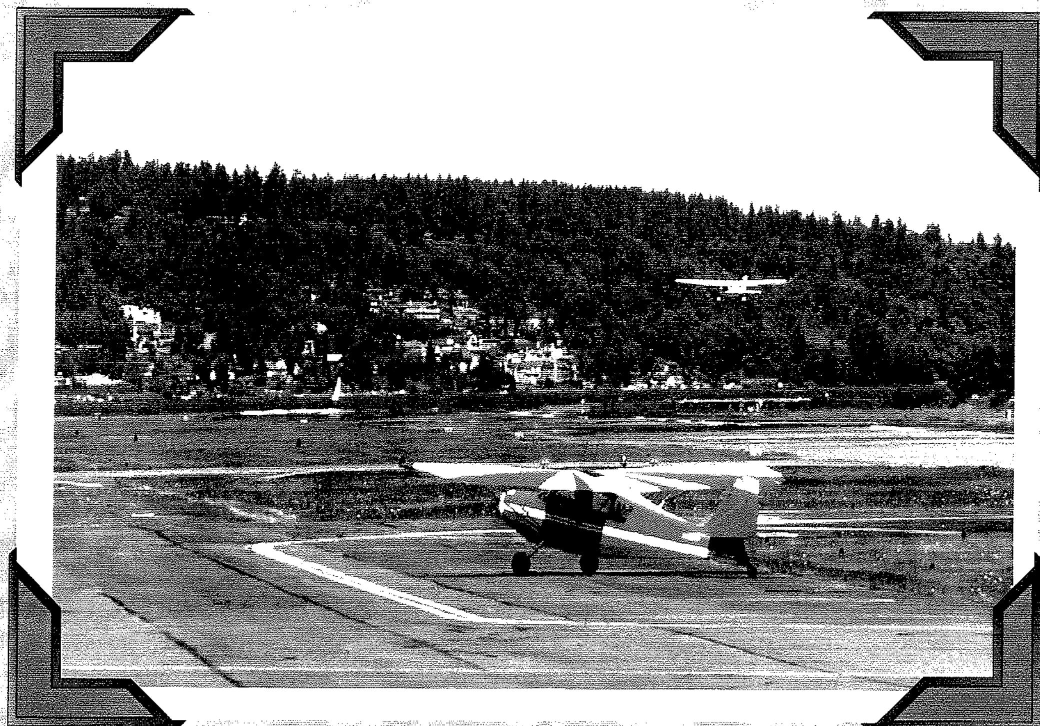

Chapter Four:

Airport Facility Requirements

CHAPTER FOUR: AIRPORT FACILITY REQUIREMENTS

This chapter identifies the airfield, terminal area, general aviation, and access system improvements that are necessary to accommodate the forecast levels of demand at Renton Municipal Airport. In general, these requirements were determined by comparing forecast demand levels to the existing capacity of the facilities as specified. Problem areas were noted, and the facilities necessary to correct these deficiencies were identified.

Facility requirements are presented here in two distinct forms. The summary exhibits generally present requirements in an incremental-phased manner. The basic assumption here is that existing facilities will continue to be used throughout the planning period and that all of the requirements shown for Phase I will be completed prior to Phase II. Should any existing facility require replacement, relocation, or major rehabilitation, this need would be in addition to the requirements noted in these incremental tables.

For example, if the 1997 need for conventional hangars is 24,000 square feet (sf) and there now exists a 10,000 sf hangar, then a new 14,000 sf hangar should be constructed before 1997. Therefore, the facility requirements noted here would be 14,000 sf. If, however, the existing hangar deteriorates beyond economical repair, or is recommended for relocation, there may be a need for 24,000 sf of hangar construction by 1997. At this point the individual total requirement exhibits must be consulted to determine the total requirement for the individual planning.

Secondly, the requirements are developed assuming that no developmental constraints exist. If the requirements show that 90 acres of land will be needed to provide the facilities, then this amount of land is assumed to be available. If, in fact, only 50 acres are available, and no land acquisition is possible, then the requirements set forth herein must be revised. This does not mean that the facilities are no longer required, only that it is not possible to provide them. If this proves to be the case, the alternatives analysis, presented in the following chapter, will examine the implications of this situation.

A general summary of the required facilities, by planning phase, for Renton Municipal Airport is presented in Exhibit 4-1.

4.1 AIRFIELD REQUIREMENTS

Previous chapters described the major factors impacting the operation of the airport at Renton Municipal. Airfield facility requirements, in response to the relationship between the demands placed on the airfield and its capability to meet that demand, are presented in this section.

Before proceeding with the determination of facility requirements, it is appropriate to examine and define the role of the airport and determine the classification of the facility. As has been established in preceding chapters, the Renton Municipal Airport provides regional aviation services for air charter, air taxi, corporate, business and recreational flyers. It is also an FAA designated "Reliever" airport diverting general aviation aircraft traffic from Sea-Tac International Airport. The Boeing Company located on, and adjacent to, the airport manufactures Boeing 737 and 757 passenger jets and uses the airport to transport these aircraft to Boeing Field. Seaplane passenger operations also comprise a significant level of activity at the airport. Air taxi/commuter seaplane passenger service, with 10,000 enplanements, can be expected annually. Consequently, the airport should be classified as a short haul (less than 500 miles) commercial service facility for planning purposes.

EXHIBIT 4-1: FACILITY REQUIREMENTS SUMMARY

Item	Phase I 1996-2000	Phase II 2001-2005	Phase III 2006-2015
Airfield:			
Runways	Eliminate Modifications to Standards	___	___
Taxiways	Improve Taxiways	___	___
Instrumentation	GPS Nonprecision Approach	___	___
Terminal Area:			
Terminal Building		Construct Temp. Terminal Building	Construct Terminal Building
Access & Parking	Develop Terminal Area Parking	___	___
Terminal Support	Develop Centralized Fuel Facility; Customs Facility; Build Maintenance Shed	___	___
General Aviation:			
Hangars	Maintain T-hangars	___	Increase T-hangars
Support Facilities	Construct Washdown Area	___	___
Apron	Expand Itinerant Parking; Expand Hangar Apron	___	Expand Parking Apron
Seaplane Facilities:	Improve Ramp Area and Floating Dock	Improve Facilities	___

Designing the various functional elements of the airfield, however, requires the use of the FAA's Airport Reference Code (ARC). As explained in Chapter 1, the ARC is a coding system developed by the FAA to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport. The ARC has two components related to the airport design aircraft. The first component, depicted by a letter, is the aircraft approach category and relates to aircraft approach speed.

