Chapter Two:

Aviation Demand Forecasts

CHAPTER TWO: AVIATION DEMAND FORECASTS

Forecasts for aviation demand are a key element in airport planning. Reflecting the desires and needs of the service area populace and economy, demand forecasts provide a basis for determining the type, size, and timing of aviation facilities development. Consequently, these forecasts influence virtually all phases of the master planning process.

2.1 PURPOSE

Aviation demand forecasts serve four purposes in development of the master plan. Specifically, they provide the basis for:

- Determining the necessary capacity of the airfield, aircraft and pilot support facilities, and ground access system serving the airport;
- Determining the airport's role and resulting size and type of existing facility expansion or new construction;
- Estimating the potential environmental effects, such as noise and air impacts, of the airport's operation on the surrounding community; and
- Evaluating the financial feasibility of alternative airport development proposals.

2.2 APPROACH

The development of aviation demand forecasts proceeds through two distinct phases or processes: the analytical, followed by the judgmental. In general, past aviation activity data are examined in anticipation of identifying trends that will give an indication of future activity levels.

During the analytical process, historical trends of the aviation demand elements are extended into the future using a variety of techniques and incorporating a number of assumptions. Trend lines developed through the various analytical procedures are called projections. After preparing a number of projections, the analyst is able to identify a range of growth within which the true trend will probably fall.

The second phase of demand forecasting requires experienced professional judgment. The analyst examines various growth projections for each demand element, studies the character of the community and how it will influence the particular demand element, and then makes a subjective determination of the preferred forecast.

2.2.1 Projection Methodology

The most reliable approach to estimating aviation demand is through the use of more than one analytical technique. Methodologies usually considered for airport master planning include regression analysis, time-series extrapolation, market share analysis, and survey analysis.

Regression Analysis

Values for the aviation demand element in question, the dependent variable, are projected on the basis of one or more external indicators, the independent variables. Historical values for both variable types are analyzed to determine the relationship between the independent and dependent variables. This relationship may then be used to project the dependent variable with a given forecast or projection of the independent variables.

In aviation demand forecasting, elements of aviation activity, such as passengers and based aircraft, are the dependent variables. Population, income, and other socio-economic data are the most frequently used independent variable sets. In this study, projections of population provided the most complete data string for historical and future periods and, therefore, will be the primary regression independent variable set. King County employment data were also available and will be used as an independent variable.

Time Series Extrapolation

Time series, least squares extrapolation is probably the simplest and most familiar forecasting technique. It is one of the most widely used and accepted methods. Through fitting classical growth curves to the historical data and extending them into the future, this technique provides an estimate of the aviation demand element in future years.

A basic assumption of this trend analysis technique is that the historical stimuli for aviation demand will continue to exert a similar influence on future demand levels. As broad as this assumption may be, such a projection method does serve as a reliable benchmark against which other projections may be compared.

Market Share Analysis

The market share technique involves a historical review of activity at an airport as a percentage of a larger regional, state, or national market. The resulting historical market share trend may then be projected into the future, either as a static or dynamic share of the larger market.

This method has the same limitations as trend extrapolation, but it, too, provides a useful check on the validity of other, more esoteric projection techniques.

Survey Analysis

Surveys are perhaps the only method of projection having nearly universal application. In the absence of usable historical data, surveys can be developed that will indicate present and future levels of aviation demand. Numerous survey types are available to the airport planner. These include personal interviews, mail-back questionnaires, in-flight passenger surveys, mechanical or automatic counts, and structured personal observation.

Several surveys were conducted at the Renton Municipal Airport to identify present activity levels. These included an FBO survey to determine based aircraft and general aviation activity levels, field counts, and interviews.

Forecast Development

The analytical projections serve as a basis for developing aviation demand forecasts through the application of experienced, professional judgment.

Informed judgment is perhaps the most valuable factor in forecasting any aviation demand element. Many variables can be accounted for in the analysis and assigned the proper weight, as viewed by the forecaster. Such variables include: commercial service in terms of frequency and aircraft fleet; changes in a community's competitive status; fuel and labor cost fluctuations; long-term demographic shifts; and environmental limitations.

2.2.2 Aviation Demand Elements

Forecasts of aviation demand can be developed for numerous elements. In the case of airports such as Renton Municipal, the key demand elements are enplaned passengers, based aircraft, aircraft operations, and aircraft types. Other important elements are derived from these basic indicators. For this study, forecasts were prepared for:

- General Aviation Activity
  - Based Aircraft
  - Fleet Mix
  - Based Seaplanes
  - Aircraft Operations
  - Peaking Characteristics
- Military Activity
- Instrument Operations
- Commercial Operator Activity
  - Enplaned Passengers

The demand forecasts will serve as the basis for determining aviation facility requirements and staged development throughout the forecast period.

