwood Lake Airport that brings significant economic activity to the airport and surrounding community. The airshow requires that a variety of aircraft access the airport for this important event. Overflow aircraft parking for this event utilizes the decommissioned runway pavement located to the north of runway. Maintaining the ability to park aircraft in this area is important for this event and other unique airport activities that create special one-time demands. Larger transient helicopters also use this area for parking and training. It is

recommended that this pavement be preserved for utilization by aircraft/equipment during specialty and overflow conditions.

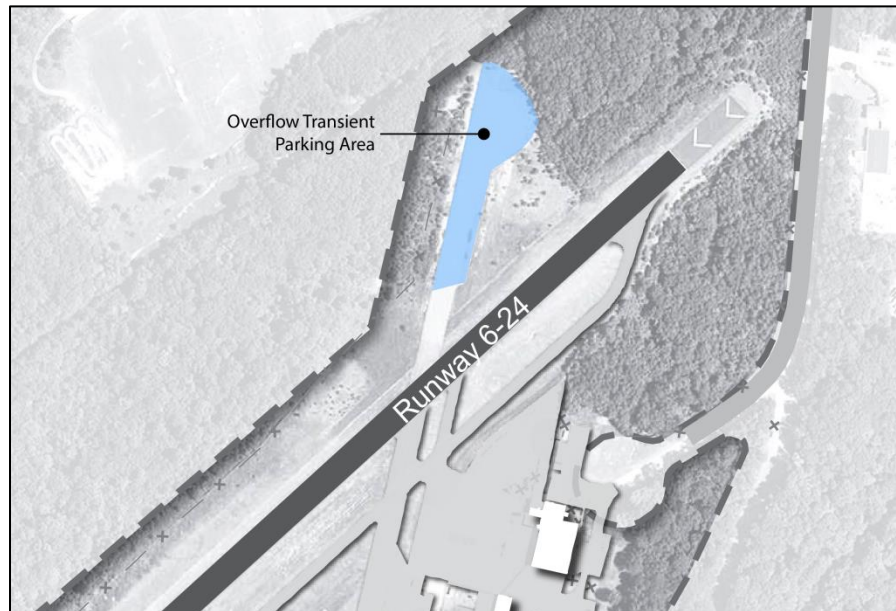


Figure 3-15. Overflow Transient Parking Area

Data Source: Google Earth.

The number of forecasted aircraft parking positions required for transient aircraft is determined through the methods provided in Appendix C of the ACRP Report 113. The ACRP method utilizes annual transient operations (itinerant general aviation and air taxi are considered transient) to identify an adequate number of parking positions.

The ACRP formula is:

$(X / 2 * T) / 365 * P = \text{Number of Transient Parking Positions}$, where:

X = Number of general aviation operations (20,000 by 2036 based on the baseline scenario)

T = Percentage of operations which are transient (20 percent according to **Table 2-12** of the Aviation Activity Forecasts)

P = Percentage of transient aircraft that are parked on the apron at any one time (assuming 90 percent outdoor, 10 percent indoor)

Therefore, the required number of transient tie-down positions by 2036 is:

$$(20,000 / 2 * 0.20) / 365 * 0.90 = 5$$

Since the existing transient apron has parking positions for six aircraft and two helicopters, and the based aircraft area has an excess number of tie-downs, **no additional tie-down positions are expected for transient aircraft. However, adding one or two ADG II parking spots should be considered.**

3.3.1.3 Helicopter Parking Area

Review of the Airport's Chart Supplement (Shown in **Figure 3-16**) indicates that the Airport does not have any helipads. However, the Airport has two "taxi-through" helicopter parking areas/pads (shown in **Figure 3-17**) in the transient apron located next to the main terminal building. The pad circles have an approximate 25-foot radius and they are about 85 feet apart from mid-point to mid-point. The circles are designed for the helicopters to come in from the south and park facing north. The parking identification markings (shown in **Figure 3-18**) show A-44 on the east position and B-46 on the west position, which

means the maximum helicopter lengths Positions A and B could accommodate are respectively 44 feet and 46 feet.

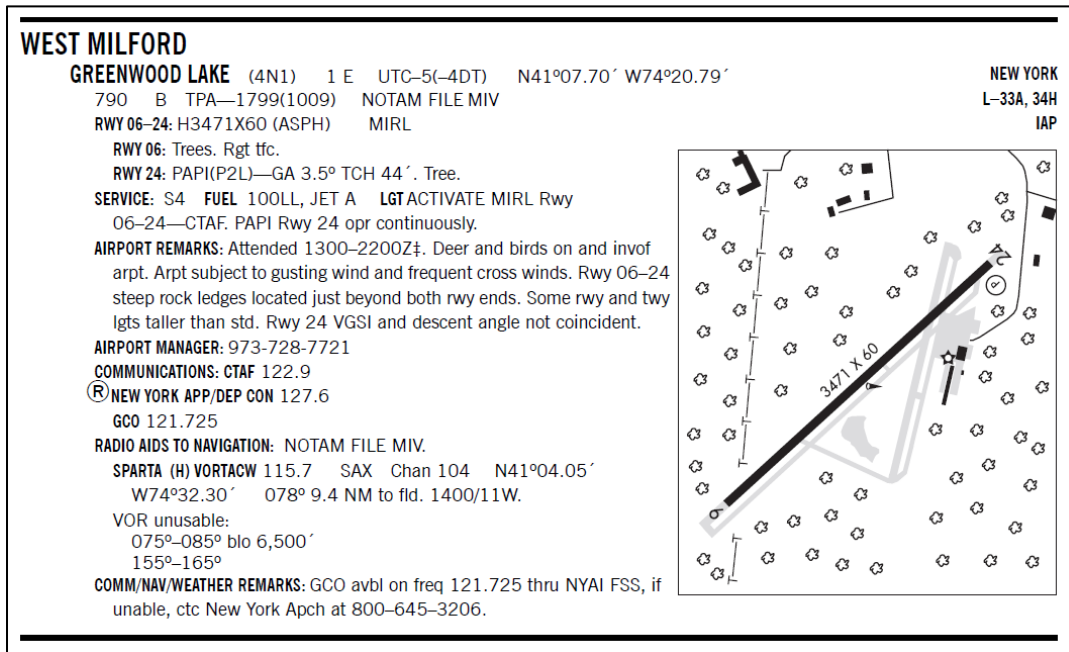


Figure 3-16. 4N1's Chart Supplement

Data Source: Federal Aviation Administration (http://aeronav.faa.gov/afd/12oct2017/ne_179_12OCT2017.pdf).



Figure 3-17. Existing Helicopter Pads

Source: Google Earth.



Figure 3-18. Existing Helipad Identification Markings

Source: AECOM (2017)

Hackensack University Medical Center (UMC) routinely operates AirMed One, an EC-135 helicopter, out of those pads. AirMed One is normally also stored in one of these two pads. While they would like to store the helicopter in the maintenance hangar more often, it is only stored inside during bad weather or when undergoing heavier maintenance.

A helicopter parking pad is similar to an apron used for parking fixed-wing aircraft. The size of the apron depends on the number and size of specific helicopters to be accommodated. In addition, if the position is expected to serve emergency service or medical uses (such as in this case), it is important to leave adequate space to provide access for vehicles such as ambulances between the airfield areas and the vehicular parking areas.

FAA recommendations and standards for helicopter facilities on airports are documented in Chapter 5 of AC 150/5390-2C, *Heliport Design*²⁴. The AC provides standards for the design of facilities serving helicopters with single rotors. In addition, the standards in Chapter 2, General Aviation Heliports, apply to helicopter facilities serving general aviation operations as well. **Figure 3-19** shows the template for “taxi-through” and “back-out” parking position markings for general aviation helicopters found in Figure 2-20 of the AC.

²⁴ Federal Aviation Administration (2012, April 24). *Heliport Design*. Retrieved on November 6, 2017, from https://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5390_2c.pdf

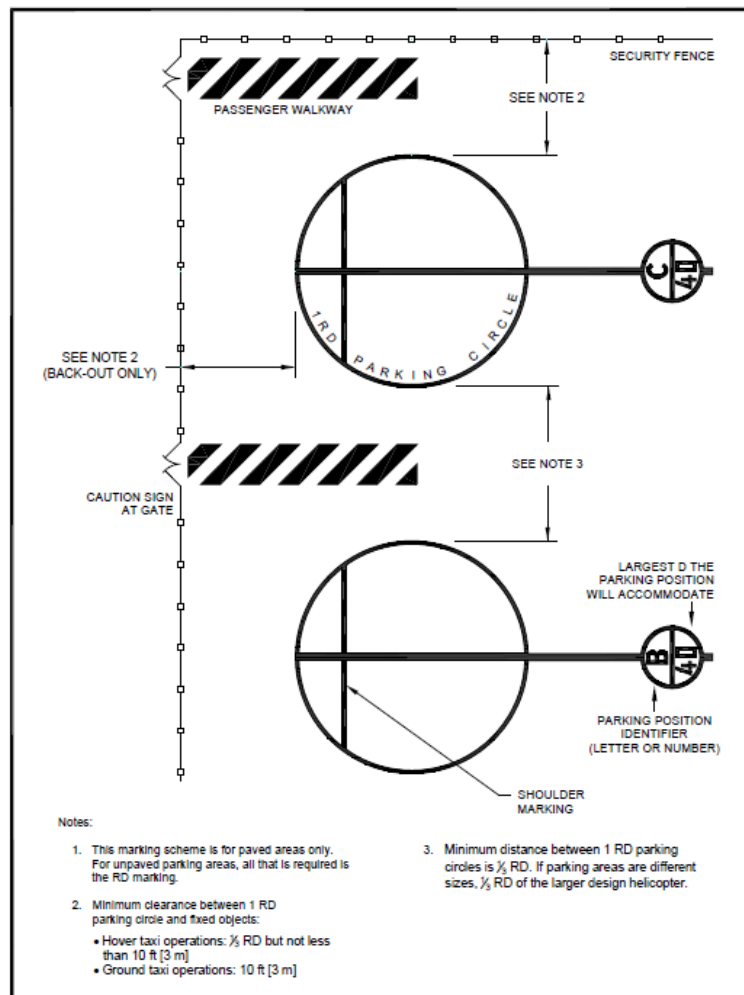


Figure 3-19. Taxi-Through and Back-out Parking Position Marking for GA

Source: Federal Aviation Administration (https://www.faa.gov/documentLibrary/media/Advisory_Circular/150_5390_2c.pdf).

Hackensack UMC is currently the only tenant operating helicopters. While they are currently operating an EC-135 (**Figure 3-20** displays its exterior dimensions), they are considering upgrading to an EC-145 (**Figure 3-21** displays its exterior dimensions) in the near future so this will become 4N1's critical helicopter.

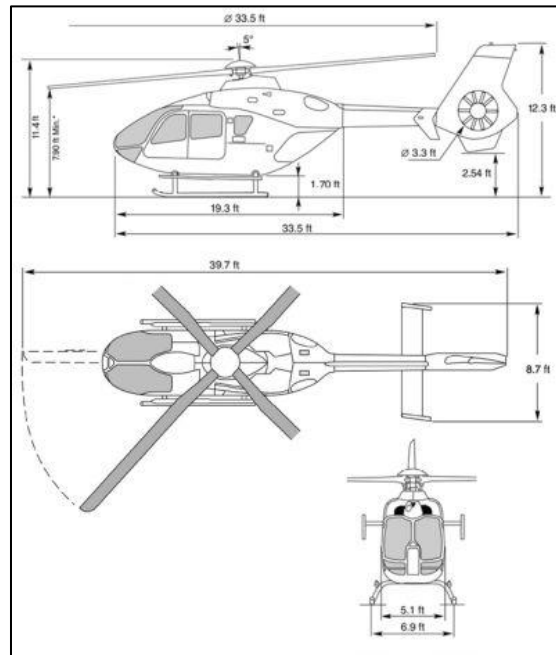


Figure 3-20. EC-135 Dimensions

Source: Airbus Helicopters (2017). H135 (formerly known as EC135) specifications. Retrieved on November 7, 2017, from <http://airbushelicoptersinc.com/products/H135-specifications.asp>

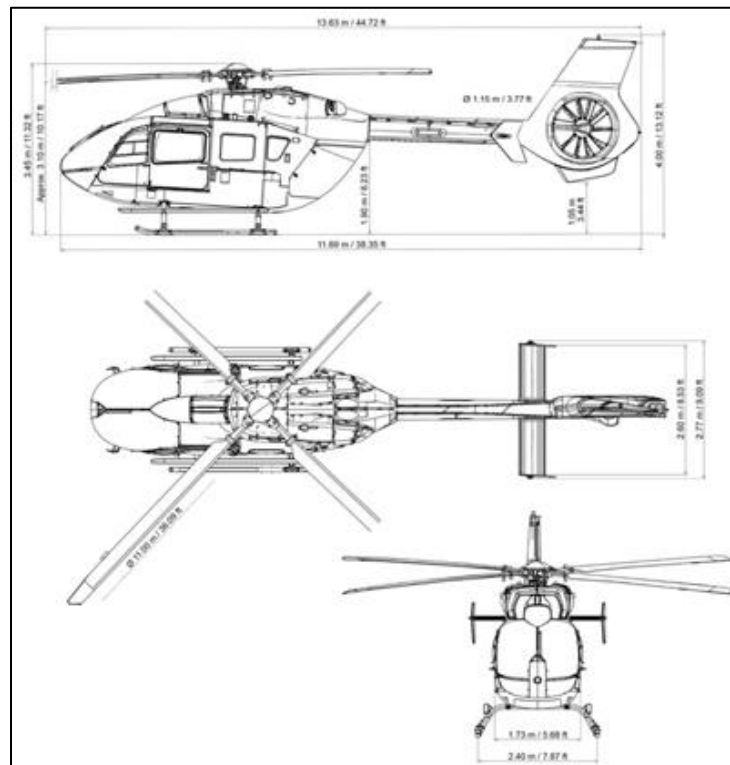


Figure 3-21. EC-145 Dimensions

Source: Airbus Helicopters (2017). H145 (formerly known as EC145 T2) Documentation. Retrieved on December 5, 2017, from <http://airbushelicoptersinc.com/products/H145-specifications.asp>

Since these dimension figures from Airbus do not include all necessary information, **Table 3-16** lists the rest.

Table 3-16. EC-135 and EC-145 Dimensions

Helicopter	Overall Length (ft)	Overall Height (ft)	Main Rotor		Undercarriage	
			Rotor Diameter (ft)	Ground Clearance (ft)	Length (ft)	Width (ft)
EC-135	40	11.5	33.5	11	10.5	6.6
EC-145/UH-72A	42.7	13	36.1	11.3	9.5	7.9

Data Source: FAA Advisory Circular 150/5390-2C, *Helipad Design*.

The helicopter parking pads at 4N1 appear to exceed AC 150/5390-2C's standards for "taxi-through" and "back-out" parking positions for the critical helicopter (except that passenger walkways are not marked), as summarized in **Table 3-17**.

Table 3-17. FAA Standards for Taxi-Through Helicopter Parking Positions

Helicopter Parking Dimensions	Minimum Requirements (EC-145 as Design Aircraft)	Existing Conditions	Deficiency
Parking Circle Diameter	1 RD (i.e. 36.1 feet)	Position A: 44 feet Position B: 46 feet	None
Distance between Parking Circles	1/3 RD (i.e. 12 feet) or 10 feet	40 feet	None
Distance between Parking Circles and Fixed Objects	1/3 RD (i.e. 12 feet) or 10 feet	At least 40 feet	None

The FAA's Aeronautical Information Manual (AIM)²⁵ addresses helicopter and fixed-wing aircraft in relation to wake turbulence in Section 7-3-7, Helicopters. It states that helicopter main rotors, in slow hover taxi or stationary hovers, generate downwash producing high velocity outwash vortices to a distance approximately three times the diameter of the rotor. The diameter of the EC-145 is 36.1 feet so it is said to produce rotor wash within 108 feet of its location. **Figure 3-22** shows how the closest helipad to other parking areas and the self-serve fuel farm at 4N1 has a clear 100-foot radius around it, making it a good, safe location for all involved, yet close to the FBO. Clearances from the other helicopter parking position are not as robust. The AIM also points out that pilots of small aircraft should avoid operating within three rotor diameters of any helicopter in a slow hover taxi or stationary hover. In addition, there is sufficient room around the helipad parking positions for ambulances to load and unload patients.

²⁵ Federal Aviation Administration (2017, October 12). *Aeronautical Information Manual*. Retrieved on November 7, 2017, from https://www.faa.gov/air_traffic/publications/media/aim_10-12-17.pdf



Figure 3-22. 4N1 Helipad with 100 Feet Radius

Source: Google Earth.

Since there is only one helicopter currently based at the Airport and the Airport has two helicopter pads providing one additional space for future based helicopter or usage by a transient helicopter, no additional helicopter parking pads are recommended at this point.

3.3.2 Hangar Storage

Three types of hangars are typically provided at GA airports: T-hangars, box (or corporate) hangars, and conventional (or community) hangars.

3.3.2.1 T-Hangars

4N1 currently has one T-Hangar with 12 bays for based aircraft. T-hangars are covered unit structures (made out of wood, steel, concrete, corrugated metal, or aluminum) for individual aircraft. They typically have common walls, are part of a long building (four to twelve bays), and often offer a tight fit. Doors generally slide horizontally and stack to the side of the hangar opening. Others have bi-fold doors which retract up. Aircraft owners are allowed privacy and individual access to their own unit.



Figure 3-23. T-Hangars at 4N1

The size of a T-hangar bay is dependent upon the type of aircraft to be stored. The length of a T-hangar row is dependent upon the number of aircraft to be stored in one building. The width of a T-hangar row is dependent upon the type of layout to choose from: nested or standard. Figure 3-24 shows both layout options.



10 Unit Nested T-Hangar Layout **10 Unit Standard T-Hangar Layout**
Figure 3-24. Types of T-Hangar Layouts

Source: Transportation Research Board (2016, October 20). Guidebook on General Aviation Facility Planning. Retrieved on November 6, 2017, from <http://www.trb.org/ACRP/Blurbs/171315.aspx>

Typically, T-hangars are designed to accommodate smaller GA aircraft. As discussed in [Section 2.6.3 Critical Aircraft](#), the existing and forecasted critical aircraft group for 4N1 is B-I(S), meaning it is designed for smaller GA aircraft with tail heights lower than 20 feet and a wingspan less than 49 feet.

The T-hangar at 4N1 is of standard design. Each T-hangar bay at 4N1 is approximately 1,000 square feet with a 42-foot hangar door opening. The existing T-hangar at 4N1 is approximately 386 feet long by 32 feet deep.

ACRP Report 113, Guidebook on General Aviation Facility Planning²⁶, recommends single T-Hangar units have the dimensions shown in **Figure 3-25** and a row of 12 units in standard configuration to be 389 feet long by 36 feet deep. 4N1's individual T-hangar dimensions are similar to ACRP's recommendation.

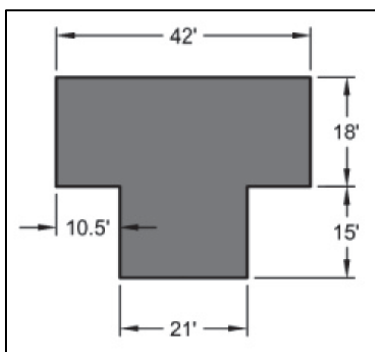


Figure 3-25. Single T-Hangar Unit Dimensions

Source: Transportation Research Board (2016, October 20). Guidebook on General Aviation Facility Planning. Retrieved on November 6, 2017, from <http://www.trb.org/ACRP/Blurbs/171315.aspx>

The existing T-hangar building, built in the 1970s, is approximately 50 years old and is in poor condition. The building should be demolished and reconstructed.

All T-Hangar bays at 4N1 are currently occupied with based tenants so no transient aircraft can be parked in T-hangar bays. However, it is not typical for transient aircraft to occupy T-hangars. T-hangars are almost always occupied by based tenants at airports throughout the country. Therefore, T-hangar units for transient traffic are not recommended.

3.3.2.2 Box Hangars

Greenwood Lake Airport does not currently have any box hangars. Box hangars are also referred to as “corporate hangars.” They are characterized as high-bay, clear span, rectangular structure often capable of accommodating two or more aircraft.

²⁶ Transportation Research Board (2016, October 20). Guidebook on General Aviation Facility Planning. Retrieved on November 6, 2017, from <http://www.trb.org/ACRP/Blurbs/171315.aspx>



Figure 3-26. Sample Small Box Hangar at Another Airport

Box hangars vary in size, but are commonly an intermediate size between a T-hangar and a conventional/community hangar. Box hangars are typically square-shaped and accommodate three to six aircraft. The key dimensions of a box hangar bay are clear door opening width and height, as well as bay depth. Box hangars are generally separated from other hangars, but sometimes they are joined side by side in groups of four to six bays in one building.

Aircraft owners are allowed privacy and individual access to their space. These hangars are often used for storing business jets, including small jets (such as Citation IIs, IIIs, and IVs or the Beechcraft Premier) and turboprops (such as King Airs). They often feature attached offices, lounges, and bathrooms. Commonly, corporations work with the airport owner and an airport developer to build box hangars.

For based aircraft, box hangars are a good alternative to T-hangars. If the Airport chooses to consider building box hangar(s), transient aircraft could be stored there as well.

3.3.2.1 Conventional Hangars

4N1 currently has one conventional hangar where maintenance services are performed and where two based aircraft (and on occasion, the Hackensack helicopter) are stored.



Figure 3-27. Conventional Hangar at 4N1

Conventional hangars are also referred to as “community hangars”. They are the largest type of hangars compared to T-hangars and box hangars.

Conventional hangars also vary in size and are able to accommodate several aircraft, from small single-engine aircraft to large-size jets and helicopters. Similar to box hangars, the key dimensions of community hangar bays are clear door opening width and height and bay depth. They are open-space facilities with no interior supporting structure. Often, other airport services are offered from community hangars, such as Fixed Base Operator (FBO) activities including maintenance.

The existing maintenance hangar is a conventional hangar. A maintenance hangar can serve both aircraft storage and maintenance purposes. It has an area of approximately 7,200 square feet and is well connected to the apron, terminal building, and administrative offices. Light aircraft maintenance (not including avionics) is performed. The hangar is 85 feet by 85 feet and has enough space for storage and tools in a parts office. In addition to maintenance services, the hangar can accommodate up to six ADG I aircraft assuming two are on lifts, as shown on **Figure 3-28**.

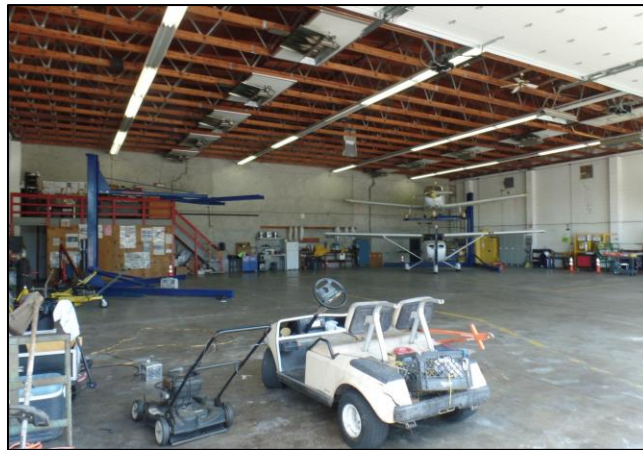


Figure 3-28. Interior of the Maintenance Hangar

Based on current activity and discussions with the Airport operator, the Airport does not need an additional maintenance hangar unless an avionics provider decides to start operating out of 4N1, something the airport operator is actively searching for.

For based aircraft, conventional hangars are also a good alternative to T-hangars. If the Airport chooses to consider building conventional hangar(s), transient aircraft could be stored there as well.

3.3.2.2 Recommended Storage

Section 2.13 Summary, projects that the number of based aircraft at 4N1 will increase from 46 today to 51 aircraft in the planning horizon with the following breakdown:

- 46 Single-Engine (90.2 percent)
- 3 Multi-Engine (5.9 percent), with the Beechcraft Baron as the critical aircraft
- 1 Helicopter (2 percent)
- 1 Other (2 percent)

The current 12 T-hangar bays at 4N1 accommodate approximately 26 percent of the existing based aircraft or 24 percent of the projected based aircraft in 20 years. The rental records indicate that all the units are currently occupied. According to the Airport operator, there is a waiting list that fluctuates between 15 and 20 aircraft for the T-hangar space. In addition, if given the option, some of the tie-down tenants are believed to prefer a T-hangar over an outdoor position exposed to weather elements. The operator also explained that the Airport has lost rental business in the past to nearby airports due to the lack of adequate hangar space.

Some aircraft owners simply refuse to park their aircraft outside because T-hangars offer storage for aircraft parts and equipment (such as tools, engine oil, charts, headsets, or seats) and protect the aircraft from:

- Apron rash (incidents where a tug, a vehicle, or another aircraft damage a parked aircraft)
- Normal deterioration from the weather elements (such as tire pressure changes, snow or ice accumulation, or rust amongst others)
- Weather damage (each year, numerous aircraft are needlessly damaged or totaled by storms because of inattention to weather forecasts, lack of hangar facilities, or improper tie-down procedures)
- Security concerns (aircraft break-ins, theft, etc.)

ACRP Report 113 states that “most State Airport System Plans that have guidance on storage of based aircraft recommend that 75 to 100 percent should be stored in hangars.” However, consideration of historical records of based aircraft storage, demand for hangars (waiting lists), available development space, and funding should also be taken into account. Based on discussions with the airport sponsor, it would be desirable to store approximately 50% of the based aircraft in hangars. Therefore, in addition to rehabilitating or rebuilding the existing 12 T-hangar units, additional hangar storage for another 12 to 14 aircraft is recommended.

These additional hangar spaces can be provided as T-hangars and/or as part of box hangars and conventional hangars. If the Airport chooses to consider box or conventional hangars, these hangars could store transient aircraft in addition to based aircraft. Based on conversations with the airport sponsor, it would be ideal to provide enough hangar space so that 10% of the transient aircraft, which translate to one aircraft, could be parked indoors.

As one of the state’s core general service aviation airports, the GA aircraft operating at 4N1 primarily consist of single and twin-engine planes, such as a Cessna 182 Skylane, a Beechcraft Baron 58, or a Piper PA-23-250 Aztec. The new hangars should be sized to at least accommodate the Airport’s critical aircraft, the Beechcraft Baron 58. **Table 3-18** provides dimensions for the Beechcraft Baron 58.

The T-hangar dimensions shown in **Figure 3-25** would meet the need of Beechcraft Barons (and, therefore, all smaller based aircraft). The opening of the door should accommodate the Baron’s tail (height of 9.75 feet).

Should the Airport decide to add a helicopter flight school as advocated by the operator, Robinson 22 and 44 helicopters can provide sizing references as these are the most widely used helicopter trainers nationwide.

If box/conventional hangars are selected, larger aircraft, such as King Air or Pilatus, could also be stored indoor. Section 3.3.1.2 Transient Aircraft Tie-Down Parking Requirements, notes how these larger aircraft are often parked across the field, on the old, closed runway because the Airport does not currently have apron or hangar space for them.

Table 3-18 provides characteristics and dimensions for the above-mentioned aircraft.

Table 3-18. Aircraft Data

Aircraft	Airplane Design Group (ADG)	Taxiway Design Group (TDG)	Wingspan (in feet)	Length (in feet)	Height (in feet)
Beechcraft Baron 58	I	1A	37.83	29.83	9.75
Cessna 182T Skylane	I	1A	36.10	29.00	9.2
Piper PA-23-250 Aztec	I	1A	37.17	31.23	10.3
Robinson 22 Beta II	--	--	Length 28.75 Rotor Diameter 25.16		8.92
Robinson 44 Raven II	--	--	Length 38.25 Rotor Diameter 33.01		10.75
King Air C90GTx	II	1A	53.67	35.50	14.25
King Air B200	II	2	54.49	43.77	14.80
King Air 350i	II	2	57.92	46.65	14.34
Pilatus PC-12 NG	II	2	53.25	47.24	14.00

Sources:

- (1) FAA Aircraft Characteristics (September 2017). Appendix 1 of FAA AC 150/5300-13A, Airport Design.
- (2) Aircraft Manufacturer's Technical Specifications.
- (3) Transoft Solutions' Aircraft Data Viewer 3.0.
- (4) Piper PA-23-250 Aztec C Owner's Handbook (<http://www.flyblocktime.com/pdf/OPERATION/PA23-250.pdf>).
- (5) King Air B200 Specs and Description (<http://jetav.com/hawker-beechcraft-king-air-b200-specs-and-description/>).
- (6) AECOM Analysis (including the most conservative/constraining of all results).

Even though 4N1 is designed as an ADG I airport, to provide operational flexibility, it is recommended to consider ADG II standards for taxiways leading up to a couple of ADG II tie-downs and conventional/box hangars if they are built to accommodate them as well. **Table 3-19** displays the taxiway design standards for ADG II aircraft.

Table 3-19. FAA Design Standards for ADG II

Items	ADG II Requirement (in feet)
Taxiway/Taxilane Safety Area (TSA)	79
Taxilane Object Free Area (OFA)	115
Taxilane Centerline to Fixed or Movable Object	57.5
Taxilane Wingtip Clearance	18

Data Source: FAA Advisory Circular 150/150-13A, Airport Design.

3.3.3 General Aviation Terminal Facilities

General aviation airports typically have at least one building for administrative purposes and customer amenities. 4N1's two-story terminal building, located at 126 Airport Rd. West Milford, New Jersey 07480, houses the Airport's administrative offices, a restaurant, and SkyTraining, LLC (a fixed wing flight school). It also serves as Northeast Aero Services' FBO offering space (such as a pilot lounge, a deck, and a banquet hall) and amenities (such as rental cars) for patrons (based tenants, pilots, and passengers) entering and exiting the airfield. Hackensack University Medical Center's AirMed One has offices located in the rear of the main building. The terminal is connected to the transient aircraft apron, the public parking lot, and the maintenance hangar.

The existing building is 4,460 square feet which is usually the size required for a building for an airport with peak hour operations of 14.

The existing facility does not necessarily require an expansion as it meets the current demand but it could be upgraded and renovated to retain and attract more business.

3.3.4 Summary

In summary, the following improvements should be provided to the GA facilities at 4N1 to meet FAA standards and future demand.

Based and Transient Aircraft Apron Improvements

- Since there are 45 available based aircraft tie-down positions, the Airport has sufficient positions for accommodating the 26 based aircraft.
- Although there is sufficient number of parking positions on the tie-down apron to accommodate the forecasted number of based aircraft, the apron still requires reconfiguration to meet safety standards.
- The Airport should mark the taxilanes inside the apron area to avoid any possible pilot confusion and to ensure proper clearance is maintained between aircraft and fixed and moveable objects.
- No additional tie-down positions are required for transient aircraft. However, Reconfiguration for one or two ADG II parking spots should be considered.

Helicopter Storage Improvements

- Since there is only one helicopter currently operating at the Airport and the Airport has two helicopter pads providing one additional space for future expansion, no additional helicopter parking pads are recommended at this point.
- The two helicopter parking pads appear to exceed the FAA's template for "taxi-through" and "back-out" parking positions for the critical helicopter, the EC-145, except that passenger walkways are not marked. The operators could add passenger walkways markings if preferred. Should the airport desire accommodating a larger helicopter in the future one of the parking positions may need to be relocated.

Hangar Space Improvements

- The existing 12-unit T-hangar building is approximately 50 years old and is not in good condition. It should be rehabilitated or rebuilt. T- hangar units for transient traffic are not recommended.
- Based on discussions with the airport sponsor, it would be desirable to store approximately 50% of the based aircraft in hangars. Therefore, in addition to rehabilitating or rebuilding the existing T-hangars, additional hangar storage for another 12 to 14 aircraft is recommended.
- While the critical aircraft group for 4N1 is a B-I-1A, consideration should be given to ADG-II aircraft when designing new hangar space. The Airport receives some (such as King Airs and Pilatus) on occasion and parking them across the airfield is not desirable to the operators. One ADG-II position is recommended for parking transient aircraft if box/conventional hangar is provided.
- Based on current activity and discussions with the Airport operator, the Airport does not need an additional maintenance hangar. However, the airport operator is actively searching for an avionics provider and a dedicated hangar may be needed for this prospect.

GA Terminal Improvements

- The existing general aviation terminal facility does not require an expansion as it meets the current demand but it could be upgraded and renovated to retain and attract more business.

3.4 Support Facilities

This section will review the existing support infrastructure and equipment (such as for aircraft fueling, Aircraft Rescue and Fire Fighting (ARFF), and servicing of aircraft) needed to meet future demand at 4N1.

3.4.1 Fueling Storage

This analysis evaluates the average demand for aviation fuel (Jet A and 100LL Avgas), the potential need for more fuel storage facilities, and the number of times a fuel shipment would be needed based on existing conditions and the previously prepared activity forecast.

Piston engine aircraft normally burn Avgas (unless they were modified to utilize mogas or diesel) and turbine/jet powered aircraft utilize Jet A.

In [Section 2.10.1.3](#), the airport forecast estimates that based aircraft will grow to 51 aircraft, up from 46 aircraft today based on the following breakdown:

- 46 Single-Engine (90.2 percent), of which the majority are piston and at least three or four may be used for flight training
- 3 Multi-Engine, Piston (5.9 percent), with the Beechcraft Baron as the Airport's critical aircraft
- 1 Helicopter, Turbine (2 percent)
- 1 Other (2 percent)

In addition, [Section 2.11 General Aviation Operations](#), explains that annual aircraft operations are forecasted to range between 18,000 and 20,000 by 2036, of which 80 percent are considered to be local operations and the remaining 20 percent to be itinerant.

As documented in [Section 1.2.3 Support Facilities](#), the existing fuel facilities at 4N1 include the following:

- One Jet A fuel truck (2,200 gallons)
- One Avgas fuel truck (1,200 gallons)
- One Jet A fuel tank (6,000 gallons)
- One Avgas self-serve fuel tank (6,000 gallons)

The fuel tanks were constructed and opened in 2016.

During conversations with the Airport operator and its fuel supplier (currently Purvis Brother, a regional distributor for Phillips 66 Aviation Fuels), the following information was obtained:

- Delivery trucks can carry up to 8,000 gallons (of either fuel).
- The freight cost is a fixed cost so the more gallons the Airport purchases, the lower the "per gallon" cost is.
- Splitting fuel loads with nearby airports/FBOs saves 4N1 on freight costs, resulting in a price similar to a full load price.
- Shipping costs are \$0.08 per gallon of Jet A and \$0.15 per gallon of Avgas.
- 4N1 averages a delivery every six weeks of either Jet A or Avgas. The Airport uses twice as much Jet A as they do Avgas so Jet A deliveries are more common than Avgas deliveries.
- 4N1 averages 4,000 gallons per delivery (of either Jet A or Avgas).
- Most fuel tanks are set up to have 5 percent usable fuel in the bottom (for quality control reasons) so the tanks can never be filled by more than 95 percent of their total capacity to meet required overfill protection.

Bigger fuel tanks would make fuel deliveries more efficient from both an operational and financial standpoint. Since fuel loads are 8,000 gallons, 10,000, or 12,000-gallon tanks (for each Avgas and Jet A) would allow ongoing operations and full load deliveries to avoid having to time deliveries with other airports and to take full advantage of fixed freight costs. However, the existing tanks (6,000 gallons each) are new and it is not uncommon for fuel tanks to last 30 years. Therefore, the need to replace or expand the existing fuel tanks at 4N1 may only be driven by a higher demand for fuel to capitalize on the recent investment made.

As detailed in Section 2.9 Existing General Aviation Communities at 4N1, Hackensack University Medical Center (UMC)'s AirMed One helicopter, operated by Air Methods, and Sky Training LLC, the based flight school, consumed most of the fuel at the Airport in 2016. Below are some other trends identified:

- Increases in activity from the Greenwood Lake Air Show (held over one three-day weekend each year) and by DOWNTOWN Aero
- Stable activity by Hackensack UMC
- Decreases in fuel purchases by the remaining tenants (including the flight school) and self-serve users were also identified.

The Jet A fuel tank was installed to accommodate the Hackensack UMC EC-135 helicopter which has two turbine engines and a 185-gallon fuel (Jet A) capacity with a maximum endurance (with no reserves) of 3.5 hours²⁷. According to the operator, the aircraft operates approximately 428 missions a year, of which 50 are for community/education purposes. The operator purchases between 45 and 55 gallons each time they refuel (a mean of 50 gallons is used for calculations) and they refuel at 4N1 90 percent of the time. Based on that information, it is estimated that the EC-135 purchases approximately 1,605 gallons of Jet A each month²⁸.

In 2016, \$106,804 or 22,788 gallons of Jet A were sold at an average of \$4.69/gallon. Of that, Hackensack purchased \$69,146 or 14,743 gallons²⁹. That is a 65 percent market share. It is also noted that there is a difference of 4,517 gallons between 2016 estimates and operator estimates³⁰ so an average of 17,000 gallons will be used for forecasting purposes.

The operator is expecting to increase the number of missions, up gauge the 4N1-based helicopter from the EC-135 to the EC-145, and add a second helicopter at another airport. While the operator does not expect the second helicopter to impact the operations of the first one, it is expected that the 4N1 helicopter may be used less initially while the crews are training on the new helicopter. The EC-145 helicopter has two turbine engines and a 229-gallon fuel (Jet A) capacity with a maximum range (no reserves) of 367 nautical miles³¹. Based on a direct proportion of the difference in fuel tank size, if the EC-135 was adding 50 gallons of fuel per mission, it is estimated that the EC-145 would add 62 gallons of fuel per mission³².

A 20 percent increase in the number of missions performed by Hackensack's then EC-145 is projected. As such, Greenwood Lake Airport may see the following demand for Jet A:

- Hackensack is forecasted to purchase 20,400 gallons of Jet A per year.

²⁷ Airbus Helicopters (2017). *H135 (formerly known as EC135) specifications*. Retrieved on November 2, 2017, from <http://airbushelicoptersinc.com/products/H135-specifications.asp>

²⁸ 428 missions a year = 35.7 missions a month

90% of 35.7 missions refueling at 4N1 = 32.1 missions a month refueling at 4N1

32.1 missions * 50 gallons/mission = 1,605 gallons purchased a month

²⁹ Historical data provided by the Greenwood Lake Airport ("FuelReport ten year" spreadsheet).

³⁰ 1,605 gallons/month * 12 = 19,260 gallons a year

19,260 – 14,743 = 4,517 gallons difference

³¹ Airbus Helicopters (2017). *EC145 (formerly known as EC145e) specifications*. Retrieved on November 16, 2017, from <http://airbushelicoptersinc.com/products/EC145-specifications.asp>

³² (229 * 50) / 185 = 61.9 gallons

- Hackensack has a 65 percent market share of Jet A purchases and the Jet A purchases by remaining tenants/operators are expected to remain fairly flat. Therefore, non-Hackensack operators are expected to purchase 8,045 gallons of Jet A a year.
- The combined total of Jet A gallons purchased a year is forecasted to be 28,445.
- Based on that total, seven to eight 4,000-gallon Jet A deliveries are estimated to be needed a year.
- Approximately one 4,000-gallon Jet A delivery would be expected to arrive every seven weeks.
- Therefore, the need to expand the existing Jet A tank is not expected based on anticipated demand.
- Additional Jet A fuel trucks are not forecasted to be needed either; however, the existing truck may need replacement due to age and condition.

Annual operations are expected to grow from 18,099 in 2016 to 20,000 in 2036. Based on a direct proportion of the difference in annual operations, if 24,308 gallons of avgas were purchased in 2016 with 18,099 annual operations, it is estimated that 26,861 gallons of Avgas will be purchased by 2036 with 20,000 annual operations. Based on that, almost seven 4,000-gallon Avgas deliveries are estimated to be needed a year. Approximately one 4,000-gallon Jet A delivery would be expected to arrive every seven weeks. Therefore, the need to expand the existing Jet A tank is not expected based on anticipated demand. Additional Avgas fuel trucks are not forecasted to be needed either; however, the existing truck may need replacement due to age and condition. If so, a slightly larger fuel truck (maybe one with capacity for 2,200 gallons, like the Jet A truck) may be considered as a replacement to reduce the number of transfers from the fuel tank.

3.4.2 Aircraft Rescue and Fire Fighting (ARFF)

Greenwood Lake Airport is not a 14 CFR Part 139 certificated airport. There are no FAA regulatory requirements for onsite Aircraft Rescue and Fire Fighting (ARFF) services at non-139 certificated airports; however, the FAA recommends that those airports have ARFF coverage.

The FAA, under 14 CFR Part 139.317(a)³³, requires Index A airports (those with aircraft less than 90 feet in length as is the case at 4N1) have at least one fire fighting vehicle on standby. Per 14 CFR 139.319(h)(2)(i)³⁴, the vehicle shall reach the midpoint of the farthest runway from its assigned post and begin application of extinguishing agent within three minutes from the time of the alarm. The vehicle should carry at least:

- 500 pounds of sodium-based dry chemical, halon 1211, or clean agent; or
- 450 pounds of potassium-based dry chemical and water with commensurate quantity of Aqueous Film Forming Foam (AFFF) to total 100 gallons for simultaneous dry chemical and AFFF application.

Figure 3-29 displays a picture of a sample truck (a Stinger Q4) capable of carrying 500 lbs of dry chemicals.

The Township of West Milford Department of Fire is comprised of six volunteer fire companies³⁵. The closest response facility to 4N1 is the Greenwood Forest Volunteer Fire Company (VFC) #3, incorporated in 1898³⁶ and located at 1835 Greenwood Lake Turnpike; Hewitt, New Jersey 07421, which is 1.1 miles from the Airport. The volunteer firefighters can respond to structural, ARFF, and Emergency Medical

³³ U.S. Government Publishing Office (n.d.). 139.317. Retrieved on November 3, 2017, from <https://www.gpo.gov/fdsys/pkg/CFR-2007-title14-vol2/pdf/CFR-2007-title14-vol2-sec139-317.pdf>

³⁴ U.S. Government Publishing Office (n.d.). 139.319. Retrieved on November 3, 2017, from <https://www.gpo.gov/fdsys/pkg/CFR-2013-title14-vol3/pdf/CFR-2013-title14-vol3-sec139-319.pdf>

³⁵ Township of West Milford (n.d.). *Fire Prevention Bureau, Fire Companies*. Retrieved on November 14, 2017, from <http://www.westmilford.org/Cit-e-Access/webpage.cfm?TID=11&TPID=2023>

³⁶ Greenwood Forest Fire Company (n.d.). *Greenwood Forest Fire Company "To Protect Life and Property."* Retrieved on November 6, 2017, from <http://gffc3.tripod.com/index.html>

Service (EMS) calls. Every firefighter receives Firefighter One training and different ones receive additional training on different topics, such as heavy rescue which includes vehicle extrication.