The approach categories are as follows:

- Category A: Speed less than 91 knots;
- Category B: Speed 91 knots or more, but less than 121 knots;
- Category C: Speed 121 knots or more, but less than 141 knots;
- Category D: Speed 141 knots or more, but less than 166 knots; and
- Category E: Speed 166 knots or more.

The second component, depicted by a Roman numeral, is the airplane design group and relates to airplane wingspan. This grouping links an airport's dimensional standards to aircraft wingspans. The design categories are as follows:

- Design Group I: Wingspan up to but not including 49 feet;
- Design Group II: Wingspan 49 feet up to but not including 79 feet;
- Design Group III: Wingspan 79 feet up to but not including 118 feet;
- Design Group IV: Wingspan 118 feet up to but not including 171 feet;
- Design Group V: Wingspan 171 feet up to but not including 197 feet; and
- Design Group VI: Wingspan 197 feet up to but not including 262 feet.

Generally, aircraft approach speed applies to runways and runway related facilities. Airplane wingspan primarily relates to separation criteria involving taxiways and taxilanes.

Airport design first requires selecting the ARC and then applying the airport design criteria associated with the airport reference code. Airports expected to accommodate single-engine airplanes normally fall into Airport Reference Code B-I. Airports serving larger general aviation and commuter-type planes are usually Airport Reference Code B-II or C-II. Small to medium-sized airports serving air carriers are usually Airport Reference Code C-III, while larger air carrier airports are usually Airport Reference Code D-VI.

In order to prevent over-design of facilities designated solely for small aircraft, or under-design of individual critical items such as apron taxilanes, specific aircraft characteristics may be applied in some instances.

Chapter 2 presented the details on the types of aircraft currently using the airport and expected to do so in the future. As described, aircraft operating at the airport range from small single-engine piston aircraft, both land and water dependent, to twin engine turbo-props, to large commercial Boeing passenger jets. Renton Municipal Airport is not unique in accommodating this range of aircraft types, but it is unique in the nature of how these aircraft operate and interact on the airfield.

Although Boeing is perhaps the most visible user of airport facilities, the predominate type of activity on the airfield is by small single engine piston airplanes under 12,500 pounds, and small twin engine piston and turbo-prop airplanes. The most demanding aircraft identified within this group is a Beechcraft Super King Air B200. The Super King Air B200 is a twin engine turboprop with an approach speed of 103 knots, a wingspan of 54.4 feet, and a maximum takeoff weight of 12,500 pounds. It is considered to be a ARC B-II aircraft. Current annual operations by twin engine turbo props is estimated to be approximately 560, expected to grow to 1,690 annual operations by the end of the planning period.

Accounting for less than one half of one percent of the total airfield operations are the Boeing commercial passenger jets. Although a significant user of airport facilities, Boeing jet operations are not a part of the routine traffic utilizing the airport. As explained in Chapters 1 and 2, the limited amount of Boeing 737 and 757 flight activity (less than 80 annual operations for the 757) involves predetermined departures only, scheduled for periods of low traffic. Additionally, the stage length and takeoff weights of the Boeing aircraft leaving the airport are not typical of these jets when they are in commercial service.

Based upon this information, it is reasonable to consider the Beechcraft Super King Air B200 as the appropriate critical design aircraft, making the FAA Airport Reference Code for Renton Municipal Airport B-II. An ARC of B-II includes aircraft with approach speeds of 91 knots or more but less than 121 knots and wingspans of 49 feet up to but not including 79 feet. Certain facilities critical to Boeing 737 (ARC C-III) and 757 (ARC-CIV) operations, such as runway width, pavement strength and taxiway clearances, should be designed appropriately.

4.1.1 Runways

The requirements for runways and taxiways may be described in a number of terms. In this study, the following descriptors are used:

- Runway Orientation;
- Runway Capacity;
- Runway Length;
- Geometric Design Standards;
- Runway Width;

- Pavement Strength; and
- Taxiway Configuration.

Each of these requirement categories are discussed below.

Runway Orientation

The orientation of runways for takeoff and landings is primarily a function of wind velocity and direction, together with the ability of aircraft to operate under adverse conditions. As a rule, the primary runway at an airport is oriented as closely as possible in the direction of the prevailing winds. The most desirable runway configuration will provide the largest wind coverage for a given maximum crosswind component. The crosswind component is the vector of wind velocity and direction that acts at a right angle to the runway. Further, runway coverage is that percentage of time in which operations can safely occur because of acceptable crosswind components. The desirable wind coverage criterion for a runway system has been set by the FAA at 95 percent.

As a part of the master plan process, a detailed analysis of the wind and weather data was prepared for the airport. The existing layout of the airfield at Renton Municipal Airport provides for a runway configuration that provides 96.4% coverage at 10.5 knots and 98.5% coverage at 13.0 knots during all weather conditions. Based on this, no new runways are required to increase wind coverage.

Runway Capacity

The preceding chapter examined the capacity of the airfield at Renton, compared it with the forecast demand, and determined that sufficient capacity exists to accommodate future activity levels. This indicates that no future improvements will be required to increase airfield capacity.

Runway Length

Runway length requirements are a function of the most demanding aircraft expected to regularly use the airport, the mean maximum temperature, and the elevation of the runway. An analysis of the active and future fleet mix composition results in a required runway length of 3,900 feet. This length is based upon two types of calculations: (1) Chapter 2 of FAA Advisory Circular 150/5325-4A, Runway Length Requirements for Airport Design, presented in Exhibit 2-2; and (2) individual runway length requirements for Boeing 737 and 757 aircraft, presented in Exhibit 2-3.

