2001 Regional Airport System Plan

August 2001

Puget Sound Regional Council
PSRC

The 2001 Regional Airport System Plan is a Modal Component of DESTINATION 2030

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This report was prepared by
Puget Sound Regional Council Staff
with input from the
Regional Airport System Plan Advisory Committee

The *2001 Regional Airport System Plan*
is a Modal Component of
Destination 2030
the Metropolitan Transportation Plan for the
Central Puget Sound Region

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For additional information or to obtain copies of the *2001 Regional Airport System Plan* report, please contact the Puget Sound Regional Council's Information Center at 1-206-464-7532 or infoctr@psrc.org

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Table of Contents

Chapter 1 - INTRODUCTION 1-1
Chapter 2 - GOALS, ISSUES, AND TRENDS 2-1
Chapter 3 - AIRPORT SYSTEM PLANNING BACKGROUND 3-1
History of Regional Airport System Planning 3-1
New Planning Authority 3-4
Guiding Principles for the National Airport System 3-5
Airport Service Levels and Airport Roles 3-6
Regional Airspace 3-7
Chapter 4 - SYSTEM INVENTORY 4-1
System Airports 4-1
Reliever Airports 4-4
Aircraft Owners and Pilots 4-6
General Aviation Based Aircraft 4-8
General Aviation Fleet Mix 4-11
Aircraft Operations 4-11
Airport Facilities - Runways 4-15
Airport Facilities - Airport Pavements 4-16
Airport Facilities - Control Towers, Navigational Aids, and Lighting 4-19
Airport Landside Facilities 4-20
Air Cargo 4-21
Airport Access 4-23
Context for the Airport Access Discussion 4-23
Roadway Component of the MTS 4-23
Transit Component of the MTS 4-25
Freight and Goods Component of the MTS 4-27
Chapter 5 - AVIATION FORECASTS 5-1
Historical Aviation Trends 5-1
Previous Forecasts 5-20
Forecast Methodology 5-40
Based Aircraft Forecast 5-42
Factors Affecting the Forecast 5-44
Discussion of Based Aircraft Forecasts 5-47
Regional Distribution of Based Aircraft 5-50
General Aviation Fleet Mix Forecast 5-55
Aircraft Operations Forecast 5-60
Discussion of Operations Forecasts 5-61
Regional Distribution of Aircraft Operations 5-63
Allocation of Forecast Based Aircraft and Aircraft Operations to Airports 5-67
Passenger Forecasts 5-67
Air Cargo Forecasts 5-68
Chapter 6 - SYSTEM CAPACITY AND FUTURE SYSTEM REQUIREMENTS 6-1
Existing Based Aircraft Storage Capacity 6-2
Existing Airfield Capacity 6-3
Future Based Aircraft Storage Capacity Requirements 6-4
Future Airfield Capacity Requirements 6-5
Airport Standards 6-8
Support Facilities 6-15

Chapter 7 - AVIATION SYSTEM STRATEGY 7-1
System Needs and Strategic Options 7-1
Reliever Airports 7-1
Airfield Capacity 7-7
Aircraft Parking Supply 7-8
Pavements 7-9
Safety and Standards 7-10
Potential System Enhancements 7-12
Support Facilities 7-15
Critical Privately Owned Airports 7-16
Regional Airport System Improvement Priorities 7-17
Recommended Regional Airport System Improvement Program 7-21
Regional Airport System Policy 7-21
Regional Airport System Strategy 7-24
Regional Airport System Improvements 7-28
Summary of Airport System Improvements 7-33
Chapter 8 - LAND USE COMPATIBILITY 8-1
The Three Dimensions of Land Use Compatibility 8-1
Technical Guidance in Planning for Airport Compatible Land Use 8-5
Mandates Supporting the Regional Council's Involvement in Airport Compatible Land Use 8-6
Existing and Planned Land Use Adjacent to System Airports 8-8
Land Use Compatibility Findings 8-10
Chapter 9 - IMPLEMENTATION PLAN 9-1
Airport Capital Improvement Plan (ACIP) 9-1
Implementation Plan 9-10
Existing Funding Sources 9-10
Potential Funding Programs 9-11
Chapter 10 - AIRPORT ACCESS PLAN 10-1
Components of Airport Access Demand 10-1
Regionally Significant Transportation Routes and Services Serving the Region's Major Airports 10-4
Airport Trip Generation Data Produced by the Regional Travel Demand Model 10-6
Planned Access Improvements to Major Regional Airports 10-7
Future Issues and System Planning Needs 10-11
Chapter 11 - AGENCY AND PUBLIC INVOLVEMENT PROGRAM 11-1

Bibliography Bib-1

Appendix A Glossary of Terms AA-1
Appendix B Regional Airport System Database AB-1

List of Exhibits

Exhibit 3-1	Regional Airspace	3-8
Exhibit 4-1	Regional Airport System Map	4-2
Exhibit 4-2	Total U.S. Public Use Airports	4-3
Exhibit 4-3	Reliever Airports Matrix	4-5
Exhibit 4-4	Aircraft Owners by County	4-7
Exhibit 4-5	Aircraft Pilots by County	4-7
Exhibit 4-6	Airport Facilities by County	4-9
Exhibit 4-7	Based Aircraft by County	4-9
Exhibit 4-8	Distribution of Airports	4-10
Exhibit 4-9	Distribution of Based Aircraft	4-10
Exhibit 4-10	Based Aircraft per 100,000 Population and Employment	4-12
Exhibit 4-11	Regional Based Aircraft by Type	4-12
Exhibit 4-12	Total Based Aircraft by County	4-12
Exhibit 4-13	Single Engine Piston Aircraft	4-12
Exhibit 4-14	Multi-engine Piston Aircraft	4-13
Exhibit 4-15	Turbo Jet Aircraft	4-13
Exhibit 4-16	Rotorcraft Aircraft	4-13
Exhibit 4-17	Experimental, Ultralight, Gliders, and Other Aircraft	4-13
Exhibit 4-18	Top 10 Regional Airports Ranked by Operations and Based Aircraft (1998)	4-14
Exhibit 4-19	Runway Length by Airport Role	4-15
Exhibit 4-20	Condition of Airport Pavements	4-17
Exhibit 4-21	Regional Air Freight Trends	4-22
Exhibit 4-22	Sea-Tac and King County Int'l Airport (Boeing Field) Air Cargo Market Shares	4-22
Exhibit 4-23	Regional Airport and MTS Roadway System	4-24
Exhibit 4-24	Regional Airport and Transit System	4-26
Exhibit 4-25	Regional Airport and Freight Mobility System	4-28
Exhibit 4-26	Airport Railroad Access	4-29
Exhibit 5-1	Historic Pilot Trends	5-2
Exhibit 5-2	Growing Pilot Sectors	5-2
Exhibit 5-3	Trend in U.S. Pilot Age	5-3
Exhibit 5-4	Active U.S. General Aviation Aircraft	5-5
Exhibit 5-5	GA Aircraft Operations at U.S. Airports with Air Traffic Control Service	5-5
Exhibit 5-6	Total U.S. Local and Itinerant GA Operations at Airports with Air Traffic Control Service	5-7
Exhibit 5-7	GA Aircraft Instrument Operations at Airports with FAA Air Traffic Control Service	5-7
Exhibit 5-8	GA Aircraft Hours Flown	5-9
Exhibit 5-9	Active U.S. GA Aircraft Average Hours Flown	5-9
Exhibit 5-10	General Aviation Fuel Consumed	5-10
Exhibit 5-11	Annual New U.S. Manufactured GA Aircraft Shipments	5-11
Exhibit 5-12	Recent Trends in New GA Aircraft Shipments	5-11
Exhibit 5-13	Total GA Aircraft Billings	5-12
Exhibit 5-14	General Aviation Aircraft Cost Indices - Single Engine Piston Aircraft	5-14
Exhibit 5-15	General Aviation Aircraft Cost Indices - Multi-Engine Piston Aircraft	5-14
Exhibit 5-16	General Aviation Aircraft Cost Indices - Turboprop Piston Aircraft	5-15
Exhibit 5-17	General Aviation Aircraft Cost Indices - Turbojet Piston Aircraft	5-15
Exhibit 5-18	General Aviation Aircraft Cost Indices - Comparison of Total Cost	5-16
Exhibit 5-19	Aircraft and Fuel Price Indices	5-16
Exhibit 5-20	Comparison of 1998 Aviation Activity Measures	5-18
Exhibit 5-21	Comparison of Based Aircraft Forecasts with Actual	5-21
Exhibit 5-22	Comparison of Operations Forecasts with Actual	5-21
Exhibit 5-23	Comparison of Forecast Operations per Based Aircraft with Actual	5-22

Exhibit 5-24 U.S. Economic Forecasts 5-25
Exhibit 5-25 FAA Forecast of Active Pilots 5-27
Exhibit 5-26 FAA Forecast of GA Active Aircraft 5-27
Exhibit 5-27 FAA Forecast of GA Operations at U.S. Airports with Air Traffic Control Service 5-30
Exhibit 5-28 FAA Forecast of U.S. Local and Itinerant GA Operations at Airports with Air Traffic Control Service 5-30
Exhibit 5-29 FAA Forecast of GA Instrument Operations at Airports with Air Traffic Control Service 5-31
Exhibit 5-30 FAA Forecast of GA Aircraft Hours Flown 5-31
Exhibit 5-31 FAA Forecast of GA Aircraft Fuel Consumed 5-32
Exhibit 5-32 FAA Forecast of Rotorcraft Fleet and Hours Flown 5-32
Exhibit 5-33 Regional Population 5-34
Exhibit 5-34 Regional Employment 5-34
Exhibit 5-35 Regional Per Capita Income 5-36
Exhibit 5-36 Puget Sound Region Demographic Forecasts 5-36
Exhibit 5-37 Regional Population Forecast by County 5-37
Exhibit 5-38 Regional Employment Forecast by County 5-37
Exhibit 5-39 Regional Per Capita Income Forecast by County 5-38
Exhibit 5-40 Summary of Regional Based Aircraft Forecasts 5-43
Exhibit 5-41 Regional Distribution of Based Aircraft 5-51
Exhibit 5-42 Forecast Future Distribution of Based Aircraft 5-54
Exhibit 5-43 Fleet Mix Forecasts 5-57
Exhibit 5-44 Existing and Forecast Based Aircraft Fleet Mix by County 5-59
Exhibit 5-45 Summary of Regional Operations Forecasts 5-60
Exhibit 5-46 Regional Distribution of Aircraft Operations 5-64
Exhibit 5-47 Forecast Future Distribution of Aircraft Operations 5-65
Exhibit 5-48 Selected Regional Aviation Forecasts Summary 5-66
Exhibit 6-1 Existing Airport System Capacity (1999) 6-21
Exhibit 6-2 Future Landside Capacity Requirements 6-22
Exhibit 6-3 Future Airfield Capacity Requirements 6-23
Exhibit 6-4 Airport Runway Standards 6-24
Exhibit 6-5 Airport Safety Areas, Approaches, Obstructions, and Visibility Minimums 6-25
Exhibit 6-6 Airport Support Facility Requirements 6-29
Exhibit 6-7 Summary of Top Ten Airports 6-30
Exhibit 7-1 Summary of Reliever Airports 7-2
Exhibit 7-2 Potential Reliever Airports 7-3
Exhibit 7-3 Comparison of Aviation System Improvement Policies and Priorities 7-19
Exhibit 7-4 Regional Airport System Improvements 7-30
Exhibit 8-1 Land Use Compatibility with Yearly Day-Night Average Sound Levels (DNL) 8-2
Exhibit 8-2.1 Airport Compatible Land Use - Part 1 8-12
Exhibit 8-2.2 Airport Compatible Land Use - Part 2 8-13
Exhibit 8-3 Aircraft Accident Safety Zone Diagram 8-14
Exhibit 9-1 Airport System Capital Improvement Program 9-2
Exhibit 9-2 Airport System Capital Improvement Summary 9-8
Exhibit 10-1 Airport-Related Employment 10-3

Chapter 1 - Introduction

Background on the *2001 RASP* and *Destination 2030*

The *2001 Regional Airport System Plan* (RASP) is the aviation technical component of *Destination 2030*, the adopted long range multi-modal transportation plan for the Central Puget Sound Region. *Destination 2030* serves as the region's federally mandated Metropolitan Transportation Plan (MTP) and state mandated Regional Transportation Plan (RTP). In addition to the regional airport system component, *Destination 2030* addresses other multi-modal components of the region's transportation system, including highways, transit, freight and goods mobility, ferries, demand and system management programs, intelligent transportation system (ITS) program, and the non-motorized system. Numerous plans, studies, and programs related to the many elements of the regional transportation system have provided critical background data and technical analysis that is incorporated into *Destination 2030*. Similarly, the *2001 RASP* provides technical detail to supplement the aviation component of *Destination 2030*.

The two documents are inherently different in level of detail, with the *2001 RASP* being a more technical document, and *Destination 2030* reflecting adopted regional policy and long range needs and development strategies. The region's previously approved long range commercial air transportation capacity decisions, which are documented in *Destination 2030*, continue to support planning for a third runway at Sea-Tac to meet the region's long term commercial passenger demand. The *2001 RASP* incorporates these decisions. In addition, the *2001 RASP* provides updated information and analysis for the region's general aviation airports, which was incorporated into *Destination 2030*. The adoption of *Destination 2030* on May 24, 2001, established a new regional transportation plan that supercedes the 1995 Metropolitan Transportation Plan (*1995 MTP*) and the region's *1988 Interim Regional Airport System Plan* (*1988 RASP*).

The *2001 RASP* presents technical documentation regarding the general aviation airport system planning process. The plan includes a discussion of issues and trends affecting the general aviation market, an inventory of the current airport system, general aviation forecasts to the year 2020, analysis of system capacity and future requirements, recommended general aviation airport system improvement strategy, and a regional airport system capital improvement program (CIP). In addition, the report contains supporting discussions of related planning issues, including airport compatible land use and airport ground access. The report also provides a summary of the technical advisory committee process which was highly instrumental in overseeing the development of the plan as it relates to the region's general aviation airports.

The 2001 Regional Airport System Plan presents a 20-year general aviation airport system improvement program that focuses on maintaining and preserving the existing system combined with strategic investments in system enhancement. The program will enhance airport system safety by addressing FAA and State DOT airport design standards, provide system enhancements to meet forecast growth and changing user needs, support ground access improvements serving the region's major airports, and support airport compatible land use in communities adjoining the region's airports.

Summary of the Regional Airport System

The region's 26 public use airports provide the residents and businesses of the Puget Sound region access to the state, the nation, and the world's aviation system. The region's major commercial airport, Sea-Tac International, provides passenger and air cargo service, while the general aviation airports provide a wide range of aviation services that support businesses, recreation, training, natural resources, emergency response, military missions, and personal mobility. In 1999 the region's 25 general aviation airports accommodated over 1.6 million take-offs and landings (80% of the region's total). Sea-Tac Airport, with over 400,000 annual takeoffs and landings, comprised the other 20%. The region is home to over 3,600 general aviation aircraft, which range from the smallest single engine Cessna to traffic and medical evacuation helicopters, from gliders and ultralight aircraft to large corporate jets.

Seattle-Tacoma International Airport served over 28 million annual passengers in 2000 and processed some 500,000 US tons* of cargo. Air cargo, with an annual growth rate of 6%, is the fastest growing segment of the aviation industry. The region's two major air cargo airports (Sea-Tac International and Boeing Field) provide the region with two gateways to world commerce, bringing us daily goods such as that new shirt from Eddie Bauer, a box of Alaskan King Salmon, the latest software, and yesterday's order from Amazon.com. In 2000, the region saw nearly 650,000 US tons of air cargo processed through these two airports. This translates to moving over 400 pounds of cargo per capita per year, or just over one pound per person every day.

The public use airport system supports the region's economy and life style in a wide variety of ways. Studies of the economic impact of airports show significant benefits to the region, including direct and indirect employment, public tax revenues, travel and tourism revenues, salaries and associated spending, and secondary economic impacts. Boeing Field, Paine Field, and Renton Municipal Airport, three of the airport system's busiest general aviation airport facilities, provide infrastructure that directly supports the Boeing Company's manufacture, testing, certification, and customer delivery of its passenger and cargo jet aircraft. The benefits of airports go beyond economic and numerical measures. The region's general aviation airports provide cost-effective alternatives to commercial air transportation for businesses and individual travelers. These include corporate, business, and charter aircraft used for business and personal travel. The region's airports provide a network of facilities for pilot training and certification, and serve a full range of student pilot programs. Many of these pilots eventually continue to become commercial airline or military pilots. In this sense, the region's airports provide an infrastructure for supplying our nation's military and commercial airlines with an essential ingredient - qualified new pilots.

Airports also serve several essential but less well known public functions, such as medical evacuation, police reconnaissance, fire fighting, aerial surveying and photography, traffic and news reporting, and emergency response. In rural areas, airports are typically used by aerial application businesses, such as crop spraying and aerial analysis of natural resources. Even more than in urban areas, airports that serve isolated rural communities are a critical transportation link to the "outside world." During natural disasters airports provide essential staging areas for emergency medical teams, disaster relief, evacuation, and other emergency response team functions. Recognizing the benefits the region derives from the airport system, the *2001 RASP* documents the region's airport system improvement strategy - to preserve the existing system and provide strategic enhancements to meet the region's future airport needs. The report begins with a summary of goals, issues, and trends to provide a context for the overall airport system planning process.

* *A standard US ton = 2,000 lbs*

Chapter 2 - Goals, Issues, and Trends

Following is a list of aviation goals, issues, and trends that will help to shape the future of aviation in the Central Puget Sound Region. Planning for PSRC's airport system began with a statement of current and likely future international, national, statewide, and regional trends in the aviation industry.

GOALS OF THE PLAN UPDATE

The key goals of this *2001 RASP* work effort are as follows:

- To provide current and accurate information about the region's airport infrastructure.
- To document historic trends and current and emerging issues that will affect the region's airports.
- To present a comprehensive system-wide perspective on the region's airports.
- To evaluate current and future airport roles in light of regional aviation trends and needs.
- To identify existing and future regional airport preservation and capacity enhancement needs, and develop a strategy and airport improvement program for meeting those needs.
- To develop a regional airport capital improvement program (CIP) and establish a project priority system for airport system investments, including airport pavements.
- To evaluate the extent of airport land use compatibility problems in the region and identify actions to address them.
- To identify key airport-access needs and begin to integrate planning for airport access with other MTP components, including coordinated planning and programming of capital improvement funds through the ISTEA process.

AVIATION ISSUES

Following is a list of aviation issues and trends that may affect the future of aviation in the Central Puget Sound Region.

Airport Development and Funding

- Airport funding
- Airport development and spending priorities
- Airport pavement
- Airfield capacity and aircraft parking supply
- Airport safety and security
- Standards (RPZs, safety areas, OFAs, separations, BRL, etc.)
- Airspace protection/obstruction marking and removal
- Navigational aids
- Lighting
- Fencing
- Ground access

Airports' Relationship to Other Transportation System Components

- Airports' role in the region's freight and goods mobility
- Airports' role in the region's emergency response network
- Integration of the region's airports with other transportation systems, such as highways, transit, rail, and marine terminals
- GA airports' potential role in providing regional passenger and air cargo service
- The airports' role in the local, regional, and state economies

Airport-Community Compatibility and Environmental Issues

- Noise
- Air quality
- Water quality
- Hazardous materials/fuel storage
- Airport preservation
- Land use encroachment
- Compatible land use planning
- Growth Management Act (GMA) provisions related to airports as "essential public facilities"
- Additional GMA issues related to land use compatibility planning around the State's airports (definitions, applicability, education, implementation, funding, technical assistance, etc.)
- Economic development at airports

Aviation Trends

General Aviation Market

- The decade-long decline in the General Aviation industry bottomed out in the early to mid-1990s, and has since that time shown signs of stabilizing. Some components, such as business and corporate aviation, have seen steady growth.
- There continues to be a steady market for business and corporate aviation.
- The strong market for airline pilots continues. Fueled by strong growth in the air carrier and air cargo airline industry, there is a continuing demand for qualified pilots. This demand translates into a need for new student pilots, pilot training programs, new aircraft, and airport facilities to serve these programs.
- Passage of GA product liability insurance limitations in 1994 (*General Aviation Revitalization Act)* has caused a resurgence in the manufacturing of general aviation aircraft and a renewed interest in aviation.

- **Economic Development and Employment**

- Larger general aviation airports have become magnets for economic development, including aircraft manufacturing, business and corporate aviation, and related businesses.
- Larger general aviation airports have become the centroids of major regional employment centers, generating significant surface traffic with related impacts.

- Because of the growth in economic development and employment around larger general aviation airports, there is a growing need for surface access improvements and access capacity enhancements (including transit) as well as programs aimed at demand and system management (TDM, TSM, ITS, etc.). There is also a growing need for better integration of the region's airports with other transportation systems, such as highways, transit, rail, and marine terminals.

Airport Roles

- As Sea-Tac Airport and King County Int'l Airport (Boeing Field) continue to grow and focus on the passenger, air cargo, and corporate and business aviation markets, the region's general aviation airports experience "ripple" effects. There may be a need to re-evaluate the role of the region's airports (particularly the reliever airports) in light of these recent trends and future forecasts.

Funding

- While AIR-21 has provided additional nationwide funding for aviation system improvements, actual funding levels have not been sufficient to meet the regional airport system's needs. As a result, there is an increasing need to coordinate regional, state, and federal funding priorities. There is also a need to increase revenue retention (aircraft and pilot registration fees and aviation fuel taxes), as well as seeking additional revenue sources.

Environmental Concerns

- For political and environmental reasons, the implementation of airport system improvements has become more difficult. There is increasing concern over environmental issues, including noise, air quality, and water quality (related to storm water runoff, wetlands, aircraft de-icing, aircraft fueling, and fuel storage). These concerns, combined with the encroachment and funding issues, are making it more difficult for general aviation airports to preserve existing airport infrastructure and accommodate growth.
- Airports in King, Pierce, Snohomish, and Kitsap Counties play an increasing role in the regional/state economy. At the same time, the environmental impacts of airport operation and development are well-known. In planning to meet the region's future aviation needs there is a need to identify and balance environmental, economic, and social objectives.

Freight and Goods Mobility

- Airports play an important role in the region's freight and goods mobility. In 1999 Sea-Tac International Airport and King County Int'l Airport (Boeing Field) processed over 1.25 billion pounds of air cargo, or about 400 pounds per person. Much of this cargo (which includes air mail, overnight express, and traditional air freight) moved through these airports and onto the region's highway system. Access to the region's ground transportation system, as well as the adequacy of landside cargo processing space, are increasingly critical for air cargo carriers' facility and operational planning. In response to these and other volatile market factors in the air cargo industry, increasing amounts of air cargo activity have moved from Sea-Tac to King County Int'l Airport (Boeing Field). Between 1994 and 1999 Boeing Field's regional air cargo market share has increased from 8% to over 22%.

- Between 1985 and 2000 total air cargo volume in the region grew by 180% (an average annual growth rate of 7%). According to the Boeing Company's *2000 Current Market Outlook (August 2000)*, total world air cargo will grow by between 6 and 7% per year, more than tripling total cargo volume between 1997 and 2017. To meet these demands the region's public and private sectors will need to provide adequate airport capacity (both airside and landside), adequate cargo processing space, and improved access to the regional ground transportation system and the regional air cargo market (customers, suppliers, shippers, etc.).

Emergency Response

- Airports play a critical role in the region's emergency response network. One of the issues to be addressed in future airport system planning efforts (and the MTP) is how to define and fund a minimum emergency response airport system that will meet the region's future needs.

Other Airport System Plan Considerations

Land Use Encroachment/Growth Management Act (GMA)

- Land Use Encroachment continues to threaten the future of general aviation airports. In 1996, SB 6422 amended the state's Planning Enabling Act (RCW Chapter 36.70) and the Growth Management Act (RCW Chapter 36.70A). The amended law requires all local jurisdictions engaged in comprehensive planning under GMA to discourage the siting of incompatible uses adjacent to general aviation airports in their jurisdiction. The State and PSRC are exploring how the provisions of the Growth Management Act (GMA) can be applied to address the issues of airport preservation and land use encroachment. Possible actions might include defining certain airports to be of regional or statewide significance and the adoption of stronger compatible land use controls around these airports. Under existing state law (RCW 36.70A.200) airports are defined as essential public facilities, and cities and counties planning under the Growth Management Act are required to include a process for identifying and siting essential public facilities (including airports) in their comprehensive plans.

Economic Pressures

- Public use airports are increasingly threatened by economic issues. The high cost of flying combined with the lack of sufficient funding for airport maintenance, safety improvements, and capacity enhancement have placed airports on shaky financial ground. In addition, increasing land values in the urban region threaten privately owned airports, whose owners may seek to redevelop airport property into more profitable uses. These issues, combined with land use encroachment and environmental issues, has forced the closure of many public use airports, across the country and in the Puget Sound Region. Documenting the importance of airports and preserving them has become an important issue for the aviation industry.

FAR Part 150 Limitations

- On April 3, 1998, the **FAA adopted a new policy** which restricts the use of FAA Part 150 funds for remedial noise projects. The new policy states:

  *"....as of October 1, 1998, the FAA will approve under 14 CFR part 150 (part 150) only remedial **noise mitigation** measures for existing noncompatible development and only preventive **noise mitigation** measures in areas of potential new noncompatible development. The FAA **will not** approve remedial **noise mitigation** measures for new noncompatible development that occurs in the vicinity of airports after the effective date of this final policy."*

  Under the new policy FAA Part 150 money could not be used to install noise insulation in new homes built after October 1, 1998. In addition to airport sponsors, the new policy is directed at local agencies with land use authority. The policy sends a message calling for stronger local commitment to effective compatible land use planning and building codes. The clear intention of the new policy is to encourage noise insulation in new development within airport noise contours, rather than allow such development to occur and then attempt to address the noise problem "after the fact," using Federal Part 150 funding. This new FAA rule correlates well with the State's new GMA requirement to discourage incompatible land uses adjoining the state's general aviation airports.

Impacts and Mitigation

- The benefits which accrue from major airports are usually distributed throughout the region they serve, while the majority of significant impacts are confined to the communities immediately adjoining the airport. There is a growing need for regional strategies to mitigate the localized impacts of airports which benefit the entire region.

Airport Pavement

- Airport pavement conditions information collection systems and pavement management strategies continue to be a critical issue at the regional, state, and national level. There is a need for coordinated efforts to address this issue. As a first step in creating a comprehensive statewide pavement program, visual inspections of existing pavement conditions were performed in 1998 by the WSDOT Aviation Division. The results of these visual inspections were incorporated into the *2001 RASP* where appropriate, primarily for the smaller airports. Additional more detailed airport pavement inspection, condition assessment, and analysis of future pavement needs, was completed at 13 of the region's larger general aviation airports in late 2000 by the WSDOT Aviation Division. This analysis, which used the latest pavement analysis computer software ("MicroPaver"), is incorporated into the *2001 RASP*.

Chapter 3 - Airport System Planning Background

History of Regional Airport System Planning

The following provides a brief summary of the region's previous airport system planning activities. It is included here to provide background and context for the system plan.

1969 Air Transportation System Advance Plan (ATSAP)

The first Airport System Plan for the Central Puget Sound Region was prepared by the Puget Sound Governmental Conference (PSGC) in 1969. The 1969 plan was called the *Air Transportation System Advance Plan (ATSAP)*. The plan, which had a planning horizon of the year 2000, was prepared amid strong economic growth in the Puget Sound region, highlighted by spectacular growth in the commercial and general aviation industries. Employment in the region's aerospace industry, led by Boeing's 747 program, had doubled from 52,000 to 104,000 between 1964 and 1968. Recognizing this strong growth trend, the 1969 plan was built upon very optimistic forecasts, and included an ambitious regional airport development program. The plan called for major improvements to the region's existing airports, construction of several new general aviation airports, construction of a second regional air carrier airport, and creation of a regional airport district to own and operate the two commercial air carrier airports. In 1970 the region entered a steep economic downturn. The ATSAP was shelved, and the plan was never officially adopted.

1974 Regional Airport System Plan (RASP)

In 1974 the Puget Sound Council of Governments (PSCOG), the successor to PSGC, received an FAA grant to prepare a new regional airport system plan (the 1975 plan). The 1975 plan had a planning horizon of 1990, and was based on scaled back forecasts of air carrier and general aviation demand. In the five years since the region's first airport plan, the regional economy had experienced a dramatic downturn that was especially hard on the regional aviation industry. Regional unemployment reached 11.6% in 1971, and aerospace employment in the four-county region fell from 104,000 in 1968 to 43,000 in 1971. Between 1967 and 1971 the Boeing Company's company-wide employment dropped from 145,000 to 50,000. Based on these factors, the 1975 plan concluded that Sea-Tac Airport had sufficient capacity to meet forecast passenger and air cargo demand through the forecast period (1990). The 1975 plan retained the earlier plan's recommendation for construction of a new general aviation airport on the east side of Lake Washington in King County. Like its predecessor, however, the new airport plan was tabled in 1975 before it was adopted.

1979 Regional Airport System Plan (RASP)

In 1979 PSCOG received another FAA grant to update the 1975 Regional Airport System Plan. Although the region's economy was recovering from a 3-year slump, the 1979 plan again concluded that Sea-Tac had sufficient capacity to serve the region's air carrier needs through the year 2000. The 1979 plan did, however, recommend construction of a new general aviation airport by the year 1990 to serve general aviation demand in King and Snohomish counties. Although the concept of a new general aviation airport was controversial, the plan was adopted in 1982.

1988 Regional Airport System Plan (RASP)

In 1985 PSCOG initiated an update of the 1979 plan. This effort, completed in 1988, was coordinated with updating of the *Regional Transportation Plan,* and both plans were based on a year 2020 horizon. This was the first plan that had looked beyond the turn of the century. As the 1988 plan was being prepared, the region had seen steady economic and population growth for 17 years, and the longer range forecasts predicted these trends would continue.

In addition to addressing commercial and public use general aviation needs, the scope of the *1988 RASP* was broadened to address helicopter service needs, seaplane facility needs, privately owned airport issues, and sport aviation issues. The three-year planning process produced an updated Regional Airport System Plan (*RASP*), which was adopted in 1988. The plan developed two primary sets of recommendations; one for the air carrier system and one for the general aviation system.

1988 RASP Air Carrier System Recommendations

The plan recommended the following air carrier alternatives be evaluated:

- Develop satellite airports by upgrading existing airports; candidates included Bremerton National, McChord AFB, Snohomish County Airport (Paine Field)

- Develop new satellite airports at one or two sites

- Maximize air carrier capacity at Sea-Tac International Airport (analysis showed the existing airport would reach capacity shortly after the year 2000)

- Develop a new primary air carrier airport

- Optimize existing airport system capacity through a variety of resource management actions (no major expansions)

The plan also recommended the following air carrier system actions:

- PSCOG proceed expeditiously with detailed evaluation and selection of a preferred regional air carrier system alternative

- Renton Municipal, Snohomish County Airport, and Bremerton National airports encourage increased corporate and training aviation to divert flights from King County Int'l Airport (Boeing Field)

- Prevent further encroachment and incompatible development around area airports through local land use plans and zoning codes

- Evaluate King County Int'l Airport's potential role in meeting the region's air carrier demand

- Investigate institutional and financing options for development and operation of the air carrier airport system

1988 General Aviation System Recommendations

- Preserve existing public use general aviation airports
- Prevent further encroachment and incompatible development around area airports through local land use plans and airport overlay zones
- Support economic incentives designed to preserve privately owned public use general aviation airports
- Consider public acquisition of privately owned public use airports threatened with closure
- Assess the feasibility of constructing new general aviation airports in King County
- Encourage the Port of Seattle to consider the impacts of its actions at Sea-Tac on general aviation activity and facilities at other system airports
- Retain for further analysis the following GA system alternatives: (a) maintain the viability of existing GA airports; (b) expand capacity of selected existing GA airports; and (c) expand capacity by developing new GA airports
- Provide helicopter landing facilities in central city locations if warranted
- Protect privately owned public use airports through zoning for land use compatibility, economic incentives, and liability insurance programs
- Preserve existing seaplane services and facilities and reduce their negative impacts
- Provide adequate physical and operating facilities for sport aviation activity, and mitigate adverse community impacts.

After the adoption of the Regional Airport System Plan in 1988, the region proceeded with many of the recommendations regarding the air carrier airport system, but did not move ahead to implement the new facility components of the general aviation airport system program. The *2001 RASP* has filled some of these gaps by focusing on the needs of the region's general aviation airports. However, the *2001 RASP* did not revisit previous decisions regarding the region's long range commercial air transportation capacity needs.

New Planning Authority

Since adoption of the last Regional Airport System Plan in 1988 several new laws have expanded the Regional Council's authority to develop and implement regional transportation plans. These include the Washington State Growth Management Act (GMA), Substitute Senate Bill SSB-6422 (which amended the GMA), Regional Transportation Planning Organization (RTPO) authority to prepare Regional Transportation Plans, and the recently adopted national Transportation Equity Act for the 21st Century ("TEA-21").

Growth Management Act

The Regional Council has specific authority under GMA to review and certify the transportation elements of local comprehensive plans. Funding for transportation projects included in the regional Transportation Improvement Program (TIP) is conditioned on certification of the plans. The plan review and certification process assures that local plans meet specified state requirements for transportation planning and that local plans are consistent with the Metropolitan Transportation Plan (MTP). The 1996 amendments to GMA (SSB-6422) require counties, cities, and towns planning under GMA to use their comprehensive plans and development regulations to discourage the siting of incompatible land uses adjacent to public use general aviation airports. The responsibility for implementing the provisions of SSB-6422 are shared by the Washington State Department of Community, Trade, and Economic Development, the Washington State Department of Transportation Aviation Division, and the Puget Sound Regional Council. The Regional Council has amended its plan certification process to identify and review actions and plan provisions being taken by local governments to prevent incompatible land uses. One of the tasks included in this plan is to document the extent of incompatible land use problems adjoining the region's airports and identify possible actions needed to address these problems. The task also reviews how the "Essential Public Facility" provisions of GMA might be used to help preserve the public use airports of the region [*See Chapter 8: Land Use Compatibility*].

Regional Transportation Planning Organization (RTPO) Authority

The Regional Council's authority to develop the Regional Transportation Plan (also known as the Metropolitan Transportation Plan, or "MTP") is contained in Chapter 47.80 of the Revised Code of Washington (RCW). The RCW instructs the Regional Council to cooperate with the State DOT, public transportation providers, ports, and local governments to prepare the RTP (or MTP). The plan, which is reviewed every two years, identifies existing and planning transportation facilities, services, and programs, including roadways, transit, multi-modal and intermodal facilities, marine ports and airports, and railroads. The RCW also instructs the Regional Council to include a financial plan for implementing the MTP, which in the Central Puget Sound region consists of the 6-year Transportation Improvement Program (TIP) and related 6-year Action Strategy. The Regional Council has prepared a major update to the 1995 MTP, called *Destination 2030*. The update, adopted on May 24, 2001, incorporates the results of this Regional Airport System Plan, including support for airport access improvement projects [*see Chapter 10: Airport Access Plan*].

Guiding Principles for the National Airport System [1]

Section 504 of the *Airport and Airway Improvement Act of 1982* (P.L. 97-248), as amended, directs the Secretary of Transportation to prepare, publish, and revise every two years a national airport system plan for the development of public use airports in the United States. The Secretary of U.S. DOT has given the Federal Aviation Administration (FAA) responsibility for developing and maintaining the *National Plan for Integrated Airport Systems (NPIAS).* The NPIAS, or National Airport System, was envisioned over 50 years ago. Since that time, the national airport system has been developed and nurtured by close cooperation among Federal, State, and local agencies and airport sponsors. The NPIAS represents a consolidation of planning, forecasting, development, and funding data derived from individual airport master plans, regional airport system plans, and state airport system plans from across the nation, and also includes national aviation forecasts and other relevant national data. The NPIAS currently comprises over 3,600 public use airports in all 50 states, Puerto Rico, Virgin Islands, and the Pacific Islands. The FAA's *Guiding Principles* for Federal involvement in the National Airport System have remained unchanged for over half a century:

- Airports should be safe and efficient; located at optimum sites; and developed and maintained to appropriate standards.

- The system should be extensive, providing as many people as possible with convenient access to air transportation, defined as 30 minutes ground travel time to the nearest civil airport.

- Airports should be affordable to both users and Government, relying primarily on user fees and placing minimal burden on the general revenues of local, state, and Federal Government.

- Airports should be flexible and expandable, able to meet increased demand and to accommodate new aircraft types.

- Airports should be permanent, with assurances that they will remain open for aeronautical use over the long term.

- Airports should be compatible with surrounding communities, maintaining a balance between the needs of aviation and the requirements of residents of neighboring areas.

- The airport system should help air transportation contribute to a productive and competitive national economy.

[1] *National Plan of Integrated Airport Systems (NPIAS),* April 1995, by FAA

Airport Service Levels and Airport Roles [2]

Airport Service Level Categories

When planning for airport systems, both *airport service levels* and *airport roles* must be defined. *Airport Service Level* defines the overall type of airport. The designation of *Airport Role* sets forth the physical parameters for airport development. There are 5 airport service levels which specify the overall type of airport. These include:

PR Commercial Service - Primary
CM Commercial Service - Other
CR Reliever Airport with Commercial Service
RL Reliever Airport
GA General Aviation Airport

The Central Puget Sound Regional Airport System includes 28 airports. There is one Primary (PR) Commercial Service Airport: Sea-Tac. The NPIAS criterion for a Primary Airport is a commercial service airport with more than 10,000 annual passenger enplanements. A commercial service airport has more than 2,500 annual passenger enplanements. There are no other designated commercial service airports, either CM or CR. There are currently five designated reliever airports, including King County Int'l Airport (Boeing Field), Renton, Auburn, Snohomish County Airport, and Harvey Field. The remaining system airports include 21 general aviation airports and the two military airfields (McChord Air Force Base and Gray Army Airfield at Fort Lewis). Of these 21 GA airports, 4 are seaplane bases.

Reliever Airports Defined

Reliever airports are general aviation airports in metropolitan areas which are intended to reduce congestion at large commercial service airports by providing general aviation pilots with alternative landing areas. According to the NPIAS, to be designated as a "reliever" an airport must provide substantial capacity or instrument training relief, as evidenced by: (a) a current activity level (or, in the case of a new airport or an airport that is slated for major improvement, a forecast of activity level) of at least 100 based aircraft, or 25,000 annual itinerant operations, or 35,000 annual local operations (a heliport may qualify as a reliever if it has one-half of this activity level); or, (b) the FAA Regional Administrator has determined that the airport is a desirable location for instrument training activity.

Reliever airports need to provide a range of services and facilities to serve aviation users. The FAA does not specify what these facilities should include. As a practical matter, general aviation reliever airports will attract greater activity (operations, based aircraft, fuel sales, training, etc.) if they respond to the demands of the general aviation market.

[2] *National Plan of Integrated Airport Systems (NPIAS),* April 1991, by FAA

The following are criteria which should be considered in designating a reliever airport:

- Airport location related to aircraft owners/pilots
- Level of aircraft activity (operations)
- Runway length
- Approaches / approach lighting
- Electronic navigation aids
- Fuel availability
- Pilot training
- Weather reporting
- Local/regional airspace constraints
- Compatible adjoining land use
- Number of based aircraft
- Airfield and landside capacity
- Pavement condition
- Airport lighting
- Visual navigation aids
- Aircraft maintenance facilities
- GA terminal facilities
- Facility, product, and service pricing
- Ground access
- Obstructions

Airport Role Categories

In addition to airport service level, airports are classified according to the types of aircraft that use them. This classification system responds to aircraft size (wing span) and performance (approach speed), and is the basis for airport design standards. These include runway and taxiway separation standards, runway and taxiway design standards, runway and taxiway safety area requirements, runway protection zone ("RPZs") and obstacle free area ("OFAs") requirements, runway approach requirements, navigational aids and lighting standards, and other airport design criteria. These airport classifications include:

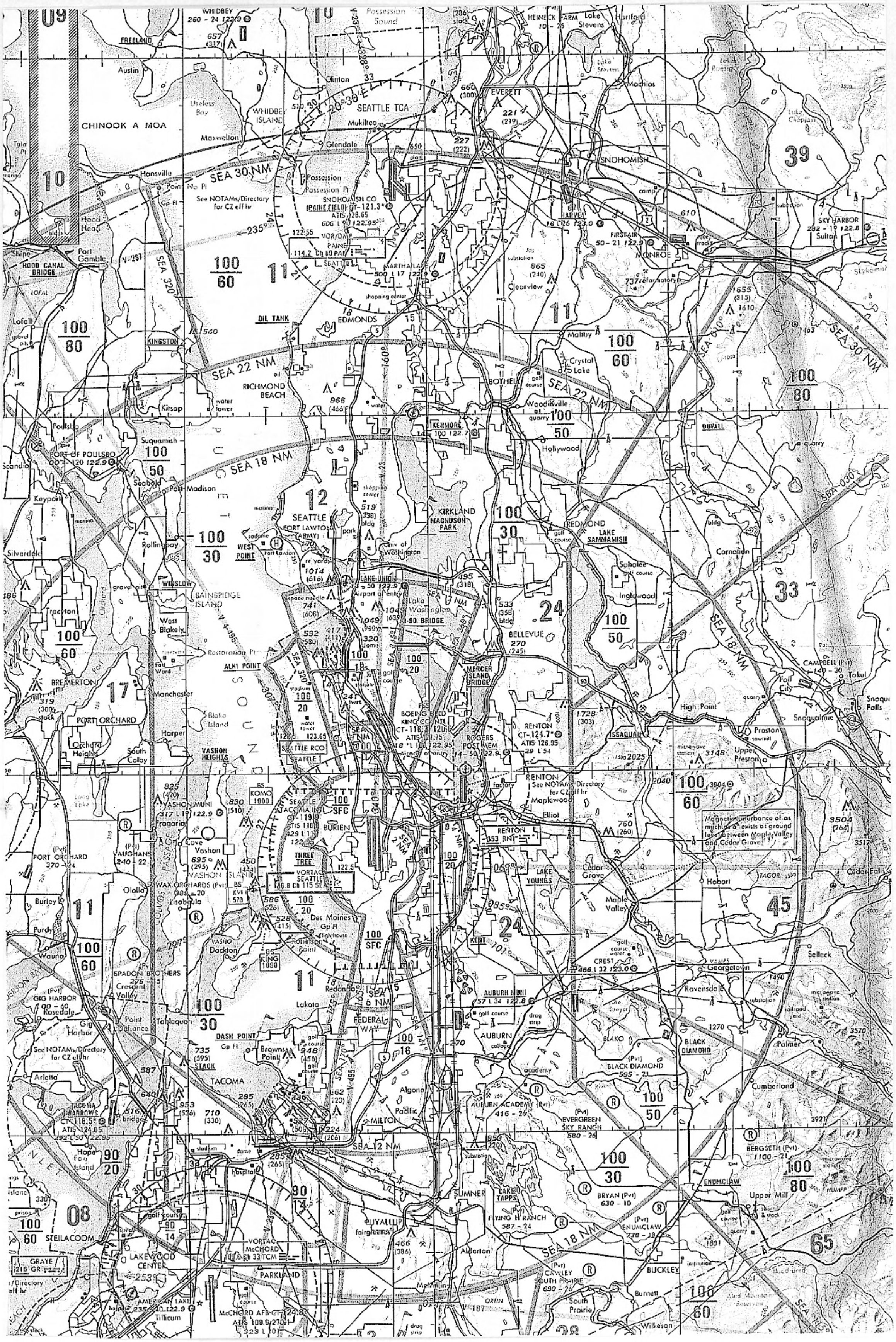
BU Basic Utility
GU General Utility
TR Transport

The ***Basic Utility*** airport (BU) accommodates most single engine and many small twin engine aircraft, or about 95% of the general aviation fleet. The average BU airport has a 3,200 foot long runway. ***General Utility*** airports (GU) accommodate virtually all general aviation aircraft, and typically have runways of 4,300 feet in length. Other general aviation airports are designed using standards to accommodate transport type aircraft or business jets.

Regional Airspace

The Federal Aviation Administration (FAA) is responsible for the safe and efficient use of air space. Air space is divided into three specific types: (1) tower; (2) terminal; and (3) enroute. Most aircraft use all three types of airspace, and are "handed off" from one type of air traffic controller to another when they transition from one type of airspace to the next. When an aircraft departs from an airport the aircraft is flying in airspace under the control of air traffic controllers working in an air traffic control *tower*. This airspace is known as tower airspace. When the aircraft is approximately 1 mile from the airport, the aircraft is handed off to controllers working in the *Terminal Radar Approach Control Facility (TRACON)*. This is terminal airspace. The TRACON controllers are responsible for the airspace extending out approximately 30 miles in all directions from the airport. This terminal airspace can be seen in Exhibit 3-1. As an aircraft leaves the terminal air space it enters *enroute* air space, and becomes the responsibility of enroute air traffic controllers working in an *Air Route Traffic Control Center (ARTCC)*. The enroute controllers retain control until the aircraft nears its destination, when the process is reversed for landing.

Exhibit 3-1 Regional Airspace



The Seattle-Tacoma International Airport Terminal Area air space is shown in Exhibit 3-1. This air space has been delegated to the Sea-Tac TRACON facility by the Seattle ARTCC (or "Center"). The Center provides air traffic control (ATC) services to aircraft between terminal areas. The Seattle TRACON provides approach and departure services within its designated air space (Terminal air space). There are twelve airports with air traffic control towers located in the Seattle TRACON airspace. These include Seattle-Tacoma International, King County Int'l Airport (Boeing Field), Snohomish County Airport, Renton Municipal, McChord AFB, Gray Army Air Field, and Tacoma Narrows Airport). These towers provide air traffic control within the Seattle TRACON's airspace.