The three-bay station stores the following apparatus:

- Engine 3, with a 1,000 gallon tank and foam, is first to respond to structural fires.
- Tanker 3, which can bring additional water to the scene of an incident or accident. This equipment is especially important at 4N1 since there are no onsite fire hydrants to provide additional water.
- Rescue 3 brings additional firefighting equipment, aircraft foam, and first aid equipment.



Figure 3-29. Sample Fire Fighting Vehicle Meeting Requirements for Index A Airports

Source: Oshkosh Airport Products (<http://www.oshkoshairport.com/arfftrucks/stinger/stingerq4>).

Figure 3-30 displays a picture of Greenwood Forest VFC #3 and their apparatus. **Figure 3-31** illustrates the route, distance, and time it takes to travel from the fire station to the entrance of the Airport.



Figure 3-30. Greenwood Forest Volunteer Fire Company #3 and its Apparatus

Source: Greenwood Forest Volunteer Fire Company #3.

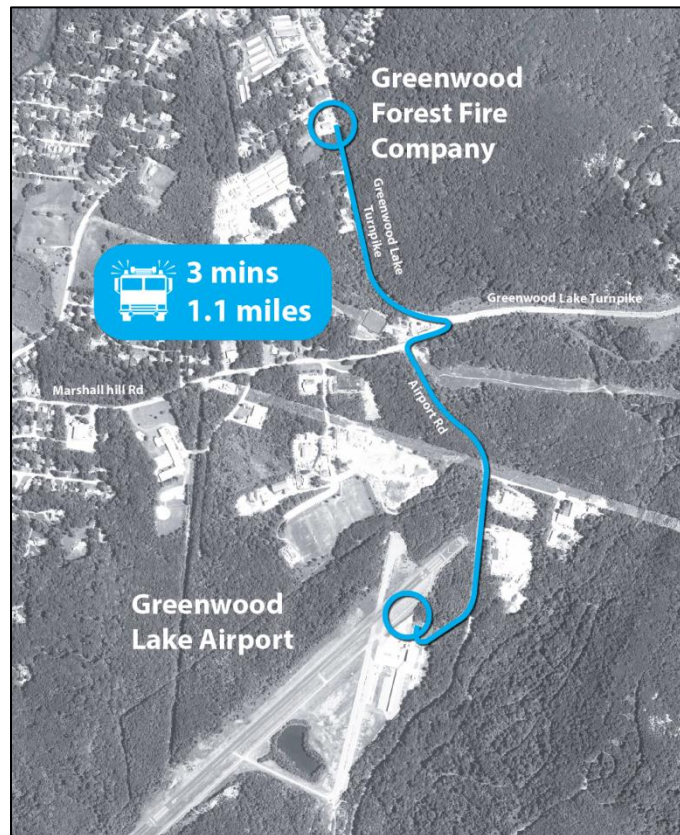


Figure 3-31. Route- Airport Entrance & Greenwood Forest Volunteer Fire Company #3

Source: Google Maps and AECOM.

Because all fire stations in West Milford are operated by volunteers, the fire stations are not staffed 24/7 and are often empty or lightly staffed during week days. More staff is available on week nights and weekends when the firefighters are off duty from their full-time, paying employments.

While the trip from the station to the entrance of the Airport normally takes three minutes, according to VFC #3 Chief Mike Blondin, it could take the apparatus and firefighters up to 12 minutes to appear if there are not enough firefighters on standby at the fire station when the emergency call is received. Volunteer firefighters are alerted of incidents/accidents via radio pagers and cell phones. While West Milford is a small town without traffic, the firefighters could be at their homes when receiving the call.

To prevent possible delays, two more fire companies are called out for support: West Milford VFC #6 on Ridge Road (2.4 miles or six minutes from the Airport) and Upper Greenwood Lake VFC #5 on Warwick Turnpike (5.9 miles or 12 minutes from the Airport). During major accidents, Macopin VFC #4 on Macopin Road (5.7 miles or 10 minutes from the Airport) is also requested.

Airport management cooperates with Greenwood Forest VFC #3 during emergencies and biannual drills are also performed. They normally involve typical aircraft and Hackensack's AirMed One helicopter. Firefighters are able to familiarize themselves with the aircraft, including learning about the type of aviation fuel used and identifying where lift points, doors, and fuel tanks are. During the annual airshow, firefighters and apparatus are also placed on standby and emergency personnel meet with the airshow pilots after the daily morning briefing to discuss and familiarize themselves with their aircraft.

3.4.3 Ground Support Equipment

As explained in Section 1.2.3 Support Facilities, 4N1 has three aircraft tugs, one front-end loader with a snow plow (stored in a fabric tent adjacent to the main hangar), and no aircraft deicing equipment. Deicing agent is occasionally poured on the apron using the front-end loader to melt snow.

Weather data from two different sources³⁷ provides average snowfalls for West Milford, as shown on **Figure 3-32**.

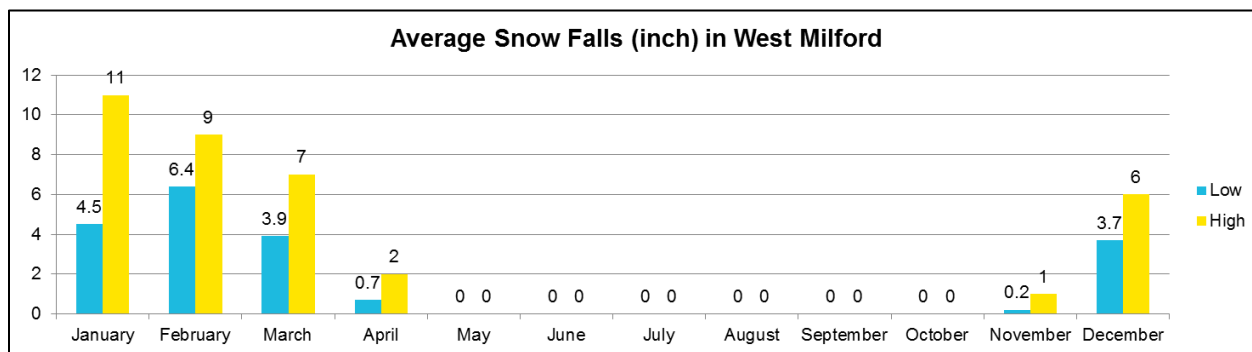


Figure 3-32. Average Snow Falls (inch) in West Milford

Snow/ice accumulation is a serious safety hazard for aircraft. While weather data may suggest the need for the purchase of an aircraft deicer and additional (ground) snow removal equipment, typical aircraft operations appear to suggest otherwise.

Section 2.9 Existing General Aviation Communities at 4N1, identifies Greenwood Lake as a vacation destination, where flying is mostly performed for personal and recreational activities rather than for business. In addition, Greenwood Lake does not have any based turboprops, jets or air taxi operations. Unlike business flying or flying in turboprops and jets, personal/recreational flying in small piston aircraft is not normally time or deadline driven and pilots/aircraft operators are not as likely to fly when the weather conditions are considered low Instrument Meteorological Conditions (IMC), such as those times when the visibility is low, precipitation or snow is moderate, icing conditions may be present, etc. The majority of small piston aircraft do not have onboard deicing (removes accumulation) or anti-icing (prevents accumulation) equipment. Even if the presence of ice or snow is removed on the ground, pilots do not have the capability to prevent/remove any further accumulation once in flight, so small aircraft are normally grounded during those weather days.

As the based aircraft and aircraft operation figures are not forecast to change significantly, additional ground support for deicing services is not recommended at this time; however, the Fixed Base Operator (FBO) or other based tenants may choose to replace outdated equipment or purchase more equipment to service or operate aircraft.

3.4.4 Airport Electrical Power

The electric service to the airport is a 200 Amp 120/208 3Φ4wire service and is located behind the office in the boiler room. The service enters the building on the north-east corner as outlined in **Figure 3-33**. There are additional services for other devices and facilities in the same area.

³⁷ Intellicast (2017). *Historic Average – West Milford, New Jersey*. Retrieved on November 3, 2017, from <http://www.intellicast.com/Local/History.aspx?location=USNJ0551> (for the low averages)
U.S. Climate Data (2017). *Climate West Milford – New Jersey*. Retrieved on November 3, 2017, from <https://www.usclimatedata.com/climate/west-milford/new-jersey/united-states/usnj0879> (for the high averages)



Figure 3-33. Airport Electrical Service Entrance

The main distribution panel feed the following other subpanels;

- Panel #1 – Boiler Room - 100 Amp 120/208 3Φ4wire
- Panel #2 – First Floor Kitchen - Two Single pole 20 Amp 120v
- Panel #3 – East Offices - Two Single pole 40 Amp 120v
- Panel #4 – Rear Hanger - 70 Amp 120/208 3Φ4wire

In addition, the main distribution panel feed the additional devices listed below:

- 5 Ton A/C unit - 40 Amp 120/208 3Φ4wire
- Second Floor A/C unit - 50 Amp 120/208 3Φ4wire
- T Hanger Panel - 100 Amp 120/208 3Φ4wire
- Gas – One Two pole 20 Amp 208v

Panel #1 provides power to most equipment in the office building. It contains 42 spaces for breakers of which thirteen are vacant. The panel feeds;

- | | |
|--------------------------------|------------------------------|
| • Pump | • Bar Emergency Lights |
| • Boiler | • Bar Refrigerator |
| • Water Heater | • Bar Wall Outlets |
| • AV Gas | • Utility Room Lights |
| • Refrigeration Unit | • Utility Room Outlets |
| • AC unit | • Rear Office |
| • Septic Alarm | • Pilots Counter Area Lights |
| • Septic Pump | • First Floor Rest Rooms |
| • Second Floor AC | • Front Office Lights |
| • Time Clock | • First Floor East Outlets |
| • Air Circulator for Air Plane | • First Floor West Outlets |

Panel #2 provides power to most equipment in the kitchen and restaurant. It contains 30 spaces for breakers of which fourteen are vacant.

3.4.4.1 T-Hangar Service

On the north wall of the boiler room is a “Red Leg Phase B” disconnect switch that feeds the T-hangar. The red-leg delta is a type of electrical service connection for three-phase electric power installations. It is used when both single and three-phase power is desired to be supplied from a three phase transformer. The feed for the T-hangar runs from the boiler room across the tarmac to the hangar as outlined below in **Figure 3-34**:



Figure 3-34. T-Hangar Feed Location

Inside the T-hangar a subpanel for the “Red Leg Phase B” is located as a 100 amp distribution panel. This panel feed several other panels most located within the same room and also includes the fuel farm control systems.

The panel labeled “B” provides power to the following;

- Runway Lights
- Taxiway Lights
- Beacon
- Beacon Heater

3.4.4.2 Recommendations

The electrical system is reasonably well maintained. That is not to say that some modernization could not be undertaken. As with most electrical systems it has been added to over the years creating one subpanel after another rather than changing and modernizing the main service.

A complete detailed review of the electrical system should be undertaken to insure all facilities are in conformance with the National Electric Code and to provide a detailed plan for maintenance purposes. A survey of the facility should be done to determine areas where energy saving can be obtained: for example, changing the lighting to Light Emitting Diode (LED) fixtures which would reduce maintenance costs.

One major improvement that should be investigated is the installation of a standby electric generator. Since superstorm Sandy the need for standby systems has become more apparent. The system could be

configured to shut down specific loads such as the beacon and runway lights, the loss of which could create hazards or impede rescue operations, considering the airport is used by the Hackensack UMC helicopter.

The airport building is set up with the offices on the right side of the picture below. The restaurant is located on the ground and second floor on the left side of the picture below. This area behind the building is a potential site for the generator. See **Figure 3-35**. The location is in the yard area adjacent to the boiler room which would reduce installation costs. This site provides an area away from traffic and adjacent to natural gas service for the generator.



Figure 3-35. Proposed Emergency Generator Location

3.4.5 Security

The Transportation Security Administration (TSA), in cooperation with the general aviation community, has developed guidelines to enhance security at general aviation airports. The TSA's *Security Guidelines for General Aviation Airport Operators and Users* report, dated July 2017, provides a set of security best practices and a method for determining when and where these enhancements would be appropriate. The TSA has not regulated the requirement of formal security measures at GA airports. The logic behind this is that while the potential for misuse of an aircraft operating from a rural airport exists, adherence to a single security requirement across the nation would be physically and economically unfeasible. Security at GA airports is focused on people we do not know, aircraft that are not secure and protecting infrastructure. As outlined within the TSA's *Security Guidelines* there is a "Protective Measures Matrix" that is recommended for use by a GA airport for assessing security risk. It is recommended that Greenwood Airport utilize this guidance to develop a formal security program.

3.4.5.1 Suggested Security Measures

Suggested security measures for General Aviation airports include the following:

- **Fences-** Physical barriers, such as fences, should be constructed around the airport perimeter securing it from unauthorized access. Physical barriers can also be in the form of natural barriers.

4N1 is secured with an 8-foot high security fence with barbed wire. The only location of the fence that is lower than 8 feet is along the end of Runway 6. This lower fence height is believed to be necessary to prevent creating an obstruction to aircraft, but should be reviewed in light of the changed location for the runway landing threshold.

- *Access Gates-* The main personnel access gate to the airfield is controlled with a lock. The vehicle access gate is controlled electronically utilizing a password system.
- *Law Enforcement Office Support-* Airport operators are encouraged to have regular patrols of the airport by local law enforcement
- *Signage-* Signs should be posted to warn against unlawful activity. Signs are present at the main airport entrance.
- *Lighting Systems-* Security lighting provides a means to deter theft, vandalism, or other illegal activity at night. Security lighting should not interfere with aircraft operations. Lights are present at the main building area
- *Personnel ID System-* Airport operators may wish to implement a method to badge employees and other authorized tenants; granting access to various areas of the airport.
- *Vehicle ID System-* Vehicles can be identified through the use of decals, stickers, or tags, aiding airport personnel and law enforcement in identifying authorized vehicles.
- *Challenge Procedures-* Challenge procedures include developing a community watch program, and encouraging airport tenants to challenge unfamiliar people at the airport. Tenants are encouraged to challenge strangers or people performing suspicious activities.
- *Security Committee-* An airport security committee is composed of airport tenants and users drawn from all segments of the airport community. The main goal of the group is to involve airport stakeholders in developing effective and reasonable security measures and disseminating timely security information. Meetings should be held regularly for the purpose of giving coordinated direction to the overall airport security program.
- *Transient Pilot Sign-In/Out Procedures-* Sign-in and out procedures can help identify non-based (transient) pilots and aircraft using the airport. No current procedures are in place.
- *Documented Security Procedures-* These are written procedures to guide airport operators on security guidelines, protocols, and procedures and should include a list of contacts for notification in the case of a security breach.
- *All Aircraft Secured-* The State of New Jersey's Domestic Security Preparedness Task Force has issued an order that requires that all GA aircraft parked or stored for more than a 24 hour period should use a combination of two locking devices to secure or disable the aircraft. All aircraft at Greenwood Lake airport should be complying with this order. Storage within a locked hangar enhances protection. Addition of new aircraft hangars at Greenwood Lake Airport will enhance security.
- *Community Watch Program-* A community watch program encourages tenants and airport users who frequent 4N1 to identify an outsider or suspicious behavior and notify the appropriate authorities.

3.4.5.2 Summary

Fuel Storage Improvements

- The existing Jet A and Avgas fuel tanks are not expected to need expansion based on anticipated demand. However, if fuel sales outgrow the forecast, bigger fuel tanks (ideally 10,000 or 12,000 gallon tanks) should be considered as they would allow ongoing operations and full load, 8,000-gallon deliveries (with their advantaged fixed freight costs and without having to time shared loads with other airports).
- Additional Jet A and Avgas fuel trucks are not forecasted to be needed; however, the existing trucks may need replacement due to age and condition. If so, a slightly larger Avgas truck (maybe one

similar to the Jet A one) may be considered as a replacement to reduce the number of transfers from the fuel tank.

- There are no FAA regulatory requirements for onsite ARFF services at non-139 certificated airports; however, the nearby Greenwood Forest Volunteer Fire Company (VFC) #3 provides ARFF services.
- Airport personnel responsible for ARFF operations at the scene of an aircraft accident should also receive some first responder training on operational actions which may be performed in the interest of preserving life while they await professional ARFF response.

GSE Improvements

- Additional ground support or service equipment owned by the Airport is not anticipated at this time; however, the FBO or other based tenants may choose to replace outdated equipment or purchase more equipment to service or operate aircraft.

Security

- It is recommended that Greenwood Airport utilize the "Protective Measures Matrix" within TSA's *Security Guidelines for General Aviation Airport Operators and Users* report, dated July 2017 to develop a formal security program.
- It is recommended that the 6-foot tall section of security fencing be assessed to see if the height can be raised to 8 feet.

Electrical Supply

- A complete detailed review of the electrical system should be undertaken to insure all facilities are in conformance with the National Electric Code and to provide a detailed plan for maintenance purposes. A survey of the facility should be done to determine areas where energy saving can be obtained: for example, changing the lighting to LED fixtures which would reduce maintenance costs. One major improvement that should be investigated is the installation of a standby electric generator.

3.5 Vehicle Parking & Ground Access

This section reviews ground transportation options, accessibility, and vehicle parking at 4N1.

3.5.1 Vehicle Parking Requirements

The number of vehicle parking spaces varies based on demand, airport services, and local planning and zoning requirements.

Section 1.2.2 Terminal Area and Aircraft Parking Aprons, lists:

- A paved public parking lot with 26 vehicular parking spaces (including two handicap/accessible parking spaces) on the north side of the main terminal building where restaurant customers, banquet hall guests, FBO visitors, three to four rental cars, and others can park,
- 16 parking spaces in the overflow/staff lot to the southeast of the main terminal building where six Hackensack employees, four to six restaurant employees, one maintenance technician and one line service technician, two to three airport operations personnel, and three flight instructors park at different times of the day, and
- The airside restricted area, located south of the overflow/staff lot, has approximately six spaces for Airport personnel and users.

In addition, tie-down tenants can park their vehicle by their spot while out flying. Hangar tenants, however, cannot park their vehicles inside their hangar when flying.

During the annual Greenwood Lake Airshow³⁸, the airport configuration is temporarily changed. The Airport sees approximately 10,000 visitors per event day, and attendees have two parking options:

³⁸ Greenwood Lake Air Show (2017). *Frequently Asked Questions*. Retrieved on November 6, 2017, from <http://www.greenwoodlakeairshow.com/faq.html>

- In the General Lot, located at the old Jungle Habitat adjacent to the Airport. Shuttle buses run from the lot to an entry gate and vice versa. According to the Airport operator, approximately 3,000 vehicles can be accommodated.
- In the Preferred Parking Lot, right on Airport property. According to the Airport operator, approximately 1,000 vehicles can be accommodated in this lot.

The restaurant has been closed, but plans are being made to reopen it. It is uncertain how much more vehicle traffic the restaurant will bring to the Airport until after it begins operations; however, the restaurant can seat up to 60 people. Graphic Parking³⁹ recommends 20 parking spaces for a 90-seat restaurant as displayed by **Figure 3-36**. Using this planning parameter, the restaurant is estimated to need at least 13 spaces for its customers.

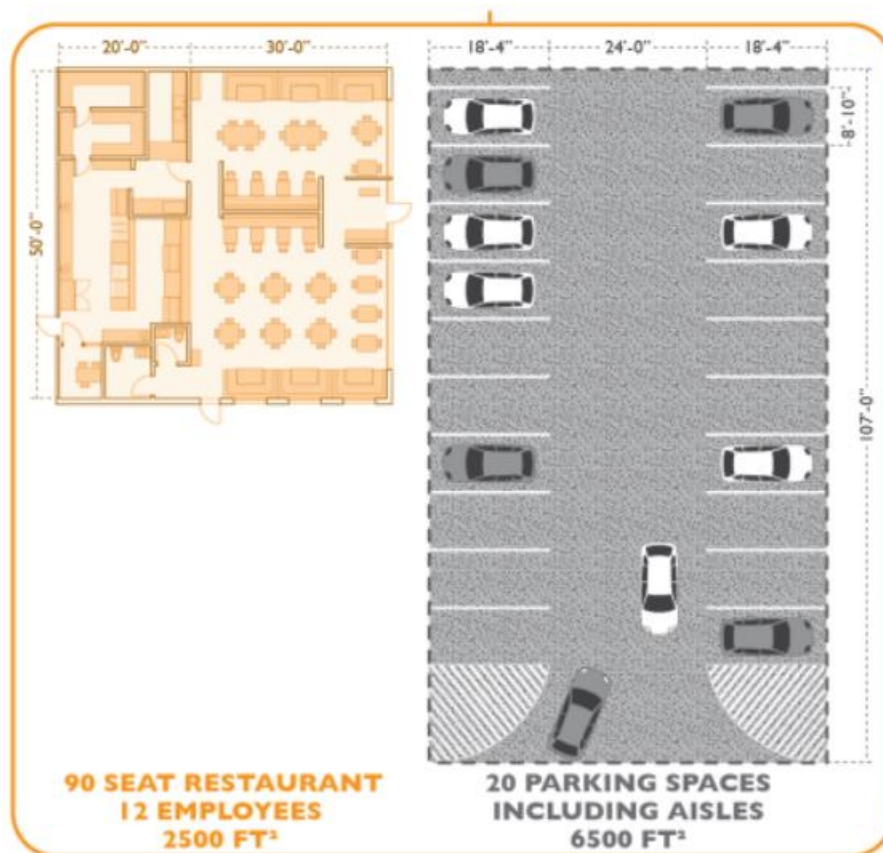


Figure 3-36. Parking Spaces for a 90-Seat Restaurant

Data Source: The State of New Jersey, Department of Human Services, Division of Disability Services
(<http://www.nj.gov/mvc/pdf/Vehicles/DDS-guide.pdf>).

According to the Airport's website⁴⁰, the banquet hall offers seating for over 100 people. Utilizing the same planning parameter used for the restaurant, 22 parking spaces would be needed during time periods when the banquet hall is fully utilized.

Reserved parking for persons with disabilities ensures safe and equal access to goods and services. The New Jersey Barrier Free Subcode and the Americans with Disabilities Act Accessibility Guidelines

³⁹ Graphic Parking (2013, February 6). *Parking Requirements for Restaurants*. Retrieved on November 8, 2017, from <https://graphingparking.com/2013/02/06/parking-requirements-for-restaurants/>

⁴⁰ Greenwood Lake Airport (n.d.). *Banquet Hall Rental*. Retrieved on November 8, 2017, from <http://www.greenwoodlakeairport.com/id68.html>

(ADAAG), summarized in New Jersey's Guide to Handicapped Parking⁴¹, both require a specific number of handicapped spaces in parking areas as shown in **Table 3-20**:

Table 3-20. Accessible Parking Requirements

Total # of Spaces	Required # of Accessible Spaces
1-25	1
26-50	2
51-75	3
76-100	4

Data Source: The State of New Jersey, Department of Human Services, Division of Disability Services
(<http://www.nj.gov/mvc/pdf/Vehicles/DDS-guide.pdf>).

In addition, the handicapped parking spaces have to be at least eight feet wide with adjacent striped access aisles at least five feet wide as shown in **Figure 3-37**. At least one handicapped parking space in each parking lot and one in every eight accessible spaces, must be van-accessible with an access aisle at least eight feet wide. The parking spaces and access aisles must be painted in a color (most often blue) contrasting with other spaces. Signage with the International Symbol of Accessibility and the Penalty Sign must be provided at each handicapped parking space and must be permanently installed five to seven feet above the ground.

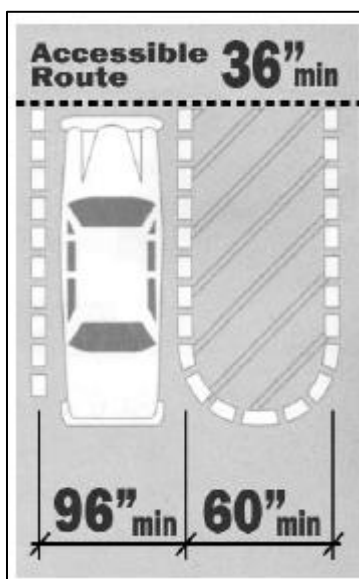


Figure 3-37. Accessible Parking Dimension Requirements

Source: The State of New Jersey, Department of Human Services, Division of Disability Services
(<http://www.nj.gov/mvc/pdf/Vehicles/DDS-guide.pdf>).

Based on the information collected, **Table 3-21** shows the number of parking spaces the public parking lot may require should the restaurant and banquet hall be operational and fully occupied at the same time:

⁴¹ The State of New Jersey, Department of Human Services, Division of Disability Services (2008, August). *Guide to Handicapped Parking*. Retrieved on November 8, 2017, from <http://www.nj.gov/mvc/pdf/Vehicles/DDS-guide.pdf>

Table 3-21. Public Parking Requirements

Airport Need*	Required # of Spaces
Restaurant	13
Banquet Hall	22
Rental Cars	3-4
FBO/Flight School	8
Other	5
Subtotal	52
Accessible Spaces	3
Total	55

Data Source: AECOM Analysis.

* No parking spaces were identified for based pilots/aircraft owners as they are expected to park on the airside restricted area, close to their aircraft parking location; however, five other parking spaces were identified for the occasional need to park there temporarily.

Starting up restaurant operations is still a work in progress and banquet activity is intermittent. The above table lists maximum airport requirements with a fully occupied restaurant and banquet hall assuming they are operational at the same time. In reality, banquet hall activity probably occurs during off-peak evening hours and predicting the success and future activity levels of the restaurant is not possible. Based on this, the 26 public parking spaces along with 16 spaces in the overflow lot are considered adequate for existing usage levels. If the restaurant and banquet facility create more demand for parking spaces then the number of parking spaces identified above may be required. The need for additional parking should be based on future usage levels. Locations are available for expansion of parking adjacent to the existing public lot.

The overflow/staff lot with its 16 parking spaces appears sufficient for the 20 employees that normally park in it considering not all 20 of them will need parking at the same time. All employees have different schedules. No additional accessible parking spaces are required in the staff lot as employees requiring this type of space could park in the public parking lot.

As the Greenwood Lake Airshow expands and grows, more temporary parking options may need to be identified. Some may have to include off-site “park and ride” options.

3.5.2 Ground Access Requirements

West Milford is in Passaic County. According to New Jersey’s 2030 Long-Range Transportation Plan⁴², Passaic County is in what NJDOT refers to as “The Urban Core,” representing several major corridors in the northern New Jersey metropolitan region. For the Plan’s purposes, the Urban Core focuses on the areas around Port Newark/Elizabeth and the trans-Hudson crossings, and includes portion of Bergen, Essex, Hudson, Passaic and Union counties. Proposed future transportation strategies for the Urban Core include:

- Investing in transit,
- Improving maintenance,
- Applying smart growth strategies, and
- Increasing the efficiency of the roadway system.

⁴² NJTRANSIT and New Jersey Department of Transportation (2008, October). *New Jersey’s Long-Range Transportation Plan*. Retrieved on November 6, 2017, from <http://www.state.nj.us/transportation/works/njchoices/pdf/2030plan.pdf>

3.5.2.1 Access Roads

The Manual on Uniform Control Devices for Streets and Highways (MUTCD)⁴³ is the official national standard published under 23 Code of Federal Regulations (CFR), Part 655, Subpart F, for traffic control on public streets, highways and bicycle trails.

There are no major highways close to Greenwood Lake Airport. U.S. 287 is approximately 12.3 miles south of the Airport can be accessed via Skyline Drive. U.S. 87 (in neighboring New York state) is approximately 13 miles east of the Airport and can be accessed via Margaret King Avenue. As identified in Section 1.2.4 Airport Access, 4N1 is accessible via Airport Road which, in itself, can be accessed via Marshall Hill Road (also known as County Road 696) and Greenwood Lake Turnpike (also known as County Route 511). The roads surrounding the Airport are considered Low Volume Rural (LVR) roads and traffic is not reported as a concern. Traffic count statistics for Marshall Hill Road (between Edgar Drive and Coolidge Terrace) for April 18, 2016, as reported by NJ DOT, indicate a peak hour volume of 502 vehicles. A typical two lane rural road (bi-directional) with 10-foot wide lanes has a capability of approximately 1,200 vehicles per hour per lane. In light of the low existing traffic volumes, the relatively small anticipated demand by the airport will not require any new roadway infrastructure.

Figure 3-38 shows a graphical representation of the access roads to/from the Airport.

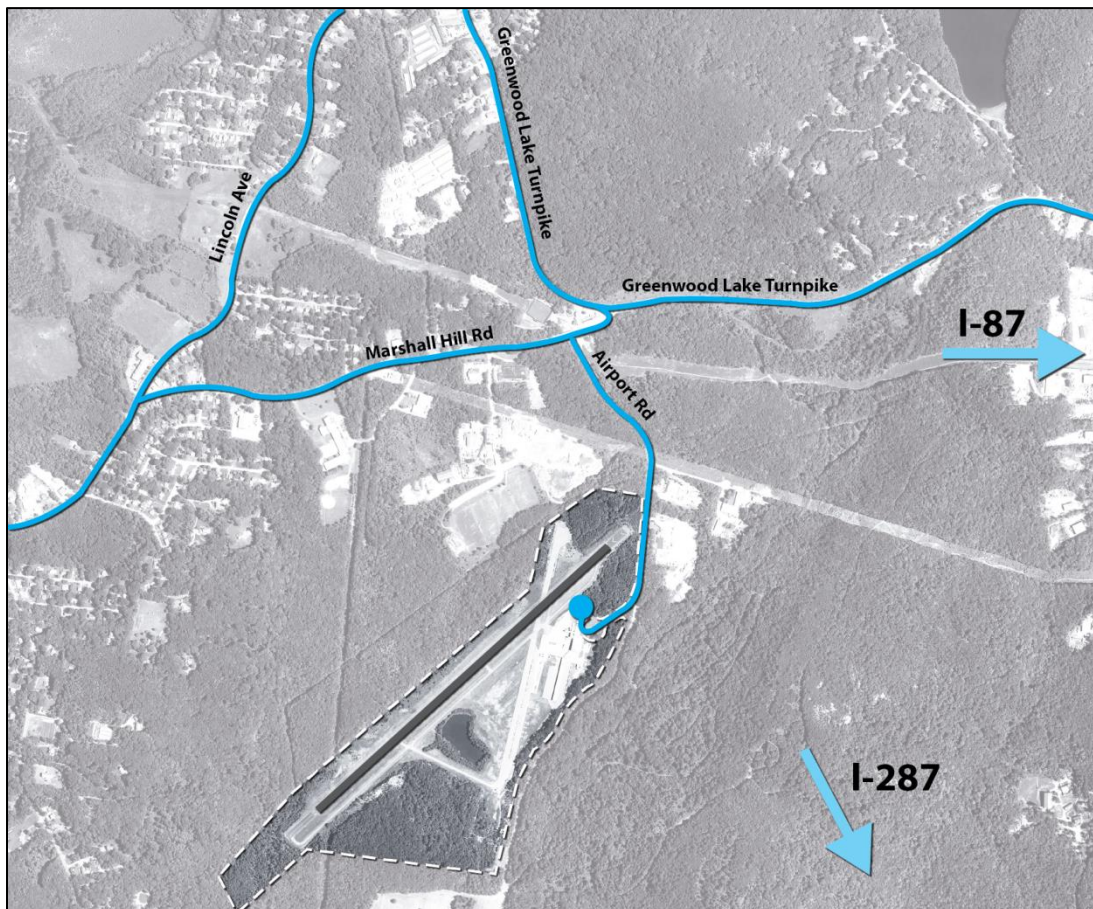


Figure 3-38. Access Roads Surrounding Greenwood Lake Airport

Source: Google Maps and AECOM.

⁴³ U.S. Department of Transportation, Federal Highway Administration (2017, September 11). *Manual on Uniform Control Devices for Streets and Highways*. Retrieved on November 8, 2017, from <https://mutcd.fhwa.dot.gov/>

The Greenwood Forest Volunteer Fire Company (VFC) #3, responsible for responding to Airport incidents/accidents, is located at 1835 Greenwood Lake Turnpike; Hewitt, New Jersey 07421. Fire trucks access the Airport via the Greenwood Lake Turnpike, Marshall Hill Road, and Airport Road (in that order). Those roads never experience traffic delays.

According to New Jersey's Long-Range Transportation Plan, NJDOT is expected to perform capacity improvements on highways owned by them to a total of about 300 lane miles (until 2030) or about 12 lane miles a year, improve approximately 100 interchanges on state roadways and 100 local intersections, and widen the NJ Turnpike, the Garden State Parkway and the Atlantic City Expressway to alleviate congestion. It is unknown whether specific improvements will be made to roads surrounding the Airport; however, none are specifically identified as needed.

3.5.2.2 Public Transit

Section 1.2.4 Airport Access, states that NJ TRANSIT provides public transportation access to the Airport via bus routes 196 (Warwick – Ringwood – New York) and 197 (Warwick – Wayne – New York):

- Bus Route 196 serves the following areas: Warwick, N.Y., (Warwick Park & Ride), Greenwood Lake, N.Y. (Greenwood Lake Park & Ride), Greenwood Lake, N.J., West Milford (West Milford Park & Ride), Ringwood (Ringwood Park & Ride), New York (Midtown - PA Bus Terminal at 8th Avenue & 41st Street). The closest 196 bus station to the Airport is on Greenwood Lake Turnpike at Olcott Avenue.
- Bus Route 197 serves the following areas: Warwick, N.Y., (Warwick Park & Ride), Greenwood Lake, N.Y. (Greenwood Lake Park & Ride), Greenwood Lake, N.J., West Milford (West Milford Park & Ride), Ringwood (Ringwood Park & Ride), Wanaque, Pompton Lakes, Totowa, Wayne (Preakness Shopping Center, Willowbrook Mall Shoppers' Stop, Willowbrook Park & Ride, Packanack Lake via Ratzer Road), New York (Midtown - PA Bus Terminal at 8th Avenue & 41st Street). The closest 197 bus station to the Airport is on Marshall Hill Road at Coolidge Terrace.

As New Jersey's population and work force continue to increase, public transportation will become ever more necessary and feasible. Public transit provides mobility for those who do not drive, improves air quality by taking cars off the highway and reducing fossil fuel consumption, helps to relieve congestion for those who must drive, conserves energy and is less expensive than owning a car. New Jersey's Long-Range Transportation Plan indicates that NJ TRANSIT has committed to increasing both the availability and convenience of public transit so there is a possibility that additional public transit options (bus, light rail, and/or rail) may be added by the Airport in the future. The report makes mention of extensions of the Access to the Region's Core (ARC), a commuter rail project, and building a tunnel to Monmouth, Ocean, Passaic, Bergen, and Somerset counties.

Airport users are not believed to rely on public transit to access the Airport so specific public transportation needs are not identified at this time.

3.5.2.3 Commercial Vehicles

Comfort Auto Rental⁴⁴, working in conjunction with SkyTraining, LCC, offers rental cars at the Airport. According to the Airport operator, and as previously mentioned, three to four rental cars are typically parked in the Airport's public parking lot.

Uber, Lyft, and taxi services serve the Airport. These vehicles spend a short amount of time at the Airport while picking up and dropping off customers and do not require permanent parking spaces.

A commercial vehicle parking lot or holding area is not necessary at this time due to its low usage.

⁴⁴ Comfort Auto Rental (2015). *Locations*. Retrieved on November 6, 2017, from <http://www.comfortautorental.com/locations.html>

3.5.2.4 Bicycle Routes

New Jersey encourages adults and children to take advantage of the many opportunities to bicycle for both commuting and recreation. The New Jersey Bicycle Map and Resource Guide⁴⁵ is a comprehensive tool for those traveling by bicycle for recreation or transportation in New Jersey. **Figure 3-39** illustrates its 2012 map (with an approximate location of the Greenwood Lake Airport) with the following bike routes close to the Airport:

- **Figure 3-40** displays a detailed map of the 16.8-mile Greenwood Lake Ride, Passaic (GL) state bicycle tour route that starts and ends at Brown's Point Park in West Milford and travels along Lincoln Avenue and County Road 696 among other roads
- "Least Suitable" on-road bicycle lanes on the south portion of Union Valley Road and the west portion of Marshall Hill Road
- "Most Suitable" on-road bicycle lanes on the north portion of Union Valley Road

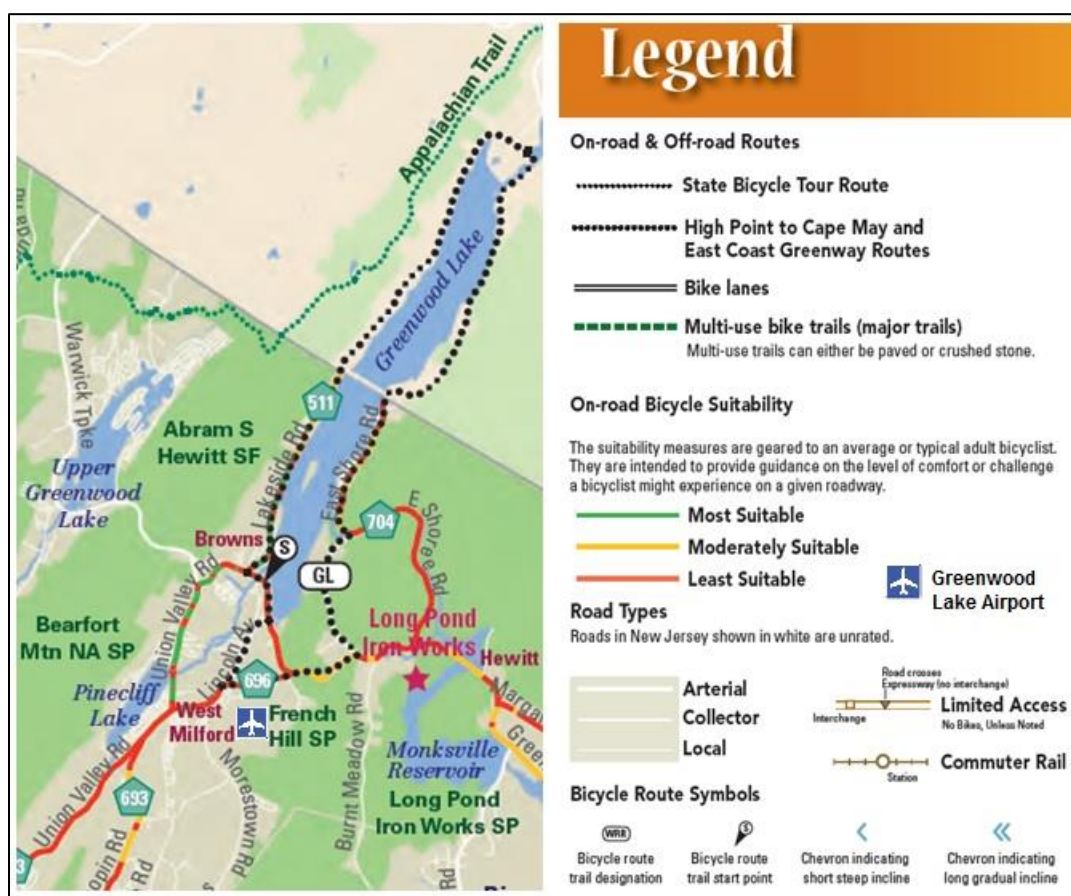


Figure 3-39. 2012 Bike Map for Northern New Jersey

Source: New Jersey Department of Transportation

(<http://www.state.nj.us/transportation/commuter/bike/pdf/njbicyclemapnorthern.pdf>).

⁴⁵ State of New Jersey Department of Transportation (2013, May 9). *Bicycle Map and Resource Guide*. Retrieved on November 6, 2017, from <http://www.state.nj.us/transportation/commuter/bike/guide.shtml>

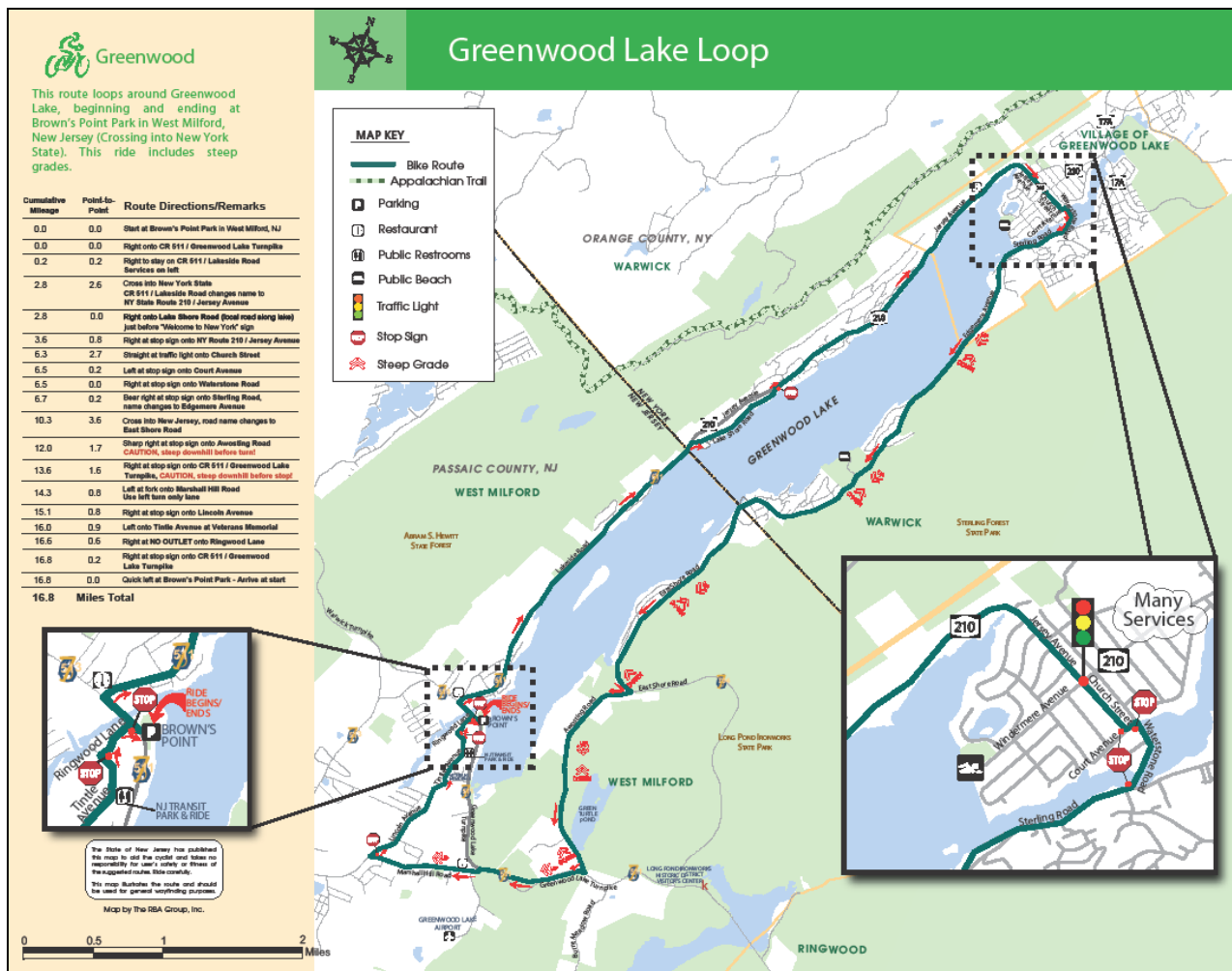


Figure 3-40. Greenwood Lake Loop

Source: New Jersey Department of Transportation

(<http://www.state.nj.us/transportation/commuter/bike/application3/geospatialpdf/GreenwoodLakeLoop-geo.pdf>).