EXHIBIT 4-2: RUNWAY LENGTH CALCULATIONS

Airport and Runway Data

Airport elevation	29 feet
Mean daily maximum temperature of the hottest month	75.00 F.
Maximum difference in runway centerline elevation	7 feet
Length of haul for airplanes of more than 60,000 pounds	500 miles
Dry runways	

Runway Lengths Recommended for Airport Design

Small airplanes with approach speeds of less than 30 knots	300 feet
Small airplanes with approach speeds of less than 50 knots	800 feet
Small airplanes with less than 10 passenger seats	
75 percent of these small airplanes	2360 feet
95 percent of these small airplanes	2910 feet
100 percent of these small airplanes	3440 feet
Small airplanes with 10 or more passenger seats	***4010 feet***
Large airplanes of 60,000 pounds or less	
75 percent of these large airplanes at 60 percent useful load	4630 feet
75 percent of these large airplanes at 90 percent useful load	5830 feet
100 percent of these large airplanes at 60 percent useful load	5000 feet
100 percent of these large airplanes at 90 percent useful load	7180 feet
Airplanes of more than 60,000 pounds	Approximately 5020 feet

Reference: Chapter 2 of AC 150/5325-4A, Runway Length Requirements for Airport Design, no Changes included.

EXHIBIT 4-3: BOEING AIRCRAFT RUNWAY LENGTH REQUIREMENTS

Design Aircraft:	Boeing 737-400	Boeing 757-200
Engines:	2 CFM56-36-1	2 PW2040
Takeoff Weight (Minimum):	85,000 lbs.	150,000 lbs.
Temperature:	86 degrees F.	84 degrees F.
Airport Elevation:	29 ft. mean sea level	29 ft. mean sea level
Elev. Difference in R/W Ends:	7 ft.	7 ft.
Runway Length Requirement:	3,900 ft.	3,000 ft.

Reference: Boeing Commercial Airplane Group, Boeing 737-300/400/500 Airplane Characteristics-Airport Planning, Page 43. Boeing 757 Airplane Characteristics-Airport Planning, Page 35.

Runway 15-33 at Renton Municipal Airport is 5,379 feet long with a threshold displacement of 340 feet on Runway End 33. Based upon an examination of the data presented in this section, a runway length of 4,010 feet will accommodate most of the aircraft expected to regularly utilize Renton Municipal Airport over the planning period.

Runway Dimensional Standards

The runway at Renton Municipal Airport has various dimensional criteria that are based upon the relevant aircraft design groups as discussed earlier in this chapter. All existing and proposed runways and taxiways must be constructed in accordance with FAA geometric design standards for both design and facility separation. These standards are included in the FAA's Airport Design (for microcomputers) Version 4.1B. A printout as to how they apply to Renton Municipal Airport is produced below in Exhibit 4-4. These standards have been developed to assure that facilities can be operated in a safe and efficient manner and represent a minimum standard to be achieved.

All runway improvements at the airport must incorporate these criteria in their design to the degree possible. In some instances, deficiencies exist and facility improvements are best designed to coordinate with the existing condition. This is only true, however, when the criteria being violated can be waived by the FAA after a determination that no negative impact will result from such a waiver.

EXHIBIT 4-4: RUNWAY DIMENSIONAL CRITERIA

Airport Design Airplane and Airport Data

Aircraft Approach Category B	
Airplane Design Group II	
Airplane wingspan	78.99 feet
Primary runway end is nonprecision instrument > 3/4-statute mile	
Other runway end is visual	
Airplane undercarriage width (1.15 x main gear track)	13.00 feet
Airport elevation	29 feet

Runway Width and Clearance Standard Dimensions	Airplane Group/ARC
Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is not treated as a factor:	
VFR operations	700 feet
VFR operations with intervening taxiway	700 feet
VFR operations with two intervening taxiways	700 feet
IFR approach and departure with approach to near threshold 2500 feet less 100 ft for each 500 ft of threshold stagger to a minimum of 1000 ft.	
Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is a factor:	
VFR operations	2500 feet
IFR departures	2500 feet
IFR approach and departure with approach to near threshold	2500 feet
IFR approach and departure with approach to far threshold 2500 feet plus 100 feet for each 500 feet of threshold stagger.	
IFR approaches	3400 feet
Runway centerline to parallel taxiway/taxilane centerline	240 feet
Runway centerline to edge of aircraft parking	250 feet
Runway protection zone at the primary runway end:	
Length	1700 feet
Width 200 feet from runway end	500 feet
Width 1900 feet from runway end	1010 feet
Runway protection zone at other runway end:	
Length	1000 feet
Width 200 feet from runway end	500 feet
Width 1200 feet from runway end	700 feet
Departure runway protection zone:	
Length	1000 feet
Width 200 feet from the far end of TORA	500 feet
Width 1200 feet from the far end of TORA	700 feet
Runway obstacle free zone (OFZ) width	400 feet
Runway obstacle free zone length beyond each runway end	200 feet
Approach obstacle free zone width	400 feet
Approach obstacle free zone length beyond approach light system	200 feet

EXHIBIT 4-4: RUNWAY DIMENSIONAL CRITERIA Con't.

Approach obstacle free zone slope from 200 feet beyond threshold	50:1
Inner-transitional surface obstacle free zone slope	0:1
Runway width	75 feet
Runway shoulder width	10 feet
Runway blast pad width	95 feet
Runway blast pad length	150 feet
Runway safety area width	150 feet
Runway safety area length beyond each runway end or stopway end, whichever is greater	300 feet
Runway object free area width	500 feet
Runway object free area length beyond each runway end or stopway end, whichever is greater	600 feet
Clearway width	500 feet
Stopway width	75 feet
Threshold surface at primary runway end:	
Distance out from threshold to start of surface	0 feet
Width of surface at start of trapezoidal section	400 feet
Width of surface at end of trapezoidal section	1000 feet
Length of trapezoidal section	1500 feet
Length of rectangular section	8500 feet
Slope of surface	20:1
Threshold surface at other runway end:	
Distance out from threshold to start of surface	0 feet
Width of surface at start of trapezoidal section	400 feet
Width of surface at end of trapezoidal section	1000 feet
Length of trapezoidal section	1500 feet
Length of rectangular section	8500 feet
Slope of surface	20:1

REFERENCE: AC 150/5300-13, Airport Design, including Changes 1 through 3.