Twenty two other general aviation airports operate without control towers or published instrument approaches. Although aircraft using these GA airports operate under visual approach rules (VFR), most of these airports utilize the region's terminal air space, and air traffic operating under both IFR (instrument flight rules) and VFR (visual flight rules) to and from the region's towered airports must be separated to maintain safety within the region's air space. Because of the complexity and congestion within the Seattle terminal airspace, a majority of activity is related to either scheduled or unscheduled air carrier flights (both passenger and cargo), air taxi activity, and corporate aviation. Over the years a combination of regional airspace issues, airport capacity constraints, and the higher cost of flying, have increased the pressure for lower end general aviation activity to relocate to airports around the fringe of the urban area. As a result, several airports located near the edge or outside the Seattle Terminal (TRACON) airspace have seen growth. These include Arlington, Harvey Field, FirstAir (Monroe), Snohomish County Airport, and Crest Airpark.

Since 1979 activity at these 5 airports has grown significantly. Between 1979 and 1998 total based aircraft grew from 921 to 1,704 and aircraft operations grew from 387,999 in 1979 to 551,000 in 1998. At the same time several airports located closer to the center of the urban area have seen level or reduced operations and based aircraft. For example, at King County Int'l Airport (Boeing Field) both annual operations and the number of based aircraft have declined between 1979 and 1998. At Auburn, Renton, Thun Field, and Tacoma Narrows airports the number of based aircraft has grown while annual aircraft operations have declined. During this same time frame the region saw numerous airports close. All these factors have conspired to drive a shift in the geographic distribution of general aviation based aircraft and operations activity in the region. Planning for the future regional airport system reflects these historic forces and attempt to predict future factors which may affect the regional market for general aviation, including its relationship to commercial aviation.

The region's 28 public use and military airports generated about 2 million aircraft operations in 1998, creating a busy and complex regional airspace. In addition to the air traffic, poor weather conditions and the region's topography provide additional challenges to the region's air traffic controllers. Both the Seattle ARTCC and TRACON provide control primarily to aircraft operating under instrument flight rules (IFR). In addition, TRACON provides control to aircraft operating under visual flight rules (VFR) within the Seattle Class B Airspace. An air traffic control (ATC) clearance and control is mandatory for VFR aircraft operating within Class B airspace. The Seattle Class B Airspace Area is shown in Exhibit 3-1.

In April 1990 the FAA standardized the air traffic patterns for jet aircraft flying to and from Sea-Tac Airport. The new traffic plan (the "Four Post Plan") changed the arrival and departure procedures used by the air traffic controllers to transfer aircraft from the enroute to the terminal environment. The FAA determined that safety and efficiency could be improved if the procedures used to route air traffic to the terminal airspace area were designed to be the same regardless of the direction of traffic flow. Depending on the city of origin, aircraft enter the terminal air space from one of four "posts," located on the corners of the terminal airspace area. These procedures help to alleviate difficulties associated with having two different sets of patterns that were wind dependent.

Most scheduled airline flights at Sea-Tac Airport fly using instrument approach procedures in both IFR and VFR weather conditions. During low visibility conditions, generally all aircraft use instrument approach procedures during take-off and landing. Published instrument approach procedures exist for several airports within the Seattle TRACON terminal airspace as shown in Exhibit 3-1. These include Sea-Tac, King County Int'l Airport (Boeing Field), Bremerton National, Gray Army Airfield, McChord AFB, Renton, Snohomish County Airport, and Tacoma Narrows. Instrument approach procedures include both precision and non-precision instrument approaches. A precision instrument approach, by definition, provides electronic vertical guidance to the pilot as well as horizontal (azimuth) guidance. A non-precision approach provides horizontal guidance only. Generally the azimuth guidance for a precision approach is more precise. For an Instrument Landing System ("ILS") approach procedure, a localizer transmitter provides the azimuth guidance and a glide slope transmitter provides the vertical guidance.

In addition to civilian airspace Exhibit 3-1 shows the Military Operating Areas ("MOAs") related to McChord Field and Gray Army Airfield at Ft. Lewis. These areas represent restricted airspace where military aircraft perform bombing and target practice. These areas are generally limited to military use.

Chapter 4 - System Inventory

This chapter documents the general type, size, and condition of existing facilities at system airports. The inventory draws upon data from a variety of sources. These include the 1988 Regional Airport System Plan, individual airport master plans, FAA Airport Master Records (Form 5010), FAA's Terminal Area Forecasts, FAA's National Plan of Integrated Airport Systems (NPIAS), Washington State Continuous Airport System Plan, and others.

System Airports

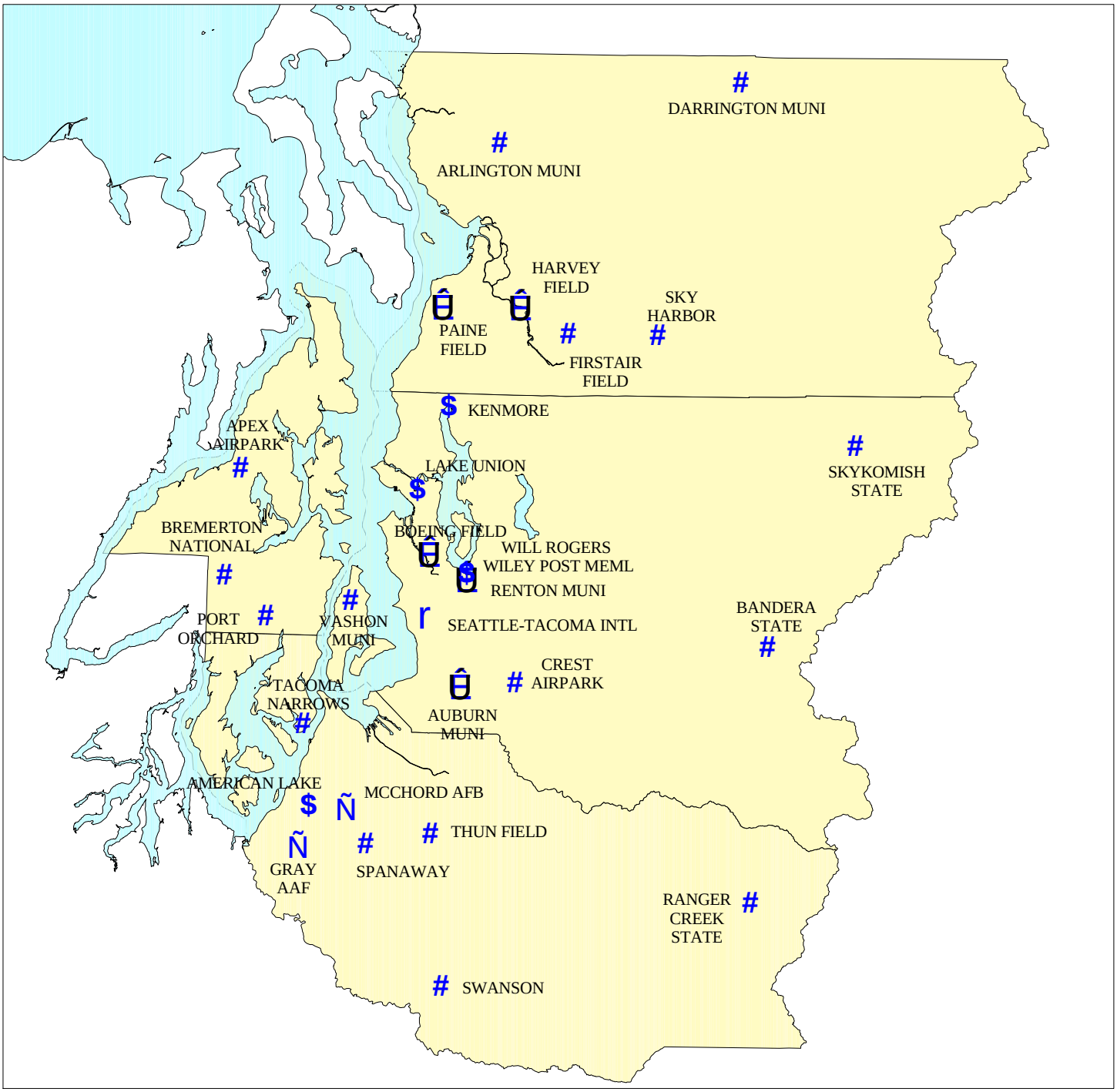
The regional airport system consists of 28 airports: 26 public use facilities (excluding Martha Lake and Lester) plus the two existing military airfields -- Gray Field at Fort Lewis and McChord Air Force Base (both located in Pierce County). As of 1999 the public use airports in the system included 22 land-based airports and 4 seaplane bases. The 28 airports in the system can be categorized as follows:

Commercial service:	1
General aviation reliever:	5
General aviation:	13
State-owned emergency:	3
Seaplane base:	4
Military:	2
Total:	28

Exhibit 4-1 displays the four-county airport system, and highlights the urban growth area. Among the 22 land-based public use airports, there is one major commercial service airport (Sea-Tac), five general aviation "reliever" airports, 13 general aviation airports, and 3 state-owned emergency airfields. The "reliever" airports consist of King County Int'l Airport (Boeing Field), Auburn Municipal, and Renton Municipal in King County and Snohomish County Airport ("Paine Field") and Harvey Field in Snohomish County. The primary purpose of general aviation reliever airports is to provide alternate landing areas and aircraft basing facilities for general aviation aircraft, so major air carrier airports, such as Sea-Tac, can concentrate on passengers and air cargo. Occasionally, reliever airports (primarily Boeing Field) also serve as alternative landing fields when weather conditions do not allow them to land at Sea-Tac International Airport.

The system's 13 general aviation airports provide a wide range of facilities and services, including aircraft tie-downs, aircraft hangars, aircraft maintenance, aircraft sales, aircraft charters, flight planning, weather services, air traffic control, and communication and navigation facilities. Martha Lake Airport was closed permanently in July 2000. While the airport is included in relevant chapters of this plan (because it was in operation at the time much of the planning analysis was done), it is not included in the airport system improvement program (see chapter 9). The regional airport system also includes 3 state-owned airports that serve as emergency landing fields. These airports have no services and no permanent aircraft basing facilities. Until 1996 the state operated four general aviation emergency landing facilities in the region. These included Skykomish, Bandera, Lester, and Ranger Creek. In 1996 Lester Airport was washed away by the Green River, and since that time has ceased to function as an airport. While Lester airport has appeared in earlier documents as a state airport, after the flood in 1996 the airport has been removed from aeronautical sectional maps and other airport inventories, and is not included here.

Exhibit 4-1 Regional Airport System



System Airports by Type

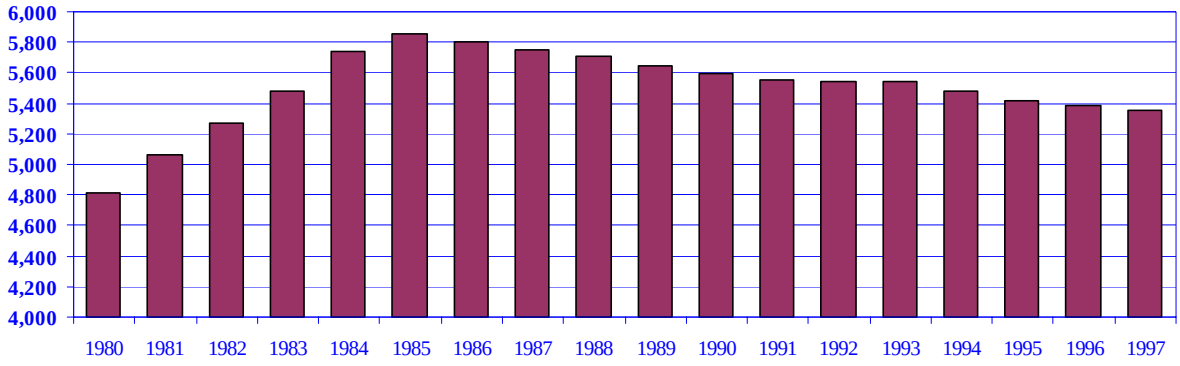
- r Primary
- Ñ Military
- Ĥ Reliever
- $ Sea Plane Base
- # General Aviation

N

The remaining three state-owned airports are used primarily as emergency airfields supporting search and rescue operations, they provide for emergency landings, and they serve as mobilization sites for natural resource activities such as agricultural spraying operations and fighting forest fires.

As mentioned in the issues and trends discussion above, land use encroachment, economic pressures, and environmental issues have combined to force the closure of many airports across the nation, as well as in the Puget Sound region. Exhibit 4-2 displays the historical trend in the number of public use airports in the U.S. from 1980 through 1997. The number of airports peaked in 1985, and since that time has declined at a rate of 42 per year. This translates to the loss of one public use airport every 9 days for the past 12 years.

Exhibit 4-2
Total U.S. Public Use Airports
Source: FAA



The Central Puget Sound Region has also seen a net loss of public use airports. Since the first regional airport system plan was prepared in 1969 the following airports have either closed or been lost to public use: Bellevue, Campbell, Cedar Grove, Duvall, Enumclaw, Green Valley, Issaquah, and Wax Orchard (Vashon Island). While the system has experienced historical airport closures, the system continues to shrink. The state-owned Lester Airport was closed in 1996 after a flood washed out the runway. Martha Lake Airport was closed in July 2000, bringing the total to ten airport closures in the past 31 years.

Exhibits 4-6 and 4-7 show in tabular and graphic form the number of airports and the number of based aircraft in the region by county. The number of airports located within each of the four counties is fairly consistent with county population, with King County having 11 airports (39% of the regional total) while containing 53% of the region's population. At the other end of the spectrum, Kitsap County has about 7% of the region's airports (2 out of 28) and 7% of the region's population. All four seaplane bases are located in King or Pierce Counties, while the region's two military airfields are both located in Pierce County south of Tacoma.

Reliever Airports

The system's five general aviation reliever airports include Harvey Field and Snohomish County Airport, located in Snohomish County, and King County Int'l Airport (Boeing Field), Renton Municipal, and Auburn Municipal, located in King County. There are currently no reliever airports in either Kitsap or Pierce County. Exhibit 4-3 below displays comparative data for the five reliever airports. The table includes data about runways, airport activity (based aircraft and operations), airfield capacity, airport facilities and services, and access.

Runway lengths vary from the 2,660 foot runway 14-32 at Harvey Field to Boeing Field's primary runway 13R-31L, which is 10,001 feet long. Based on the visual inspection conducted by the Washington DOT Aviation Division in 1998, all the runways at the reliever airports are in good condition, with the exception of the main runway at Harvey Field, which was judged to be in fair condition. Based on the pavement analysis completed in 2000 by the WSDOT, Auburn, Boeing Field, Paine Field, and Renton have pavement condition ratings of "very good." All five reliever airports have significant levels of aircraft operations, with King County Int'l Airport (Boeing Field) having double the second busiest reliever airport (Snohomish County Airport). Operations at King County Int'l Airport (Boeing Field) have hovered near or even above its defined annual runway capacity ("annual service volume") of 380,000 operations for several years.

Given its small and highly constrained site, Boeing Field may be as much constrained by its landside capacity (aircraft parking supply and support facilities) as its airside capacity. Whichever is the case, the other four regional reliever airports have been designated to accommodate traffic which cannot be handled at Sea-Tac Airport or King County Int'l Airport (Boeing Field). The other four reliever airports could potentially accommodate additional air traffic, each having unused runway capacity. On the landside, however, Auburn, King County Int'l Airport (Boeing Field), and Renton are all constrained by site size and surrounding urban development, and cannot be easily expanded to provide additional aircraft parking or other landside support facilities. Snohomish County Airport occupies a rather large site, and has some potential for growth. While there is vacant land adjoining Harvey Field which could potentially accommodate future growth, this privately owned airport has financial and environmental constraints (Snohomish River flood plain), and additional airport development would likely require rezoning and/or changes to the city of Snohomish land use plan.

Exhibit 4-3
Reliever Airports Matrix

	Auburn	*Boeing Field*	*Harvey Field*	*Paine Field*	*Renton*
County	King	King	Snohomish	Snohomish	King
Ownership	Public	Public	Private	Public	Public
Runway length	3,400	10,001 / 3,710	2,660	9,010 / 4,514 / 3,000	5,379
Runway pavement condition	Good	Good / Good	Fair	Good / Good / Good	Good
Annual operations (1997)	172,000	345,120	140,700	192,612	100,710
Annual runway capacity (ASV)	230,000	380,000	230,000	288,000	230,000
Based aircraft (1997)	238	443	360	483	240
Based aircraft capacity (1997)	330	550	415	564	255
Airport growth constrained?	Yes	Yes	No	Yes	Yes
Air traffic control Tower	No	Yes	No	Yes	Yes
Precision or non-precision instrument approach	No	Yes	No	Yes	Yes
Approach lighting	No	MALSF/R	No	MALSR	No
Runway edge lights	MIRL	MIRL/HIRL	Non-standard	MIRL/MIRL/HIRL	MIRL
Visual approach aids	VASI/PAPI REIL Beacon	VASI/PAPI REIL Beacon	VASI/PAPI	VASI/PAPI REIL Beacon	VASI/PAPI REIL Beacon
Weather observation/reporting	No	Yes	No	Yes	No
Airport highway access Distance	SR 167 1 mile	I-5 1 mile	SR 9 1/2 mile	SR 525/SR 99 1 mile/2 miles	1-405 1 mile

Aircraft Owners and Pilots

Aircraft owner and pilot information was collected from the FAA and WSDOT Aviation Division. Data included total number of owners and pilots and their location by county, city, and zip code. Aircraft owner information includes data on the type of registrant (e.g., individual, corporation, government, etc.) and type of aircraft. Pilot data included certificate, rating, and medical class, as well as the pilots' rating code (single engine instrument, turbojet flight engineer, etc.). Exhibits 4-4 and 4-5 display the distribution of aircraft owners and pilots by county. According to 1998 FAA data, the four-county region was home to 4,955 registered aircraft owners and 11,743 registered pilots. The difference in numbers of owners and pilots is partially explained by the fact that many pilots do not own aircraft (they may work for an airline or a corporation, they may belong to a flying club, or they may rent aircraft when they fly). Also, due to the high cost of aircraft ownership and operation, many pilots own aircraft jointly.

The regional distribution of pilots and aircraft owners somewhat parallels regional population. King County, with 53% of the region's population, has 63% of the region's aircraft owners and 60% of the pilots. Pierce County, with 22% of the regional population, has 17% of the region's aircraft owners and 19% of its pilots. Snohomish County holds 18% of the region's population, 16% of its aircraft owners, and 15% of its pilots.

Exhibit 4-4 Aircraft Owners by County

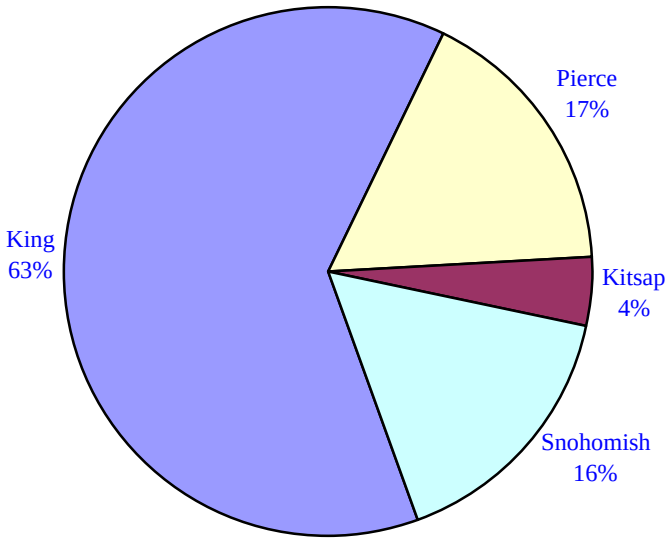
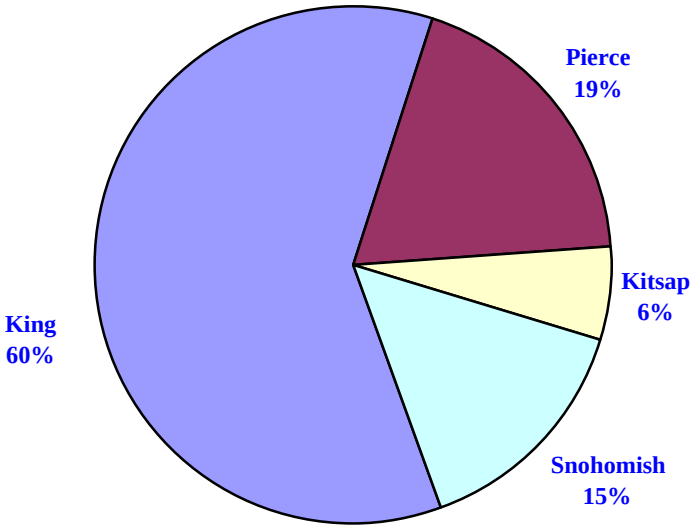


Exhibit 4-5 Aircraft Pilots by County



General Aviation Based Aircraft [3]

A review of recent based aircraft statistics shows that over 80% of the region's general aviation aircraft are located in either King or Snohomish counties (which contain about 75% of the region's population). Of the region's 3,620 based aircraft, 2,910 are based in these two counties, while 529 (15%) are in Pierce County and 181 (5%) are based in Kitsap County. One of the more notable statistics regarding the regional distribution of based GA aircraft is the disproportionate number of aircraft based in Snohomish County. Three of the region's top five airports measured in number of based aircraft are located in Snohomish County (Arlington is first with 510 aircraft, Snohomish County is second with 483, and Harvey Field is fourth with 360). With some 1,494 based aircraft, Snohomish County currently has 41% of the region's GA aircraft while containing only 18% of the region's population. As shown in Exhibit 4-10 (Based Aircraft per 100,000 Population and Employment) Snohomish County, with 263 based aircraft per 100,000 population, has more than double the region's average ratio of aircraft per population (115 per 100,000), and 3.6 times the national average (72 based aircraft per 100,000 population). Snohomish County's dominance is even more pronounced when looking at relationships between based aircraft and employment. For the region as a whole, there are 197 based aircraft per 100,000 employees. King County has the lowest ratio, with 115 aircraft per 100,000 employees. Kitsap and Pierce Counties have similar ratio's, at 192 and 188 respectively. Snohomish County's ratio of 627 aircraft per 100,000 employees is over 5 times that for King County and over 3 times the Pierce and Kitsap County ratio. For the nation as a whole, the ratio of based aircraft per 100,000 employees is 150. Snohomish County's ratio is over 4 times the national rate. Later chapters in this plan evaluate the possible reasons for such a high rate of based aircraft in Snohomish County, and its implications for planning the airport system and regional airport access.

Exhibit 4-18 shows the region's top 10 airports in terms of operations and based aircraft. Arlington Airport has the most based aircraft with 510. Snohomish County Airport was second, with 483, while King County Int'l Airport (Boeing Field) was third with 443. These top ten airports are home to over 3,150 based aircraft, which account for nearly 89% of the total for the region (3,620).

[3] *General aviation based aircraft are airplanes housed at an airport using conventional hangars, T-hangars, tie-downs, or other aircraft parking or storage. These aircraft are usually charged a monthly tie-down or hangar fee ("rent"), and as such these aircraft are recorded or registered as "based" at a particular airport.*

Exhibit 4-6 Airport Facilities by County

Facility Type	King County	Pierce County	Snohomish County	Kitsap County	Region Total
Airport *	8	5	6	3	22
Seaplane Base	3	1	0	0	4
Military Airfield	0	2	0	0	2
Total	11	8	6	3	28

* Excludes Lester and Martha Lake, which are closed.

Exhibit 4-7 Based Aircraft by County

Aircraft Type	King County	Pierce County	Snohomish County	Kitsap County	Region Total
Single engine piston	1,195	481	1,246	176	3,098
Multi-engine piston	141	41	78	5	265
Jet	41	7	25	0	73
Rotor Craft	38	0	33	0	71
Other*	1	0	112	0	113
Total	1,416	529	1,494	181	3,620
1998 Population (est.)	1,665,800	686,800	568,100	229,400	3,150,100
Based Aircraft per 100,000 Population	85	77	263	79	115
1998 Employment (est.)	1,227,798	280,644	238,108	94,425	1,840,975
Based Aircraft per 100,000 Employees	115	188	627	192	197

* Includes ultralight, experimental, and glider.

Exhibit 4-8 Distribution of Airports

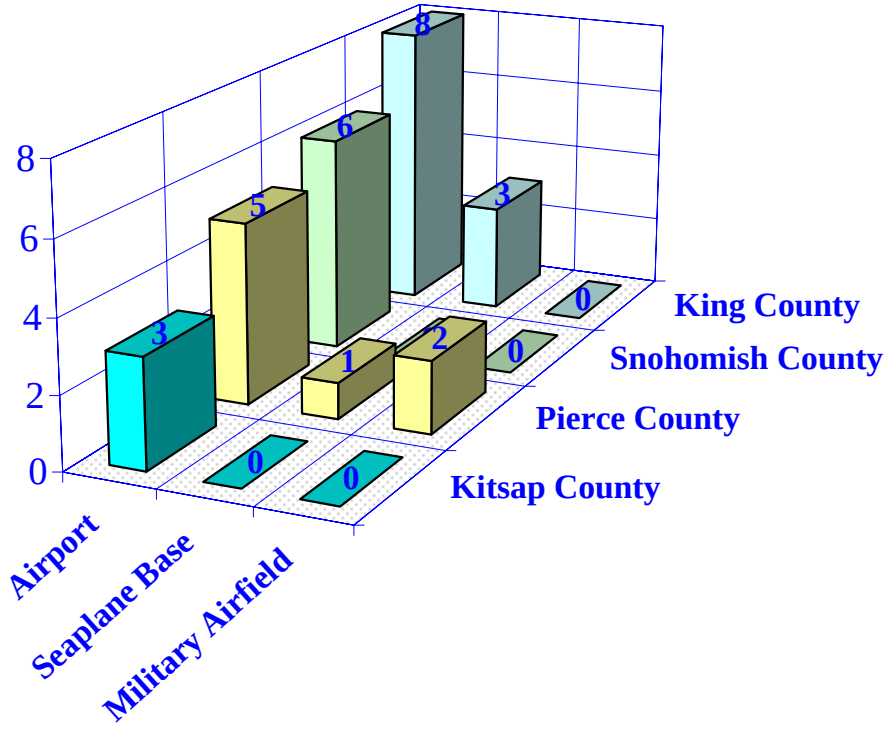
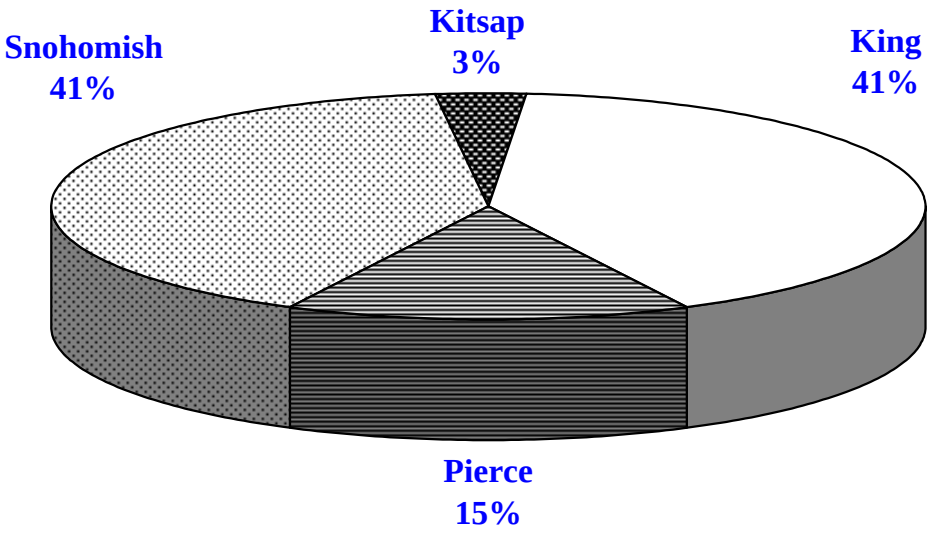


Exhibit 4-9 Distribution of Based Aircraft



General Aviation Fleet Mix

Exhibits 4-9 through 4-17 display the distribution and mix of the region's based aircraft fleet by county for each major type of aircraft in the General Aviation fleet. In addition, Section 2 of Appendix B displays the based aircraft for each system airport by aircraft type. At the regional level single engine piston aircraft comprise 84% of the total fleet. Multi-engine piston aircraft make up 8%. Turbo jet and rotorcraft (helicopters) each comprise just under 2%, while "other" aircraft account for the remainder (4%). As shown in Exhibit 4-13, the regional distribution of single engine piston aircraft closely parallels that for total GA aircraft (shown in Exhibit 4-12). For multi-engine piston and jet aircraft, however, King County tends to dominate the region, with 53% and 66% of the region's total, respectively. Most of the region's multi-engine piston aircraft (82%) are based at a handful of the region's busier airports (Arlington, King County Int'l Airport (Boeing Field), Renton, Snohomish County, and Tacoma Narrows). The clustering of higher performance aircraft, particularly jets, in King County reflects the fact that business and corporate aviation users tend to locate close to downtown Seattle, Everett, or Tacoma. As of 1998, 52% of the region's total business jets are based at King County Int'l Airport (Boeing Field), with the remainder based at Arlington, Sea-Tac, Snohomish County, and Tacoma Narrows.

Exhibit 4-16 displays the regional distribution of rotorcraft by county. As of 1998 all rotorcraft were based in either King County (57%) or Snohomish County (43%). The last category of aircraft included in this inventory is "other" aircraft. This category (shown in Exhibit 4-17) includes experimental, glider, and ultra-light aircraft. All the region's experimental, glider, and ultra-light aircraft are currently based in Snohomish County. Of these, the vast majority (90%) are based at Arlington Airport, which has a national reputation as a center for ultra-light, gliders, and experimental aircraft activity, including the manufacture of aircraft and aircraft kits.

Aircraft Operations

Total annual aircraft operations (including general aviation, air carrier, commuter, air cargo, and military) for 1998 for the region as a whole are estimated at 2,086,000. Of these, Sea-Tac International and King County Int'l Airport (Boeing Field) accounted for over 750,000. Snohomish County, Auburn, Arlington, Harvey Field, Bremerton, and Renton Airports each had between 100,000 and 200,000 annual operations in 1998. Aircraft operations (either a landing or a take-off) are categorized into several types. For 1998 the region's aircraft operations breakdown were as follows:

Type of Operations (1998)	**Total for Region**	**Percent of Regional Total**
Local General Aviation Operations	656,141	32 %
Itinerant General Aviation Operations	897,045	43 %
Air Taxi Operations (charter, unscheduled)	50,359	2 %
Air Carrier Operations (including cargo, commuter and military)	482,401	23 %
	2,085,946	100 %

At the regional level, the 2.085 million annual operations translate to an average of over 5,715 operations per day, and between 240 and 480 operations per hour.

Exhibit 4-10 Based Aircraft per 100,000 Population

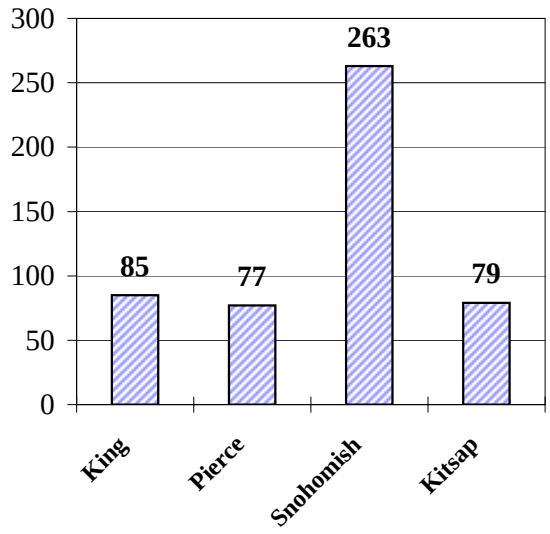
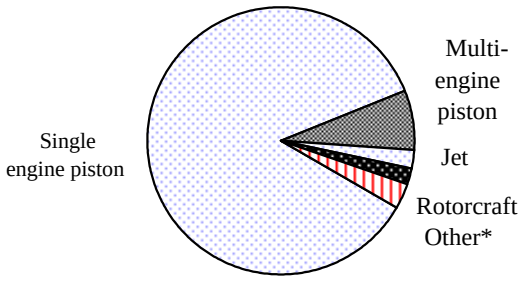


Exhibit 4-11 Regional Based Aircraft by Type



* Includes Ultra-light, Experimental, Glider, and Other A

Exhibit 4-12 Total Based Aircraft by County

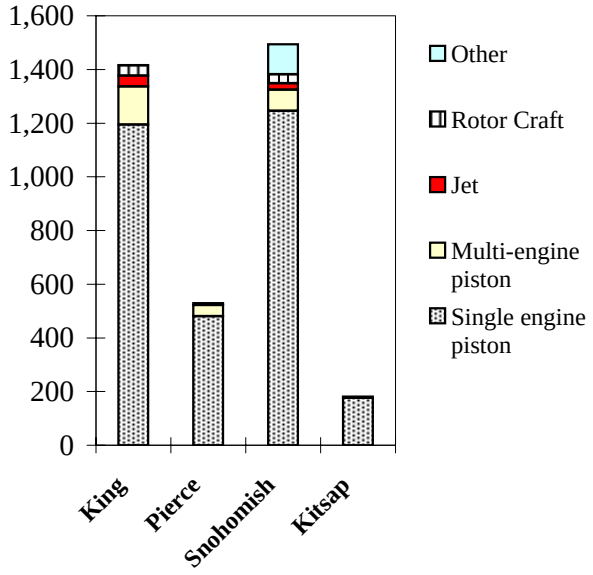


Exhibit 4-13 Single Engine Piston Aircraft

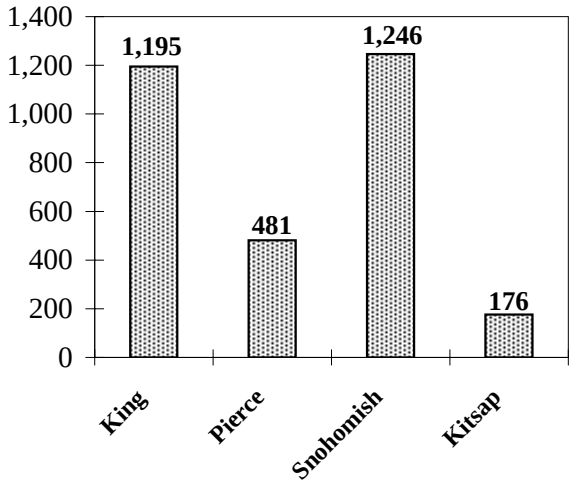


Exhibit 4-14 Multi-Engine Piston Aircraft

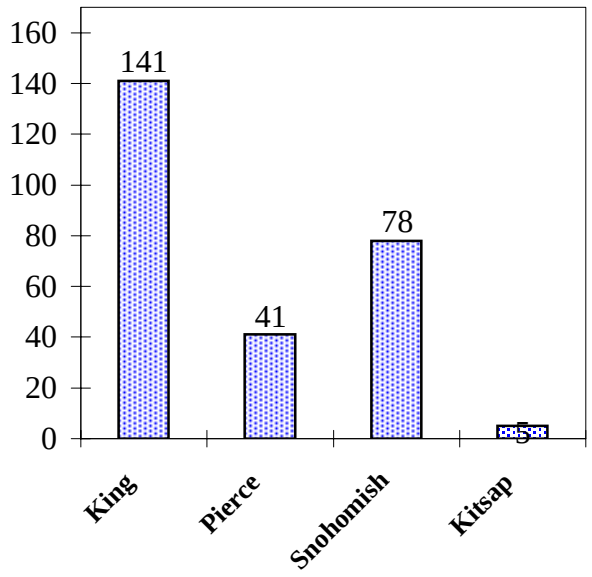


Exhibit 4-15 Jet Aircraft

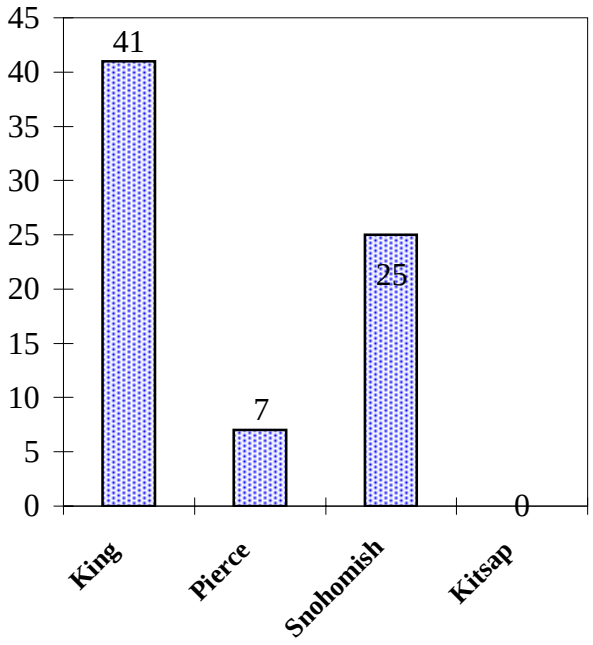


Exhibit 4-16 Rotorcraft

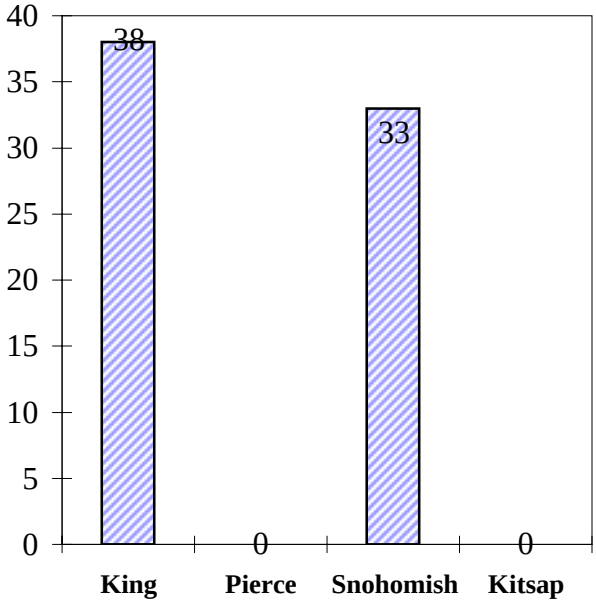
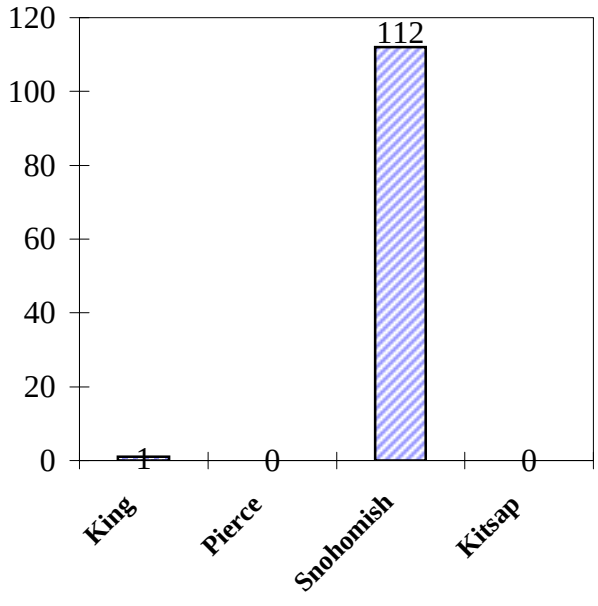


Exhibit 4-17 Other* Aircraft



Local GA operations, which consist largely of training activity, were distributed fairly evenly throughout the region. No local GA activity was recorded at the four state-owned airports or at Sea-Tac International Airport. The busiest airports for local operations were King County Int'l Airport (Boeing Field), Snohomish County Airport, Arlington, Renton, Auburn, and Bremerton National. Together these 6 airports account for 74% of the region's total local GA operations. Itinerant GA operations total nearly 900,000 for the region in 1998. The five airports with the most itinerant operations in 1998 were King County Int'l Airport, Auburn, Crest Airpark, Harvey Field, and Snohomish County.

Air taxi activity was recorded at 14 of the region's airports in 1998, with a total of just over 50,000 annual operations. Air taxi activity was largely located at Kenmore Air Harbor, Auburn Airport, Thun Field, and Arlington Airport. The final category of aircraft operations is air carrier. This category includes major air carrier passenger airline activity, commuter airlines, air cargo carriers, and military operations. Nearly all the region's air carrier activity occurs at Sea-Tac International Airport, King County Int'l Airport (Boeing Field), and Kenmore Air Harbor. Together these three airports comprise 97% of all air carrier operations in the region.

Exhibit 4-18 displays the region's top 10 airports ranked by number of annual operations as well as based aircraft. These top 10 airports accounted for nearly 1.8 million operations, or 86% of the regional total of 2.1 million.

Exhibit 4-18 -- Top 10 Regional Airports
Ranked by Operations and Based Aircraft (1998)

		Total Annual Operations*			Total Based Aircraft*
1	Sea-Tac International	407,597	1	Arlington Municipal	510
2	King Co. Int'l (Boeing Field)	345,120	2	Snohomish Co. (Paine Field)	483
3	Snohomish Co. (Paine Field)	192,612	3	King Co. Int'l (Boeing Field)	443
4	Auburn Municipal	172,000	4	Harvey Field	360
5	Harvey Field **	140,700	5	Crest Airpark	334
6	Arlington Municipal	135,000	6	Renton Municipal	240
7	Bremerton National	108,800	7	Auburn Municipal	238
8	Renton Municipal	100,710	8	Thun Field	229
9	Tacoma Narrows	95,316	9	Tacoma Narrows	200
10	Crest Airpark	95,222	10	Bremerton National	116
	Total Operations	1,793,077		Total Based Aircraft	3,153
	Percent of Regional Total	86%		Percent of Regional Total	87%

* *Source: 1998 FAA 5010 Master Records, airport master plan data, and "Washington State Continuous Airport System Plan"*

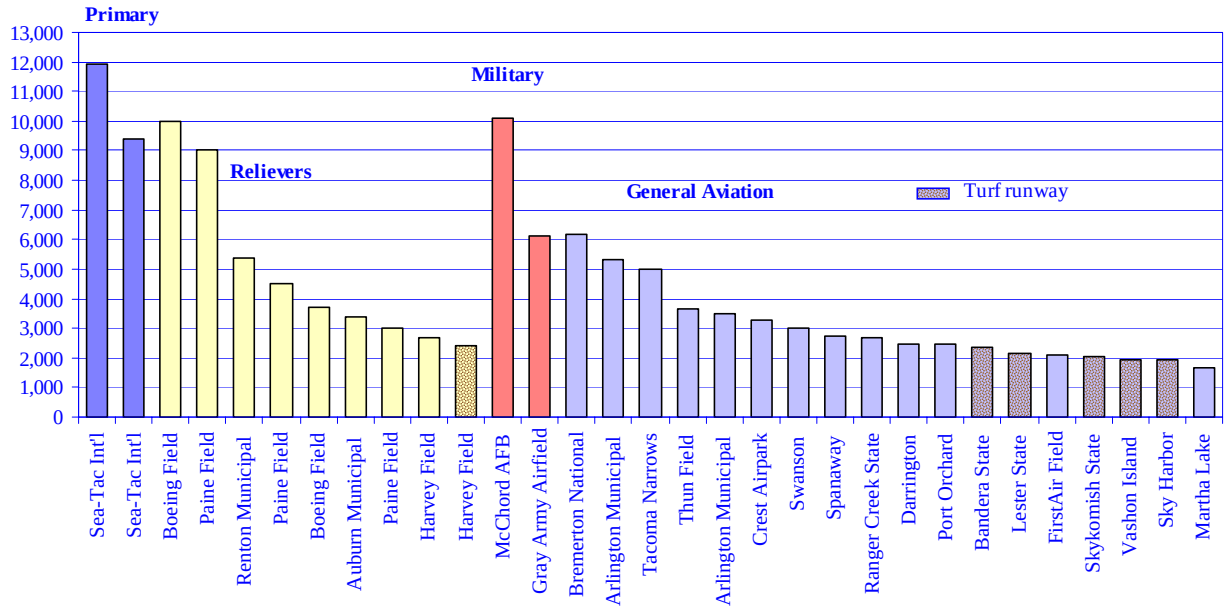
** *Operations at Harvey Field are estimates (no tower).*

Airport Facilities – Runways

As of 1998 the region's airports had a total of 36 runways ranging in length from 1,680 feet at Martha Lake Airport (now closed) to 11,900 feet at Sea-Tac International. Of the region's 36 runways, 31 were land based and 5 were located at the region's four seaplane bases. Ten of the region's runways are greater than 5,000 feet long. This is generally the runway length required to accommodate large jet aircraft (Boeing 737, 757, MD 80) carrying either passengers or air cargo. There are 8 runways between 3,000 and 5,000 feet long located at 7 airports (Snohomish County has 2). These runways can accommodate higher performance general aviation aircraft, such as multi-engine turbo-props and business jets, as well as most propeller-driven commuter aircraft. The remaining 18 runways are less than 3,000 feet long, and accommodate the lighter general aviation aircraft, typically single engine piston powered aircraft, such as the Cessna 150 and 172, the Beech Bonanza, and the Piper Aerostar.

Exhibit 4-19 displays runway length by airport role for the land-based airports in the regional airport system (excluding the four seaplane bases). The chart also notes the six runways (as of 1998) that were unpaved (turf or gravel). Sea-Tac's two existing air carrier runways (11,900 and 9,425 feet long) are designated in the "primary" category. The five reliever airports contain eight runways (King County Int'l has two and Snohomish County Airport has three); the former crosswind runway at Harvey Field is now closed. The two runways at McChord Air Force Base and Gray Army Airfield at Ft. Lewis are 10,000 and 6,000 feet long, respectively. The remaining general aviation airports have runways ranging from 6,200 feet at Bremerton to 1,930 at Sky Harbor (Martha Lake Airport, with a 1,680 foot runway, was closed in July 2000). The region's four remaining turf runways are located at Bandera State, Skykomish State, Vashon, and Sky Harbor airports (Lester State Airport, which had a turf runway, is now closed).