According to New Jersey's Long-Range Transportation Plan, NJDOT is expected to construct approximately 1,340 miles of sidewalk, 500 miles of shared-use paths, and 35 pedestrian and/or bicycle bridges.

The Airport appears well served by bicycle lanes and routes; however, when/where possible, dedicated bike lanes (versus riding on roads or sidewalks or having portions of roads designated by signage and pavement markings as bike lanes) are recommended to ensure and improve bicyclist safety.

In addition, as a pleasure/recreational/vacation destination, Greenwood Lake Airport may want to consider installing bike racks for bicycle parking and offering a few bicycle rentals to attract additional traffic to the Airport, especially since the Greenwood Lake Loop can be joined within a half a mile ride.

3.5.2.5 On-Airport Roads

At towered airports, the airside surface is divided into two areas: movement and non-movement. While Greenwood Lake Airport is a non-towered airport, the concept can still be applied (even if not clearly delineated with Non-Movement Area Boundary Markings). **Figure 3-41** shows 4N1's general areas. The Movement Area is defined by all taxiways and runways under the jurisdiction of the control tower; however, in the case of 4N1, it is all taxiways and runways under the jurisdiction of individual pilots/operators utilizing the Common Traffic Advisory Frequency (CTAF) to communicate. The non-

movement area is defined as the taxiways/taxilanes and aprons not controlled by air traffic control; however, in the case of 4N1, it is the area comprised of the aprons, terminal, hangars, and aircraft parking positions.

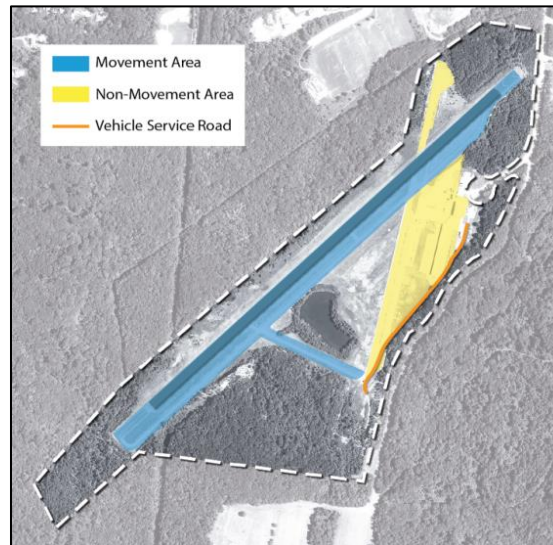


Figure 3-41. Greenwood Lake's Movement/Non-Movement Areas

Source: AECOM.

The Airport is fenced and only those with a business purpose (such as tenants and employees) are provided the access code by the airport manager. The majority of vehicles at 4N1 drive in the non-movement area to access aircraft and hangars. Only airport management and authorized vehicles (such as those performing maintenance on the airfield) are given access to the movement area. Airport personnel normally escort non-Airport personnel onto taxiways and the runway.

4N1 has one on-airport service road. The road runs southwest along the southern edge of the airport from the airside entrance gate to the end of the based aircraft ramp (See **Figure 3-41**) and provides access to the based aircraft parked within this area. In other locations, taxilanes and taxiways are joint use taxilanes/taxiways. They are both accessible to aircraft and authorized vehicles, which are always required to give way to aircraft. Vehicles should also remain clear of the Runway Safety Area (RSA), the area surrounding the runway and intended for use by aircraft in emergency situations, any time aircraft are taxiing, taking off, or landing. Vehicles should also be aware of jet blast, prop wash, or rotor wash when operating around moving aircraft.

Extra vigilance is necessary when driving on an airport during construction. Previously used driving routes may be altered, runways and taxiways may be closed, runway thresholds may be displaced or relocated and host spots may be identified.

The Airport has not identified safety concerns with current operations and vehicle traffic on the airside (especially on the movement area) is minimal (and is expected to remain as such) so no proposed changes have been identified.

3.5.2.6 Summary

Vehicle Parking Improvements

- The public parking lot currently has 26 vehicle spaces (including two accessible spaces) and existing parking capacity is considered adequate for now. Should the restaurant or banquet facility expand operations additional parking spaces may be required.
- The staff parking lot currently has 16 vehicle spaces and that number is deemed sufficient at this time based on current employee figures.

- The airside restricted area has a few additional parking spaces for Airport personnel and users; however, those are not expected to increase.
- Tie-down tenants can park their vehicle by their spot while out flying. Hangar tenants, however, cannot park their vehicles inside their hangar when flying.
- As the Greenwood Lake Airshow expands and grows, more temporary parking options may need to be identified which may include off-site “park and ride” options.

Ground Access Improvements

- The access roads leading up to the Airport are considered Low Volume Rural (LVR) roads and no improvements or traffic concerns have been identified for them.
- Airport users are not believed to rely on public transit to access the Airport so specific public transportation needs are not identified at this time.
- While specific access road and public transit improvements have not been identified, some may be realized as part of New Jersey's Long-Range Transportation Plan. There are mentions of several projects in Passaic County.
- A commercial vehicle parking lot or holding area is not necessary given current and expected activity.
- The Airport appears well served by bicycle lanes and routes; however, when/where possible, dedicated bike lanes are recommended to ensure and improve bicyclist safety, especially to connect with the nearby Greenwood Lake Loop.
- The Airport should consider installing bike racks for bicycle parking and offering a few bicycle rentals to attract additional visitors (both neighbors and pilots looking for nearby bicycle trails) to the Airport.
- No additional on-airport roads have been identified as necessary.

4. Airport Development Alternatives

Given the facility requirements identified in Chapter 3, the master planning process develops and evaluates a variety of alternatives to help envision the future for the Airport. The goals of the alternative analysis are to ensure Greenwood Lake Airport (Airport) is prepared to accommodate the existing and future aviation demand for the next 20 years, conform to the latest Federal Aviation Administration (FAA) design standards, and meet the needs of the airport sponsor, airport operator, and airport tenants. The four major operating elements analyzed in this section include airfield, general aviation facilities, support facilities, and landside facilities.

4.1 Evaluation Methodology

This section describes the alternatives analysis, the evaluation criteria to be utilized and any environmental or land use constraints considered significant.

4.1.1 Alternatives Analysis Process

Per FAA guidance, the alternatives analysis process is an iterative process, intended to be flexible enough to permit creative thinking about the future of the airport, but sufficiently structured to ensure consideration of all pertinent factors. During the alternatives analysis process, planners will obtain new information and input that will help refine the alternatives or result in the introduction of new alternatives. It is important to make sure the process is comprehensive, logical, well-documented, and has meaningful stakeholder participation.

The key elements in this process are:

- (1) Identify alternative ways to meet the facility requirements outlined in **Chapter 3 Facility Requirements**, while addressing the development constraints outlined in Section 4.2.1.
- (2) Evaluate the alternatives individually and collectively, including the strengths, weaknesses, and other implications unique to each alternative.
- (3) Select the recommended alternative based on the evaluation criteria.

The process of identifying, analyzing, and recommending alternatives for 4N1 is illustrated in **Figure 4-1**. The first step is to identify primary and secondary elements. Primary elements are typically those functional elements that require large contiguous land areas (examples of primary elements may include airfield and apron redesign projects). Secondary elements have greater planning flexibility and can often be fit in around primary elements (for example, installation of an emergency generator). The alternatives analysis process starts with a group of alternatives for the primary elements and reduces them to a single recommended alternative based on the evaluation criteria. The requirements for the secondary elements are then incorporated into the recommended primary alternative to become the recommended airport development plan for 4N1. The process is further summarized below:

Step 1: Determine Primary and Secondary Elements – Based on the facility requirements, the airfield layout, taxiway geometry, and general aviation facilities development are considered primary elements. The secondary elements are the support and landside facilities, which have greater flexibility to be filled in around the primary elements.

Step 2: Identify Primary Element Alternatives – Alternatives are developed for airfield and general aviation facilities, and are presented in Section 4.3 and Section 4.4. The general aviation facilities have a greater range of possibilities at 4N1 and warrant a multi-round screening process with increasing levels of detail.

Step 3: Evaluate and Select the Primary Recommended Alternative – The alternatives are evaluated based on both qualitative and quantitative evaluation criteria listed in Section 4.1.2. Steps 2 and 3

are iterative as findings in Step 3 drive changes and refinements in Step 2. The outcomes of the evaluation and recommendations are presented in [Section 4.3.2](#) for airfield alternatives and [Section 4.4.3](#) for GA alternatives.

Step 4: Develop Layouts for Secondary Elements – The simplicity of the requirements for the secondary elements at 4N1 eliminated the need to develop various alternatives. Focused layouts are developed to meet the requirements for support and landside facilities as discussed in [Section 4.5](#) and [Section 4.6](#).

Step 5: Combine and Prepare Recommended Airport Development Plan –The final step in the process is to combine the primary and secondary elements to prepare for the recommended airport development plan, as presented in **Chapter 5 Implementation Plan and Financial Analysis**.

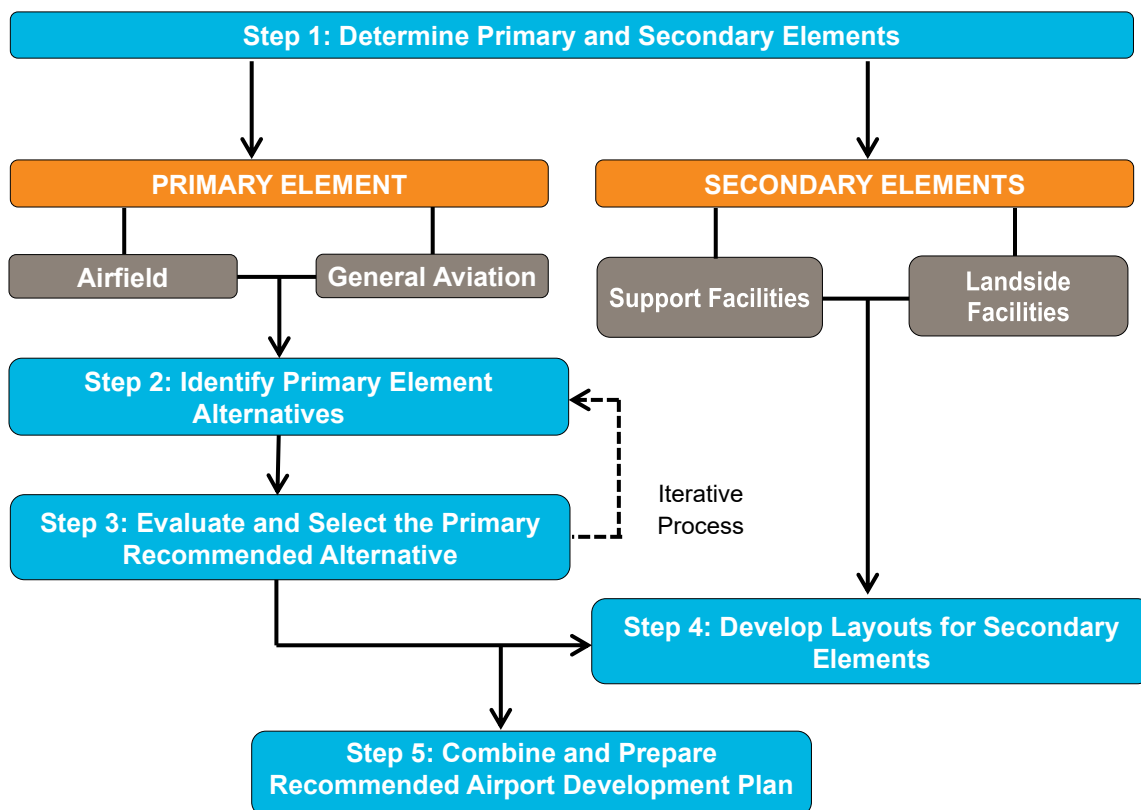


Figure 4-1. Alternatives Analysis Process

4.1.2 Evaluation Criteria

The evaluation criteria were developed to achieve a balanced evaluation focused on the sponsor and airport operators needs while still being responsive to the various study participants' point of view. The evaluation criteria are both strategic and qualitative to ensure the evaluation process remains at an appropriate level of detail. For each alternative evaluation process, a selection of the criteria will be used based on applicability.

A color-coded scoring system is used. Colors are assigned based on the level of support considered to be provided by each alternative to individual criterion. Green reflects a high level of support, yellow fair and red poor.

The evaluation criteria are listed as follows:

- Operational Performance:
 - **Capacity and Capability:** Provides sufficient capacity to meet the 4N1 facility requirements through 2035.
 - **Safety and Efficiency:** Ensures safe and efficient operations on and around the airfield. This includes removing obstructions at runway ends, reducing potential runway incursions, and providing reasonable taxiing paths from the airfield to aircraft parking area.
- Standards & Best Practices:
 - **FAA Design Standard Compliance:** Conforms to FAA design standards and other applicable planning guidelines
 - **Flexibility for Expansion:** Allows for growth in the event of unforeseen demand increase
 - **Visions of Airport Sponsor & Operator:** Reflects strategic vision of the airport sponsor and operator, and satisfies the user needs
- Implementation Feasibility:
 - **Estimated Development Cost:** Rough order-of-magnitude cost associated with implementing the alternative, including capital investment and land acquisition.
- Environmental Impact and Land Use:
 - **Impact on Existing Environmental Features:** Magnitude of the impact to the environmentally sensitive features and associated mitigation measures, given applicable state laws and regulations.
 - **Compatible with Local Zoning Ordinances:** Compliance with the applicable local and state zoning ordinances, development restrictions, and surrounding land uses.

4.2 Development Constraints

Alternatives should be developed with consideration of the environmental and local zoning constraints. This section outlines the constraints specific to 4N1.

4.2.1. Environmental Constraints

Details regarding relevant environmental features are identified in Chapter 1, Inventory, as potential constraints to future airport development. The environmental constraints do not necessarily preclude development; however, they require coordination with the New Jersey Department of Environmental Protection (NJDEP) and New Jersey Highlands Water Protection and Planning Council, and further study prior to any proposed construction.

The Airport is within the NJ State Highlands Preservation Area; therefore, the development of impervious surfaces may be limited by the Highlands Water Protection and Planning Act. In addition, NJDEP freshwater wetlands, streams, threatened and endangered species, and vernal habitats are located in close proximity to the Airport. The airport is also located adjacent to Long Pond Ironworks State Park.

Greenwood Lake Airport is located entirely within the Highlands Preservation Area. As such, any development on airport must comply with the Highlands Water Protection and Planning Act. In accordance with the Highlands Water Protection and Planning Act Rules, “Highlands Open Waters” are defined as all springs, streams (including intermittent streams), wetlands, and bodies of surface waters, whether natural or artificial (excluding swimming pools), located wholly or partially within the boundaries of the Highlands Region. A 300-foot development constraints buffer is typically required though exemptions are possible for safety related transportation projects and linear development for infrastructure projects provided there are no other feasible alternatives.

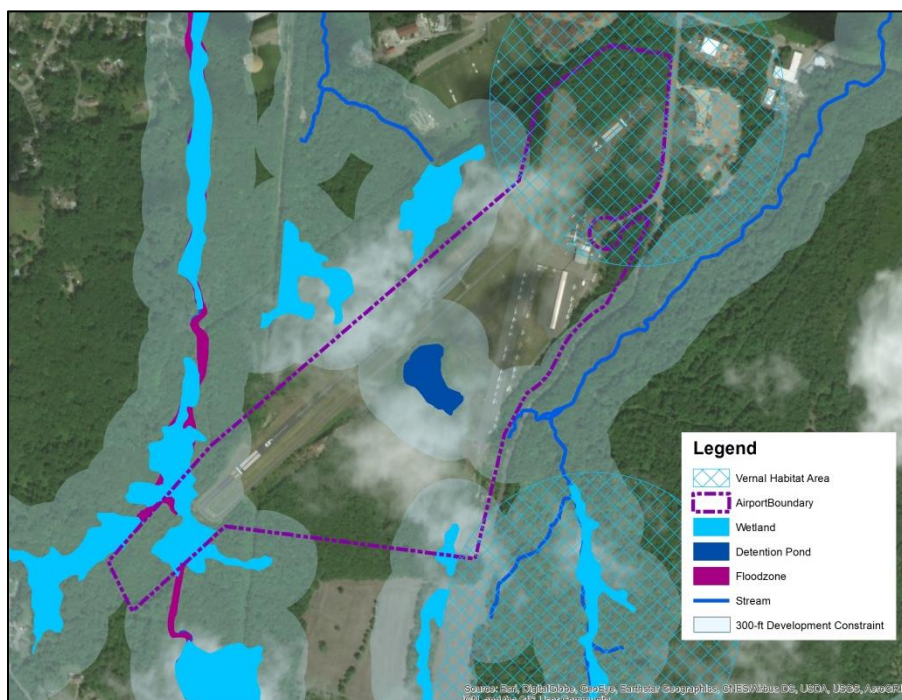


Figure 4-2. Highlands Open Water & Vernal Habitat Constraints

Data Sources: NJDEP Bureau of GIS; FEMA.

While the environmentally sensitive areas are not necessarily restrictive to airport development, the timing and costs associated with mitigating the alternatives are an important evaluation criterion.

4.2.2. Local Zoning Constraints

The airport is bounded by public property, residential and industrial land uses.

The Air Safety and Zoning Act of 1983 established standards for land use adjacent to airports, which municipalities in the State of New Jersey must implement. The act requires that an Airport Safety Zone must be established for each runway, and each Airport Safety Zone must have a Runway Subzone, two Runway End Subzones, and two Clear Zones. These zones establish minimum standards for the control of airport and aeronautical hazards. Airports, residential (single-family dwelling units), open space, agriculture land uses are permitted within Airport Safety Zones.

West Milford Township has set standards for an Airport Safety Zone in compliance with the Air Safety and Zoning Act of 1983. Furthermore, the township has adopted stricter standards for control of these areas under the Municipal Land Use Law. Only residences of at least four acres in size are allowed in the Airport Safety Zone compared with the State law that allows residences of three acres or greater. Two multi-family townhouse dwellings located on Richmond Road within the 4N1 clear zone are exempt from state and township air hazard regulations. Additionally, any developments located in the clear zone before May 15, 1989 are also exempt from the airport safety zone requirements.

4.3 Airside Development Alternatives

A number of components of the airfield at Greenwood Lake Airport do not meet FAA design standards. Compliance with FAA design standards is required for airports that receive FAA Airport Improvement Program (AIP) funding. In cases where it is determined by FAA that it is not feasible to meet design standards an analysis is conducted of operations and a Modification of Standards (MOS) is issued if it is judged that the airport can be operated safely with the nonstandard condition in place. It is not unusual for

some level of operational restriction to be included as part of an MOS process. **Chapter 3 Facility Requirements** identified the airfield facility requirements over the 20-year planning period. Those conditions found to be non-standard requiring mitigation or establishment of an MOS include all of the following except runway blast pads which are included as an optional consideration.

- Standardize parallel taxiway separation from the runway
- Address in-line taxiway at Runway 6 end
- Reconfigure non-standard taxiway geometry issues
- Mitigate incompatible land uses in RPZs
- *Optional - Add runway blast pads

Several alternatives were developed based on different combinations of the above requirements.

4.3.1 Alternatives

Table 4-1 provides a summary of the three airfield alternatives series developed for this process. Series 1 is the “no-build” scenario. Series 2 focuses on relocating the parallel taxiway 20 feet further from the runway to meet the FAA runway/taxiway separation standard (150 feet) for an airport serving predominately Group I aircraft. Series 3 keeps the parallel taxiway at the existing 130-foot separation. Both Series 2 and 3 have two sub-alternatives (A and B). The sub-alternative “A” is the higher-impact variation which provides standard blast pads at both ends of the runway and also reconfigures Taxiway A5 near Runway 24 end. The sub-alternative “B” is the lower-impact variation that does not include blast pads or reconfiguration of Taxiway A5. Except for the “no-build” scenario, all alternatives remove the in-line taxiway at the Runway 6 end and reconfigure non-standard taxiway geometries. Each of the alternatives requires different levels of tree clearance and earthwork.

Table 4-1. Airfield Development Alternatives

Airfield Alternatives	Existing	Runway		Taxiway		
		Remove In-line Taxiway	Blast Pad	Centerline Relocation	Reconfigure Taxiway Geometry	Twy A5 Reconfiguration
1	x					
2A		x	x	x	x	x
2B		x		x	x	
3A		x	x		x	x
3B		x			x	

Airfield Alternative 1

As shown in **Figure 4-3**, the airfield will remain in its current configuration with no proposed improvements. The Airport will continue to operate as it does today without addressing the FAA design deficiencies. There are no construction costs or environmental impacts associated with this alternative.

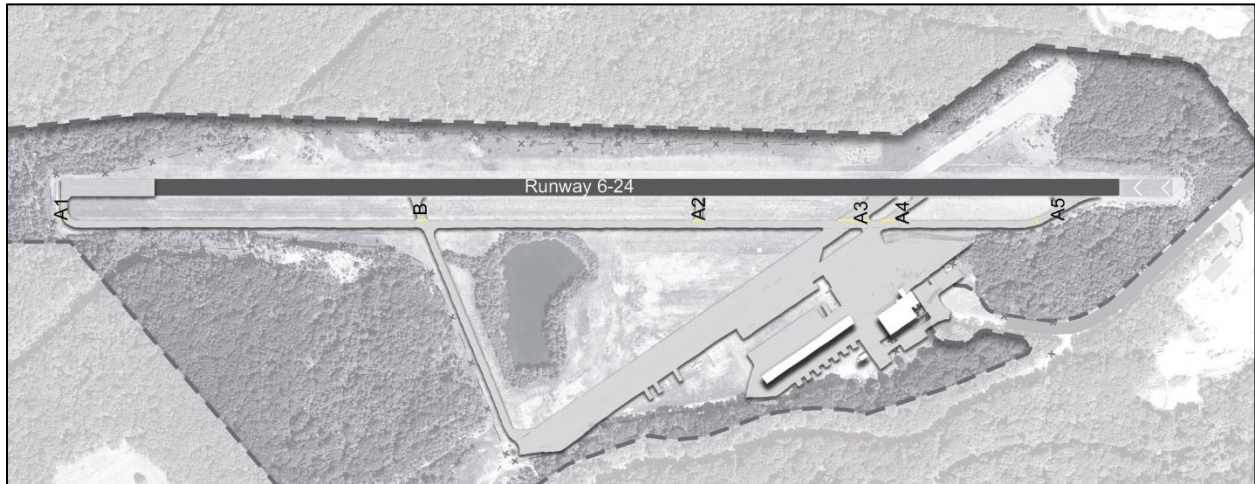


Figure 4-3. Airfield Alternative 1

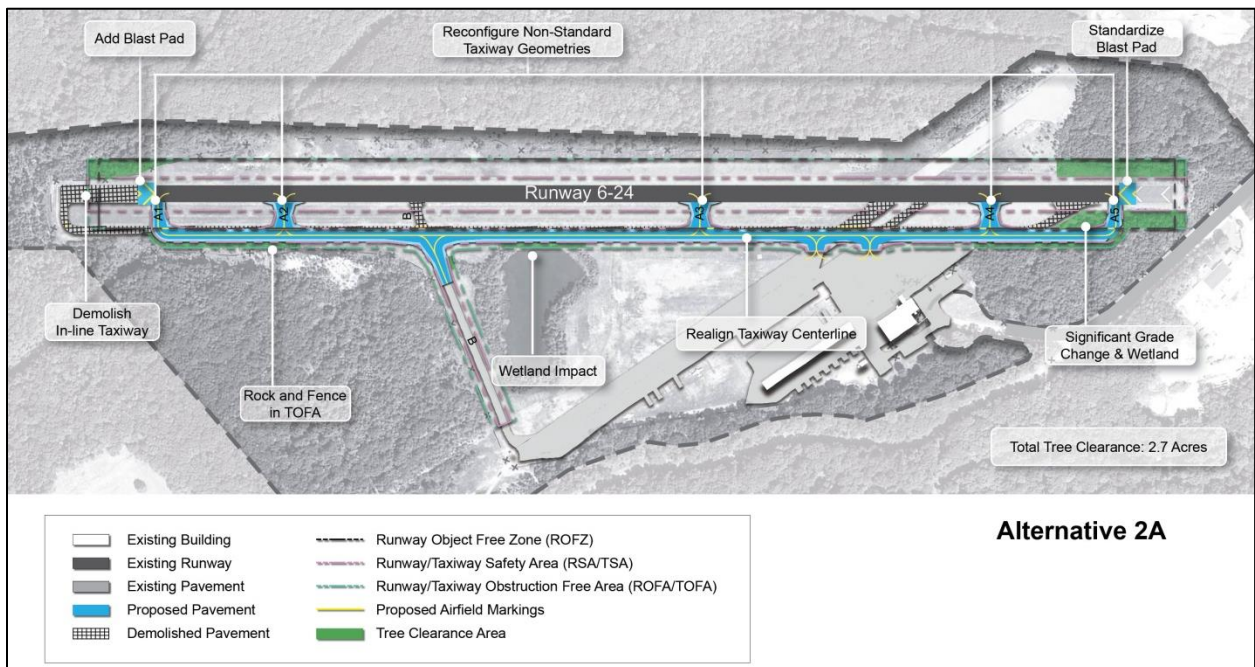


Figure 4-4. Airfield Alternative 2A

Airfield Alternative 2A

Airfield Alternative 2A is a maximum development alternative that addresses multiple facility requirements collectively. The full parallel taxiway is realigned to achieve standard separation from the runway, and standard blast pads are added to both runway ends. All the non-standard taxiway geometries are reconfigured and all taxiway/runway intersections at other than right angles are demolished and replaced with right-angle entrance taxiways. Direct accesses from apron to runway are also eliminated.

This alternative requires the highest acreage of tree clearance. A large outcropping of rock exists above ground near the proposed Taxiway A2 and portions must be removed to provide TOFA clearance. Moreover, wetland and significant grade change exist immediately adjacent to the existing Taxiway A5 at the Runway 24 end; therefore the reconfiguration of Taxiway A5 is associated with substantial environmental mitigation and earthwork.

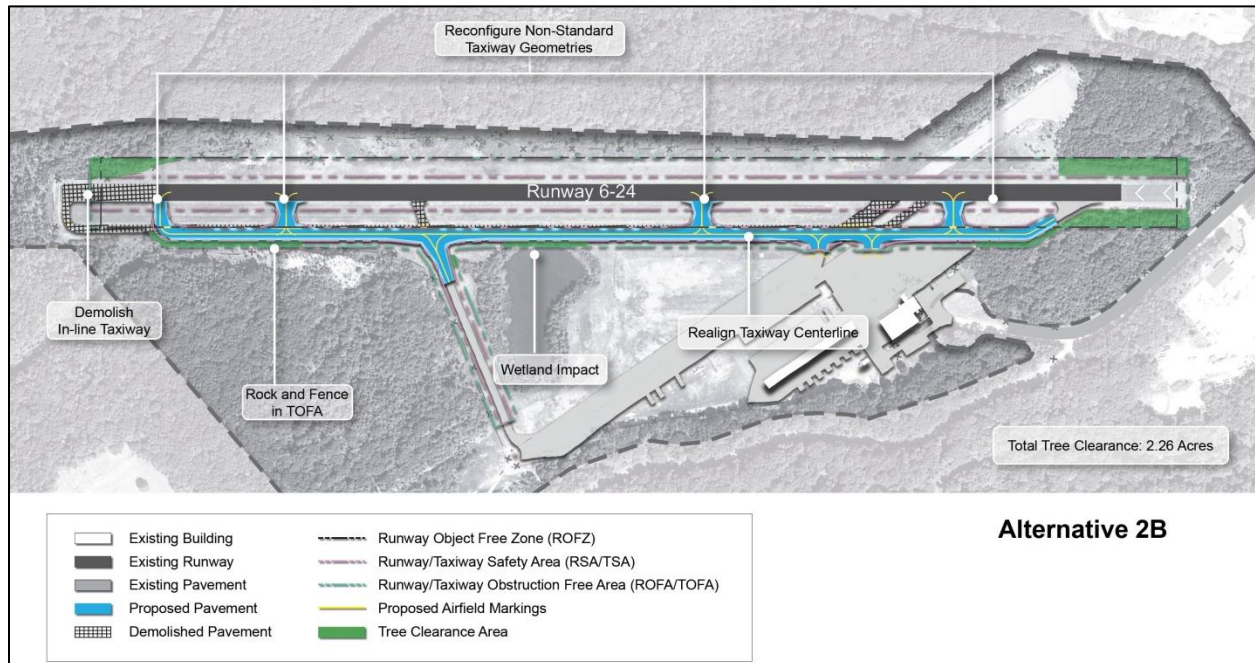


Figure 4-5. Airfield Alternative 2B

Airfield Alternative 2B

Airfield Alternative 2B is a step-down version of 2A with the intent to limit costs and environmental disruption. This alternative does not provide blast pads. As mentioned in [Section 3.2.2 Runway System](#), blast pads are not an FAA design requirement. Also, Taxiway A5 is not reconfigured given the significant environmental and construction challenges associated with this modification. This reduces the tree clearance and earthwork requirements associated with Taxiway A5.

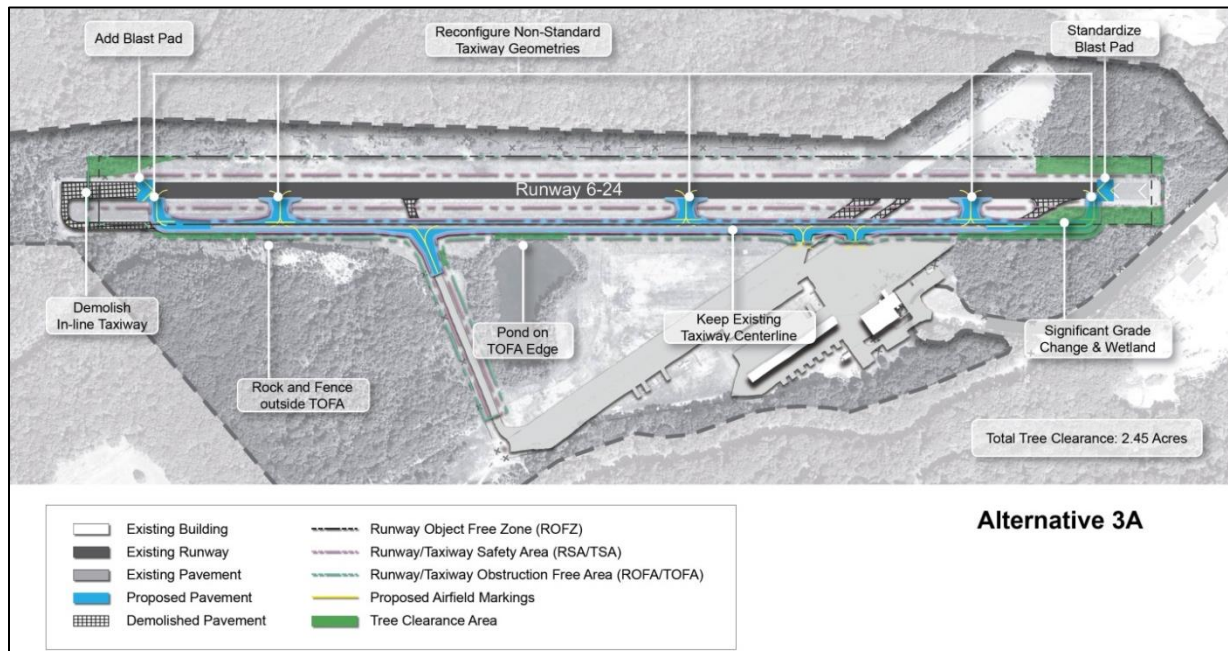


Figure 4-6. Airfield Alternative 3A

Airfield Alternative 3A

This alternative retains the existing parallel taxiway centerline. Approval for modification of standards (MOS) must be obtained from the FAA to allow for this non-standard condition. All of the non-standard taxiway geometry issues are addressed in a manner similar to Alternative 2A.

This alternative requires a lower acreage of tree clearance and would not require earthwork near the proposed Taxiway A2; however, it still requires substantial cut and fill and environmental mitigation for the Taxiway A5 reconfiguration.

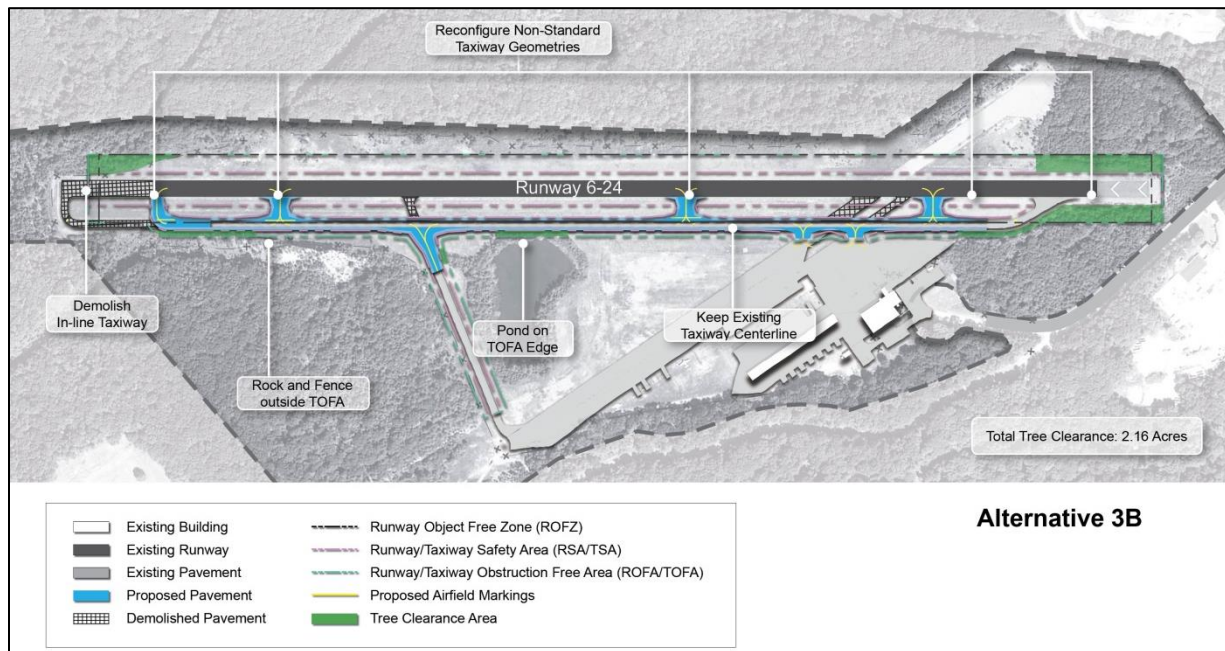


Figure 4-7. Airfield Alternative 3B

Airfield Alternative 3B

This is the minimal development alternative, in which only the non-standard taxiway geometries and the in-line taxiway at Runway 6 end are addressed. Correspondingly, this alternative requires the least amount of tree clearance, but would require MOS approval from FAA.

One alternative solution to mitigate the in-line taxiway is to claim the pavement as a part of Runway 06/24 while keeping the Runway 6 threshold at the existing location as a displaced threshold. This will in effect move the end location of Runway 6 to the end of pavement, and increase the runway takeoff lengths by approximately 337 feet. This is preferable from the aeronautical perspective; however, the Airport has reached an agreement with the Bald Eagle Commons residential complex in 2002 to relocate the Runway 6 end to the location today, in order to provide clearance of the residential complex from the Airport Safety Zone. Therefore, this alternative to reclaim the pavement as runway is dismissed as it would be incompatible with the local zoning ordinances.

In addition to the alternatives discussed above, below is a list of improvements that should be provided to meet the facility requirements, regardless of which alternative is selected as the recommended alternative:

- Remove trees from the ROFZ, RSA, ROFA, and TOFA
- Relocate fence from the ROFZ, RSA, ROFA, and TOFA
- Provide standard surface gradients within RSA

- Mitigate obstructions to the Runway 24 Threshold Siting Surface (TSS)
- Provide taxiway designations to all the taxiways

4.3.2 Alternatives Evaluation

Table 4-2 below summarizes the airfield alternatives as they relate to the applied evaluation criteria. Green indicates a scenario that is more favorable for the evaluation criteria, yellow for less favorable, and red for not favorable.

Table 4-2. Airfield Development Alternatives Evaluation

Evaluation Criteria	Series 1: 1	Series 2: 2A	Series 2: 2B	Series 3: 3A	Series 3: 3B
Safety and Efficiency	●	●	●	●	●
FAA Design Standard Compliance	●	●	●	●	●
Construction Phasing	●	●	●	●	●
Impact on Environmental Features	●	●	●	●	●
Visions of Airport Sponsor & Operator	●	●	●	●	●
Estimated Development Cost	N/A	\$\$\$\$	\$\$\$	\$\$	\$

The key difference between Series 2 and 3 is that Series 2 increases the taxiway separation from the runway, which improves the safety of aircraft operations. Series 3 keeps the non-standard taxiway separation, but reconfigures some of the taxiway geometries that are conducive to runway incursions.

Alternative 2A addresses all the non-standard conditions for the airfield to meet FAA design standards. Alternative 2B address almost all of the non-standard conditions, but leaves Taxiway A5 in its existing condition in order to reduce cost and environmental impact. Series 3A and 3B would fail to meet taxiway/runway separation standard.

Alternative 2A, while being the best alternative to enhance safety and meet FAA standards, would require the highest amount of tree clearance and wetland mitigation, though impacts would be localized to Taxiway A5 near the Runway 24 end. Alternative 2B and 3B avoids impacting the wetland near Taxiway A5. Alternatives 3A and 3B keeps clear from the pond near Taxiway B (although tree clearance from TOFA is still required), and Alternative 3B would not encroach the wetland near Taxiway A5.

The airport sponsor, airport operator, and the FAA would all like the airport to meet safety standards to the maximum extent possible. For this reason, Alternatives 2A and 2B are most desirable. Alternative 1 would maintain the existing condition which is unacceptable and Alternatives 3A and 3B would not significantly improve the airfield operating environment as they do not mitigate the nonstandard runway/taxiway separation.

The estimated construction costs associated with each alternative are presented in an order-of-magnitude manner in **Table 4-2**, with Alternative 2A being the most expensive and Alternative 3B the least.

4.3.3 RPZ Mitigation

RPZs are used to enhance the protection of people and property on the ground and in the vicinity of runway ends. Although some land uses are permitted within the RPZ, the FAA recommends that objects located within the RPZ be cleared from the RPZ if feasible.

As discussed in [Section 3.2](#), the Runway 24 RPZ is penetrated by Airport Road, Industrial Road, a number of properties which are not owned by the New Jersey Department of Transportation, and a plethora of trees. The airport has 3 alternatives for Runway 24 RPZ mitigation:

- Property Acquisition and Relocation of Roads
- Relocation of RPZ
- Avigation Easement

4.3.3.1 Property Acquisition and Relocation of Roads

The Airport has the option of demolishing the existing Airport Road and relocating it approximately 1,000 feet southeast in order to remove it from the RPZ (See **Figure 4-8**). Industrial Road, which also falls within the RPZ, would also be demolished in this scenario. The cost of the road demolitions, property relocations and environmental mitigation is anticipated to be in the hundreds of millions of dollars. In this alternative, the Airport would also acquire all properties located in the RPZ, which include properties owned by the New Jersey Department of Environmental Protection, Township of Milford, and private entities.

This alternative would clear all above ground objects from the RPZ and is therefore most preferable from an FAA airspace safety perspective. However, given the cost of the road relocation and property acquisition, this alternative is not recommended.

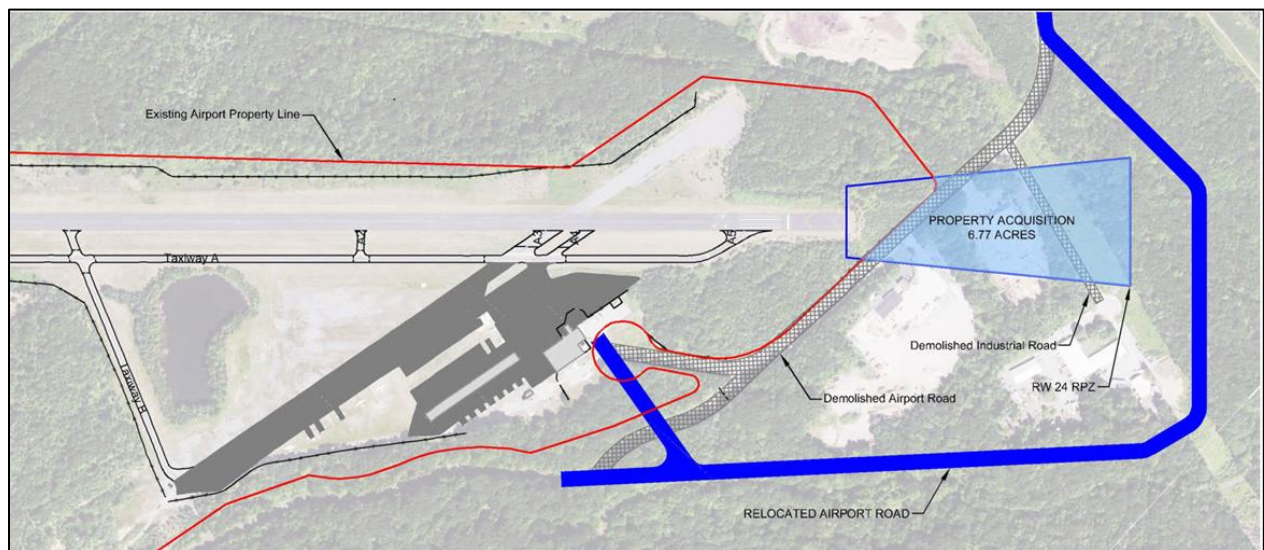


Figure 4-8. Property Acquisition and Relocation of Roads

4.3.3.2 Relocation of the RPZ

The Airport has the option of utilizing declared distances to clear the RPZ from incompatible land uses. In this alternative, the Runway 24 Departure and Approach RPZ could be displaced to provide clearance from the public road. This displacement would reduce the Landing Distance Available (LDA) and Takeoff Distance Available (TODA) by 1,040 feet, as shown in **Figure 4-9**.