2.2.3 Demand Forecast Summary

The major forecast elements of the master plan are summarized in Exhibit 2-1. Development of the various demand elements are described in detail through the remainder of this chapter.

2.3 AVIATION FORECAST

A critical role of Renton Municipal Airport is to serve general aviation demand. General aviation activity includes all aviation activity except that of military and air carriers certified in accordance with Federal Aviation Regulations (FAR). The types of aircraft used in general aviation activities covers a wide spectrum. They range from corporate multi-engine jet aircraft piloted by professional crews, to kit-built single engine piston airplanes, acrobatic planes, balloons, and dirigibles.

EXHIBIT 2-1: SUMMARY OF FORECASTS

Activity Indicator	1993	1998	2003	2013
BASED AIRCRAFT				
• Total	252	264	270	290
• Seaplanes	40	42	44	49
ANNUAL OPERATIONS				
• Total	114,254	149,035	152,400	163,660
• General Aviation	113,875	148,630	152,010	163,270
• Boeing	226	252	238	238
• Military	153	153	153	153
PEAK HOUR OPERATIONS	---	72	73	79
INSTRUMENT OPERATIONS	3,770	4,920	5,030	5,400
PASSENGER ENPLANEMENTS	3,500	4,370	5,450	8,490

General aviation is an important component of both the aviation industry and the local and national economy. It provides aviation services that commercial aviation services cannot or will not provide. The sale of general aviation aircraft, avionics, and other equipment, along with the provision of support services such as flight schools, air taxi operators, fixed base operators (FBOs), finance, and insurance, make the general aviation industry an important contributor to the nation's and the region's economic health.

2.3.1 General Aviation Trends

As with commercial airline activity, general aviation activity is influenced by various socioeconomic factors as well as local, regional, and national trends. For the past ten years or more, the entire general aviation industry has experienced substantial changes. Indications are that growth rates of the active fleet are slowing. U.S. aircraft shipments have dropped continuously from a high of 17,811 in 1978 to 954 in 1993. Concurrently, aircraft prices and operating costs have been increasing faster than the rate of inflation. Additional evidence that shows general aviation growth to be moderating is the continuing decline of students and private pilots. Ultimately the shrinking stock of pilots and the slowing in the expansion of the existing fleet will reduce the rate of growth at most airport facilities.

The one area of general aviation that is expected to grow substantially is that of business flying. The shake up of the airline industry following deregulation in 1978 and the number of new entrant carriers, as well as the recent bankruptcies and consolidations, have made commercial airline travel less certain, especially to smaller size communities. This condition has led to an increased usage of business aircraft. According to FAA data, more than 61,000 general aviation aircraft are used for business purposes.

Corporate sales now make up almost 90 percent of the general aviation market. Of the Fortune 500 companies, 321 operate aircraft. These companies generate sales of over $2.0 trillion annually and employ more than 11 million people. The trend in aircraft type used by business is toward the twin-engine piston and turbo-prop fixed wing aircraft, rotocraft, and jets such as the Gulfstream III and IV and the Falcon Jet.

There are four specific measures of general aviation demand that are particularly important to the airport planning process: the number of air taxi enplanements, the number of based aircraft, the level of activity categorized as local, itinerant, and total operations, and the peaking characteristics of the general aviation operations.

2.3.2 Seaplanes

A unique component of general aviation activity at Renton Municipal Airport is that of seaplanes. (The general term "seaplane" as used in this document refers to all aircraft capable of operating on water: seaplanes, floatplanes, and amphibians). Seaplanes have been utilized in the region since the early 1930s. Though historical data is scarce, according to the Washington State Aeronautics Division, seaplane use and seaplane landing areas have grown substantially over the last decade, with the Puget Sound the most active region.

A contiguous seaplane environment exists from the southern part of the Puget Sound through the protected waters of British Columbia and Southeast Alaska to the remote lakes of the Arctic Circle. Seaplane support facilities are common in this area. Flights originating in the Puget Sound are able to navigate to Anchorage and beyond using water bases exclusively for landings, fuel, and supplies.

In the north, Anchorage has become an active seaplane center, as have Juneau, Ketchikan, Sitka, and Lake Spenard. Along the coast of Western British Columbia and Eastern Vancouver Island seaplanes are a predominant method of transportation. The Puget Sound is significant as the southern terminus of this entire operational area. Seattle area firms are the major source of maintenance and technical support for the Northwest and Alaska regions. Renton Municipal Airport is the only seaplane base in the Puget Sound with haul-out facilities for maintenance and service.

2.3.3 Based Aircraft Forecast

The number of general aviation aircraft that can be expected to base at a particular airport is an important factor in the planning of future airfield and landside facilities. A based aircraft is a general aviation aircraft that is permanently stationed at an airport. As demonstrated below in Exhibit 2-2, the number of aircraft based at Renton have remained somewhat steady over the last ten years. Based aircraft ranged from a high of 260 in years 1982, 1983, and 1984 to a low of 252 in 1992. In the ten years between 1982 and 1992, the number of based aircraft at Renton decreased 3.2 percent; however, for the same period, the active general aviation fleet for the Northwest-Mountain Region declined 5.8 percent.