Exhibit 4-19 Runway Length by Airport Role (1998)



Airport Facilities – Airport Pavements

As part of its Washington State Airport System Plan airport condition assessment in 1998, the state DOT Aviation Division performed visual inspections of airport pavements at non-primary, non-military, and non-reliever airports. This information was then augmented by FAA Master Record (Form 5010) data, individual airport master plans, and other sources to produce a comparative assessment of airport runway pavement conditions for the state airport system, with runway condition categorized as "good," "fair," or "poor." Those results are displayed in Exhibit 4-20 for the region's 22 public use airports and two military airfields (the region's four seaplane bases were excluded). Pavements at 16 of these 24 airports were considered "good," six were "fair," and two (Bandera State and Spanaway) were in "poor" condition.

Additional more detailed airport pavement condition analysis for 13 of the Puget Sound region's larger and busier airports was completed in 2000 by the state DOT Aviation Division as part of its Statewide Airport Pavement Management Program. The goal of the program is to provide the latest technical information regarding the airport system's pavement condition and future maintenance needs, including related funding requirements. The information is intended to help airport sponsors identify, plan for, and fund their airport pavement needs. In addition, the program is intended to provide pavement needs and funding information that will inform funding agencies (such as the FAA) and the state legislature. As part of the statewide pavement management program, each airport sponsor received a comprehensive pavement conditions report as well as recommended pavement improvement program.

Exhibit 4-20 displays results of this analysis, showing average pavement age and the pavement condition index ("PCI") for the 13 larger GA airports. The analysis also shows, for each airport, the condition of three major pavement types (apron, runway, and taxiway). Pavement condition index numbers range from 0 to 100, with 0 being the lowest and 100 being the highest. For comparative purposes, the WSDOT airport pavement maintenance program includes both pavement condition index numbers and pavement condition ratings. Pavement condition for the region was slightly higher than for the rest of the state:

Pavement Condition Index (PCI) Range *	Pavement Condition Rating	Percentage of Airport Pavements in Each Category	
		Region	State
86-100	Excellent	42.35 %	39.01 %
71-85	Very good	20.71 %	15.27 %
56-70	Good	20.92 %	20.17 %
41-55	Fair	8.13 %	12.89 %
26-40	Poor	4.61 %	4.66 %
11-25	Very poor	2.66 %	5.74 %
0-10	Failed	0.62 %	2.26 %

As shown above, over 42% of the region's airport pavements are in excellent condition, compared with 39% for the state as a whole. The region has more pavements considered very good than the state, while the state has more pavements in the "fair," "very poor," and "failed" categories. In the "good" and "poor" categories the region and the state are nearly equal.

Exhibit 4-20 Condition of Airport Pavements

Airport	Runway Surface Type	Pavement Condition (1998) *	Weighted Average PCI (2000) ** Apron	Runway	Taxiway	Total	Average Pavement Age
American Lake	Water	-	-	-	-	-	-
Apex Airpark	Asphalt	Good	-	-	-	-	-
Arlington Municipal	Asphalt	Good	67.66	97.40	73.38	77.14	18.09
Auburn Municipal	Asphalt	Good	84.13	80.34	77.86	80.90	22.06
Bandera State	Turf	Poor	-	-	-	-	-
Bremerton National	Asphalt	Good	78.29	64.19	82.92	74.01	20.96
Crest Airpark	Asphalt	Fair	61.00	78.39	66.02	70.81	16.42
Darrington	Asphalt	Good	99.00	100.00	98.16	99.25	4.00
FirstAir Field	Asphalt	Fair	52.17	46.72	56.20	50.01	14.69
Gray Army Airfield	Asphalt	Good	-	-	-	-	-
Harvey Field	Asphalt	Fair	-	-	-	-	-
Kenmore Air Harbor	Water	-	-	-	-	-	-
King County Int'l/Boeing Field	Asphalt/Conc.	Good	81.65	66.06	71.08	72.30	18.61
Lake Union Chrysler Air	Water	-	-	-	-	-	-
McChord AFB	Asphalt/Conc.	Good	-	-	-	-	-
Pierce County/Thun Field	Asphalt	Good	80.06	87.00	86.64	83.99	15.03
Port Orchard	Asphalt	Fair	-	-	-	-	-
Ranger Creek State	Asphalt	Good	-	-	-	-	-
Renton Municipal	Asphalt/Conc.	Good	85.64	94.67	62.87	80.25	18.27
Sea-Tac International	Asphalt/Conc.	Good					
Sky Harbor	Turf	Good	-	-	-	-	-
Skykomish State	Turf	Fair	-	-	-	-	-
Snohomish County/Paine Field	Asphalt	Good	73.24	91.21	72.39	76.76	14.50
Spanaway	Asphalt	Poor	31.00	63.69	39.56	48.65	36.71
Swanson	Asphalt	Good	100.00	98.00	-	98.16	2.00
Tacoma Narrows	Asphalt	Fair	84.36	66.29	73.20	77.12	26.34
Vashon Municipal	Turf	Good	-	-	-	-	-
Will Rogers/Wiley Post	Water	-	-	-	-	-	-
Regional Totals **			0.00	0.00	0.00	76.19	18.00

* Pavement condition information for GA airports is based on 1998 WSDOT visual inspections.
Information for Gray Army Airfield and McChord AFB was obtained from the military.

** Regional weighted average PCI numbers for apron, runway, and taxiway are arithmetic averages (calculated by PSRC)
for the 13 regional airports included in the State's analysis. Total weighted average PCI was calculated by Pavement Consultants, Inc.

Note: Pavement conditions information excludes region's four seaplane bases.

Sources: Washington State Aviation Pavement Management Program, 2000, prepared by Pavement Consultants Inc.
WSDOT Airport Conditions Inspections, 1998

The following summarizes the results of the more detailed pavement analysis performed in 2000 for the 13 larger GA airports in the region:

- Average pavement age at inspection: 18.00 years
- Youngest pavement age is at Darrington (4.00 years)
- Oldest pavement age is at Spanaway (36.71 years)
- Regional weighted average PCI: 76.19 - Pavement condition rating: Very good
- Statewide weighted average PCI: 73.06 - Pavement condition rating: Very good
- Highest PCI rating was at Darrington (99.25) - Pavement condition rating: Excellent
- Lowest PCI rating was at Spanaway (48.65) - Pavement condition rating: Fair
- Of the 13 Puget Sound Region airports included in the analysis, total airport pavement conditions at two airports were rated excellent, eight were rated very good, one was rated good, and two were rated fair.
- Of the three pavement types evaluated in the WSDOT study, the region's runways are in the best condition, with an average PCI of 79.54. Aprons are second, with an average PCI of 75.25, and taxiways are third, with an average PCI of 71.69. All these pavement conditions are categorized as "very good."
- The more detailed analysis performed in 2000 confirmed most of the results of the visual inspections done in 1998. Crest Airpark's rating improved from "fair" in 1998 to "good" (with a PCI of 70.81) in the 2000 analysis, and Tacoma Narrows improved from a "fair" rating in 1998 to a "very good" rating (total airport PCI=77.12) in 2000.
- Regional averages do not necessarily reflect the conditions, or related pavement improvement needs, at each airport. While the region's runways, taxiways, and aprons were all rated very good at the regional level (13 airports), two airports (FirstAir Field and Spanaway) were rated fair, with total airport PCIs of less than 55. In addition, numerous pavements across the region were rated significantly below regional averages. These include aprons at Arlington, FirstAir Field, and Spanaway; runways at Bremerton, FirstAir Field, Boeing Field, Spanaway, and Tacoma Narrows, and taxiways at Crest Airpark, FirstAir Field, Renton, and Spanaway. While regional averages show the relative condition of pavements for the airport system, airport specific pavement improvement programs should be based on the more detailed analysis for each airport.
- The cost of maintaining pavements varies significantly from one airport to another, based upon airport size (amount of pavement), activity levels, and aircraft types. The WSDOT recommended pavement management program for a small airport such as Darrington could cost as little as a few thousand dollars per year, while programs at both Boeing Field and Paine Field are recommended at over a million dollars per year. In addition, the relative importance of pavement management and maintenance programs reflect the needs of each airport's users. Maintaining a high PCI is likely to be a high priority at airports that regularly serve heavy jet aircraft activity, such as Boeing Field, Paine Field, and Renton. At these airports the significant expense associated with maintaining airport pavements can be justified by both the amount and type of activity, and the associated need to maintain a high level of safety and reliability.

Airport Facilities – Control Towers, Navigational Aids and Lighting -

Sections 6 and 7 of Appendix B - Airport System Database contains information on existing navigational aids, airport and airfield lighting, and air traffic control towers. Seven of the region's 28 airports have control towers: King County Int'l, Gray Army Airfield, McChord AFB, Renton, Sea-Tac International, Snohomish County Airport, and Tacoma Narrows. Of the region's top ten busiest airports (measured in annual operations) only five have air traffic control towers. Similarly, only four of the region's top 10 airports (measured in numbers of based aircraft) have control towers.

Appendix B (sections 6 and 7) also indicate the presence of airport and runway lighting and navigational aids. Instrument landing systems ("ILSs") are currently in place at King County Int'l, Bremerton, Sea-Tac, Snohomish County Airport, and Tacoma Narrows. An ILS is a ground based navigational system that consists of a glide slope antenna (which provides vertical guidance) and a localizer antenna, which provides horizontal guidance to pilots as they approach the runway for landing. Instrument Landing System (ILS) equipment is a commonly deployed approach guidance system for landing during low visibility conditions. Similar to the ILS, the newer "microwave landing system" (MLS) operates in the microwave spectrum to provide horizontal and vertical guidance to landing aircraft with compatible equipment. Microwave landing systems and satellite-based Global Positioning Systems ("GPS") are now being used in some locations to provide more flexibility in designing runway approaches. MLS and GPS allow for curved approaches (ILS allows only straight-in approaches) to accommodate terrain near airports and to allow for increased aircraft traffic and differing mixes of aircraft approaching an airport. MLS technology is considered obsolete, and most future navigation and landing system technology is moving toward GPS combined with Wide Area Augmentation System (WAAS) and Local Area Augmentation System (LAAS) technology.

Four airports in the region (Arlington, King County Int'l, Sea-Tac, and Snohomish County Airport) have either DME (Distance Measuring Equipment) or VOR (Very-high frequency (VHF) Omnidirectional Range) equipment. These transmitting devices provide distance and directional information to aircraft, and allow for non-precision instrument approaches to runways during low visibility conditions. VOR and DME equipment are most commonly used in conjunction with an ILS to provide increased accuracy in guiding aircraft to an airport, and then to the final runway approach where it intercepts the ILS for landing. In this region four of the five airports with an ILS also have VOR and/or DME equipment.

About half of the region's airports have either Visual Approach Slope Indicators ("VASI") or Precision Approach Path Indicators ("PAPI"), both of which provide vertical approach slope guidance to pilots as they approach the runway to land.

Section 8 of Appendix B includes a list of existing runway edge lighting for each runway at the region's airports. Excluding the four seaplane bases, 24 runways have runway edge lighting while 7 do not. The intensity of these lights (usually categorized as either high, medium, or low intensity) generally varies with the level and importance of the airport's activity. Airports with high intensity runway edge lighting (HIRL) include King County Int'l, Bremerton National, Gray Army Airfield, McChord AFB, Sea-Tac, and Snohomish County Airport. Four of the region's five reliever airports have either medium or high intensity runway edge lighting. Harvey Field has non-standard runway edge lighting, but has plans to install standard low intensity runway edge lighting (LIRL).

Airport Landside Facilities

Airport landside facilities of importance in regional airport system planning include aircraft parking and storage (tie-downs and hangars), fixed base operators (which provide a variety of aviation related services such as aircraft fuel, aircraft maintenance, aircraft sales, flight training, air charters, etc.), passenger terminals, auto parking, and air cargo facilities. Information about the existing supply of aircraft tie-downs and hangars is include in Chapter 6 - System Capacity and Future Facility Requirements. Based on 1998 information the region's supply of aircraft parking is divided nearly equally between tie-downs and hangars (both t-hangars and conventional hangars).

Fixed base operators ("FBOs") are available at 18 public use airports (excluding the two military airfields). These include all but the three State-owned airports, Darrington, Kenmore Air Harbor, Lake Union Seaplane Base, and Sea-Tac. Being devoted almost entirely to commercial air carrier passenger and air cargo use, Sea-Tac Airport has minimal itinerant general aviation activity, and only one corporate tenant: Weyerhaeuser. Hence there is no need for traditional FBO services.

Aviation fuel is available at most of the region's airports. Excluding the two military airfields, fuel is available at all but five airports: Bandera, Ranger Creek, Skykomish, Swanson, and Vashon.

Air Cargo

Exhibit 4-21 (Regional Air Freight Trends) displays regional air freight trends from 1961 through 2000. Historically, the region saw moderate but steady growth from 1961 through 1977. Between 1977 and 1985, however, air freight volumes remained stagnant. Since that time, the regional, national, and international air freight markets have grown at phenomenal rates. Between 1985 and 2000 the region's total air freight volume increased 178%, from 232,000 to 645,000 US tons. As shown on Exhibit 4-21, all three major air freight sectors (air mail, domestic, and international) have grown. By far the largest area of growth has been domestic air freight, which tripled from 131,000 US tons in 1985 to 404,000 US tons in 2000. Virtually all the region's air cargo is handled at either King County Int'l or Sea-Tac International Airport. Historically, most of the region's air cargo was processed at Sea-Tac. In the past several years, however, King County Int'l has experienced very strong growth in air cargo volumes, and now controls nearly a quarter of the regional air cargo market (see Exhibit 4-22: Sea-Tac and King County Int'l Air Cargo Market Shares). While assisted by the strong regional economy, King County Int'l's recent cargo growth is largely attributed to the relocation of UPS's air cargo operation from Sea-Tac to King County Int'l, as well as several other cargo carriers (including Burlington and Airborne) commencing operations at Boeing Field.

The implications of air freight on the regional transportation system are numerous. First, these trends are indicative of the strong regional economy as well as the tremendous growth in the entire cargo industry. Second, the region enjoys an important strategic position in relation to world trade, particularly between North America and the Pacific Rim. How well our region fulfills this role is important globally. Third, the region's surface transportation system connects directly with the region's air cargo airports, connecting the region to the State, the nation, and the world.

Exhibit 4-21 Regional Air Freight Trends

(in U.S. tons)

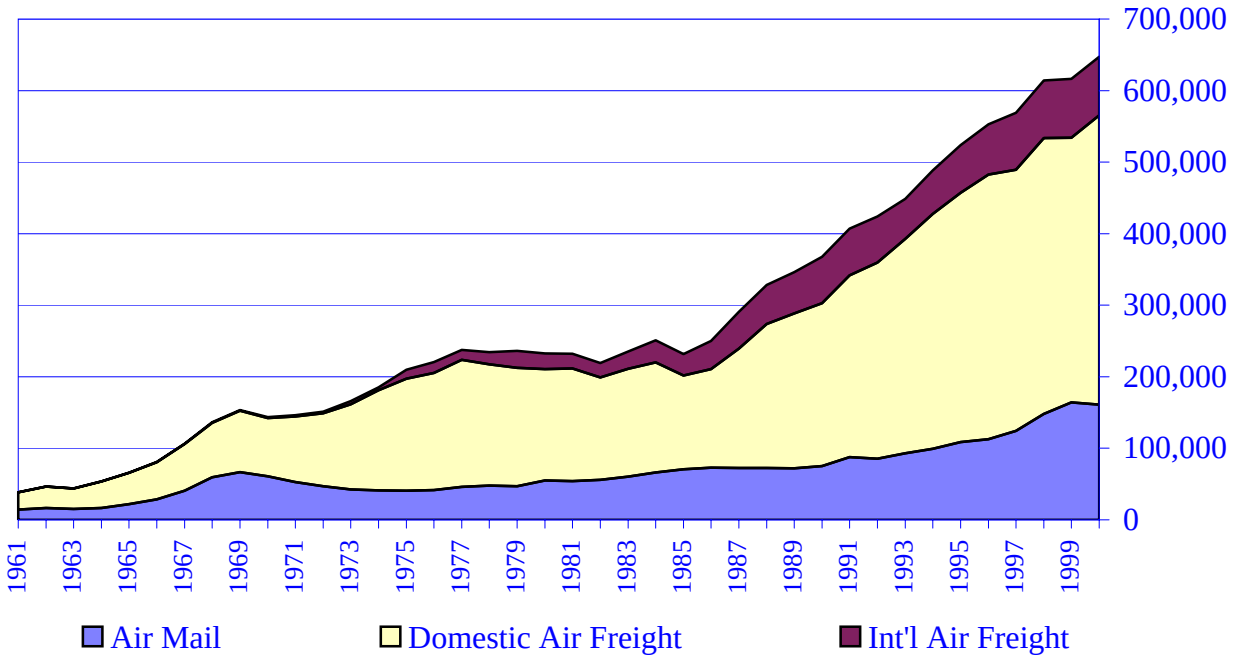
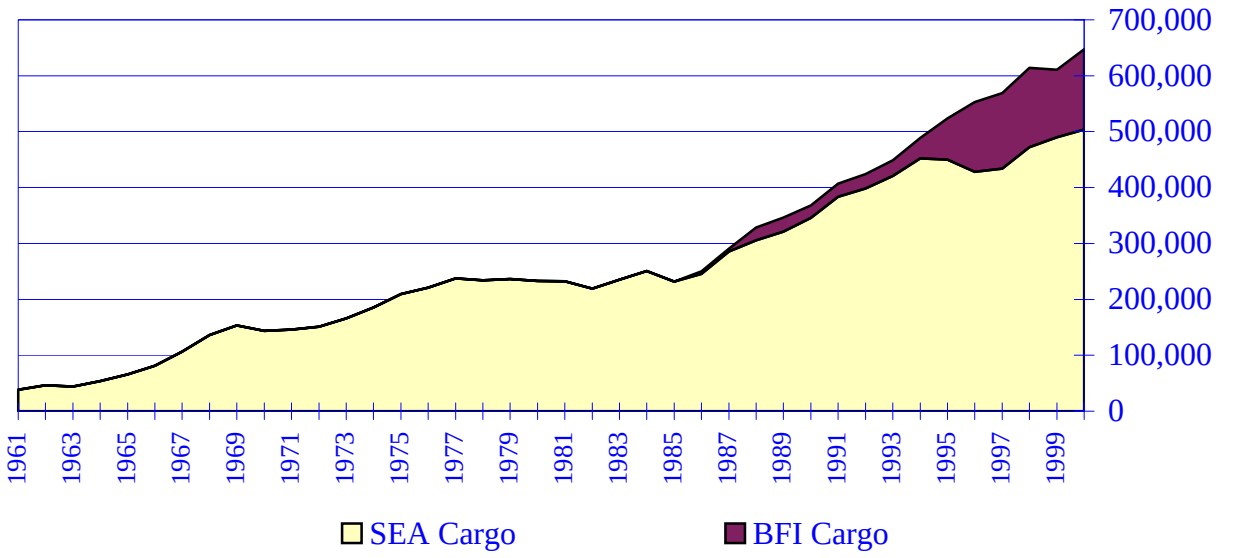


Exhibit 4-22 Sea-Tac and Boeing Field Air Cargo Market Shares

(in U.S. tons)



Airport Access

Context for the Airport Access Discussion - Airports are far more than just places where airplanes take off and land. Within large urban areas, such as the central Puget Sound Region, airports serve as transportation centers, multi-modal/inter-modal facilities, passenger terminals, freight and goods terminals, and employment/commercial/manufacturing centers. In the cases of Sea-Tac, King County Int'l, Snohomish County Airport, and Renton, the airports are located inside larger industrial and employment centers which have significant ground transportation needs. To some degree, all of the region's airports are nodes within a complex intermodal system where people and goods arrive, are transferred from one mode of transportation to another, and then continue on their journey. Very little traffic actually begins or ends at the region's airports.

Airport access is the point where the region's airport system interfaces with the rest of the region's transportation system. A wide variety of "traffic" passes through the region's airports. In 2000 the region's airports served over 28 million passengers, over 2 million aircraft landings and take-offs, and over 1.25 billion pounds of air cargo. This activity delivers a wide variety of traffic into the region's surface transportation system. This traffic includes domestic and international passengers, a variety of types of air cargo, employees who work at or near airports, goods and products related to manufacturing activities at airports, and other commercial traffic doing business at airports.

This discussion of airport access is divided into three sections: (1) airport access via the roadway component of the Metropolitan Transportation System (MTS); (2) airport access via the transit component of the MTS; and (3) airport access via the freight and goods component of the MTS. This is being done recognizing that there are overlaps among MTP components. For example, many of the region's roadways are used for transit (major bus routes) as well as freight and goods mobility facilities.

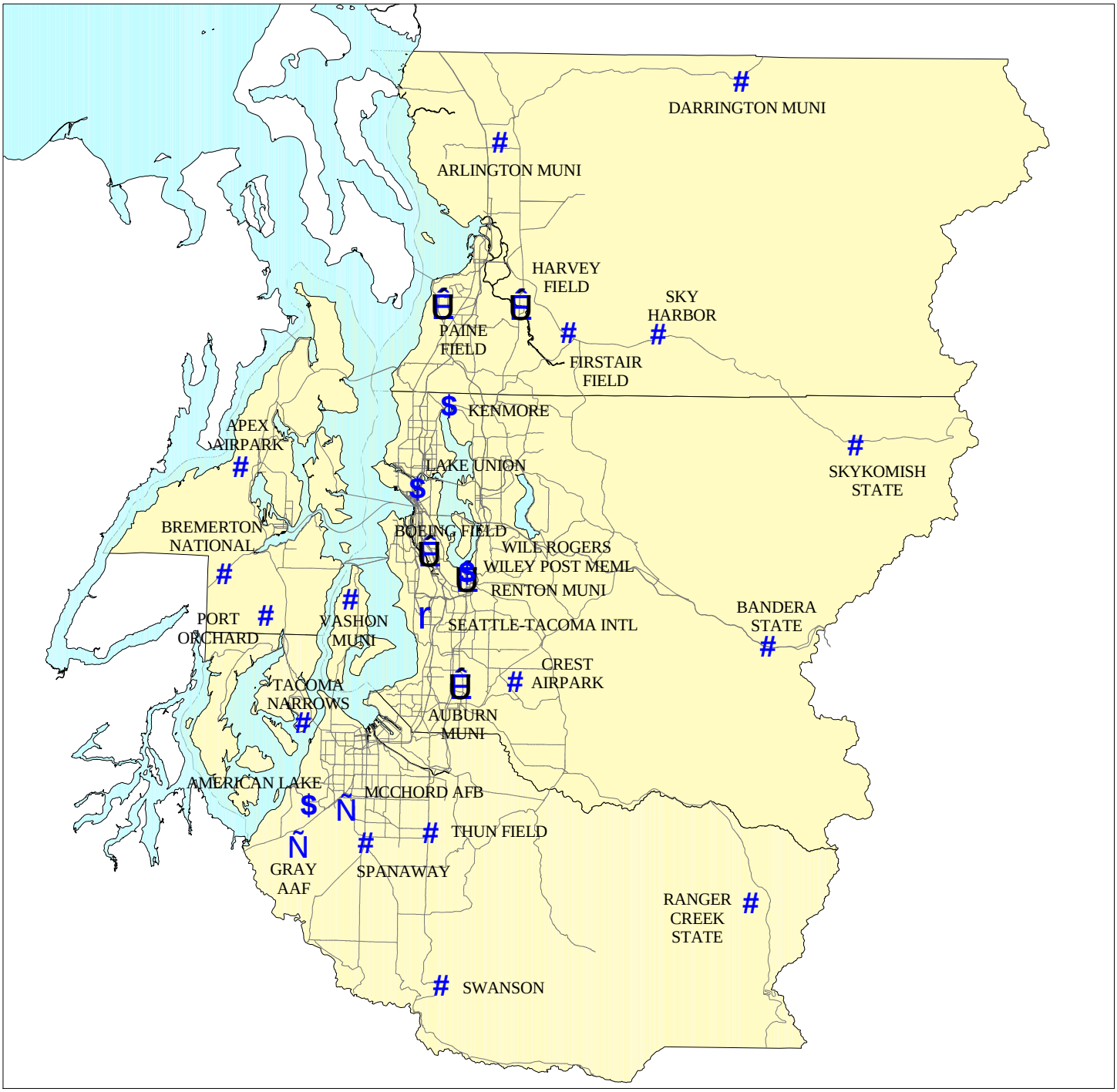
Roadway Component of the MTS - Exhibit 4-23 displays the region's airports and how they are served by the roadway component of the existing Metropolitan Transportation System (MTS). As shown on the map, there are three sub-elements of the roadway component:

- The National Highway System – This system includes Federal interstate highways, other federal highways, and major State-owned highways.

- The State Highway System – This system includes all other State highways not included in the National Highway System.

- The Principal Arterials – This system includes all principal arterials located in either cities or unincorporated counties.

Exhibit 4-23 Regional Airport and MTS Roadway System



System Airports by Type

- r Primary
- Ñ Military
- Ĥ Reliever
- $ Sea Plane Base
- # General Aviation

N

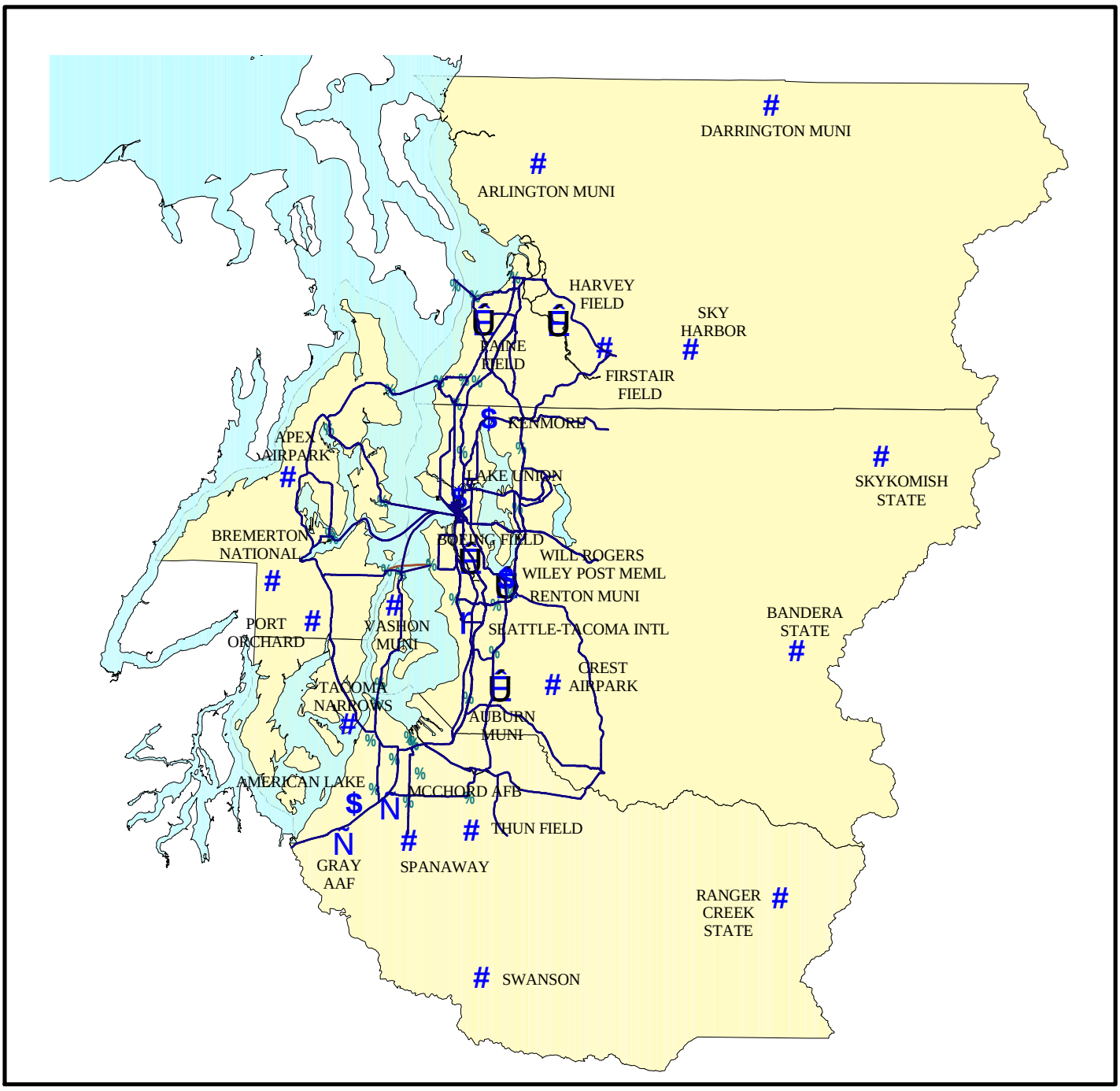
In addition, this Aviation Element includes the State Ferry System as a sub-component of the Roadway Component, since the ferries serve as extensions of the State's major roadways.

Most of the region's airports are served by the MTS roadway system. Exceptions are Ranger Creek State Airport, and Port Orchard Airport. The region's busier airports are generally better served by the roadway system. Of the region's top 10 airports in terms of either annual operations or based aircraft, 8 are located within 4 miles of multi-lane divided limited access Interstate or State highways. The other two (Crest Airpark and Harvey Field) are served by non-divided State highways. Currently underway and planned improvements to State Route 18 in King County will eventually provide Crest Airpark with freeway access. The region's two military airports, Gray Field at Fort Lewis and McChord Air Force Base, have good regional access via I-5.

Highway access from I-5, I-405, and State Route 509 to Sea-Tac International Airport is provided by State Route 518. Planned Improvements to State Route 509 will provide better access to Sea-Tac. The region's five "reliever" airports consist of Auburn, King County Int'l, Harvey Field, Renton Municipal, and Snohomish. Of these, Auburn, King County Int'l, Renton, and Snohomish County enjoy excellent freeway access via State Route 167, Interstate 5, Interstate 405, and State Route 526 respectively. Harvey Field has the poorest regional access, being located between 10 and 12 miles from I-5 via State Route 9 or U.S. Highway 2.

Transit Component of the MTS - Regional growth continues to increase urban and suburban development densities, urban sprawl, population and employment, surface traffic, and congestion on the region's transportation system. As a component of this system, airports will increasingly rely on alternative modes of transportation to serve the access needs of passengers and employees. This is especially true for the region's largest urban airports. In addition to their role in the regional airport system, these airports serve as major employment and economic centers. King County Int'l, Snohomish County Airport, and Renton Municipal Airport are major aircraft production and flight testing facilities for the Boeing Commercial Airplane Company. Sea-Tac Airport is the region's major commercial airport, serving over 28 million passengers in 2000, and providing employment for some 14,500 on-airport employees who work for the Port, the airlines, rental car businesses, airport concessions companies, and dozens of other businesses who serve the airport (source: Port of Seattle, May 1998). As the overall activity level at the region's largest airports continues to grow, transit access will become a more important and more feasible option for both airport passengers, airport employees, and airport-related businesses. One of the goals of this MTP refinement effort is to document existing transit access to the region's airports and to identify future needs and opportunities. The Regional Airport and Transit System map (Exhibit 4-24) displays the major elements of the existing regional transit system (regionally significant transit service and major park and ride facilities) and their geographic relationship to the regional airport system. In addition to transit, the region can provide high occupancy vehicle lanes, transportation demand management, transportation system management, intelligent transportation systems, and other intermodal facilities and services that could serve the growing demand for access to the region's airports and related trip generators (see also chapter 10: airport access).

Exhibit 4-24 Regional Airport and Transit System



System Airports by Type

- Primary
- Reliever
- General Aviation
- Military
- Sea Plane Base

Transit System

- Major Transit Routes
- Transit Stations

N

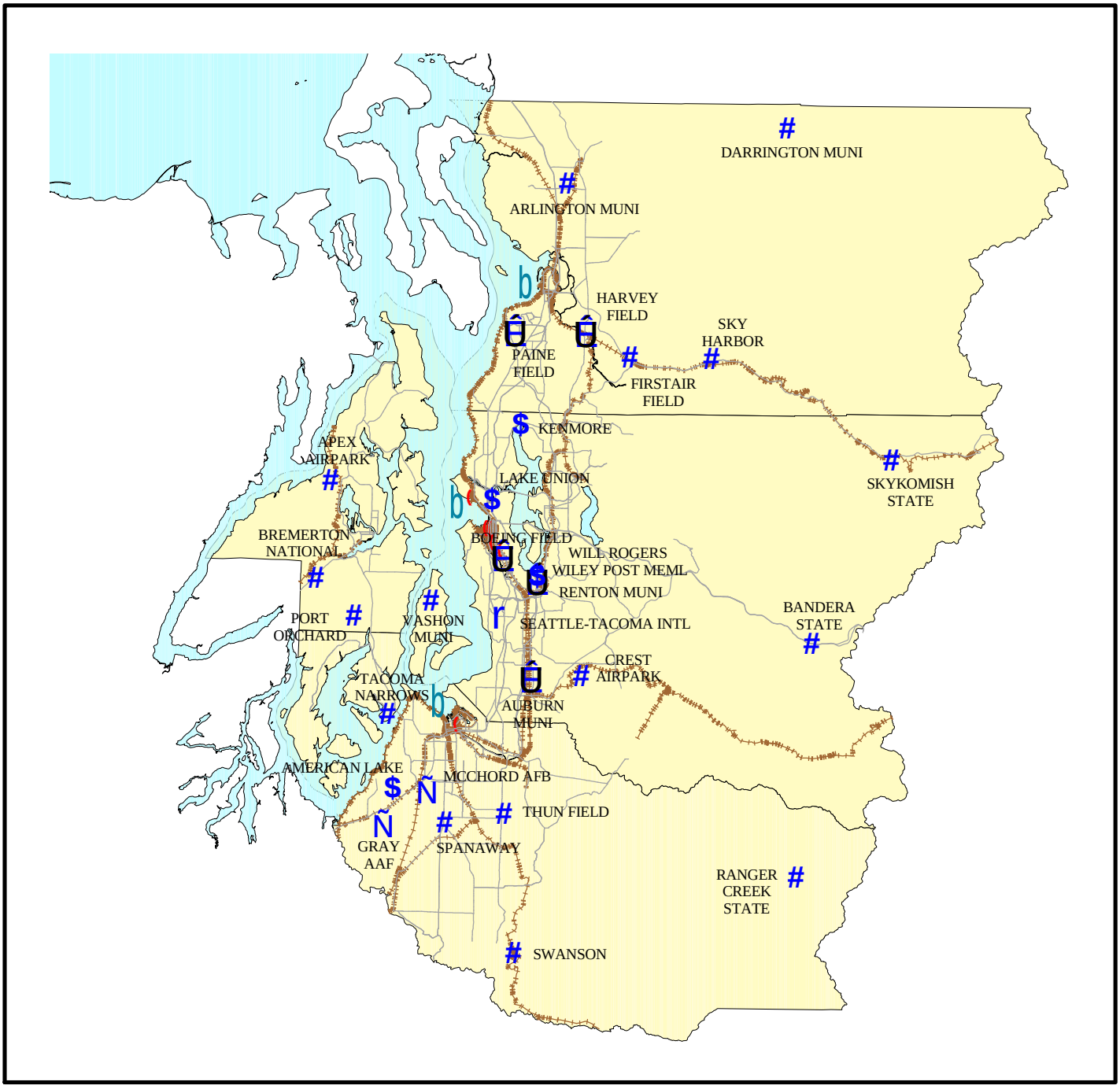
As shown on Exhibit 4-24, numerous existing bus routes serve the region's airports, either directly or indirectly. Direct service exists between Sea-Tac Airport and downtown Seattle, south King County, and the east side. As of 1998 at least 10 metro bus routes served King County Int'l and the adjoining Boeing Company plant. Renton Municipal airport and the adjacent Boeing Plant are served by eight metro bus routes. Community transit provides 11 commuter bus routes serving Snohomish County Airport and/or the Boeing Plant in Everett. In addition, two express routes connect the Snohomish County Airport/Everett Boeing Plant with Seattle via Interstate 5. In Pierce County, two Pierce Transit bus routes provide local service between downtown Tacoma, Lakewood, Fort Lewis, and McChord Air Force Base. The RTA's future plan includes light rail service to both King County Int'l and Sea-Tac by 2009. In addition, the RTA will provide commuter rail access to a "Boeing Access" station near King County International Airport/Boeing Field. Regional express bus service to Sea-Tac began operating in 2000.

Freight and Goods Component of the MTS - Exhibit 4-25 shows the existing elements of the regional freight and goods mobility system and how it relates geographically to the region's airports. The region's freight and goods system includes port/marine terminals and adjoining intermodal yards, railroads and major rail yards, and the regionally significant freight and goods roadways. These roadways are also part of the regional roadway component of the MTS. The region supports three deepwater marine ports: Tacoma, Seattle, and Everett. These facilities are located on the central waterfront of each city, and are displayed in Exhibit 4-25. Both Tacoma and Seattle have intermodal yards (shown on Exhibit 4-25) associated with their marine ports.

Although there is a small "sea-air" link between the Port of Seattle's marine terminals and Sea-Tac Airport, the primary issue of concern between the region's airports and freight and goods system is how the regional surface access system provides convenient connections to meet our air cargo needs. In 2000 King County Int'l and Sea-Tac Airport processed nearly 1.3 billion pounds of air cargo, with about 22% processed at King County Int'l and 78% at Sea-Tac. Most of this cargo moved to or from aircraft via the region's highway system. In 2000 the region's cargo carriers delivered and picked up nearly 400 pounds of air mail, overnight express packages, and traditional cargo for every person in the region. In addition, the region's freight system serves the region's residents and business community with medical supplies, just-in-time parts and supplies for manufacturing, computer software, and thousands of other uses. This complex regional system is dependant on safe, fast, and efficient movement of cargo from the airports through the surface access system to a wide range of customers located throughout the region. One of the goals of the MTP Regional Airport System work effort is to document these cargo movements and develop a plan for meeting these cargo needs through the integrated planning for airport access improvements and freight and goods mobility projects.

In addition to the marine and highway components mentioned above, railroads are a major element of the region's freight mobility system. Many of the region's airports are located in close proximity to railroad tracks. Exhibit 4-26 identifies the nearest railroad line to each system airport, the approximate distance between them, and major obstacles that separate the railroad and the airport. Of the 28 system airports, 20 are located within 4-1/2 miles of an existing rail line, while 14 are within 1 mile. Port Orchard Airport is located 10 miles south of the branch line serving Kitsap County.

Exhibit 4-25 Regional Airport and Freight Mobility System



System Airports by Type

- Primary
- Reliever
- General Aviation
- Military
- Sea Plane

Freight Mobility System

- Freight Roadways
- Railroads
- Ports
- Intermodal Facilities

N

Two of the three State-owned airports (Bandera and Ranger Creek) are far removed (via distance and/or topography) from existing rail lines. Skykomish State Airport is located near the BNSF Stevens Pass Mainline. Vashon Airport has no rail service, and no service was assumed for the four sea plane bases.

Exhibit 4-26 – Airport Railroad Access

Airport	*Nearest Railroad*	*Distance*	*Obstacles Between Airport and Rail Line*
American Lake	NA	-	-
Arlington Municipal	BNSF Branch Line	½ mile	I-5
Auburn Municipal	BNSF Mainline	1/4 mile	None
Bandera State	None	-	-
King County Int'l	BNSF Mainline	1/8 mile	Airport Way
Bremerton National	BNSF Branch Line	1 mile	State Route 3
Crest Airpark	BNSF Mainline	1 mile	None
Darrington Municipal	BN Preserved Corridor	1/8 mile	None
FirstAir Field	BNSF Mainline	1/4 mile	U.S. Highway 2
Gray Army Airfield	BNSF Branch Line	2 miles	I-5
Harvey Field	BNSF Mainline	1/8 mile	None
Kenmore Air Harbor	NA	-	-
Lake Union Chrysler Air	NA	-	-
McChord AFB	BNSF Branch Line	1/8 mile	None
Pierce County/Thun Field	Tacoma Eastern	2 miles	State Route 161
Port Orchard	BNSF Branch Line	5 miles	State Route 3
Ranger Creek State	None	-	-
Renton Municipal	BNSF Branch Line	1 mile	Cedar River, State Route 900
Sea-Tac Int'l	UP Mainline	2 mile	State Route 99, I-5
Sky Harbor	BNSF Mainline	1 mile	U.S. Highway 2
Skykomish State	BNSF Mainline	1/8 mile	None
Snohomish Co./Paine Field	Boeing Spur*	1 mile	State Route 526
Spanaway	Tacoma Eastern	2 miles	None
Swanson	Tacoma Eastern	1/16 mile	None
Tacoma Narrows	BNSF Mainline	3-1/2 miles	Puget Sound
Vashon Island	None	-	-
Will Rogers/Wiley Post	NA	-	-
* Boeing Spur connects to BNSF Mainline			

Of the 20 regional airports with proximate access to railroad lines, eight have no major physical obstacles separating the airport from the rail line. Twelve have obstacles, most of which are interstate freeways, state or federal highways, or major arterial streets. In the case of Tacoma Narrows Airport, the Puget Sound "Narrows" separates the airport from the BNSF mainline, which traverses the east shoreline of the Sound. Other rail connections to Tacoma Narrows Airport are 20 miles to the northwest between Bremerton National Airport and the city of Belfair.

Chapter 5 - Aviation Forecasts

Forecast Approach

The general approach used to prepare these regional airport system forecasts included analysis of historical aviation trends data for the nation, the state, the region, and the airports; a review of previous forecasts prepared for the region and the state; a review of the most recent FAA National Aerospace Forecasts; a summary of regional socio-economic forecasts; selection of a forecast methodology; and preparation of the selected forecast methodology.

Historical Aviation Trends

Analysis of historical trends provided a base of information useful in preparing future aviation activity forecasts. A wide range of aviation data from numerous sources was reviewed in documenting historical trends. These data included information about the number, type, and age of active pilots; total based aircraft and aircraft fleet mix; aircraft operations by type and operations per based aircraft ("OPBA"); fuel consumption; aircraft hours flown; and new aircraft production/shipments. In addition, related historical population, employment, and income data for the Puget Sound region was reviewed and documented. Major data sources included the FAA, General Aviation Manufacturers Association ("GAMA"), the Regional Council, the State DOT Aviation Division, and the individual airports.

Most of the historical data from the FAA was taken from the most recent *Aerospace Forecast* for 1999 through 2010 (March 1999); *Long Range Aerospace Forecasts* for 2015, 2020, and 2025 (June 1999); *Statistical Handbook of Aviation*; *Census of Civil Aircraft*; *General Aviation and Air Taxi Activity and Avionics Survey*; and *General Aviation Pilot and Aircraft Activity Survey*. Most of the historical data analysis was based on the years 1987 through 1998, for which common data were available. This provided a reasonable data string for analysis of historical trends. The FAA's 1999 *Aerospace Forecast* (previously called Aviation Forecast) shows a base period of 1993-1998 plus its 12-year forecast for the years 1999 through 2010. Other FAA data (Airport Master Records) were also collected for the period 1987 through 1998 to provide for comparable analysis. Aircraft shipment data from GAMA are displayed for the years 1970 through 1998. PSRC historical data on population, employment, and income are shown for the years 1985-1998. Where additional historical data for earlier years were available and useful to the analysis, those data were used and are shown here.

Pilots

The number and type of aircraft pilots is a fundamental component of the aviation industry. Drawing primarily from nationwide FAA information, historical trend data on the number, type, and age of active pilots were collected and analyzed. These trends are displayed in Exhibits 5-1 through 5-3. For the years 1987 through 1998 the total number of U.S. active pilots by certificate type is shown in Exhibit 5-1. The data show 5 basic types of pilot certificates: student, private, commercial, airline transport, and flight instructor. Private pilots is by far the largest group. Between 1987 and 1998 this pilot group has declined from 300,000 to 247,000 (18%). This continues a longer term historical trend which began in the 1980's after the termination of the "GI Bill."