This reduction in runway length would prevent a significant number of aircraft that operate at the airport today from operating in the future and adversely impact runway safety. As a result, this option is not recommended.

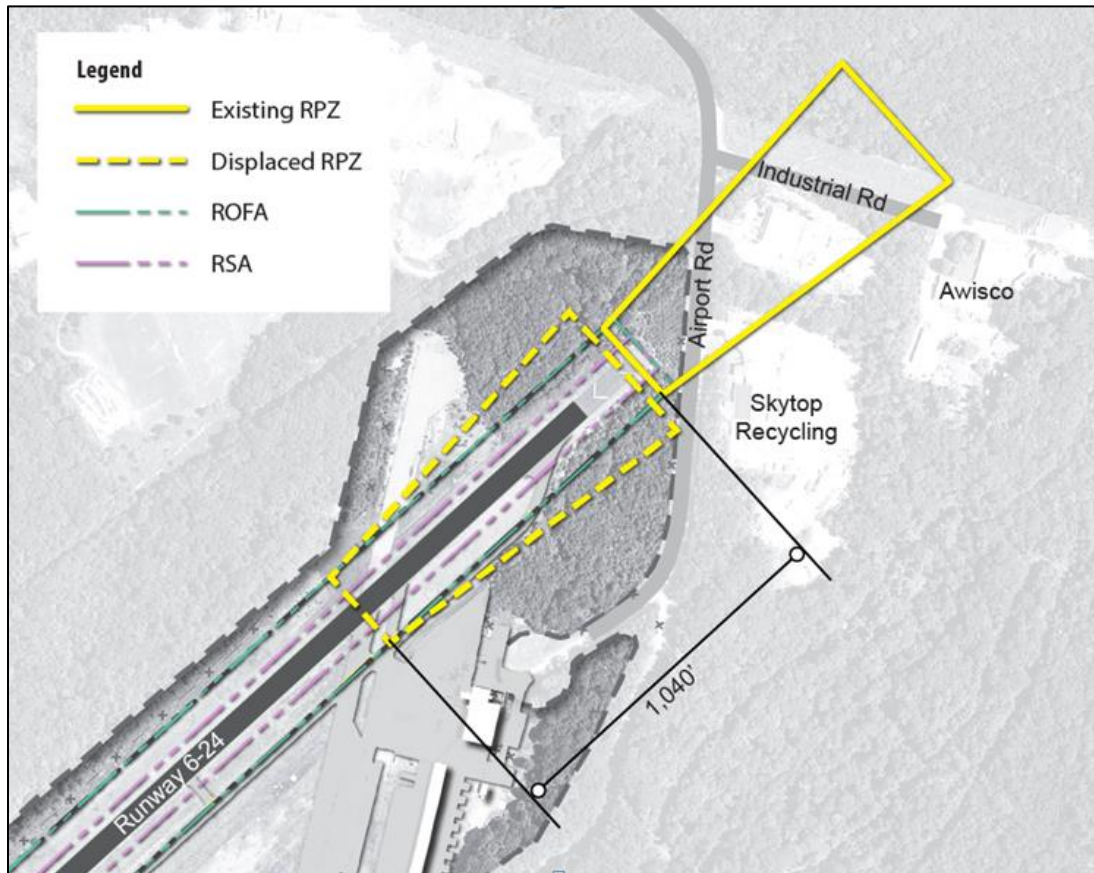


Figure 4-9. Relocation of RPZ

4.3.3.3 Avigation Easement

The Airport has the option of acquiring avigation easements within the RPZ. In this alternative, property owners would grant rights to the airport in exchange for compensation. Avigation easements would permit the unobstructed use and passage of all aircraft through the airspace. Aircraft would be granted the right to create incidental effects, such as noise, vibrations, and interference with sleep or communication. Additionally, existing accepted structures within the RPZ would not be allowed to be further modified, and the development of new structures or planting of trees within the RPZ would not be allowed. Certain land uses would also be prohibited, including residences and places of public assembly such as churches, schools, hospitals, office buildings, and shopping centers.

Avigation easements are commonly utilized to mitigate incompatible land uses within the RPZ and are eligible for FAA funding. Complications include the level of existing development within the RPZ and the existing roadway. It is recommended that options in regard to RPZ conflicts be reviewed with the FAA.

4.3.4 Obstruction Mitigation

The Obstacle Evaluation Study for 4N1 identified a significant number of penetrations to the 20:1 Threshold Siting Surface and the 40:1 Departure Surface for the Runway 06 and Runway 24 ends, as shown in **Table 3-11**. The majority of the penetrations are natural obstacles, such as trees and bushes. However, there are also a number of buildings, poles, and powerlines that penetrate the surfaces as well.

The Obstacle Evaluation Study identified strategies for clearing obstacles to air navigation at each runway end. The ability to successfully remove obstacles from imaginary surfaces depends upon factors such as the type of obstacles requiring removal (natural or manmade structures), the number of property owners involved and potential impacts to property value, the proximity to environmentally sensitive areas and the overall cost and complexity of removal. No two runway ends with obstacles are the same and removal strategies are typically tailored to the unique characteristics of the runway end. In some instances, complete removal of obstacles may be possible, while in others a combination of obstacle removal and airport operational procedure changes may prove most effective. Strategies for mitigation may include: obstacle removal, obstacle marking and lighting, threshold displacement, and/or adjustment of the VGSI angle. Early coordination with key stakeholders, including the airport operator, property owners, utility companies, and state agencies is recommended during the mitigation process.

This obstacle mitigation plan for Greenwood Lake airport is broken down into three focus areas. The Part 77 Primary and Transitional Surfaces, the Runway 6 end, and the Runway 24 end. It is recommended that obstacle removal efforts begin on-airport and then proceed to off-airport locations.

4.3.4.1 Part 77 Primary and Transitional Surfaces

As part of the obstruction survey conducted for Greenwood Lake Airport, objects located within the non-vertically guided Primary Surface defined within FAA AC 150/5300-18B have been identified (surface is 1,000 feet wide centered on the runway, extending 200 feet beyond the runway end). This surface is wider than the Part 77 Primary Surface (500 feet wide centered on the runway, extending 200 feet beyond the runway end). A survey of Part 77 surfaces was not included in the scope of this effort, but obstacle penetrations to the Part 77 Primary Surface have been identified since it is within the area surveyed under Advisory Circular 150/5300-18B guidance. 55 obstacles with penetrations to the Part 77 Primary Surface were found. These include trees, a significant rock outcropping adjacent to Runway 6 and manmade structures.

The majority of obstacle numbers provided in the survey identify individual vegetative or manmade objects. However, a number of vegetative obstacle numbers identify “grids” of multiple objects. Grids within 10,200 feet of the runway threshold, use a 200-foot grid spacing; Grids further than 10,200 feet from the threshold, use a 500-foot spacing. The height identified within the individual grid identifies the highest obstacle point within each grid sector. The numbers of objects within an individual grid area are not identified. Field surveys conducted as part of developing obstacle mitigation plans are necessary to identify the most appropriate type of mitigation for these areas and the exact number of trees affected.

Figure 4-10 outlines the dimensions of both the NVG primary surface (outlined in Blue) and the Part 77 Primary Surface (outlined in Red) and the location of objects within these areas. The Transitional Surface extends along the lateral sides of the Part 77 Primary Surface at a slope of 7:1.

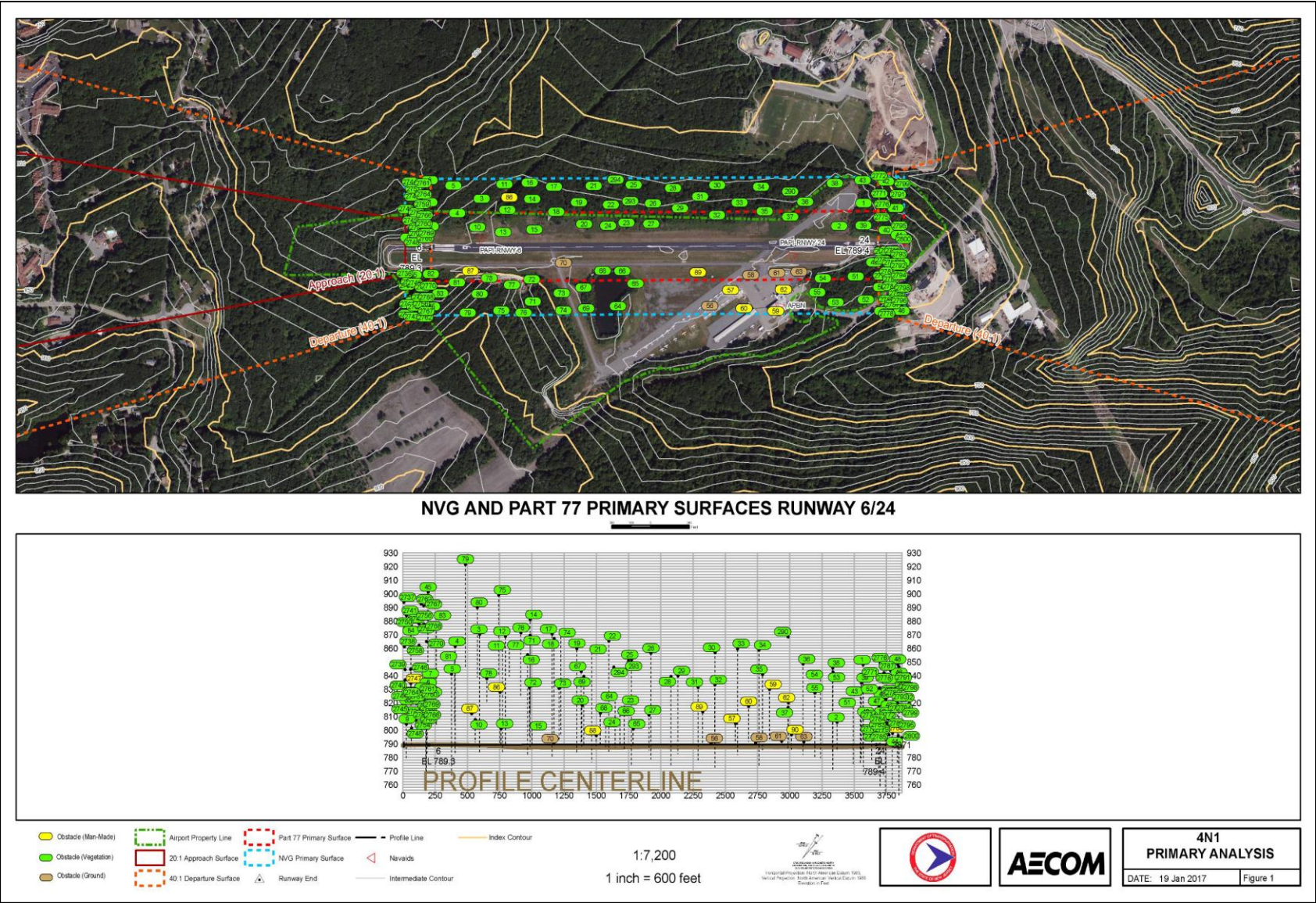


Figure 4-10. Part 77 and AC 150/5300-18B Primary Surfaces

Manmade obstacles are identified in **Figure 4-10** with yellow highlighted obstacle identification numbers. Obstacle ID numbers 59, 62, 87, and 89 identify prominent manmade obstacles within this area. A number of poles associated with the Constellation aircraft, the old fuel tank, the new fuel tank, the administrative building, and T-Hangar are penetrations to the transitional surface (see **Figures 4-11** through 4-13). It is recommended that a representative number of these be lit. The existing Wind Sock and AWOS system are within the Primary Surface, but have obstruction lights attached (**Figure 4-14**). There is a rock outcropping within the Part 77 Primary Surface (see **Figure 4-10** and **Figure 4-15**) which, if possible, should be lit with an obstruction light. For the vegetative objects a field survey should be conducted for contracting purposes to determine the exact number of trees to be addressed and the type of mitigation most practical (trimming versus full removal). It is recommended to first clear vegetation within the Primary Surface (all of which is on airport property) and then proceed to clearing the 313 obstructions in the Transitional Surfaces, a portion of which are located off airport property.



**Figure 4-11. Poles Penetrating the Part 77 Transitional Surface
Adjacent to Administration Building**



Figure 4-12. Poles Adjacent to T-Hangar that Penetrate the Part 77 Transitional Surface



Figure 4-13. Fuel Farm Penetrations to the Part 77 Transitional Surface



Figure 4-14. Existing Wind Sock and AWOS Within the Primary Surface with Obstruction Lighting



Figure 4-15. Rock Outcropping Adjacent to the Runway 6 End

4.3.4.2 Runway 06 Mitigation

The locations of all obstacles relative to the Runway 06 end 40:1 Departure and 20:1 Approach Surfaces are outlined in **Figure 4-18**.

There are over 1000 obstacles to the 40:1 Departure Surface and over 200 obstacles to the 20:1 Threshold Siting Surface. The recommendation is to remove all of these obstacles to the Part 77 and 40:1 surfaces. However, should that prove impracticable the following analysis presents an alternative option.

Because of the quantity and degree of penetrations to the 40:1 Departure Surface (Runway 24 departure) and the 20:1 Threshold Siting Surface for the Runway 6 end, options for mitigation were assessed. It is recommended that the Part 77 Approach Surface and Runway 6 threshold location be modified to aid in mitigation of penetrations to the 20:1 Threshold Siting Surface and that the climb gradient for Runway 24 departures be increased to aid in mitigation of the 40:1 obstacles.

The Part 77 Approach Surface assessed for the Runway 06 end was identified in AC 150/5300-13A Consolidated Change 1, Table 3-2 #3. Given the level of obstacles off the Runway 6 end it is proposed that the approach be downgraded to a visual approach as identified in AC 150/5300-13A Change 1 Table 3-2 #2. The proposed visual Approach Surface is narrower than the existing Approach Surface and begins at the runway threshold instead of 200 feet from the threshold. These dimensional changes result in the removal of a number of obstacles from the Approach Surface.

The facility requirements chapter indicates a minimum landing length of 3,000 feet is required. Given this, a number of alternatives were reviewed for threshold displacement (see **Table 4-3** below).

Table 4-3. Alternatives Assessed for Threshold Displacement

			Obstacle Impacts Visual Approach- Various Threshold Locations					
			LDA	Total Obstacles	Trees	Obstacle Grid Trees	Poles	Buildings
Existing Threshold			3471	131	92	34	2	3
			3163	102	69	30	1	2
			3113	98	66	31	1	0
			3063	88	60	27	1	0
Tolerable Displacement			3013	82	56	26	0	0
			2963	71	48	23	0	0
			2913	60	40	20	0	0
			2863	56	37	19	0	0

As shown in **Table 4-3**, analysis of various changes to threshold location indicate a gradual reduction in obstacles the further the threshold is displaced. A threshold displacement of 358 feet results in landing distance available of 3,113 feet which is operationally acceptable and removes all buildings from the approach surface.

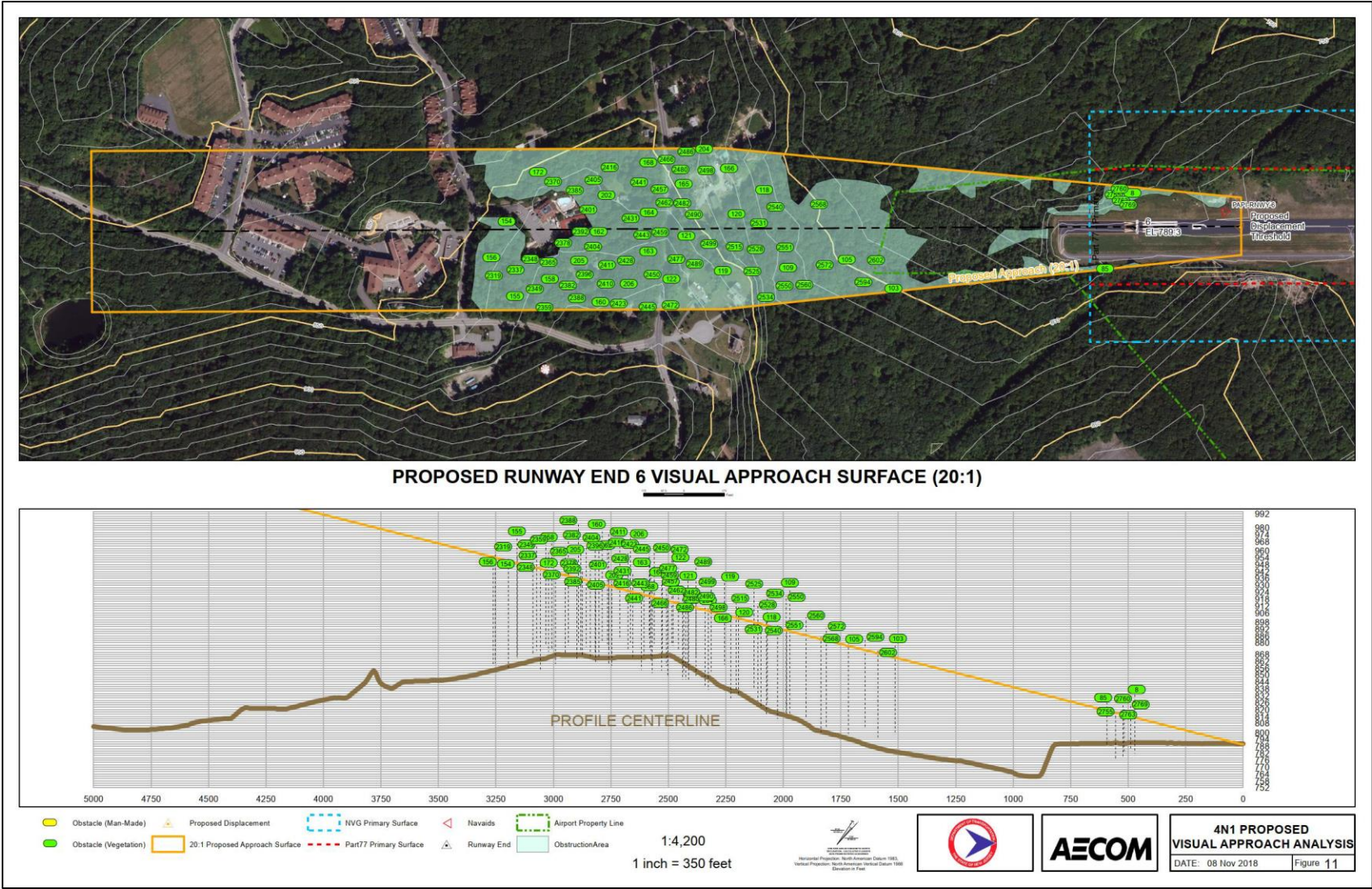


Figure 4-16. Proposed Runway 06 End Visual Approach Surface

As identified in **Table 4-3** estimates of both individual trees and “Obstacle Grid Trees” are identified. Obstacle Grid Trees represent those areas of tree canopy so tightly clustered that individual trees cannot be identified. For the vegetative objects a field survey should be conducted for analysis purposes to determine the exact number of trees to be addressed and the type of mitigation most practical (trimming versus full removal). In addition, the location of trees (public versus private land) and an assessment of the practicability of removal should also be made to determine the most feasible plan for removal.

While there are fewer vegetative penetrations to the 20:1 Threshold Siting Surface, associated with the threshold shift, the overall magnitude of vegetation penetrations has not changed significantly. In practice, vegetation mitigation involves removing penetrations to the 20:1 surface and also vegetation expected to grow into the 20:1 surface in future years. Given the dense tree cover within this area the overall number of vegetative objects requiring mitigation will not be significantly different under the threshold displacement scenario.

In regards to the 40:1 Departure Surface, analyses were conducted on raising the climb gradient for Runway 24 departures. This analysis takes into consideration that low close in obstacles (within 1 nautical mile of the departure end of runway), less than 200 feet above the departure end of the runway, do not require increased takeoff minimums. To eliminate publishing excessive climb gradients such obstacles can be published in the takeoff minimums and departures procedures section of the Terminal Procedures publication for the airport. The existing airport climb gradient is 200 feet per nautical mile and analyses were conducted to determine the most practicable climb gradient for avoiding obstacles.

The existing fleet at Greenwood Lake Airport averages a maximum climb gradient of 700 feet per nautical mile. Such a climb gradient may be technically possible, but is not desirable from a day to day aircraft operating perspective. A 4.5 to 5-degree climb angle corresponds to a climb gradient of 500 feet per nautical mile which better balances the tradeoff between obstacle mitigation and aircraft operations. Such a climb gradient would obviate the need to mitigate existing obstacles greater than 1 NM from the runway end. Within one mile from the runway, 63 tree locations which exceed 200 feet above the departure end of runway, would require mitigation.

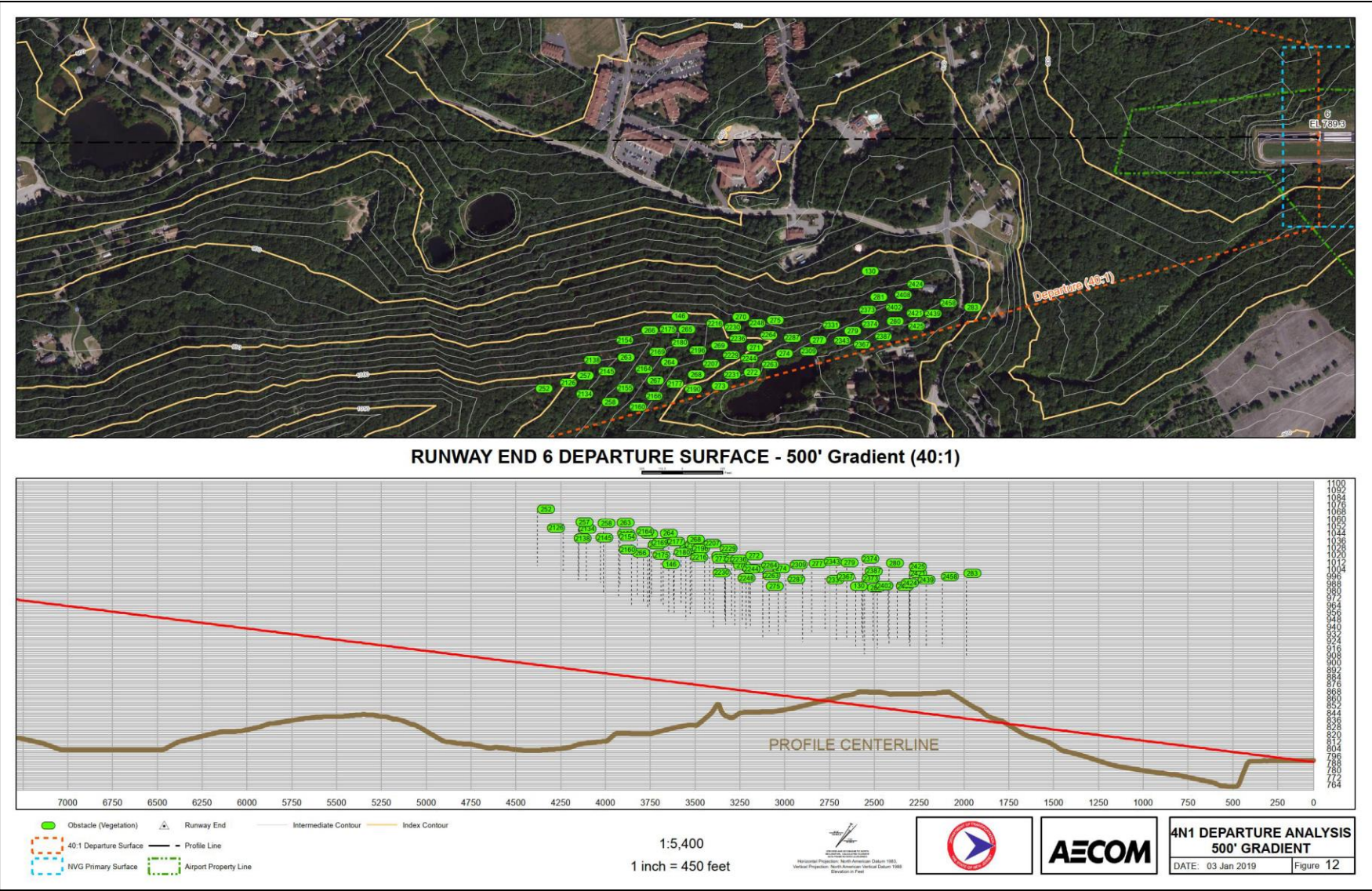


Figure 4-17. Alternate Runway 24 Departure Surface

Therefore, an alternative to mitigate impacts to the Runway 24 Departure Surface is to increase the climb gradient to 500 feet per nautical mile and to publish existing obstacles which are less than 200 feet above runway elevation in the Terminal Procedures manual.

4.3.4.3 Runway 24 Mitigation

The Runway 24 end has a few manmade obstacles (four) and a modest number of tree obstacles that penetrate both the 40:1 Departure and 20:1 Threshold Siting Surfaces (See **Figure 4-19**). Obstacles to the 40:1 Departure Surface span an area of approximately eight acres. Obstacles within the 20:1 surface span an area of approximately one acre. Rough order of magnitude costs for tree clearing in non-wetland areas are approximately \$10,000 to \$15,000 per acre. Environmental approval requirements for the Runway 24 end are significantly less onerous than the Runway 6 end.

It is recommended that coordination with property owners is undertaken to assess options for land acquisition, avigation easements, or right of entry for tree clearing or topping for natural obstructions within the 20:1 and 40:1 surfaces. It is also recommended that utility companies be contacted to discuss obstacle impacts from utility poles and discuss the necessary steps for installing obstruction lighting or removing the poles. It is recommended that mitigation efforts for the Runway 24 end focus on mitigating obstacles to the Runway 24 Part 77 Approach Surface as transition of Runway 6 to a visual Approach Surface will eliminate the need to maintain the 40:1 surface for Runway 6 departures.

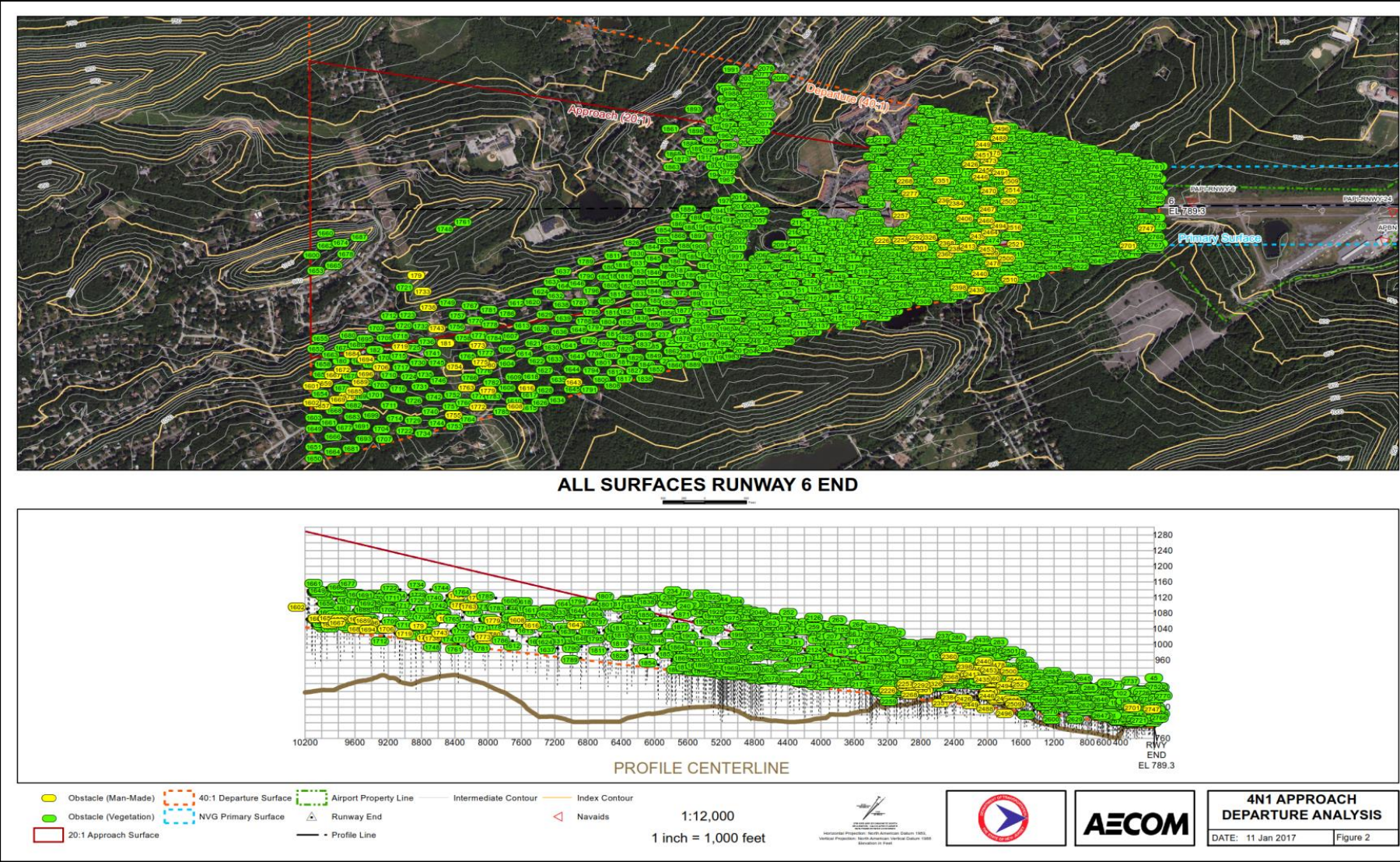


Figure 4-18. Runway 06 Obstacles



ALL SURFACES RUNWAY 24 END

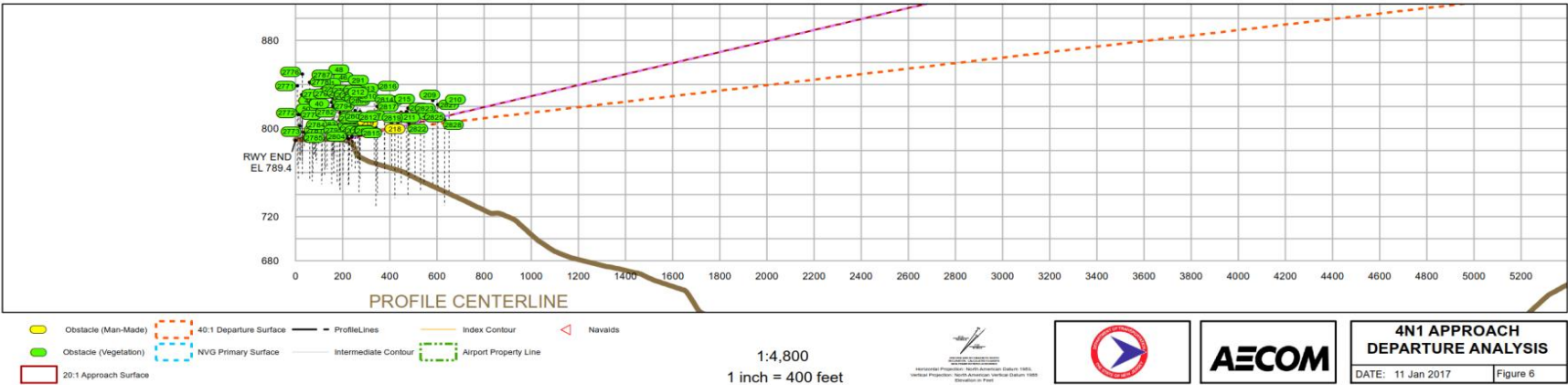


Figure 4-19. Runway 24 Obstacles

4.4 General Aviation Development Alternatives

Given the core operational and business role of general aviation at 4N1, GA development is the primary focus of the Master Plan. **Chapter 3 Facility Requirements** identified the minimum recommended GA facility requirements over the 20-year planning period. Those that are relevant to the GA layout alternatives are summarized below:

- Based aircraft parking on apron
 - Provide minimum 26 positions (all should be at least ADG-I) and room for expansion
 - Apron should meet FAA safety standards with taxilane markings
- Transient aircraft parking on apron
 - Provide minimum four ADG-I positions and one or two for ADG-II aircraft
 - Provide ADG-II taxilane to access the ADG-II positions (one of the positions could be in a box or conventional hangar)
- Helicopter parking on apron
 - No change. New development should stay clear from the 108-foot radius of rotor wash
- Hangar storage
 - Twelve (12) ADG-I positions in replacement T-hangar
 - Another fourteen (14) in new T-hangar, box hangar or conventional hangar
 - If box/conventional hangar(s) are proposed, ADG-II taxilane access should be provided.

The alternative evaluation process includes two rounds of screening. The initial screening examined a broad range of alternatives and identified those that best met the evaluation criteria. These selected alternatives then underwent a second round of more rigorous development and evaluation.

4.4.1 Screening Round I

The first round of screening explored a wide range of possibilities. In addition to the “no-build” alternative, three series of alternatives were developed. Most of the alternatives in the initial round were developed with a goal of meeting the facility requirements with minimal environmental disruption.

The constraints outlined for the alternatives in the initial screening include:

- New development should be kept 300 feet away from Highland open waters (all springs, streams, wetlands, bodies of surface waters) to the extent possible.
- Disruptions to the wooded area should be limited to the extent possible.
- The expansion of impervious surface should be minimized.

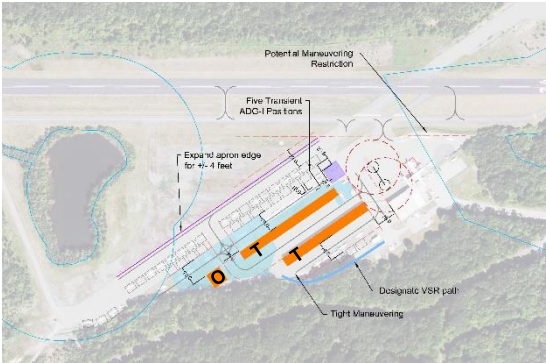
4.4.1.1 Alternatives

All of the alternatives will provide at least one 12-unit T-hangar. Series 2 focuses on meeting the facility requirements with T-hangars. Series 3 focuses on conventional hangars, and Series 4 explores the possibilities of using box hangars. **Table 4-4** provides a summary of the capacity provided by each alternative.

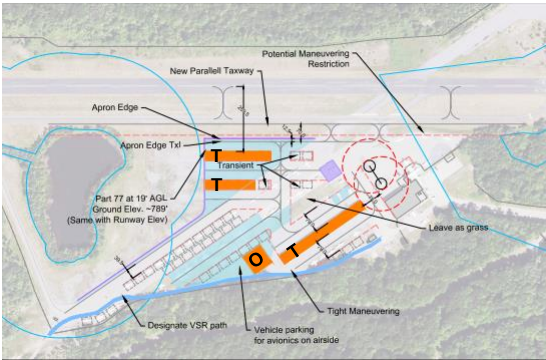
Table 4-4. General Aviation Development Alternatives

GA Alternatives	Existing	Hangar Storage				Apron		Additional Hangar
		Replace Existing T-Hangar	Build New T-Hangar	Build Box Hangar	Build Conventional Hangar	Based Aircraft	Transient Aircraft	
1	x	-	-	-	-	-	-	-
2A		12	14	2	-	31 (I)	5 (I)	No
2B		12	8 + 6	-	-	32 (I)	5 (I)	Yes
2C		-	26	-	-	20 (I), 2 (II)	4 (I), 3 (II)	Yes
3A		12	-	-	14	28 (I), 1 (II)	5 (I)	Yes
3B		12	6	-	8	25 (I), 1 (II)	4 (I), 2 (II)	No
3C		-	12	-	14	30 (I), 3 (II)	4 (I), 2 (II)	Yes
4A		12	-	4+4+6	-	22 (I), 2 (II)	4 (I), 2 (II)	-
4B		-	12	4+4+6	-	23 (I), 2 (II)	4 (I), 2 (II)	No

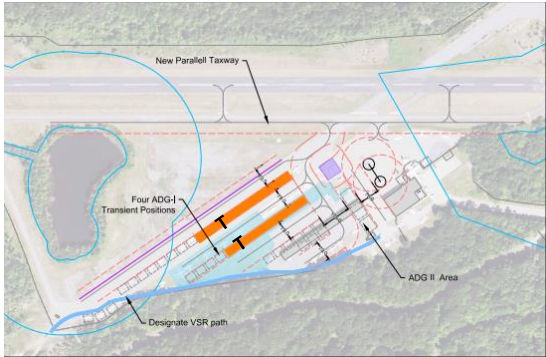
Figure 4-20 presents all of the airfield alternatives in a single graphic. This format provides a graphical summary to compare the differences between the alternatives listed in **Table 4-4**.



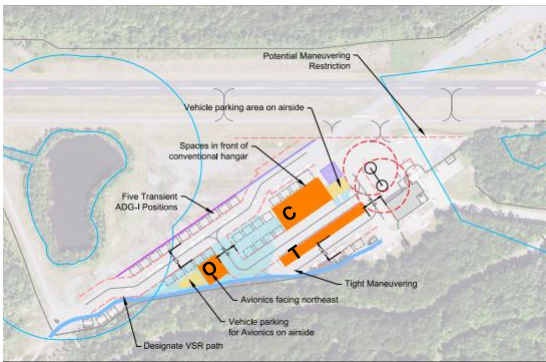
2A



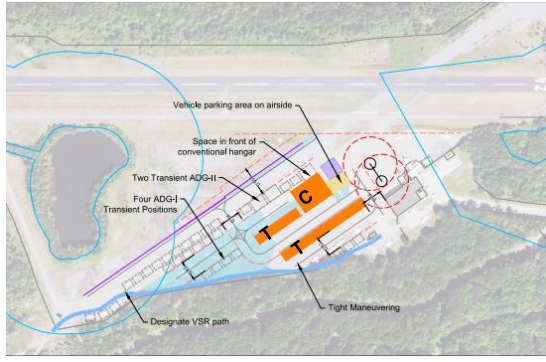
2B



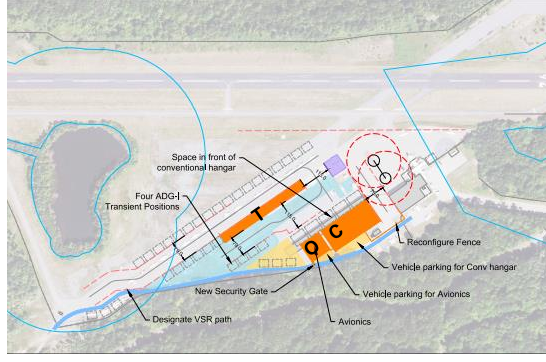
2C



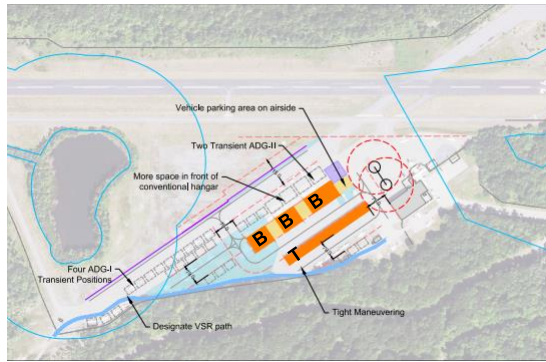
3A



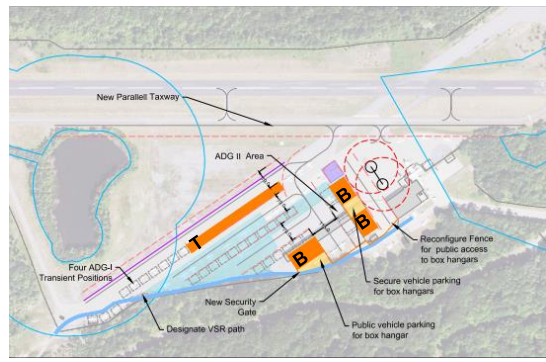
3B



3C



4A



4B

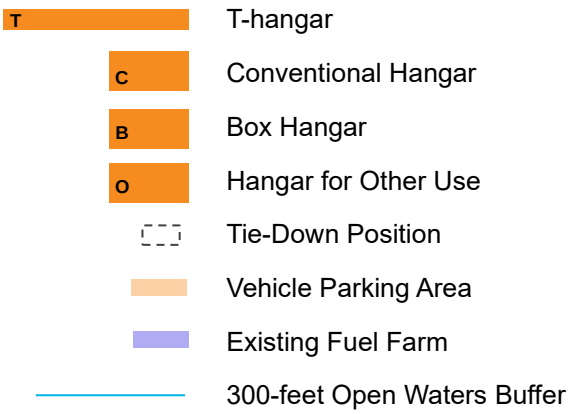


Figure 4-20. General Aviation Development Alternatives – Initial Screening

The no-build alternative would retain all the existing conditions. The key issues with the existing conditions include but are not limited to:

- Inadequate indoor storage for based aircraft, which causes 4N1 to lose prospective tenants to other airports,
- Non-standard taxilane separation, which compromises operational safety,
- Lack of designated parking positions for ADG-II transient aircraft,
- Lack of box or conventional hangars for flexible indoor storage of ADG-II aircraft and helicopters, or to attract GA businesses such as fixed based operator, flight school, or avionics shop.

GA Alternative 2A

This alternative reconstructs the 12-unit T-hangar in its existing footprint and builds another 14-unit T-hangar parallel to the existing T-hangar. The existing transient apron will be vacant as any ADG-II aircraft will be a penetration to the Part 77 airspace. Five ADG-I transient positions will be provided adjacent to the fuel farm. To meet FAA design standard for taxilane width, the apron edge must be expanded for approximately four feet.

