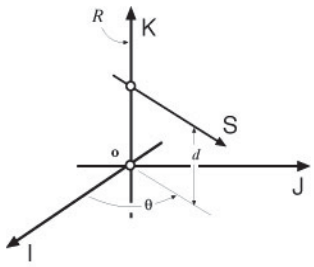
SECTION 4: AIRPORT FACILITY NEEDS

4.1 AIRPORT GEOMETRIC DESIGN FACTORS

This section identifies airfield and terminal area facilities to satisfy the 20-year forecast of aviation demand at the Dare County Regional Airport. Airport facilities are developed in accordance with FAA/NCDOA airport design standards and airspace criteria. The recommendations in this section are not an absolute design requirement, but are rather options to resolve various types of facility or operational inadequacies, or to make improvements as demand warrants.



The following is an outline of facilities documented in this section:

- Runway Length & Width Design Standards
- Taxiway System
- Pavement Strength
- Navigational, Communication and Weather Aids
- Terminal Area Facilities
- Airport Land Acquisition

The NCDOT-Division of Aviation (NCDOA) has designated the Dare County Regional Airport as a 'Red Group' facility, for which the Airport Layout Plan (ALP) must, at minimum, meets ARC B-II design standards as defined by FAA Advisory Circular 150/5300-13, *Airport Design*. The NCDOA recommends compliance with ARC C-II design standards for Red Group facilities.

4.2 RUNWAY LENGTH DESIGN STANDARDS

Runway length is determined from the greater of the takeoff or landing performance characteristics of the critical aircraft, or composite family of airplanes as represented by the critical aircraft's Airport Reference Code (ARC).[1] The takeoff length, including takeoff run, takeoff distance, and accelerate-stop distance, is the more demanding of the runway length requirements. The business jets are the most demanding type of aircraft for runway length requirements at the Dare County Regional Airport.

[1] Runway performance length factors are used for the development of the recommended runway length and ultimate design of airport runways, and not as a substitute for calculations required by airplane operating rules. For planning purposes, only an "unrestricted" runway length is contemplated, which does not invoke declared distances (displaced landing or takeoff threshold).

As described below, there are three sources of guidance in determining the future primary runway length for the Dare County Regional Airport. These same sources are also referenced to provide recommended lengths for the crosswind runway:

1) Airport Master Plan (AMP) Update forecasts: identify existing and future user demands (500 annual itinerant operations).

2) FAA recommended runway length: runway length based on computer modeling software for composite aircraft groups.

3) NCDOT, Airport Development Plan (NCADP): criteria for 'minimum' and 'recommended' runway length (red group airport).

4.2.1 PRIMARY RUNWAY LENGTH REQUIREMENTS

The following are used to describe primary runway length requirements at MQI:

1) Runway Length Standards – AMP Update Demand

The following shows a composite of average takeoff-lengths for the three (3) critical jet aircraft identified for the Dare County Regional Airport. The standard FAA takeoff length has been adjusted for Dare County conditions, including ambient temperatures of 88ºF to 96ºF during the hottest month (July) and 60% to 100% useful load for passengers, baggage and fuel.

- 5,500' 100% useful load and average of 88ºF to 96ºF temperatures
- 5,000' 60% to 100% useful load and average of 88ºF to 96ºF temperatures
- 4,400' 60% useful load and average of 88ºF to 96ºF temperatures

Critical Aircraft	ARC	88ºF to 96ºF 60% Load	88ºF to 96ºF 60%-100%	88ºF to 96ºF 100% Load
Cessna 560 Citation Series	B-II	3,380'	3,810'	4,230'
Raytheon/Hawker 800XP	B-II	4,920'	5,530'	6,150'
Cessna 750 Citation Series	C-II	4,820'	5,430'	6,025'
TAKEOFF LENGTH (AVERAGE)		4,400'	5,000'	5,500'

Note: Higher temperatures and greater load factors decrease the aircraft's acceleration performance (engine), lifting and climb capabilities (aerodynamics), thereby increasing the runway length required for takeoff. Per FAA guidance, the runway length required under 60% aircraft useful load is roughly 70 to 80 percent of that required for 100% useful load. Note: Average runway length rounded up to closest 100th. Note: Takeoff distances reflect performances under 'ideal' pilot and test conditions, which is further cause to view these as minimum lengths.

Source: FAA Runway Length Aircraft Data / Calculation Worksheet.

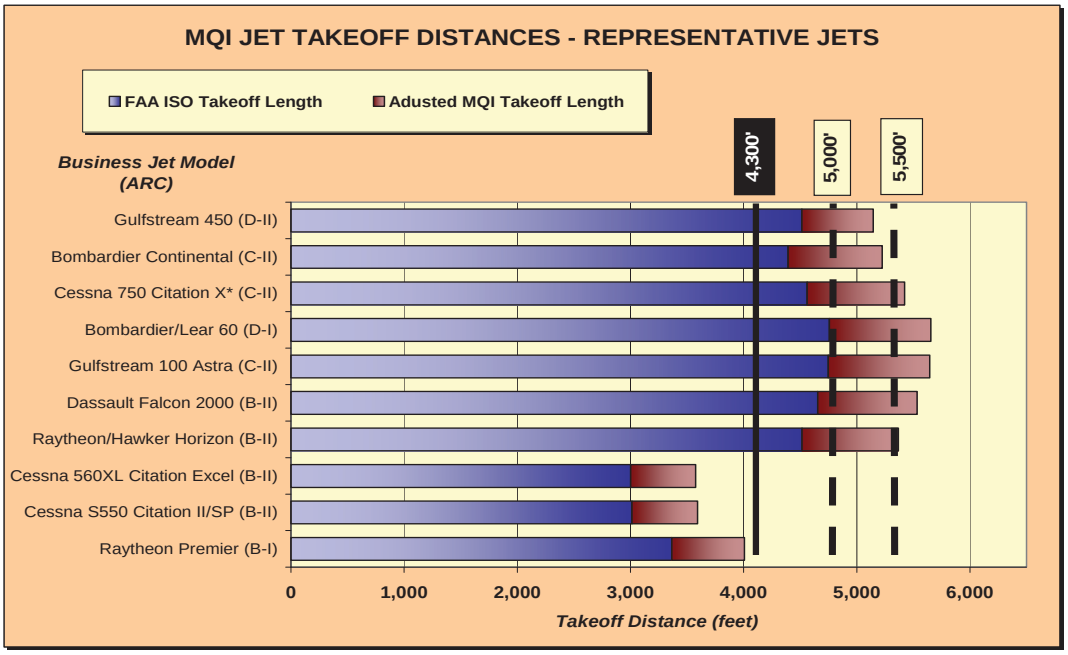
2) FAA Runway Length Standards:

The following are FAA recommended runway lengths computed for the Dare County Regional Airport using the *FAA Advisory Circular 150/5325-4A, Runway Length Standards*, microcomputer program. The computed lengths serve as a general planning guide for a 'composite' group of aircraft, determined by the aircraft's useful payload of 60% or 90%, and as represented by either 75% or 100% of the business jet fleet. Per FAA Regional Letter RGL-01-2, the 75% of the fleet at 60% useful load (passengers, baggage, cargo, and usable fuel) is used for initial runway planning purposes. The computer-calculated FAA-recommended model length adjusted for the Dare County Regional Airport is 5,500' (5,430 rounded-up).

Model Inputs	Inputs
Airport Elevation (MSL)	14'
Mean Daily Maximum Temperature of Hottest Month (July)	96° F
Maximum Difference in Runway Centerline Elevation	3'
FAA Recommended Runway Length	**Length-Wet**
75 percent of large airplanes at 60 percent useful load	5,430' (5,500')
100 percent of these large airplanes at 60 percent useful load	5,700' (5,700')

Note: Runway length is rounded to the next 100-foot increment beyond 30 feet.
Note: Wet & slippery conditions used for landing distance – greater 75 days of the year with 0.01-inch or more of rain. Model assumes no wind. Runway end elevation coincides with existing and future runway ends.