Presently, most facilities meet or exceed these standards with the following exceptions:

1. **Runway Safety Area:** The paved portion of Runway 15 extends to the edge of Lake Washington leaving no room for the recommended 150 foot by 300 foot runway safety area.

2. **Runway Protection Zone (RPZ):** The runway protection zone for Runway 33 does not conform to FAA recommendations that the RPZ be clear of incompatible uses (see Section 4.4.4).

3. **Runway Object Free Area (OFA):** The runway OFA is a two dimensional area surrounding the runway which must remain clear of objects except those needed for air navigation or aircraft ground maneuvering. An object is considered any ground structure, person, equipment, terrain, or parked aircraft. Though not an object, per se, the seaplane ramp is also within the OFA and aircraft and launch/retrieval vehicles parked on the ramp would be in technical violation of the OFA.

Differing strategies related to runway length, dimensional criteria, and how to eliminate or mitigate existing modifications to standards will be identified and discussed in Chapter 5: Alternatives Analysis.

Runway Width

The existing width of Runway 15-33 is 200 feet. To accommodate the critical aircraft, FAA design guidelines recommend a runway width of 75 feet, with a shoulder width of 10 feet. Recommended runway width for the Boeing 757 is 150 feet, with a 25 foot shoulder. Since relocating the lights and removing pavement would be cost prohibitive, it is recommended that the runway width be kept at 200 feet. The existing runway shoulders can be removed. They are not needed because the 200' wide runway eliminates the potential for blast erosion.

Runway Pavement Strength

The minimum design takeoff weight, IE., spec operating empty weight (weight of structure, power plant, furnishing system, unusable fuel and other propulsion agents, and other items of equipment that are considered an integral part of a particular airplane configuration necessary for full operations, excluding usable fuel and payload), with one quarter usable fuel for a Boeing 757 out of Renton Municipal Airport is approximately 155,000 pounds dual tandem gear. The maximum pavement strength to accommodate the design aircraft is 12,500 single wheel gear.

Runway 15-33 pavement strength is rated for 100,000 pounds single wheel gear, 130,000 pounds dual wheel gear, and 340,000 pounds dual tandem gear. No additional strengthening is necessary at this time.

Run-up Area

A run-up area for pre-flight checks should be established and marked at both ends of the runway. These run-up areas should be signed with the appropriate GPS coordinates for the airport.

Helicopter Activity

Helicopters are able to operate at most airports without unduly interfering with airplane traffic. An area developed/designated for helicopter landings and takeoffs may be located anywhere on the airport. The takeoff/landing area should provide ready access to helicopter users origin or destination. A FATO/TLOF should have at least one approach/takeoff path aligned with the direction of the predominant wind. The approach/takeoff path should conform with FAR Part 77 heliport approach surfaces. Taxiways should be established for taxiing to helicopter parking positions.

4.1.2 Taxiway Requirements

As with the runway system, taxiways also have various dimensional criteria that are based upon the most critical aircraft to use the facility. Taxiways that serve the Boeing 737 and 757 aircraft (Taxiways Alpha, Bravo (in part), Charlie, Delta, and Kilo) should either be built or upgraded to meet the FAA dimensional criteria outlined below in Exhibit 4-5.

EXHIBIT 4-5: TAXIWAY DIMENSIONAL CRITERIA FOR DESIGN GROUP C-IV

Taxiway Width and Clearance Standard Dimensions

Taxiway centerline to parallel taxiway/taxilane centerline	215 feet
Taxiway centerline to fixed or movable object	129.5 feet
Taxilane centerline to parallel taxilane centerline	198 feet
Taxilane centerline to fixed or movable object	112.5 feet
Taxiway width	75 feet
Taxiway edge safety margin	15 feet
Taxiway shoulder width	25 feet
Taxiway safety area width	171 feet
Taxiway object free area width	259 feet
Taxilane object free area width	225 feet
Taxiway wingtip clearance	44 feet
Taxilane wingtip clearance	27 feet

REFERENCE: AC 150/5300-13, Airport Design, including Changes 1 through 3.

Taxiways serving general aviation design group B-II (Taxiways Bravo (in part), Echo, Foxtrot, Golf, Hotel, Lima, Mike, and November) should either be built or upgraded to meet the FAA dimensional criteria outlined below in Exhibit 4-6.

EXHIBIT 4-6: TAXIWAY DIMENSIONAL CRITERIA FOR DESIGN GROUP B-II

Taxiway Width and Clearance Standard Dimensions

Taxiway centerline to parallel taxiway/taxilane centerline	105 feet
Taxiway centerline to fixed or movable object	65.5 feet
Taxilane centerline to parallel taxilane centerline	97 feet
Taxilane centerline to fixed or movable object	57.5 feet
Taxiway width	35 feet
Taxiway edge safety margin	7.5 feet
Taxiway shoulder width	10 feet
Taxiway safety area width	79 feet
Taxiway object free area width	131 feet
Taxilane object free area width	115 feet
Taxiway wingtip clearance	26 feet
Taxilane wingtip clearance	18 feet

REFERENCE: AC 150/5300-13, Airport Design, including Changes 1 through 3.

Given the type of activity at Renton, the taxiway system is overly developed. Taxiways C, E, L, and N were designed as high speed taxiways. These taxiways have extremely long entrances that create long unlighted portions of runway, are expensive to maintain, and are of limited value given the type of aircraft utilizing the airport. Other examples of an over developed taxiway system are represented by the presence of three taxiways serving 30 hangars and a few tiedowns on the east side of the runway, the extreme width of Taxiway H, and the need for only 240 feet of separation from the runway centerline rather than the existing 300 feet of separation.