The key advantage of this alternative is that it provides the highest number of tie-down parking positions on the apron.

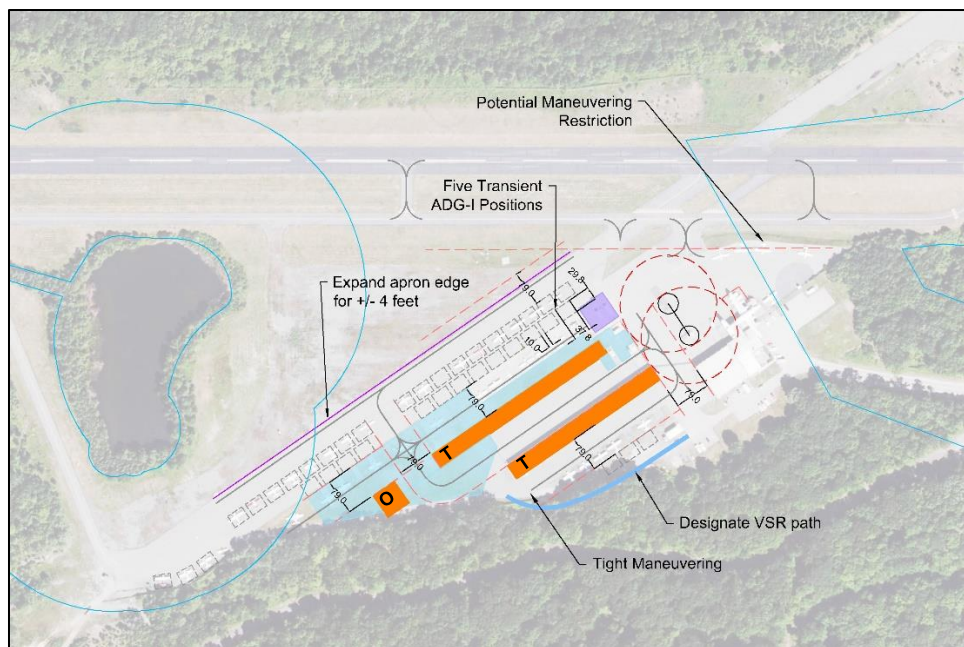


Figure 4-21. General Aviation Alternative 2A

Note: please refer to Figure 4-20 for the legend.

GA Alternative 2B

This alternative explores the possibility of providing T-hangars close to the airfield and in parallel to the runway and taxiway.

As shown on **Figure 4-22**, this alternative requires expansion into the triangular shaped area formed by the parallel taxiway, the existing apron, and the 300-foot buffer from the pond. Such expansion would significantly increase the impervious surface, compared to other GA alternatives in this screening round. It would also bring structures close to the runway environment potentially requiring a downgrading in approach category. In addition, the airport operator indicated that this area is where spectators watch the Greenwood Lake Air Show and should be kept clear of any structures that could obstruct the view. Moreover, the different alignments of the existing T-hangar footprint and the new T-hangars lead to a reduced efficiency in terms of space utilization. As a result, the larger expansion of impervious area would generate lower number of aircraft parking positions, as compared in **Table 4-4**.

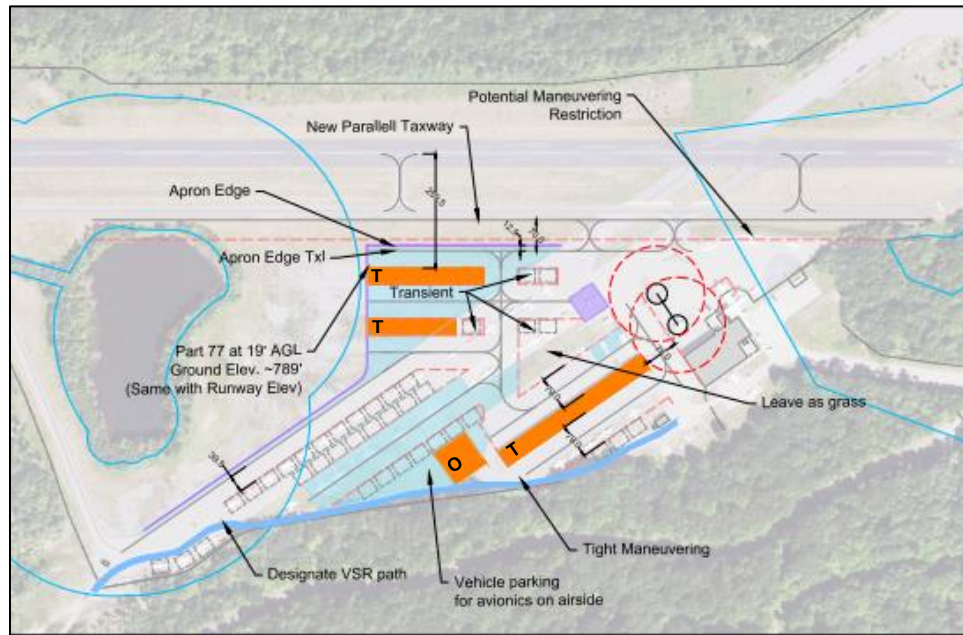


Figure 4-22. General Aviation Alternative 2B

Note: please refer to Figure 4-20 for the legend.

GA Alternative 2C

This alternative seeks to build the new T-hangars closer to the existing apron edge, and therefore vacate the existing T-hangar footprint to provide an area dedicated to ADG-II aircraft parking. Compared to Alternative 2A, this alternative provides fewer tie-down parking positions on the apron. The airport operator expressed preference to keep larger box/conventional hangars near the wooded area. Correspondingly, this alternative provides some flexibility to accommodate larger conventional and box hangars along the wooded area should there be demand for these facilities.

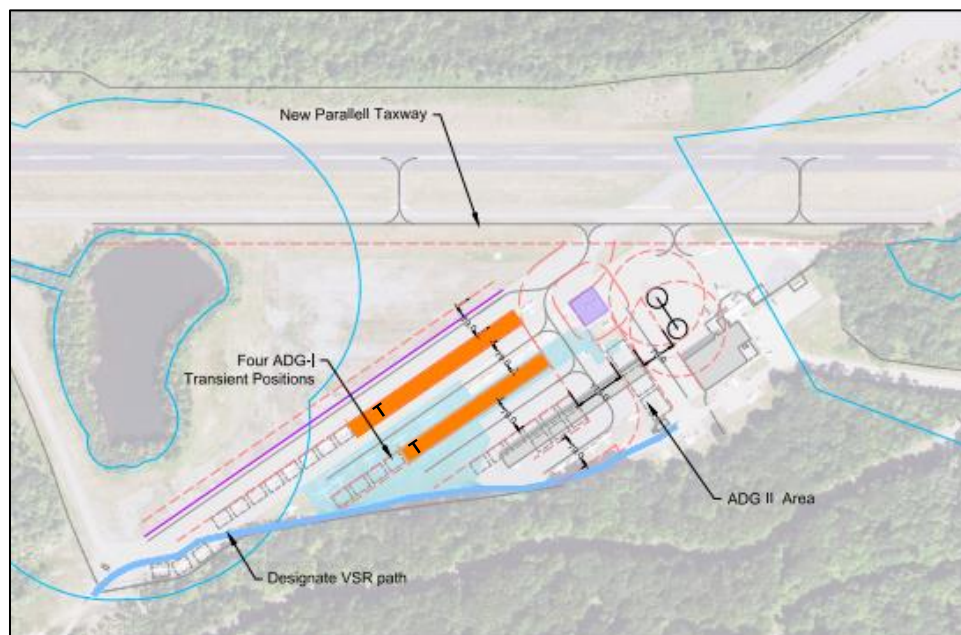


Figure 4-23. General Aviation Alternative 2C

Note: please refer to Figure 4-20 for the legend.

GA Alternative 3A

Alternative Series 3 focuses on meeting the facility requirements with replacing the existing T-hangar and providing 14 more indoor ADG-I parking positions in a conventional hangar. The conventional hangar provides flexibility that T-hangars cannot provide in terms of accommodating both ADG-I and ADG-II aircraft. The drawback of conventional hangars is the lack of independent aircraft maneuvering as provided by the T-hangars. A hangar manager would be required to coordinate the movement of aircraft. ADG-II taxiway access is provided to access the conventional hangar. Aircraft parking positions are also provided in front of the conventional hangar, so that when an aircraft is pulled out of the hangar it won't be penetrating the taxiway OFA.

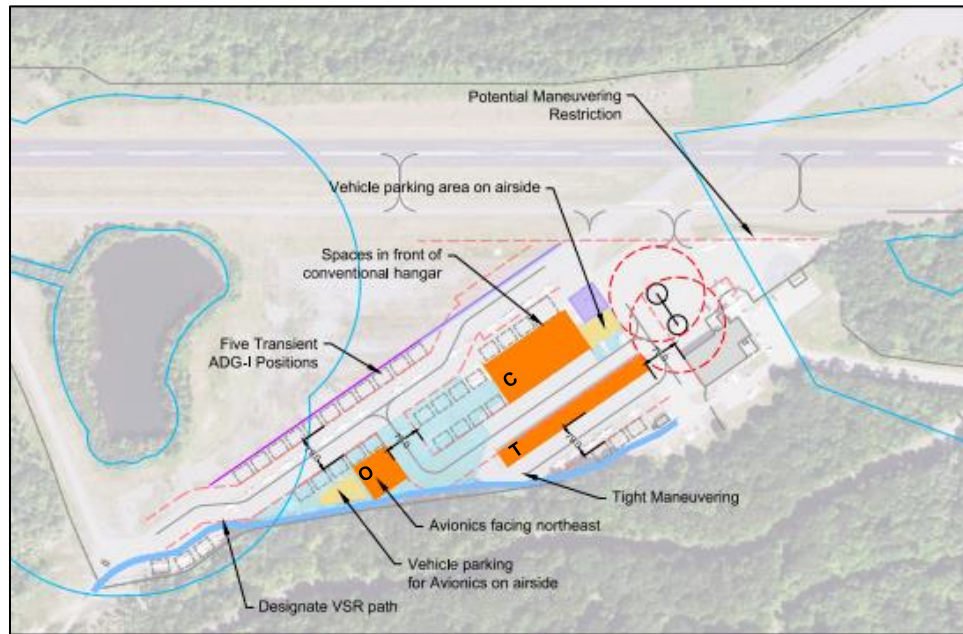


Figure 4-24. General Aviation Alternative 3A

Note: please refer to Figure 4-20 for the legend.

GA Alternative 3B

Alternative 3B seeks to replace the existing T-hangar, and to provide the additional 14 indoor aircraft positions through a 6-unit T-hangar and an 8-unit conventional hangar.

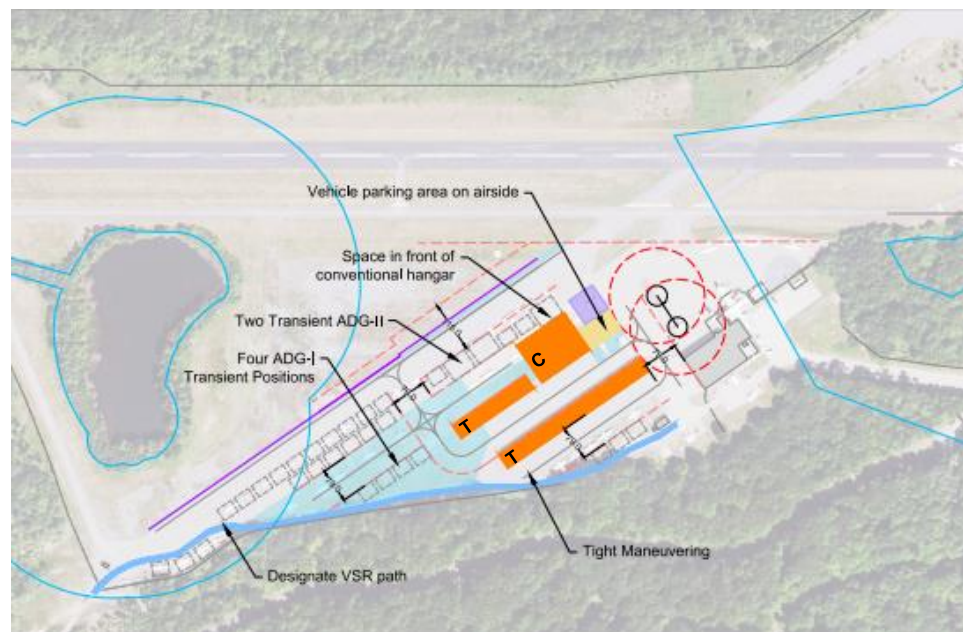


Figure 4-25. General Aviation Alternative 3B

Note: please refer to Figure 4-20 for the legend.

GA Alternative 3C

Alternative 3C rebuilds the T-hangar closer to the existing apron edge and dedicates the existing T-hangar footprint area to accommodate the 14-unit conventional hangar and a smaller hangar possibly for an avionics establishment. The fence will be reconfigured to provide public vehicle parking access to the conventional hangars. This layout provides the highest number of tie-down positions among all the alternatives in the initial screening round.

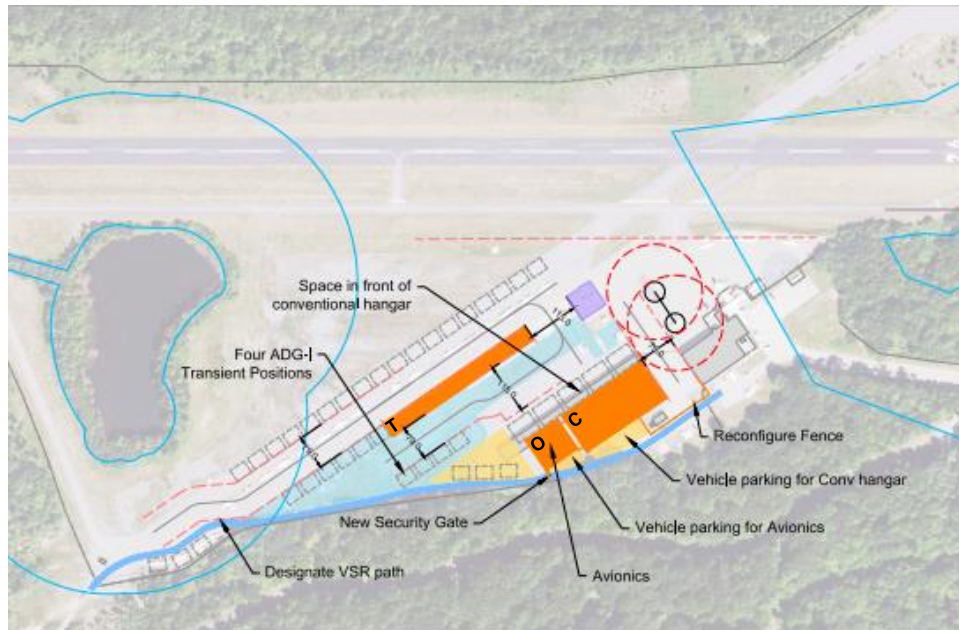


Figure 4-26. General Aviation Alternative 3C

Note: please refer to Figure 4-20 for the legend.

GA Alternative 4A

Alternative Series 4 provides capacity through a combination of T-hangars and box hangars. Alternative 4A accommodates a row of box hangars, two with 4 ADG-I parking positions and one with 6 ADG-I parking positions, in parallel to the new T-hangar rebuilt at the existing T-hangar footprint. ADG-II taxiway access is provided for the box hangars because they also provide flexibility to accommodate ADG-II aircraft. Similar to the drawback of conventional hangar, box hangars also require coordinated maneuvering of aircraft in and out of the storage.

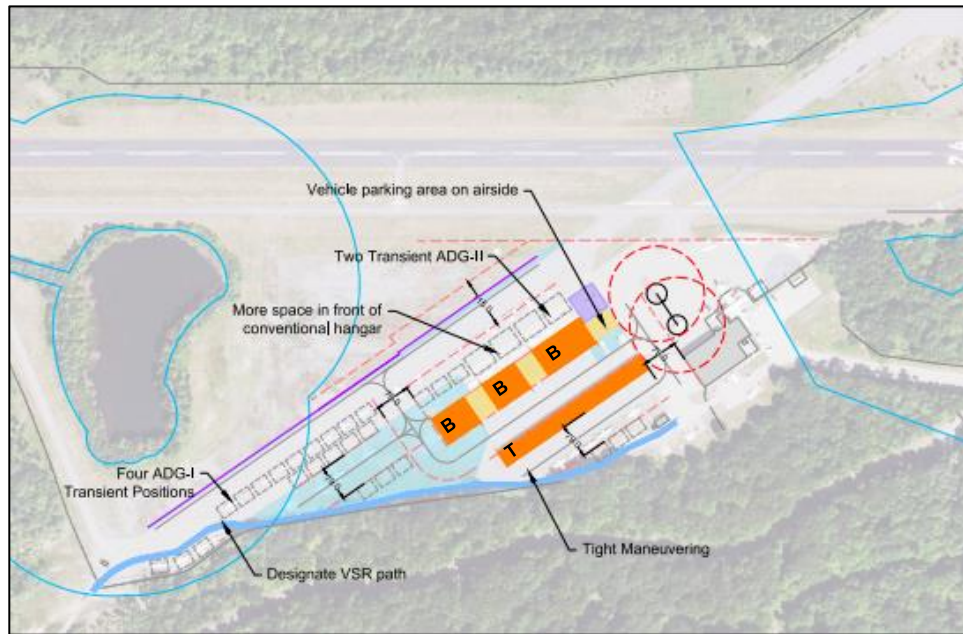


Figure 4-27. General Aviation Alternative 4A

Note: please refer to Figure 4-20 for the legend.

GA Alternative 4B

Alternative 4B locates the new T-hangar closer to the apron edge and provides a cluster of box hangars near the wooded area. This box hangar area would have ADG-II access and also aircraft and vehicle parking space in front of box hangars.

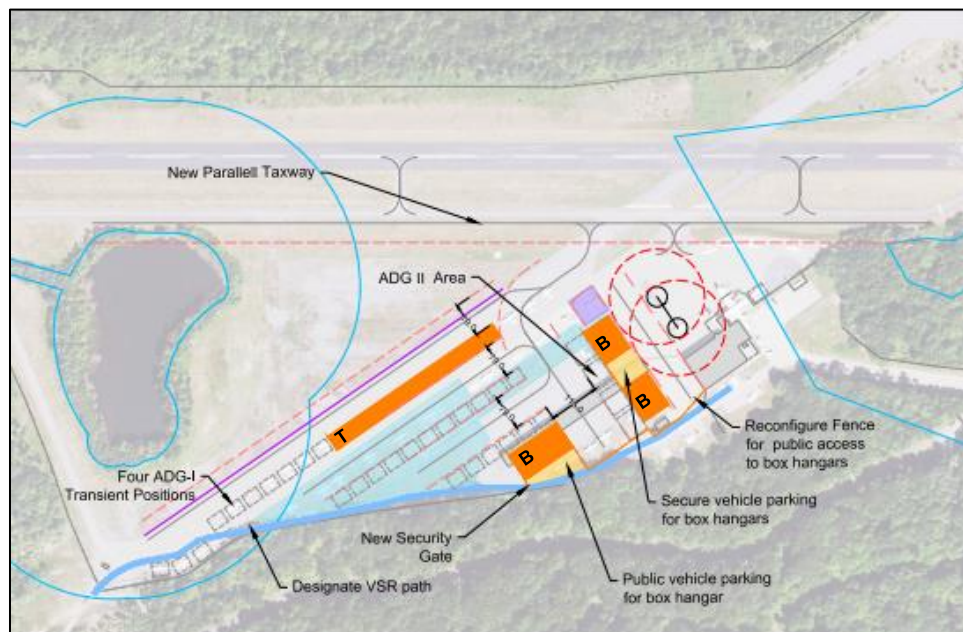


Figure 4-28. General Aviation Alternative 4B

Note: please refer to Figure 4-20 for the legend.

4.4.1.2 Alternatives Evaluation

Table 4-5 shows a comparison of the GA alternatives in the Screening Round I. Since all of the alternatives meet capacity, safety, and local zoning requirements, these criteria are not included in the comparison matrix. Green indicates a scenario that is more favorable for the evaluation criteria, yellow for less favorable, and red for not favorable.

Table 4-5. General Aviation Development Alternatives Evaluation – Round I

Evaluation Criteria	1	2A	2B	2C	3A	3B	3C	4A	4B
Hangar Storage Capacity (ADG-I Position)	12	28	26	26	26	26	26	26	26
Dedicated Tie-Down Positions for ADG-I	45	31	32	20	28	25	30	22	23
Dedicated Tie-Down Positions for ADG-II	0	0	0	2	1	1	3	2	2
Dedicated Transient Positions for ADG-I	5	5	5	4	5	4	4	4	4
Dedicated Transient Positions for ADG-II	0	0	0	3	0	2	2	2	2
Capability to Accommodate ADG-II Aircraft	●	●	●	●	●	●	●	●	●
FAA Taxilane Design Standards	●	●	●	●	●	●	●	●	●
Flexibility for Expansion	●	●	●	●	●	●	●	●	●
Visions of Airport Sponsor & Operator	●	●	●	●	●	●	●	●	●
Estimated Development Cost	-	●	●	●	●	●	●	●	●
Impact on Environmental Features	-	●	●	●	●	●	●	●	●
Increase in Impervious Surface (Acres) ¹		1.99	3.22	1.85	2.10	2.20	2.01	2.22	2.07

Note:

(1) Impervious surface includes pavement and building.

In terms of operational performance, all the alternatives provide the same number of hangar storage positions for ADG-I aircraft. Excluding the no-build alternative (Alternative 1), Alternatives 2A and 3C provides the highest number of tie-down positions for ADG-I, and Alternative 3C provides the highest number of ADG-II tie-down positions.

When it comes to standards and best practices, Alternatives Series 3 and 4 are more catered towards providing storage capabilities for ADG-II aircraft given the provisions of box and conventional hangars.

For any alternative that keeps the T-hangar at its existing location (2A, 2B, 3A, 3B, 4A), the FAA taxilane design standards cannot be met near the south end of the T-hangar without tree clearance. Except for Alternative 2B, all the other alternatives preserve the possibility of expanding into the triangular area in the future.

Upon reviewing the initial round of alternatives, the airport sponsor and operator indicated the strong need to prioritize expanding T-hangar capacity in order to accommodate and attract more based aircraft tenants. Therefore, Alternatives 2A and 2C are preferred. Also, the airport sponsor and operator pointed out that Alternative 3C presents an ideal overall layout of the GA area, in a sense that the larger box and conventional hangars are located closer to the wooded area and the T-hangar closer to the airfield.

The costs and environmental impact of developing Alternative 2B would be the highest due to the expansion into the triangular area. The costs to develop box or conventional hangars are typically higher compared to T-hangars from a rough order-of-magnitude perspective. Alternatives 2A and 2C would be the least costly and have the lowest acreage of increase in impervious surface.

Alternatives that scored four green points or more were advanced into the second round of screening. These alternatives are 2A, 2C, and 3C.

4.4.2 Screening Round II

The airport sponsor and operator suggested that the second round of screening should emphasize the following merits of the selected alternatives:

- Prioritize on building T-hangars to provide the 26 ADG-I indoor storage positions
- Maintain one helicopter parking position sized for the Agusta 139 Maintain a 50-foot clearance from the existing fuel farm
- Identify locations east and south of the existing T-hangar to accommodate a conventional hangar and/or box hangar should there be future interest from business tenant(s) for such facilities. If necessary to meet facility requirements and separation standards, expansion into the wooded area east of the Airport should be considered.

The three selected alternatives from Round I were further refined based on these principles.

4.4.2.1 Alternatives

Alternative 2A-Refined

Figure 4-29 shows the refined graphic for Alternative 2A. Alternative 2A tries to balance maximizing property utilization, without significantly encroaching into the triangular infield area or the wooded area adjacent to the existing general aviation ramp east of the airport. In addition to the two T-hangars that provide 26 aircraft positions, this alternative allows for the future development of two box hangars should there be demand for these for these facilities. One location would be at the southern end of the based aircraft tie down area and the other next to the existing maintenance hangar. Each of these box hangars could accommodate at least four ADG-I aircraft parking positions.

The box hangar next to the existing maintenance hangar would be restricted to ADG-I aircraft given the limited clearance between the T-hangar and the existing maintenance hangar. The box hangar to the south of the based aircraft tie down area could also accommodate ADG-II aircraft, but would also require ADG-II taxiway access from Taxiway B. Such an upgrade would require relocating the fence out of the ADG-II TOFA.

The fence and vehicle service road will be reconfigured around both of the proposed hangars, which would require some tree clearance. The security gate will be relocated together with the reconfigured perimeter fence to provide public vehicle parking space for the new hangar next to the maintenance hangar.

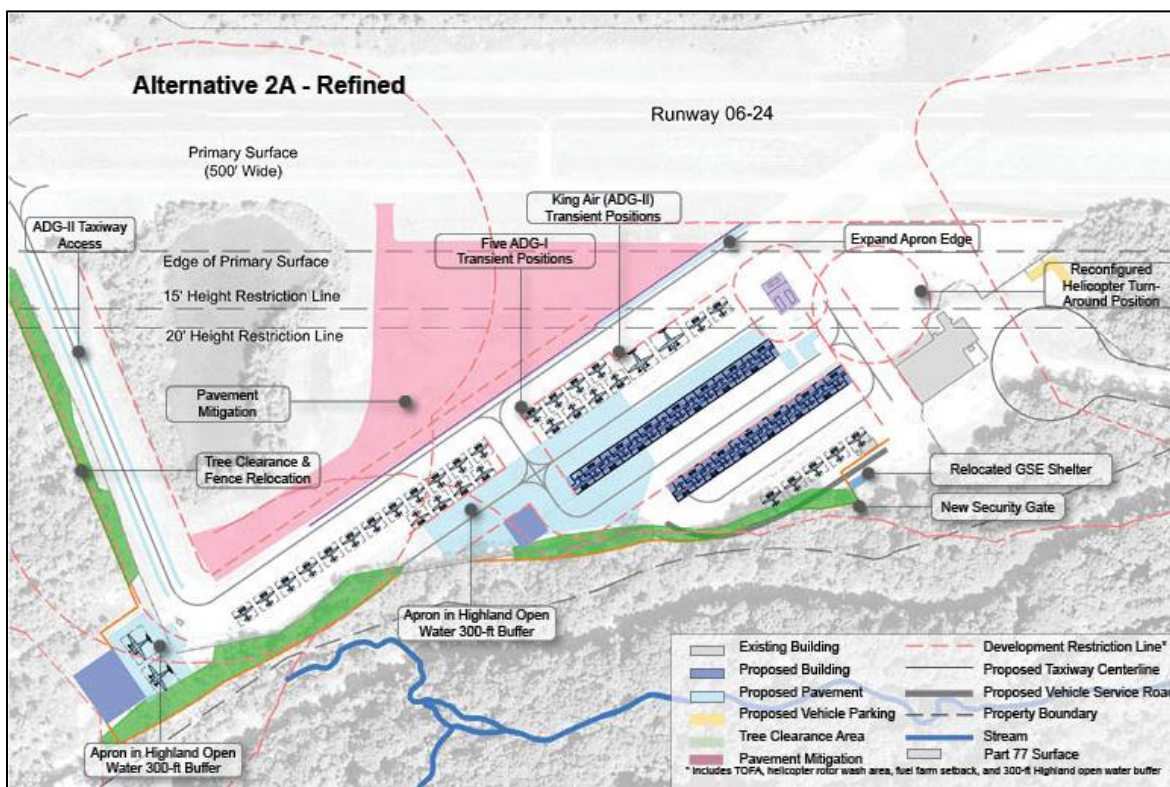


Figure 4-29. General Aviation Alternative 2A Refined

Alternative 2C-Refined

Alternative 2C proposes building the two new T-hangars with 26 positions closer to the airfield, instead of rebuilding one of the T-hangars at the existing T-hangar site. This approach opens the possibility of accommodating box hangars near or in the wooded area should there be demand from business tenant(s). In addition to the box hangar in the Quarry Area, three more box hangars could be accommodated within the property boundary of 4N1 as shown on **Figure 4-30**. The smaller box hangars in the wooded area could store approximately six ADG-I aircraft, and the larger box hangar could store approximately eight ADG-I aircraft. The larger box hangar would also have ADG-II taxiway access to accommodate ADG-II aircraft indoors. This alternative focuses on maximizing all available airport property, particularly the area adjacent to the existing GA ramp east of the airport.

All three of the new box hangars would require tree clearance, and the two smaller box hangars would encroach into the 300-foot development constraint buffer from the Hewitt Brook to the east of the airport boundary. Also, the security gate, fence, and vehicle service road will all need reconfiguration. Only the larger box hangar would have public vehicle parking access.

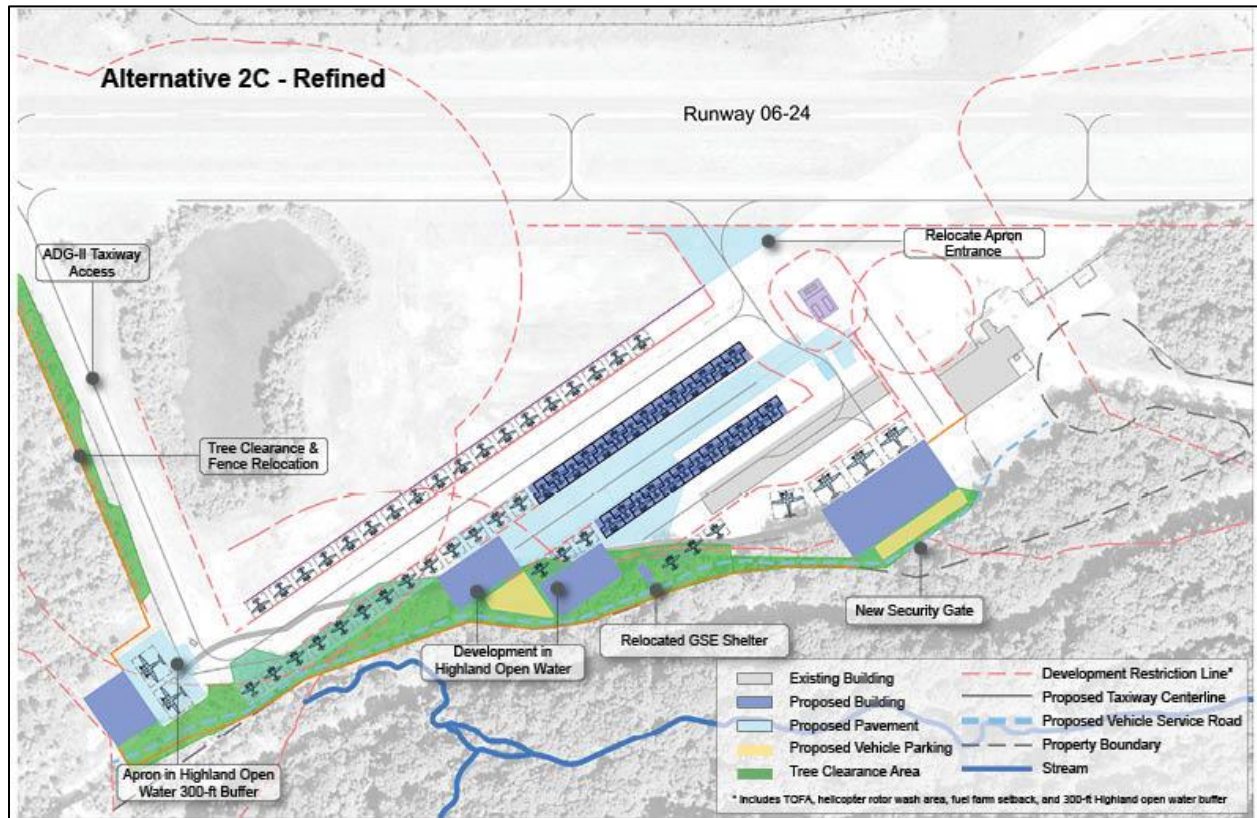


Figure 4-30. General Aviation Alternative 2C Refined

Alternative 3C-Refined

Alternative 3C focuses on providing box hangars within already disturbed airport apron areas at the perimeter of the airport and relocating T-hangars closer to the triangular infield area. A conventional hangar of 14 ADG-I positions, and two box hangars of four ADG-I positions will be provided in a cluster near the existing maintenance hangar. One box hangar of four ADG-I positions will be accommodated to the area south of the based aircraft tie down area.

The conventional hangar and one box hangar will have ADG-II taxilane access and thus flexibility to accommodate ADG-II aircraft indoor. All large hangars will have public vehicle parking access except for the one located to the south of the based aircraft tie down area. The security gate, fence, and vehicle service road will all be reconfigured accordingly. Minimal tree clearance will be required for the reconfigured gate and fence, but not as significantly as that in the refined Alternative 2C.

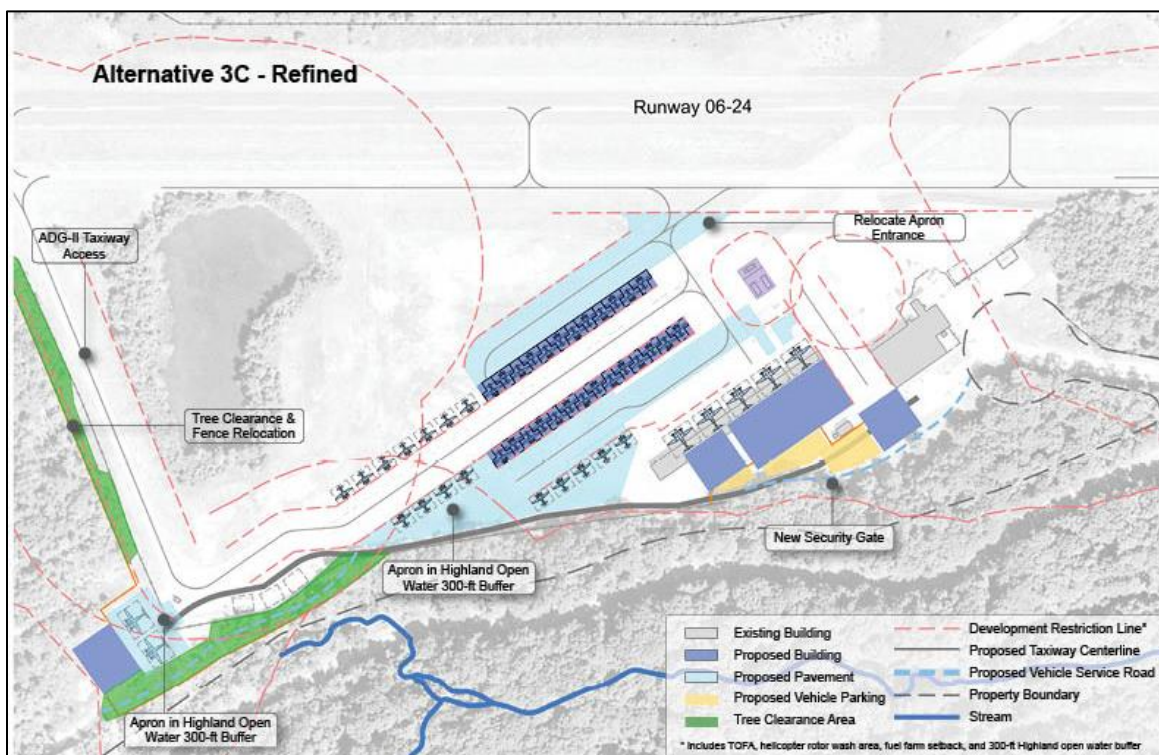


Figure 4-31. General Aviation Alternative 3C Refined

4.4.2.2 Alternatives Evaluation

The evaluation of the Round II alternatives focuses on striking a balance between providing extra capacity and limiting environmental impact. All of the three alternatives provide five ADG-I transient positions and two ADG-II transient positions. As shown in **Preferred GA Alternative**

Based on the screening general aviation development alternatives, Alternative 2A was selected as the preferred alternative.

To depict the preferred alternative's potential for future development, preferred alternative 2A was divided into three phases. **Figure 4-32** shows the Phase I graphic for Alternative 2A, while **Figures 4-33** and **4-34** show the Phase II and III graphics for Alternative 2A. A major benefit of this alternative is providing the ability for future expansion if demand for services increases, Alternative 2A, Phase 1 is designed to meet forecast demand. Phase II and Phase III reflect expansion that would be possible to accommodate demand in excess of that forecast.

Phases 2 and 3 of Alternative 2A allow for expansion in case of future airport demand above that forecast. Phase 2 demonstrates a shift in the taxiway which allows for ADG-I parking west of the apron, expanding the infield. Additionally, Phase 2 also provides a 5-Bay T-hangar which shifts the five ADG-I transient positions to the west of the apron. Aircraft parking also extends south towards the ADG-II box hangar. Phase 3 allows for even more future demand, allows aircraft storage in another 5-Bay t-hangar, and expands the infield even further as the five transient positions for ADG-I aircraft shift to the north.

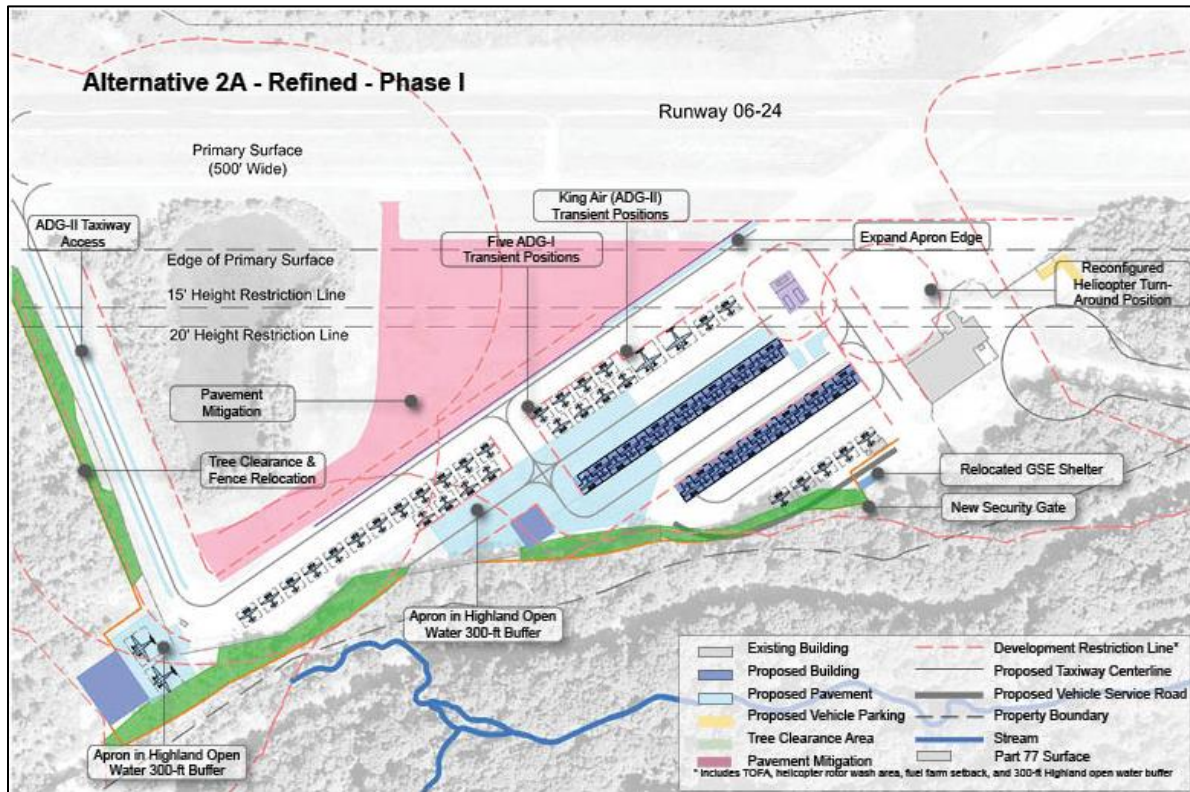


Figure 4-32. Alternative 2A Preferred – Phase I

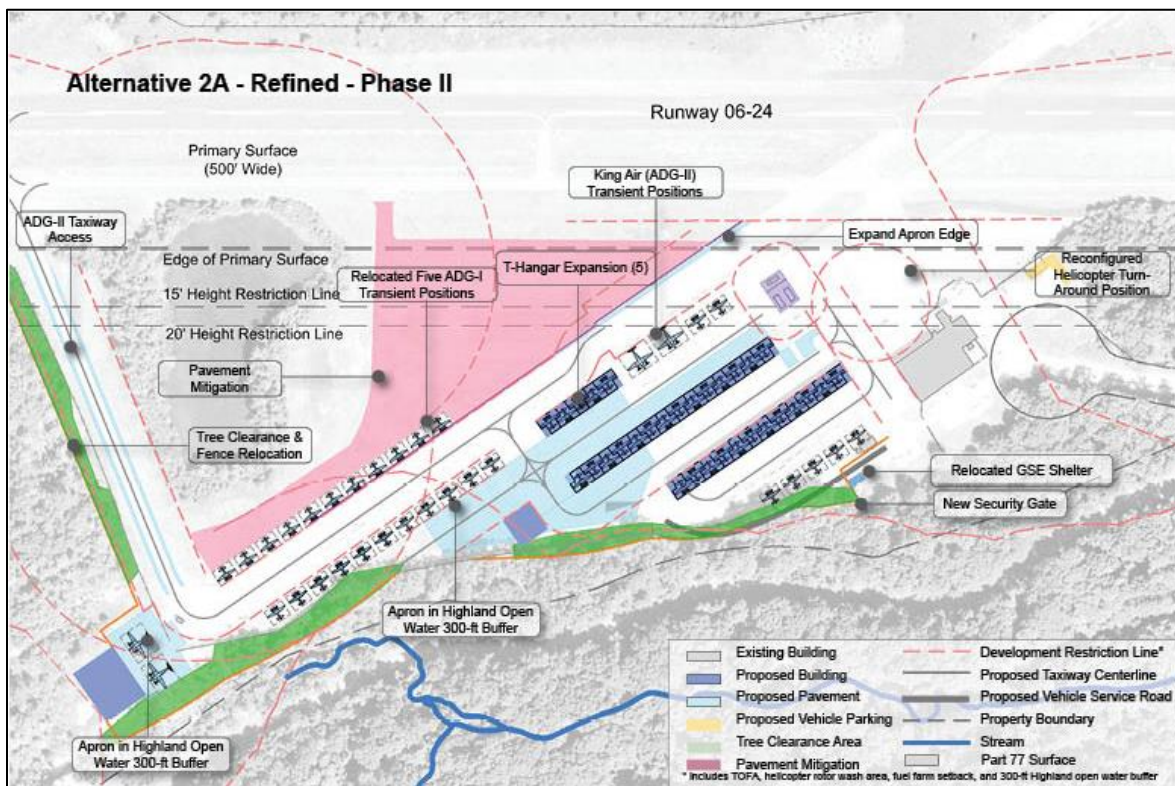


Figure 4-33. Alternative 2A Preferred – Phase II

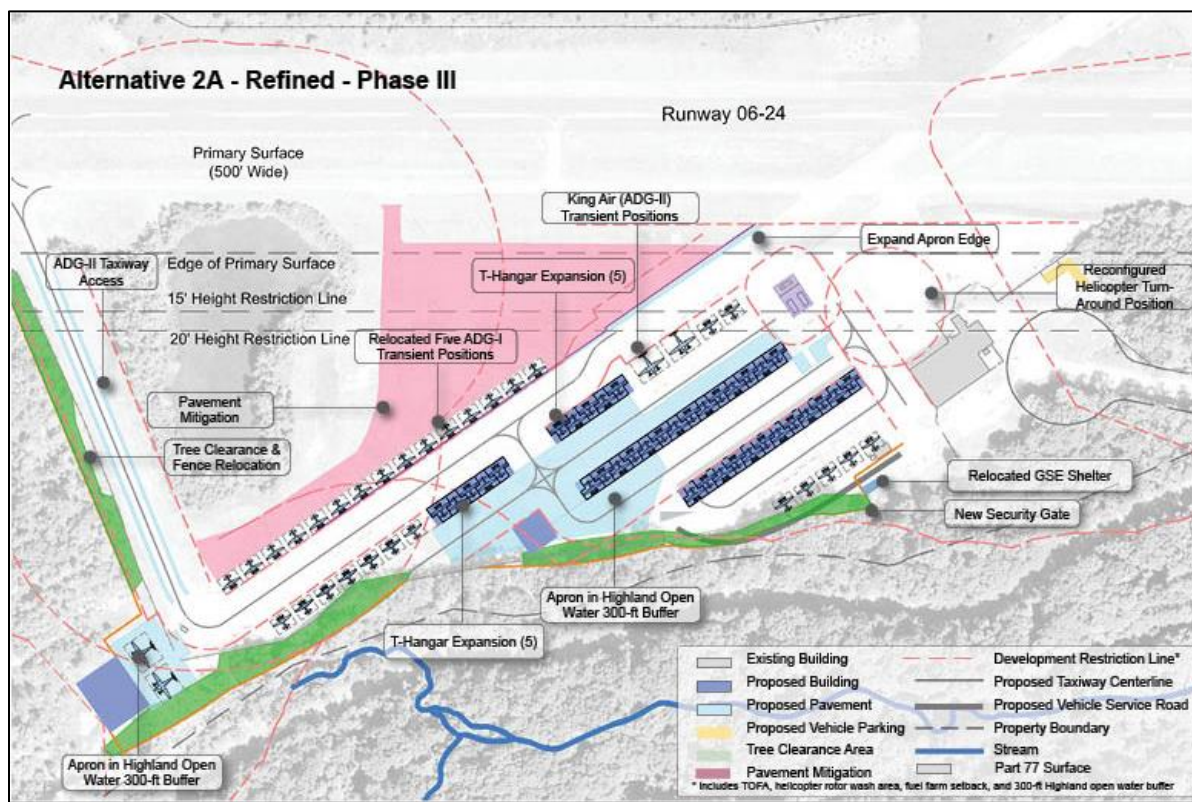


Figure 4-34. Alternative 2A Preferred – Phase III

, Alternative 2C provides the highest number of based aircraft parking positions, but it also has the most significant environmental impact in terms of impervious surface and tree clearance. Green indicates a scenario that is more favorable for the evaluation criteria, yellow for less favorable, and red for not favorable.