Source: *FAA Advisory Circular 150/5325-4A, Runway Length Standards*, Program 4.2.



3) Runway Length Standards - NCDOA Runway Length Criteria:

The following lists the runway requirements per the North Carolina DOT, Division of Aviation (NCDOA) criteria, for 'minimum' and 'recommended' development. The Dare County Regional Airport has been designated by the NCDOA as a 'Red Group' facility, in which the 'minimum' runway length is 5,000' and the 'recommended' runway length is 6,500'.

NCDOT, Airport Development Plan (Red group)	'Minimum' Runway Length & Width	'Recommended' Runway Length & Width
Dare County Runway Length	5,000' x 75'	6,500' x 100'

Source: NCDOT, Division of Aviation: 2004 NC Airport Development Plan (NCADP).

Summary of Recommended Runway Length – Primary Runway

The following is the progression of planned runway length expansion for the primary runway throughout the 20-year planning period:

- Existing Dimension = 4,300' (Displaced Thresholds)
- Minimum Dimension = 4,400' (Correct Displaced Thresholds)
- 0-5 Year Dimension = 5,000'
- 6-20 Year Dimension = 5,500'

A 5,500' runway is typically considered a 'pure-jet length', and 5,000' an 'interim jet length' that also accommodates all utility (piston) aircraft.

The recommendation for runway expansion is premised on: 1) ability to accommodate medium-cabin business jet demand; including takeoff, landing and accelerate-stop distances; 2) meet NCDOT, Airport Development Plan 'recommended' runway length standards; 3) meet FAA recommended runway length standards for useful jet loads and payloads; 4) accentuate County competitiveness in competing with surrounding airports and ability to attract growth; 5) maintain consistency with insurance industry benchmarks set for business jet runway length requirements; 6) parallels evolving FAA Federal Aviation Regulation SubPart 91k (fractional ownership) and proposed Part 135 (on-demand) regulations[1]; 7) achieves an unrestricted length allowable for a precision instrument approach procedure (minimum length is 4,200').

[1] Note: FAA regulation under FAR Part 91 Subpart K holds on-demand Part 135 operators and now fractional operators to landing requirements within 60 percent of the available runway length. FAR Part 135 operators must also meet insurance requirements for particular aircraft to satisfy balanced field length requirements (decision speeds based on V_1, V_2 and Vr), which involves the aircraft being able to accelerate to rotation speed, decelerate, *and* stop prior to the departure end of the runway.

4.2.2 SECONDARY (CROSSWIND) RUNWAY LENGTH REQUIREMENTS

Secondary runways commensurate the primary runway by providing an alternate during strong crosswind conditions, convenience for taxiing to-and-from terminal/parking areas, instrument approach procedures into the prevailing winds, and periods when the primary runway is not operational (weather, accidents, maintenance/repairs).

Crosswind Conditions & Operational Activity

Based strictly on wind patterns, the crosswind Runway 17-35 would be favored 30% to 35% of the time over Runway 5-23. Light piston aircraft rely on Runway 17-35 most frequently. On occasion, larger turboprop and small-cabin business jets use Runway 17-35 when strong crosswinds effect Runway 5-23, and in order to shoot the Runway 17 instrument approach. The following shows Runway 17-35 traffic, as a true crosswind.

Runway 17-35 Usage (Traffic Exceeding Runway 5-23 Crosswind Component)			
Aircraft Category	Crosswind Rwy 17-35 Usage	Total MQI Operations	Crosswind Operations
Category A & B Piston Aircraft	±8% to ±30%	41,500	11,200
Category B Turboprops	±5%	3,500	170
Category B, C & D Jets	±3%	700	30
AVERAGE / TOTAL	27%	46,000	11,400 (25%)

Note: Does not include rotorcraft operations.

Because Runway 5-23 does not achieve 95% coverage at 10.5-knots, the crosswind runway should, by design, accommodate small ARC Category A and B piston and single turboprop aircraft. Also, the minimum length required for a straight-in instrument approach procedure is 3,200', a landing length marginal for accommodate turboprop aircraft operating during inclement weather, and wet-and-slippery pavement conditions. Because it is only infrequent used by larger turbine aircraft, the crosswind length would not need to accommodate small piston-aircraft with 10 or more passenger seats.

Crosswind Runway Length

The following are FAA recommended runway lengths computed for the small aircraft fleet based on *FAA Advisory Circular 150/5325-4A, Runway Length Standards*. Similar to the primary runway length analyses, the computed lengths serve as a general planning guide to determine the takeoff distance for a 'composite' group of small piston-aircraft, expressed as a percent of the piston-aircraft fleet. Therefore, the recommended FAA design length is 3,700', which accommodates 100% of the small aircraft fleet with less than 10 passenger seats.

FAA Recommended Runway Length (Small Aircraft)	Design Runway Length-Wet
95% of the small aircraft fleet (Less than 10 Passenger Seats)	3,200'
100% of the small aircraft fleet (Less than 10 Passenger Seats)	3,700'
100% of the small aircraft fleet (10+ Passenger Seats)	4,400'

Small Aircraft (defined): An aircraft less than 12,500 pounds maximum takeoff weight.

Source: *FAA Advisory Circular 150/5325-4A, Runway Length Standards*, Program 4.2.

The following shows the takeoff-lengths for the more demanding Category A and B small piston-aircraft regularly using the crosswind runway. This demonstrates that, at minimum, the 'unrestricted' crosswind length without displaced thresholds is 3,000'. Runway 17-35 currently has a restricted length totaling 1,300'; 1,000' for Runway 35 and 300' for Runway 17.

Critical Aircraft	ARC	Aircraft Type	96ºF @ 100% Useful Load
Cessna Grand Caravan	B-I	Single-Engine Turboprop	2,950' (3,000')
Piper Meridian	B-I	Single-Engine Turboprop	3,050' (3,100')
Raytheon Baron	A-I	Multi-Engine Piston	2,800' (2,800')
		TAKEOFF LENGTH (AVERAGE)	± 2,970' (3,000')

Note: The standard FAA takeoff length has been adjusted for local conditions, including ambient temperatures (96ºF during the hottest month) and aircraft useful payloads of 100% (passengers, baggage and fuel).

Crosswind Runway Length Recommendation

The recommended crosswind runway (ARC B-II) length is premised on: 1) restore existing pavement marked as 'displaced' in order to reduce/eliminate declared distances, 2) meet FAA recommended runway length standards for the small aircraft fleet; 3) provide a length realistic with the expected types and frequency of business-class traffic unable to use the primary runway due to unfavorable crosswind components; 4) minimizes business-class having to circle-to-land on Runway 5-23 after shooting the instrument approach to Runway 17-35, and 5) funding priority for crosswind runways under the current NCDOA/FAA grant program.

The following summarizes the recommendation for crosswind runway lengths:

- Existing Dimension = 3,303' x 75' (Correct Displaced Thresholds)
- 5-15 Year Dimension = 3,700' x 75' (Restricted Length)
- 15-20 Year Dimension = 3,700' x 75' (Unrestricted Length)

4.3 TAXIWAY SYSTEM

The FAA recommends a full-length parallel taxiway system for runways that exceed 20,000 annual operations, and is required for precision runways. By design, the Runway 5-23 taxiway system should follow ARC C-II design and separation standards, and ARC B-II design standards should apply to future taxiway improvements to Runway 17-35.

The existing full-length taxiway system for Runway 5-23 provides sufficient exit and entry. The taxiway configuration for Runway 17-35 is circuitous, and less efficient. It is recommended that Runway 5-23 and 17-35 support a full-length taxiway, with a traditional parallel-taxiway to Runway 17-35 with not less than 240' separation.