Presently, all taxiways meet or exceed the recommended standards with the exception that Taxiway Bravo's OFA extends into the tiedown area next to the Boeing compass pad.

4.1.3 Instrumentation, Visual NAVAIDs, and Lighting

The existing instrumentation and lighting equipment at Renton Municipal Airport have been described in Chapter 1, Inventory.

<u>Instrumentation</u>

The current electronic navigational system is sufficient to provide for a NDB or GPS non-precision instrument approach to Runway 15. Due to the limited amount of land available for accommodating FAR Part 77 airspace requirements and the fleet mix using the airport, a precision instrument approach is not recommended at this time.

Lighting

Taxiway Foxtrot has been identified as having inadequate lighting and should be equipped with medium intensity taxiway lights. Consideration should be given to lighting the landing lanes for late evening and night seaplane operations on Lake Washington.

4.1.4 Runway Protection Zones and Approach Slopes

Approach slope and runway protection zone standards are set by FAA recommendations. For runways accommodating non-precision instrument approaches for small aircraft and visual approaches, the approach slope ratio is 20:1.

The Runway Protection Zone is a trapezoidal area representing the ground level at the innermost portion of the runway approach. The exact dimensions of this zone are defined by the type of aircraft and operations to be conducted on the runway. Unless there is a displaced threshold, the RPZ begins 200 feet beyond the runway threshold at the end of the area usable for takeoff and landings, and is centered along the extended runway centerline. The RPZ function is to enhance the protection of people and property on the ground.

Where practical, the airport should own the property under the runway approach and departure areas to at least the limits of the RPZ. It is desirable to clear the entire RPZ of all above ground objects. Where this is impractical, airport owners, as a minimum, shall maintain the RPZ clear of all facilities supporting incompatible activities. Incompatible activities include, but are not limited to, those which lead to an assembly of people.

The RPZ for Runway 15 should meet the following dimensional criteria:

Length	1700 feet
Width 200 feet from runway end	500 feet
Width 1900 feet from runway end	1010 feet

The dimensions for Runway 33 RPZ are:

Length	1000 feet
Width 200 feet from runway end	500 feet
Width 1200 feet from runway end	700 feet

The runway protection zone for Runway 33 does not conform to FAA recommendations that the RPZ be clear of incompatible land uses. Current state law requires local governments to recognize the special need to plan appropriately around airports.

4.2 TERMINAL AREA REQUIREMENTS

As discussed in Chapter 2, Forecast of Demand, a significant amount of activity at the airport is commercial service passenger operations conducted by seaplane air taxi operators utilizing Lake Washington. Existing levels and forecasts of growth in this area are significant enough to warrant the establishment of combination air taxi passenger/general aviation terminal area. Components of a terminal area complex include a terminal building, terminal apron, support facilities, and access system. Specific seaplane facility requirements will be addressed Section 4.4.

4.2.1 Terminal Building

Adequate space should be available for processing enplaning and deplaning seaplane passengers, administrative functions, a pilots' lounge, flight planning area, and waiting area for non-air taxi itinerant pilots and passengers, customs, restrooms, storage rooms, and food service and concession area. Currently, most of these functions are performed off airport, in dispersed areas around the airport, or outside on the apron.

To determine terminal building requirements, air taxi design hour passengers and design hour itinerant pilots and passengers were related to functional areas within the terminal to produce overall building size. The recommended building size for each design year is presented in Exhibit 4-7. In calculating the design hour air taxi passengers and itinerant non-air taxi pilots and passengers, an average of 2.8 passengers and pilots per design hour itinerant aviation operation was assumed.

EXHIBIT 4-7: TERMINAL BUILDING REQUIREMENTS

Terminal Functional Area	Area per Design Hour Pilots and Passengers	Terminal Building Area		
		1998	2003	2013
Design Hour Pilots and Passengers	___	87	87	95
Waiting Lounge	15.0 sf	1,305 sf	1,305 sf	1,425 sf
Management/ Operations	3.0 sf	261 sf	261 sf	285 sf
Air Taxi	20.0 sf	1,740 sf	1,740 sf	1,900 sf
Public Conveniences	4.0 sf	348 sf	348 sf	380 sf
Concession Area	10.0 sf	870 sf	870 sf	950 sf
Circulation, Storage, HVAC	24 sf	2,088 sf	2,088 sf	2,280 sf
Customs	Minimum	300 sf	300 sf	300 sf
Meeting Room	Optional	1,000 sf	1,000 sf	1,000 sf
Restaurant	Optional	5,000 sf	5,000 sf	5,000 sf
Total Building Requirements	___	12,912 sf	12,912 sf	13,520 sf

Terminal Auto Parking

Vehicle parking demand in the terminal area is dependent on the level of air taxi and itinerant operations that occur. The methodology used in this analysis follows the steps outlined in the following information.

- Determine design day, general aviation itinerant pilots, and passenger levels based on an aircraft occupancy level of 2.8 persons per operation.
- Assume an average occupancy rate of 1.5 person per vehicle.
- Multiply the number of vehicle spaces required by the planning standard of 22.2 square yards per parking space to determine the total parking area requirements for itinerant operations.

Exhibit 4-8 shows the result of this analysis.

EXHIBIT 4-8: TERMINAL AUTO PARKING DEMAND

Description	1998	2003	2013
Itinerant Pilots & Passengers	663 people	678 people	728 people
Itinerant Parking Requirement	442 spaces	452 spaces	485 spaces
Area	9,812 sy	10,034 sy	10,767 sy

4.2.2 Terminal Support Facilities

Terminal support facilities are those that support the commercial operations side of airport activity.