To determine future levels of based aircraft six separate projections were prepared using regression analysis, time series extrapolation, and market share analysis. The projections generated through these techniques were then compared to forecasts that were prepared by others, and a preferred forecast was selected.

EXHIBIT 2-2: HISTORICAL BASED AIRCRAFT FOR THE RENTON MUNICIPAL AIRPORT

Year	Based Aircraft
1982	260
1983	260
1984	260
1985	258*
1986	256
1987	256
1988	256
1989	256*

1990	256
1991	252
1992	252

Source: Airport Master Record, FAA form 5010-2, for respective years.
* Interpolated by BWR.

Time Series Extrapolation

The first model is a projection using the time-series extrapolation (trend analysis) method. Historical number of based aircraft were extrapolated using a least square method through the planning period. Figures from historical based aircraft from 1982 to 1992 were applied to the least square method to obtain projected based aircraft for corresponding years. The extrapolation yielded a projection of 248 based aircraft in 1998, 244 in 2003, and 237 in 2013.

Because of the decline in the number of based aircraft at the Renton Municipal Airport during the base period (1982-1992), the trend analysis methodology projected total based aircraft to continue its present downward trend, dropping to 244 aircraft in year 2003 and 237 in year 2013.

Population and Employment Regression Projection

Two regression projections were developed using King County population and employment. Forecast population and employment were applied to the regression equation to obtain projected based aircraft for the corresponding years.

Both projections indicated a decline in based aircraft. The population regression yielded a projection of 249 based aircraft in 1998, declining to 243 in year 2013 with a relatively high correlation coefficient of 0.94. The closer the value the correlation coefficient is to plus or minus 1, the better the correlation. The employment regression showed based aircraft declining from the current level of 252 to 244 in year 2013. The correlation coefficient of this model was 0.93.

Regional FAA Growth Rate Model

The third method to project based aircraft utilized regional FAA aircraft growth rate projections in the *FAA Aviation Forecast* for Fiscal Years 1993-2004 for active general aviation aircraft for the Northwest-Mountain Region. The model applied a projected rate of growth by the FAA to the existing fleet of aircraft at Renton. This model resulted in a increase of based aircraft to 292 by year 2013.

Market Share Projections

The market share model is based on Renton's historic share of the total Northwest-Mountain Region general aviation fleet. Two market share projections were developed representing a constant average and dynamic trend.

The constant share projection was developed by applying Renton's historic average share of the market to FAA forecasts of the total Northwest-Mountain regional general aviation forecasts. Renton's market share over the last ten tears has averaged 1.275 percent. The average market share calculations project that in 1998 there would be 264 based aircraft, and in year 2013 there would be 290 based aircraft.

The dynamic market share, or increasing share, is based upon the historical trend established over the years 1980 through 1992. While the share percentages exhibited during this period vary, the pattern exhibited a general upward trend in market share. This forecasts utilizes a market share of 1.285 percent for the first five years, then a modest increase in share to 1.350 percent. This projection resulted in 269 based aircraft in 1998 and 310 aircraft by year 2013.

Forecast Projections By Others

The last projections to be considered were previous planning efforts that included forecasts for the Renton Municipal Airport. Documents reviewed included the *1993 Washington State Continuous Airport System Plan* and previous Renton Municipal Airport Master Plans produced in 1978 and 1988.

The 1978 Airport Master Plan identified three constraints to airport growth: (1) the lack of available storage facilities; (2) lack of a precision instrument approach system; and (3) inadequate seaplane facilities. Based upon these assumptions the Plan produced a constrained and unconstrained forecast. The constrained forecast predicted that based aircraft would increase from its existing 1978 level of 187 to the airport's field capacity of 210 based aircraft by year 1980. The unconstrained forecast predicted based aircraft to increase to 456 by year 1995.

The 1988 Master Plan produced a high and low forecast of based aircraft at Renton dependent upon reorganization and relocation of Boeing lease areas on and off the airport . The low forecast projected based aircraft to reach 200 by year 2007, while the high forecast predicted 370.

The *Washington State Continuous Airport System Plan* forecast for Renton projected 275 based aircraft for the airport in year 1995, 287 in year 2000 and 299 based aircraft in year 2005.