Entry/Exit taxiways should be marked with holdlines not less than 200', and future taxiways must allow for aircraft to remain clear of the runway obstacle free zone (OFZ). Taxiway pavement strength should be commensurate with the associated runway strength.

4.4 TAXILANE SYSTEM

Taxilanes provide aircraft maneuvering between the public-use taxiway system and hangar/ramp areas. Taxilanes should be constructed commensurate with the type of aircraft requiring access, with hangar taxilanes constructed with sufficient width to accommodate the aircraft wheelbase, turning radius, and allow unencumbered wingtip clearance between fixed objects (hangars, fence, fueling facilities, light poles, etc.).

It is recommended that future taxilane construction for single and twin-piston aircraft follow ARC Group I design and separation standards. ARC Group II standards should apply to taxilanes serving turboprop and business jets. The taxilane strength should be commensurate with the associated runway/taxiway system, and not less than 12,500 pounds.

4.5 PAVEMENT STRENGTH

The existing Runway 5-23 pavement strength is published at 48,000 pounds, which by design, supports most small to medium-cabin business jets. In 2004-2005, nearly 30% of business jet operations were conducted by Category C and D aircraft.

A typical medium-cabin business jet has a 1,200-gallon fuel capacity, which equates to 8,400 pounds of fuel. With a standard 4 to 8 passenger seating configuration, nearly 85% of the aircraft's payload is dedicated to fuel. Since passenger payloads are considered fixed, fuel loading is the largest variable of aircraft performance as related to runway length and strength.

The following lists the weights of common ARC Category B, C and D turboprop and business jets using the Dare County Regional Airport. These aircraft typically range from 12,000 to 50,000 pounds, with most aircraft over 20,000 pounds having a dual-wheel gear (DWG) configuration.

Note: The gear type and configuration dictate how the aircraft weight is distributed to the pavement and determines the pavement response to aircraft loadings. (swg): single-wheel gear aircraft – each landing gear is supported by a single tire. (dwg): dual-wheel gear aircraft – each landing gear consists of a single axle with two tires per axle that equally share the weight of the aircraft and provide for greater weight distribution.

Aircraft	Cabin Size	ARC	Gear Type	Take-off Weight
Turboprop Aircraft				
Piper Cheyenne	Twin Turboprop	B-II	SWG	11,900 lbs.
Beech King Air	Twin Turboprop	B-II	DWG	12,500 lbs.
Business Jet Aircraft				
Cessna Citations ❶	Small to Large	B-II/C-II	DWG	16,000–32,000 lbs.
Learjet Series	Small to Medium	C-I/D-I	SWG	13,000–21,500 lbs.
Sabreliner Series	Small to Medium	B-II	SWG	16,000-20,100 lbs.
Westwind Series	Small to Medium	C-I/C-II	DWG	21,000-24,000 lbs.
Jetstar Series	Small to Medium	C-II	DWG	40,000–43,500 lbs.
Hawker Series ❷	Medium to Large	C-II	DWG	23,000–28,000 lbs.
Challenger Series	Large	C-II	DWG	43,000–46,200 lbs.
Falcon Series	Large	C-II	DWG	26,000–48,300 lbs.
Gulfstream Series	Ultra Large	C-II,D-III	DWG	50,000–90,000 lbs.

❶ Existing Demand Aircraft ❷ Ultimate Demand Aircraft

Single Gear Type (SWG)
Dual Gear Type (DWG)

Source: FAA Advisory Circular 150/5300-13, Change #8 Airport Design

Table 4-1 identifies recommended runway and taxiway pavement strengths for each major Airport pavement component.

MQI Recommended Pavement Strength

Runway 5-23 (Primary Runway): For planning purposes, the maximum takeoff weight (MTOW) is used to recommend future pavement strength. For the Dare County Regional Airport, a 60,000 pound pavement strength will sufficiently provide weight bearing loads throughout the 20-year development period. This strength should coincide with a runway extension of 5,000' to 5,500'.

Runway 17-35 (Crosswind Runway): The existing Runway 17-35 pavement strength is published at 20,000 pounds. This strength is sufficient to accommodate small Category A and B aircraft, including the larger 6 to 10 passenger twin-turboprops.

Table 4-1: Recommended Pavement Strength

Pavement Area	Ultimate ARC Design Category	Existing Pavement Strength (lbs.)	Ultimate Pavement Strength (lbs.)
Runway 5-23	ARC C-II	48,000 lbs. (DWG)	48,000 (DWG) to 60,000 lbs. (DWG)
Parallel and Exit Taxiway System	ARC C-II	48,000 lbs. (DWG)	48,000 (DWG) to 60,000 lbs. (DWG)
Runway 17-35	ARC B-II	12,500 lbs. (SWG)	12,500 lbs. (SWG)
Runway End Taxiways (to Rwy 17-35)	ARC B-II	8,000 lbs. (SWG)	12,500 lbs. (SWG)
Main Westside Apron (Transient)	ARC B-II to ARC C-II	12,500 (SWG) to 48,000 lbs. (DWG)	12,500 (SWG) to 60,000 lbs. (DWG)
Based Tie-Down Parking Area	ARC A-I to B-II	12,500 (SWG) to 48,000 lbs. (DWG)	20,000 lbs. (SWG)
Eastside Taxilane (Hangar) System	ARC A-I to B-II	20,000 (SWG) to 48,000 lbs. (DWG)	20,000 (SWG) to 48,000 lbs. (DWG)

(SWG): single-wheel gear aircraft – each landing gear is supported by a single tire.
(DWG): dual-wheel gear aircraft – each landing gear consists of a single axle with two tires per axle

Note: Current apron strength estimated based on runway and taxiway pavement design.

Source: FAA Advisory Circular 150/5300-13, Change #8, *Airport Design*

4.6 SUMMARY OF AIRFIELD FACILITY NEEDS

Table 4-2 provides a summary of runway facility requirements to accommodate the level of activity projected for the Dare County Regional Airport for each of the three planning phases spanning the 20-year development plan. A runway length of 5,500' should be the long-term goal for meeting business jet demands at the Dare County Regional Airport.

Table 4-2: Summary of Airside Facility Requirements

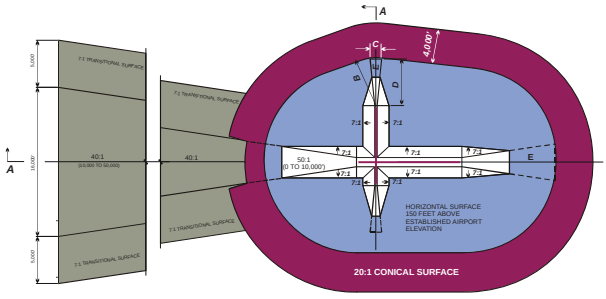
Airport Component	Phase 1 (0-5 Years) Short-Term Year 2010	Phase 2 (6-10 Years) Mid-Term Year 2015	Phase 3 (11-20 Years) Long-Term Year 2025
RUNWAY 5-23 Dimension Strength Approach Runway Lighting Taxiway System	5,000' x 75'/100' 48,000 lbs. ¾-Mile (Precision) or 1-mile (GPS-LPV) MIRL PAPI-2 - 5 & 23 REIL - 5 & 23 Distance-to-Go Airport Signage Full-Parallel MITL	5,000' x 75'/100' 48,000 lbs. ¾-Mile (Precision) or 1-mile (GPS-LPV) MIRL PAPI-2 - 5 & 23 REIL - 5 & 23 Distance-to-Go Airport Signage Full-Parallel MITL	5,500' x 100' 60,000 lbs. ¾-Mile (GPS-WAAS) MIRL/HIRL PAPI-2 - 5 & 23 REIL - 5 & 23 23 Distance-to-Go Airport Signage Full-Parallel MITL
RUNWAY 17-35 Dimension Strength Approach Runway Lighting Taxiway System	3,303' x 75' (displaced) 20,000 lbs. 1-Mile (NPI) PAPI-2 - 17 & 35 REIL - 17 & 35 Partial-Parallel MITL	3,300' x 75' (restricted) 20,000 lbs. 1-Mile (NPI) PAPI-2 - 17 & 35 REIL - 17 & 35 Partial-Parallel MITL	3,700' x 75' (unrestricted) 20,000 lbs. 1-Mile (NPI) PAPI-2 - 17 & 35 REIL - 17 & 35 Full-Parallel MITL
Navigational, Communication & Weather Aids	Rotating Beacon Windsock Segmented Circle GPS-RNAV, NDB, TVOR AWOS / GCO	Rotating Beacon Windsock Segmented Circle GPS-RNAV, ILS, TVOR AWOS / GCO	Rotating Beacon Windsock Segmented Circle GPS-WAAS, ILS, TVOR AWOS / GCO
See Appendix for list of acronyms and definitions.			