Exhibit 5-1 U.S. Pilot Trends

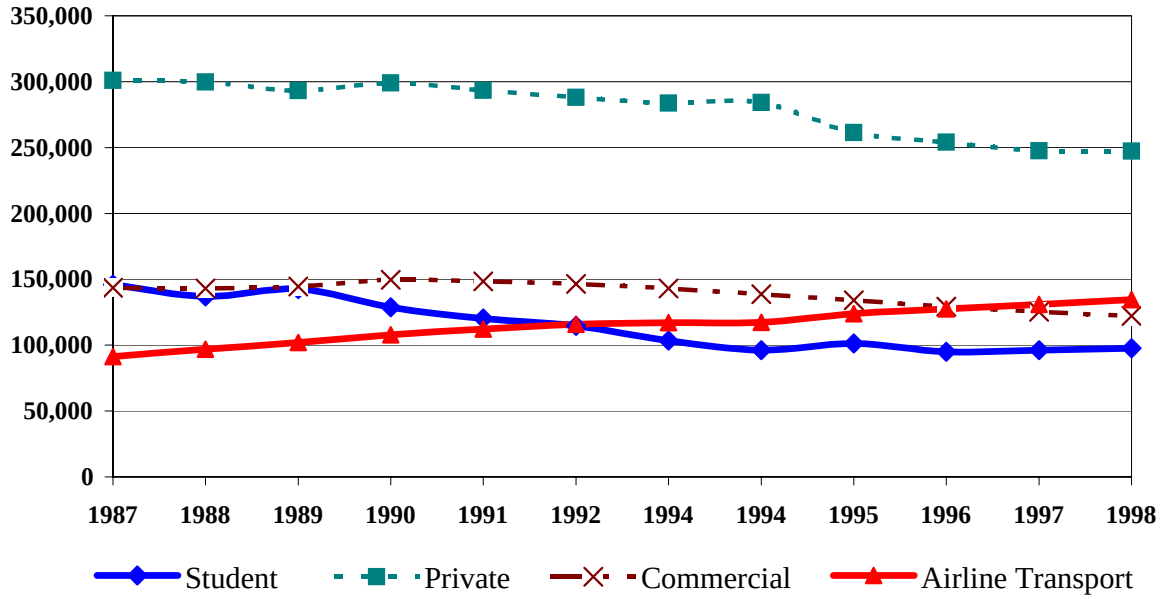


Exhibit 5-2 U.S. Growing Pilot Sectors

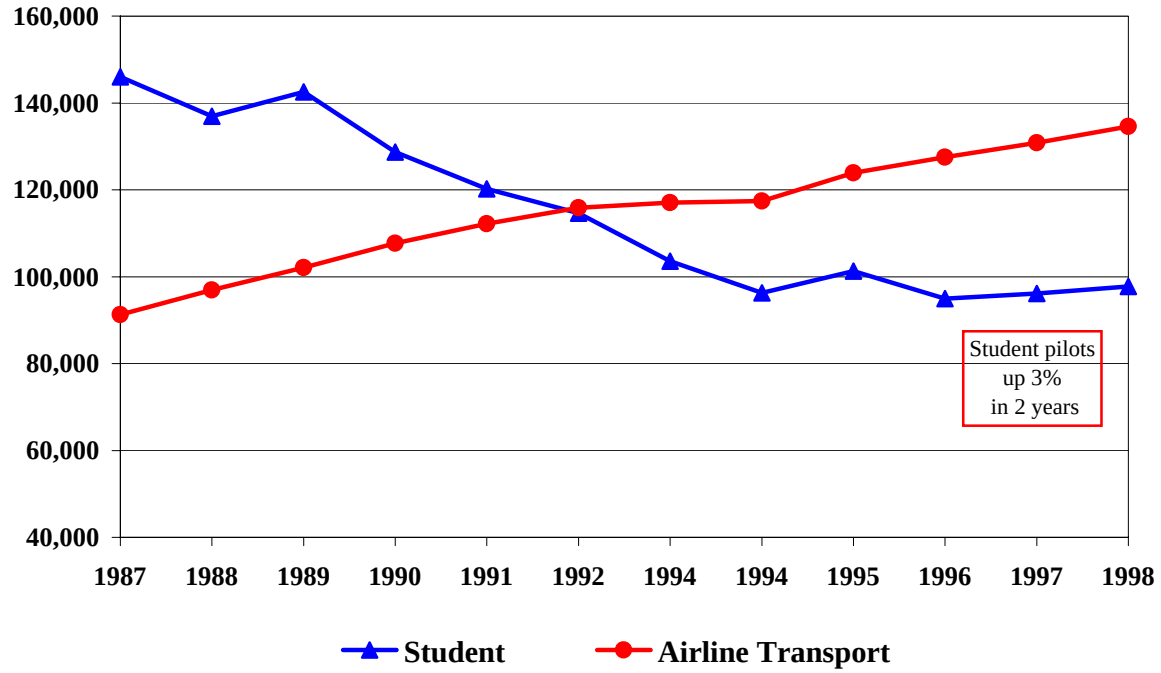
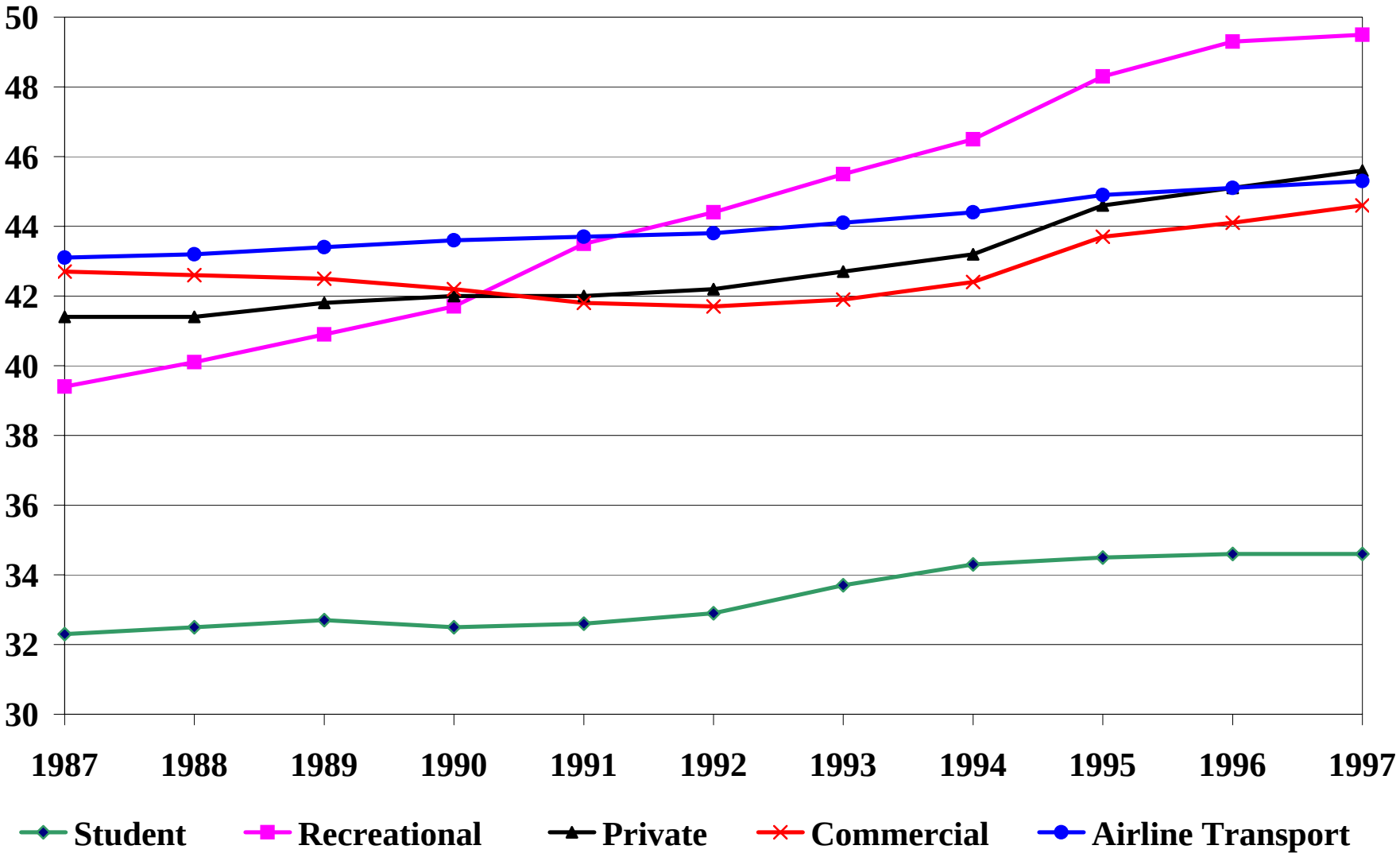


Exhibit 5-3 Trend in U.S. Pilot Age



Other pilot groups that have also declined in the past several years include student pilots, which dropped from 146,000 to 98,000 (33%); and commercial pilots, which declined 15% from 144,000 in 1987 to 122,000 in 1997. In total, these three pilot groups declined from 590,000 to 469,000 (20.5%) in the last decade. Upon more detailed analysis, these data show that while all three pilots groups declined over the decade, the commercial pilot sector declined the least, and the student pilot market sector appears to have bottomed out in 1994. The student population has remained somewhat stable, with a growth trend in 1997 and 1998. During these past two years, the student pilot population increased by nearly 3%. The stabilized pilot population may be attributable in part to the general aviation product liability reform in 1994, favorable economics in recent years, and the continued strong market for air transport pilots.

One component of the pilot population has shown growth in recent years (see Exhibit 5-2). Among all U.S. pilots, the strongest growth continues to occur among airline transport pilots. In the decade from 1987 to 1998 this group increased from 91,000 to 135,000 (48%), or a growth rate of nearly 4% per year. The airline transport pilot group is clearly fueled by the strong airline passenger and air cargo markets. As demand grows, there appears to be a continuing strong market for new pilots in the airline transport sector.

In addition to the number and type of pilots, trends in pilot age affect the aviation industry, and need to be considered in preparing aviation forecasts. Exhibit 5-3 displays average age for these same five pilot groups over the period 1987 through 1997. Two important trends are apparent in the chart. First, between 1987 and 1997 the age of recreational pilots increased almost exactly 10 years, from 39 to 49 years. These data seem to represent recreational pilots as a static demographic group that is simply aging, with no significant influx of new members. Second, all other pilot groups are aging at significantly lower rates. Over the 10 year period, the average age of student pilots increased from 32 to 34; private pilots aged from 41 to 45; commercial pilots aged from 43 to 44; and airline transport pilots aged by only 2 years, from 43 to 45. Two factors could explain these trends: (1) older pilots retiring or simply choosing not to renew their certificates; or (2) younger pilots are entering the pilot population.

U.S. Active Aircraft/Aircraft Fleet Mix

Historical data on numbers of U.S. active aircraft and fleet mix were obtained from FAA Airport Master Records (5010 forms), FAA Aerospace Forecasts, FAA Statistical Handbook of Aviation, FAA Census of Civil Aircraft, airport master plans, directly from airport sponsors, from other FAA sources, and from other regional and state resources. At the national level annual data are available, and are displayed in Exhibit 5-4. Between 1987 and 1994 the historic downward trend in active general aviation aircraft continued. Hardest hit were the single and multi-engine piston powered aircraft, both of which declined in numbers until 1994. Turboprop, turbojet, and rotorcraft numbers have remained relatively constant throughout the period from 1987 to 1998. In recent years, two categories of aircraft have grown. Single engine aircraft increased from 127,000 to nearly 142,000 between 1994 and 1998. The “other” category, which includes gliders, ultra-light, and experimental aircraft, grew steadily throughout the 10-year period, from 6,300 in 1987 to over 19,000 aircraft in 1998.

The U.S. General Aviation (GA) aircraft fleet mix has shown modest shifts over the past decade. In general, single engine piston aircraft have declined both in numbers and as a percentage (from 78% in 1987 to 73% in 1998) of total GA aircraft. Multi-engine piston powered aircraft also declined in absolute numbers and in their share of the fleet. This group declined from 21,800 (11% of the total fleet) in 1987 to 16,065 (8%) in 1997. Turboprop (5,700 aircraft) and turbojet aircraft (about 5,500) both declined until 1993-1994, and have increased in the last 4-5 years. Between 1987 and 1998 these combined aircraft types increased their share of the total GA fleet from 4 to 6%.

Exhibit 5-4 Active U.S. General Aviation Aircraft

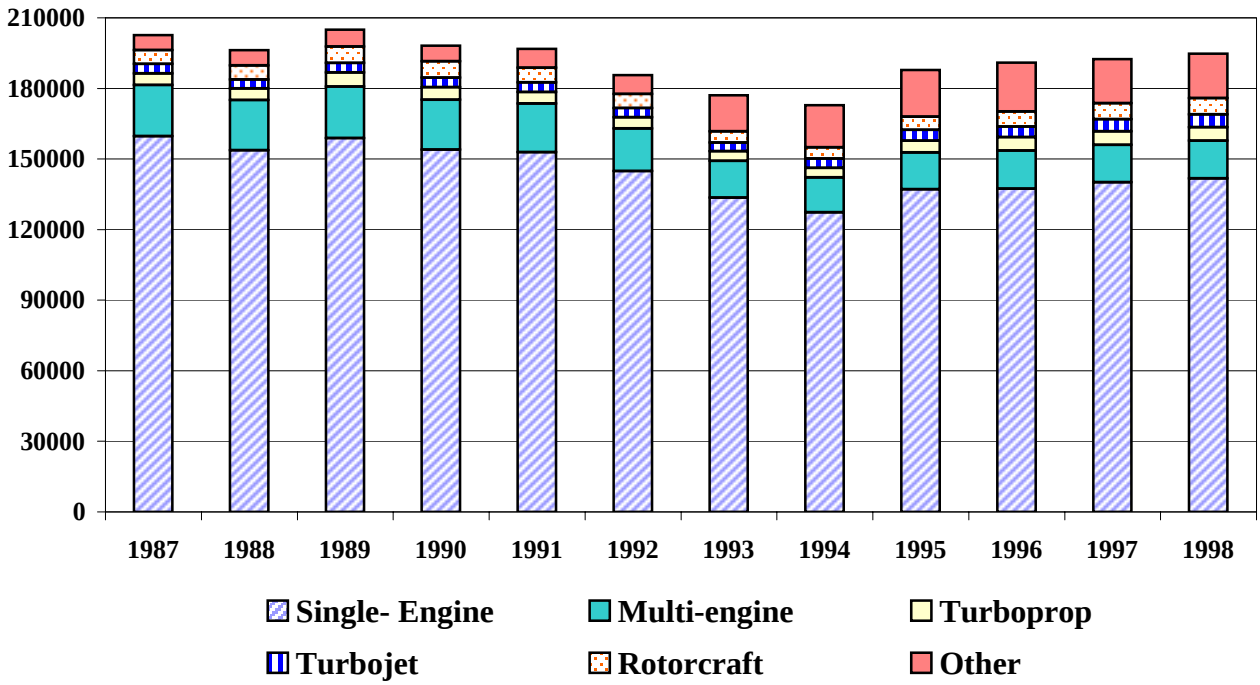
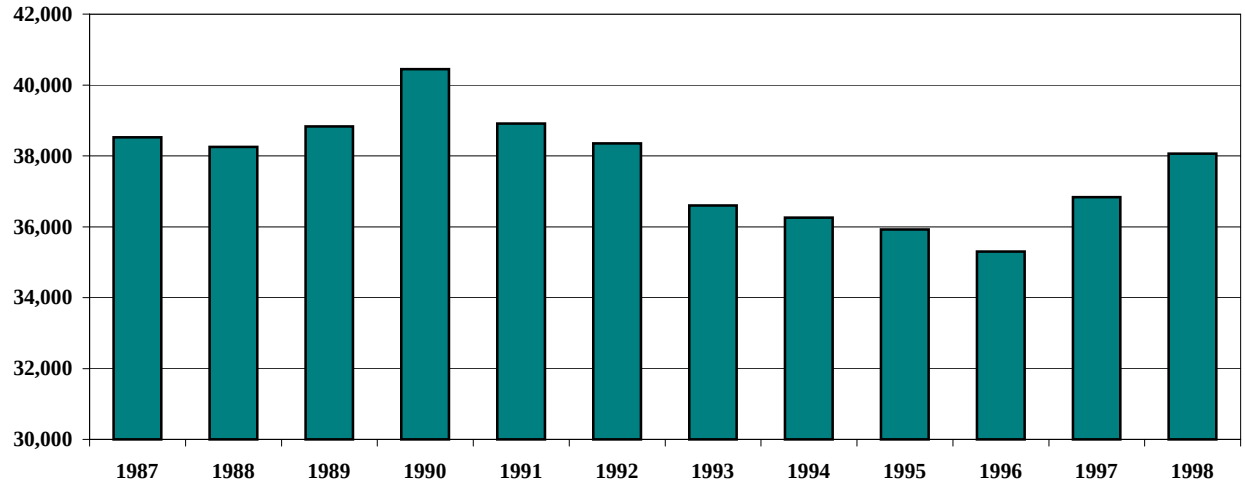


Exhibit 5-5 GA Aircraft Operations at U.S. Airports with Air Traffic Control Service

(in thousands)



Perhaps the most remarkable shifts in the GA fleet in the past decade relate to the glider, ultra-light, and experimental aircraft category. Together, these three aircraft types increased from 6,300 in 1987 to over 19,000 aircraft in 1998. The group's share of the total fleet grew accordingly, from 3% to 10%. A portion of this shift is due to the changing definition of experimental aircraft. As an example, prior to 1993, single engine experimental aircraft were combined with all single engine aircraft. After 1993 these were placed in the separate "experimental" category. As a result, some of the apparent drop in fixed wing and rotorcraft aircraft in 1993 can be explained by the aircraft re-classification.

At the regional level, the four-county PSRC airport system is more concentrated toward single engine piston aircraft than the nation as a whole, with this category comprising nearly 86% of the region's total based aircraft as of 1998. Multi engine piston and turboprop aircraft comprise 7.3% of the regional fleet; Turbojet comprise 2%; rotorcraft 2%; and other (gliders, ultralights, and experimental) comprise 3.1%.

Aircraft Operations

National aircraft operations data were obtained from the FAA. Regional data were obtained from airport records, from FAA Airport Master Records (Form 5010), and from the WSDOT Aviation Division. At the national level, operations data are available for airports with either FAA or contract air traffic control services. At the region's smaller airports historical operations data are sketchy, and are available only where airport management undertook a counting program and where the State DOT Aviation Division deployed its acoustical counters. At regional airports with control towers, operations data are consistently available. Because aircraft operations data are not regularly collected at all airports, the historical string of operations data for the region's airports is incomplete. There is a need for more consistent data collection at the region's small airports.

While the FAA's national operations data excludes many of the nation's small general aviation airports, it does include larger airports with control towers, and is useful in tracking national trends. Exhibits 5-5 through 5-7 display FAA national aircraft operations data. Exhibit 5-5 shows the national trend in total GA aircraft operations at airports with air traffic control services (either FAA or contract towers). Between 1987 and 1998 total U.S. GA operations peaked in 1990 at over 40 million, then declined to 35.3 million in 1996. This trend shifted in 1997, when operations showed a 4.2% increase to 36.8 million, and again in 1998, when total GA operations grew another 3.3%. Exhibit 5-6 displays the same data as Exhibit 5-5 showing the split between local and itinerant* GA operations. After growing from 1987 to 1990, both local and itinerant GA operations declined from 1991 through 1996, when operations reached a low point for the decade. From 1996 to 1998 both local and itinerant GA operations increased: local operations grew from 14,475,000 to 15,976,700, while itinerant operations increased from 20,823,000 22,086,400. Among the measures of GA aircraft activity, the largest area of recent growth has been in the number of instrument operations, shown in Exhibit 5-7. Similar to total GA operations, instrument operations grew strongly from 1987 until 1989, then declined sharply for four years to a low point in 1993. Since then, instrument operations have increased four of the past five years. Between 1993 and 1998 total U.S. GA instrument operations grew by nearly 12%.

** An "itinerant" operation is a landing or take-off at one airport by an aircraft that is based at another airport, or by a based aircraft flying to another airport. Itinerant operations are differentiated from "local" operations, which start and stop at the same airport, and include training flights and touch-and-go flights.*

Exhibit 5-6 Total U.S. Local and Itinerant GA Operations at Airports with Air Traffic Control Service

(in thousands)

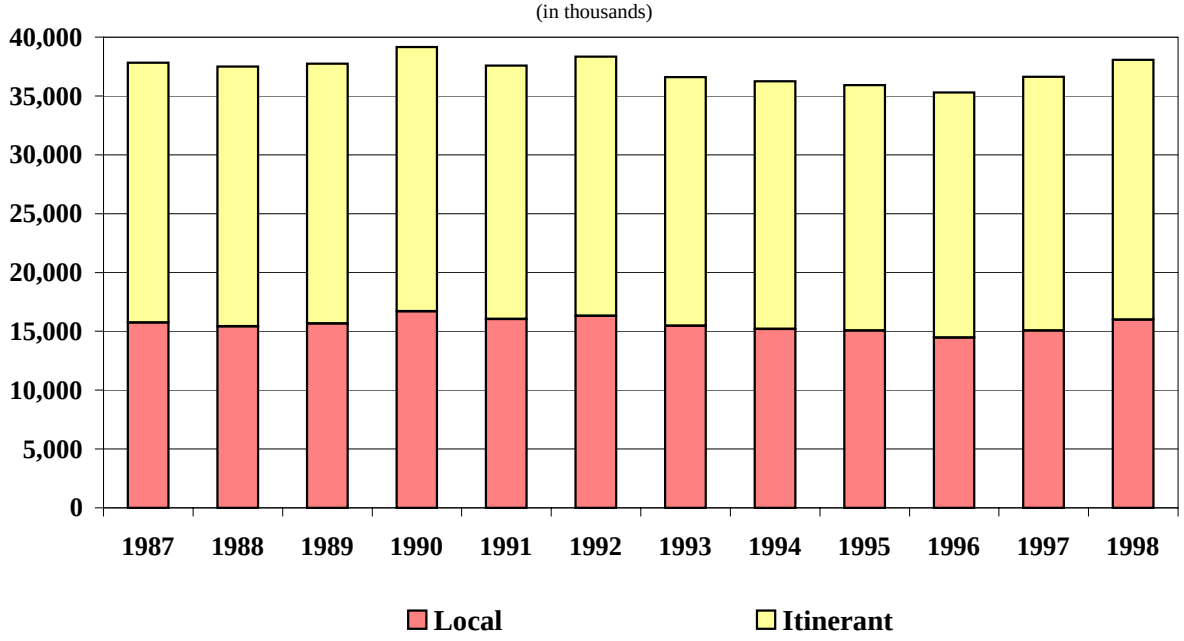
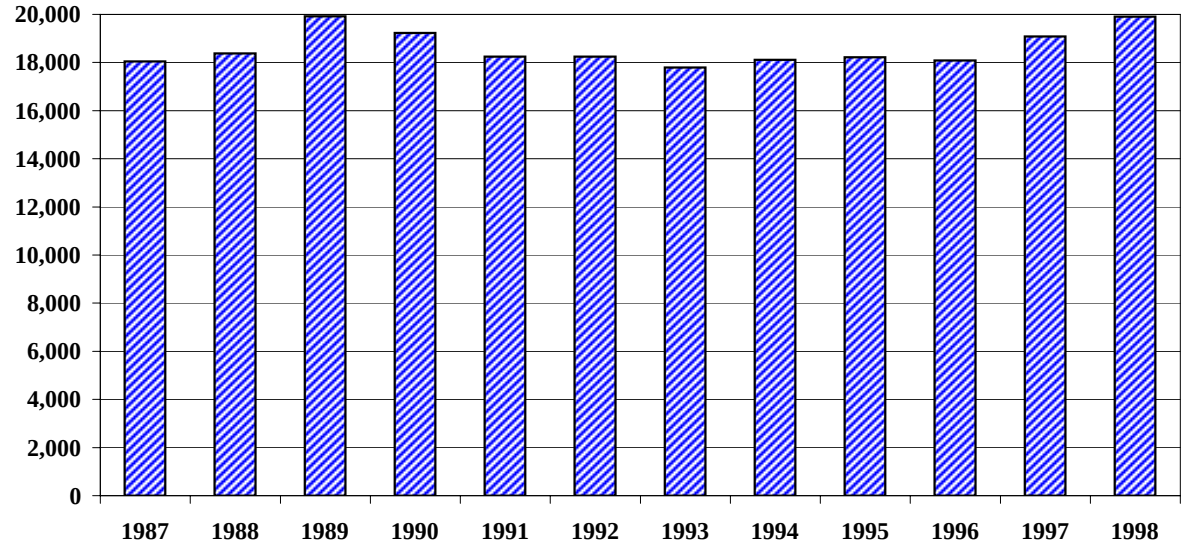


Exhibit 5-7 GA Aircraft Instrument Operations at Airports with FAA Air Traffic Control Service

(in thousands)



Aircraft Hours Flown

In addition to the number of aircraft operations, FAA data show historical trends in aircraft hours flown. These data are displayed in Exhibits 5-8 and 5-9. GA aircraft hours flown held steady at between 33 and 34 million from 1987 through 1991. Total annual hours flown then fell for three years, and reached a low point of 24 million hours in 1994. Since then the number of total GA aircraft hours flown has increased each year through 1998. These trends were experienced equally among the various aircraft types. Exhibit 5-9 shows the 10-year trend in average annual aircraft hours flown by aircraft type. Turboprop, turbojet, and rotorcraft consistently show the highest level of use, with total average flight hours per aircraft between 250 to 500 per year. Piston engine and other aircraft (gliders, ultralight, and experimental) show a much lower level of annual use: piston engine aircraft hovered near 140 hours per year through the period, while "other" aircraft were flown between 50 and 75 hours per year. Among the higher-use aircraft types, turboprops have generally declined, from a peak of nearly 500 hours per year in 1989 to 300 hours in 1996. After declining for three prior years, turbojet aircraft use has increased steadily for the past 5 years, growing from 260 hours in 1991 to 340 hours in 1996.

Aircraft Fuel Consumption

Aircraft fuel consumption is another measure of aviation activity which takes into account the number of aircraft operations, aircraft type, and length of flight. While the number of operations is most critical for determining airport needs, the amount of fuel consumed is a more complete measure of total aviation activity. The FAA collects information on the amount of general aircraft fuel consumed by aircraft type. Historical national trends in GA fuel consumption for the years 1987 through 1998 are displayed on Exhibit 5-10. Fuel consumption held fairly steady between 1987 and 1991, then dropped significantly (31%) from 1991 to 1993. Since 1993 the industry has seen steady growth each year, from 703 million gallons in 1993 to 965 million gallons in 1998. This represents a 37% increase in 6 years. This trend is a direct reflection of the number of hours flown, as discussed above.

While the other types of aircraft have not shown significant change in fuel consumption (most have been stable or declined slightly), the turbojet category has seen major growth in the past 5 years. Between 1992 and 1997 fuel consumed by GA turbojet aircraft has increased from 287,800,000 gallons to 481,800,000 gallons. This represents an annual growth rate of 8.8%, and a total 6-year increase of 67%. This is one of the strongest measures of growth in the General Aviation sector. Another trend noticeable in Exhibit 5-10 is the reduction in fuel use by multi-engine piston and turboprop aircraft, which corresponds with 1993. Since that time both multi-engine piston and turboprop aircraft fuel use has been intermittently up and down.

New Aircraft Production/Shipments and Aircraft Billings

Information on the historical trend in new fixed wing aircraft production/shipments and billings is shown in Exhibits 5-11 through 5-13. These data were obtained from the *1999 General Aviation Statistical Databook*, published by the General Aviation Manufacturers Association (GAMA). The information collected from GAMA goes back to 1970, and shows the unprecedented growth trend until the year 1978 followed by the steep decline from 1978 until 1983. This decline continued at a lesser rate from 1983 until about 1987, when the industry seemed to reach bottom. Total new aircraft shipments grew from 7,292 in 1970 to 17,811 in 1978, then declined to 1,085 in 1987.

Exhibit 5-8 U.S. GA Aircraft Hours Flown

(in thousands)

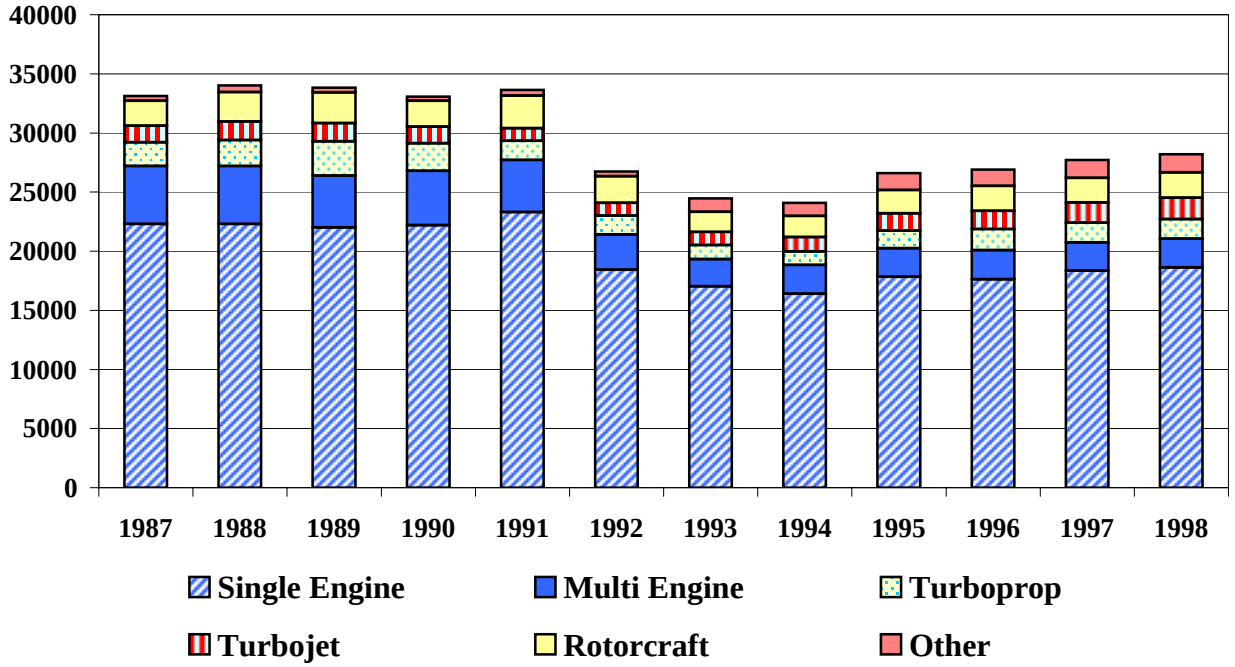


Exhibit 5-9 Active U.S. GA Aircraft Average Hours Flown

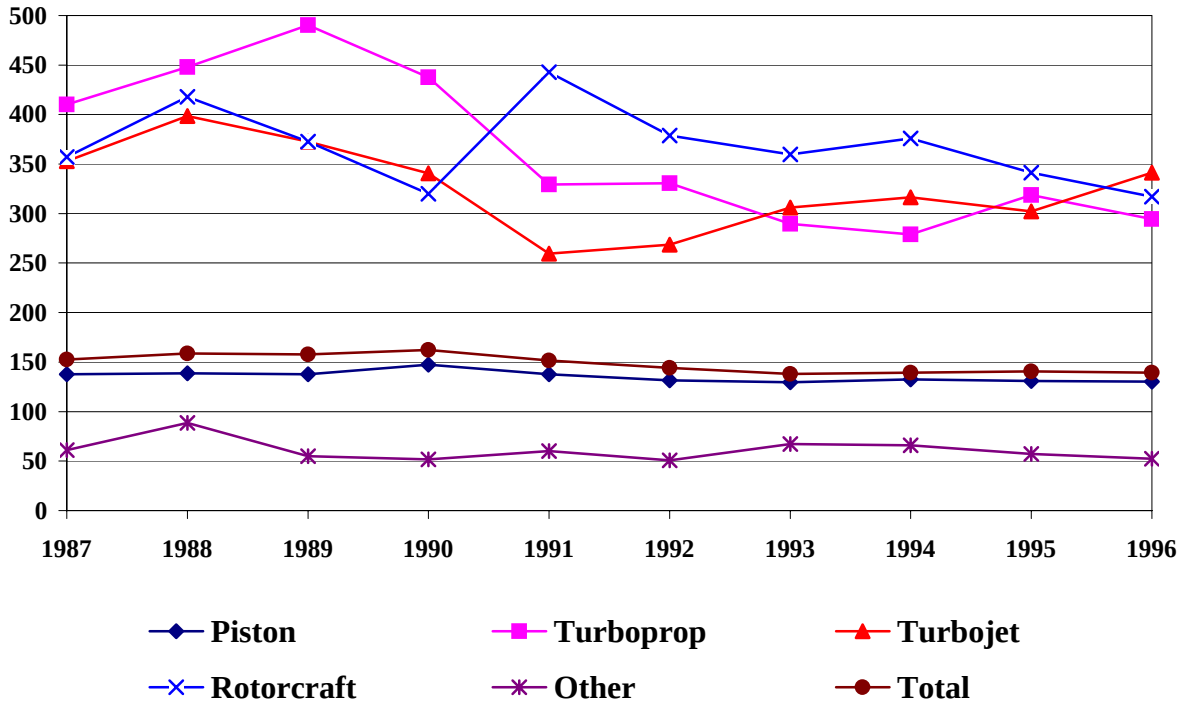


Exhibit 5-10 U.S. GA Aircraft Fuel Consumed

(millions of gallons)

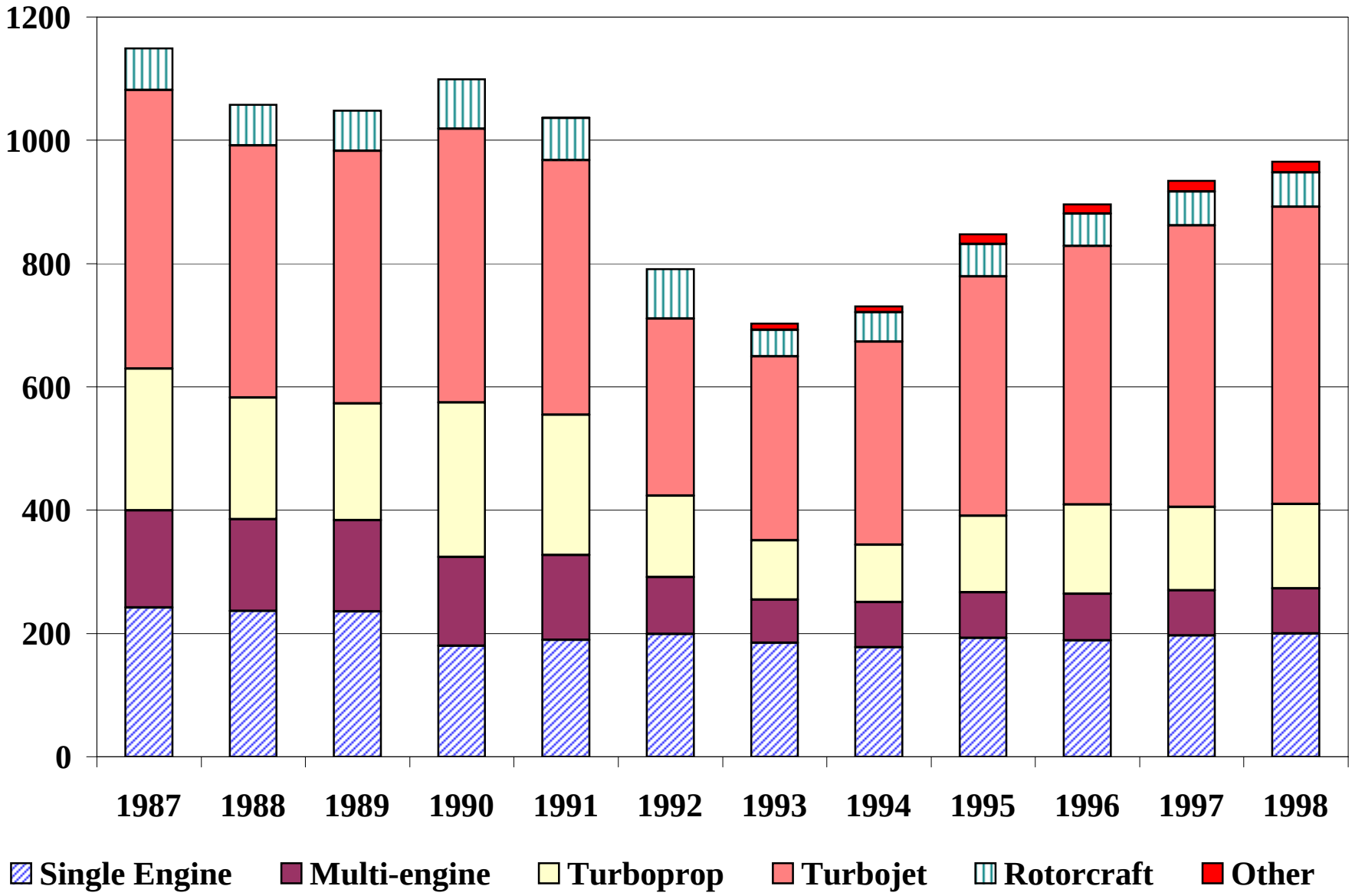


Exhibit 5-11 Annual New U.S. Manufactured GA Aircraft Shipments

(source: GAMA 1998 Statistical Databook)

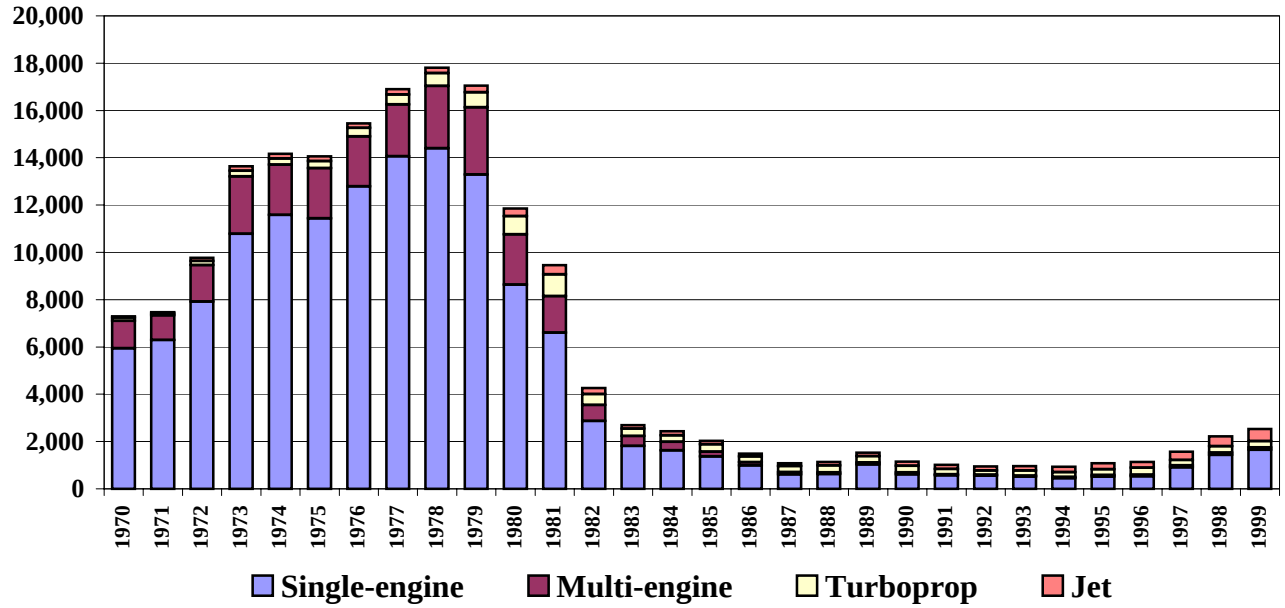


Exhibit 5-12 Recent Trends in New U.S. GA Aircraft Shipments

(source: GAMA 1998 Statistical Data Book)

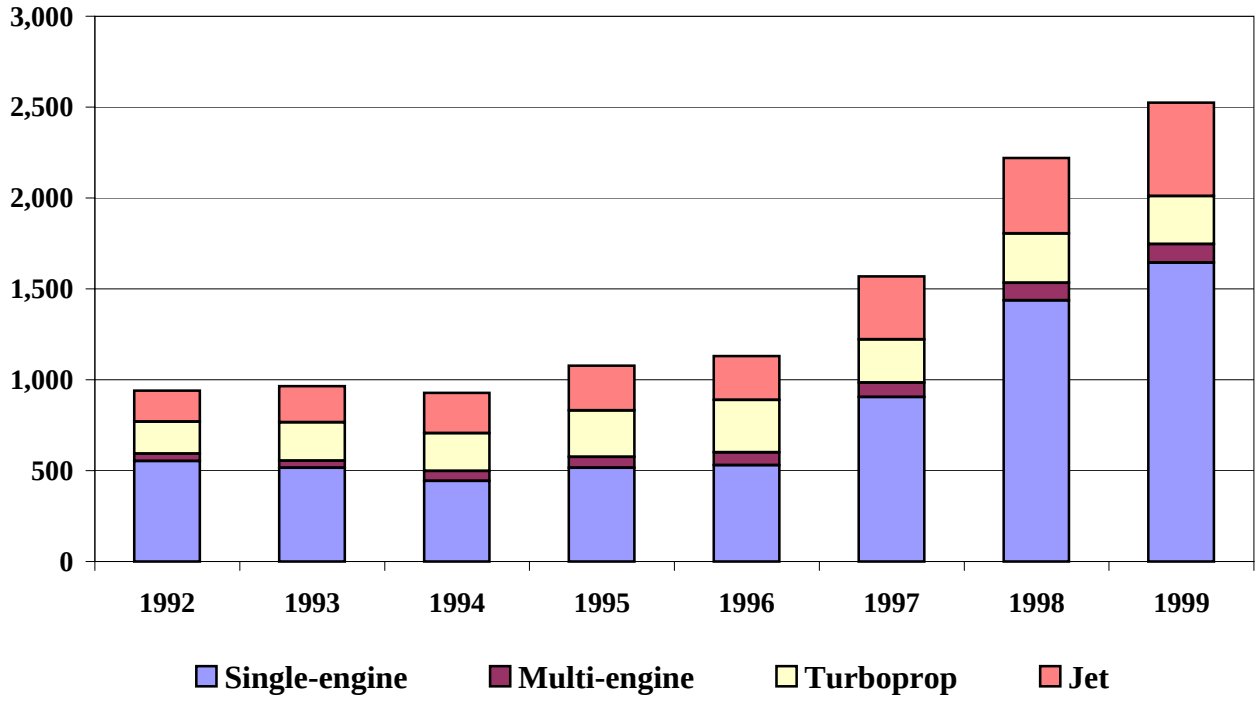
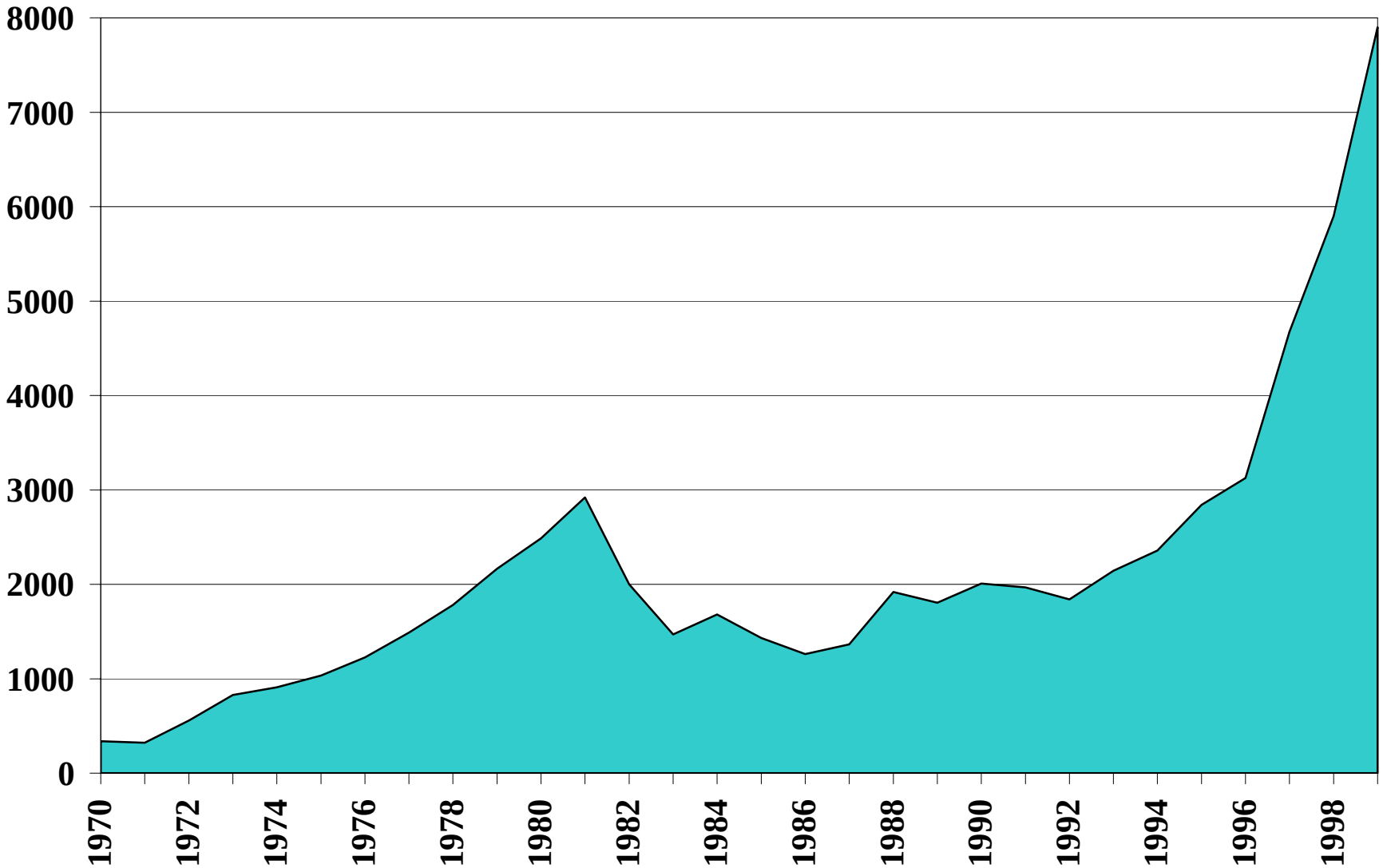


Exhibit 5-13 Total GA Aircraft Billings (in millions)

(source: GAMA 1998 Statistical Databook)



After several years of stagnation, the industry has seen a resurgence, growing from a low of 928 new units in 1994 to 2,525 in 1998, a 172% increase in just 4 years. The 1999 figure is the highest level of new aircraft shipments since 1983. Historically, the strong growth in aircraft shipments which peaked in 1978, the succeeding decline until the early 1980's, and the recent growth trend, affected all four major aircraft types (single-engine, multi-engine, turboprop, and jet) about equally.

Exhibit 5-12 shows the recent upward trend in aircraft production between 1992 and 1999. While growth was moderate through 1996, total shipments jumped significantly in 1997, when total new GA aircraft shipments grew by 39% in a single year, and again in 1998, when units shipped increased by 42% over 1997. Growth slowed slightly in 1999, when shipments increased by 14% over 1998. Taken together, the growth in GA aircraft shipments in 1997, 1998, and 1999 represent more than a doubling of shipments in the last three years. The strong 3-year growth spurt in aircraft production from 1996 to 1999 was not felt equally among the four major aircraft types. Shipments of single engine piston aircraft showed the most growth, increasing from 530 units in 1996 to 1,645 units in 1999, a 3-year increase of 210%. Jet aircraft shipments increased by 113% for the same 3-year period; multi-engine piston aircraft shipments grew by 46%; and turboprops, after having grown for several years, dropped by 18% in 1997, rebounded in 1998, increasing by 15% for the year, and then fell slightly (2.5%) in 1999.