Preferred Forecast

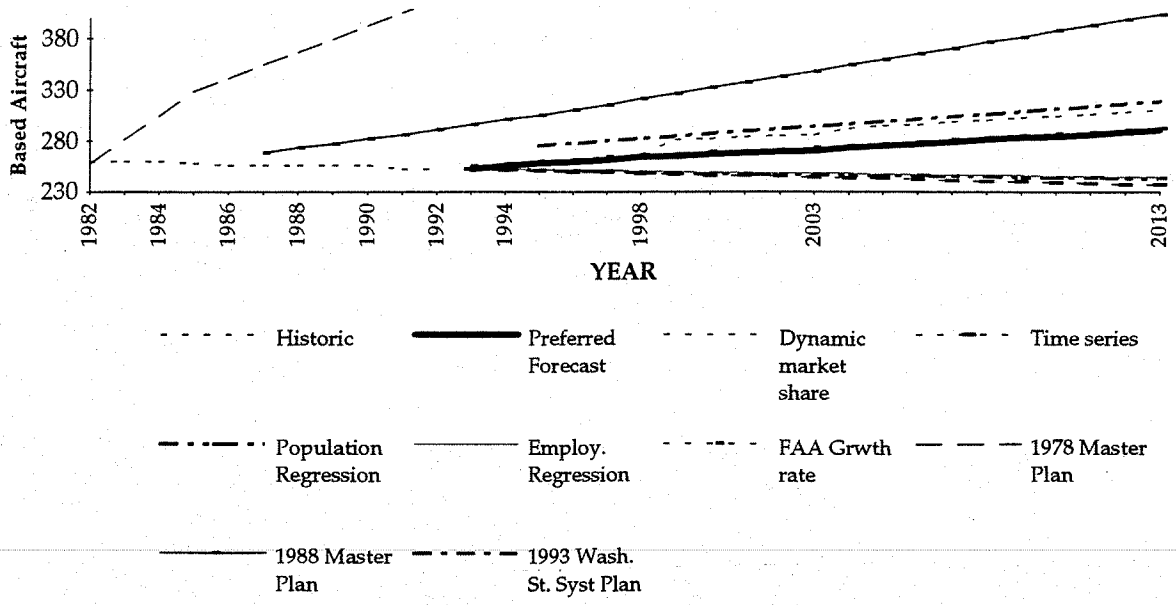
As the preceding projections indicate, there is a wide range of numbers produced within which the true forecast lies. The preferred forecast was derived from an analysis of the previous projections and a review of forecasts prepared by *Washington State System Plan* for Renton Municipal Airport, prepared in 1993. All models are summarized and graphically depicted in Exhibit 2-3.

EXHIBIT 2-3: SUMMARY OF PROJECTIONS

Year	Average Market Share	Dynamic Market Share	Time Series	Population Regression	Employ. Regression	FAA Grwth Rate	1978 Master Plan*	1988 Master Plan*	1993 Wash. Syst Plan*
1994	255	257	251	252	252	257	433	301	
1995	258	260	250	251	252	260	**456**	305	**275**
1996	259	261	249	250	251	261	469	310	277
1997	261	264	249	250	251	264	482	**315**	280
1998	264	266	248	249	250	266	494	321	282
1999	265	281	247	248	250	267	507	326	285
2000	267	282	246	248	249	269	520	332	**287**
2001	268	284	246	247	249	270	533	337	289
2002	269	285	245	247	248	271	546	343	292
2003	270	286	244	247	248	273	558	348	294
2004	273	292	243	246	248	275	571	354	297
2005	275	295	243	246	247	277	584	359	**299**
2006	277	296	242	246	247	279	597	365	301
2007	279	299	241	245	246	281	610	**370**	304
2008	281	300	240	245	246	283	622	376	306
2009	283	303	240	244	246	285	635	381	309
2010	284	304	239	244	245	287	648	387	311
2011	286	306	238	244	245	288	661	392	313
2012	288	308	237	243	244	290	674	398	316
2013	290	310	237	243	244	292	686	403	318

Source: BWR

* Extrapoloated to 2013 by BWR



Although general aviation has seen a significant nationwide and local decline during the past several years, it is unlikely that this trend will continue indefinitely. There is no evidence that general aviation at Renton Municipal Airport will decline to levels below the historical minimum of about 250 based aircraft. Considering its convenient location and the investment in current facilities, it is reasonable to assume that the Airport will continue to support, at the least, a minimum threshold fleet of based aircraft. For this reason the trend and regression forecasts were rejected.

On a national level, factors that indicate modest growth in future general aviation activity is a reasonable assumption include possible passage of product liability reform legislation, the strength of the used aircraft market, increasing international use of general aviation aircraft, the long-term trend toward increasing operations at towered airports, the FAA and NASA commitment to aeronautical research that could benefit general aviation, development of common world-wide aviation standards (JAR/FAR harmonization), and an increasing use of air taxi.

Locally, factors that support an increase in activity at Renton Municipal Airport include a population growth rate for the Seattle-Tacoma area that is higher than the national average, the traditional presence of the aerospace industry in the region, the significant use of helicopters and seaplanes in the region as evidenced by the approximately 48 heliports and eight seaplane bases in the Puget Sound, and the continued use of Renton Municipal Airport as not only a reliever for Seattle-Tacoma International Airport, but as a lower cost and less congested alternative to King County International Airport (Boeing Field).