Source: TBI - Airport Facility Requirement Summary.
Source: FAA Advisory Circular 150/5300-13, Change #8, Airport Design.
Source: NCDOT, Airport Development Plan (red group) planning criteria.

4.7 AIRPORT GEOMETRIC DESIGN STANDARDS

Compliance with airport design standards is required to maintain a minimum level of operational safety. The major airport design elements, as follows, are established by FAA Advisory Circular 150/5300-13, Change #8, Airport Design and FAR Part 77, Objects Affecting Navigable Airspace, and should conform to FAA and NCDOT airport design criteria without modification of standards.

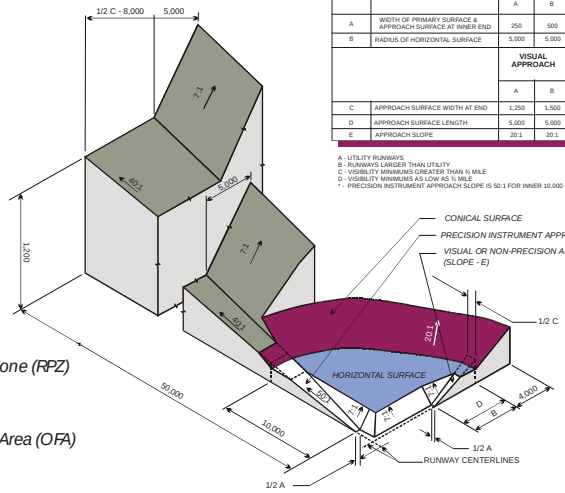
The following illustrates the relative geometric safety areas for the RSA, OFA, RPZ and BRL, as depicted on the Airport Layout Plan drawings. Also illustrated is the isometric views of the FAR Part 77 imaginary airspace surfaces, including the primary, approach, transitional, horizontal and conical surfaces:

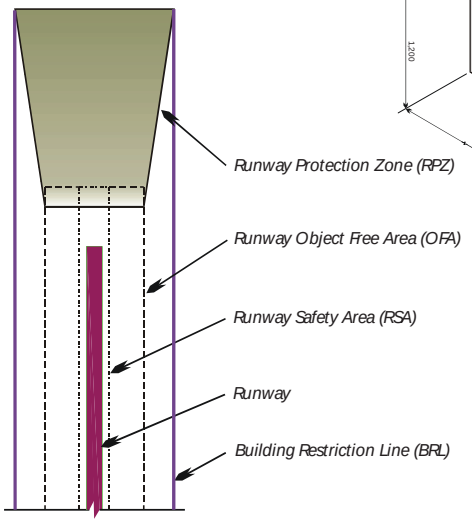


AIRSPACE SURFACES

DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		A	B	A	B		
					C	D	
A	WIDTH OF PRIMARY SURFACE & APPROACH SURFACE AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT RUNWAY
		A	B	A	B		
					C	D	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A - UTILITY RUNWAYS
B - RUNWAYS LARGER THAN UTILITY
C - VISIBILITY MINIMUMS GREATER THAN ¾ MILE
D - VISIBILITY MINIMUMS AS LOW AS ¾ MILE
* - PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET





RUNWAY SAFETY AREAS

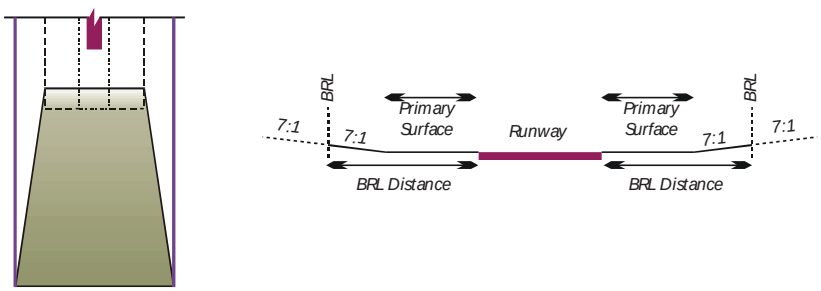


Table 4-3A shows a comparison of FAA geometric airport design criteria between ARC B-II and ARC C-II standards for the primary runway – assuming the establishment of a precision instrument procedure.

Table 4-3A: Airport Geometric Design – Primary Runway (ARC B-II and ARC C-II Standards)

Runway Design Factors Runway 5-23	- FAA ARC B-II - Precision Not Lower Than ¾-Mile ❶	- FAA ARC C-II - Precision Not Lower Than ¾-Mile ❶
Runway Width	75'	100'
Runway to Taxiway CL Distance Runway to Parking Distance Runway to Holdline	240' (300' Existing) 250' (350' Existing) 250'	400' 500' 250'
Runway Safety Area (RSA): RSA width / Length beyond	RSA: 150' / 300'	RSA: 500' (400' CI/CII) RSA: 1,000' (D) / 600' (A)
Object Free Area (OFA): OFA width / Length beyond	OFA: 500' / 300'	OFA: 800' / 1,000'
Obstacle Free Zone (OFZ) / (POFZ): OFZ width / Length Beyond POFZ width / Length beyond	OFZ: 400' / 200' POFZ: 800' / 200'	Apply FAA Design Standards
FAR Part 77 Primary Surface: Width / Length beyond	1,000' / 200'	1,000' / 200'
Building Restriction Line (BRL)	750' from centerline ❸	750' from centerline
Runway Protection Zone (RPZ): Inner width Length Outer width RPZ Size (Acres)	Rwy 5 / Rwy 23 1,000' / 500' 1,700' / 1,700' 1,510' / 1,010' 48 acres / 29 acres	Rwy 5 / Rwy 23 1,000' / 500' 1,700' / 1,700' 1,510' / 1,010' 48 acres / 29 acres
Approach Surface (FAR Part 77): Inner width Length Outer width Approach Slope	Rwy 5 / Rwy 23 ¾-mile / 1-mile 1,000' / 1,000' 50,000' / 10,000' 16,000' / 4,000' 50:1 / 34:1	Rwy 5 / Rwy 23 ¾-mile / 1-mile 1,000' / 1,000' 50,000' / 10,000' 16,000' / 4,000' 50:1 / 34:1
Approach Lighting System (ALS)	MALSR – N/A ❷	MALSR – N/A ❷
See Appendix for list of acronyms and definitions.		
❶ Assumes establishment of precision instrument approach procedure to Runway 5 End. ❷ Installation of MALSR or other Approach Lighting System not required or anticipated. ❸ BRL is a line of suitability, not a safety area.		

Source: Talbert & Bright, Inc. - Airport Facility Requirement Summary.
Source: FAA Advisory Circular 150/5300-13, Change #8, Airport Design.