Exhibit 5-13 displays the historical trend in new billings for fixed wing GA aircraft manufacturers for the period 1970 through 1999. Though the exhibit displays similar trends to those seen in Exhibits 5-11 and 5-12, the affect of inflation on the price of aircraft softened the decline in total billings for the years between 1981 and 1986. Whereas total new aircraft shipments declined by 95% in the period from 1978 to 1986, total billings declined by only 57% during its decline (1981-1986). Since that time, GA aircraft manufacturers' total annual billings related to new aircraft production have increased at a very robust average annual growth rate of nearly 14%. Total growth in billings for the period 1986-1999 was 525%, much of which occurred in the past three years. In the last two years both aircraft manufacturing and total billings have grown at unprecedented rates. From 1996 to 1997 total billings grew 49%, while 1998 billings exceeded 1997 figures by some 25%. In 1999, billings took another steep increase, growing by 34% over 1998.

The consistent upward trend in new GA aircraft production/shipments and manufacturers' billings over the past 5 to 6 years is an encouraging sign that the aviation industry may have "turned the corner," and may possibly be entering a new era of growth and stability.

General Aviation Aircraft Cost Indices

Historical cost index data for general aviation aircraft are available from the FAA. Exhibits 5-14 through 5-19 show these trends divided into the various cost components for various aircraft types. The cost index data use 1972 as a base year, setting the indices at 100 for that year. Single-engine piston aircraft costs are shown in Exhibit 5-14. The data for purchase cost end in the year 1986 because aircraft production for the aircraft models in the index ceased that year. Overall, the patterns shown in all five aircraft cost index charts are similar: costs have risen consistently over time, and by 1991 had quadrupled their 1972 levels. While all cost components have increased, operating costs have grown more than other costs. Among other items, these costs include fuel and insurance. Historically, the operating cost for any general aviation aircraft grew very rapidly between the mid-1970's and the early 1980's, then leveled off, dropped in the mid-1980's, and began growing again in 1989.

Exhibit 5-14 General Aviation Aircraft Cost Indices
Single Engine Piston Aircraft
(1972 = 100)

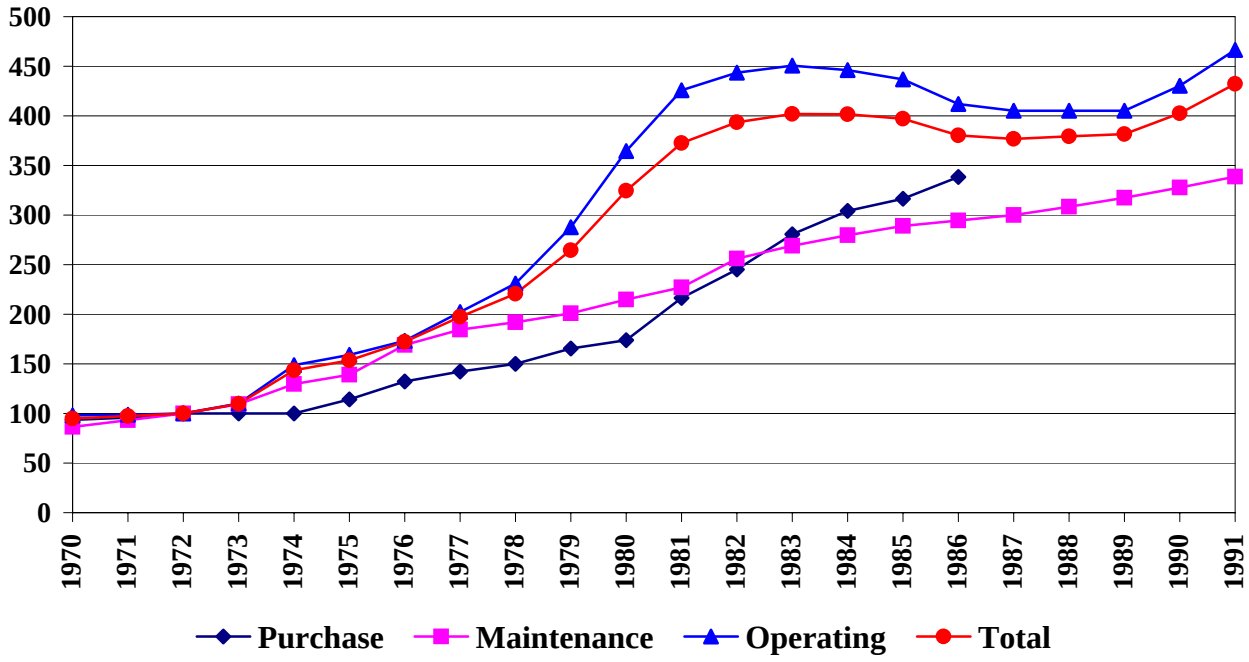


Exhibit 5-15 General Aviation Aircraft Cost Indices
Multi-Engine Piston Aircraft
(1972 = 100)

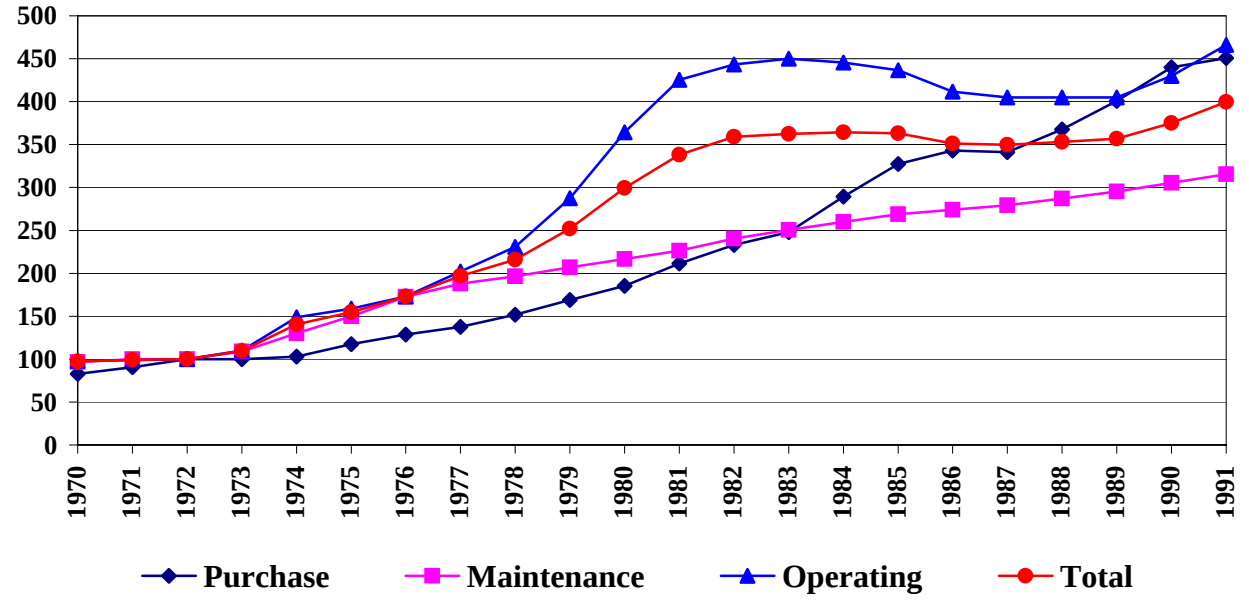


Exhibit 5-16 General Aviation Aircraft Cost Indices
Turboprop Aircraft
(1972 = 100)

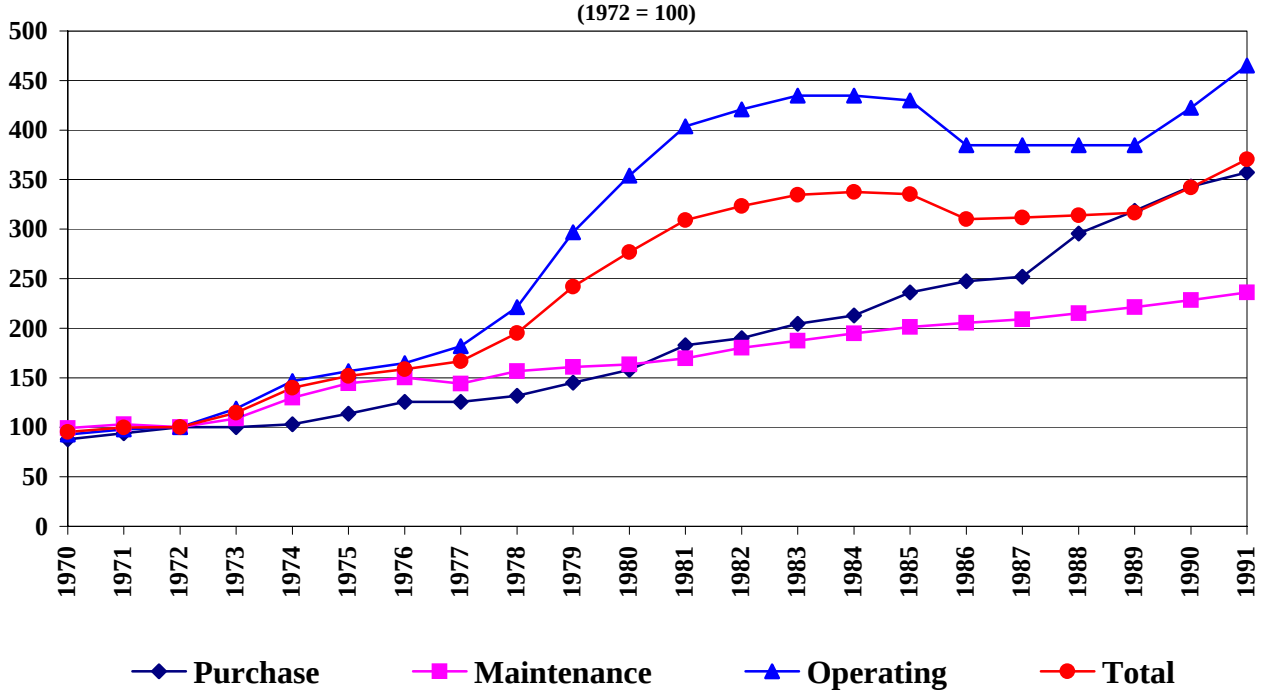


Exhibit 5-17 General Aviation Aircraft Cost Indices
Turbojet Aircraft
(1972 = 100)

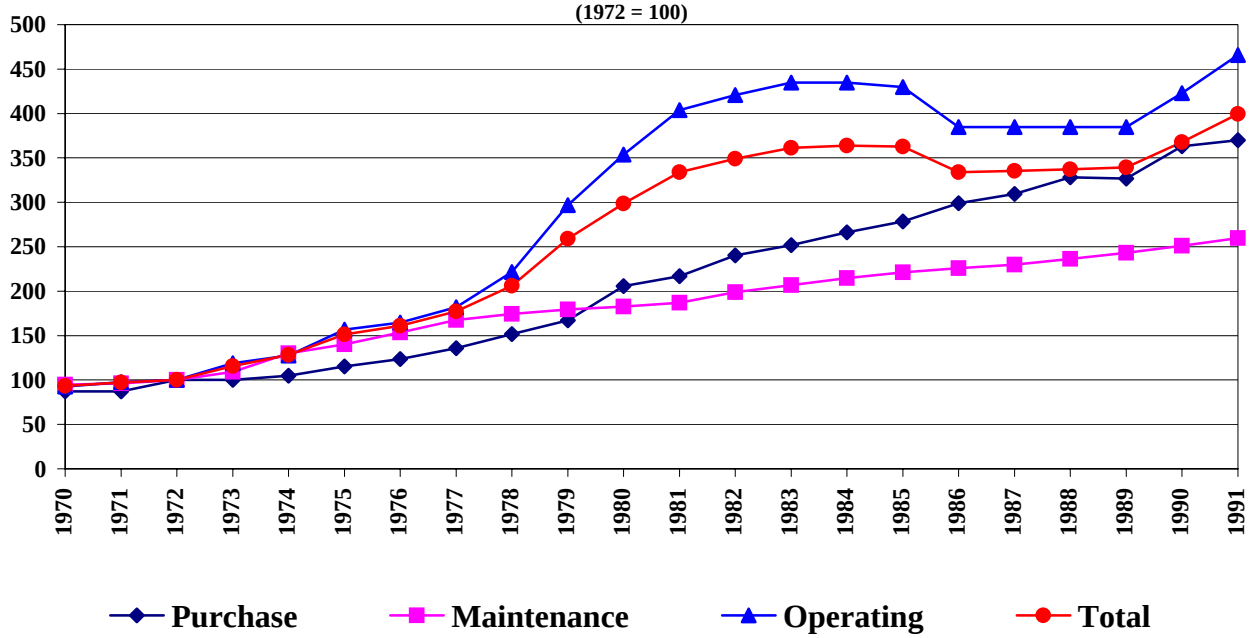


Exhibit 5-18 General Aviation Aircraft Cost Indices
Comparison of Total Cost
(Aircraft index: 1972 = 100 / CPI: 1982 = 1)

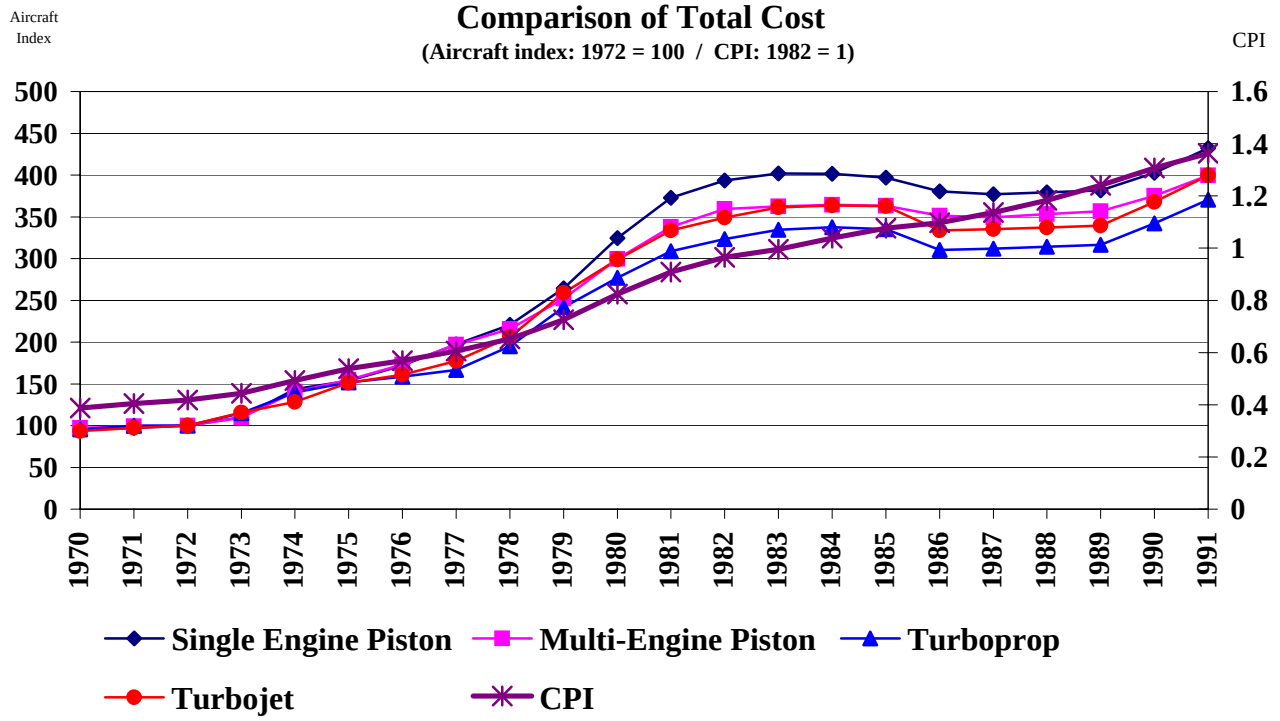
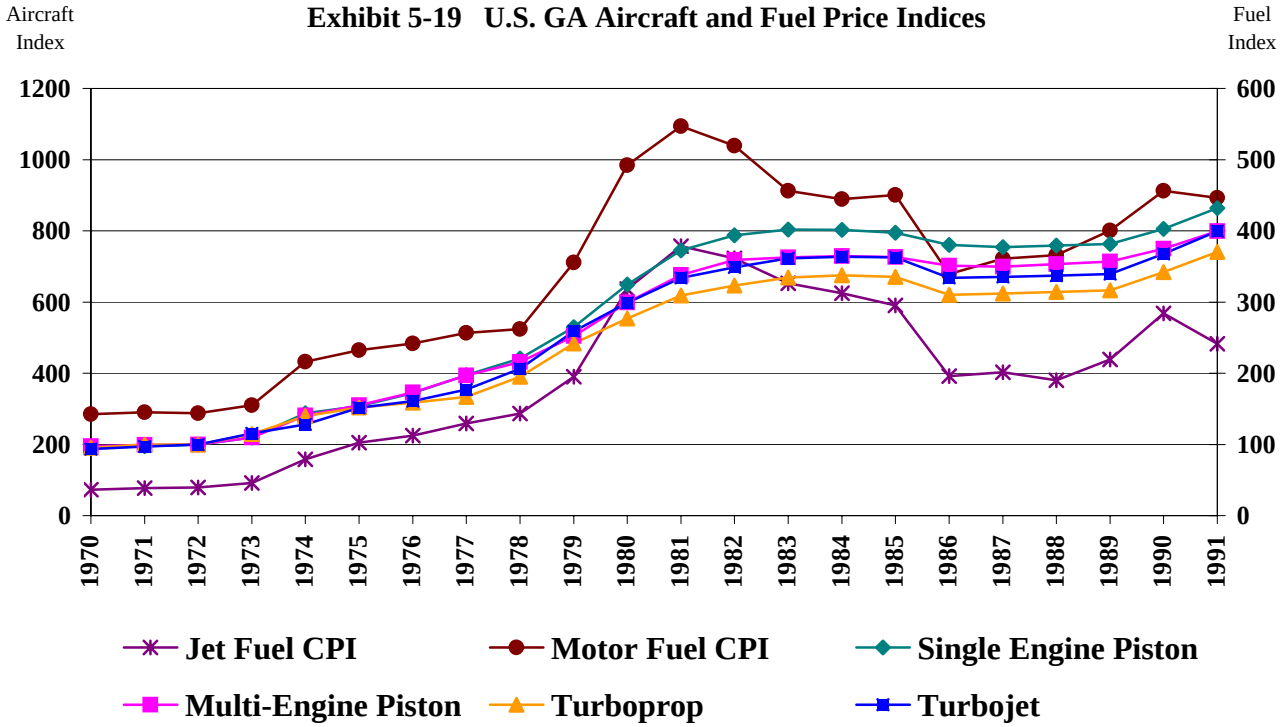


Exhibit 5-19 U.S. GA Aircraft and Fuel Price Indices



Also shown on Exhibit 5-18 is the overall U.S. Consumer Price Index (CPI). Beginning in 1970 the U.S. CPI grew from a value of 0.4 and reached nearly 1.4 by the year 1991, for an increase of 250%. During this same time frame, the average cost index for all GA aircraft grew from about 100 to about 400, an increase of 300%. As these two sets of numbers show, the cost of owning and operating a general aviation aircraft has risen somewhat faster than the national consumer price index, particularly from 1978 to 1982. During this time frame the national CPI also increased at a rate higher than previous years, but aviation prices were affected more than general prices. From 1978 to 1982, while the overall national consumer price index increased by 48%, the total cost of aircraft ownership and operation increased by between 160 and 180%. Between 1983 and 1991 aviation costs slowed, and were overtaken by general consumer prices, so that by 1991 aviation costs had fallen slightly below the CPI.

The cost of fuel is clearly an important component of the cost of operating an aircraft. To assess how these two prices have compared over time, historical price indices are displayed in Exhibit 5-19. There is a close correlation between the fuel price and aircraft cost indices. Both are flat from 1970 until 1973, grow somewhat through 1978, skyrocket from 1978 until 1981, decline until 1986, and begin to increase again in 1989.

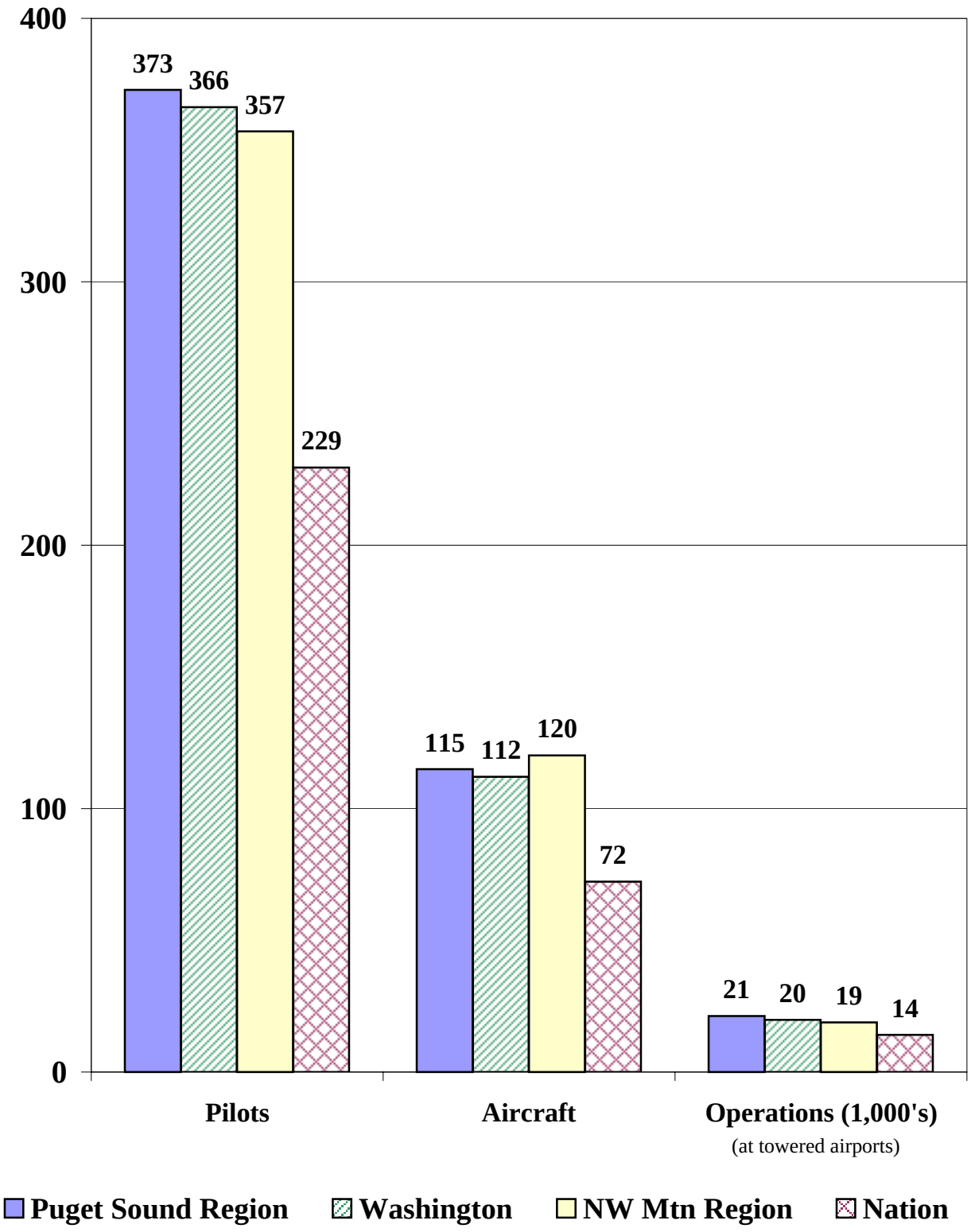
Comparison of Regional and National Per Capita Aviation Activity

One method of measuring the relative level of aviation activity in the PSRC region is to compare it to larger geographic areas. These comparative data can be useful in "calibrating" future forecasts for the region when compared to national aviation forecasts. To allow for such a comparison, aviation activity data were collected for the nation, the FAA's Northwest Mountain Region, the State of Washington, and the Puget Sound Region. Three basic measures of aviation were analyzed: the number of active pilots, number of active GA aircraft, and GA aircraft operations at airports with air traffic control services. To measure the relative propensity for aviation activity, these aviation data were then compared with the respective national, state, and regional population to develop a ratio of activity per unit of population. The results, which are described below and displayed in Exhibit 5-20, show the ratio of active pilots, active GA aircraft, and GA operations (at towered airports) per 100,000 population for 1998.

As of 1998 there were approximately 618,000 active pilots in the nation with an estimated April 1, 1998 population of 269,429,000. Comparable figures for the PSRC region were 11,743 active pilots and a total population of 3,149,700. Active GA aircraft in the U.S. totaled 194,826 in 1998, while the Puget Sound Region had 3,620. Total national GA aircraft operations at airports with air traffic control services equaled 38,063,100 for the 1998 calendar year, while the Puget Sound Region's total was 668,000. Comparable figures for the FAA's Northwest Mountain Region are also shown below. The ratios of pilots, aircraft, and operations per population for these three geographic regions are shown in tabular form below and in graphic form in Exhibit 5-20.

Exhibit 5-20 Comparison of 1998 Aviation Activity Measures

(per 100,000 population)



Comparison of Aviation Activity Levels

1998 Activity Levels	Nation	FAA NW Mtn. Region *	State of Washington	PSRC Region
Active Pilots	618,298	62,969	20,841	11,743
Active Aircraft	194,826	21,190	6,379	3,620
GA Operations **	38,063,100	3,315,760	1,228,291	668,000
Ratio of Activity to Population				
Population	269,429,000	17,632,010	5,685,300	3,149,700
Active Pilots per 100,000	229.5	357.1	366.3	372.8
Active Aircraft per 100,000	72.3	120.2	112.1	114.9
GA Operations (1,000s) per 100,000 **	14.1	18.8	19.8	21.2

* *FAA's NW Mountain Region includes Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming*
** *Operations numbers are for GA aircraft operations at airports with air traffic control services*

All three measures of aviation activity relative to population show the Puget Sound Region significantly above the national ratios. Comparing active pilots to population, the ratio is nearly 62% higher for the Puget Sound region (372.8 pilots per 100,000) than for the nation (229.5). Similarly, active aircraft figures for the region are 59% higher than the nation, and operations figures for 1998 are 50% higher in the region than for the nation as a whole. While the operations figures are more difficult to verify, due to differences in data collection techniques and data sources, the figures clearly show the Puget Sound region has a much higher ratio of GA aircraft operations to population than the rest of the nation.

The Puget Sound Region can be favorably compared with the FAA's Northwest Mountain Region, which contains the seven northwest states of Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming. This region contains nearly 18 million people, 63,000 active pilots, over 21,000 active GA aircraft, and in 1998 accounted for over 3 million aircraft operations at airports with air traffic control services. Similar to the PSRC region of western Washington, the FAA Northwest Mountain Region has consistently generated higher levels of aviation activity per unit of population than the nation as a whole. The mountain region had a pilot ratio of 357.1 per 100,000 resident population; aircraft ratio of 120; and annual operations ratio (in 1,000s) of 18.8. These figures are consistent with the Puget Sound region, all being considerably higher than the nation. Comparable numbers for the state of Washington are also shown above. These figures show that the Puget Sound Region has slightly higher ratios of pilots, aircraft, and operations than the state, but both areas are significantly higher than the nation. The only measure where the FAA's Northwest Mountain Region had higher ratios is in the number of active aircraft per population. This high propensity to own aircraft might be partially explained by the large geographic size of most states in the region, and the relatively large distances between urban centers.

Based upon these numbers, the Puget Sound region, the state of Washington, and the FAA's Northwest Mountain Region are all generating per capita general aviation activity levels higher than the national average. If this relationship holds true into the future, both regions can be expected to experience higher numbers of pilots, aircraft, and aircraft operations (relative to population) than those forecast by the FAA for the nation as a whole. Several factors which are likely to affect this relationship include forecasts of regional population, employment, and economic growth. Analysis of these factors is included later in this chapter.

Previous Forecasts

Several sources of previous aviation activity forecast data were reviewed. These included the *1982 PSRC Regional Airport System Plan*, the *1988 PSRC Regional Airport System Plan*, forecasts prepared in 1992 by the Washington State Air Transportation Commission ("AIRTRAC"), and the 1993 *Washington State Aviation System Plan*. Most of these sources included forecasts of based aircraft and operations, either by airport, by county, for the region, or for the entire state. Several difficulties arise from using data from previous forecasts. These include the differing times when each forecast was prepared, different geographic areas of analysis, differing forecasting horizons, differing sets of historical information and forecasting assumptions, and forecasts of differing measures of aviation activity. These difficulties can be seen in viewing the several previous forecasts shown in Exhibits 5-21 through 5-23. These charts display based aircraft, operations, and operations per based aircraft (OPBA) forecasts for the total regional airport system (excluding Sea-Tac). In addition, these charts display actual counts through the year 1998 for comparison.

Previous forecasts of based aircraft for the Puget Sound Region's airports show a wide range (see Exhibit 5-21). For the year 2000 the regional based aircraft forecasts range from a low of 3,712 to a high of 5,784. The actual number of regional based aircraft in 1998 was about 3,620, below even the lowest forecast. For the year 2020 three forecasts range from 3,732 to 7,207.

Previous aircraft operations forecasts show a similarly wide range. As seen in Exhibit 5-22, operations forecasts for the year 2000 range from 1,804,703 (1993 SASP) to 3,376,380 (1982 RASP). Total aircraft operations in the region for the year 1998 reached 1,678,354, below all the previous estimates.

1982 Regional Airport System Plan (RASP)

The *1982 Regional Airport System Plan* (RASP) used 1979 as its base year and projected growth through the year 2000. That forecast showed some 3,100 based aircraft in 1979 growing to about 5,800 in the year 2000, an average annual growth rate of 3%. The based aircraft forecast was developed using the historical relationship between growth in the regional based aircraft fleet and growth in the regional population. Assumptions were made for future (increasing) aircraft ownership rates and then applied to the projected population through the forecast period. The total regional based aircraft forecast was then allocated to the individual airports based on their "market share" in the base year (1979). The 1982 RASP forecast for aircraft operations was prepared by applying aircraft utilization rates for each airport (based on 1979 utilization rates) to the based aircraft forecast. Future utilization rates were assumed to remain at the 1979 level. That forecast showed regional operations increasing from 1,782,298 in 1979 to 3,376,380 in the year 2000.

1988 Regional Airport System Plan (RASP)

Although the 1988 RASP also predicted steady growth, it assumed slower growth than contained in the earlier plan. The *1988 RASP* forecast showed 3,551 based aircraft in 1985 (its base year) and developed both high and low forecasts. The high forecast showed 4,518 based aircraft in the year 2000 and 6,214 based aircraft in 2010. The low forecast showed 3,627 based aircraft in the year 2000 and 3,732 based aircraft in the year 2020. While the high forecast proved to be too optimistic through 1998, the low forecast is consistent with actual based aircraft numbers in 1998. The 1988 RASP based aircraft "high" forecasts were based on FAA national projections for the period 1986 to 1997 and were then extrapolated for the years 1998 through the year 2020.

Exhibit 5-21 Comparison of Based Aircraft Forecasts with Actual

(excluding Sea-Tac)

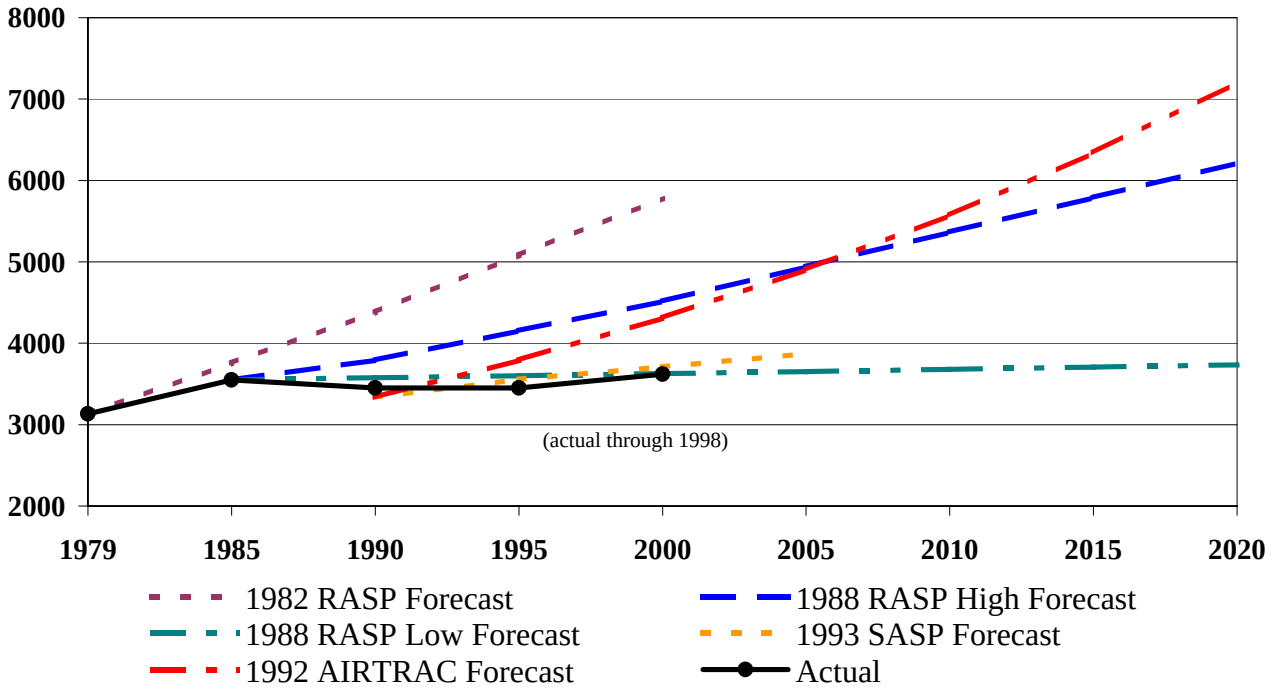


Exhibit 5-22 Comparison of Previous Operations Forecasts and Actual

(excluding Sea-Tac)

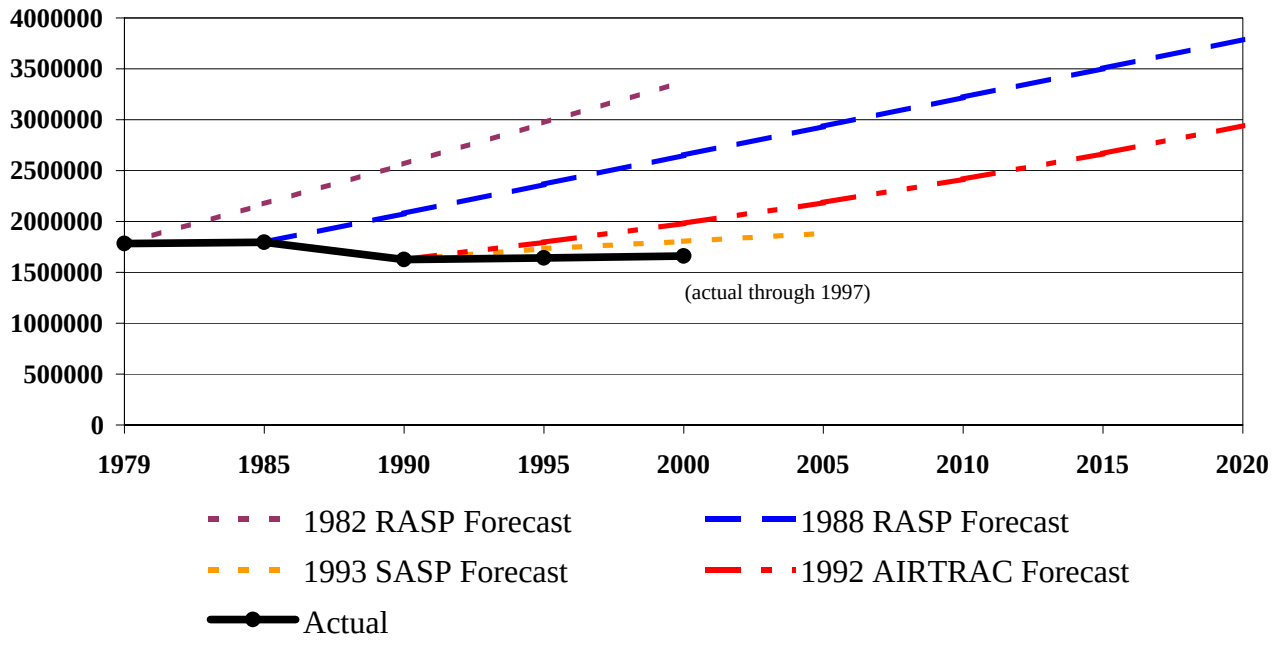
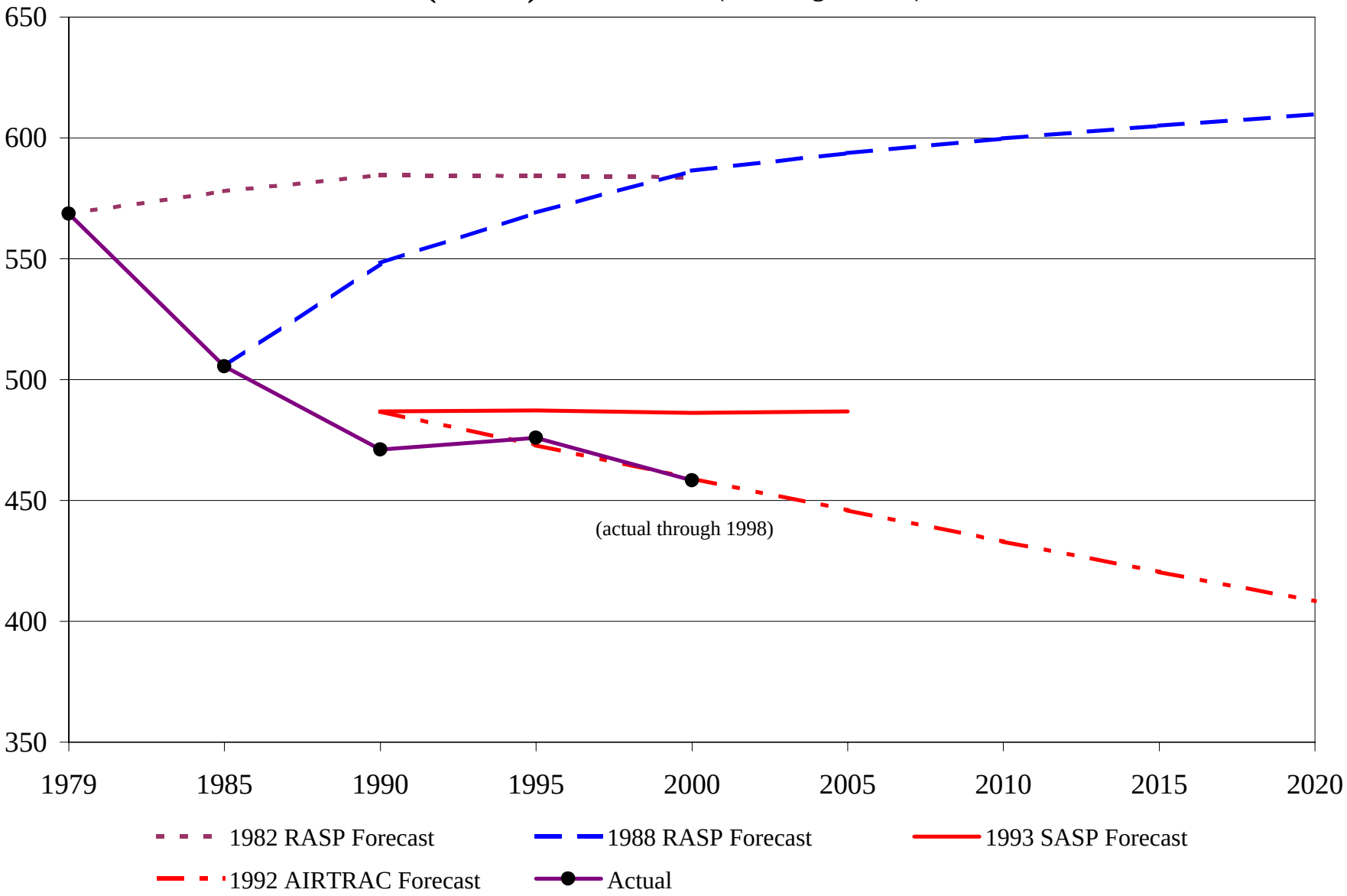


Exhibit 5-23 Comparison of Forecast Operations per Based Aircraft (OPBA) with Actual (excluding Sea-Tac)



Using FAA national based aircraft forecasts as a baseline, the regional aviation forecast was adjusted upward based upon the region's historically higher rate of aircraft ownership and projections of greater population growth in the four counties. Much of the growth was forecast for the east and southeast areas of King County.

Unlike the 1982 RASP forecast, the 1988 forecast assumed the 1988 aircraft ownership rate for the region would remain constant in the future. The "low" forecast contained in the 1988 RASP was based on conservative assumptions at the national and regional levels. The 1998 RASP aircraft operations forecast was developed using FAA national forecast for the year 1997 and extrapolating that forecast to the year 2020.

1992 AIRTRAC Forecast

The Washington State Air Transportation Commission (AIRTRAC) prepared aviation forecasts in 1992 as part of its statewide analysis of aviation trends, demand, and capacity needs. That forecast was based on average annual growth rates derived from recent historic aviation activity across the state. Those forecasts were based in a average annual growth rate of 2.6%, and show total regional based aircraft growing from 3,337 in 1990 (base year) to 3,870 in the year 2005 and 7,207 in the year 2020. The 1992 AIRTRAC forecast for aircraft operations utilized annual growth rates derived from the FAA's Terminal Area Forecasts and Washington State Aviation System Plan. That forecast, when applied to the PSRC region airports, predicted regional aircraft activity growing from 1,624,925 operations in the base year (1985) to 2,943,327 operations in the year 2020.

1993 Washington State Aviation System Plan (SASP)

The 1993 Washington aviation system consisted of 129 public use airports, seaplane bases, and heliports. The State Aviation System Plan ("SASP") developed forecasts for each of these facilities (see Exhibits 5-21 and 5-22). The figures discussed below were derived by separating the PSRC region airports from the statewide system. The 1993 SASP used 1990 figures as its base year and forecast based aircraft to the year 2005. The SASP developed relatively conservative forecasts, showing the region increasing from 3,337 based aircraft in 1990 to 3,870 based aircraft in the year 2005. This is only slightly above the 1988 RASP low forecast.

In addition to based aircraft and aircraft operations forecasts, the SASP developed statewide forecasts of active pilots, using FAA nationwide forecasts as a base. The statewide active pilot forecasts were correlated to nationwide pilot forecasts, nationwide population, and statewide population. The number of active pilots in the state were forecast to grow by an average annual rate of 1.85% from 1990 to the year 2005, or from 22,110 to 28,643 over the 15 year period.

Using the pilot forecast as a base, the 1993 SASP developed registered aircraft forecasts using a linear regression built upon the historical relationship between pilots and aircraft. The resulting registered aircraft forecast equates to an average annual growth rate of 1.00%. The total statewide registered aircraft forecast was then allocated to each county in the state based on each county's average "market share" of the total state aircraft for the period 1980-1990. Once allocated to the counties, the aircraft were allocated to airports in a similar way, assuming each airport's share of the county's aircraft would remain constant. The 1993 SASP developed aircraft operations forecasts by applying an assumed "operations per based aircraft (OPBA)" factor to the based aircraft forecast. These OPBA levels are displayed in Exhibit 5-23. These forecasts assume a constant number of annual operations per based aircraft over the forecast period, using historical OPBA figures for each airport. Applying the OPBA estimate to projections of future based aircraft yields a forecast of total aircraft operations. By combining the state's operations

forecasts for just the PSRC region airports, the state's forecast process yielded an increase from 1,624,925 PSRC regional aircraft operations in the base year (1990) to 1,883,709 PSRC regional aircraft operations in the year 2005.

Summary of Previous Forecasts

All the previous forecasts have exceeded actual activity levels over time. The earliest forecasts contained in the 1982 RASP were prepared during a period of strong growth in the general aviation market, and predicted continued growth in the numbers of pilots, aircraft, operations, and aircraft production. Between 1970 and 1978 the number of new general aviation aircraft had increased by 144%, and all components of the aviation industry were on the rise. Those forecasts simply did not anticipate the structural change that was about to occur, and the ensuing decline in general aviation, which was to begin in 1980 and last into the mid-1990s.

The newest forecasts contained in the State's 1993 SASP are much more conservative, reflecting more recent general aviation trends. The SASP forecast comes closest to matching actual activity levels for the period 1990 through 1998. The SASP forecast predicts 3,712 regional based aircraft in the year 2000, which compares with an actual number of 3,620 in 1998. The SASP operations forecast for the year 2000, while not as accurate as the based aircraft prediction, is still within 9% of actual figures for 1998. In terms of the number of operations per based aircraft, the 1992 AIRTRAC forecast comes closest to matching actual levels. For 1998 estimated OPBA levels stood at 464, while the AIRTRAC forecast predicted 459 by the year 2000. Clearly, the more recent forecasts, which had the benefit of more recent aviation trend information, have thus far been better reflections of actual aviation activity levels during the 1990s.