It is unlikely, however, that Renton will experience the growth in activity that was predicted in previous master plans. As can be seen graphically in Exhibit 2-3, projections prepared in the 1978 and 1988 master plans have not been supported by recent historical trends. The average market share projection was chosen as the preferred forecast because it is believed that Renton Municipal Airport will continue to maintain modest and sustained growth over the 20 year forecast period. The preferred forecast of based aircraft is presented in Exhibit 2-4.

2.3.4 Based Aircraft Fleet Mix

It is necessary to know the aircraft fleet mix expected to utilize the airport to plan for the proper facilities that will best serve the airport. The present and forecast based aircraft fleet mix is shown in Exhibit 2-5. The fleet mix of based aircraft was determined by an analysis of aircraft currently registered in King County and those based at Renton Municipal Airport. This was compared with existing and forecast United States and Washington State general aviation fleet mix to take into account the overall market trend.

EXHIBIT 2-4: PREFERRED FORECAST OF BASED AIRCRAFT

Year	Forecast of Based Aircraft
1994	255
1995	258
1996	259
1997	261
1998	264
1999	265
2000	267
2001	268
2002	269
2003	270
2004	273
2005	275
2006	277
2007	279
2008	281
2009	283
2010	284
2011	286
2012	288
2013	290

Source: BWR

EXHIBIT 2-5 BASED AIRCRAFT FLEET MIX

Year	Single Engine Piston	Multi Engine Piston	Turbo Prop	Jet	Roto Craft	Total
1993 (Actual)	230	21	1	2	0	252
1998	234	22	2	2	4	264
2003	237	24	2	3	4	270
2013	252	26	3	3	6	290

Source: BWR

Seaplanes

The exact number of based seaplanes at Renton Municipal is difficult to obtain because many of these aircraft operate as seaplanes on a seasonal basis. A visual survey of apron storage areas revealed approximately sixty pairs of empty floats that are utilized over the year. As reported in Chapter 1, Inventory, a survey of based aircraft owners, with a return rate of approximately 25 percent, indicated there are an estimated 40 seaplanes based at the airport. This figure represents approximately 16 percent of the total based aircraft at Renton.

Currently there are estimated to be 120 seaplanes in the Puget Sound area according to the 1993 Washington State Continuous Aviation System Plan. Thirty three percent of these are based at Renton Municipal. Based on a system plan forecasted rate of growth of 0.97 percent per year for seaplanes statewide, the projected increase for Renton is for 42 seaplanes in year 1998, 44 in year 2003, growing to 49 by year 2013. The forecast for based seaplanes is shown in Exhibit 2-6.

EXHIBIT 2-6: BASED SEAPLANE FORECAST

Year	Based Seaplanes
1993 (Actual)	40
1998	42
2003	44
2013	49

Source: BWR

2.3.5 General Aviation Aircraft Annual Operations

An airport operation is defined as any takeoff or landing performed by an aircraft. There are two types of operations: local and itinerant. A local operation is a takeoff or landing performed by an aircraft that will operate in the local traffic pattern, within sight of the airport, or that will execute simulated approaches or *touch-and-go* operations at the airport. Itinerant operations are all arrivals and departures other than local. Generally, local operations are characterized as training operations and itinerant operations are those aircraft with a specific destination away from the airport. Typically, itinerant operations increase with business and industry use since business aircraft are used to carry people from one location to another.

As reported in the Inventory Chapter, general aviation operations at Renton have remained fairly consistent since 1980, averaging approximately 144,360 annual operations for the 14 year period. A slight drop in operations from 145,100 in 1992 to 114,300 in 1993 can be attributed to the relocation of a flight training school during this period, and annual operations are expected to rebound.

The most widely accepted forecasting technique for general aviation operations is to apply a historical average number of operations per based aircraft (OPBA) to the forecast of based aircraft. A review of airport and FAA control tower records shows that operations per based aircraft have ranged from a high of 687 in 1983, to 635 in 1988, to a low of 451 in 1993. The average OPBA for this period was 574, with a median of 563 for the eleven year period. To determine future operations, an OPBA of 563 was used.

Historically, the percentage of local operations has ranged from a high of 65 percent in 1987 to a low of 57 percent in 1993. Indications are that local operations as a percent of total operations is slowly declining.

Exhibit 2-7 summarizes the projected based aircraft operations for the planning period.

EXHIBIT 2-7: GENERAL AVIATION AIRCRAFT OPERATIONS FORECAST

Year	Local	Itinerant	Total
1993 (Actual)	64,908	48,966	113,875
1998	84,720	63,910	148,630
2003	86,645	65,365	152,010
2013	93,065	70,205	163,270

Source: BWR
* Excludes operations by Boeing.