Table 4-3B shows the FAA geometric airport design criteria for ARC B-II standards for the crosswind runway – assuming non-precision instrument approach procedures not less than 1-mile.

Table 4-3B: Airport Geometric Design (ARC B-II Non-Precision)

Crosswind Runway Design Factor	- FAA ARC B-II - Non-Precision Not Lower Than 1-Mile
Runway Width	75'
Runway to Taxiway CL Distance Runway to Parking Distance Runway to Holdline	240' 250' (1,250' Existing) 200' to 250' (Beyond OFZ)
Runway Safety Area (RSA): RSA width / Length Beyond	150' / 300'
Object Free Area (OFA): OFA width / Length Beyond	OFA: 500' / 300'
Obstacle Free Zone (OFZ) / (POFZ): OFZ width / Length Beyond	OFZ: 400' / 200'
FAR Part 77 Primary Surface: Width / Length Beyond	500' / 200'
Building Restriction Line (BRL)	495' from centerline ❶
Runway Protection Zone (RPZ): Inner width Length Outer width RPZ Size (Acres)	Rwy 17 / Rwy 35 500' / 500' 1'000' / 1,000' 700' / 700' 13.77 acres / 13.77 acres
Approach Surface (FAR Part 77): - Approach Minimums - Inner Width Length Outer Width Approach Slope	Rwy 17 / Rwy 35 1-mile / 1-mile 500' / 500' 5,000' / 5,000' 2,000' / 2,000' 20:1 / 20:1
Approach Lighting System (ALS)	N/A
See Appendix for list of acronyms and definitions.	
❶ Based on typical 35' building clearance height	

Source: Talbert & Bright, Inc., 2005.
Source: FAA Advisory Circular 150/5300-13, Change #8, Airport Design.

The attainment of certain ARC C-II design standards for accommodating the future, or ultimate medium to large-cabin business jet has significant implications; in terms of safety area dimensions/separations, setback distances, grading requirements and airspace criteria. Therefore, meeting these standards involves differences in land acquisition and development costs.

Table 4-4 lists grading and line-of-sight standards for ARC Category C and D design standards.

Table 4-4: Profile & Grading (ARC C-II Airport Design)

Surface	Longitudinal Grade	Maximum Allowable Grade Change	Vertical Curves for Longitudinal Change	Transverse Grade Limitations	Shoulder Grade Limitations
Runway	± 1.5% (not exceed ± 0.8 in first and last quarter of runway)	± 1.5%	1,000' per 1% of change	1%-1.5%	1.5%-3% (4:1 Slope)
Associated Taxiway	1.5%	3.0%	100' per 1% of change	1% to 1.5%	3% to 5% within 10'; 1.5% to 3% until edge of TOFA
Apron	N/A	1% in any direction	N/A	N/A	N/A
Safety Area	No penetration of approach surface permitted	2% per 100'	0% to 3% for first 200' beyond runway	5% ❶	N/A
Line of Sight	With a full-length parallel taxiway system, the runway profile may be such that an unobstructed line-of-sight exists from any point 5' above the runway centerline to any other point 5' above the runway centerline for one-half the runway length.				

❶ Runway and taxiway surface gradient requirements apply to the design of airport surfaces required for the landing, takeoff and ground roll movements of airplanes. Transverse slopes should be adequate to prevent the accumulation of water on the pavement surface. It is desirable to maintain a 5% slope for the first 10' of unpaved surface immediately adjacent to the paved surface, after which, the recommended maximum slope is 4:1. Runways, taxiways and apron areas should conform to local drainage and fire code requirements. At any point on a taxiway centerline, the allowable difference in elevation between the taxiway and a perpendicular point on the runway, taxiway or apron edge is 1.5% of the shortest distance between the points. Slope and line-of-sight requirements are in accordance with ARC Category B aircraft.

Source: FAA Advisory Circular 150/5300-13, Change #8 (Chapter #5), *Airport Design*

Table 4-5 lists grading and line-of-sight standards for ARC Category B design standards.

Table 4-5: Profile & Grading (ARC B-II Airport Design)

Surface	Longitudinal Grade	Maximum Allowable Grade Change	Vertical Curves for Longitudinal Change	Transverse Grade Limitations	Shoulder Grade Limitations
Runway	>/= 2%	2%	300' per 1% of change	1%-2%	1.5%-5%
Associated Taxiway	>/= 2%	3%	100' per 1% of change	1% to 2%	3% to 5% within 10'; 1.5% to 5% until edge of TOFA
Apron	N/A	2% in any direction	N/A	N/A	N/A
Safety Area	No penetration of approach surface permitted	2% per 100'	0% to 3% for first 200' beyond runway	5% ❶	N/A
Line of Sight	With a full-length parallel taxiway system, the runway profile may be such that an unobstructed line-of-sight exists from any point 5' above the runway centerline to any other point 5' above the runway centerline for one-half the runway length.				

❶ Runway and taxiway surface gradient requirements apply to the design of airport surfaces required for the landing, takeoff and ground roll movements of airplanes. Transverse slopes should be adequate to prevent the accumulation of water on the pavement surface. It is desirable to maintain a 5% slope for the first 10' of unpaved surface immediately adjacent to the paved surface, after which, the recommended maximum slope is 4:1. Runways, taxiways and apron areas should conform to local drainage and fire code requirements. At any point on a taxiway centerline, the allowable difference in elevation between the taxiway and a perpendicular point on the runway, taxiway or apron edge is 1.5% of the shortest distance between the points. Slope and line-of-sight requirements are in accordance with ARC Category B aircraft.

Source: FAA Advisory Circular 150/5300-13, Change #8 (Chapter #5), *Airport Design*

4.8 AIRPORT NAVIGATIONAL AIDS

Existing MQI NAVAIDS:

The following is the anticipated status of existing ground-based navigational aids serving the Dare County Regional Airport:

Very High Frequency Omnidirectional Range (TVOR): The Dare County Terminal VOR is not anticipated to be phased-out during the next 10 to 15 years.

Non-Directional Beacon (NDB): The NDB is a navigational aid being phased-out by the FAA due to the recent development of new and more precise GPS-based systems. Parts and equipment for some NDB models have become expensive (cost prohibitive), and may not be FAA eligible (AIP or F&E) in the near future.

Recommended MQI NAVAIDS:

As a business-class airport, a precision instrument approach is recommended for at least one runway end. At present, the Instrument Landing System (ILS) and Precision Radar Approach (PAR) are the only available types of precision approach. The following are recommended navigational systems for the Dare County Regional Airport, as allowable by design or as approved by the FAA in the future:

Instrument Landing System (ILS): The ILS provides precision instrument approach capabilities to a runway end using horizontal and vertical electronic guidance. The ILS components consist of the glideslope antenna (vertical descent), localizer antenna (lateral guidance), and marker beacons, with supporting components including distance measuring equipment (DME), approach lighting system (ALS), runway edge lights (MIRL/HIRL), and runway visual range (RVR) measurement. The application of supporting components is determined by FAA benefit-cost analysis. The ILS components and general locations are:

Localizer Antenna/Shelter: Located on the extended runway centerline, at a minimum distance of 600' (end of RSA) and an optimal distance of 1,000' from the stop end of the runway. The localizer equipment shelter is placed at least 250' to either side of the antenna array and within 30º of the extended longitudinal axis of the antenna array. See *FAA Order 6750.16C* for safety areas based on specific ILS equipment components.

Note: The localizer, alone, is a non-precision instrument approach procedure.

Glideslope Antenna/Shelter: Located on the side of the runway with the least signal interference (south side) not less than 250' lateral to the runway centerline, beyond the obstacle free zone (OFZ). The glideslope antenna ranges from 25' to 50' tall. The glideslope equipment shelter is placed at least 10' behind the antenna. See *FAA Order 6750.16C* for safety areas based on specific ILS equipment components.