Federal Inspection Services (FIS) Facilities

FIS is provided by the U.S. Customs Service, Department of the Treasury. They control the entry and clearance of aircraft arriving in and departing from the United States and inspect the crew, passengers, baggage, stores, and cargo carried thereon. As a Landing Rights airport, customs will respond with one hour notification. The primary users of FIS are the seaplane operators providing air service to and from British Columbia.

Currently, FIS takes place in less than ideal conditions. No facilities are provided at the airport for customs operations, and all inspection must be done at the floating dock at the north end of the airport under open skies. This results in the delay of processing and inconvenience to passengers as they cannot leave the area until they have been cleared. Recommendations include a separate holding area for aircraft arriving from international destinations, and a minimum 300 square foot roofed area for offices, inspection facilities, and restrooms.

Fuel Storage

Fuel storage facilities were identified in Chapter 1, Inventory. Existing fuel storage is in privately owned underground tanks and dispensed by FBOs. Underground fuel storage has undergone a great deal of scrutiny in the past few years because of the potential for fuel leaks and contamination of groundwater. Consequently, the installation, design, and monitoring requirements, from both the state and federal government, related to underground fuel storage have increased significantly. Future fuel storage should be in above ground tanks.

To improve the fueling efficiency at the airport, a centralized fuel farm should be established on the west side of the airport. This area should have above ground fuel tanks and be used as a disbursement area for FBO-owned refueling vehicles. Consideration should also be given to a self fueling vending area where pilots can fuel their own aircraft.

Future fuel storage requirements for Renton Municipal Airport were projected following an analysis of historical fuel use characteristics. The average rate of consumption for 1993 was 2.6 gallons per operation. Exhibit 4-9 provides a forecast of monthly fuel storage requirements for the planning period. Storage requirements are based on a one month supply. More frequent deliveries can reduce the storage capacity requirement.

EXHIBIT 4-9: FUEL STORAGE REQUIREMENTS

	Available	1998	2003	2013
Annual Operations	--	148,630	152,010	163,270
Peak Month Operations	--	17,139	17,526	18,821
Average Fuel Ratio	--	2.6	2.6	2.6
Monthly Fuel Storage Requirement	34,000 Gal.	44,560 Gal.	45,570 Gal.	48,935 Gal.

Maintenance Building

An airport maintenance/equipment/storage building should be provided. The minimum recommended size is 1,500 square feet.

Aircraft Rescue and Fire Fighting (ARFF)

Primary fire fighting capabilities are those of the City of Renton. Regulations and guidelines that control ARFF facilities include the following: FAA Advisory Circular 150/5210-10, and Federal Aviation Regulations (FAR) Part 139. These documents establish a level of service index based upon the type, size, and frequency of aircraft serving the airport in scheduled air service. ARFF facilities are not currently required at Renton Municipal Airport and are only necessary when an airline using aircraft with a passenger carrying capacity of 30 or more utilizes the airport. This type and level of activity is not anticipated to occur at Renton Municipal Airport. Boeing maintains a private Index B ARFF facility at their plant.

Air Traffic Control Tower

The Air Traffic Control Tower (ATCT) is located mid-field on the west side of the airport. From this location the ATCT personnel cannot adequately observe seaplane activity. Consideration should be given to relocating the ATCT to a proposed terminal complex at the north end of the field.

4.3 BASED GENERAL AVIATION FACILITIES

Personal and business use aviation encompasses the majority of activity at Renton Municipal Airport at the present time, and forecasts indicate that this can be expected to continue. Therefore, it is important to determine what facilities will be required to accommodate this component of users.

Existing general aviation facilities are positioned on both the east and west sides of the airport. Available facilities include fixed base operator (FBO) facilities, privately owned hangars, aircraft parking aprons, and fuel storage/distribution.

Facility projections were prepared for the following facility categories:

- Hangars and Hangar Apron;
- Local Parking Apron;
- Itinerant Parking Apron;
- FBO/Maintenance Areas;
- Aircraft Washdown Facilities;
- Aircraft Parking Apron; and
- Auto Parking.

The requirements for each of these areas are shown in Exhibit 4-10, and the methods used in determining them are detailed in the following paragraphs.

EXHIBIT 4-10: GENERAL AVIATION DEMAND

Facility	1993 Inventory	Planning Year Requirements 1998	2003	2013
Hangars:				
Number of Aircraft to be Hangared	---	190	194	210
Conventional Hangar Spaces	---	28	29	34
Conventional Hangar Area	50,456 sf	46,200 sf	49,700 sf	59,100 sf
T-Hangars	89	162	165	176
T-Hangar Area	116,200 sf*	226,800 sf	231,000 sf	246,400 sf
FBO/Maint.	9,082 sf*	27,300 sf	28,070 sf	30,550 sf
Total Area	175,738 sf*	300,300 sf	308,770 sf	336,050 sf
Apron:				
Hangar	---	42,933 sy	44,022 sy	47,600 sy
FBO		3,033 sy	3,119 sy	3,394 sy
Local Aircraft Parking	56,400 sy	22,200 sy	22,800 sy	24,300 sy
Itinerant Aircraft Parking	3,600 sy	10,800 sy	10,800 sy	11,880 sy
Total	___	78,966 sy	80,741 sy	87,174 sy
Auto Parking:				
Spaces	150*	132	135	145

* Estimated

4.3.1 Hangars and Hangar Apron

Hangar demands imposed by general aviation aircraft are a function of the number of based aircraft, the type of aircraft accommodated, owner preferences, and area climate. Hangar apron demand is based upon the amount of hangar space provided. Hangar apron demand, when combined with hangar space requirements, provides a planning guideline for the amount of total area needed for hangar separation distances and associated pavement such as hangar taxiways and taxilanes.

<u>Hangars</u>

Generally, more sophisticated aircraft types, such as turbine or multi-engine aircraft, tend to have higher demands for hangar facilities than do single-engine aircraft. Due to the major capital investment more expensive aircraft represent, hangar storage rates increase with the size and costs of stored aircraft.