Current FAA Aerospace Forecasts

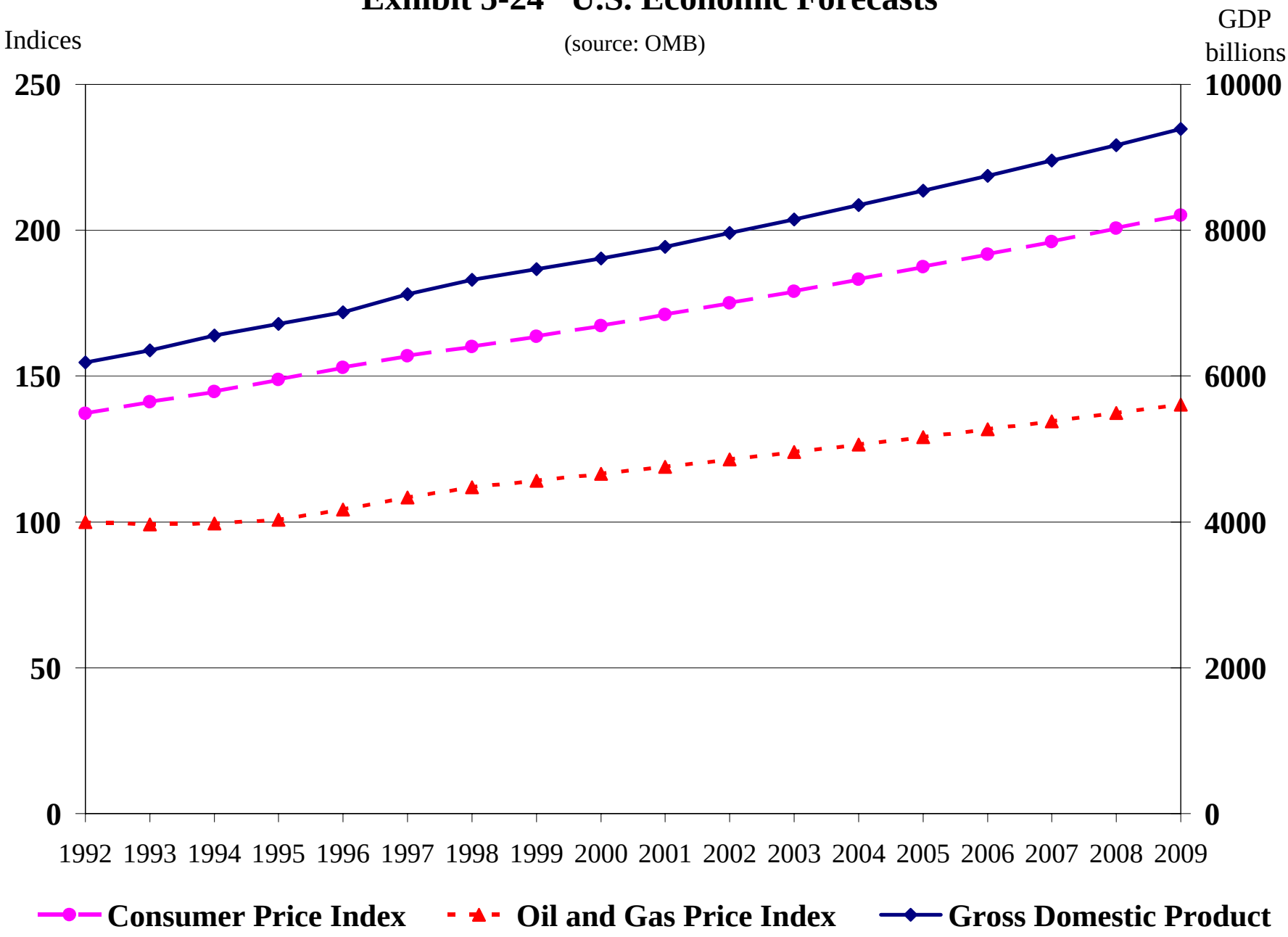
The most recent FAA Aerospace Forecasts were published in March 1999. In addition, the FAA's most recent Long Range Forecasts for the years 2015, 2020, and 2025 were published in June 1999. These forecasts provide a backdrop for the forecasting of regional activity. Among the many methods used by the FAA to measure aviation activity, the following are considered to be the most important: U.S. economic forecasts, active pilots, active aircraft, aircraft operations, aircraft hours flown, and aircraft fuel consumed. Each of these are discussed below.

U.S. Economic Forecasts

National economic forecasts form an important underpinning of the FAA's annual aviation forecast. A summary of U.S. long term economic forecasts (prepared in December 1997 by the U.S. Office of Management and Budget) was derived from the FAA's 1998 *Aviation Forecasts.* The OMB economic forecast (see Exhibit 5-24) displays historical data for the years 1992 through 1997 and shows forecasts for the years 1998 through 2009. The U.S. forecasts include an estimate of the consumer price index (CPI), the oil and gas price index, and gross domestic product (GDP). The consumer price index is indexed to 1983 (1983=100). The CPI forecast shows steady growth, from 157 in 1997 to 205 in the year 2009. This forecast translates to an average annual CPI increase of just under 2.3%. For the total period the index is forecast to increase by 30%. The oil and gas price index is also forecast to increase by 30% between 1997 and 2009. Also included is a forecast of the U.S. Gross Domestic Product (GDP), which is estimated to grow from $7.124 trillion in 1997 to $9.386 trillion in the year 2009, a total increase of 32%, and an average annual growth rate of 2.3%.

Exhibit 5-24 U.S. Economic Forecasts

(source: OMB)



FAA Forecasts of General Aviation Activity

To summarize the thrust of the most recent FAA general aviation forecasts, the following quote was taken from the March 1999 FAA forecast report *FAA Aerospace Forecasts Fiscal Years 1999-2010*:

Review of 1997-98

> *"In 1998, general aviation completed its fourth year of operations following the enactment of the General Aviation Revitalization Act of 1994. The industry followed through with constructive actions to stimulate the development and production of new general aviation products and services. The industry also made efforts to promote interest in general aviation flying and pilot training. Over the past several years this optimistic outlook and the positive actions began yielding tangible results. The resurgence of the industry is evidenced by increased general aviation activity at FAA air traffic facilities, an increasing active fleet size, and record shipments and billings of fixed-wing general aviation aircraft. What follows is a review of the industry's performance during 1997 and 1998. For the most part, results for this period have been positive. On this foundation the forecast is for continued growth over the next 12 years and the foreseeable future.*

The FAA's general aviation forecasts for the period 1999-2010 (briefly summarized below) reflect this optimism on the part of the FAA and the general aviation industry as a whole. The FAA forecasts are based on the assumption of moderate and sustained economic growth for the U.S. In addition, the FAA's forecasts for general aviation assume that the legislation enacted in 1994 limiting the liability of GA aircraft manufacturers will have its greatest impact on the general aviation fleet around the turn of the century and beyond. The FAA states that while the predicted growth in GA activity will, to some degree, be driven by an expanding U.S. economy, the actual rate of growth will depend on how successful the industry is in stimulating the development of new general aviation products and services. To the extent that industry and government programs/initiatives are successful in revitalizing and expanding the market for general aviation products and services, the FAA's forecasts are likely to be met or possibly exceeded. If the industry's programs are not successful, the number of active general aviation fleet, hours flown, and pilots may be considerably lower than forecast.

FAA Forecast of Active Pilots

The U.S. population of active pilots, as shown in Exhibit 5-25 is forecast to increase at an average annual growth rate of 1.5% between 1999 and 2010, with a total increase of nearly 117,000 pilots for the period. For the entire long range forecast period (1998-2025) the FAA predicts annual growth of 1.2%. This forecast reflects the industry view that current initiatives, such as "GA Team 2000," will foster the growth of student starts.

Exhibit 5-25 National Forecast of Active Pilots

(source: FAA)

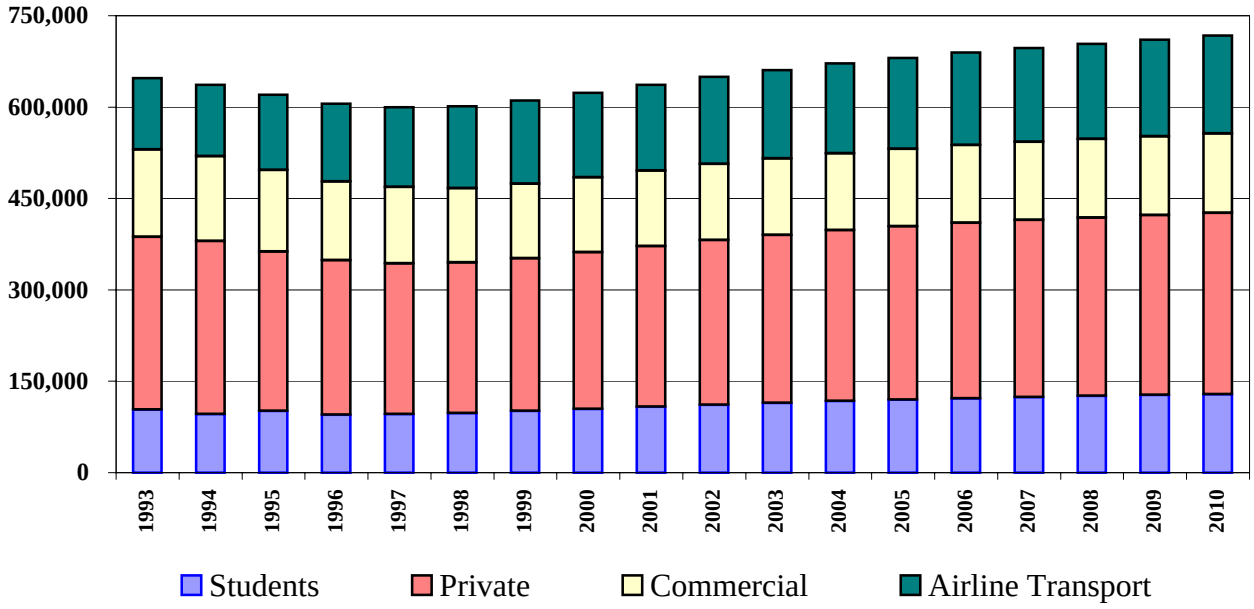
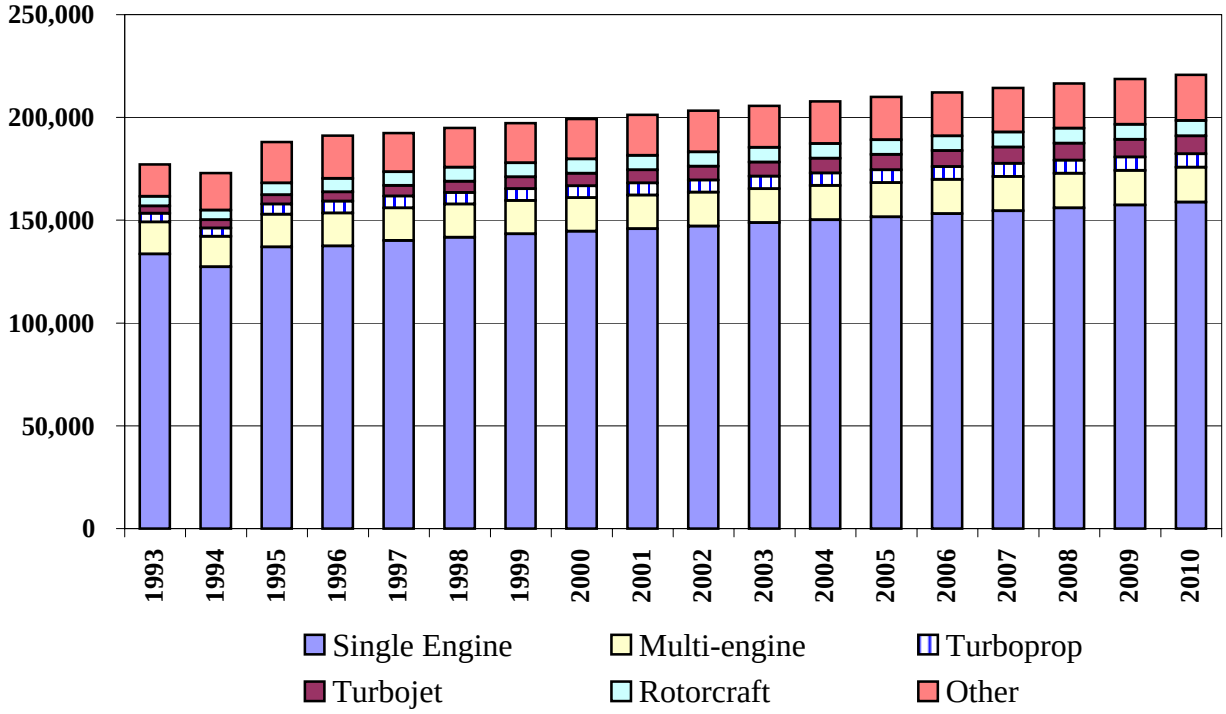


Exhibit 5-26 National Forecast of GA Active Aircraft

(source: FAA)



Increased student starts are expected to lead to larger numbers of pilots in other categories, particularly private pilots, over the course of the forecast period. The FAA's forecasts show the following annual growth rates for the four major pilot groups:

FAA Forecast 1999-2010

Pilot Group	Annual Growth Rate
Student	2.3%
Private	1.6%
Commercial	0.5%
Airline transport	1.5%

These growth rates can be seen on Exhibit 5-25. Excluding glider-only and helicopter-only pilots, the chart shows the total population of U.S. active pilots increasing from 618,000 in 1998 to 735,000 in 2010. The most pronounced growth can be seen in the student and private pilot groups. Whereas in recent years, when air transport pilots were the only growth sector for general aviation, the FAA forecast shows this trend will change.

FAA Forecast of GA Active Aircraft

Recent trends and the FAA's forecast of active general aviation aircraft are displayed in Exhibit 5-26. Total U.S. GA active aircraft bottomed out at 173,000 in 1994, and has grown each year since. The estimated total for 1998 was 195,000. Figures from the General Aviation Manufacturers Association (see Exhibits 5-11, 5-12, and 5-13) support the resurgence in the market for new GA aircraft, which is partially responsible for these increased numbers in the past 3 years. In addition, these numbers reflect a trend toward bringing formerly inactive aircraft back into the active fleet. Between 1998 and 2010 the FAA estimates the total U.S. general aviation active aircraft fleet will grow from 195,000 to 221,000.

Three trends are apparent in the FAA aircraft forecast. First is the steady overall growth throughout the period. The FAA's forecast is based on a 1% annual growth rate over the forecast period. Second is the fact that most of the predicted growth in active aircraft will occur in single engine aircraft. The forecast shows this sector of the GA fleet increasing from 127,000 in 1994 to 159,000 by the year 2010, a total increase of 25% for the period. This forecast is based on recent trends. The actual U.S. fleet of single engine piston GA aircraft has increased from 127,000 in 1994 to an estimated 142,000 in 1998, an increase of nearly 12% in 4 years. Third, the FAA forecast shows much slower growth in the multi-engine piston and rotorcraft fleets.

Within the rotorcraft fleet, the number of piston-powered helicopters are forecast to remain constant at 2,259 while the turbine-powered helicopter fleet is expected to grow by nearly 12%, from 4,589 in 1998 to 5,151 in 2010. Total percentage growth for the various GA aircraft fleet segments for the period 1997-2009 are as follows:

FAA Forecast 1998-2010

Aircraft Type	Total Growth
Single engine piston	12.0%
Multi engine piston	5.0%
Turboprop	16.0%
Turbojet	59.5%
Rotorcraft:	8.2%
Piston-powered	0%
Turbine-powered	14.8%
Experimental and Other	17.6%

The projected growth of single engine piston aircraft reflects the resurgence of the industry following the liability reform bill passed in 1994, and the optimism for growth in student and private pilot activity. The higher growth rates in the turboprop and turbojet sectors of the GA fleet reflect the already-established growth in the market for business and corporate general aviation. The figures for the two rotorcraft types reflect a significant shift in propulsion systems coupled with a continuing market for business-related rotorcraft applications, such as traffic reporting, police activity, medical evacuation, and others.

FAA Forecast of GA Operations at Airports with Air Traffic Control Services

Exhibits 5-27 through 5-30 display the FAA's current forecast of general aviation aircraft operations activity at airports with air traffic control services. These are typically airports with air traffic control towers. While there are a number of airports not included in these figures (airports without towers), the numbers represent an important component of the GA industry. Activity levels at towered airports is measured regularly, and can provide more statistically reliable data useful in forecasting this component of industry activity.

Total general aviation operations at towered airports are shown in Exhibit 5.27. After dropping from 38,355,000 to 35,300,000 annual operations between 1992 and 1996, operations rebounded, with a 2-year 7.8% jump to 38,063,100 in 1998. The forecast predicts this number will reach 45,215,000 annual GA operations in 2010, a growth rate of just under 1.5% per year.

Exhibit 5-28 displays the same data as Exhibit 5-27, but adds the split between local and itinerant GA operations. Both sectors of GA activity are forecast to grow, though itinerant will grow slightly faster than local. The forecast shows the split between local and itinerant will remain stable at 42% local versus 58% itinerant. Itinerant operations are forecast to increase by a total of 19.1% between 1998 and 2010, while local operations will increase by 18.4% for the period. The FAA's instrument operations forecasts are displayed in Exhibit 5-29. These are a measure of the increasing sophistication of the GA industry as well as the health of the corporate and business segment of general aviation. The FAA predicts GA instrument operations to increase from 19,908,300 in 1998 to a projected 24,354,000 in the year 2010, a total growth of 22%. This is consistent with the projected growth in GA itinerant operations discussed above (see Exhibit 5-28).

Exhibit 5-27 FAA Forecast of GA Operations at U.S. Airports with Air Traffic Control Service

(in thousands)

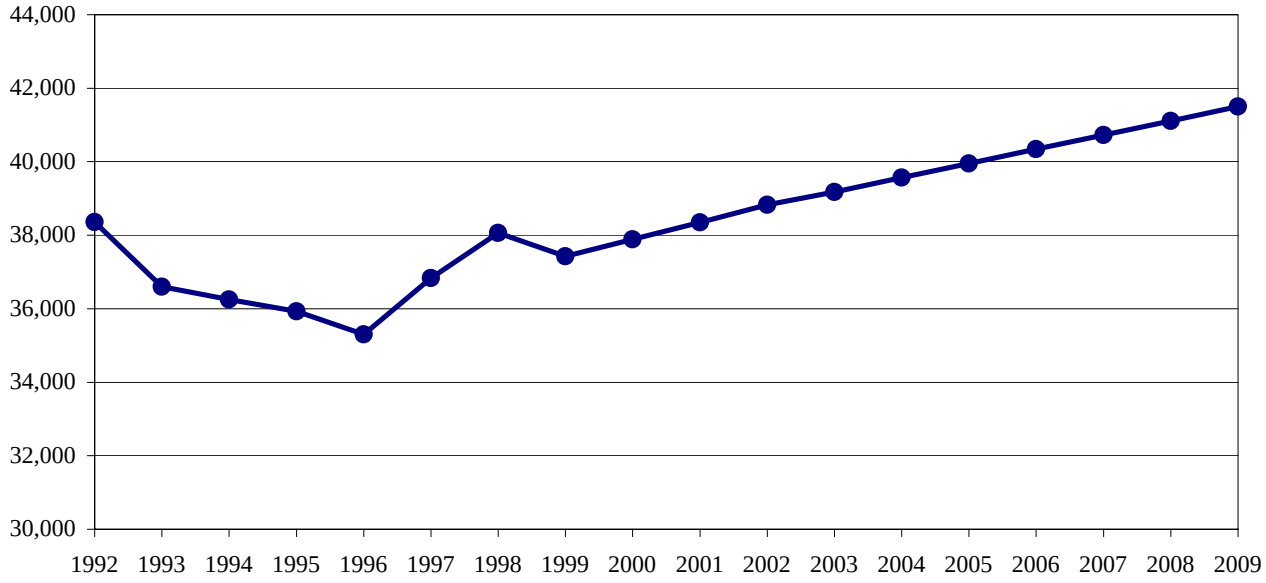


Exhibit 5-28 FAA Forecast of U.S. Local and Itinerant GA Operations at Airports with Air Traffic Control Service

(in thousands)

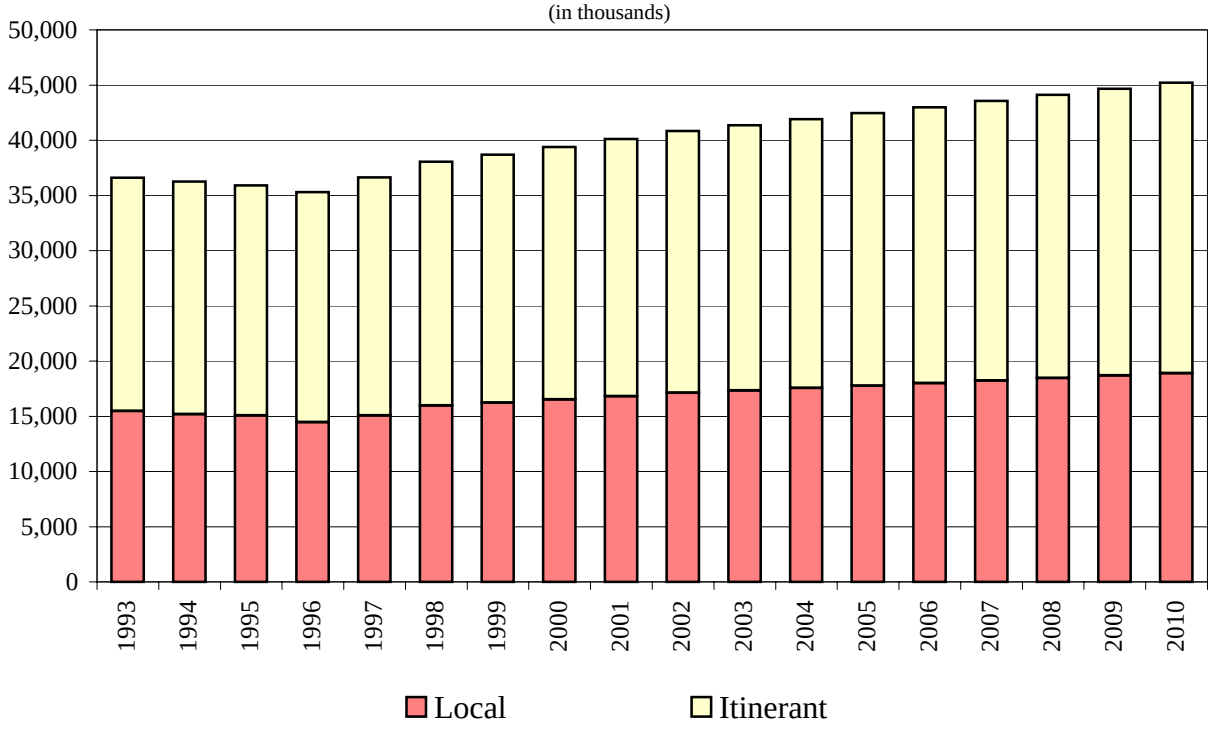


Exhibit 5-29 FAA Forecast of GA Instrument Operations at Airports with Air Traffic Control Services

(In thousands)

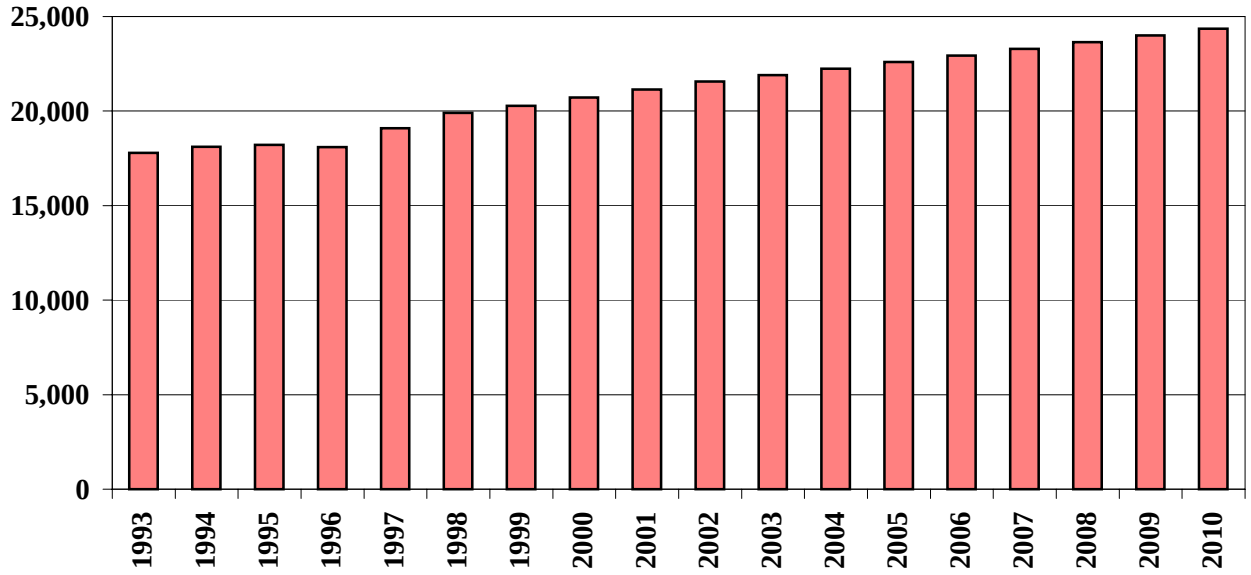


Exhibit 5-30 National Forecast of GA Aircraft Hours Flown

(in thousands)
(source: FAA)

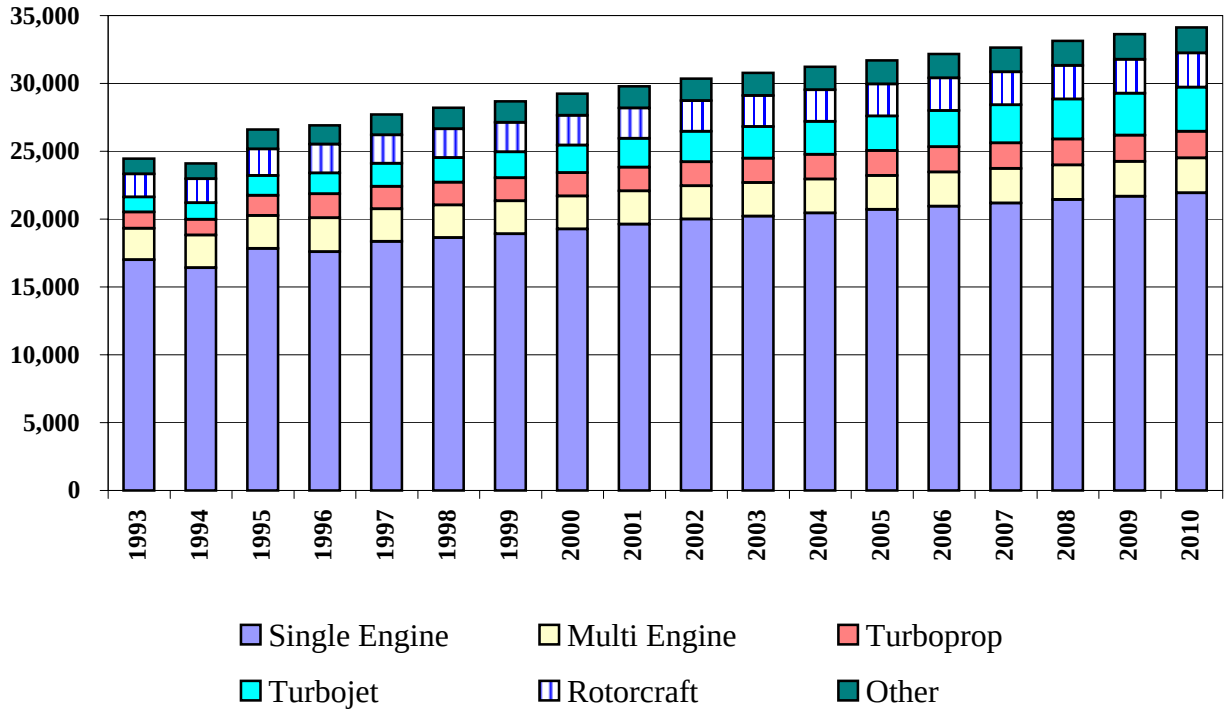


Exhibit 5-31 National Forecast of GA Aircraft Fuel Consumed

(millions of gallons)
(source: FAA)

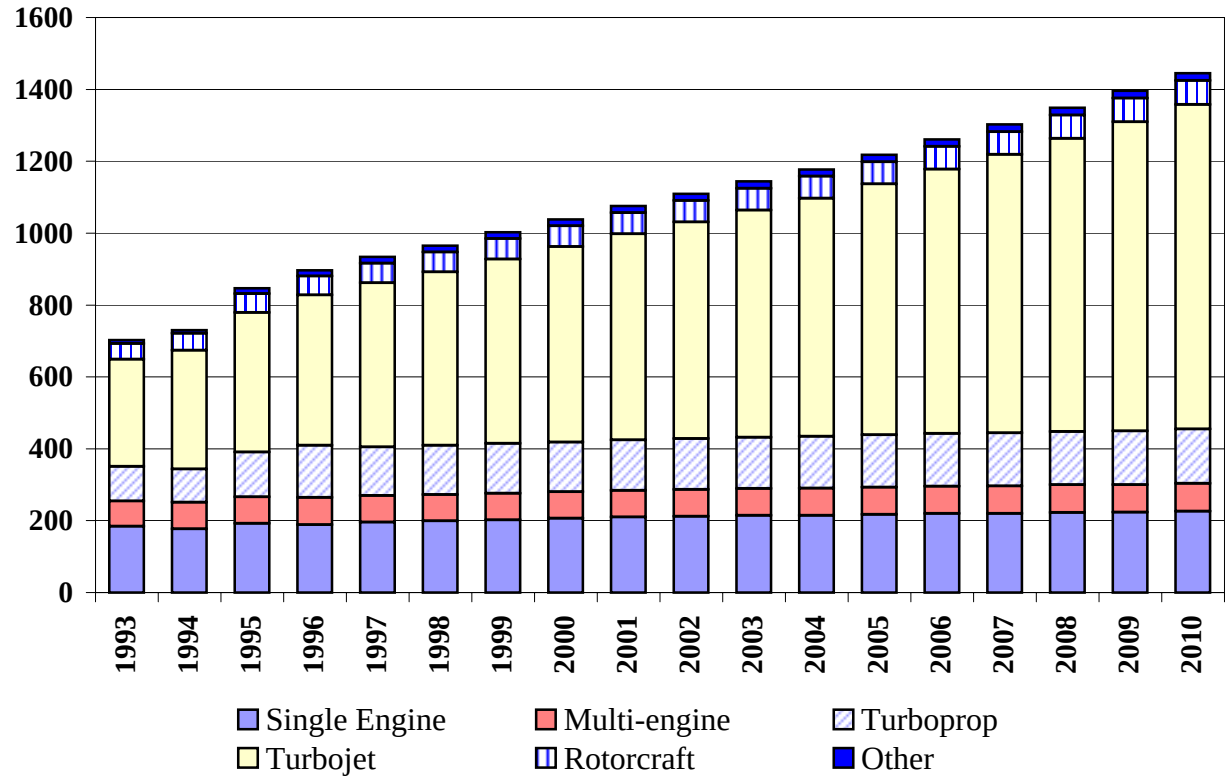
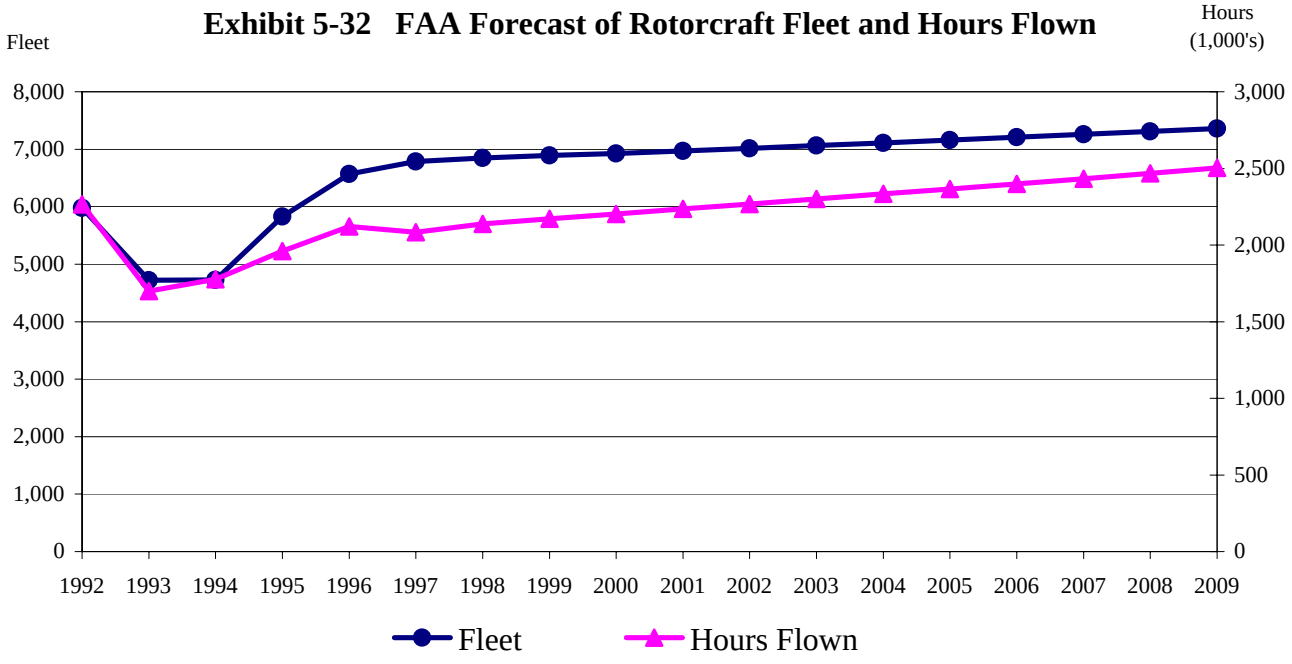


Exhibit 5-32 FAA Forecast of Rotorcraft Fleet and Hours Flown



FAA Forecast of GA Aircraft Hours Flown

Another measure of aviation activity is the amount of time aircraft are flying. The FAA forecast of aircraft hours flown (see Exhibit 5-30) is the total number of annual flight hours logged by general aviation aircraft. The forecast predicts total U.S. GA hours flown to grow from 28.2 million in 1998 to 34.1 million in 2010, a total increase of 21%. Exhibit 5-30 displays total aircraft hours flown for the six major aircraft types. The largest increase in total hours flown is predicted for single engine piston aircraft, which are forecast to increase by 18% for the period 1998 to 2010. Turboprop and rotorcraft will see gains of 16% and 19%, respectively, while multi engine piston aircraft will see slower gains of only 7% for the period. The greatest percentage increase in flight hours is expected to occur in turbojet use, with a total increase of 81%. This forecast reflects the assumption that business and corporate aviation will continue its strong growth trend of the past several years.

Exhibit 5-32 displays the FAA's forecast for rotorcraft fleet size and number of hours flown. From low points in 1993, both these measures have increased over the past 4 years, and both are expected to grow at moderate levels through the forecast period. The total rotorcraft fleet will grow by 8%, from 6,848 in 1998 to 7,410 in 2009, with turbine powered rotorcraft accounting for virtually all the growth. Rotorcraft hours flown are also predicted to grow steadily, from about 2,200,000 hours in 1998 to 2,500,000 hours in 2009, a total of 13.6%. The higher forecast for hours flown compared with fleet size results from a prediction of greater utilization of the rotorcraft fleet.

FAA Forecast of GA Aircraft Fuel Consumed

Exhibit 5-31 displays the FAA forecast of general aviation aircraft fuel consumption by aircraft type. Overall, fuel consumption reached a low point of 703 million gallons in 1993, and has grown steadily, reaching 965 million gallons in 1998. Total fuel consumed is forecast to increase to 1,445 million gallons by 2010, an increase of 50 % over 1998. The most significant component of the forecast is fuel consumed by turbojet aircraft. During the coming 12 forecast years, this segment of general aviation is expected to grow by 87%, from 482 million gallons to 903 million gallons by the year 2010. All other components are forecast to grow by between 10 and 20% overall during the forecast period, except for multi-engine piston aircraft fuel consumed, which is forecast to increase by only 5% in the coming 12 years.

Regional Socio-economic Forecasts

Historical analysis has shown a correlation between the level of aviation activity and three underlying socio-economic factors: population, employment, and income. Exhibits 5-33 through 5-35 display historic regional totals for these three demographic forecasts for the period from 1985 through 1998 while Exhibits 5-36 shows regional demographic forecasts for the entire region for the period 1998 through 2020. Exhibits 5-37 through 5-39 show the demographic forecasts by county.

Exhibit 5-33 Regional Population

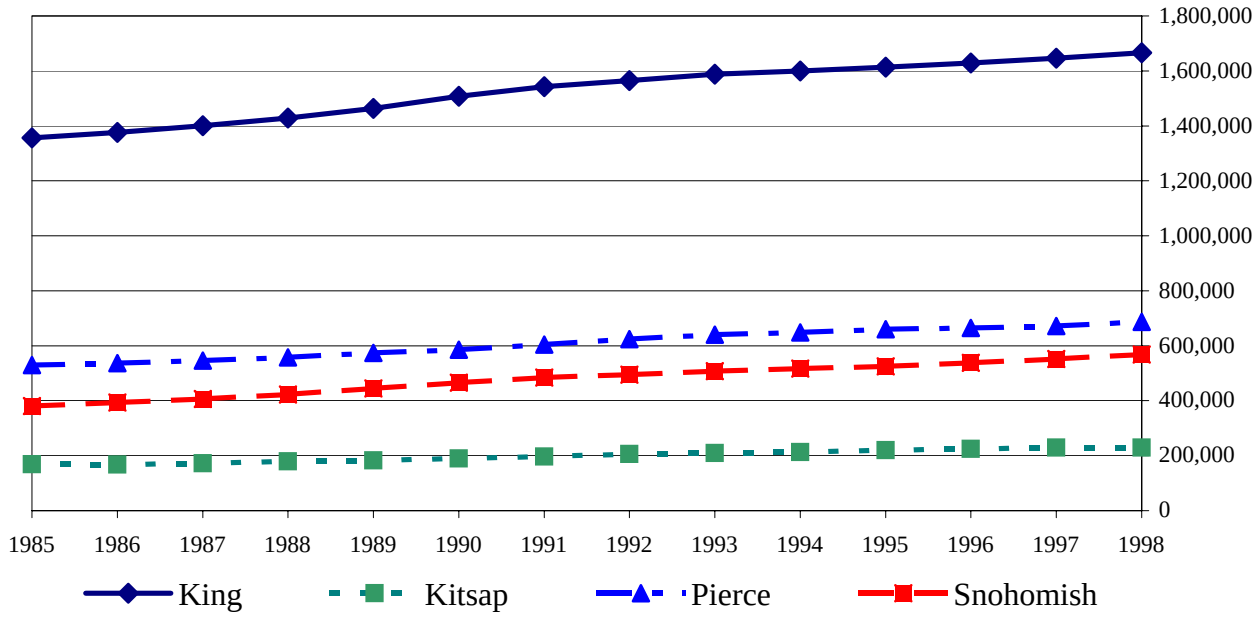
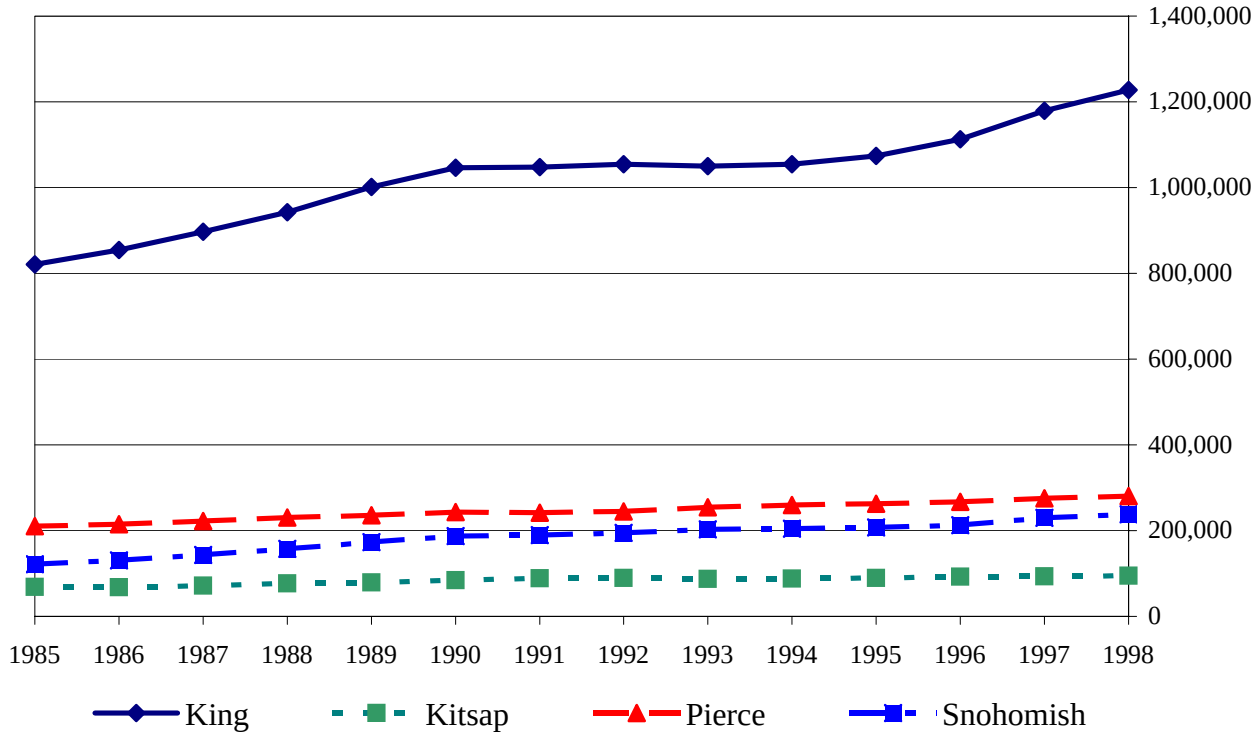


Exhibit 5-34 Regional Employment



Population

The most recent population forecasts for the Central Puget Sound Region show total population growing from 3.2 million in 1998 to 3.8 million in 2010 and 4.3 million in 2020, a total increase of 34% between 1998 and 2020. Average annual population growth is expected to be nearly 1.5%. Exhibit 5-37 displays forecast population for the region by county. Those forecasts are summarized below.

Puget Sound Population Forecasts by County

	1998		2010		2020	
County	**Population**	**% of Region**	**Population**	**% of Region**	**Population**	**% of Region**
King	1,665,800	52.9%	1,922,888	50.6%	2,122,453	49.8%
Kitsap	229,000	7.3%	293,486	7.7%	347,438	8.2%
Pierce	686,800	21.8%	841,722	22.1%	938,906	22.0%
Snohomish	568,100	18.0%	744,134	19.6%	853,956	20.0%
Total	3,149,700	100.0%	3,802,230	100.0%	4,262,753	100.0%

Within the region slight population shifts are expected to occur. King County's share of regional population will decline from 52.9% in 1998 to 49.8% by the year 2020. Most of that shift will go to Snohomish County, which will pick up 2 percentage points (from 18% to 20%), and Kitsap County, which will increase its share from 7.3% to 8.2%.

Employment

Regional employment is forecast to increase by an average annual growth rate of slightly over 1.2% over the 22 year period, from 1.84 million in 1998 to 2.2 million in 2010 and 2.4 million in 2020. The table below summarizes the annual employment forecasts, which are displayed in Exhibit 5-38. Similar to the expected intra-regional population trends shown above, regional employment is expected to shift slightly over time, with King County's share declining and the other three counties increasing. Pierce County should see its share of regional employment increase the most over the period, from 15.2% to 16.6%.