Outer Marker / DME / Compass Locator: For Category I ILS, an Outer Marker Beacon (OM) or alternate final approach fix (DME) is required. The DME may be used in lieu of the Outer Marker Beacon, and is co-located at the localizer. A Locator Outer Marker (LOM) may be installed as an auxiliary aid to an ILS (existing NDB could be used as a missed approach fix to the ILS procedure, or support a future GPS precision approach).

Future GPS/RNAV/WAAS instrument approach possibilities include:

GPS Precision Instrument Approach: The existing GPS-based non-precision instrument procedures can potentially be upgraded to a GPS-based precision approach procedure in the future. The following is the current status of GPS (RNAV) instrument approach capabilities, in which WAAS rather than LAAS is applicable to the Dare County Regional Airport for future planning purposes:

GPS Wide Area Augmentation System (WAAS): Augments GPS data to enhance the accuracy and reliability during all phases of flight (enroute, terminal and instrument approaches), from 20 to about 1.5 meters in both the horizontal and vertical dimensions. WAAS became operational in July 2003, providing enroute navigation and vertical guidance performance (LPV) capabilities throughout the lower 48 state's national airspace system. The addition of ground reference stations in 2004-2008 will enable lower decision heights approaching Category I precision minimums (LPV), and with the availability of a second GPS civil frequency in the 2012-2015 timeframe will enable WAAS to support Category I precision approaches over the majority of the country.

GPS Local Area Augmentation System (LAAS): LAAS is currently under development and not available as a navigational system. LAAS will augment the GPS to yield extremely high accuracy for future straight and curved Category I, II and III precision approaches, and surface navigation capability to approximately 1-meter using a land-based unit providing service within a 20 to 30 mile radius. LAAS is pending approval of specifications, ground and avionic type acceptance, site criteria and operational performance standards.

The following are the existing GPS (RNAV) instrument approach procedures, assuming the aircraft avionic equipment and pilot are appropriately certified:

LNAV/VNAV: a 'precision-type' instrument approach with less signal integrity than provided by WAAS, providing a height above touchdown (HAT) down to 250'.

LNAV: a 'non-precision type' instrument approach, providing lateral navigation without positive vertical guidance, with a minimum descent altitude (MDA) between 250' and 400'.

LPV: a new, interim WAAS precision instrument approach methodology using vertical alarm limits that supports vertical guidance with visibility minimums of ¾ mile and a decision height as low as 250'.

IPV: Satellite or flight management system (FMS) LNAV navigation with computed positive vertical guidance based on barometric or satellite elevation.

If or when established, it is expected that precision Category I ILS/GPS-WAAS instrument procedures will provide minimums down to ¾-mile visibility, and a height above touchdown (HAT) between 200' and 300' for Category A, B, C and D aircraft (*FAA Order 860.3B, US Terminal Instrument Procedures - TERPS)*. Although not now FAA-approved, it is possible that GPS-WAAS-RNP technology might be able to provide a 'curved' precision approach procedure sometime later in the 20-year Airport Master Plan period.

MQI Precision Approach Feasibility:

As part of the AMP Update, the possibility of establishing a 'precision' instrument procedure to an existing or potential runway ends was assessed; in particular the Runway 5 end[1]. The precision procedure, per FAA Order 8260.3B (Change #19), involves 4 segments that extend about 22 nautical miles from the runway end, as depicted in Figure 4-1 and discussed below:

Initial Approach Segment: The instrument approach commences at the Initial Approach Fix (a point established by navigational facilities). The Initial Approach segment extends not less than 6 nautical miles and serves as the transition from the enroute phase. The segment is broken into two obstacle clearance surfaces, the primary surface and the secondary surface. The primary OCS requires 1,000' of clearance and the secondary surface requires 500' at the inner edge, tapering to 0' at the outer edge.

Intermediate Approach Segment: This segment transitions from the intermediate to final approach segment, in which aircraft configuration, speed and positioning adjustments are made for entry to the final approach segment. The Intermediate Segment consists of two obstacle clearance surfaces; the primary and the secondary surface. Within the primary obstacle surface closest to the extended runway centerline a 500' clearance above obstacles is required. In the secondary obstacle surface, the required 500' clearance gradually tapers to 0' at the outer boundary.

[1] It should be noted unique factors exist for each airport in developing an instrument procedure, particularly precision approaches - there is no single template that applies to all airports. However, options for overcoming unique factors include; lengthening or shortening approach segments, using radar to establish fixes, offsetting the approach course, marking/lighting obstruction, and using variable descent gradients.

Final Approach Segment: This segment descends and transitions the aircraft to the runway threshold. The obstacle clearance surface begins 200' from the runway threshold and extends 50,000'. The width of the narrowest point is 2,000' and widens uniformly to 17,152' at the widest point. Within this final approach segment three sub-surfaces for the Obstacle Clearance Surface (OCS) exist: "W" OCS, "X" OCS, and "Y" OCS.

Missed Approach Segment: Used to transition the aircraft to a holding point, or fix, in order to re-establish the approach. The Missed Segment involves a 40:1 departure (obstacle clearance) surface.

Figure 4-1 shows the TERPS Obstacle Clearance Surfaces (OCS). Figure 4-2 shows the TERPS Initial, Intermediate and Final Approach Segments.

EXHIBIT 4-1
US TERMINAL AREA PROCEDURES
OBSTACLE CLEARANCE AREAS (X, W & Y SURFACES)
PROPOSED PRECISION INSTRUMENT APPROACH END