Prefabricated, conventional hangars, and T-hangar units are available from a variety of manufacturers throughout the nation. Storage space for based aircraft was determined by using guidelines suggested in manufacturer's literature. Typical aircraft sizes were also reviewed in light of the evolution of business aircraft sizes. Conventional hangar space was based upon a standard of 1,200 square feet for single-engine aircraft, 1,400 square feet for multi-engine pistons, 1,800 square feet for turbo-props, 3,500 square feet for turbojet/fans, and 2,500 feet for rotocraft. A standard of 1,400 square feet per piston aircraft was used in calculating T-hangar space requirements.

Exhibit 4-11 sets forth the requirements for hangar space at Renton Municipal Airport through the planning period as well as the assumptions used in calculating the various hangar types.

Hangar Apron

Hangar apron demands were established using an aviation industry planning guideline which indicates a need to develop conventional hangar apron equal to hangar area and T-hangar apron equal to 1-1/2 times hangar area. Exhibit 4-12 details these requirements.

4.3.2 Local Aircraft Parking Apron

Local apron area is planned to ensure adequate tie down space for those based aircraft that are not anticipated to desire hangar storage. FAA Advisory Circular 150/5300-13 indicates that 300 square yards is an adequate tiedown area for piston aircraft. Applying these standards to the number of based aircraft expected to require space on the local apron results in the areas set forth in Exhibit 4-13.

EXHIBIT 4-11: HANGAR AREA DEMAND

Planning Year & Aircraft Type	Total Aircraft by Type	Conventional Hangar		T-Hangars	
		No. of Spaces	Area	No.	Area
1998					
Single-Engine[1]	234	12	14,400 sf	152	212,800 sf
Multi-Engine[2]	22	8	11,200 sf	10	14,000 sf
Turboprop[3]	2	2	3,600 sf	-	-
Turbojet/Fan[3]	2	2	7,000 sf	-	-
Rotocraft[3]	4	4	10,000 sf	-	-
Total	264	28	46,200 sf	162	226,800
2003					
Single-Engine	237	12	14,400 sf	154	215,600 sf
Multi-Engine	24	8	11,200 sf	11	15,400 sf
Turboprop	2	2	3,600 sf	-	-
Turbojet/Fan	3	3	10,500 sf	-	-
Rotocraft	4	4	10,000 sf	-	-
Total	270	29	49,700 sf	165	231,000 sf
2013					
Single-Engine	252	13	15,600 sf	164	229,600 sf
Multi-Engine	26	9	12,600 sf	12	16,800 sf
Turboprop	3	3	5,400 sf	-	-
Turbojet/Fan	3	3	10,500 sf	-	-
Rotocraft	6	6	15,000 sf	-	-
Total	290	34	59,100 sf	176	246,400 sf

1 Thirty percent stored on local apron, 65 percent in T-hangars, 5 percent in conventional hangars.
2 Twenty percent stored on local apron, 45 percent in T-hangars, 35 percent in conventional hangars.
3 One hundred percent in conventional hangars.

EXHIBIT 4-12: HANGAR APRON

Year	Conventional Hangars	T-Hangars	Total
1998	5,133 sy	37,800 sy	42,933 sy
2003	5,522 sy	38,500 sy	44,022 sy
2013	6,566 sy	41,067 sy	47,600 sy

EXHIBIT 4-13: LOCAL AIRCRAFT PARKING APRON

Year	Number of Aircraft			Total Area Required
	Single-Engine[1]	Multi-Engine[2]	Total	
1998	70	4	74	22,200 sy
2003	71	5	76	22,800 sy
2013	76	5	81	24,300 sy

1 Thirty percent of total.
2 Twenty percent of total

4.3.3 Itinerant Aircraft Parking Apron

Areas designated for parking transient aircraft are termed itinerant aprons. The amount of itinerant apron area required was estimated using an approach suggested by the FAA. Notable steps in the methodology employed are as follows:

- Use the general aviation itinerant design day operations as the basis for estimating itinerant apron demands;

- Estimate that 12.5 percent of the design day itinerant aircraft will require apron parking space at any one time. This estimate is derived from one-half design day operations, to account for aircraft, with the assumption that 50 percent will be based aircraft and only 50 percent of the remaining will be on the ground at any one time; and

- Estimate itinerant ramp demands on the basis of 360 square yards per piston aircraft and 800 square yards per turbine aircraft in accordance with FAA guidelines.

Applying this approach to the general aviation itinerant operations forecast developed in Chapter 2 yields the demand for itinerant apron area as shown in the following exhibit.

EXHIBIT 4-14: ITINERANT PARKING APRON DEMAND

Year	Design Day Itinerant Operations	Number of Aircraft Needing Parking	Required Itinerant Apron
1998	237	30	10,800 sy
2003	242	30	10,800 sy
2013	260	33	11,880 sy

4.3.4 Fixed Base Operator/Maintenance Area

Fixed base operator (FBO) maintenance area demands differ according to the level and type of services provided. Therefore, no fixed guidelines are available. A frequently used estimate is to compute FBO maintenance area at ten percent of the total aircraft hangar area. Using this approach produces the planning year maintenance hangar demands shown in Exhibit 4-15. The demand for maintenance apron area is equal in size to building area.

EXHIBIT 4-15: FBO/MAINTENANCE AREA DEMAND

		Required FBO/Maintenance Area	
Year	Total Hangar	Hangar	Apron
1998	273,000 sf	27,300 sf	3,033 sy
2003	280,700 sf	28,070 sf	3,119 sy
2013	305,500 sf	30,550 sf	3,394 sy

4.3.5 Aircraft Washdown Facilities

Given the existing level of activity at the airport and the extensive use of seaplanes, an area for washing down aircraft is needed. In general, aircraft washing involves pressure spraying the entire aircraft surface with cleaning agents to loosen accumulated oil film, dirt, and oxides, brushing the surfaces with alkaline water-based cleaner to help loosen foreign matter, and hosing down the surfaces with hot or cold water for thorough removal of emulsified oil, grease, and dirt from the aircraft.