Puget Sound Employment Forecasts by County

	1998		2010		2020	
County	**Employment**	**% of Region**	**Employment**	**% of Region**	**Employment**	**% of Region**
King	1,227,798	66.7%	1,441,245	64.9%	1,554,278	64.4%
Kitsap	94,425	5.1%	117,613	5.3%	128,564	5.3%
Pierce	280,644	15.2%	362,360	16.3%	401,398	16.6%
Snohomish	238,108	12.9%	297,890	13.4%	328,357	13.6%
Total	1,840,975	100.0%	2,219,108	100.0%	2,412,597	100.0%

Exhibit 5-35 Regional Per Capita Income

(1992 dollars)

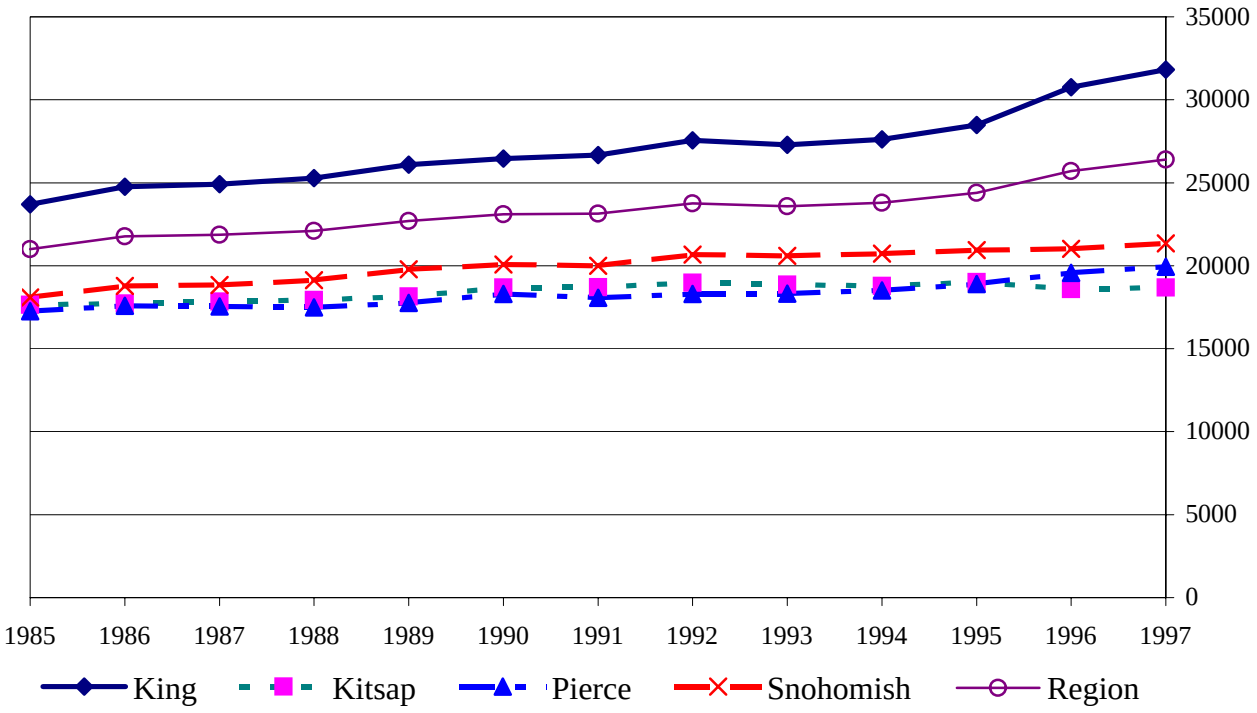


Exhibit 5-36 Puget Sound Region Demographic Forecasts

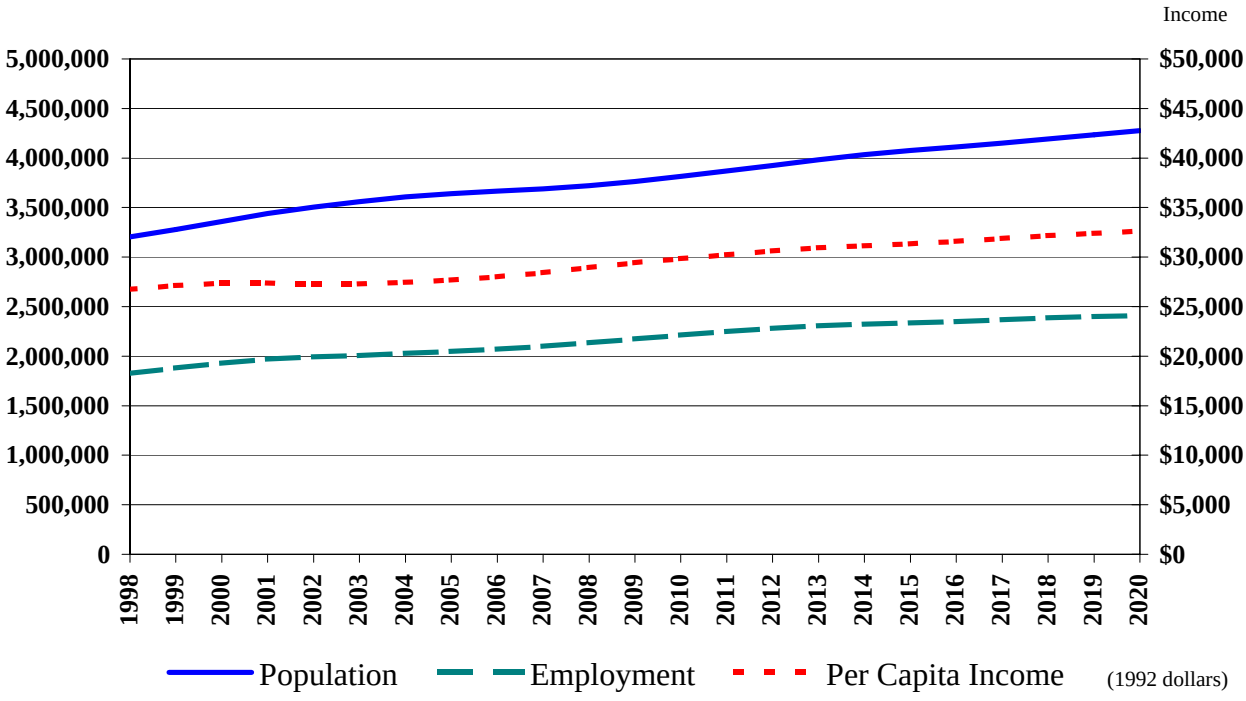


Exhibit 5-37 Regional Population Forecast by County

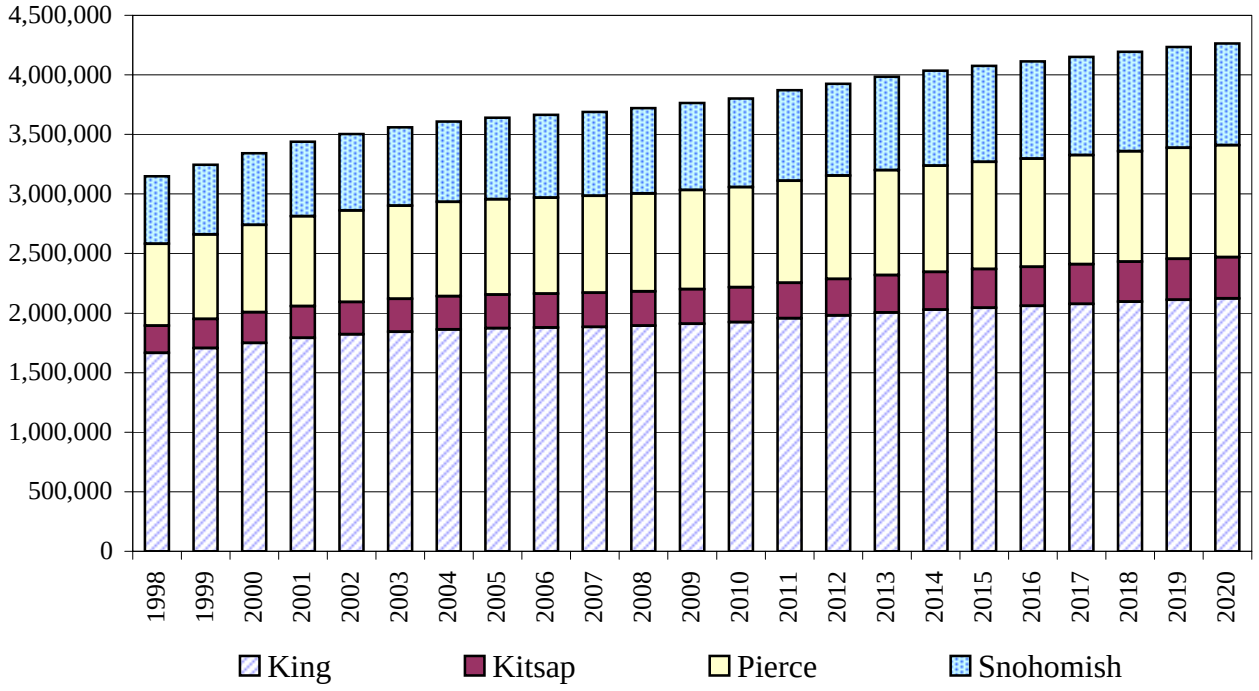


Exhibit 5-38 Regional Employment Forecasts by County

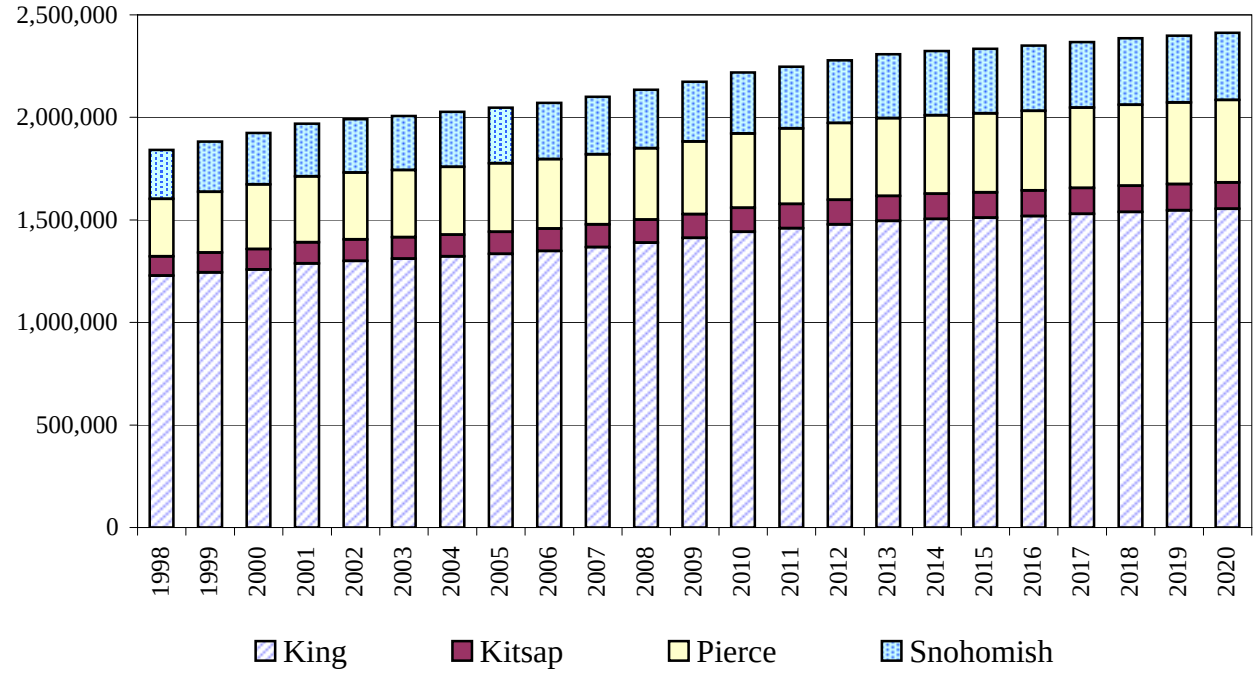
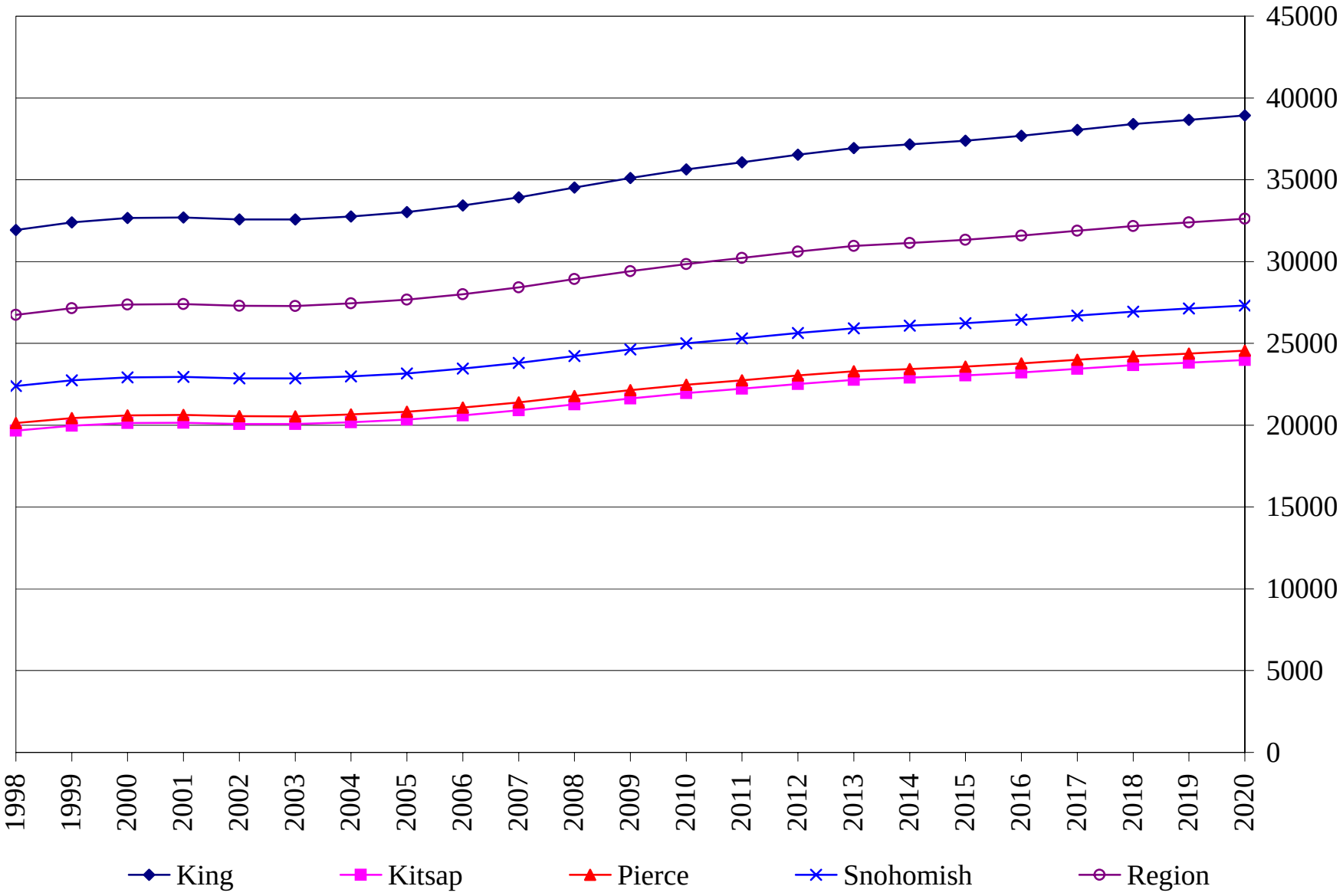


Exhibit 5-39 Regional Per Capita Income Forecast by County

(1992 dollars)



Per Capita Income

Forecasts of future per capita income are displayed in Exhibit 5-36 along with the population and employment forecasts. The figures show income in constant 1992 dollars. Over the 22-year forecast period, per capita income is expected to grow from $26,747 in 1998 to $32,615, a total increase of 22% and an average annual increase of 0.9%. Exhibit 5-39 shows the region's income forecast by county. King County is expected to hold the lead in per capita income, increasing from $32,000 in 1998 to $39,000 in 2020. Snohomish, Pierce, and Kitsap County per capita income is also expected to grow, but will remain well below King County.

Comparison of Regional and National Socio-economic Forecasts

Continuing historical trends, the Central Puget Sound Region is expected to grow at a faster rate than the rest of the nation. Between 1998 and the year 2020, total U.S. population is forecast to increase by an average annual growth rate of 0.8% compared with the PSRC region's projected 1.5% annual growth rate. This places the regional population growth rate 87.5% higher than the national growth rate for population. National employment is expected to grow by 0.85% per year between 1996 and 2006 (U.S. Bureau of Labor Statistics), increasing from 124 million in 1998 to 150.8 million in the year 2020. This compares with the regional employment forecast of 1.2% growth per year for the period 1998 through 2020. This regional employment growth rate is 41% higher than the national employment growth rate.

Forecast Methodology

This forecast methodology includes the preparation of forecasts using a variety of forecast approaches, a discussion of the results of those forecast approaches, and selection of a preferred forecast. Following is a summary of typical approaches to aviation activity forecasting.

Trend Analysis

A trend analysis forecast is based solely on historical trends. Using historical aviation data it establishes a linear trend (mathematical regression) and simply extends that trend into the future to establish a forecast. Trend analysis can be accurate in predicting future activity when historical trends have shown a low level of volatility, and where time is the only major variable affecting growth. A trend forecast is included here as one of several approaches to forecasting regional based aircraft and aircraft operations. One of the weaknesses of trend analysis forecasts is their inability to account for unpredictable variables, such as population, employment, or income shifts, changing prices, or other factors affecting aviation.

Market Share

Market share forecasts are based upon the historical relationship between the Puget Sound region and larger markets, such as the State, the FAA's Northwest Mountain Region, and the nation. Typically a market share forecast reviews these historical relationships and establishes the region's "share" of the larger market. That share may be static or changing over time. If, for example, the region is growing at the same rate as the nation, a market share forecast would simply apply the region's existing "market share" (or percentage) to a national forecast to develop a regional forecast. If, on the other hand, the region were growing faster than the nation, the region's share of the national market would be increasing. Applying this approach to a national forecast would result in a higher regional forecast. The market share approach is included here to produce a regional forecast of based aircraft.

FAA National Forecast

An annual growth rate forecast is included here to reflect the FAA's national active aircraft forecast. The latest *FAA Aerospace Forecasts 1999-2010* (March 1999) and *FAA Long Range Aviation Forecasts for 2010, 2015, and 2020* (June 1999) predict the total number of active aircraft to grow at 1.0% per year between 1998 and the year 2010 and then 0.85% per year between 2011 and 2020. As a comparison, we have included a regional based aircraft forecast here using these same average annual growth rates applied to the existing regional aircraft fleet (3,620 based aircraft in 1998).

Demographic Regression

One of the most widely used forecast approaches is demographic regression. This approach documents the historical relationship between aviation activity and demographic variables such as population, employment, and income. This type of forecast approach can be accurate when there is a strong correlation between aviation activity and demographic variables. Using statistical regression techniques, this approach produces an aviation forecast by applying the historical relationship to demographic forecasts. Demographic regression analysis is used in the RASP to prepare three based aircraft forecasts based on population, employment, and income.

Bottom Up Forecasts (Master Plans)

Using the "bottom up" approach, regional aviation forecasts could be developed by combining the individual forecasts for each airport. This would most likely be done using the current forecasts from airport master plans throughout the region. Unfortunately, this approach has several drawbacks. First, it requires fairly consistent forecast data for all regional airports, and such data are not available. Second, it would require consistent forecasts from each master plan to allow for a regional aggregation of the forecast data into a regional aviation forecast. Again, this level of consistency is not available. And third, a regional forecast prepared using individual master plan forecasts would need to account for each airport's "market area," and would have to eliminate all "duplication" caused by overlaps in the forecast markets for each airport, including duplicate waiting lists for all regional airports. Because the market area for each airport is not well defined, this task would be very difficult, making preparation of a bottom-up regional forecasts nearly impossible. For these reasons a bottom-up forecast was not done.

Hybrid/Scenario Forecast

This type of forecast approach might combine some aspects of the other approaches. In addition, this approach might be built around a specific set of assumptions describing the effects of some future scenario. An example might be a forecast assuming the successful deployment of NASA's proposed *National General Aviation Roadmap* and *Small Aircraft Transportation System (SATS)* concept. Such a forecast would likely predict significantly greater numbers of based aircraft and operations, and would generate the need for a much expanded aviation infrastructure to serve those emerging markets.

Regional Allocations

Once a regional based aircraft forecast is complete, those aircraft must be allocated within the region. A regional based aircraft allocation methodology allows us to assign total regional aircraft to each of the four counties and then to each airport. The regional allocation model considers numerous factors which are likely to affect the regional distribution of based aircraft. These factors might include such items as: aircraft tie-down and hangar rates; landing fees; airport facilities and services (availability, type, price, and condition); airport and airspace complexity and congestion; airport access; regional distribution of population, employment, and aircraft owners and pilots; and airport locations within the region relative to population, employment, and aircraft owners and pilots.

Sensitivity Analysis

The forecasts may include sensitivity analysis to assess the impact of changing forecast variables on the actual forecasts. For example, if the selected forecast were based on regional population, sensitivity analysis would allow us to predict how future aviation activity might be affected by higher or lower population growth. This might allow us to monitor the difference between our forecasts and actual activity, and make adjustments as needed to our regional airport development program.

High and Low Forecasts/Forecast Ranges

Where there is some degree of uncertainty in our ability to predict future aviation activity, we might develop high and low forecasts, or a forecast range, to account for that uncertainty. Such a forecast would likely set a range wide enough so that there is a high probability that future aviation activity levels will fall inside the forecast range. Planning would not be dependent on precise forecast accuracy, but would focus on meeting the needs within the forecast range of activity.

Market Sectors

Certain sectors of the general aviation industry might behave in ways that are quite different than the industry as a whole. For these reasons it may be necessary to prepare separate sub-forecasts for these aviation markets. Examples include seaplane and heliport activity. These sectors may respond to a different set of market forces, and might therefore require a different approach to forecasting.

Based Aircraft Forecast

Eight regional based aircraft forecasts were prepared, as displayed in Exhibit 5-40. They increasing market share, constant market share, trend, modified trend, FAA's national forecast (based on a 1% average annual growth rate), and three separate demographic forecasts based on population, employment, and income.

The highest forecast is the increasing market share. This forecast is based on the Puget Sound Region's historical share of the total national active aircraft fleet. The region's share has been growing steadily over the past 20 years, from 1.49% of the national total in 1979 to 1.86% in 1998. These figures are consistent with other data reported in this chapter, that the Puget Sound Region has seen greater growth in aircraft ownership than the nation as a whole. The increasing market share forecast is built on the region's increasing share of the national fleet, and predicts that share will continue to grow from 1.86% in 1998 to 2.31% in the year 2020. Applying this increasing market share to the FAA's most recent national forecast of active aircraft yields a regional based aircraft forecast of 4,662 in the year 2010 and 5,558 in the year 2020. By combining the region's greater propensity for aviation activity with the FAA's optimistic national aviation forecasts, the market share forecast is the highest of all the based aircraft forecasts. Translated into an average annual growth rate, the increasing market share forecast yields a growth rate of nearly 2.0%.

A constant market share forecast was also prepared. This forecast is based on the Puget Sound Region maintaining its current (1998) share of the national active aircraft fleet. That share is 1.86%. The forecast is derived by applying that share to the FAA's most recent forecast of total national active aircraft. The results of this forecast show the regional GA fleet growing from 3,620 in 1998 to 4,465 in the year 2020, an average annual growth rate of approximately 1%.

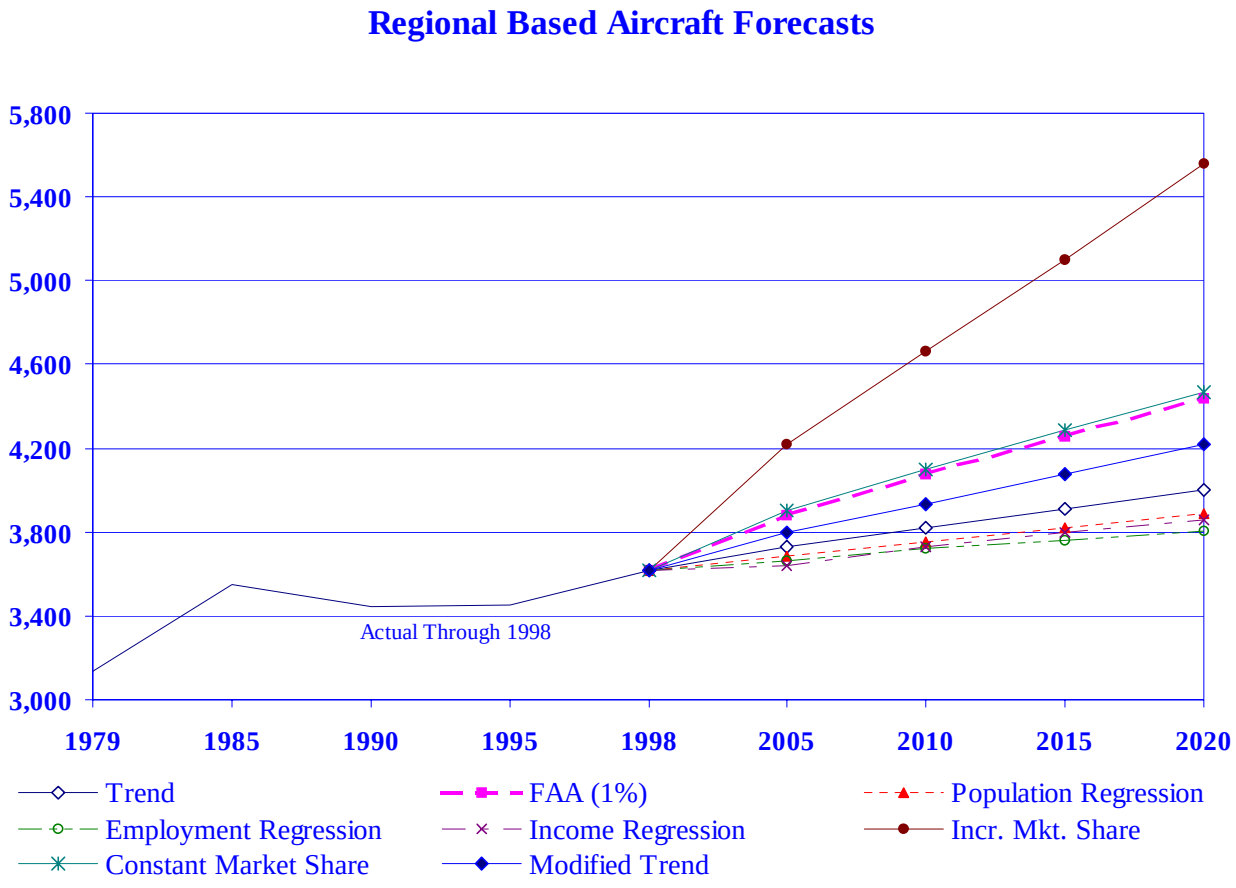
The FAA's most recent national forecast of active aircraft (March 1999) predicts an average annual growth rate of 1% for the years 1999 through 2010 and 0.85% from 2011 until 2020. Applying this growth rate to the existing number of regional based aircraft produced a future forecast of 4,439 based aircraft in the region. This is the third highest of the based aircraft forecasts, just below the constant market share forecast.

The trend forecast predicts a total of 4,004 based aircraft in the region by the year 2020. This forecast is equivalent to an average annual growth rate of 0.46% (under ½ of 1%). This forecast is based on historical trends in based aircraft from 1979 to 1998. A second trend forecast, the "modified trend," used a shorter historical base period (1990 to 1998). The modified trend forecast predicts 4,220 based aircraft by the year 2020, an average annual growth rate of 0.7%.

Three demographic forecasts were prepared using the historical relationship between regional based aircraft and regional population, employment, and income. These three forecasts yielded similar results, all of which predict between 3,800 and 3,900 based aircraft in the year 2020. Average annual growth rates for these three forecasts fall between 0.23% and 0.33%.

Exhibit 5-40 Summary of Regional Based Aircraft Forecasts

	1998	2005	2010	2015	2020
Increasing Market Share	3,620	4,223	4,662	5,100	5,558
Constant Market Share	3,620	3,902	4,103	4,284	4,465
FAA 1% (selected)	***3,620***	***3,881***	***4,079***	***4,255***	***4,439***
Modified Trend	3,620	3,801	3,936	4,076	4,220
Trend	3,620	3,727	3,819	3,911	4,004
Population Regression	3,620	3,686	3,754	3,823	3,891
Income Regression	3,620	3,637	3,733	3,798	3,855
Employment Regression	3,620	3,661	3,723	3,764	3,805



Analysis of Based Aircraft Forecasts

The regional based aircraft forecast forms the foundation of the aviation forecast, and is used along with the analysis of system capacity (airfield capacity and aircraft parking supply) to identify existing and future system requirements. As shown in Exhibit 5-40 above, eight potential based aircraft forecasts were prepared. In the year 2020 they range from a high of 5,558 to a low of 3,805, this compared with the existing number of 3,620 regional based aircraft. The following two sections present a synopsis of factors affecting the forecast and a discussion of each regional based aircraft forecast.

Factors Affecting the Forecast

- ***U.S. and regional economies*** - - Strong growth in both the national and regional economies have been major contributors to the overall aviation industry's health and to the current rebound in the general aviation segment. Growing employment and increasing disposable income, combined with a healthy overall business climate, have led to increased investment in private and business aircraft and to growing general aviation activity. The Puget Sound Region has seen economic growth above the nation as a whole, which contributes to the region's higher ratio of aircraft ownership and use than the nation as a whole. If current projections of national and regional economic activity hold true, the resulting strong economy is likely to lead to continued growth in the national general aviation industry. The Puget Sound Region could expect to see additional demand for based aircraft and aircraft operations. If the strong economy does not materialize, future aviation activity could stagnate.

- ***Regional population and employment growth*** - - Aviation activity is linked to the region's economy and to its population and employment base. Increasing regional population and employment, combined with a growing economy, have translated into increasing numbers of based aircraft and aircraft operations in recent years. Forecasts of regional population, employment, income, and other economic indicators all point to continued growth, and should exert upward pressure on regional aviation activity. Given the Puget Sound Region's higher than average propensity to engage in aviation, forecast growth in population, employment and income will very likely translate into growing aviation demand. Perhaps the most critical forecasting issue will be where, within the region, that demand lies, and how it should be accommodated.

- ***Cost of aircraft ownership (purchase, operation, fuel, maintenance, insurance)*** - - One of the greatest historical influences on aviation activity, especially general aviation, is cost. Analysis of historical data on aviation cost and activity levels shows that aviation is extremely price sensitive, with the most critical elements being aircraft purchase price, operating cost (particularly fuel cost), aircraft maintenance, and insurance. Until passage of the General Aviation Revitalization Act of 1994 the cost of aircraft product liability insurance had increased rapidly as a result of several major aircraft liability suits, making the cost of flying prohibitively expensive.

  The cost of fuel is another major factor affecting the level of activity. Between 1970 and 1981 the average national cost of motor fuel increased nearly fourfold while jet fuel increased by nearly 700%. Since 1981 the price of both fuel types has decreased sharply, and since 1994 several other cost factors have turned around. It appears these downward shifts in aviation cost have contributed to the recent resurgence in general aviation. As shown in Exhibit 5-24, U.S. long term economic forecasts predict stable oil and gas prices (as measured by the oil and gas price index), with overall fuel prices rising less than the consumer price index over the coming 10 years. If these predictions occur, the price of aviation fuel would effectively decrease over time, creating an upward push on aviation activity. On the other hand, if unforeseen increases in aviation fuel prices occur in the future, they will likely have a significant downward influence on aviation activity, primarily aircraft operations. If other factors remain favorable, short term increases in fuel prices would tend to reduce the number and or length of flights, but would have little affect on the basic structure of the GA industry. Long term fuel price increases could have a more significant impact on the overall industry.

  While the factors listed above have, in recent years, combined to produce an upturn in overall general aviation activity, there has not been a marked change in the purchase price for small general aviation aircraft. In order for the recent growth in GA to be sustainable, aircraft must be affordable. The long term prospect of more affordable aircraft would likely have a strong impact on the market for new

GA aircraft. If prices fall due to the affects of the General Aviation Revitalization Act of 1994, new technologies, or other factors, the number of new aircraft entering the fleet could increase. If prices do not stabilize or fall, the prospects of continued growth in new aircraft production are not likely to materialize. As an alternative, continued high aircraft prices could further stimulate the fractional ownership industry. In spite of the high cost of aircraft, the market for new higher end corporate GA aircraft continues to be strong, and appears to be somewhat less sensitive to purchase price and other operations and maintenance costs.

- ***Fractional ownership of general aviation aircraft*** - - Because of increasing costs and other factors, more and more aviators are joining together to purchase aircraft in partnership. Fractional ownership companies purchase aircraft, sell shares of the aircraft, and provide management services, including managing the use of the aircraft, provision of pilots, and aircraft maintenance. Combining their resources provides fractional owners with several benefits, including lower purchase cost, sharing of operating and maintenance costs, reduced insurance cost, and sharing of the costs of aircraft storage. The reduced costs associated with fractional ownership may allow owners to purchase more advanced aircraft that would otherwise be far too expensive to own individually. In addition, it's likely that the joint owners of such aircraft would demand higher quality storage facilities rather than open tie-downs. As fractional ownership grows in popularity, this could lead to greater demand for T-hangars and conventional hangars. The national trend toward fractional ownership may decrease the demand for new aircraft, but it may also increase the utilization rate of those aircraft. The trend toward fractional ownership can be seen in the latest FAA forecasts published in April of 1999. These forecasts for the period 2000-2010 predict a 1% annual growth rate in the nation's general aviation fleet and a 2.1% average annual growth rate in active pilots. The General Aviation Manufacturers Association (GAMA) 1999 figures show 15% of all new GA turbojet aircraft shipments are delivered to fractional owner programs.

- ***Congestion and complexity of regional airspace/availability and cost of landside facilities/intra-regional trends*** - - The Central Puget Sound Region has experienced rapidly increasing aviation activity over the past 10 years. Sea-Tac Airport in particular is one of the fastest growing airports in the U.S. Combined with the overall resurgence in general aviation throughout the region, the region's airspace has become more congested and complex, and many of the region's airports have seen increased landside and runway congestion. With the supply of airport facilities generally fixed, this growing demand has increased the pressure for regional airports to increase prices. The increasing cost of operating airports is also pressuring airports to pass those costs on to their users in the form of higher landing fees, fuel costs, tie-down and hangar rates, and other aviation services. While the region-wide demand for aviation may increase in the future, intra-regional trends in pricing may have a significant effect on which airports can actually accommodate future demand. In addition, the availability of adequate land for airport expansion and new aviation facilities and services will affect how much demand can be met, and where. Related issues include potential regulatory and environmental factors (discussed below), which may also affect future demand. Related to the above items, recent years have seen noticeable trends within the region. In the past 10-15 years, growth in based aircraft and aircraft operations has begun to focus around the edges of the urbanized region, with aviation activity growing at airports like Arlington, Harvey Field, Crest Airpark, and Tacoma Narrows. At the same time, Boeing Field, Bremerton National, and Renton Airports have seen little or no growth. In terms of regional aviation market share, Snohomish County has seen a steady increase over the past 10 years, while King and Pierce Counties' shares have dropped. Meanwhile, Kitsap County has maintained a fairly constant share. If these trends continue in the future, the region's aviation growth may be further concentrated at the peripheral airports, primarily in Snohomish County.

- ***Competitive relationship between commercial and general aviation/climate and market for business aviation*** - - Although commercial and general aviation generally have separate and distinct markets, certain aspects of these two aviation sectors overlap. In the short to medium range passenger market, corporate aviation competes cost effectively with the commercial air carriers. Two major factors contribute to this equation: cost and convenience. As long as corporate general aviation can compete in these two areas the market will remain strong. There is the potential, however, for the growing commuter airline industry to cut into the corporate aviation market as more city pairs are served, as new commuter jets enter the fleet, and if commuter flight ticket prices fall. This market is untested, and it is currently unclear how commuter ticket prices and flight schedules will compare/compete with the corporate aviation alternative.

- ***Regulatory, legal, and environmental factors/new aviation initiatives*** - - Regulatory, legal, and environmental factors are difficult to predict, but can have a significant effect on future aviation activity. It is widely believed that the reform of general aviation liability laws in 1994 is partially responsible for the current resurgence of the general aviation industry nationwide. Conversely, during the 1980s several major aviation liability lawsuits are held responsible for skyrocketing insurance costs, which had a devastating affect on general aviation across the country. While liability insurance costs have relaxed somewhat since passage of the General Aviation Revitalization Act of 1994, it is still too early to tell what the long term impacts of the new law may be on the overall price structure of general aviation.

  Environmental constraints (including noise, air and water quality, and land use encroachment) continue to affect airports' ability to serve the nation's aviation needs. Additional constraints may dampen future aviation demand, especially if they translate into higher costs to either airport operators, airport users, or both.

  Several recent aviation initiatives may have a long term positive affect on the forecast. These initiatives include the *Advanced General Aviation Transport Experiments ("AGATE"),* the *National General Aviation Roadmap,* the *GA Team 2000* program, the *Be A Pilot* program, and others. These programs are designed to stimulate new pilots and introduce new technology to the general aviation industry, and so far have been successful. According to the GAMA, since 1996 the number of new student pilot starts has increased by nearly 12% while employment at GAMA member companies was up 11.5% for the year 1998 and is up 46% since 1994. If these programs continue to be successful, they could increase demand, reduce costs, improve safety, and usher in a new era of aviation growth. The FAA's optimistic forecasts for general aviation are based, in part, on the anticipated success of these programs. If they are less successful than anticipated, aviation activity may not reach the levels forecast.

  Several regulatory proposals being considered in Congress have the potential for major impacts on general aviation. These include proposals to privatize air traffic control (which would then be dependent on user fees) and to charge GA aircraft for use of Air Traffic Control services similar to commercial aircraft. These proposals would significantly increase costs for GA users, which could have a major dampening effect on GA activity.

Discussion of Based Aircraft Forecasts

Increasing Market Share Forecast

The increasing market share forecast yields a 2020 regional total of 5,558 based aircraft, an increase of 53.5% over the existing total. The forecast is based on a continuation of recent trends, which show the Puget Sound Region has seen more growth in based aircraft than the nation as a whole. Thus its share of the nation's total aircraft has increased over time. Applying this increasing market share to the rather robust FAA forecasts of total U.S. active aircraft produces a doubly robust regional forecast. This forecast translates to an annual growth rate of nearly 2.0%, which compares with the FAA's national active aircraft forecast growth rate of 1.0% per year. While the region has seen growth above that of the nation over the past several years, it is unlikely that such growth will continue at its current rate through the 20-year forecast period. In the past 3 years the rate at which the region's based aircraft fleet grew showed significant slowing when compared with the nation. In addition, the region's economic growth has softened in recent years, in part due to Boeing Company slowdowns. Regional employment growth, which had reached 5.44% in 1997 over 1996, fell back to 3.6% in 1998. These data point toward a modest cooling of the region's overall economy, which is likely to result in a slightly lower future growth rate in based aircraft. The increasing market share forecast is therefore considered overly optimistic.

Constant Market Share Forecast

The constant market share forecast assumes the Puget Sound Region will retain its existing share of the nation's general aviation fleet in the future. In 1998 that share was 1.86%, or 3,620 aircraft out of the national total of 194,826 active aircraft. Applying that percentage to the FAA's national forecast of active GA aircraft resulted in a regional based aircraft of 4,465 in the year 2020. This forecast is nearly identical with the FAA 1% annual growth forecast discussed below, and results in a 23.3% increase in the regional based aircraft fleet between 1998 and 2020. This forecast is relatively high (the second highest of the seven forecasts contained here) because it applies the Puget Sound Region's historically high market share of the national GA aircraft fleet to the FAA's optimistic national GA fleet forecast.

FAA U.S. Active GA Aircraft Forecast (FAA's 1% annual growth)

The FAA's most recent national long range forecast of active GA aircraft (June 1999) is based on an average annual increase of 1.0% for the period 1999 through 2010 and then 0.85% per year from 2011 through 2020. At the national level, this forecast shows the nation's active GA aircraft fleet growing from 194,826 in 1998 to 240,300 in 2020 for a total 20-year increase of 22.6%. Factors included in the FAA's forecast are the recent upward trends in new GA aircraft production, positive trends in the U.S. active GA aircraft fleet, increasing GA aircraft hours flown and fuel consumed, increasing numbers of operations, the current Federal budget surplus, stable fuel prices, forecast economic growth, and predicted success of several new aviation programs. The recent increases in the number of student pilots, a 15.3% increase in the number of GA aircraft whose primary use is instructional, and a 4% increase in the number of instruction hours flown by GA aircraft are noted in the FAA's 1999 Aerospace Forecasts as particularly encouraging for the future of GA. These measures point to a brightening future by increasing the supply of future aviation system users (young pilots). Translating these FAA growth forecasts into regional based aircraft numbers yields a forecast of 4,079 in 2010 and 4,439 in the year 2020 for a total 22-year gain of 22.6%.

The FAA forecast does not appear to consider any significant negative forces which could reduce future general aviation demand. These forces, discussed above, include increasing fuel prices, regulatory controls (such as user fees), slower economic growth, lower expectations regarding the success of the new general aviation initiatives, and external factors such as environmental regulations, legal issues, land use encroachment, and overall public sentiment. A variety of these factors could potentially dampen the prospects for future GA growth, and could reduce any of the forecasts discussed here.

On the other hand, the Puget Sound Region has experienced stronger growth in its GA market, and higher levels of activity, than the nation as a whole, which might support the use of the FAA's national forecast. This might be particularly true since the region's larger, urban airports are attracting new GA demand.

Trend (time series) Forecast/Modified Trend Forecast

The trend forecasts extrapolate historical regional based aircraft fleet trends into the future. The first trend forecast used based aircraft numbers for the period 1979 through 1998 and generated future forecasts for the years 1999 through 2020. The forecast is a simple trend projection, and incorporates no other variables. The trend forecast predicts a regional total of 4,004 based aircraft numbers in the year 2020. The trend forecast is quite low (4,004) when compared to the increasing market share forecast (5,558) and compares somewhat more favorably with the constant market share forecast (4,465) and FAA annual growth forecast (4,439). The trend forecast (4,004) is slightly higher than the three demographic forecasts, which predict between 3,805 and 3,891 based aircraft in the year 2020. While the trend forecast does not specifically incorporate external factors, extrapolating the historical trend in regional based aircraft does inherently account for the same variables that have historically affected the regional based aircraft fleet. One weakness in the trend methodology is that it does not account for any future changes in the factors affecting aviation, but rather assumes the future will match the past. One of the strengths of the trend forecast is its simplicity. It looks only at the past performance of the regional aviation system and projects that performance into the future. From this perspective it captures the regional aviation system. On the other hand, the Trend Forecast's annual growth rate of 0.46% is somewhat low, especially when compared with the FAA's 1% forecast and actual growth in the region's GA aircraft fleet, which has averaged 0.7% per year from 1990 through 1998 and 1.5% per year for 1996, 1997, and 1998.

In order to capture more recent trends in the regional aviation market, a second trend forecast (the "Modified Trend" forecast) was prepared. The modified trend forecast uses a shorter historical baseline (1990-1998), reflecting the more recent growth in the regional aviation market. The Modified Trend Forecast (displayed in Exhibit 5-40) was derived by projecting historical regional trends from 1990 through 1998 into the future. It results in an average annual growth rate of 0.7%, and yields 4,220 regional based aircraft in the year 2020. This forecast adds 600 new aircraft to the regional aircraft fleet over the 22-year forecast period, an average annual gain of 27 aircraft. This is consistent with long term regional trends and it reflects recent growth rates since 1990. The Modified Trend Forecast therefore captures both long term regional trends and the effects of recent changes in the aviation industry. Notwithstanding the above, both the trend and modified trend forecasts are somewhat conservative. Both are below the FAA's national active aircraft forecast, and both fall well below the region's recent growth rate of 1.5% for the past three years. A more robust forecast, one that captures the more recent trends in the GA industry, would probably use a higher growth rate.

Population, Employment, and Income Regression Forecasts

All three demographic forecasts evaluated historical relationships between the region's based aircraft fleet and regional population, employment, or income. Those historical relationships (expressed as linear regression equations) were then applied to future forecasts of regional population, employment, and income to generate three regional forecasts of based aircraft. The results are quite similar. For the year 2020 the population regression forecast yields 3,891 based aircraft, the income regression 3,855, and the employment regression 3,805. Average growth rates for these forecasts vary between 1/4% and 1/3% per year, significantly less than the FAA's projected 1% annual growth forecast. In simple terms, the three demographic forecasts predict the region's entire aircraft fleet will grow by only 8-12 aircraft per year for the 22 year forecast period. Historically, the regional GA based aircraft fleet has grown by an average of 26 aircraft per year between 1979 and 1998, a period that includes over a decade of stagnation and decline in the national and regional GA markets. While population, employment, and income are thought to be closely related to general aviation activity, these three demographic based forecasts do not seem to reflect the recent positive trends in both the national and regional aviation markets. These upward trends have occurred as a result of specific aviation industry-related forces (such as the GA Revitalization Act of 1994 and more recent industry initiatives), which are not associated with population, employment, or income. None of the demographic regression forecasts are considered to be reasonable for use in this aviation system plan.

Selected Regional Based Aircraft Forecast

This plan uses the FAA's national forecast (1% annual growth), which predicts a regional total of 4,439 based aircraft in the year 2020, or 819 new aircraft for the 22 year period. This equates to 37 new aircraft per year. The FAA national forecast growth rate (1%) falls between the region's actual growth rate of 0.7% for the period 1990 to 1998 and 1.5% for the more recent period 1996-1998. The 0.7% growth the region has seen since 1990 was dampened by stagnation of the fleet which continued until 1995. On the other hand, the region's recent steep rebound (1.5% growth per year) since 1996 probably cannot be sustained. Use of the 1% annual growth rate recognizes that the future probably lies between the two. And while the FAA's national forecast may be optimistic for the nation as a whole, it seems appropriate for more urbanized regions of the nation (such as the Puget Sound Region) where aviation activity levels are higher, particularly in the business and corporate aviation sectors. As discussed above (see Exhibit 5-20 and supporting text), the central Puget Sound Region experiences significantly higher rates of aviation activity (measured in the number of per capita pilots, based aircraft, and aircraft operations) than the nation as a whole. The 1998 ratio of based aircraft to population for the region was nearly 60% above the nation as a whole. The ratio of based aircraft to population was also significantly higher for the state of Washington and for the FAA's Northwest Mountain Region than for the nation, suggesting that the northwest part of the country sees higher levels of aviation activity in general than the rest of the nation. Selecting the FAA's national 1% forecast sets an optimistic mark for regional airport planning purposes, one that is above the middle of a confidence range for the forecast. It is estimated that the actual number of regional based aircraft could reach 5% higher (4,661 based aircraft) and 10% lower (3,995 based aircraft) than the selected forecast for the year 2020.

Regional Distribution of Based Aircraft

In addition to forecasting the total number of based aircraft in the region, it is important to forecast how those aircraft will be distributed to the counties and individual airports throughout the region. Historical data show noticeable trends in the distribution of based aircraft. These regional trends are displayed in Exhibit 5-41 and summarized in the table below.