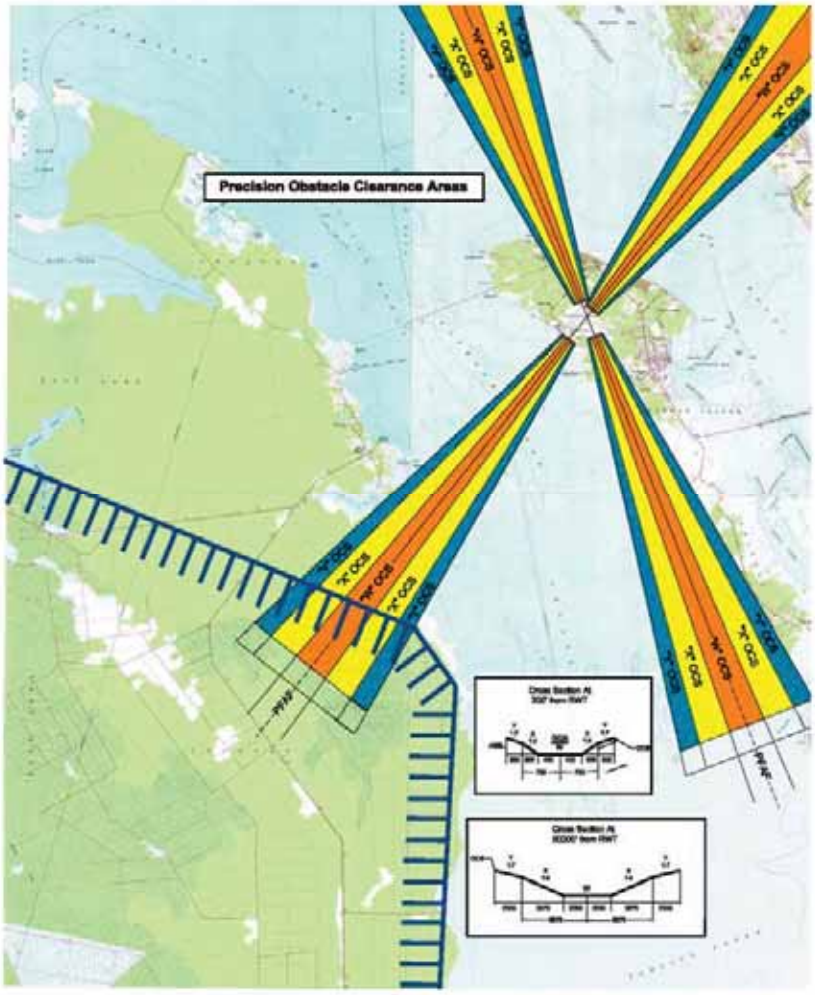
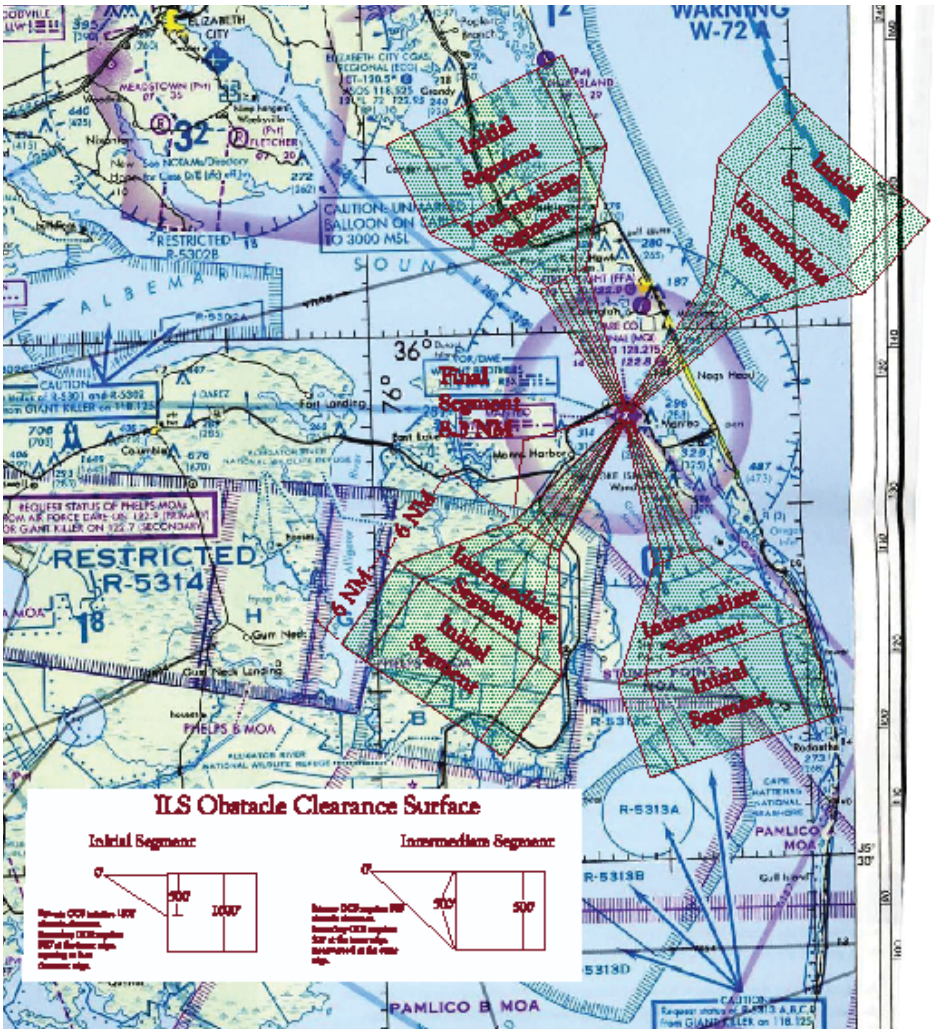


EXHIBIT 4-2
US TERMINAL AREA PROCEDURES
OBSTACLE CLEARANCE AREAS
(INTERMEDIATE & FINAL APPROACH SURFACES)
PROPOSED PRECISION INSTRUMENT APPROACH – RUNWAY 5 END



Finding on MQI Precision Approach Capability:

The following is a summary of precision capabilities per runway end:

Runway 5 End: The TERPS Obstacle Clearance Surfaces (OCS) penetrates R-5314 A, B, C, D, E, F, and G (approach not permitted while SUA active). Letter of agreement between Air Force Dare, Washington ARTCC and Dare County Airport necessary to ensure prompt turnover of the Restricted Area airspace to Washington ARTCC during periods of DOD inactivity / However, no close-in

published obstructions impacting minimums.

Runway 23 End: TERPS Obstacle Clearance Surfaces (OCS) penetrates Warning Area W-72 near the beginning of the final approach fix, requiring an agreement with the Range Control agency for W-72 (Giant Killer based at NAS Oceana). Heavy wooded area along 50' – 60' sand dunes west-northwest on Roanoke Island encroaches TERPS Obstacle Clearance Surfaces (OCS). Substantial tree clearing required, or else higher approach minimums would be expected.

Runway 17 End: No penetrations to TERPS Obstacle Clearance Surfaces (OCS), or approach segments. Instrument winds predominately favor an approach 'to' the north -- directly opposite of Rwy 17 procedure. Tall communications tower in Currituck County peninsula in-line with final approach segment. Runway length is less than the 4,200' minimum length for a precision approach, and also requires a full full-parallel taxiway. Moderate tree clearing (easements) required within approach surface(s).

Runway 35 End: TERPS Initial and Intermediate Segments penetrates R-5313 and multiple MOAs. While the Initial and Intermediate segments for the inbound course could be aligned to avoid R-5313, there would still likely be encroachments of the primary and/or secondary procedure turn area. (TERPS permits the intersection of the Initial and Intermediate Segments not to exceed 120°, and 30° for the intersection of the Intermediate and Final Segments). In addition, Pea Island National Wildlife Refuge is protected by a 2,000' altitude restriction which is calculated as an obstruction in TERPS criteria. Multiple towers at the southern end of Roanoke Island that could penetrate the final approach segment, and raise minimums. The existing 2,303' landing distance available (LDA) is below the minimum 3,200' required for straight-in approach, and minimums for a precision approach. Significant tree clearing (easements) required within the approach surface(s).

4.9 TERMINAL AREA FACILITIES & SPACE ALLOCATION

The terminal area includes facilities necessary for processing pilots/passengers and aircraft. The Airport's operational peaking characteristics are used to determine the allocation of space to meet aircraft parking and storage demands for based aircraft operators, itinerant users, on-airport commercial tenants and other Airport operational requirements. Both peak-day and extreme busy-day were considered in the terminal area recommendations.

TERMINAL AREA FACILITY NEEDS:

Overall, the terminal area is capable of expansion, but necessitates the acquisition of additional property. While there is some existing expansion area, these efforts are essential for providing immediate hangar demand space, and the reservation of areas to accommodate long-term user demands.

The following is a brief description of major terminal facility needs:

MQI Terminal Building: Expansion or relocation of the terminal building is not an imminent requirement. Terminal building expansion was recommended in the 1989 AMP, largely contingent upon the establishment of scheduled commercial air service. The location of the existing terminal building is capable of future expansion, as demand warrants.

MQI Hangars: The coastal climate is strong impetus for hangar storage. The Airport has experienced a variety of hangar development in recent years, ranging from nested T-hangar units to large 10,000 SF common hangars. The majority of future hangar space will be for 4 to 8-seat aircraft. T-hangars typically range from 8,000 to 12,000 SF and are usually not more than 18' tall. Common/executive hangars typically range from 6,400 to 10,000 SF and rarely exceed 35' tall. However, the trend towards larger, special-purpose common hangars can be expected, including hangars with crew and office space. Overall, new hangar construction is normally tied-to waiting-list and favorable payment schedules.