2.3.6 Military Operations

Military aircraft do not routinely use the airport. Exhibit 2-8 shows historical and forecast military operations for Renton Municipal Airport. The number of military operations occurring at the airport has little or no correlation with local population, economic or other civilian air traffic indicators. For the most part, the level of military activity at any airport is determined solely by the requirements of the Department of Defense. At Renton there is no basis for a military operations forecast other than assuming a continuation into the future the present level of activity.

EXHIBIT 2-8: HISTORICAL AND FORECAST MILITARY OPERATIONS

Year	Annual Military Operations
1983	144
1988	179
1993	153
Forecast	
1998	153
2003	153
2013	153

Source: BWR

2.3.7 Boeing Operations

As described in Chapter 1, Inventory, the Renton Division of the Boeing Company produces the 757, an Airport Reference Code (ARC) C-IV aircraft with a range of 4,500 miles, and three versions of the new generation 737: the 737-300, the 737-400, and the smallest version, the 737-500, all of which are classified as ARC C-III aircraft. The Renton Municipal Airport is used by Boeing to perform pre-flight tests on all 737s and 757s before they make their initial test flight. After the flight, planes land at King County International Airport (Boeing Field), in Seattle, where final preparations are made before delivering the aircraft to the customer.

An average First Flight (B1) is three hours, which allows time to test many interrelated components of the aircraft. The minimum flight path is over Lake Washington to the Commercial Delivery Center in Seattle at King County International Airport (Boeing Field), only 8 miles and a few minutes away. Once the aircraft departs Renton Municipal, it is not anticipated to return. Flights in 1993 totaled 152 for the 737 and 74 for the 757. Estimates by the Boeing Renton Division for 1994 activity, based on existing orders, is for 114 departures for the 737 and 64 departures for the 757.

Forecasts for future levels of activity were based upon world market demand and airplane supply requirements developed by the Boeing Commercial Airplane Group. Historical and forecast operations by aircraft type are presented below in Exhibit 2-9. Nearly 5,500 jet airplanes of all types are forecast by Boeing to be delivered from 1993 to the year 2000, an average of 687 per year. From year 2001 through 2010, another 6,500 airplanes are forecast to be delivered, or 650 per year. The largest share of future airplane deliveries is expected to be in the 120 to 170 seat market (included in this category is the 737-300/400), with 171-240 seat aircraft (this category includes the 757) expected to make up approximately 20 percent of the future market. Historically, Boeing has maintained a 58 percent world market share of commercial jet orders.

EXHIBIT 2-9: BOEING AIRCRAFT OPERATIONS

Year	Boeing 737 (ARC C-III)	Boeing 757 (ARC-IV)
1985	132	36
1986	132	36
1987	168	48
1988	168	48
1989	168	60
1990	204	84
1991	252	84
1992	168	102
1993	152	74
Forecast		
1994*	114	64
1998	171	81
2003	161	77
2013	161	77

Source: The Boeing Company * Figures for 1994 are based on known orders.

2.3.8 Annual Operations Summary

Each of the forecasts previously presented represents a specific segment of aviation activity at the airport. Each of these segments exerts influence on the development of individual portions of the airport on its own. However, when examining total airport needs, it is necessary to look at the total number of operations expected at the airport. Exhibit 2-10 presents a summary of annual aircraft operations.

EXHIBIT 2-10: TOTAL AIRFIELD OPERATIONS

	Local	Itinerant			
Year	General Aviation	General Aviation	Boeing	Military	Total
1993	66,500	45,200	178	153	112,031
1994	81,830	61,735	252	153	143,970
1995	82,795	62,460	252	153	145,660
1996	83,120	62,700	252	153	146,220
1997	83,760	63,185	252	153	147,355
1998	84,720	63,910	252	153	149,040
1999	85,040	64,155	252	153	149,600
2000	85,685	64,640	252	153	150,725
2001	86,005	64,880	238	153	151,275
2002	86,325	65,120	238	153	151,840
2003	86,645	65,365	238	153	152,400
2004	87,610	66,090	238	153	154,090
2005	88,250	66,575	238	153	155,215
2006	88,890	67,050	238	153	156,340
2007	89,535	67,545	238	153	157,470
2008	90,175	68,030	238	153	158,595
2009	90,820	68,510	238	153	159,720
2010	91,140	68,755	238	153	160,285
2011	91,780	69,240	238	153	161,410
2012	92,420	69,720	238	153	162,535
2013	93,065	70,205	238	153	163,660

Source: BWR
* Numbers may not add up due to rounding.

2.3.9 Peaking Characteristics

The determination of airfield and certain landside facilities requires an analysis and forecast of aircraft operational peaking. Levels of aircraft activity during relatively busy periods can be closely correlated to the needs of various facilities such as runways, taxiways, and passenger facilities. A number of peak activity descriptors have been identified and are maintained as accurate measures of aviation activity. Among these descriptors are the following:

- Peak Month Operations: Defined as the calendar month when peak aircraft operations levels occur. A level equal to 11.5 percent of annual operations will be used for Renton.
- Design Day Operations: Defined as the average day within the peak month. This indication is developed by dividing the peak month operations by 31.
- Design Hour Operations: Defined as the peak hour within the design day, often between 10 and 15 percent of the design day.