An aircraft washdown facility must accommodate aircraft with wingspans up to 80 feet and have access to a water source and discharge facility with specifically designed wastewater treatment. A minimum area of approximately 3,500 square feet will be needed.

4.3.6 Auto Parking

Vehicle parking demand in the hangar area is dependent on the level of local and itinerant operations that occur. Itinerant parking demand was assumed to be concentrated in the terminal area. Parking for local activity was calculated by assuming one parking space for every two based aircraft and then multiplying the number of vehicle spaces required by the planning standard of 39 square yards per parking space to determine the total parking area requirements for local operations. Exhibit 4-16 shows the result of this analysis.

EXHIBIT 4-16: HANGAR AREA VEHICLE PARKING DEMAND

Description	1998	2003	2013
Based Parking Requirement	132 spaces	135 spaces	145 spaces
Total Area	5,148 sy	5,265 sy	5,655 sy

Because general aviation activity is scattered around the airport, actual vehicle parking requirements will vary according to individual facility needs.

4.3.7 Miscellaneous

Based on a survey of based aircraft owners and operators, the following facilities were suggested: a card-lock fuel dispensing facility, a hazardous material/oil disposal facility, airplane washdown area, improved seaplane facilities, restrooms on the south end of the airport, pilot's lounge, public telephones on both sides of the runway, electricity to all T-hangars, and availability of mogas.

4.3.8 Landside Facility Requirements

The preceding sections calculated total general aviation landside area demand. To determine phased facility requirements, existing capacity is compared with these demands to produce required new facilities by phase. Exhibit 4-17 shows this relationship.

EXHIBIT 4-17: LANDSIDE AVIATION FACILITY REQUIREMENTS

Facility Type/Descriptor	Existing	Requirements by Phase		
		1993-1998	1999-2003	2004-2013
Hangars:				
Conventional Hangar Area	63,698 sf	0	0	0
T-Hangars	89	79	3	11
T-Hangar Area	12,4600 sf*	110,600 sf	4,200 sf	15,400 sf
FBO/Maint. Area	9,082 sf	0 sf	0 sf	0 sf
Total Area	175,738 sf	110,600 sf	4,200 sf	15,400 sf
Aprons:				
T-Hangars	---	18,433 sy	700 sy	2,567 sy
Conventional Hangars	---	0	0	0
FBO/Maint.	___	0	0	0
Local Parking	56,400 sy	0	0	0
Itinerant Parking	3,600 sy	7,200 sy	0	1,080 sy
Washdown Area	___	389 sy	0	0
Total Apron	___	25,911 sy	700 sy	3,647 sy
Auto Parking:				
Spaces	150*	0	0	0

* Estimated

4.4 SEAPLANE FACILITIES

This section will examine the shoreline facilities necessary to accommodate existing and forecast seaplane operations at Renton Municipal Airport. Shoreline installations are partly on land and in the water. They are required to perform two general functions: (1) to provide servicing, loading and unloading, handling, and tie-up facilities for seaplanes without removing them from the water, and (2) to provide haul-out facilities for removing seaplanes from the water for maintenance and/or fresh water wash down.

4.4.1 Ramps

A ramp is a platform laid on a sloping shore, with half its length in the water. The slope of the ramp should not be greater than 8:1, with a ramp toe depth of four feet. Ramp width should be 30 feet to handle aircraft in all wind, current, and changes in water height. A minimum of 100 feet of unobstructed water should be available directly offshore.

The existing ramp is concrete and wood and is 31.5 feet wide with a 7.15:1 slope. Its size and construction is sufficient for current and anticipated activity. However, the centerline of the ramp is 202.75 feet from the centerline of the runway which puts it within the 250 foot Runway OFA that is required to be clear of all objects not fixed by function. Back-ups and congestion during peak season have been reported by seaplane operators, although more supporting information may be necessary before a second ramp should be considered.

4.4.2 Floating Docks and Gangways

Floating docks offer the greatest flexibility in providing docking facilities. The float should provide an unobstructed wing clearance of 21 feet. The gangway should not be less than 15 feet in length and should be a minimum of six to eight feet wide to permit the use of baggage carts and freight equipment.

Each docking unit should be located so that an aircraft may approach and tie up in any one of the units when adjacent units are occupied. The desired clearances between the various docking units will be influenced by the final design and arrangement. The recommended minimum separation between the near faces of piers, floats, and ramps is 60 feet. A minimum of 100 feet of unobstructed water should be available directly offshore.

Based on an assumed design hour demand of 10 aircraft, an additional 100 feet of dock should be considered. Docking areas should accommodate short term loading and unloading positions and longer term tie-up positions.

<u>Identification Marking</u>

A seaplane dock marker should be provided to facilitate the aerial identification of seaplane docking facilities. Located on the upper horizontal surface of the dock, the marker is an equilateral triangle, orange and white in color.

4.4.3 Fueling Facilities

Dockside fueling capability should be available to seaplanes. Two means of providing dockside fueling are installed fueling facilities and mobile facilities. The commonly used installed fuel dispensing system consists of a pump, motor, strainer, meter, hose reel, automotive and manual control switches, and a hose and nozzle. This type of facility may be impractical due to environmental regulations associated with Lake Washington. The most feasible alternative may be through truck delivery. With either system, any waterside designated fueling point should include fuel spill protective devices, equipment and procedures.

4.5 SUMMARY

This chapter identifies, in general terms, the deficiencies in existing facilities and outlines what new facilities will be needed to accommodate forecast demand under normal or anticipated growth. Alternatives for providing these facilities will be evaluated in the next chapter to determine the most efficient and cost-effective means of implementation.

Facility needs that may require further examination and discussion include the feasibility of shortening the existing runway to accommodate a runway safety area for Runway End 15 and provide more operating area for seaplane activity; the feasibility of a terminal building at the north end to service air taxi enplanements, customs, and private pilots; and the need for an additional 79 T-hangars.

Additional data and information may need to be obtained from seaplane users in order to provide more detailed supporting information regarding number of enplaned passengers, peak time, and future needs prior to final facility design.