MQI Apron: The apron reaches nearly at 100% capacity during peak season days. At present, there are no designated or segregated aircraft tie-down parking areas for larger versus small itinerant airplanes -- as airplanes are parked at pilot discretion or directed by FBO based on space availability. The removal/demolition of the nested T-hangar units on Apron 'A' from Hurricane Isabel allowed ±45,000 square feet of added parking areas. Future apron expansion is recommended, to accommodate additional parking spaces and maneuvering areas during the growing peak-season activity; including a plan for separating small aircraft from the larger business-class turboprops and small-cabin business jets. Ideally, future apron expansion should be contiguous to the existing apron, and within the core terminal building area.

MQI Aircraft Fueling: Both truck dispensing and a self-fuel service is available. The truck fuel facility is located south of the terminal building, with fuel trucks parked east of the terminal building. The self-fuel facility is located north of the terminal building, and mainly serves based users. Modification to the self-service fuel dispensing location may be required based on future terminal expansion.

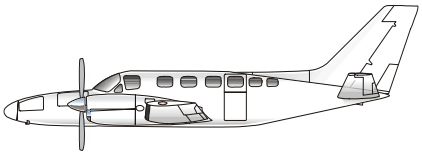
MQI Public Auto Parking: Auto parking lot contains approximately 128 spaces within 45,000 S.F. The auto parking lot is sufficient to accommodate peak-day parking needs.

The following provides information on common aircraft parking dimensions:

Small Aircraft Parking

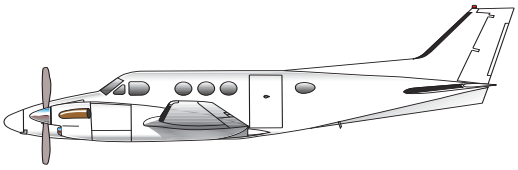
Single Engine - Small Aircraft
Cessna 210 Centurion
38' Wingspan / 32' Length
(±1,200 SF Footprint)

Light Twin - Small Aircraft
Cessna 401 Businessliner
42' Wingspan / 36' Length
(±1,500 SF Footprint)

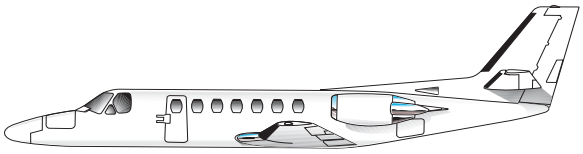


Turbine Aircraft Parking

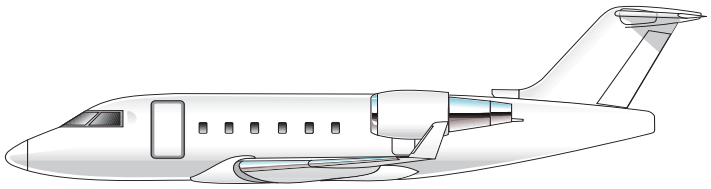
Twin-Turboprop
Beechcraft King Air Model
50' Wingspan / 40' Length
(±2,000 SF Footprint)



Small-Cabin Jets
Cessna Citation 550 Series
54' Wingspan / 56' Length
(±3,000 SF Footprint)



Medium/Large-Cabin Jets
Challenger 600 Series
65' Wingspan / 70' Length
(±4,500 SF Footprint)



TERMINAL AREA FACILITY STANDARDS / NEEDS

Table 4-6 summarizes applicable NCDOA Airport Development Plan (NCADP) terminal area standards for 'red group' facilities.

Table 4-6: NCADP Airport Development Plan – Terminal Area (Red group)

Component / NCADP #	NCADP Standards	Airport Meets Criteria
Aircraft Apron Requirements (#12)	Minimum: A paved aircraft parking area capable of parking twenty-five based aircraft and five itinerant aircraft. Of these thirty aircraft, allotment for three multi-engine aircraft is required. Tie-downs should be provided for all parking spaces. Spacing between aircraft and for taxilanes should meet FAA guidelines. Pavement strength for the itinerant parking area should match the pavement strength of the runway. Expansion: Document the existing ramp is at least 75% occupied with airworthy aircraft and/or there is a documented change in the size and/or type of transient aircraft that justifies an expansion (transient areas needs room for 3 large corporate jets that use the field 8 times a month). Any deviations will be based on a case-by-case basis.	Yes
Terminal Building (#13)	Minimum: Must include designated FBO/Operational area, flight planning room, public meeting room, and public restrooms. Recommended: Up to 2,500 square feet. NCDOA participation based on current square footage rate for commercial building and participation percentage reevaluated annually. This includes all utility tie-ins. Additional space at Sponsor cost.	Yes
Taxiway & Apron Edge Lighting (#14)	Minimum: Reflective markings or markers Minimum: Medium intensity taxiway lights (MITL)	No
Aircraft Rescue & Fire Fighting Equipment (#18)	Minimum: At least 1 fully-charged fire extinguisher available and easily accessible 24 hours a day for use around the main apron area. Fire extinguishers at Sponsor cost.	Yes
Airfield Equipment & Storage Building (#19)	Minimum: Airfield maintenance equipment (approved tractor and attachments) and an approved building to store equipment. Request considered every ten years.	No
Source: NCDOA, Airport Development Plan (NCADP)		

Table 4-7 summarizes terminal area facilities for accommodating demand projected for the Dare County Regional Airport spanning the 20-year planning period.

Table 4-7: Summary – Public Landside/Terminal Facility Requirements

Facility (Existing – 2004/05)	Phase 1: Year 2010 (0-5-Years)	Phase 2: Year 2015 (6-10-Years)	Phase 3: Year 2025 (11-20-Years)
Based Aircraft (62) Operations (46,000) Passengers (42,000)	74 Aircraft 50,000 Ops. ±60,000	85 Aircraft 54,000 Ops. ±70,000	109 Aircraft 64,000 Ops. ±80,000
Core Terminal Building Space (5,700 SF)	Total Building 5,000 to 6,200 SF	Total Building 5,600 to 6,800 SF	Total Building 6,400 to 7,800 SF
Apron (441,000 SF) Parking Demand (60 Tie-Downs/ Parking Spaces)	+0 SF (Ph. 1) 441,000 SF – Total 70 Parking Spaces (8 to 12 Based) (50 Small) (6 Medium) (4 Large) (1 Helicopter)	+56,000 SF (Ph. 2) 497,000 SF - Total 80 Parking Spaces (8 to 10 Based) (55 Small) (7 Medium) (5 Large) (1-2 Helicopter)	+108,000 SF (Ph. 3) 605,000 SF – Total 95 Parking Spaces (10 to 12 Based) (65 Small) (10 Medium) (8 Large) (1-3 Helicopter)
Hangar Space (73,000 SF) Hangared Aircraft (41 Aircraft)	+37,000 SF (Ph. 1) 110,000 SF – Total 68 Hangared Aircraft (90%)	+30,000 SF (Ph. 2) 140,000 SF - Total 78 Hangared Aircraft (90%)	+40,000 SF (Ph. 3) 180,000 SF – Total 100 Hangared Aircraft (90%)
Jet-A Fuel Storage 100LL Fuel Storage (30,000 Gallons)	15,000 (Jet-A) 15,000 (100LL) 30,000 Gallons	20,000 (Jet-A) 15,000 (100LL) 35,000 Gallons	30,000 (Jet-A) 15,000 (100LL) 45,000 Gallons
Public Auto Area (45,000 SF) Auto Spaces (128)	- Same - 45,000 SF 128 Spaces	- Same - 45,000 SF 128 Spaces	- Same - 45,000 SF 128 Spaces
Note: + denotes additional facilities per applicable planning period. Note: A portion of existing apron near removed nested hangars might be used for a proposed on-airport restaurant.			

Source: Talbert & Bright, Inc. Terminal Facility Requirement Summary.

It should be noted that extenuating demand could accelerate the need for additional terminal facilities to meet unforeseen circumstances, particularly in respect to future runway expansion, precision instrument approach capability, passenger airline service or more active based charter service.

END OF SECTION #4