Exhibit 2-11 summarizes general aviation peaking.

EXHIBIT 2-11: AIRFIELD PEAKING CHARACTERISTICS

Year	Annual Ops.	Peak Month Ops.	Design Day Ops.	Design Hour Ops.
1998	149,037	17,139	553	72
2003	152,401	17,526	565	73
2013	163,661	18,821	607	79

Source: BWR

2.3.10 Instrument Operations

For the purposes of this study, an instrument operation is defined as an arrival or departure from an airport by aircraft operating in accordance with an instrument flight rule (IFR) flight plan, or the provision of IFR separation from other aircraft by a terminal control facility. Instrument operations can be conducted at any time regardless of meteorological conditions. Actual instrument approaches, however, are defined as instrument operations conducted during instrument meteorological conditions. Instrument meteorological conditions exist when the cloud ceiling is less than 1,000 feet above ground level (AGL) and/or visibility is less than three miles.

FAA Air Traffic Control records maintained at the Renton Tower were reviewed for the years 1992 and 1993. This data indicates that IFR operations account for approximately 3.3 percent of the total operations. In developing a forecast of VFR/IFR operations, an average percentage of IFR operations is applied to the total operations forecast. The percentage applied was 3.3 percent, representing an average based on the years examined. Exhibit 2-12 presents the forecast of VFR/IFR operations for the airport.

EXHIBIT 2-12: FORECAST OF INSTRUMENT OPERATIONS

Year	Instrument Operations	Visual Operations	Total Annual Operations
1993 (Actual)	3,770	110,484	114,254
1998	4,920	144,120	149,040
2003	5,030	147,370	152,400
2013	5,400	158,260	163,660

Source: BWR

2.3.11 Commercial Air Service Enplanements

The purpose of this section is to quantify existing and future levels of commercial air service activity to determine appropriate facility requirements including parking and terminal service needs. Information regarding commercial air service enplanements is also important to determine eligibility for additional FAA entitlement funds. Airports with scheduled service that enplanes 10,000 or more passengers per year are entitled to a minimum of $500,000 in FAA Airport Improvement Program (AIP) funds per year.

Commercial air service refers to the transport of passengers or property by aircraft for compensation or hire. Aircraft operators providing commercial air service utilizing aircraft with greater than 30 seats are considered air carriers and must be certified under Federal Aviation Regulations (FAR) Part 121. Aircraft operators providing commercial air service with aircraft with less than 30 seats (either scheduled or on-demand charter) are considered commercial operators and must be certified under FAR Part 135.

Air carriers, which includes commuters such as Horizon and major airlines such as Delta and United, are limited to operating at commercial service airports that are certified under FAR Part 139, and can not operate at Renton at this time. However, commercial operators, which are commonly referred to as air taxis, are not considered air carriers, and may operate at most general aviation airports, including Renton. Part 135 air taxi operators are certified on the number of seats, categorized by: nine seats or less, 10 to 19 seats, and 20 to 29 seats. The larger (more seats) an aircraft, the more stringent the operating regulations.

Almost all of the commercial Part 135 air service activity at Renton Municipal Airport is seaplane related. Commercial seaplane operators provide on-demand and seasonal air taxi services throughout Washington State and British Columbia. Activities include sightseeing, environmental testing and monitoring, contract shuttle service, photography, and general transportation. A key segment of the seaplane activity is the transport of passengers during the summer salmon fishing season. During this time, lasting approximately four months, a majority of flights are conducted to popular fishing areas in British Columbia.

Although commercial air service has been in operation for some time at Renton Municipal Airport, little is known regarding activity levels. Partly for proprietary reasons, air taxi operators are reluctant to share what is viewed as confidential business information. Investigation into seaplane air taxi activity in the Puget Sound reveals that seaplane air taxi operators are experiencing significant growth.

According to the *1993 Washington State Continuous State Aviation System Plan* (Table I-24), seaplanes utilizing Lake Union enplaned over 40,000 passengers in 1990. This established the Lake Union Seaplane Base as ranking sixth out of 15 commercial service airports in Washington State in airline passenger enplanements in 1990. Forecasts predict enplanements to reach almost 80,000 passengers by year 2005.

Commercial seaplane operating firms that are known to operate from Renton Municipal Airport/Wiley Post Memorial Seaplane Base include Action Aviation, Northwest Seaplanes, Sound Flight, Ludlow Aviation, Kenmore Air, and Puget Sound Seaplanes. Action Aviation, Northwest Seaplanes, and Sound Flight are based at Renton Municipal Airport.