Table 4-6. GA Development Alternatives Evaluation – Round II

Evaluation Criteria	2A	2C	3C
T-hangar Storage Capacity for ADG-I	26	26	26
Additional Box Hangar Capacity for ADG-I	10	24	26
Dedicated Tie-Down Positions for ADG-I	31	38	20
Dedicated Tie-Down Positions for ADG-II	2	4	5
FAA Taxilane Design Standards	●	●	●
Flexibility for Box/Conventional Hangars and ADG-II Aircraft	●	●	●
Flexibility for Further T-Hangar Expansion	●	●	●
Visions of Airport Sponsor & Operator	●	●	●

Evaluation Criteria	2A	2C	3C
Estimated Development Cost	●	●	●
Impact on Environmental Features	●	●	●
Increase in Impervious Surface (Acres) ¹	2.62	4.77	3.12
Tree Clearance (Acres)	1.47	3.14	1.05

Note:

(1) Impervious surface includes pavement and building.

In terms of providing flexibility to accommodate box hangars and conventional hangars, Alternatives 2C and 3C exceed that which could be provided by alternative 2A. Locating the T-hangars further away from the wooded area as on 2C and 3C leaves more space within the airport property boundary to accommodate box and conventional hangars, should there be demand from business tenant(s).

In terms of flexibility for further expansion of T-hangars, 2A is most favorable because, if required to meet demand, this alternative can accommodate a third T-hangar in parallel to the two proposed T-hangars largely within the confines of the existing apron pavement. There would be limited need to expand into the triangular infield area, the wooded area, or Highland open water 300-foot buffer area. The other two alternatives require further expansion into undisturbed areas to the east of the airport and encroachment into Highland open waters areas to accommodate future expansion which would present greater environmental impact.

Alternative 2A is also most consistent with the vision of the sponsor and airport operator to prioritize the addition of T-hangar space to the airport. It is expected to minimize environmental impacts by keeping development activity largely within already impacted areas and it requires the least addition of impervious surface when compared to the other alternatives. The estimated development costs of 2C and 3C will be higher than that of 2A because of the higher capital costs associated with box and conventional hangars, as well as the higher mitigation costs associated with environmental impacts and requiring development outside of the existing plateau that defines the current airport operating area.

4.4.3 Preferred GA Alternative

Based on the screening general aviation development alternatives, Alternative 2A was selected as the preferred alternative.

To depict the preferred alternative's potential for future development, preferred alternative 2A was divided into three phases. **Figure 4-32** shows the Phase I graphic for Alternative 2A, while **Figures 4-33** and **4-34** show the Phase II and III graphics for Alternative 2A. A major benefit of this alternative is providing the ability for future expansion if demand for services increases. Alternative 2A, Phase 1 is designed to meet forecast demand. Phase II and Phase III reflect expansion that would be possible to accommodate demand in excess of that forecast.

Phases 2 and 3 of Alternative 2A allow for expansion in case of future airport demand above that forecast. Phase 2 demonstrates a shift in the taxilane which allows for ADG-I parking west of the apron, expanding the infield. Additionally, Phase 2 also provides a 5-Bay T-hangar which shifts the five ADG-I transient positions to the west of the apron. Aircraft parking also extends south towards the ADG-II box hangar. Phase 3 allows for even more future demand, allows aircraft storage in another 5-Bay t-hangar, and expands the infield even further as the five transient positions for ADG-I aircraft shift to the north.

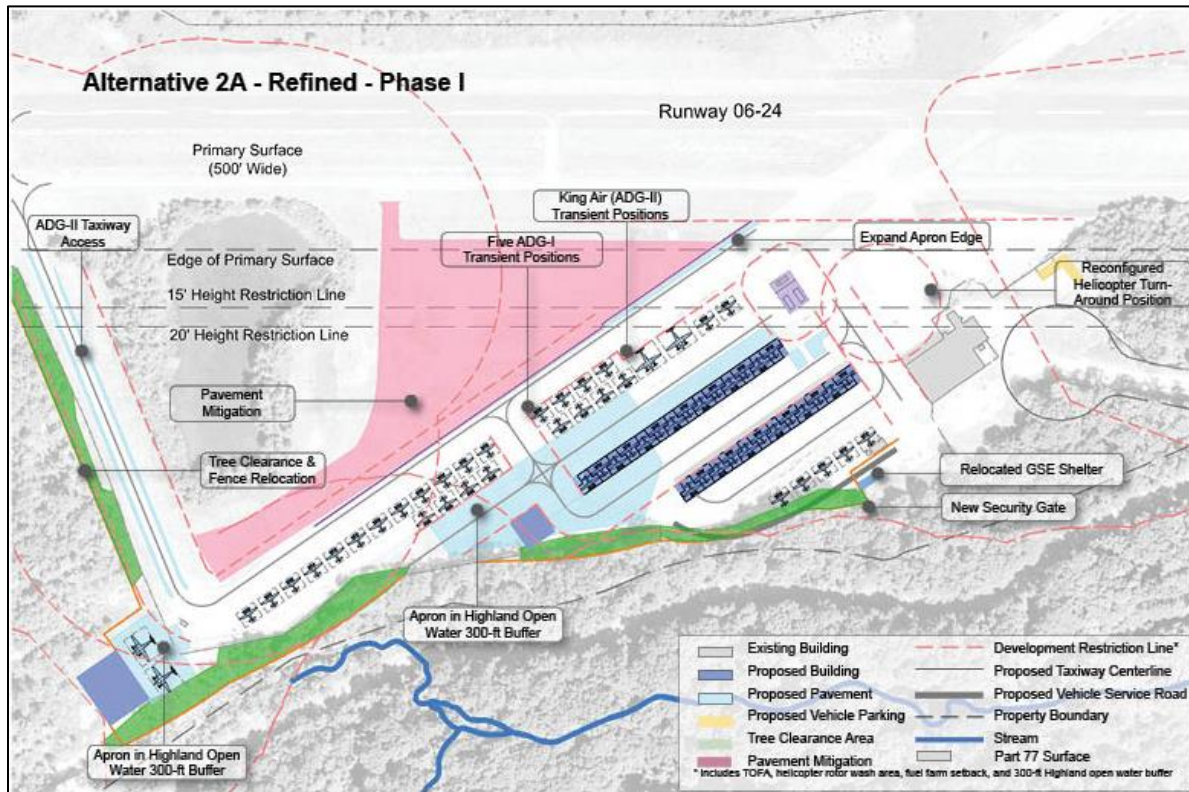


Figure 4-32. Alternative 2A Preferred – Phase I

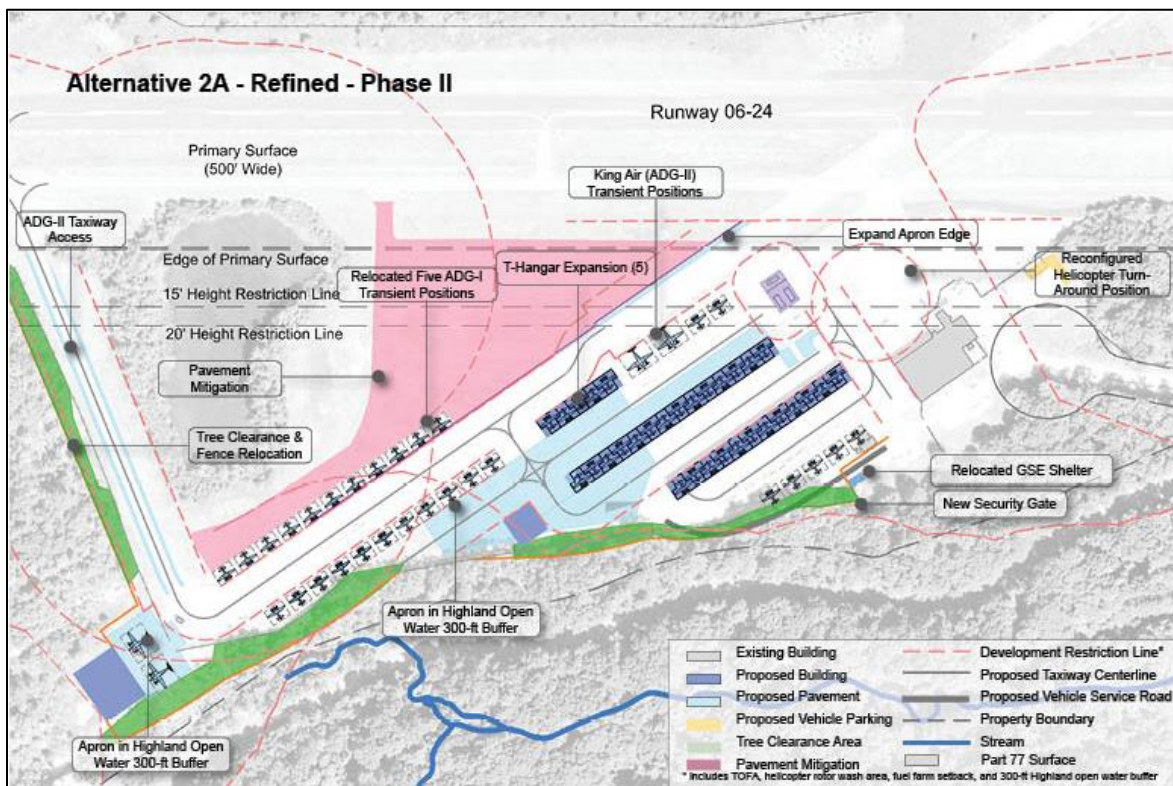


Figure 4-33. Alternative 2A Preferred – Phase II

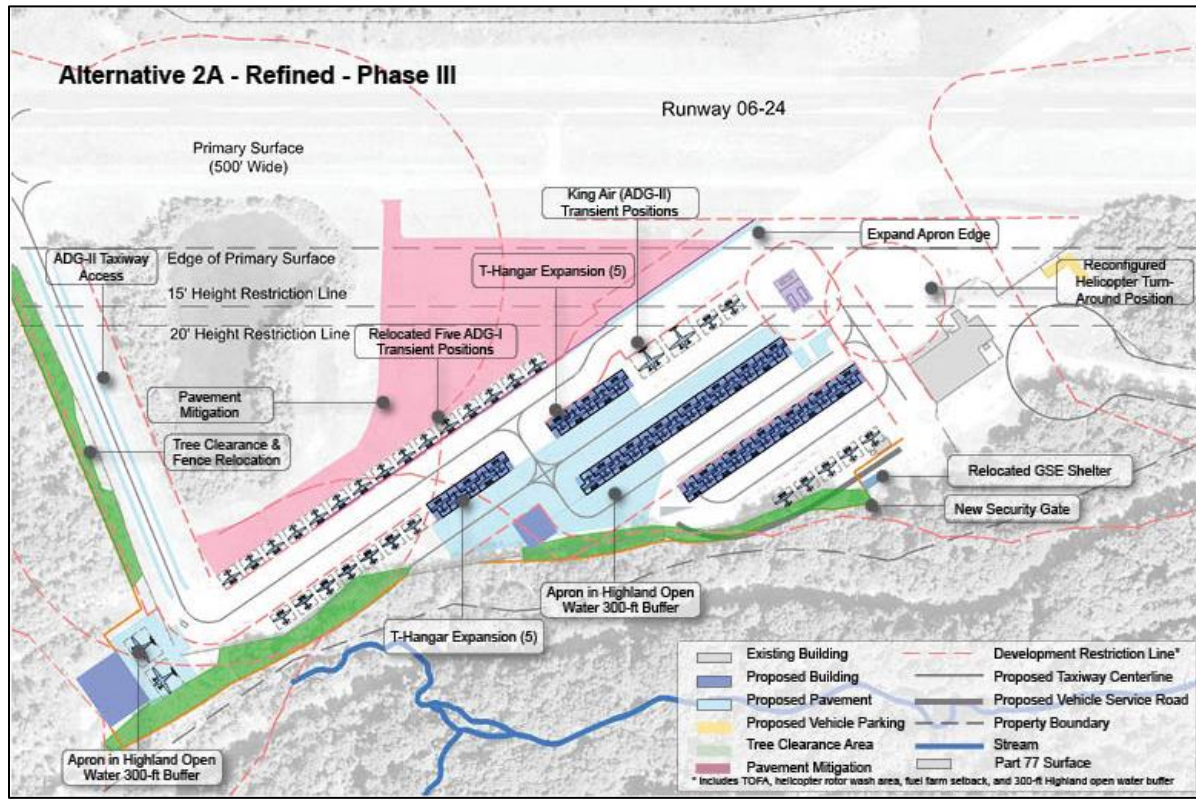


Figure 4-34. Alternative 2A Preferred – Phase III

4.5 Landside Facilities

4.5.1 Parking Layout Analysis

As identified in [Section 3.5](#) the Airport has plans for opening a restaurant and an on-site banquet hall is also utilized occasionally. At this time, there are 42 parking spaces available at the airport. Should the restaurant reach full capacity and the banquet hall increase usage, approximately 13 additional parking spaces may be required. As outlined in **Figure 4-35**, the area occupied by the old fuel storage tank to the west of the existing lot and the grass areas to the north and east of the existing lot are available for expansion of parking if needed. A potential schematic design is outlined in **Figure 4-35**.



Figure 4-35. Schematic Parking Design

The existing parking spaces reserved for people with disabilities are of the correct dimension but the painted lines have faded. These lines should be repainted so these spaces are more visible.

4.5.2 Bicycle Airport Access

As identified in [Section 3.5](#) there are several bicycle routes within half a mile of Greenwood Lake Airport, including the Greenwood Lake Loop, which is a State Bicycle Tour Route beginning and ending in West Milford. There are also on-road bicycle lanes along Marshall Hill Road and Union Hill Road, although some sections of Marshall Hill Road are not considered to be suitable for cycling. Additionally, there are over ten miles of recreational mountain bike trails on the former Jungle Habitat property adjacent to the Airport, which is now a part of Ringwood State Park.

Given that the Airport is well served by multiple bicycle lanes and routes, it is recommended that NJDOT install shared lane markings (See **Figure 4-36**) in the travel lanes along Airport Road to encourage travel to the Airport and the adjacent parkland via bicycle. It is also recommended that signage be installed at the intersection of Airport Road and Marshall Hill Road to alert motorists of cyclists on Airport Road (See **Figure 4-37**).

The Airport should also install bicycle infrastructure on site, such as a bicycle rack or covered bike parking area near the terminal entrance to allow for easy storage options for those traveling to the airport and surrounding parkland for recreational activities. Given the proximity of recreational mountain biking trails and the Greenwood Lake Loop, the Airport might also consider establishing a partnership with a local bicycle shop to offer bicycle rentals from the airport.

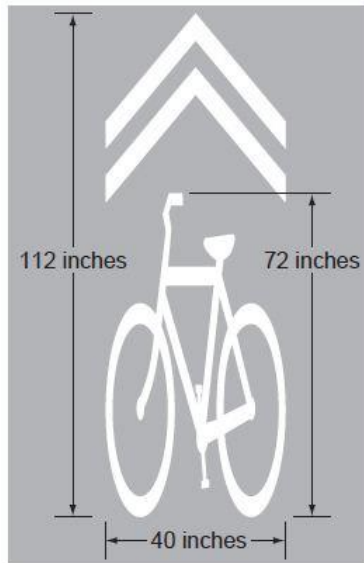


Figure 4-36. Shared Lane Markings

Source: NJDOT/FHA New Jersey Bicycling Manual



Figure 4-37. Bicycle Signage

Source: NJDOT/FHA New Jersey Bicycling Manual

4.6 Support Facilities

4.6.1 Fuel Storage

Two new 6,000-gallon fuel storage tanks were installed at the Airport in 2016. Analysis of existing and projected fuel usage at the Airport indicates these tanks are of sufficient capacity to meet airport needs for the study period.

4.6.2 Airport Security

The prime security measure in place at the Airport is fencing and controlled access gates to secure the airfield. The existing fencing within the vicinity of the end of Runway 6 is six feet tall versus the eight-foot tall fence that surrounds the remainder of the airport. It is believed the height of the fence in this area was established to not create an obstruction to air navigation. As the end of this runway has shifted, the fence height should be evaluated to determine if it can be raised to eight feet tall. The TSA has issued recent guidance (July 2017) for securing general aviation airports that is focused on the people we do not know, aircraft that are not secured, and protecting infrastructure. It is recommended that the Airport utilize this guidance to develop a formal security program.

4.6.3 AWOS

Automated Weather Observing Systems (AWOS) are a critical safety and operational feature for an airport. Accurate weather information allows pilots to safely plan trips to and from an airport and determine whether weather conditions are conducive for flying. The existing AWOS at Greenwood Lake Airport is not commissioned by the FAA and operates intermittently. The closest FAA commissioned AWOS is approximately 13 miles away at Sussex Airport. Weather conditions this far away can be significantly different at Greenwood Lake airport. It is recommended that the existing AWOS at Greenwood Lake be repaired and commissioned by the FAA or that a new AWOS be installed and commissioned.

4.6.4 Emergency Generator

Greenwood Lake Airport will shortly implement a project to upgrade runway and taxiway lighting systems, install a new PAPI for Runway 24, and establish an electrical field lighting vault. It is recommended that these systems along with airport communication systems be supported by a fixed emergency generator that can provide auxiliary power in the case of a power failure. The emergency generator should be sized to provide power for at least 4 hours. Having such a system in place will enhance the safety provided by airfield lighting, landing and communication systems.

5. Implementation Plan and Financial Analysis

Chapter 4 of this Master Plan, **Development Alternatives**, evaluated development alternatives at Greenwood Lake Airport (4N1) over the next 20 years based on the forecast activity, operational efficiency, safety, and design standard compliance requirements. The next element of the master planning process is to present a phased facilities implementation plan, which provides guidance for the New Jersey Department of Transportation (NJDOT) on how to implement the findings and recommendations of the master plan throughout the 20-year planning period. The implementation plan provides an overview of the proposed projects including approximate start dates and duration. This schedule is broken down into three phases throughout the 20-year planning period: Phase I, Phase II, and Phase III. Phase I encompasses years 0 to 5 of the overall implementation plan, Phase II is years 6 to 10, and Phase III is years 11 to 20. **Figure 5-1** depicts the various proposed projects included in each phase.

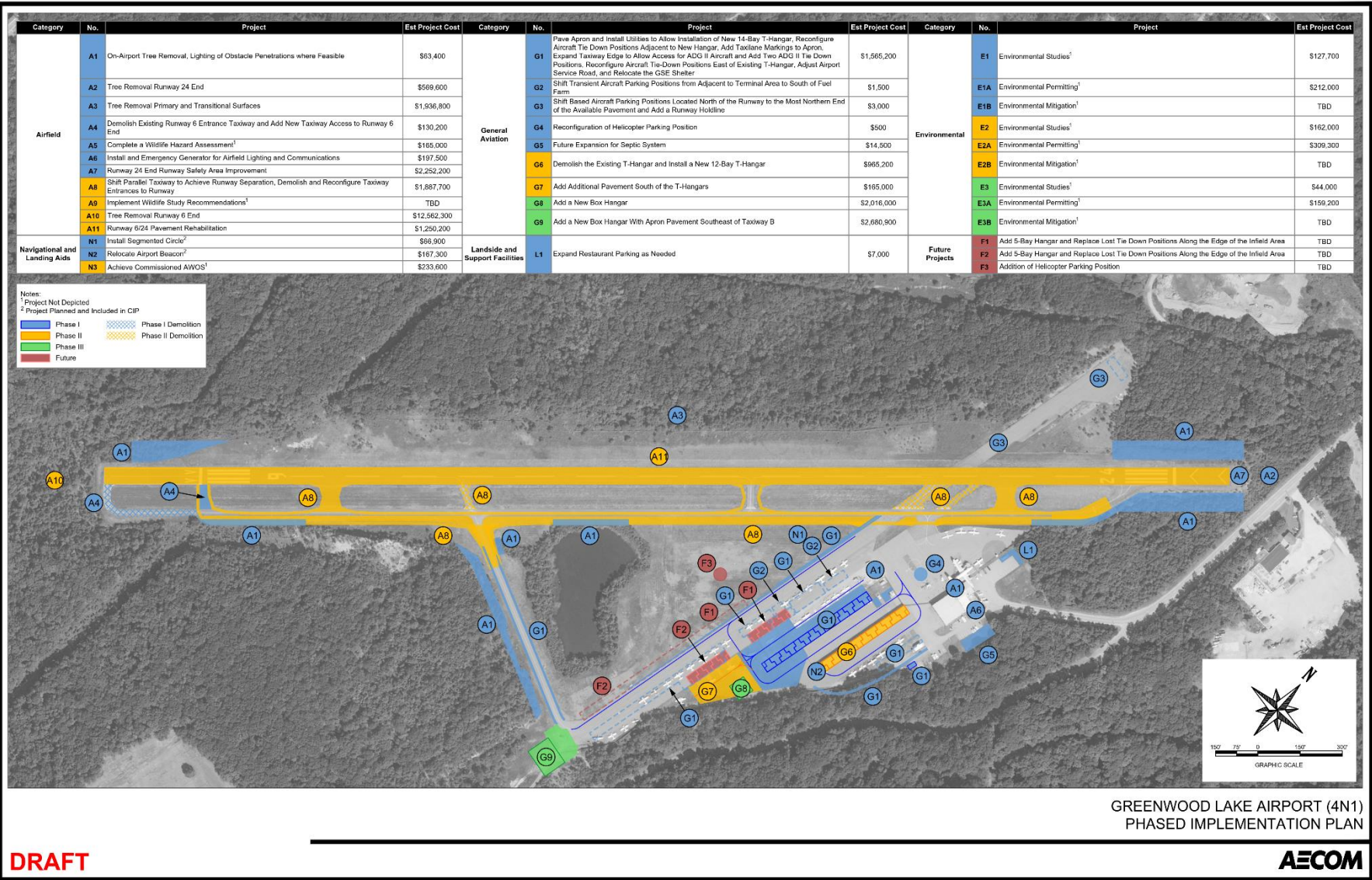
To accompany the phased implementation plan, a financial analysis is conducted to provide NJDOT with federal, state, and local funding considerations for realizing the recommendations.

Due to the unique conditions associated with 4N1, the majority of the recommended airport development and implementation projects are based on the need for obstruction removal, satisfying FAA design standards, providing improved hangar facilities and increasing the safety and efficiency of the Airport. The runway and taxiway improvements are the major components required to satisfy the FAA design standards, as identified through the facility requirements and alternatives analysis. The phased implementation evaluates and identifies the projects that are of the highest priority, such as obstruction removal, improving facility deficiencies, and adhering to the FAA design standards; and should thus be completed in the first ten years of the planning period. The phased implementation also ensures all of the interrelated projects or third-party studies are completed prior to the construction of the improvements identified in the Implementation Plan.

5.1 Key Activities and Responsibilities

Per the guidance and best practices presented in *FAA Advisory Circular 150/5070-6B Airport Master Plans*, the key activities and responsibilities associated with the proposed projects are identified in the Implementation Plan. Due to the unique and often extensive lead-time associated with certain projects and any collaboration required between government agencies, these key activities and responsibilities are essential to the implementation of the recommended airport development plan. The activities include:

- **Sponsor-Specific Project Approvals:** Certain projects that require NJDOT approval, various budgetary approvals, and funding appropriations; and similar sponsor-specific items would be included in this activity.
- **Airport Operator and Tenant Approvals:** Includes the approvals required for any lease modifications.
- **Project Funding:** This activity includes the FAA and other government agency grant applications.
- **Environmental Processing:** Activities required and identified accordingly through the Environmental Overview, and required under *FAA Order 1050.1E Environmental Impacts: Policies and Procedures*, and *FAA Order 5050.4B NEPA Implementing Instructions for Airport Actions*.
- **Land Acquisition:** The activities that require land acquisition and coordination with the NJDOT, West Milford Township, and affected property owners.
- **Greenwood Lake Airport Project Implementation Process:** All of the projects included in the implementation plan will address the design and construction activities.
- **Agency Coordination:** These agencies include the FAA, the Airport Operator (Greenwood Lake Airport Management, operated by Tim Wagner), New Jersey Department of Environmental Protection, New Jersey Highlands Water Protection and Planning Council (Highlands Council), and any other agencies that may have direct involvement with the airport for the proposed projects.
- **Public Coordination:** Activities that carry the public involvement process into the project implementation phase regarding any necessary proposed projects.



GREENWOOD LAKE AIRPORT (4N1)
PHASED IMPLEMENTATION PLAN

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Figure 5-1. Phased Implementation Plan

5.2 Key Environmental Considerations

Prior to the proposed construction and implementation of the recommended development, the environmental features that are affected require further study, and potential mitigation measures to alleviate their impacts. A summary of the requirements and considerations are listed below, with a summary of existing conditions within **Chapter 1 Airport Inventory** and an analysis of development constraints within Section 4.2.1 of the **Chapter 4 Airport Development Alternatives**.

Highlands Preservation Area

As outlined earlier in this master plan, 4N1 is located entirely within the Highlands Preservation Area. As such, any development on airport must comply with the Highlands Water Protection and Planning Act. The Highlands Preservation Area has strict requirements for development projects, particularly the addition of impervious pavement. However, discussions with representatives of the Highlands Council at the Realization meeting for this project indicated that Exemption #4 and #10 are potentially applicable to the airport. Exemption #4 is for the reconstruction of a building or structure within 125 percent of the footprint of the lawfully existing impervious surface provided that the reconstruction or development does not increase the lawfully existing impervious surface by one-quarter acre or more. Exemption #10 is for the construction of transportation safety projects by a State entity or local government unit. In addition, NJDEP staff indicated that the millings located within the infield towards the center of the airport may qualify as impervious pavement; thus, their removal may be used to mitigate impacts associated with addition of new pavement to the airport. These agreements should be documented to develop a plan for advancing airport development projects.

The applicability of Exemption #4 and #10 cannot be confirmed until a formal application detailing the proposed work is submitted to the Highlands Council and NJDEP. Projects or activities that are exempt from the Highlands requirements are still required to comply with all other Federal, State and local requirements that may apply to the proposed project including, but not limited to, the *Freshwater Wetlands Protection Act*, N.J.S.A.13:9B-1 *et seq.*; the *Endangered and Nongame Species Conservation Act*, N.J.S.A. 23:2A-1 *et seq.*; the *Flood Hazard Area Control Act*, N.J.S.A.58:16A-50 *et seq.*), and all implementing rules.

Wetlands, Floodplains, and Threatened and Endangered Species

A portion of the site for the proposed projects in the phased implementation plan contains regulated wetlands, wetland transition areas, floodplains and riparian areas under the jurisdiction of the NJDEP and Highlands Council. To verify the presence, absence, and the extent of the existing wetlands, wetland transition areas, and State open waters (SOWs) on the airfield, an NJDEP Letter of Interpretation (LOI) should be obtained for projects expected to be advanced. Once issued, the LOI is classified as a legally binding document that remains valid for a period of five years. The LOI would then be utilized to determine impacts to wetlands and wetland transition areas for any proposed development and provide an understanding of the required wetland mitigation to offset project impacts.

To verify the presence, absence and extent of floodplains and riparian zones on the airfield, an NJDEP Flood Hazard Area Verification should be obtained. The Verification is a legally binding document that can be used to determine the full extent of any proposed development impacts and the required mitigation to alleviate the issues relative to floodplains and riparian zones.

Habitat for many threatened and endangered species were identified within the vicinity of the airport and within the airport boundary. In the vicinity of the departure end of Runway 24, a potential vernal pool was observed. Depending upon the project advanced, a detailed survey may be required to be completed and reviewed by the NJDEP prior to any proposed construction.

5.2.1 Environmental Studies and Mitigation

Environmental studies pertaining to Historic and Archeological Sites, Wetlands, Vernal Habitat, Flood Hazard Areas, and Threatened and Endangered Species are required to determine the presence/absence

of these features and ascertain if regulatory approvals are required prior to the advancement of any project. Impacts to Green Acres properties and forested areas would also require regulatory approvals. Many of these regulated resources may require mitigation should there be an adverse impact to them as a consequence of a proposed project.

To avoid potential delays in the Phase 1 development of the implementation plan, environmental studies should be initiated as the first step. The environmental studies are required to identify the location of the regulated resources so that project designs can be modified to avoid and/or minimize their impact. The Wetlands, Vernal Habitat, Flood Hazard Areas, and Threatened and Endangered Species permitting and approval process will require an Alternatives Analysis demonstrating that avoidance and minimization measures have been incorporated into the project design. Permit applications to the resource agencies are typically prepared once 30% design drawings are available. Due to the lead-time required to perform the environmental studies and project design, all of the construction projects identified in Phase I cannot begin until year three of the planning period.

A wetland delineation was previously conducted for areas within 150 feet of the proposed projects; however, additional surveys for wetlands and streams within 300 feet of the project area may be required if the proposed projects do not qualify for a Highlands Exemption #4 and/or #10 as the *Highlands Water Protection and Planning Act Rules* mandates a 300-foot buffer around Highlands open waters, which includes wetlands. Projects or activities that are exempt from the Highlands requirements, are still required to comply with all other Federal, State and local requirements that may apply to the proposed project. Therefore, even if the project is exempt from the Highlands Rules, it would still need to comply with the *Freshwater Wetlands Protection Act Rules* (N.J.A.C. 7:7A) and the *Flood Hazard Area Control Act Rules* (N.J.A.C. 7:13).

NEPA Coordination and Permit Submissions

An idealized plan for development of this airport is included within this Master Plan. As individual projects are identified for funding, development prioritizations may change. In addition, certain projects are independent of each other. For example, removal of tree obstructions is a safety project wholly unrelated to airfield projects such as taxiway relocations or new hangars. NEPA analyses and permit submissions should be advanced for projects that have funding available and projects with independent utility should be considered for advancement autonomous of other activity, particularly safety projects. Categorical Exclusions may be appropriate for projects such as installation of an emergency generator or on-airport tree removal, while greater levels of tree removal may qualify for a short form Environmental Assessment.

5.3 Phase I (0-5 Years)

The Phase I Implementation Plan includes projects that are recommended for immediate and near-term implementation to address the existing safety issues, to advance airport competitiveness, and to allow the Airport to adhere to applicable FAA design standards. Due to the long-lead times involved with the environmental studies, the design and permitting required prior to project construction, and airport operational restrictions certain projects were identified as encompassing more than one phase.

5.3.1 Airfield

The airfield projects are primarily associated with the runway and taxiway improvements required to address FAA design standard deficiencies, along with the required environmental studies.

On-Airport Tree Removal, Lighting of Obstacle Penetrations where Feasible (A1): In order to ensure safe and secure operations at the airport, the removal of on-airport trees and mitigating obstacle penetrations is prioritized in Phase I. This project consists of all obstructions that are located within the airport property line.

Tree Removal Runway 24 End (A2): Tree obstacles at the Runway 24 End are clustered relatively close to the runway end, penetrating the departure (40:1) and approach (20:1) surfaces. Tree removal at the Runway 24 End is prioritized in Phase I, as it impacts safe and secure aircraft operations.

Tree Removal Primary and Transitional Surfaces (A3): It is essential that the primary and transitional surfaces are clear of all obstacles. Trees penetrating the primary and transitional surfaces are prioritized for removal in Phase I.

Demolish Existing Runway 6 Entrance Taxiway and Add New Taxiway Access to Runway 6 End (A4): In order to correct non-standard taxiway geometries in accordance FAA design standards, the existing Runway 6 entrance taxiway will be demolished and a new Runway 6 entrance will be configured to enter Runway 6 at the runway end threshold.

Complete a Wildlife Hazard Assessment (A5): The Wildlife Hazard Assessment will be conducted in accordance with FAA Advisory Circular 150/5200-36A Qualifications for Wildlife Biologist Conducting Wildlife Hazard Assessments and Training Curriculums for Airport Personnel Involved in Controlling Wildlife Hazards on Airports, and includes a determination of wetland impacts, the mitigation requirements, and appropriateness of areas adjacent to the airport for mitigation relative to potential wildlife hazards.

Install an Emergency Generator for Airfield Lighting and Communications (A6): An emergency generator, of 150 KVA capacity, will be installed to provide standby power for airfield lighting and communications facilities.

Maintaining Airport Operations

To maintain seamless aircraft operations during Phase I, the new taxiway access to Runway 6 End is recommended for construction prior to the demolition of the existing Runway 6 End entrance. This allows for aircraft to use the new entrance to the runway as the existing runway entrance is demolished.

5.3.2 Navigational and Landing Aids

The navigational and landing aids (NAVAIDS) identified for Phase I construction are both necessary to improve the safety of the airfield and allow for the construction of associated projects to begin.

Install Segmented Circle (N1): A segmented circle will be installed to provide better guidance to pilots utilizing 4N1.

Relocate Airport Beacon (N2): The existing Airport Beacon needs to be relocated in order to provide adequate visibility for pilots utilizing the Airport.

5.3.3 General Aviation Facilities

The GA facility improvements recommended in Phase I are those required to enhance capacity to meet forecast activity and ensure aircraft can safely maneuver around the apron area.

Pave Apron and Install Utilities to Allow Installation of New 14-Bay T-Hangar, Reconfigure Aircraft Tie Down Positions Adjacent to New Hangar, Add Taxilane Markings to Apron, Expand Taxiway Edge to Allow Access for ADG II Aircraft and Add Two ADG II Tie Down Positions, Reconfigure Aircraft Tie-Down Positions East of Existing T-Hangar, Adjust Airport Service Road, and Relocate GSE Shelter (G1): Improvements to the general aviation facilities consist of paving the apron to allow for a new 14-bay T-Hangar and reconfiguring aircraft tie-down positions west of the new T-hangar. Tie-down positions are to be reconfigured to better meet the needs of the Airport. Taxilane markings are to be marked and the taxiway edge is to be expanded to meet safety standards for ADG II aircraft to operate and utilize the tie-down positions. In order to accommodate the reconfigured tie-down positions, the airport service road will be realigned and the existing GSE shelter will be relocated.

Shift Transient Aircraft Parking Positions from Adjacent to Terminal Area to South of Fuel Farm (G2): To allow for adequate clearance from Runway 06/24's primary and transitional surfaces, the transient aircraft parking positions adjacent to the terminal area will be relocated to the area south of the fuel farm.

Shift Based Aircraft Parking Located North of the Runway to the Most Northern End of the Available Pavement and Add a Runway Holdline (G3): To ensure Runway 06/24's primary and transitional surfaces are clear of aircraft tail heights, based aircraft parking positions will be relocated to the most northern end of the available pavement. In addition, to ensure safe and secure aircraft operations to and from the runway, a runway holdline will be installed at the entrance to Runway 06/24.

Reconfiguration of Helicopter Parking Position (G4): To allow accommodation of the Agusta 139 helicopter, the two helicopter positions are to be reconfigured into one helicopter parking position designed to accommodate the Agusta 139, which will be adequate to accommodate current and forecasted helicopter operations. Should future demand arise an additional position can be sited within the infield area between Taxiway A and the ramp.

5.3.4 Landside and Support Facilities

The landside and support facilities in Phase I include:

Expand Restaurant Parking as Needed (L1): Restaurant parking will be expanded by 13 parking spaces to meet forecast activity driven by the new airport restaurant.

Future Expansion for Septic System (G5): A 15,000 gallon septic tank will be installed to accommodate the needs of the restaurant.

5.3.5 Environmental

Activities under Phase I that may result in environmental impacts are grouped into three projects. The anticipated environmental studies and mitigation for these projects are discussed in further detail below.

Project 1:

- On-Airport Tree Removal, Lighting of Obstacle Penetrations where Feasible (A1)
- Tree removal primary and transitional surfaces (A3)

As the proposed activities listed under Project 1 would impact wetlands, transition areas, and/or SOWs, a freshwater wetlands permit would be required pursuant to the *Freshwater Wetland Protection Act Rules* (N.J.A.C. 7:27A). As a vernal pool and a potential vernal pool are located at the end of Runway 24 and impacts would probably be greater than 1 acre, it would preclude the use of a wetlands general permit to conduct a regulated activity. Therefore, it is anticipated that an Individual Permit (IP) would be required.

A detailed survey would be required to determine if the potential vernal pool on the south side of Runway 24 meets the regulatory definition of vernal pool habitat. If a project is proposed within or near any on-site wetland/waterbody, it is recommended that its potential status as vernal pool habitat be investigated since target species surveys can only be completed between late March and June of each year.

Compensatory mitigation is required for the loss of wetlands, transition areas, and/or SOWs and are to be provided in accordance with the *Freshwater Wetland Protection Act Rules*. Mitigation for permanent impacts shall be performed prior to or concurrently with the regulated activity that causes the disturbance. Depending upon the size and type of impact, mitigation may include restoration, creation, or enhancement on-site or, if that is not feasible, then off-site in the same watershed management area as the disturbance or through the purchase of in-kind credits from a mitigation bank with a service area that includes the site of disturbance. If none of these options are feasible, then mitigation may be in the form of a monetary contribution to the NJDEP's in-lieu fee program, upland preservation, or a land donation. Mitigation through restoration, creation, or enhancement would require post-construction monitoring for five years. As the proposed project is within Watershed Management Area 3, if mitigation is in the form of purchasing credits from a mitigation bank, credits would need to be purchased from the Pio Costa wetland mitigation bank as its service area includes WMA #3, 4, and 6. At the time this report was prepared, this mitigation bank is approved by NJDEP to sell credits. The estimated cost per credit is \$650,000. A single credit equals one acre of impact; however, the actual amount of credits to be purchased would be determined by NJDEP as part of the IP approval.

If the proposed project requires a flood hazard area individual permit, impacts to riparian zones above the allowable threshold would require mitigation. Mitigation for permanent impacts required under an individual permit shall be performed prior to or concurrently with the regulated activity that causes the disturbance. Mitigation may be in the form of creation, restoration, enhancement, preservation, or the purchase of credits from a mitigation bank.

Tree removal activities associated with A3 would impact Green Acres-encumbered property, therefore, approval from the NJDEP Green Acres Program would be required. Depending on the impacts, the proposed diversion would be considered either a minor or major disposal or diversion of parkland. Compensation may be required in the form of eligible replacement land, parkland improvements, dedicated funds for the acquisition of land for recreation and conservation purposes or other monetary compensation. If the proposed diversion requires the removal of trees greater than 6-inch diameter at breast height (DBH) or the clearing of greater than 0.5 acre of trees; a plan to either replace or provide compensation would need to be provided pursuant to N.J.A.C. 7:36-26.5(c)5. A tree survey would be required, indicating the total number of trees over 6 inches DBH to be removed, the size and species of each tree to be removed, and the total number of each species to be removed within the Green Acres parcel.