The most popular aircraft utilized in commercial seaplane operations are the four to five passenger single engine Cessnas, the six to seven passenger de Havilland Beaver, and the eight passenger turbine Otter. Action Aviation utilizes a single engine Cessna, Northwest Seaplanes operates eight de Havilland Beavers, Sound Flight operates two Cessnas, two de Havilland Beavers, and one eight passenger Otter, Puget Sound Seaplanes operates two Cessnas and two de Havilland Beavers, and Ludlow Aviation operates one Beaver.

Forecast of Enplaned Passengers

Passenger enplanements are defined as the number of revenue passengers boarding an aircraft, including both on-demand (charter) flights and scheduled flights. No reliable historical data exists on the number of enplaned passengers at the Renton Municipal Airport.

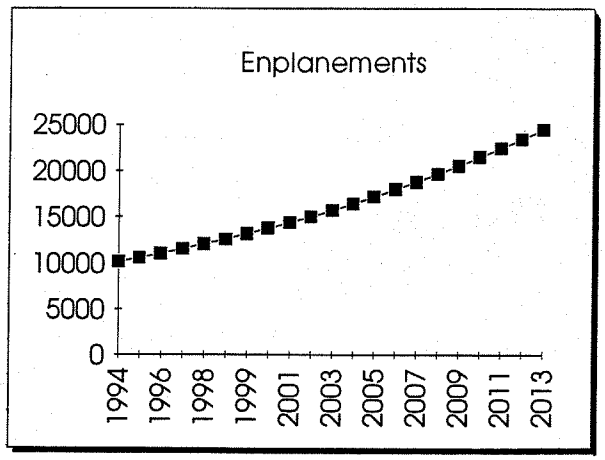
Discussions with the airport manager, the Air Traffic Control Tower, and seaplane operators indicate that starting about mid May, and sometimes as early as April, seaplanes begin operating regularly scheduled charter flights seven days a week until about mid September. During this period, commercial seaplane operators generally operate flights twice a day; typically an outbound morning flight and an afternoon inbound flight, averaging approximately 15 departures and 15 return flights per day. Load factors average approximately 5.5 passenger per de Havilland Beaver, approximately 4 passengers per single engine Cessna, and approximately 6 passengers for the Otter. This level of activity translates into an estimated 9,900 passenger enplanements per four month long season.

During other times of the year, both land based and water based on-demand charters operate from the airport. Conservative estimates put this level of activity at approximately 200 additional enplanements. This brings the total number of annual passenger enplanements at Renton Municipal Airport to 10,100. This represents a total of approximately 20,200 total revenue passengers traveling through the Renton Airport in one year.

To project the potential number of future enplanements over the twenty year planning period at Renton Municipal Airport, a average annual growth rate of 4.53 percent was used. This is the same growth rate utilized in the *1993 Washington State Continuous State Aviation System Plan* to forecast enplanements at Lake Union. Projected operations and passenger enplanements over the twenty year planning period, shown in Exhibit 2-13. are expected to reach approximately 23,400 by year 2013.

EXHIBIT 2-13: FORECAST OF PASSENGER ENPLANEMENTS

Year	Passenger Enplanements
1994	10,100
1995	10,600
1996	11,500
1997	11,500
1998	12,100
1999	12,600
2000	13,200
2001	13,800
2002	14,400
2003	15,000
2004	15,700
2005	16,400
2006	17,200
2007	18,000
2008	18,800
2009	19,600
2010	20,500
2011	21,500
2012	22,400
2013	23,400



Source: BWR

2.4 CRITICAL AIRCRAFT

A critical aircraft is considered to be the aircraft with the most demanding requirements at an airport, and conducts at least 250 itinerant takeoffs or landings (500 operations) per year. The critical aircraft is used to determine the appropriate Airport Reference Code (ARC), which in turn, defines the appropriate design criteria to be utilized at an airport. The critical aircraft for Renton Municipal Airport is currently the Boeing 757. The Boeing 757, with an approach speed of 135 knots and a wingspan of 124.8 feet, is a C-IV category aircraft.

As discussed in Section 2.3.7, annual operations by the Boeing 757 have declined, from a high of 102 in 1992, to 74 in 1993. Forecasts of future 757 operations project these to increase to only 77 by the end of the 20 year planning period. Similarly, annual operations of the next most demanding aircraft utilizing the airport, the Boeing 737 (ARC C-III), has declined from a high of 252 in 1991, to 152 annual operations in 1993. Forecast indicate that Boeing 737 annual operations will only reach 161 by year 2013.

Based on existing and forecast operations, as well as the unique characteristics of Boeing 757/737 operations, it is recommended that the critical aircraft designation be reconsidered.

A more representative aircraft typically utilizing Renton Municipal Airport is the 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 20 year planning period.

The subject of applying the appropriate airport design standards and criteria to differing airport elements will be discussed in more depth in Chapter 4, Facility Requirements.