The *New Jersey No Net Loss Reforestation Act* (N.J.S.A. 13:1L-14.1 *et seq.*) requires State entities to provide a plan for compensatory reforestation for each project that results in the deforestation of 0.5 acres or more on land that are owned or maintained by that State entity. A reforestation plan resulting in no net loss of existing forested area is required for areas subject to deforestation. The extent of deforestation would need to be calculated by NNL ½ acre GIS Grid Analysis Method. If it is determined that the proposed project would impact more than 0.5 acre of forested area, a reforestation plan would be required. There are 3 methods of compensatory reforestation and include in order of preference, on-site reforestation, alternative-site reforestation, and monetary compensation. Reforestation on- or off-site would require post-construction monitoring.

If a Highlands Preservation Area Approval (HPAA) is required, mitigation for upland forested areas to be removed or damaged as a result of the activity would be required in compliance with the *Highlands Water Protection and Planning Act Rules*. A trees survey would be required entailing the measurement and density of trees to be impacted. Mitigation would be required in accordance with the following hierarchy: planting trees on-site; planting trees off-site in the preservation or planning area, provided that the mitigation site is in the same HUC 14 as the site where upland forest was removed or damaged by the activity approved under the HPAA; planting trees off-site in the preservation area; and lastly, paying into a fund dedicated to the purchase of upland forested areas in the Highlands Region. Mitigation through planting of trees on- or off-site would require post-construction monitoring for two years. An annual post-planting monitoring report shall be submitted each year for a period of three years following the planting.

As part of the permitting process, certain biological surveys and investigations would need to be conducted to determine the presence or absence of threatened and endangered species and their habitats as several State and Federally protected species are potentially present on the Airport property. These surveys may require conducting presence/absence surveys during certain times of the year (i.e., during a particular species breeding season).

According to NJDEP NJ-GeoWeb, historic fill material is located on the northside of the taxiway in the central portion of the site and in the area of Runway 24. Historic fill material is material generally deposited to raise the topographic elevation of the site, which may have been contaminated prior to emplacement and was used extensively throughout the State. Historic fill contains construction debris, dredge spoils, incinerator residue, fly ash, or other non-hazardous solid waste. Historic fill should be managed consistent with NJDEP's Historic Fill Material Technical Guidance.

Project 2:

- Tree removal Runway 24 end (A2)

Activities listed under Phase I Project 2 would need to comply with the same requirements listed under Phase I Project 1, except for riparian zone mitigation. Based on NJDEP NJ-GeoWeb, there are no

streams within 300 feet of the proposed activities associated with A3; however, this should be confirmed during field surveys. In addition, tree removal would impact Long Pond Ironworks, which is a State park. Although this parcel is not listed on the Green Acres Recreation and Open Space Inventory (ROSI), according to NJDEP NJ-GeoWeb, it is Green Acres encumbered.

Project 3:

- Demolish existing Runway 6 entrance taxiway and add new taxiway access to Runway 6 end (A4)
- Pave apron and install utilities to allow installation of new 14 bay T-hangar. Reconfigure aircraft tie-down positions adjacent to new hangar and add taxilane markings to apron. Expand apron edge to allow access for ADG II aircraft and add two ADG II tie-down positions. Reconfigure aircraft tie-down positions east of existing T-hangar, adjust airport service road and relocate the GSE shelter. (G1)

Environmental studies and mitigation would be similar to what would be required for Phase 1 Project 1 except historic fill and Green Acres properties would not be impacted by the proposed activities and forested impacts are anticipated to be under the 0.5 acre>NNL threshold. However, in addition to mitigation required for riparian zone impacts, mitigation may also be required for flood storage impacts.

5.4 Phase II (6-10 Years)

Phase II of the Implementation Plan includes projects recommended for implementation during the 6-10 years of the 20-year planning period. The projects during this time period include improvements that are still in construction from Phase I of the Implementation Plan, including some of the obstacle penetration mitigation projects and (A1, A2, and A3) and the taxiway entrance reconfiguration project (A4).

5.4.1 Airfield

The airfield projects are primarily associated with the runway and taxiway improvements required to address FAA design standard deficiencies and implementing recommendations from the Wildlife Hazard Assessment conducted in Phase I.

Runway 24 End Runway Safety Area Improvements (A7): The runway safety area on the Runway 24 End requires tree removal and grading to meet FAA design standards.

Shift Parallel Taxiway to Achieve Runway Separation, Demolish and Reconfigure Taxiway Entrances to Runway, Rehabilitate Taxiway Pavement (A8): The parallel taxiway will be shifted and taxiway entrances will be reconfigured to achieve runway separation, per FAA design standards. The taxiway pavement will be rehabilitated as part of this project.

Implement Wildlife Study Recommendations (A9): The recommendations from the Wildlife Hazard Assessment conducted in Phase I will be implemented in Phase II.

Tree Removal Runway 6 End (A10): Trees penetrating the Runway 6 End departure (40:1) and approach (20:1) surfaces are extensive and will be prioritized for removal in the beginning of Phase II.

Runway 06/24 Pavement Rehabilitation (A11): Runway 06/24's pavement requires rehabilitation. This project is dependent upon pavement condition and is estimated to be required towards the end of Phase II.

5.4.2 Navigational and Landing Aids

The NAVAIDS improvement identified for Phase II is as follows:

Achieve Commissioned AWOS (N3): The existing AWOS at 4N1 is not commissioned by the FAA. A new AWOS is to replace the existing to meet FAA's requirements.

5.4.3 General Aviation Facilities

The general aviation facility improvement identified for Phase II is to rehabilitate the existing hangar facility and provide additional pavement:

Demolish the Existing T-Hangar and Install a New 12-Bay T-Hangar (G6): The existing T-hangar is beyond its useful life and requires replacement. The existing T-hangar will be demolished and replaced with a new 12-bay T-hangar.

Add Additional Pavement South of the T-Hangars (G7): Additional pavement south of the T-hangars to be provided.

5.4.4 Environmental

Activities under Phase II that may result in environmental impacts are grouped into two projects. The anticipated environmental studies and mitigation for these projects are discussed in further detail below.

Project 1:

- Tree removal Runway 6 end (A10)

Activities listed under Phase II Project 1 would need to comply with the same requirements listed under Phase I Project 1. Tree removal at the Runway 6 end would impact Long Pond Ironworks, which is a State park. Although this parcel is not listed on the Green Acres ROSI, according to NJDEP NJ-GeoWeb, it is Green Acres encumbered.

Project 2:

- Demolish the existing T-hangar and install a new 12 bay T-hangar (G6)
- Add additional pavement and based aircraft parking positions to the south of the T-hangars (G7)

Structures on the airport that are over 50 years of age may require further investigation to determine their historical significance. A Phase 1A Survey may need to be completed by a qualified Cultural Resources professional. In addition, mitigation may be required for flood storage and riparian zone impacts. Certain biological surveys and investigations may need to be conducted to determine the presence or absence of threatened and endangered species and their habitats. If an HPAA is required, the proposed project would need to comply with the impervious surface requirements at N.J.A.C. 7:38-3.5 along with any other applicable regulations.

5.5 Phase III (11-20 Years)

Phase III of the Implementation Plan includes long-term general aviation facility improvement projects, along with the required environmental studies.

5.5.1 General Aviation Facilities

Add a New Box Hangar (G8): A new box hangar is proposed. Hangar development is driven by demand and the Airport should assess the need for hangars depending on future demand levels.

Add a New Box Hangar with Apron Pavement (G9): An additional box hangar is proposed. Hangar development is driven by demand and the Airport should assess the need for hangars depending on future demand levels.

5.5.2 Environmental

Due to the length of validity of each environmental study performed in Phase I, the Wetlands, Flood Hazard Areas, and Threatened and Endangered Species may need to be re-evaluated during Phase III should the previous studies expire. The re-evaluation of the environmental features in Phase III is not as

extensive as the studies performed in Phase I, due to the recent survey data and mapping that was provided during Phase I. The surveys in Phase III can utilize the information from the surveys developed during Phase I to expedite the process.

Activities under Phase III that may result in environmental impacts are grouped under one project. The anticipated environmental studies and mitigation for these activities are discussed in further detail below.

Projects:

- Add a new box hangar (G8)
- Add a new box hangar with apron pavement southeast of Taxiway B (G9)

Mitigation may be required for the loss of transition areas and for flood storage and riparian zone impacts. In addition, certain biological surveys and investigations may need to be conducted to determine the presence or absence of threatened and endangered species and their habitats. If an HPAA is required, the proposed project would need to comply with the impervious surface requirements at N.J.A.C. 7:38-3.5 along with any other applicable regulations.

5.6 Ultimate Plan – Future Phase

The ultimate implementation plan includes projects that are recommended for the Airport to undertake beyond the 20-year planning horizon, or even sooner if the demand for the facilities arises. These consist of general aviation facility additions and are described below.

5.6.1 General Aviation Facilities

Add 5-Bay Hangar and Replace Lost Tie Down Positions Along the Edge of the Infield Area (F1):

An additional hangar and tie down positions are proposed for development in the future phase. Hangar and tie down position development are driven by demand and the Airport should assess the need for these general aviation facilities depending on future demand levels at 4N1.

Add 5-Bay Hangar and Replace Lost Tie Down Positions Along the Edge of the Infield Area (F2):

An additional hangar and tie down positions are proposed for development in the future phase. Hangar and tie down position development are driven by demand and the Airport should assess the need for these general aviation facilities depending on future demand levels at 4N1.

Addition of Helicopter Parking Position (F3): An additional helicopter parking position is proposed for the infield area adjacent to the parallel taxiway. The Airport should assess the need for an additional helicopter parking position depending on future helicopter traffic demand levels.

5.7 Modification of Standards

The existing airport has a number of nonstandard conditions. These include:

- Transient aircraft parking in Primary/Transitional surface
- Runway/taxiway Separation
- RSA grade deficiencies
- Fence/trees within future Taxiway B TOFA
- Nonstandard apron separations
- Nonstandard runway holding position markings
- Public roads and private properties within Runway 24 RPZ

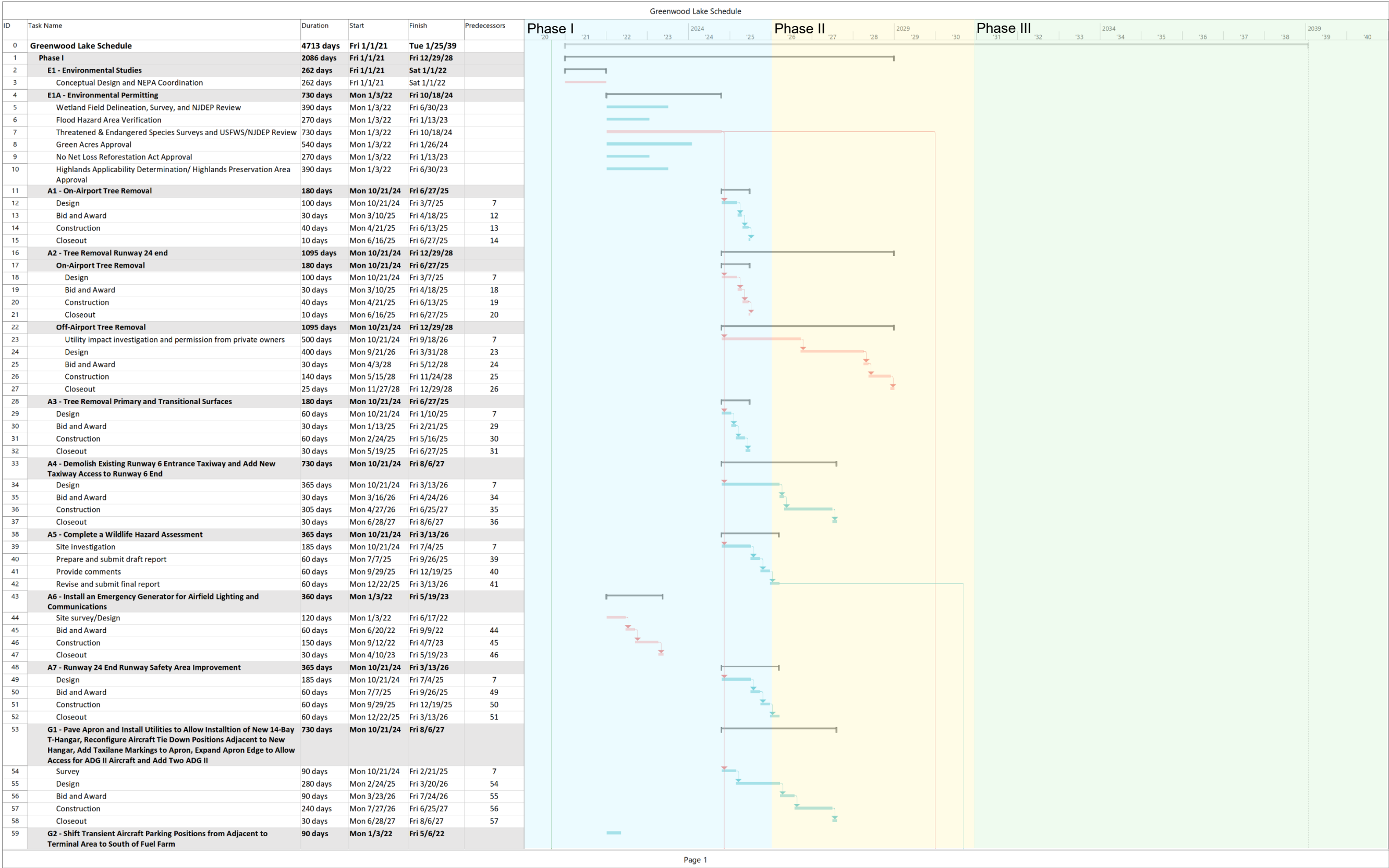
For a number of these conditions mitigation has been proposed, while certain conditions such as improving the Runway 24 RPZ have been determined to require further coordination with NJDOT/FAA. Some mitigation actions, such as the shift of the Runway 6 threshold may occur years in the future. This

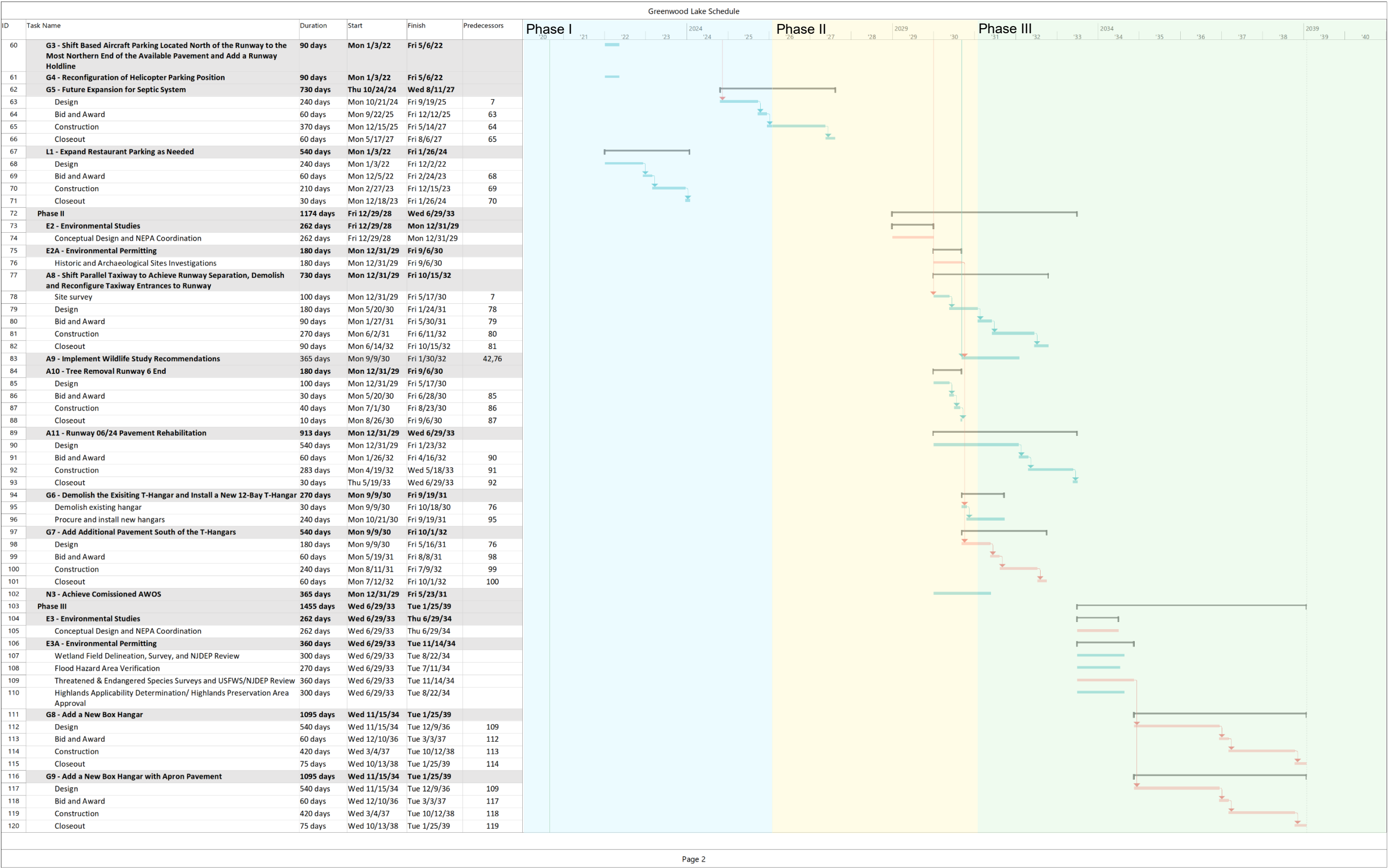
action will alleviate approach and departure obstacle conflicts for this runway and also result in a compliant RSA. The need for Modification of Standards to address interim conditions such as this should be coordinated with FAA. In some circumstances, a Modification of Standards may be more appropriate than mitigation. The fence and trees adjacent to taxiway B are within the Taxiway Object Free Area, however given the wingspan of aircraft that utilize Greenwood Lake Airport, an aircraft would have to have its wheel gear off the taxiway to present a collision risk. In such situations, a Modification of Standards may be appropriate.

5.8 Schedule

The preliminary phasing schedule was developed for the projects identified through the implementation plan previously discussed. The schedule includes planning level design, permitting, and construction estimates to complete the identified projects. Estimated durations for the projects are shown with their associated phase, and are categorized by the following: Environmental Studies and Permitting, Airfield, Navigational and Landing Aids, General Aviation, and Landside and Support Facilities, as shown in **Figure 5-2**. A separate schedule for the Ultimate Plan – Future Phase is not provided.

Figure 5-2. Preliminary Phasing Schedule for Phased Implementation Plan





5.9 Financial Analysis

The financial plan includes an overview of the cost and funding considerations that facilitate the implementation of the airport improvement projects detailed in 4N1's recommended 20-year development plan, consisting of three phases: Phase I (0-5 years), Phase II (6-10 years), and Phase III (11-20 years). The financial plan identifies the estimated costs of the proposed development and the funding sources for these projects on the federal, state, and local levels and organizes them into a Capital Improvement Plan (CIP). The CIP for 4N1 includes all of the projects in the Implementation Plan and their related costs, and provides the necessary information to enable NJDOT to program funding for these projects in the CIP throughout the 20-year planning period. The CIP indicates which agencies are anticipated to provide grants-in-aid, and by doing so helps the Airport determine how much local funding will be required.

Although the airport improvements are planned in three phases, some of the development proposed for the Airport is contingent upon future levels of aviation demand. The Airport should evaluate these projects individually during the appropriate time period. Construction of the projects could occur at varying intervals than those previously identified in this master plan, due to the actual demand and the availability of FAA grants and other sources of funding to the Airport.

It is noted that the financial plan is prepared for Master Planning purposes only. Separate cost estimates for the Ultimate – Future Phase is not provided.

5.9.1 Capital Improvement Plan Cost Estimates

Table 5-1 presents the estimated CIP costs by project and the totals for each respective phase. These costs were developed based on recent construction costs at similar airports, discussions with suppliers, and construction experience on recent projects. Costs are shown in constant 2020 dollars.

The following conditions and assumptions apply to the cost estimates:

- Project costs include estimated engineering design fees, mobilization, construction management and inspection fees, and contingency allowances. Contingency allowances are 2%; temporary construction items are 3%; mobilization is 5%; and engineering allowances, construction management, and inspection are 10% of project cost. Contingency allowances for the Environmental Studies are 10%.
- Costs associated with coordinating with adjacent property owners for tree trimming are not incorporated in the cost estimates, due to the highly unpredictable nature and varying extent of coordination required.
- Costs associated with environmental mitigation measures will be dependent upon receiving permit approvals by the various agencies, and therefore are not incorporated in the cost estimates.
- Costs associated with implementing the Wildlife Study recommendations are not incorporated, since they are contingent upon the results of the Wildlife Hazard Assessment.
- New runway, taxiway, and apron pavement will be four inches of bituminous asphalt over 6 inches of crushed aggregate base. Pavement rehabilitation mill and overlays will be 2 inches each.
- Proposed T-hangar construction will include building construction, permits and fees, utilities, fire sprinklers, and bi-fold doors.

Table 5-7. Airport Capital Improvement Plan Cost Estimates (2020 Dollars)

Phase 1 (0-5 Years)		
No.	Project	Project Cost
E1	Environmental Studies (NEPA)	\$ 127,700
E1A	Environmental Permitting	\$ 212,000
E1B	Environmental Mitigation	TBD
A1	On-Airport Tree Removal, Lighting of Obstacle Penetrations where Feasible	\$ 63,400
A2	Tree Removal Runway 24 End	\$ 569,600
A3	Tree Removal Primary and Transitional Surfaces	\$ 1,936,800
A4	Demolish Existing Runway 6 Entrance Taxiway and Add New Taxiway Access to Runway 6 End	\$ 130,200
A5	Complete a Wildlife Hazard Assessment	\$ 165,000
A6	Install an Emergency Generator for Airfield Lighting and Communications	\$ 197,500
A7	Runway 24 End Runway Safety Area Improvements	\$ 2,252,200
N1	Install Segmented Circle	\$ 66,900
N2	Relocate Airport Beacon	\$ 167,300
G1	Pave Apron and Install Utilities to Allow Installation of New 14-Bay T-Hangar, Reconfigure Aircraft Tie Down Positions Adjacent to New Hangar, Add Taxiway Markings to Apron, Expand Taxiway Edge to Allow Access for ADG II Aircraft and Add Two ADG II Tie Down Positions, Reconfigure Aircraft Tie-Down Positions East of Existing T-Hangar, Adjust Airport Service Road, and Relocate GSE Shelter	\$ 1,565,200
G2	Shift Transient Aircraft Parking Positions from Adjacent to Terminal Area to South of Fuel Farm	\$ 1,500
G3	Shift Based Aircraft Parking Located North of the Runway to the Most Northern End of the Available Pavement and Add a Runway Holdline	\$ 3,000
G4	Reconfiguration of Helicopter Parking Position	\$ 500
L1	Expand Restaurant Parking	\$ 7,000
G5	Future Expansion for Septic System	\$ 14,500
Subtotal for Phase I (0-5 Years)		\$ 7,480,300
Phase 2 (6-10 Years)		
No.	Project	Project Cost
E2	Environmental Studies	\$ 162,000
E2A	Environmental Permitting	\$ 309,300
E2B	Environmental Mitigation	TBD
A8	Shift Parallel Taxiway to Achieve Runway Separation, Demolish and Reconfigure Taxiway Entrances to Runway	\$ 1,887,700
A9	Implement Wildlife Study Recommendations	TBD
A10	Tree Removal Runway 6 End	\$ 12,562,300
A11	Runway 06/24 Pavement Rehabilitation	\$ 1,250,200
N3	Achieve Commissioned AWOS	\$ 233,600
G6	Demolish the Existing T-Hangar and Install a New 12-Bay T-Hangar	\$ 965,200
G7	Add Additional Pavement South of the T-Hangars	\$ 165,000
Subtotal for Phase II (6-10 Years)		\$ 17,010,000
Phase 3 (11-20 Years)		
No.	Project	Project Cost
E3	Environmental Studies	\$ 44,000
E3A	Environmental Permitting	\$ 159,200
E3B	Environmental Mitigation	TBD
G8	Add a New Box Hangar	\$ 2,016,000
G9	Add a New Box Hangar with Apron Pavement	\$ 2,680,900
Subtotal for Phase III (11-20 Years)		\$ 4,901,000
Total Airport CIP Cost Estimate		\$ 29,915,700

5.9.2 Capital Improvement Plan Funding Sources

Capital improvement funding for 4N1 is available through various grant-in-aid programs on both the federal and state levels. In identifying potential sources of funds, it is necessary to examine each project element to determine its eligibility for a specific program or funding source. It is also important to consider the availability of funds from each funding source. The following briefly describes the primary external funding sources which may be available to provide funding for 4N1.

5.9.2.1 Federal Grants

Various federal grant-in-aid programs have been established to develop and maintain a system of public airports and airways across the United States. Congress enacted the Airport and Airway Revenue Act of 1970, which established the Airport and Airways Trust Fund (Trust Fund). Since then, Congress has passed multiple legislative measures for the development of the national air transportation system. The major legislations include the Airport and Airway Improvement Act of 1982 which established the Airport Improvement Program (AIP) and was amended by the FAA Modernization and Reform Act of 2012. Most recently, the FAA Reauthorization Act of 2018 was signed into law and represents the first significant multi-year reauthorization since the FAA Modernization and Reform Act of 2012 and is the first five-year reauthorization since 1982.

The Trust Fund finances capital improvements of the airport and airway system, and to the extent funds are made available, it funds FAA's operation and maintenance of that system. The Trust Fund has provided the funding for the three capital accounts of the FAA, which include:

- The Airport Improvement Program (AIP) provides grants for airport planning, construction, and safety projects at airports
- The Facilities and Equipment account, which funds technological improvements to the air traffic control system, including the Next Generation Air Transportation System (NextGen)
- The Research, Engineering, and Development account, which funds research on issues related to aviation safety, mobility, and the environment

In addition, the Trust Fund may provide all or some portion of the funding for the FAA's operations account, which funds the operation of the air traffic control system, safety inspections, and other activities. General revenues from the U.S. Treasury may be used to supplement the Trust Fund revenues for FAA operations; however, this General Fund will not provide funding for capital accounts.

The Trust Fund is funded principally by a variety of excise taxes paid by users of the national airspace system, as well as by interest revenue. Typical examples of excise taxes are those imposed on airline tickets, aviation fuel, and shipments of cargo.

Out of the three capital accounts of FAA supported by the Trust Fund, it is the AIP which will provide grants for 4N1's capital improvements. Details on the AIP are elaborated upon below.

FAA's Airport Improvement Program (AIP)

The FAA AIP distributes funds to airports through grants in a manner that reflects the priorities and objectives of the nation's airport system. The distribution of AIP grants is based on a combination of entitlement funds and discretionary funds. Entitlements are apportioned into major use categories including primary airports, cargo airports, and general aviation airports, and may be used for any eligible airport or planning project identified by the airport. The remaining AIP funding is known as discretionary funding which covers specific set-aside categories such as airport noise programs and essential air service grants. In administering the AIP, FAA must comply with various statutory requirements established by legislation that specify how AIP grant funds are to be distributed among airports. FAA uses the statutory formulas to determine the amount of entitlement funds to be made available to each airport or state every year. The FAA then informs each airport or state of the amount of funding available for that year. To receive the funds it is entitled to, an airport or state has to submit a valid grant application to the FAA. The FAA Reauthorization Act of 2018 allows most airports and states up to three years to use their

apportionment funds. Once the apportionments have been determined, the remaining amount of AIP funds is deposited in that program's discretionary fund, which consists of set-asides that are established by statute and other distributions.

AIP Entitlement Funds

Eligibility

An airport must be included in the NPIAS to be eligible to receive a grant from the AIP. According to the NPIAS (2021-2025), 4N1 is classified as a Local/Basic General Aviation airport eligible for entitlement funds. The estimated five-year development costs (excluding planning costs) for airport improvements at 4N1 that are eligible for FAA grants under the AIP is \$8,597,829. This estimate will be reviewed and updated in the next NPIAS based on the new general aviation categories as previously described and the CIP for 4N1 prepared in this master plan.

Projects eligible for AIP funding consist of, but are not limited to the following:

- Runway, taxiway, and apron construction / rehabilitation
- Airfield lighting, signage, and drainage
- Land acquisition
- NAVAIDS (i.e. REILs and PAPIs)
- Access roads within airport boundaries (except for access to areas providing revenue, such as parking lots and aviation
- industrial areas)
- Environmental studies
- Safety area improvements
- Security equipment (i.e. airport perimeter fencing, surveillance cameras, etc.)

Grants may not be made for the construction of automobile parking facilities, buildings not related to the safety of persons in the airport, landscaping or art work, or routine maintenance and repair. The implementation plan for 4N1 identifies which development projects are eligible for AIP funding.

Apportionment Formula

The AIP provides a federal share of 90% for all eligible projects for small primary, reliever, and general aviation airports, based on statutory requirements, as such the FAA's share of AIP eligible projects for 4N1 will be assumed at 90%. Due to the large number of projects competing nationally for AIP funds, not all eligible projects identified for 4N1 can be funded.

AIP Discretionary Funds

FAA requires a benefit-cost analysis (BCA) to demonstrate the merit of capacity projects for which airport sponsors are seeking AIP discretionary funds. Projects subject to BCA are those projects that enhance airfield capacity in terms of increased aircraft operations, and increased aircraft seating capacity. FAA policy requiring BCA does not apply to projects undertaken solely for the objectives of safety, security, conformance with FAA standards, or environmental mitigation. Due to these requirements, only the long-term (Phase III) proposed projects could be considered capacity oriented, however it is unlikely that AIP discretionary funds are applicable to 4N1.

AIP Funds for 4N1

The historical AIP funds granted for development projects at the airport since 2005 are summarized in **Table 5-2** for reference.

Table 5-8. Historical FAA AIP Funds Granted for 4N1

Year	Grant No.	Project Description	Entitlement Funding	Discretionary Funding	Total AIP Funding
2005	1	Install Perimeter Fencing	\$25,000	\$0	\$25,000
2006	2	Install Perimeter Fencing	\$263,267	\$0	\$263,267
2007	3	Acquire Snow Removal Equipment	\$116,057	\$0	\$116,057
2009	5	Improve Airport Drainage, Improve Runway Safety Area - 06/24	\$369,373	\$0	\$369,373
2009	6	Improve Runway Safety Area - 06/24	\$431,395	\$0	\$431,395
2010	7	Rehabilitate Runway - 06/24, Rehabilitate Taxiway	\$272,175	\$0	\$272,175
2012	8	Improve Runway Safety Area - 06/24	\$422,190	\$0	\$422,190
2016	9	Update Airport Master Plan Study	\$386,892	\$0	\$386,892
2018	010	Acquire Snow Removal Equipment	\$26,197	\$0	\$26,197
2019	11	Rehabilitate Apron	\$135,459	\$0	\$135,459
Total AIP Funds Granted for 4N1 (2005-2019)			\$2,448,005.00	\$0.00	\$2,448,005.00

FAA AIP grants for capital projects are now funded in two segments. One grant is given for the design of the given project, while the second grant is provided for the construction of the project, once construction bids are received and the overall construction cost based on the design is known.

The projects identified in the recommended airport development plan that are AIP eligible, are shown in **Table 5-3** below. The total cost, estimated FAA funding, and the applicable AIP funding priority categories are included in the summary.

Table 5-9. Airport Capital Improvement Cost Estimates, AIP Eligible (2020 Dollars)

Phase 1 (0-5 Years)			
No.	Project	Project Cost	AIP Priority Category
E1	Environmental Studies (NEPA)	\$ 127,700	Environmental Requirements
E1A	Environmental Permitting	\$ 212,000	Environmental Requirements
E1B	Environmental Mitigation	TBD ⁽¹⁾	Environmental Requirements
A1	On-Airport Tree Removal, Lighting of Obstacle Penetrations where Feasible	\$ 63,400	Conform to FAA Standards; Enhance the safety of the airfield
A2	Tree Removal Runway 24 End	\$ 569,600	Conform to FAA Standards; Enhance the safety of the airfield
A3	Tree Removal Primary and Transitional Surfaces	\$ 1,936,800	Conform to FAA Standards; Enhance the safety of the airfield
A4	Demolish Existing Runway 6 Entrance Taxiway and Add New Taxiway Access to Runway 6 End	\$ 130,200	Conform to FAA Standards; Enhance the safety of the airfield
A5	Complete a Wildlife Hazard Assessment	\$ 165,000	Enhance the safety and security of the airport
A6	Install an Emergency Generator for Airfield Lighting and Communications	\$ 197,500	Enhance the safety of the airport
A7	Runway 24 End Runway Safety Area Improvements	\$ 2,252,200	Conform to FAA Standards; Enhance the safety of the airfield
N1	Install Segmented Circle	\$ 66,900	Conform to FAA Standards; Enhance the safety of the airfield
N2	Relocate Airport Beacon	\$ 167,300	Conform to FAA Standards; Enhance the safety of the airfield
G1	Pave Apron and Install Utilities to Allow Installation of New 14-Bay T-Hangar, Reconfigure Aircraft Tie Down Positions Adjacent to New Hangar, Add Taxilane Markings to Apron, Expand Taxiway Edge to Allow Access for ADG II Aircraft and Add Two ADG II Tie Down Positions, Reconfigure Aircraft Tie-Down Positions East of Existing T-Hangar, Adjust Airport Service Road, and Relocate GSE Shelter	\$ 887,880 ⁽²⁾	Conform to FAA Standards
G2	Shift Transient Aircraft Parking Positions from Adjacent to Terminal Area to South of Fuel Farm	\$ 1,500	Conform to FAA Standards
G3	Shift Based Aircraft Parking Located North of the Runway to the Most Northern End of the Available Pavement and Add a Runway Holdline	\$ 3,000	Conform to FAA Standards
Subtotal for Phase I (0-5 Years) AIP Eligible Total Project Cost			\$ 6,102,882

Phase 2 (6-10 Years)			
No.	Project	Project Cost	AIP Priority Category
E2	Environmental Studies	\$ 162,000	Environmental Requirements
E2A	Environmental Permitting	\$ 309,300	Environmental Requirements
E2B	Environmental Mitigation	TBD ⁽¹⁾	Environmental Requirements
A8	Shift Parallel Taxiway to Achieve Runway Separation, Demolish and Reconfigure Taxiway Entrances to Runway	\$ 1,887,700	Conform to FAA Standards; Enhance the safety of the airfield
A9	Implement Wildlife Study Recommendations	TBD ⁽¹⁾	Environmental Requirements
A10	Tree Removal Runway 6 End	\$ 12,562,300	Conform to FAA Standards; Enhance the safety of the airfield
A11	Runway 06/24 Pavement Rehabilitation	\$ 1,250,200	Conform to FAA Standards; Enhance the safety of the airfield
N3	Achieve Commissioned AWOS	\$ 233,600	Enhance the safety of the airfield
G7	Add Additional Pavement South of the T-Hangars	\$ 165,000	Preserve/Enhance airport capacity
Subtotal for Phase II (6-10 Years) AIP Eligible Total Project Cost			\$ 16,570,100
Phase 3 (11-20 Years)			
No.	Project	Project Cost	AIP Priority Category
E3	Environmental Studies	\$ 44,000	Environmental Requirements
E3A	Environmental Permitting	\$ 159,200	Environmental Requirements
E3B	Environmental Mitigation	TBD ⁽¹⁾	Environmental Requirements
Subtotal for Phase III (11-20 Years) AIP Eligible Total Project Cost			\$ 203,200
Total Airport CIP AIP Eligible Costs			\$ 21,198,852

(1) Costs associated with these projects are AIP eligible, but project costs are to be determined based on environmental studies.

(2) The total project cost for G1 is \$1,566,000, but the costs associated with constructing the 14-Bay T-Hangar are not AIP eligible, and are therefore not included in the stated AIP-eligible total project cost.

5.9.2.2 State Funding Program

Airport Safety Fund Program

The source for state grants is the Airport Safety Fund Program which was established by the New Jersey Airport Safety Act of 1983. The Airport Safety Fund, as part of the New Jersey Transportation Trust Fund (TTF), provides funding to preserve and rehabilitate the State general aviation airport system and to promote aviation safety, education, and aeronautics. The following paragraphs describe the state grants included in the Airport Safety Fund Program, as listed in the current NJDOT New Jersey Administrative Code Title 16, Chapter 56.

Airport Improvement Grants

An airport may apply for an airport improvement grant to obtain financial assistance for airport improvement projects meeting the purpose of the Airport Safety Fund Program. Projects eligible for this grant may include the following:

- Runway, taxiway and aircraft parking apron construction, reconstruction, overlay, rehabilitation, preventive maintenance, lighting and marking

- Development, redevelopment, rehabilitation, improvement, lighting and marking of turf and natural surface runways, taxiways, and aircraft parking aprons
- Airport beacons, approach lighting, and electronic and visual navigation aids
- Airport security equipment and security projects
- Permanently installed above ground aircraft fueling equipment
- Airport and runway obstruction removal, mitigation and marking
- Airport equipment dedicated to aircraft crash, fire, and rescue purposes

Financial assistance for airport improvement grants shall not exceed 90% of the total project cost, and the recipient's share shall not be less than 10% of the total project cost.

Matching Grants

For those projects that are eligible for the 90% federal AIP funding, an airport may apply for a matching grant from the New Jersey Airport Safety Fund Program. Matching grants shall not exceed 5% of the total project cost, to aid the airport in supplementing a portion of the remaining funding required for the project. For emergency purposes, a matching grant may be up to 100% of the airport's required match. NJDOT may also enter into multi-year matching grant agreements of up to seven years for multiple eligible projects requiring matching funds, when receiving Federal grants during the term of the agreement.

Airport Acquisition Grants

Publicly owned airports may apply for an airport acquisition grant to obtain financial assistance for the acquisition of lands, rights in land and easements, including those necessary for clear zones or clear areas. The airport acquisition grants shall not exceed 95% of the total project cost, and the recipient's share shall not be less than 5% of the total project costs.

Aviation Studies Grants

Financial assistance is available for airports and the State to conduct studies associated with safety projects, including, but not limited to, feasibility, system plan, master plan, airport layout plan, facility siting, engineering, environmental, or aviation economic study. The aviation studies grants shall not exceed 95% of the total project cost, and the recipient's share shall not be less than 5% of the total project cost.

State Fund Allocation

With reference to the Transportation Capital Program for Fiscal Year (FY) 2020, the state fund allocation to the Airport Improvement Program is \$4 million. Based on the FY 2020-2029 Statewide Transportation Improvement Program (STIP), the fund allocation to the Airport Improvement Program is \$4 million per year for the 10-year period.

For the purpose of this study, it is assumed all FAA AIP eligible projects for 4N1 will be funded by the FAA up to 90% as shown in **Table 5-4**. The New Jersey matching grants provide 5% of the project costs for FAA AIP eligible projects. The remaining 5% of the project costs shall be provided by the Airport Sponsor, Airport Operator, or other private sources which will be discussed in the subsequent paragraphs.

For those projects not included in the FAA AIP, but are eligible for the state airport improvement grant, it is assumed financial assistance from the state airport improvement grant will cover 90% of the project costs. However, it is noted the criteria for eligible projects under the state airport improvement program are very similar to the FAA AIP requirements. For the CIP of 4N1, eligible projects are allocated with the FAA AIP grants prior to applying the state Airport Safety Fund Program.

5.9.2.3 Airport Sponsor

The State of New Jersey purchased 4N1 in 2000 and became the owner of the airport, i.e., the Airport Sponsor. In 2004, the State awarded a private operator, Greenwood Lake Airport Management, to be the Airport Operator for 4N1 with the responsibility of operations and management of the Airport for 20 years. The agreement specified the Airport Operator would receive the revenue generated from 4N1 and pay the State a fixed monthly fee plus a percentage of the revenue from airport operations. The airport generates revenue through leases, fuel sales, hangar fees, and concessions.

There are smaller and less reliable sources of revenue that may be considered at the Airport, including landing fees and automobile parking fees. These fees are not typically charged at general aviation airports due to the low return of the cost of implementing and accounting for the collection.

The revenue generated from 4N1 and received by the Airport Sponsor may be considered to contribute for the remaining 5% of project costs for eligible projects. The use of this funding is subject to the net revenue available to the Sponsor and the Sponsor's decision to use it as such. Should the revenue generated from 4N1 not be available for the remaining 5% of eligible project costs, the Sponsor may apply for the state improvement grants or other sources. Although 4N1 is owned by the State, the fund sources are from different state accounts and the financial responsibility of the Airport Sponsor is kept separate from the state grants that fund capital improvements at 4N1.

5.9.2.4 Airport Operator/Private Sources

Private funding is often a source for certain airport improvements, such as Fixed Base Operator (FBO) site development, aviation industrial site development, and aircraft hangar construction. These types of funding sources include the Airport Operator/FBO, economic development grants, and other small businesses or individual investments through other private organizations.

5.9.3 Airport Capital Improvement Plan

Based on the above identified funding sources and assumed allocation, **Table 5-4** presents the Airport CIP with estimated costs by funding sources and categorized by implementation phases. **Table 5-5** presents a summary of the total Airport CIP costs for each phase by funding source.

Phase I (0-5 Years) improvements total approximately \$7.48 million and represent approximately 25% of the CIP costs. The split between federal grant, state grant, and Airport Sponsor is \$6,102,882 (82%), \$359,949 (5%), and \$904,859 (12%), respectively. All of the projects for the enhancement of the airfield to conform to FAA design standards are included in Phase I funding, even though the duration of the projects may extend into Phase II. The majority of the costs in this phase are for improving the runway safety area on the Runway 24 End, tree clearing in the primary and transitional surfaces, and various general aviation improvements on the apron.

The improvements in Phase II (6-10 Years) total approximately \$17.5 million and account for approximately 59% of the CIP costs, making up the majority of 4N1's total Airport CIP. The split between federal grant, state grant, and Airport Sponsor is \$14,913,090 (85%), \$1,745,445 (10%), and \$876,765 (5%), respectively. The costs for the adding the 14-bay and 12-bay T-hangars to the Airport will be funded by the Airport Operator, or other private sources on an as needed basis. The majority of the CIP costs in this phase are for tree clearing on the Runway 6 End and realigning the parallel taxiway. Tree clearing on the Runway 6 End will also incur additional costs due to the extent of coordination required with more than 10 property owners in the approach and departure surfaces.

The total cost for the Phase III (11-20 Years) improvements is approximately \$4.9 million. This phase represents approximately 16% of the CIP costs. The split between federal grant, state grant, and Airport Sponsor is \$182,880 (18%), \$4,472,215 (91%), and \$245,005 (5%), respectively. The costs associated with adding the box hangars make up the majority of the costs, and will be funded by the Airport Operator or other private sources on an as needed basis.

The grand total cost for all three phases spanning the 20-year planning period is approximately \$29.9 million.

Table 5-10. Airport Capital Improvement Plan, by Funding Source (2020 Dollars)

Phase 1 (0-5 Years)									
No.	Project	Total Project Cost	Est. Federal (%)	Est. Federal (\$)	Est. State (%)	Est. State (\$)	Est. Local (%)	Est. Local (\$)	
E1	Environmental Studies (NEPA)	\$ 127,700	90%	\$ 114,930	5%	\$ 6,385	5%	\$	6,385
E1A	Environmental Permitting	\$ 212,000	90%	\$ 190,800	5%	\$ 10,600	5%	\$	10,600
E1B	Environmental Mitigation	TBD	90%	TBD	5%	TBD	5%	TBD	
A1	On-Airport Tree Removal, Lighting of Obstacle Penetrations where Feasible	\$ 63,400	90%	\$ 57,060	5%	\$ 3,170	5%	\$	3,170
A2	Tree Removal Runway 24 End	\$ 569,600	90%	\$ 512,640	5%	\$ 28,480	5%	\$	28,480
A3	Tree Removal Primary and Transitional Surfaces	\$ 1,936,800	90%	\$ 1,743,120	5%	\$ 96,840	5%	\$	96,840
A4	Demolish Existing Runway 6 Entrance Taxiway and Add New Taxiway Access to Runway 6 End	\$ 130,200	90%	\$ 117,180	5%	\$ 6,510	5%	\$	6,510
A5	Complete a Wildlife Hazard Assessment	\$ 165,000	90%	\$ 148,500	5%	\$ 8,250	5%	\$	8,250
A6	Install an Emergency Generator for Airfield Lighting and Communications	\$ 197,500	90%	\$ 177,750	5%	\$ 9,875	5%	\$	9,875
A7	Runway 24 End Runway Safety Area Improvements	\$ 2,252,200	90%	\$ 2,026,980	5%	\$ 112,610	5%	\$	112,610
N1	Install Segmented Circle	\$ 66,900	90%	\$ 60,210	5%	\$ 3,345	5%	\$	3,345
N2	Relocate Airport Beacon	\$ 167,300	90%	\$ 150,570	5%	\$ 8,365	5%	\$	8,365
G1 ⁽¹⁾	Pave Apron and Install Utilities to Allow Installtion of New 14-Bay T-Hangar, Reconfigure Aircraft Tie Down Positions Adjacent to New Hangar, Add Taxilane Markings to Apron, Expand Taxiway Edge to Allow Access for ADG II Aircraft and Add Two ADG II Tie Down Positions, Reconfigure Aircraft Tie-Down Positions East of Existing T-Hangar, Adjust Airport Service Road, and Relocate GSE Shelter	\$ 887,880	90%	\$ 799,092	5%	\$ 44,394	5%	\$ 44,394 +\$	677,320
G2	Shift Transient Aircraft Parking Positions from Adjacent to Terminal Area to South of Fuel Farm	\$ 1,500	90%	\$ 1,350	5%	\$ 75	5%	\$	75
G3	Shift Based Aircraft Parking Located North of the Runway to the Most Northern End of the Available Pavement and Add a Runway Holdline	\$ 3,000	90%	\$ 2,700	5%	\$ 150	5%	\$	150
G4	Reconfiguration of Helicopter Parking Position	\$ 500	0%	\$ -	95%	\$ 475	5%	\$	25
L1	Expand Restaurant Parking	\$ 7,000	0%	\$ -	95%	\$ 6,650	5%	\$	350
G5	Future Expansion for Septic System	\$ 14,500	0%	\$ -	95%	\$ 13,775	5%	\$	725
Phase 2 (6-10 Years)									
No.	Project	Project Cost	Est. Federal (%)	Est. Federal (\$)	Est. State (%)	Est. State (\$)	Est. Local (%)	Est. Local (\$)	
E2	Environmental Studies	\$ 162,000	90%	\$ 145,800	5%	\$ 8,100	5%	\$	8,100
E2A	Environmental Permitting	\$ 309,300	90%	\$ 278,370	5%	\$ 15,465	5%	\$	15,465
E2B	Environmental Mitigation	TBD	90%	TBD	5%	TBD	5%	TBD	
A8	Shift Parallel Taxiway to Achieve Runway Separation, Demolish and Reconfigure Taxiway Entrances to Runway	\$ 1,887,700	90%	\$ 1,698,930	5%	\$ 94,385	5%	\$	94,385
A9	Implement Wildlife Study Recommendations	TBD	90%	TBD	5%	TBD	5%	TBD	
A10	Tree Removal Runway 6 End	\$ 12,562,300	90%	\$ 11,306,070	5%	\$ 628,115	5%	\$	628,115
A10	Runway 06/24 Pavement Rehabilitation	\$ 1,250,200	90%	\$ 1,125,180	5%	\$ 62,510	5%	\$	62,510
N3	Achieve Commissioned AWOS	\$ 233,600	90%	\$ 210,240	5%	\$ 11,680	5%	\$	11,680
G6	Demolish the Existing T-Hangar and Install a New 12-Bay T-Hangar	\$ 965,200	0%	\$ -	95%	\$ 916,940	5%	\$	48,260
G7	Add Additional Pavement South of the T-Hangars	\$ 165,000	90%	\$ 148,500	5%	\$ 8,250	5%	\$	8,250
Phase 3 (11-20 Years)									
No.	Project	Project Cost	Est. Federal (%)	Est. Federal (\$)	Est. State (%)	Est. State (\$)	Est. Local (%)	Est. Local (\$)	
E3	Environmental Studies	\$ 44,000	90%	\$ 39,600	5%	\$ 2,200	5%	\$	2,200
E3A	Environmental Permitting	\$ 159,200	90%	\$ 143,280	5%	\$ 7,960	5%	\$	7,960
E3B	Environmental Mitigation	TBD	90%	TBD	5%	TBD	5%	TBD	
G8	Add a New Box Hangar	\$ 2,016,000	0%	\$ -	95%	\$ 1,915,200	5%	\$	100,800
G9	Add a New Box Hangar with Apron Pavement	\$ 2,680,900	0%	\$ -	95%	\$ 2,546,855	5%	\$	134,045

(1) The total project cost for G1 is \$1,566,000, but the costs associated with constructing the 14-Bay T-Hangar are not AIP eligible. The total project cost stated is the AIP eligible cost, of which 90% and 5% is estimated to be funded using federal and state funds. The costs associated with constructing the hangar are added to the estimated local (Airport Sponsor) costs.

5.9.3.1 Summary of Funding Program

In summary, the total 4N1 CIP cost is \$29.9 million, developed in constant 2020 dollars, as shown in **Table 5-5**. It is anticipated the 4N1 CIP will be funded by Federal Grants (\$19.2 million – 69% of the total); State Grants (\$6.5 million – 23% of the total); and Local, or Airport Sponsor (\$2.0 million – 7% of the total).

Table 5-11. Summary of Airport Capital Improvement Plan (2020 Dollars)

	Phase I (0-5 Years)	Phase II (6-10 Years)	Phase III (11-20 Years)	Total Cost by Funding Source
Total Project Cost	\$ 7,480,300	\$ 17,535,300	\$ 4,900,100	\$ 29,915,700
Est. Total Federal Funding	\$ 6,102,882	\$ 14,913,090	\$ 182,880	\$ 21,198,852
Est. Total State Funding	\$ 359,949	\$ 1,745,445	\$ 4,472,215	\$ 6,577,609
Est. Total Local (Airport Sponsor) Funding	\$ 1,017,469	\$ 876,765	\$ 245,005	\$ 2,139,239



Transportation

Submitted to
Department of Transportation
The State of New Jersey

Submitted by
AECOM
30 Knightsbridge Road,
Suite 520
Piscataway, NJ 08854

An aerial photograph of Greenwood Lake Airport. The runway, marked with the number 24, runs diagonally from the bottom left towards the center. To the right of the runway is a taxiway and a parking lot filled with cars. Further back, there are airport buildings, including a large hangar, and several small aircraft parked on the tarmac. The surrounding landscape is a mix of green grass and brown, leafless trees, suggesting an autumn or winter setting. A body of water is visible in the upper right corner.

Greenwood Lake Airport Master Plan Update Appendices

October 16, 2020

Greenwood Lake Airport
Airport Master Plan Update
Appendices
Agreement #2015DPD019
Task Order No. 5

October 16, 2020

**APPENDIX A
4063a - IPAC Report**

Appendix A – 4063a - IPAC Report



United States Department of the Interior

FISH AND WILDLIFE SERVICE
New Jersey Ecological Services Field Office
4 E. Jimmie Leeds Road, Suite 4
Galloway, NJ 08205
Phone: (609) 646-9310 Fax: (609) 646-0352

<http://www.fws.gov/northeast/njfieldoffice/Endangered/consultation.html>



In Reply Refer To:

December 07, 2017

Consultation Code: 05E2NJ00-2018-SLI-0318

Event Code: 05E2NJ00-2018-E-00654

Project Name: ASGECI # 4063A - Greenwood Lake Airport Project

Subject: List of threatened and endangered species that may occur in your proposed project location, and/or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species that may occur in your proposed action area and/or may be affected by your proposed project. This species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.)

If the enclosed list indicates that any listed species may be present in your action area, please visit the New Jersey Field Office consultation web page as the next step in evaluating potential project impacts: <http://www.fws.gov/northeast/njfieldoffice/Endangered/consultation.html>

On the New Jersey Field Office consultation web page you will find:

- habitat descriptions, survey protocols, and recommended best management practices for listed species;
- recommended procedures for submitting information to this office; and
- links to other Federal and State agencies, the Section 7 Consultation Handbook, the Service's wind energy guidelines, communication tower recommendations, the National Bald Eagle Management Guidelines, and other resources and recommendations for protecting wildlife resources.

The enclosed list may change as new information about listed species becomes available. As per Federal regulations at 50 CFR 402.12(e), the enclosed list is only valid for 90 days. Please return to the ECOS-IPaC website at regular intervals during project planning and implementation to obtain an updated species list. When using ECOS-IPaC, be careful about drawing the boundary of your Project Location. Remember that your action area under the ESA is not limited to just the footprint of the project. The action area also includes all areas that may be indirectly affected through impacts such as noise, visual disturbance, erosion, sedimentation, hydrologic change,

chemical exposure, reduced availability or access to food resources, barriers to movement, increased human intrusions or access, and all areas affected by reasonably foreseeable future that would not occur without ("but for") the project that is currently being proposed.

We appreciate your concern for threatened and endangered species. The Service encourages Federal and non-Federal project proponents to consider listed, proposed, and candidate species early in the planning process. Feel free to contact this office if you would like more information or assistance evaluating potential project impacts to federally listed species or other wildlife resources. Please include the Consultation Tracking Number in the header of this letter with any correspondence about your project.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

New Jersey Ecological Services Field Office
4 E. Jimmie Leeds Road, Suite 4
Galloway, NJ 08205
(609) 646-9310

Greenwood Lake Airport Master Plan Update

12/07/2017

Event Code: 05E2NJ00-2018-E-00654

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Project Summary

Consultation Code: 05E2NJ00-2018-SLI-0318

Event Code: 05E2NJ00-2018-E-00654

Project Name: ASGECI # 4063A - Greenwood Lake Airport Project

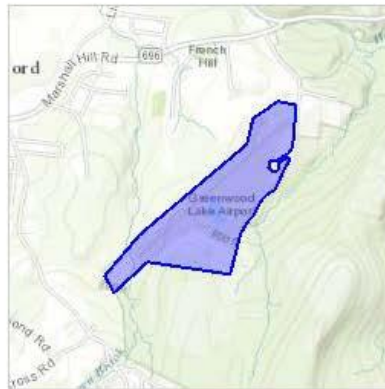
Project Type: ** OTHER **

Project Description: Master Plan update

Project Location:

Approximate location of the project can be viewed in Google Maps:

<https://www.google.com/maps/place/41.12776754834575N74.345926549316W>



Counties: Passaic, NJ

Endangered Species Act Species

There is a total of 4 threatened, endangered, or candidate species on this species list. Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

Mammals

NAME	STATUS
Indiana Bat <i>Myotis sodalis</i> There is final critical habitat for this species. Your location is outside the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/5949	Endangered
Northern Long-eared Bat <i>Myotis septentrionalis</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9045	Threatened

Reptiles

NAME	STATUS
Bog Turtle <i>Clemmys muhlenbergii</i> Population: Wherever found, except GA, NC, SC, TN, VA No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6962	Threatened

Flowering Plants

NAME	STATUS
Small Whorled Pogonia <i>Isotria medeoloides</i> No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1890	Threatened

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the [National Wildlife Refuge](#) system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act¹ and the Bald and Golden Eagle Protection Act².

Any activity that results in the take of migratory birds or eagles is prohibited unless authorized by the U.S. Fish and Wildlife Service³. There are no provisions for allowing the take of migratory birds that are unintentionally killed or injured. Any person or organization who plans or conducts activities that may result in the take of migratory birds is responsible for complying with the appropriate regulations and implementing appropriate conservation measures, as described [below](#).

-
1. The [Migratory Birds Treaty Act](#) of 1918.
 2. The [Bald and Golden Eagle Protection Act](#) of 1940.
 3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the [USFWS Birds of Conservation Concern](#) (BCC) list or are known to have particular vulnerabilities in your project location. To learn more about the levels of concern for birds on your list, see the FAQ [below](#). This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your specific project area. To see maps of where birders and the general public have sighted birds in and around your project area, visit E-bird tools such as the [E-bird data mapping tool](#) (search for the scientific name of a bird on your list to see specific locations where that bird has been reported to occur within your project area over a certain time-frame) and the [E-bird Explore Data Tool](#) (perform a query to see a list of all birds sighted in your county or region and within a certain time-frame). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list can be found [below](#).

NAME	BREEDING SEASON
Bald Eagle <i>Haliaeetus leucocephalus</i> This is not a Bird of Conservation Concern (BCC), but is of concern in this area either because of the Eagle Act, or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Mar 20 to Sep 15
Black-billed Cuckoo <i>Coccyzus erythrophthalmus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9399	Breeds May 15 to Oct 10
Bobolink <i>Dolichonyx oryzivorus</i>	Breeds

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This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	May 20 to Jul 31
Eastern Whip-poor-will <i>Antrostomus vociferus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 1 to Aug 20
Golden Eagle <i>Aquila chrysaetos</i> This is not a Bird of Conservation Concern (BCC), but is of concern in this area either because of the Eagle Act, or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1680	Breeds elsewhere
Golden-winged Warbler <i>Vermivora chrysoptera</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/8745	Breeds May 1 to Jul 20
Long-eared Owl <i>asio otus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/3631	Breeds Mar 1 to Jul 15
Red-headed Woodpecker <i>Melanerpes erythrocephalus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10
Rusty Blackbird <i>Euphagus carolinus</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds elsewhere
Wood Thrush <i>Hylocichla mustelina</i> This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Aug 31
Yellow-bellied Sapsucker <i>sphyrapicus varius</i> This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA https://ecos.fws.gov/ecp/species/8792	Breeds May 10 to Jul 15
Additional information can be found using the following links:	
■ Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php ■ Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php ■ Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf	

Wetlands

Impacts to [NWI wetlands](#) and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local [U.S. Army Corps of Engineers District](#).

FRESHWATER FORESTED/SHRUB WETLAND

- [PFO1E](#)
- [PSS1B](#)
- [PFO1B](#)
- [PFO1C](#)
- [PFO1/SS1B](#)

FRESHWATER POND

- [PUBHx](#)

APPENDIX B

Invisible Intelligence Data from the Airport

Appendix B - Invisible Intelligence Data from the Airport

The Airport/NJDOT engages Invisible Intelligence, LLC to provide data devices, namely G.A.R.D. (General Audio Recording Device), to record air traffic. G.A.R.D. records airport radio transmissions and generates radio reports by day, week, or month. The operation counts at the airport are estimated from the radio transmission records by Invisible Intelligence's software.

Figure B-1 summarizes the monthly operations estimated by Invisible Intelligence from February 2016 to July 2017. The estimated operations in April 2016, July 2016, and March 2017 are noticeably lower than other months, and less than half of the operations estimated in April 2017, July 2017, and March 2016 respectively. Some operations may be missing in these records.

Table B-1 provides the rolling 12-month estimated operations, which range from 10,841 to 11,911 annual operations. The estimated annual operations from Invisible Intelligence are 30 to 40 percent less than the estimate from FAA TAF (January 2017) at 18,099 annual operations.

The hourly operation distributions are given in **Figure B-2**. The estimated daily operations are illustrated in **Figure B-3**. These graphics are extracted from Invisible Intelligence's reports provided by the Airport/NJDOT.

Since only eighteen months of data are collected by July 2017 and some inconsistent or missing counts are identified, the estimated operations from Invisible Intelligence were not adopted as the actual number of operations at 4N1 in the base year 2016 for the forecast analysis under this airport master plan. When more data are collected over a couple of years, and demonstrated consistent patterns that reflect the actual performance at the Airport, this source of data will be valuable in providing the activity levels on hourly, daily, and monthly basis.

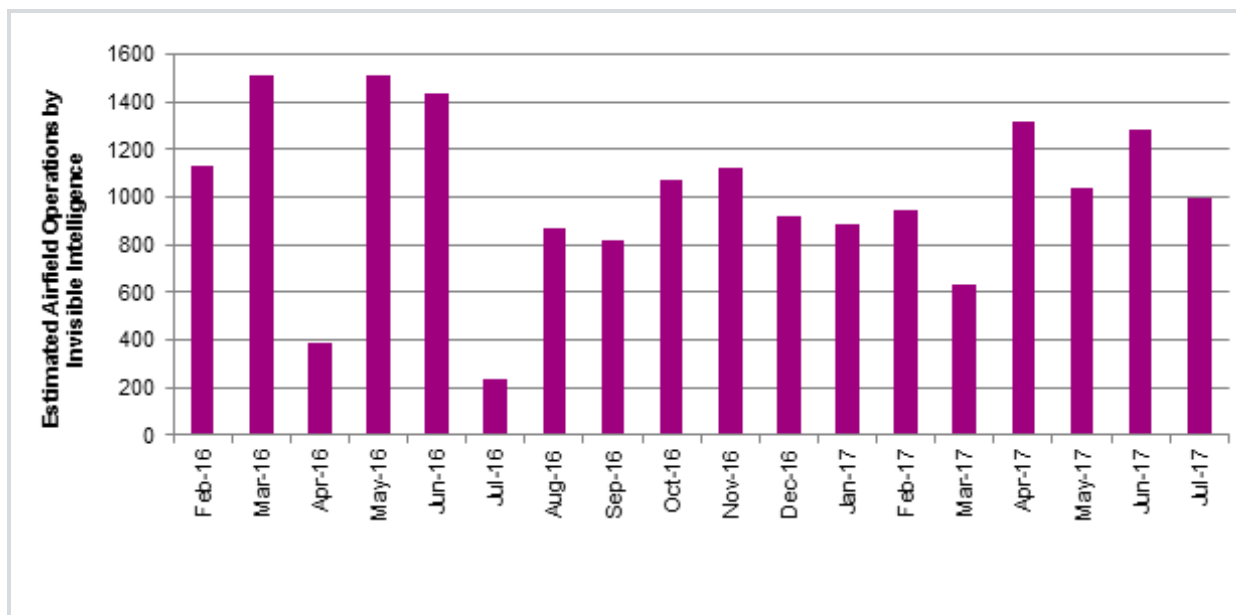


Figure B-1. Estimated Monthly Operations by Invisible Intelligence

Source: Airport's Invisible Intelligence Data. AECOM analysis

Table B-1. Rolling 12-month Estimated Operations by Invisible Intelligence

Period	Total Operations Rolling 12-Month
Feb-16 to Jan-17	11,907
Mar-16 to Feb-17	11,721
Apr-16 to Mar-17	10,841
May-16 to Apr-17	11,774
Jun-16 to May-17	11,304
Jul-16 to Jun-17	11,151
Aug-16 to Jul-17	11,911

Source: Airport's Invisible Intelligence Data. AECOM analysis.

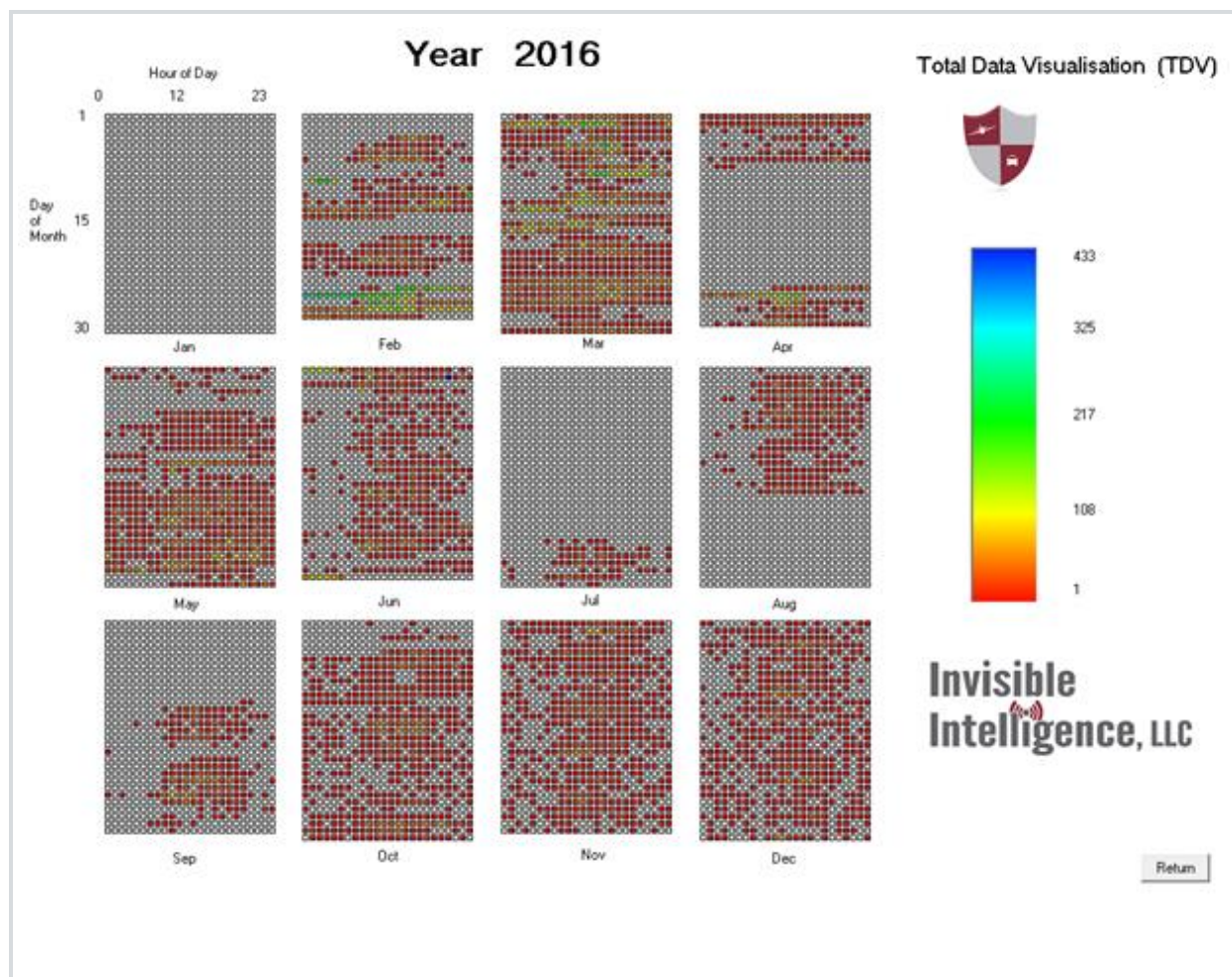
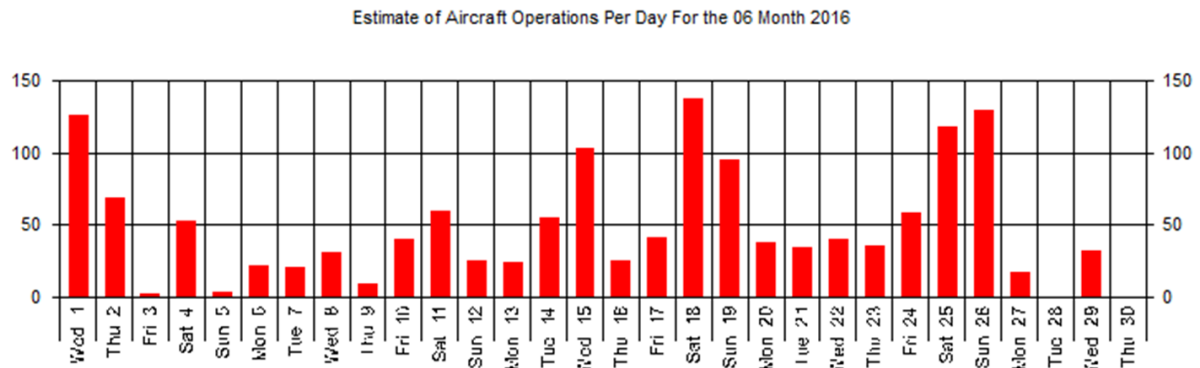


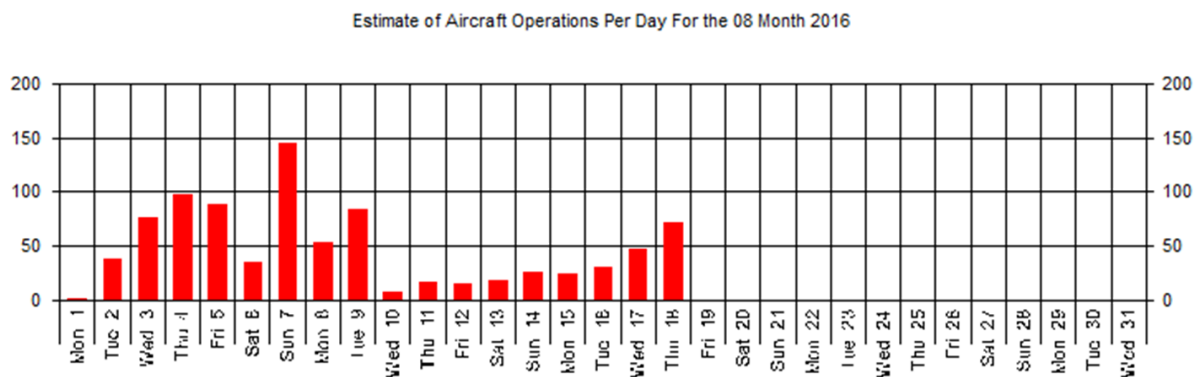
Figure B-2. Estimated Hourly Operations by Invisible Intelligence

Source: Airport's Invisible Intelligence Data.

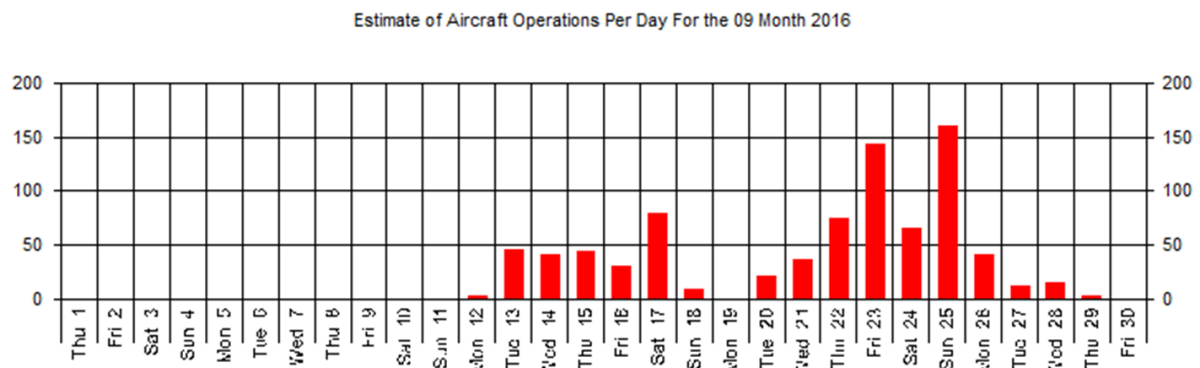
Greenwood Lake Airport Master Plan Update



Estimate of Total Aircraft Operations for the 06 Month is 1433



Estimate of Total Aircraft Operations for the 08 Month is 869



Estimate of Total Aircraft Operations for the 09 Month is 821

Figure B-3. Estimated Daily Operations by Invisible Intelligence (Page 1 of 4)

Source: Airport's Invisible Intelligence Data.

**Greenwood Lake Airport
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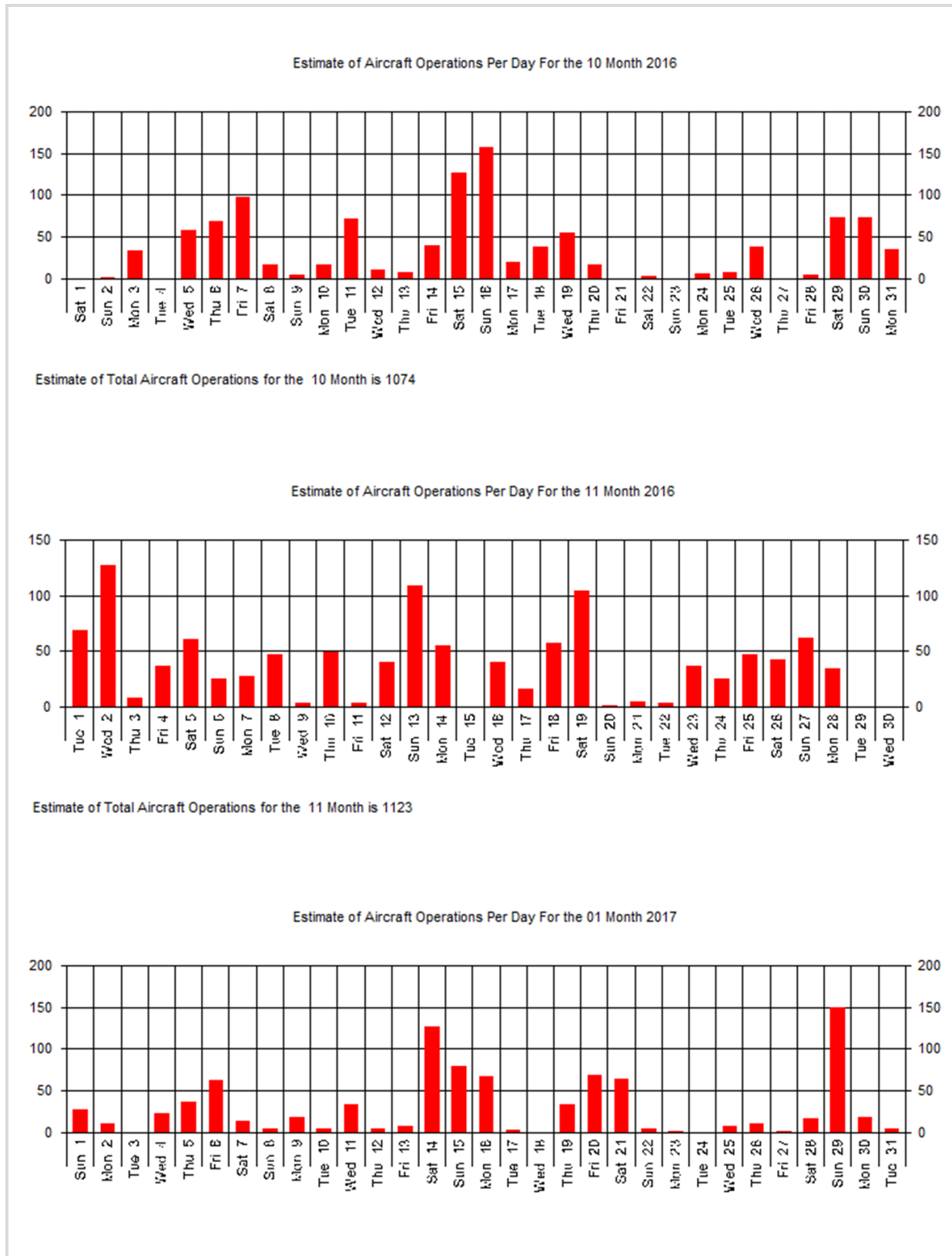


Figure B-3. Estimated Daily Operations by Invisible Intelligence (Page 2 of 4)

Source: Airport's Invisible Intelligence Data.

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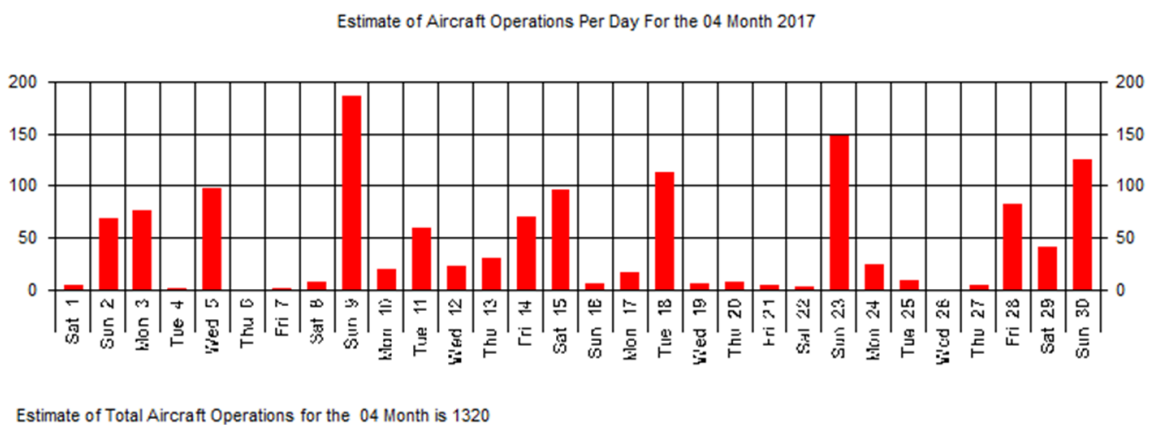
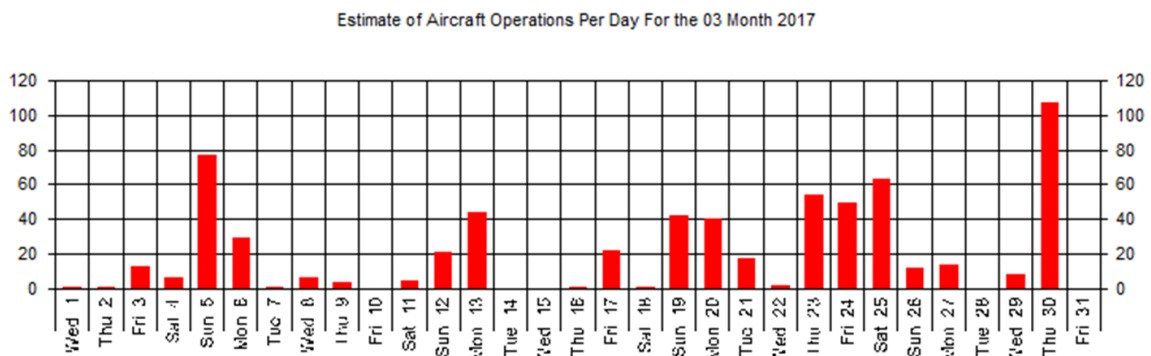
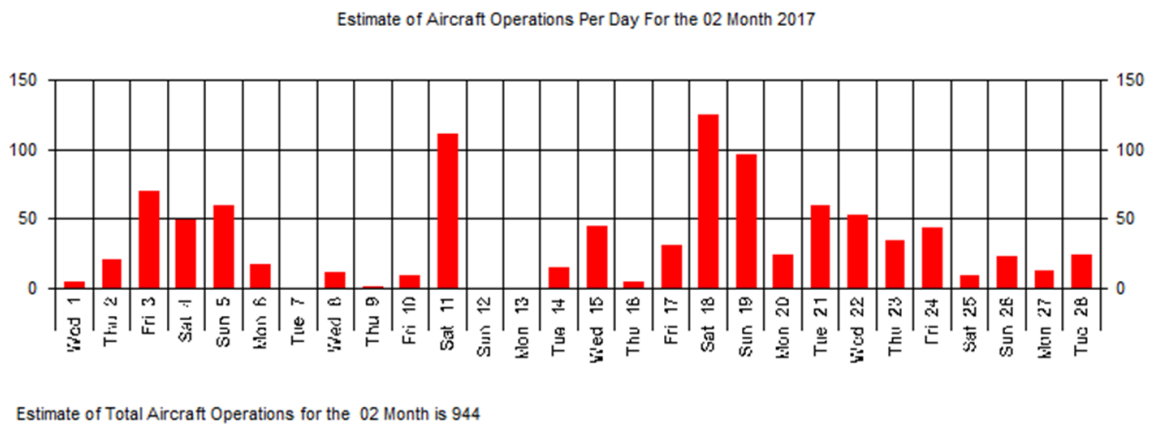
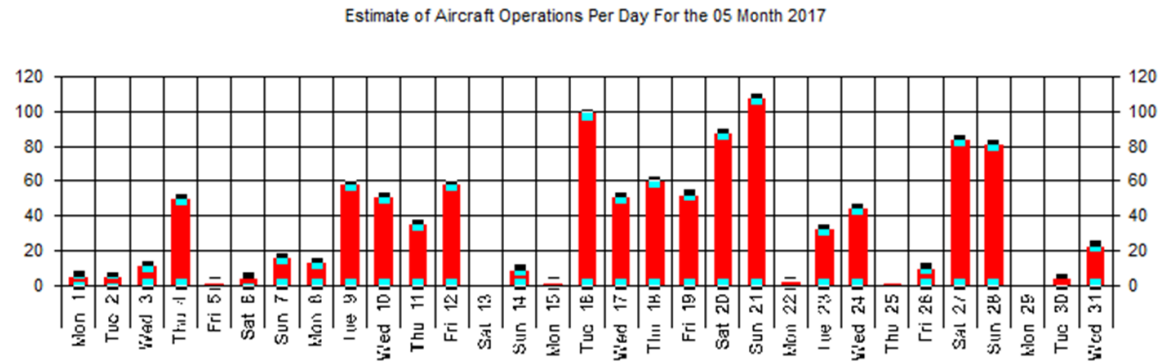


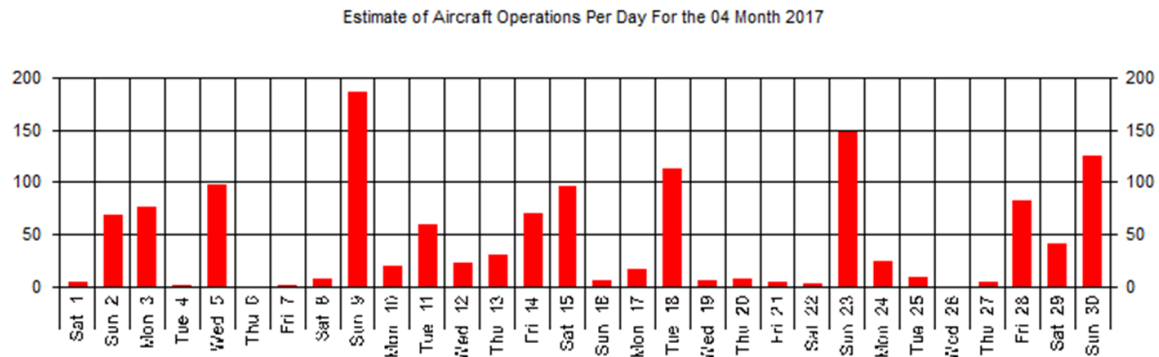
Figure B-3. Estimated Daily Operations by Invisible Intelligence (Page 3 of 4)

Source: Airport's Invisible Intelligence Data.

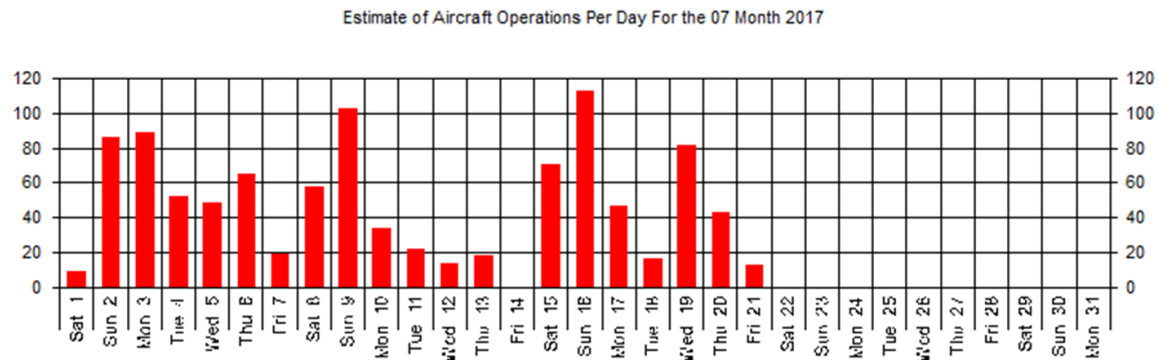
Greenwood Lake Airport Master Plan Update



Estimate of Total Aircraft Operations for the 05 Month is 1039



Estimate of Total Aircraft Operations for the 04 Month is 1320



Estimate of Total Aircraft Operations for the 07 Month is 997

Figure B-3. Estimated Daily Operations by Invisible Intelligence (Page 4 of 4)

Source: Airport's Invisible Intelligence Data.

APPENDIX C

Supplementary Information on Forecast Model

Appendix C - Supplementary Information on Forecast Model

This appendix documents the supplementary information for the forecast model.

Regression equation for the forecast based aircraft demands in the airport service area:

$$y = 1275.88 - 148.10 x_1 + 77.23 x_2 + 721.80 x_3 + 651.12 x_4 + 3228.08 x_5$$

x_1 = aviation gasoline price in 2016 dollars per gallon

x_2 = growth rate of private pilot populations in New Jersey and New York

x_3 = growth rate of gross regional product (2009 dollars) in the 8-county airport service area

x_4 = growth rate of per capita personal income (2009 dollars) in the 8-county airport service area

x_5 = growth rate of non-farm employment in the 8-county airport service area

R square = 0.94