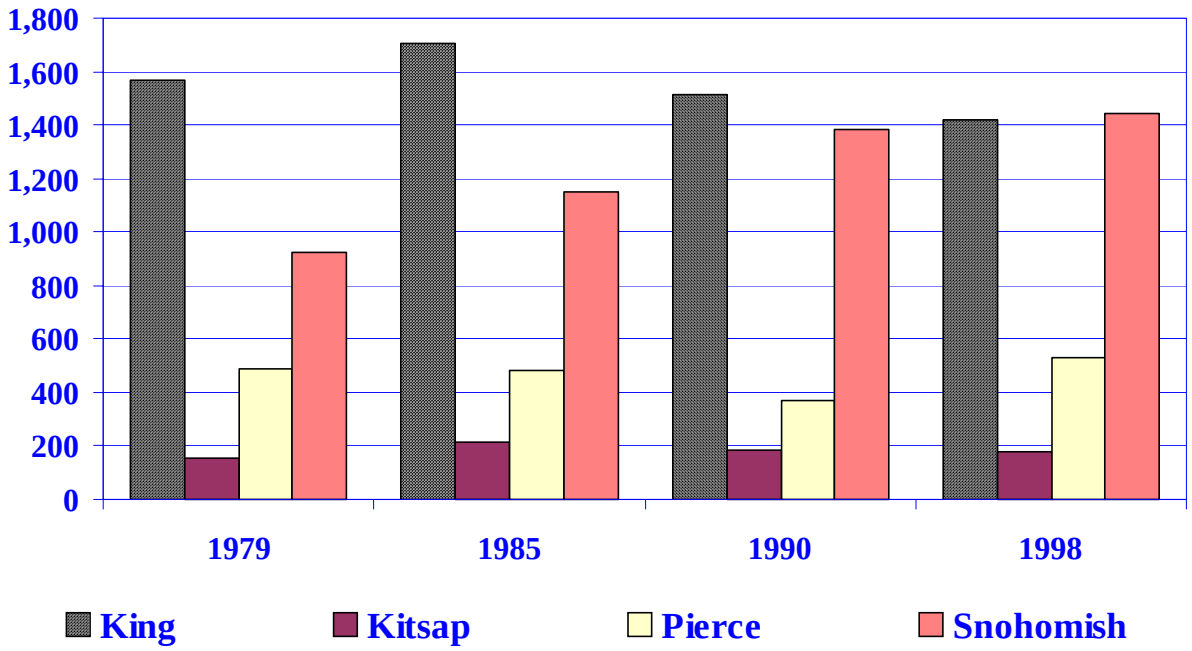
Trends in Regional Distribution of Based Aircraft

	1979	1985	1990	1998
King County Aircraft	1,565	1,702	1,514	1,498
Percent of region	50.0%	47.9%	43.9%	40.7%
Kitsap County Aircraft	154	213	183	181
Percent of region	4.9%	6.0%	5.3%	4.9%
Pierce County Aircraft	490	483	371	526
Percent of region	15.6%	13.6%	10.7%	14.3%
Snohomish County Aircraft	925	1,153	1,382	1,476
Percent of region	29.5%	32.5%	40.1%	40.1%

While the region as a whole has seen growth in the number of based aircraft (total aircraft increased from 3,134 in 1979 to 3,681 in 1998[4]), much of the growth in the region's GA aircraft fleet has occurred in Snohomish County. Between 1979 and 1998, Snohomish County's GA fleet increased from 925 to 1,476, increasing its regional share of the GA aircraft fleet from 29.5% in 1979 to 40.1% in 1998. While Snohomish County's GA aircraft fleet grew both in number and in its share of the regional GA aircraft fleet, King County lost regional market share while its fleet stayed relatively constant (between 1,500 and 1,700 aircraft). Between 1979 and 1998 King County's share of the regional GA aircraft fleet dropped from 50% to 40.7%.

[4] *These figures include Apex Airpark in Kitsap County for reasons of consistency. The current airport system does not include Apex, which reduces the regional based aircraft total for 1998 from 3,681 to 3,620.*

Exhibit 5-41 Regional Distribution of Based Aircraft



During this time frame, the shares for both Kitsap and Pierce counties remained fairly stable. But all the growth wasn't just in Snohomish County. There were some shifts within the counties, with some airports gaining and some losing based aircraft. In addition, the closure of several airports in King County created opportunities for growth at other airports in region, both within and outside King County. Notable changes in the number and regional distribution of based aircraft between 1979 and 1998 include the following:

- ***Arlington Airport*** saw based aircraft grow from 195 to 498 (a 155% increase)
- At ***King County International Airport (Boeing Field)*** based aircraft dropped from 617 in 1979 to 466 in 1998 (a 24% drop)
- ***Crest Airpark*** (Kent) tripled its based aircraft, from 106 to 334
- ***Harvey Field*** (Snohomish) grew from 235 to 360 based aircraft
- ***Renton*** and ***Auburn*** airports remained fairly stable, together increasing their based aircraft fleet by 79 aircraft over the 20-year period
- ***Snohomish County Airport (Paine Field)*** grew by 116 aircraft
- ***Tacoma Narrows Airport*** has remained stable at 200 based aircraft between 1979 and 1998
- ***Bellevue, Cedar Grove, Duvall, Enumclaw, Flying F, and Issaquah*** Airports closed, and over 200 based aircraft were forced to relocate to other airports (within and perhaps outside the region)

A number of factors may have contributed to these regional trends, including:

- Shifts in the regional distribution of population and employment. While the Puget Sound Region has seen overall growth in all factors, there have been continuing shifts in the distribution of regional demographics. King County's share of regional population has dropped from 56.68% in 1980 to 52.89% in 1998, and will continue to decline, to less than 50% in the year 2020. King County's share of regional employment has also dropped, although to a lesser degree. This share is also predicted to drop, from 66.69% in 1998 to 64.4% in the year 2020. While Kitsap and Pierce counties have increased their shares of total regional population, both have lost market share (between 1980 and 1998) in terms of regional employment. Between 1998 and the year 2020 both are predicted to show slight increases in their shares of population and employment. Snohomish County has claimed the largest gains. Between 1980 and 2020 Snohomish will have increased its regional population share from 15% to 20%, and its employment share from just over 10.3% to 13.6%.

	Population			Employment		
	1980	1998	2020*	1980	1998	2020*
King	56.68%	52.89%	49.8%	67.19%	66.69%	64.4%
Kitsap	6.57%	7.27%	8.2%	5.41%	5.13%	5.3%
Pierce	21.68%	21.81%	22.0%	17.10%	15.24%	16.6%
Snohomish	15.07%	18.04%	20.0%	10.29%	12.93%	13.6%

* *Forecast*

- The growth and regional distribution of income are shown below. King County continues to dominate the region's income growth, with the other three counties falling below the regional average. This trend is predicted to continue through the year 2020, when King County income will be double that of Kitsap and Pierce counties and 70% above Snohomish County.

	Per Capita Income		
	1980	1998	2020*
King	$22,111	$31,922	$42,652
Kitsap	$17,146	$19,671	$18,180
Pierce	$16,597	$20,131	$21,310
Snohomish	$18,245	$22,398	$25,190
Region	$20,004	$26,747	$32,615

* *Forecast*

- Urban development, land use encroachment, and financial pressures leading to the closure of several airports (containing over 200 based aircraft). In the past 20 years the region has seen the closure (to public use) of the following public use airports: Bellevue Airfield, Issaquah Skyport, Duvall Airport, Enumclaw Airport, Cedar Grove Airport, and Flying F Ranch. With the closure of these airports (all of which were located in King County), some 200 based aircraft were moved to other airports in the region. The owners of Martha Lake Airport in Alderwood Manor closed the airport in July 2000. The airport was home to 51 based aircraft, and served over 40,000 aircraft operations in 1998. This airport closure may place additional pressure on other Snohomish County airports in its market area, including Snohomish County Airport, Harvey Field, Arlington Airport, and First Air Field (in Monroe).

- Increasing complexity of the regional airspace, particularly in the vicinity of Sea-Tac Int'l Airport, King County International Airport (Boeing Field), and McChord Air Force Base
- Increasing congestion and delay at the larger, busier urban airports
- Increasing competition for reasonably priced, high quality hangar space
- Increases in the cost of hangars, tie-downs, fuel, landing fees, and other services at close-in airports such as King County International Airport (Boeing Field), Renton, and Auburn
- Increasing congestion on the region's surface transportation system (freeways, highways, bridges, arterial streets, ferries, etc.)
- Shifts in the regional distribution of aircraft owners and pilots

Forecast Shifts in Regional Based Aircraft Distribution

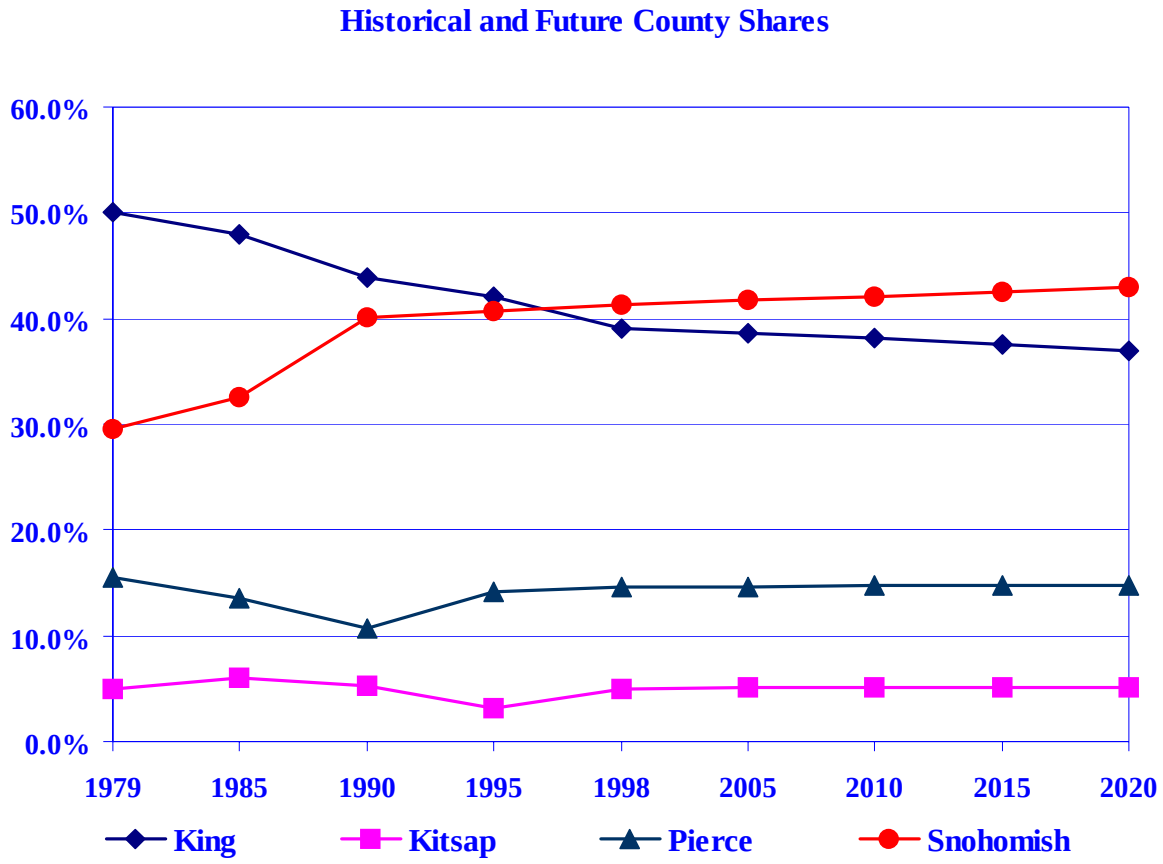
With the closure of several public use airports in the past 20 years, the region's aviation activity has been consolidated at the (fewer) remaining airports. The airport closures led to a regional shift of based aircraft from King County airports to Snohomish County airports. These airports have accommodated the aircraft displaced by the airport closures, and they have also provided facilities to accommodate the regional growth (180 new based aircraft) since 1990. In the future, however, it appears less likely that wholesale airport closures will occur. Therefore, major shifts in regional market share are less likely than in the past. Nevertheless, given regional urban development trends, airport congestion, pricing differentials, and airspace complexity, some continued shifting of based aircraft from congested urban airports, such as Boeing Field, to outlying airports, such as Crest Airpark, Harvey Field, and Arlington Airport, can be expected. These shifts are likely to respond to lower price, available parking supply, and improved services.

These shifts will also reflect continued changes in the regional distribution of population and employment between the four central Puget Sound counties. Recent forecasts by the Regional Council predict that historic trends will continue, with King County's share of regional population and employment slowly declining between 1998 and 2020. Kitsap, Pierce and Snohomish counties will all see slight increases in both population and employment market share. Snohomish County is expected to see the greatest increase in its regional population share (10%) over the forecast period. This shift in population and employment toward Kitsap, Pierce, and Snohomish counties will support increased aviation demand in these areas, and reflects the historical trend of demand moving away from the central part (Seattle) of the region. The figures below display the forecast regional distribution of based aircraft, both in terms of market share and numbers of based aircraft. The based aircraft numbers reflect the selected regional based aircraft forecast (the FAA 1% national forecast).

Exhibit 5-42 Forecast Future Distribution of Based Aircraft *

	1999	2005	2010	2015	2010
King County Aircraft	1,416	1,498	1,554	1,600	1,642
Percent of region	39.1%	38.6%	38.1%	37.6%	37.0%
Kitsap County Aircraft	181	198	208	221	230
Percent of region	5.0%	5.1%	5.1%	5.2%	5.2%
Pierce County Aircraft	529	567	600	625	659
Percent of region	14.6%	14.6%	14.7%	14.7%	14.8%
Snohomish County Aircraft	1,494	1,618	1,717	1,808	1,908
Percent of region	41.3%	41.7%	42.1%	42.5%	43.0%
Total Based Aircraft	***3,620***	***3,881***	***4,079***	***4,255***	***4,439***

* *Figures show the selected FAA 1% National Forecast (see Exhibit 5-40)*



Based on the data available, current trends in the distribution of based aircraft are expected to continue, although at a slower rate. King County's regional share will decline from 39.1% to 37%. When combined with the regional forecast of based aircraft growth, King County should see its based aircraft demand increase from about 1,400 to near 1,650 during the forecast period. Consistent with historic and current trends, much of King County's growth is predicted to be in the business and corporate aviation sectors of the market (see based aircraft fleet mix forecasts below). Kitsap and Pierce counties should each see slow growth in their market share, with resulting increases in their based aircraft. Most of these new based aircraft will be single engine piston aircraft. Snohomish County will see continued growth in its regional market share, from 41.3% in 1999 to 43% in the year 2020. This expanding market share combined with expected regional demand will result in fairly strong growth for Snohomish County, amounting to some 414 new aircraft over the 22-year forecast period, or about 19 aircraft per year. Snohomish County should see growth in all aircraft types, including small piston aircraft, jets, helicopters, and ultralights and experimental. Though not expanding as fast as Snohomish County, both Kitsap and Pierce counties will see more based aircraft over the forecast period, with Kitsap adding 49 new aircraft and Pierce adding 130 (see also *Exhibit 5-44 Existing and Forecast Based Aircraft Fleet Mix by County*).

General Aviation Fleet Mix Forecast

The based aircraft fleet mix forecast is an estimate of the number of aircraft by type. Those aircraft categories include single engine piston, multi-engine piston, turbojet, helicopter, and other (which includes gliders, experimental aircraft, and ultralight aircraft). Accurate historical fleet mix trend data for the region is not available. Therefore, the fleet mix forecast relies on the regional aircraft fleet mix figures for 1990 and 1998, fleet mix data as reported in the 1988 *Regional Airport System Plan*, and fleet mix data from individual airport master plans, to provide a historical trend. The future fleet mix forecast is based on the 1990 and 1998 regional data plus national GA fleet mix forecasts prepared by the FAA, and previous regional fleet mix forecasts prepared in 1988 by the Regional Council.

Exhibit 5-43 shows the fleet mix forecasts for the region while Exhibit 5-44 displays the existing and forecast fleet mix for each county. Exhibit 5-43 displays the previous fleet mix forecast contained in the 1988 *Regional Airport System Plan* prepared by the Regional Council. In addition, the exhibit includes the FAA's most recent (April 1999) forecast of the national active GA aircraft fleet. And finally, Exhibit 5-43 shows the regional based aircraft fleet mix forecast developed for this system plan, displaying the mix of aircraft in percentage and in numbers of based aircraft. Previous fleet mix forecasts prepared in 1988 by the Regional Council predicted strong growth in the jet, helicopter, and "other" components of the GA fleet (gliders, ultralights, and experimental aircraft) with less growth in the single and multi engine piston powered aircraft. In the years preceding the 1988 RASP forecast, the market for low end single and multi engine piston aircraft had been shrinking, while the markets for high end corporate and business aircraft, as well as cost-effective alternatives to traditional piston powered aircraft (experimental and ultralights), had been strong. As a result, the 1988 RASP showed single engine piston aircraft dropping from 85.6% of the fleet in 1990 to 74.1% in 2020. This growth differential was forecast to result in a significant shift in the composition of the regional GA aircraft fleet, as shown in the top portion of Exhibit 5-43. Much of the logic for the 1988 forecast shift was due to historical industry trends. Production of new piston powered aircraft peaked in 1978, declined until 1994, and has only recently rebounded (since 1994). New jet aircraft production fell off between 1981 and 1987, and has grown steadily over the past 11 years.

The FAA's latest national GA fleet mix forecast, also shown in Exhibit 5-43, shows trends similar to those contained in the 1988 RASP, but show a much smaller decline in the single engine piston aircraft's share of the fleet. The FAA's forecasts were influenced by the recent and continuing resurgence at the lower end of the national GA market. Production of new small, single engine piston powered aircraft has increased by 139% between 1994 and 1998, and the market for new units is predicted to remain strong for the foreseeable future. While the FAA's latest fleet forecast shows a slight decline in the share of single engine piston aircraft (from 72.7% in 1998 to 70.9% in 2020) this lower end of the GA industry is clearly predicted to benefit by the current trends in new aircraft production, new aircraft technology, and the general improved health of the GA industry. The biggest winner in terms of national market share over the next 20 years, according to the FAA, is in the GA jet market. Between 1998 and 2020, the FAA's forecast shows jet aircraft will increase their share of the GA fleet by 35% (from 5.7% to 7.7%). During the next 20 years, the FAA forecast shows the "other" category increasing its share marginally, from 9.8% in 1998 to 10% in 2020. Helicopters will also increase their share slightly, from 3.5% to 3.8%.

Exhibit 5-43 Fleet Mix Forecasts

1988 PSRC Regional Airport System Plan

	1985	1990	2000	2010	2020
Single engine	86.6%	85.6%	81.3%	77.7%	74.1%
Multi-engine	8.4%	8.3%	8.2%	8.3%	8.3%
Jet	1.4%	1.7%	2.3%	3.4%	4.5%
Helicopter	2.5%	3.0%	5.8%	6.4%	6.9%
Other	1.1%	1.4%	2.4%	4.3%	6.2%
	100.0%	100.0%	100.0%	100.0%	100.0%

1999 FAA National Forecasts

	1985	1990	1998	2010	2020
Single engine	77.8%	72.6%	72.7%	71.9%	70.9%
Multi-engine	11.5%	10.7%	8.2%	7.6%	7.6%
Jet	4.6%	4.9%	5.7%	6.9%	7.7%
Helicopter	3.2%	3.4%	3.5%	3.4%	3.8%
Other	2.9%	8.4%	9.8%	10.1%	10.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Forecast Future Fleet Mix - PSRC Region

	1985	1990	1998	2010	2020
Single engine	86.6%	85.9%	85.6%	82.3%	80.0%
Multi-engine	8.4%	7.7%	7.3%	7.2%	7.0%
Jet	1.4%	1.5%	2.0%	3.0%	4.0%
Helicopter	2.5%	1.2%	2.0%	2.5%	3.0%
Other	1.2%	3.6%	3.1%	5.0%	6.0%
	100.0%	100.0%	100.0%	100.0%	100.0%

Forecast Future Fleet - PSRC Region

	1985	1990	1998	2010	2020
Single engine	3,075	2,957	3,098	3,357	3,551
Multi-engine	297	266	265	294	311
Jet	50	51	73	122	178
Helicopter	88	43	71	102	133
Other	41	125	113	204	266
	3,551	3,442	3,620	4,079	4,439

Actual fleet mix percentages for the Puget Sound Region for 1985, 1990, and 1998 are shown in the lower half of Exhibit 5-43. As of 1998, the region had not yet seen the drop in piston powered aircraft that were predicted by either the 1988 RASP or the more recent FAA forecast. However, between 1990 and 1998, the region's actual fleet composition has shown trends similar to those predicted in both the earlier forecasts. Between 1985 and 1998 both single and multi engine piston aircraft have seen their shares decline, while the jet and "other" categories have increased their shares. Helicopters declined from 2.5% to 1.2% between 1985 and 1990, then rebounded to reach 2.0% in 1998.

The current regional aircraft fleet mix forecast anticipates these trends to continue, with slight reductions in fleet share for piston powered aircraft (both single and multi-engine) and strong, steady increases in share for jets, helicopters, and others. These shifts toward helicopters and jet aircraft underscore the historical growth pattern and continued optimism of the current market for corporate and business aviation. Corporate and business jets continue to offer cost effective, convenient, and safe travel that is competitive with commercial air carrier and commuter service. Helicopter use continues to grow in natural resource industries, police protection, news media, traffic reporting, medical evacuation, and for point to point passenger travel to sites not served by fixed wing aircraft. The market for these applications is predicted to remain strong.

While the region's strong business and corporate general aviation market will produce continued demand for high end fixed wing jet aircraft, and for helicopters, the market for gliders, ultralights, and experimental aircraft will also be steady. The "other" category should see an increase in its share of the regional fleet, though that share will not reach the national level (predicted to reach 10% in 2020). One of the constraints that could affect future growth of the regional glider, experimental, and ultralight market is the availability of landing fields with uncongested and unrestricted airspace, and the absence of conflicting land use patterns. Arlington Municipal Airport, the region's primary site for gliders, experimental, and ultralight aircraft, may find it more difficult to meet these growing demands in the future, given urban residential development in the vicinity, and increasing demand on its airfield and airspace.

Exhibit 5-44 shows the predicted distribution of based aircraft by county and aircraft type. The exhibit shows the fleet for 1999, the forecast fleet for the year 2020, and the number of additional planes expected over the coming 21 years. Consistent with both historical and current data, King County is expected to see much of the region's growth in jets (57 of 105) and helicopters (31 of 62), many of which will be used in the business and corporate sectors. Kitsap and Pierce counties will primarily see growth in single engine piston aircraft, though Pierce County is predicted to also see some additional twin engine piston aircraft and nearly a dozen new jets. Snohomish County will see the broadest growth, with increasing demand in every aircraft category. The county's three largest airports (Arlington, Harvey Field, and Snohomish County/Paine Field) have experienced strong demand for all types of GA aircraft, with Arlington Municipal and Snohomish County Airport attracting most of the county's multi-engine piston aircraft, jets, helicopters, and gliders, ultralights, and experimental aircraft. Overall, King County will attract 226 new aircraft, Kitsap County 49, Pierce County 130, and Snohomish County 414, for a regional total of 819. Based on the historical and existing distribution of gliders, experimental, and ultralight aircraft in the region (Snohomish has owned nearly 100% of the region's share) Snohomish County is predicted to see all the future growth (153 new aircraft) in these aircraft types.

Exhibit 5-44 Existing and Forecast Based Aircraft Fleet Mix by County

1999 Based Aircraft Fleet Mix by County

	King	Kitsap	Pierce	Snohomish	Total
Single engine	1,195	176	481	1,246	3,098
Multi-engine	141	5	41	78	265
Jet	41	0	7	25	73
Helicopter	38	0	0	33	71
Other	1	0	0	112	113
	1,416	181	529	1,494	3,620

2020 Based Aircraft Fleet Mix by County

	King	Kitsap	Pierce	Snohomish	Total
Single engine	1,312	222	589	1,429	3,551
Multi-engine	162	6	51	92	311
Jet	98	1	18	61	178
Helicopter	69	1	1	62	133
Other	1	0	0	265	266
	1,642	230	659	1,908	4,439

Additional Aircraft Demand by County - - 1999-2020

	King	Kitsap	Pierce	Snohomish	Total
Single engine	117	46	108	183	453
Multi-engine	21	1	10	14	46
Jet	57	1	11	36	105
Helicopter	31	1	1	29	62
Other	0	0	0	153	153
	226	49	130	414	819

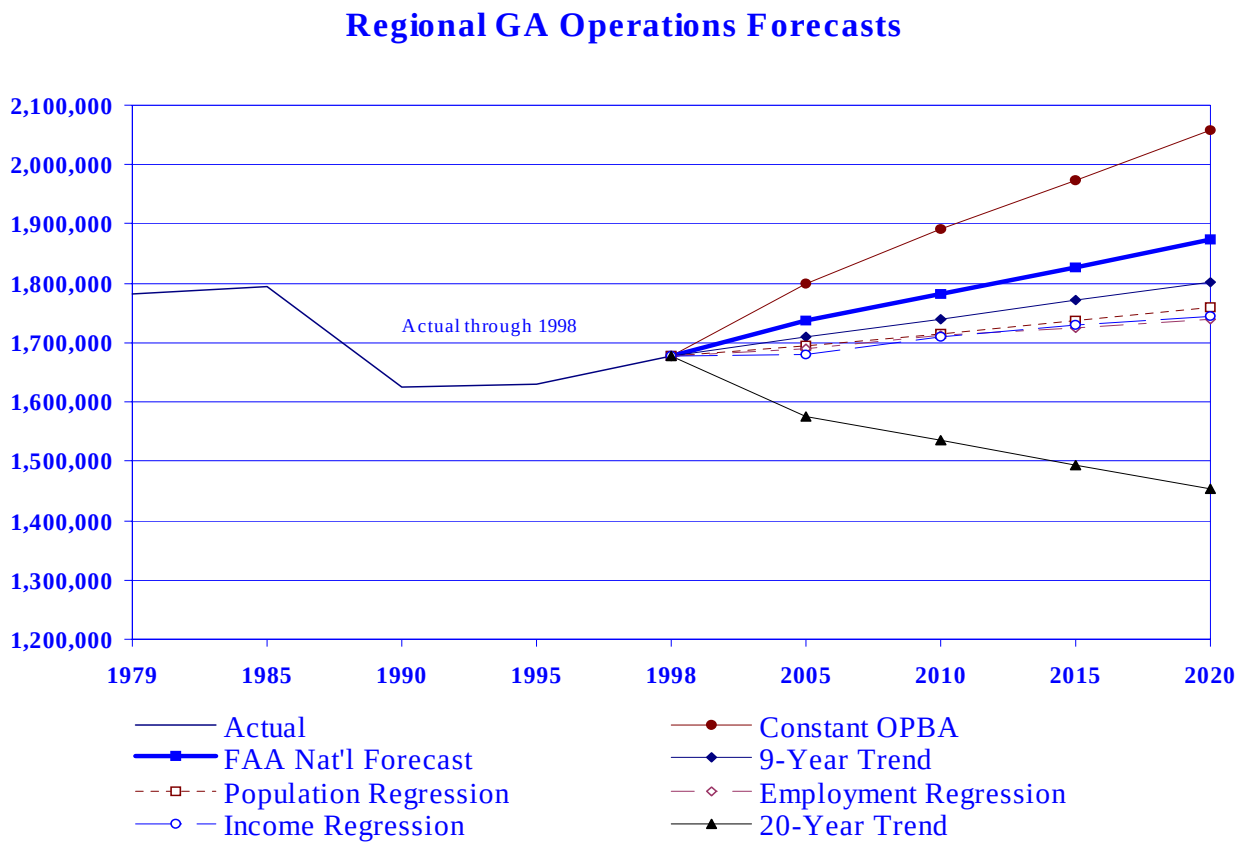
Aircraft Operations Forecast

Similar to based aircraft, several GA aircraft operations forecasts were prepared (see Exhibit 5-45). For purposes of these forecasts, air carrier and commuter operations at all regional airports were excluded. These GA operations forecasts include a constant operations per based aircraft ("OPBA"), FAA national forecast, 9-year trend, three demographic forecasts based on population, employment, and income, and a 20-year trend forecast. All forecasts are aggregate for the entire region.

Exhibit 5-45 Summary of Regional GA Operations Forecasts

	1998	2005	2010	2015	2020
Constant OPBA*	1,678,354	1,799,423	1,891,211	1,972,966	2,058,255
FAA Nat'l Forecast (selected)	***1,678,354***	***1,737,985***	***1,781,871***	***1,826,866***	***1,872,996***
9-Year Trend	1,678,354	1,709,981	1,740,573	1,771,166	1,801,758
Population Regression	1,678,354	1,694,572	1,715,802	1,737,086	1,758,370
Income Regression	1,678,354	1,680,344	1,708,992	1,728,318	1,745,244
Employment Regression	1,678,354	1,690,822	1,711,293	1,725,031	1,738,769
20-Year Trend	1,678,354	1,575,718	1,535,155	1,494,593	1,454,031

* *Derived from the FAA 1% Based Aircraft Forecast (see Exhibit 5-40)*



Discussion of Operations Forecasts

The operations forecasts for the year 2020 range from a high of 2,058,255 (constant OPBA forecast) to a low of 1,454,031 (20-year trend). Respectively, these two forecasts represent a total increase of 22.6% and a decrease of 13% from 1998 activity levels. The remaining six forecasts are based on a 9-year historical trend from 1990 to 1998. These other six forecasts are fairly tightly clustered, with all predictions falling between 1.7 and 1.9 million annual operations for the year 2020 (a spread of only 10% between the high and low forecasts). This spread is much narrower than the based aircraft forecasts (all of which showed positive growth), where the highest forecast was 46% above the lowest. This may suggest the potential for greater precision in forecasting operations than based aircraft.

Constant OPBA Forecast

The constant operations per based aircraft (OPBA) forecast develops aircraft operations estimates based on aircraft utilization rates. The forecast approach assumes the future number of aircraft operations will remain at current (1998) levels, e.g. approximately 464 annual operations per based aircraft. This aircraft utilization rate is consistent with, though slightly below, 1990 and 1995 levels. FAA national data for estimated total GA aircraft operations at towered and non-towered airports (87,400,000 GA operations) and total active GA aircraft (194,800) yields 449 operations per aircraft in 1998 (source: *FAA Long Range Aviation Forecasts Fiscal Years 2010, 2015, and 2020, Table 1*). This comparison of national and regional data confirms that the actual regional OPBA of 464 is consistent with (though slightly higher than) national data.

To generate the operations forecast, the OPBA figure of 464 was applied to the FAA 1% based aircraft forecast (see selected based aircraft forecast section above) to predict future aircraft operations. The constant OPBA operations forecast produced 2,058,255 operations in the year 2020, a total increase of 22.6% over the 22-year period, or an average annual grow rate of 0.93%. This is the highest of the seven operations forecasts, approximately 10% higher than the FAA's national GA aircraft operations forecast, and 42% higher than the 20-year trend operations forecast.

FAA National Forecast

The FAA national forecast is based on the FAA's latest long range forecasts prepared in June 1999. Those forecasts predict an average annual growth rate of 0.5% between 1998 and 2020. The regional operations forecast used these same annual growth rate figures, producing a forecast of 1,872,996 regional operations in 2020, the second highest operations forecast. The FAA national forecast represents a mid-range between the constant OPBA forecast (0.93% annual growth rate) and the 9-year trend forecast (0.32% annual growth rate). Total growth in operations from 1998 to 2020 would be 11.6%. Comparing this operations forecast with the selected FAA 1% forecast for based aircraft would yield a resulting drop in operations per based aircraft (OPBA) from the 1998 ratio of 464 to a projected ratio of 422 in the year 2020. Given the present and predicted popularity of fractional ownerships in GA aircraft, it is likely that future OPBA ratios will actually increase over time. If this were the case, this FAA national forecast of aircraft operations would likely be too conservative. On the other hand, potential external factors, such as fuel prices, potential new user fees, and increasing airport congestion could act to limit future growth in aviation activity. Taken together, the FAA forecast may be the most reasonable one, representing a blend of positive and negative factors.

9-Year Trend Forecast

The 9-year trend forecast used more recent historical data for the period 1990-1998 to forecast future aircraft operations. This forecast capitalizes on the recent growth trend, and yields 1,801,758 operations in the year 2020, a total increase of 7.4% for the 22-year forecast period and an average annual increase of 0.32%. This compares with the FAA's latest national GA operations growth rate forecast of 0.5% per year. The modest growth resulting from the 9-year trend forecast reflects the numerous factors (such as high fuel costs, liability insurance issues, rising aircraft purchase costs, and the increasingly congested and competitive regional aviation market) that dampened aviation activity even into the early 1990s. As a result, this forecast brings the region only back to the operations levels experienced in 1985 (1.8 million). Given the region's propensity to embrace aviation activity, and the nationwide positive forces affecting the industry, the annual growth rate of 0.32% contained in the 9-year trend forecast appears too low. In addition, the rapidly growing trend toward fractional ownership of aircraft would seem to support a somewhat faster growth rate for aircraft operations.

Regional Demographic Regression Forecasts

The final three operations forecasts were predicated on the assumption that regional aviation activity is based in part on regional population and economic factors, and that future activity could be forecast using independently predicted demographic variables. Three demographic forecasts were prepared based on the historical relationship between aircraft operations and regional population, employment, and income. Based on these historical relationships (using linear regression models), future operations levels were estimated using forecasts of regional population, employment, and income published by the Regional Council. All three demographic operations forecasts used the 1990 to 1998 time frame as their base years. The demographic forecasts were very tightly clustered, producing operations levels between 1,738,769 and 1,758,370 operations in the year 2020. These forecasts predict a total regional operations increase of between 3.6% and 4.8% for the 22-year period, fairly modest growth compared with the FAA's 1999 GA operations forecast, which predicts national GA operations will grow by 11.2% between 1999 and 2020.

The three regional demographic-based forecasts fail to take into account the significant positive changes in the national aviation industry in recent years. Nor do they consider recent growth in both based aircraft and aircraft operations in the region, which have grown by 5% and 3%, respectively, in the past three years alone. Because of their low predictions of future aviation activity, and their inability to consider the significant aviation trends, the three demographic forecasts are not considered to be accurate predictors of future operations growth in the region.

20-Year Trend Forecast

The 20-year trend forecast is based on a historical trend from 1979 through 1998, and was heavily affected by the drop in regional operations activity between 1985 and 1990. The 20-year trend forecast was prepared using total regional aircraft operations data (excluding Sea-Tac Airport) for the years 1979, 1985, 1990, 1995, and 1998. Historical operations data (see Exhibit 5-45) show a slight increase from 1979 to 1985 followed by a sharp decline between 1985 and 1990, when operations fell from 1.8 million to 1.6 million. This decline can be partially explained by the rapidly rising cost of flying during this time frame, which was driven by increasing fuel and insurance costs. Between 1986 and 1990 the national aviation fuel index increased by some 30%. For the period 1978 through 1988, the total annual national cost of aviation liability lawsuits increased nearly tenfold. With costs rising so rapidly, aircraft operations activity declined. In this same time frame the market for new GA aircraft had collapsed, and by 1990 aircraft manufacturers were producing a post-war low of 1,144 aircraft, down from 17,811 in 1978.

Between 1990 and 1998 regional GA operations showed renewed growth, increasing from 1,625,000 to 1,678,000. Because of the sharp decline between 1985 and 1990, however, the 20-year trend forecast shows an overall decrease in future activity, with recent growth unable to overcome the declines of earlier years. This forecast shows operations declining from 1,678,354 in 1998 to 1,454,031 in the year 2020. Given the fact that recent operations trends are positive, combined with major positive changes in the national and regional aviation market, the 20-year trend forecasts is considered too low for use in the regional airport system plan.

Selected Operations Forecast

This plan uses the FAA national forecast of aircraft operations as the selected regional aircraft operations forecast. This forecast is based on an average annual growth rate of 0.5%, and will result in regional aircraft operations growing from 1,678,354 in 1998 to 1,872,996 in 2020, a total increase of 12% for the forecast period. This forecast represents a middle ground between the region's operations growth rates for the period 1990 through 1998, which experienced a growth rate of 0.4% per year, and the more recent period 1995 through 1998, when the region's operations have grown by nearly 1% per year. It seems unlikely that the region can sustain it's recent 1% growth rate into the long term future. Therefore a 1% growth forecast would be far too optimistic. On the other hand, recent positive trends in the national and regional aviation markets would support a growth rate slightly higher than the region has experienced since 1990. Between 1990 and 1995 the region's operations grew at a rate of 0.1% per year, clearly still sharing in the stagnation of the national GA market. After the General Aviation Revitalization Act of 1994, both the region and the nation have seen significant rebounds in aviation activity, trends which are forecast to moderate but hold into the foreseeable future.

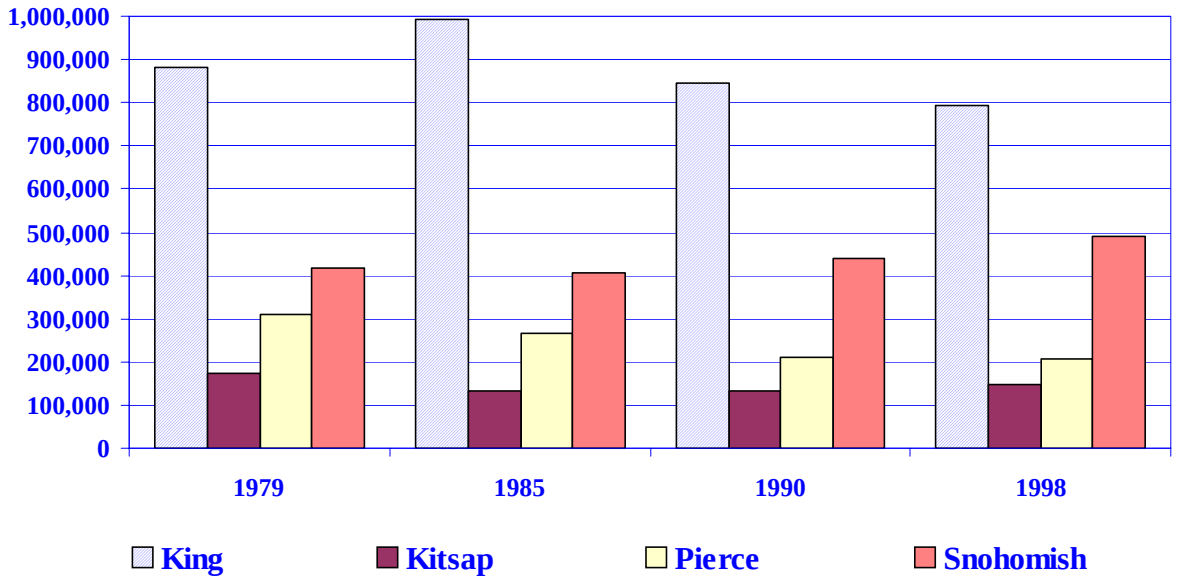
Regional Distribution of Aircraft Operations

In addition to forecasting the total number of aircraft operations in the region, this forecast distributes aircraft operations to counties and individual airports throughout the region. Similar to the regional based aircraft trends described above, historical data show noticeable regional trends in the distribution of aircraft operations. These regional trends are displayed in Exhibit 5-46 and summarized in the table below.

Trends in Regional Distribution of Aircraft Operations

	1979	1985	1990	1998
King County Operations	881,814	992,654	845,943	792,544
Percent of region	49.5%	55.3%	52.1%	47.2%
Kitsap County Operations	174,200	132,226	131,484	146,939
Percent of region	9.8%	7.4%	8.1%	8.8%
Pierce County Operations	309,500	265,904	209,145	207,965
Percent of region	17.4%	14.8%	12.9%	12.4%
Snohomish County Operations	416,784	404,127	438,418	530,906
Percent of region	23.4%	22.5%	27.0%	31.6%

Exhibit 5-46 Regional Distribution of Aircraft Operations



While King County airports saw some growth between 1979 and 1985, the county's total GA aircraft operations has fallen by over 20% since 1985. As a result, King County's regional share has declined, from 55% in 1985 to 47% in 1998. The factors behind this decline include airfield and airspace congestion and delay; increasing landing fees and fuel costs; and increasing aircraft operating costs. Pierce County's trend has been similar to King County, with declines over the entire historical period coupled with decreasing market share. While Kitsap County's market share declined from 1979 to 1985, it has rebounded somewhat since then, increasing from 7.4% in 1985 to 8.8% in 1998. As with the regional distribution of based aircraft, Snohomish County has been the regional leader in GA aircraft operations growth. Between 1979 and 1998 the county saw a total increase of 28%, with 21% of that growth in just the last 8 years. Snohomish County's regional share of GA aircraft operations has similarly grown, from 22.5% in 1985 to 31.6% in 1998. It appears that population, employment, and income growth, together with favorable pricing, available airfield capacity, adequate airport facilities, and reasonably uncrowded airspace, have combined to give Snohomish County airports an edge over many other regional airports. Since 1990 Arlington Airport has seen its operations grow by 23%, Harvey Field has grown by 22%, and Snohomish County Airport (Paine Field) has seen a 25% increase. Other notable changes in aircraft operations activity include:

- ***Auburn Airport*** operations have grown by 13% since 1990
- Operations at ***Bremerton National Airport*** have increased by 16% in the past 8 years
- ***Crest Airpark*** operations have increased by 28% since 1990
- ***Pierce County Thun Field*** has grown by 21% since 1990
- ***King County International Airport/Boeing Field*** saw a 10% decline from 1990 to 1998
- Between 1990 and 1998 operations at ***Renton Municipal Airport*** decreased by 33%
- ***Tacoma Narrows Airport*** operations have dropped 13% since 1990.

Forecast Shifts in Regional Aircraft Operations Distribution

Similar to the predicted regional shifts in based aircraft, this system plan forecasts that growth in aircraft operations will vary across the region, with some counties growing more than others. The table below displays the predicted future distribution of aircraft operations among the region's four counties.

Exhibit 5-47 Forecast Future Distribution of Aircraft Operations *

	1998	2005	2010	2015	2020
King Co. Operations	792,544	808,163	817,879	829,397	840,975
Percent of region	47.2 %	46.5 %	45.9 %	45.4 %	44.9 %
Kitsap Co. Operations	146,939	156,419	162,150	168,072	174,189
Percent of region	8.8 %	9.0 %	9.1 %	9.2 %	9.3 %
Pierce Co. Operations	207,965	218,986	228,079	237,493	247,235
Percent of region	12.4 %	12.6 %	12.8 %	13.0 %	13.2 %
Snohomish Co. Operations	530,906	554,417	573,762	591,905	610,597
Percent of region	31.6 %	31.9 %	32.2 %	32.4 %	32.6 %
Total Aircraft Operations	***1,678,354***	***1,737,985***	***1,781,871***	***1,826,866***	***1,872,996***

* *Figures show the Selected FAA National Forecast (see Exhibit 5-45)*

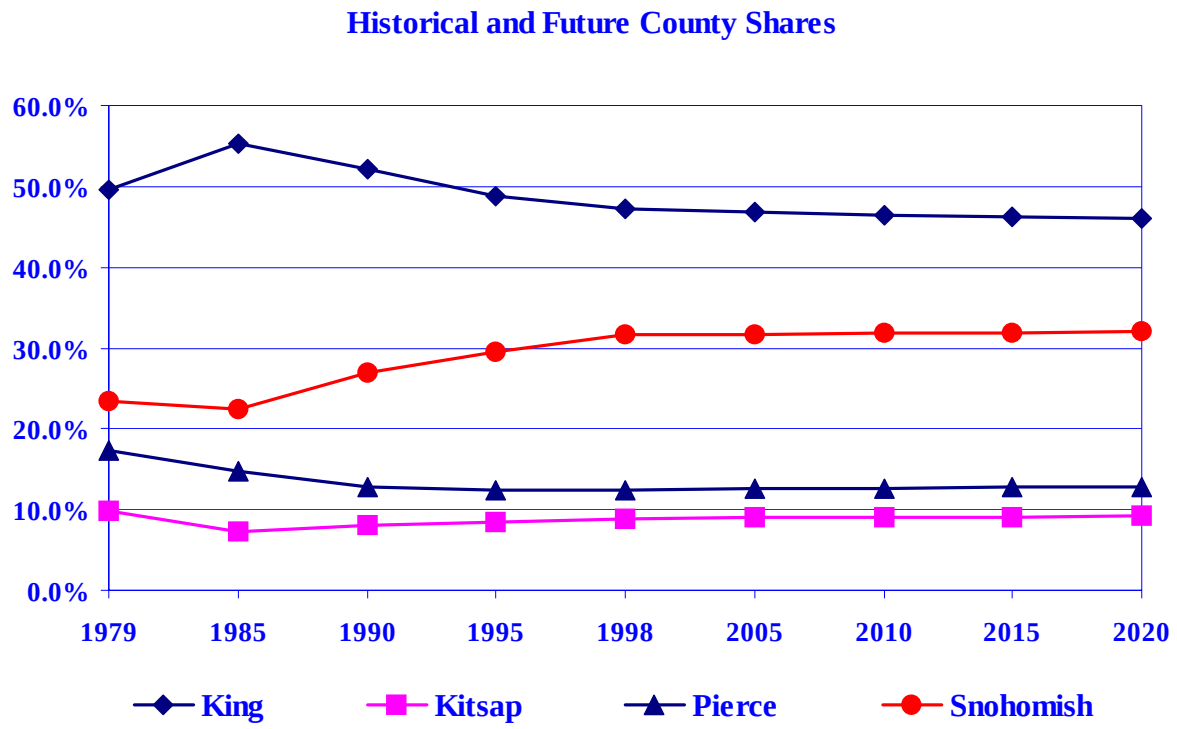


Exhibit 5-48 Selected Regional Aviation Forecasts Summary *

Based Aircraft Forecast

	1998	2005	2010	2015	2020
King	1,416	1,498	1,554	1,600	1,642
Kitsap	181	198	208	221	230
Pierce	529	567	600	625	659
Snohomish	1,494	1,618	1,717	1,808	1,908
Total	3,620	3,881	4,079	4,255	4,439

Aircraft Operations Forecast

	1998	2005	2010	2015	2020
King	792,544	808,163	817,879	829,397	840,975
Kitsap	146,939	156,419	162,150	168,072	174,189
Pierce	207,965	218,986	228,079	237,493	247,235
Snohomish	530,906	554,417	573,762	591,905	610,597
Total	1,678,354	1,737,985	1,781,871	1,826,866	1,872,996

Forecast Distribution of Based Aircraft

	1998	2005	2010	2015	2020
King	39.1%	38.6%	38.1%	37.6%	37.0%
Kitsap	5.0%	5.1%	5.1%	5.2%	5.2%
Pierce	14.6%	14.6%	14.7%	14.7%	14.8%
Snohomish	41.3%	41.7%	42.1%	42.5%	43.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Forecast Distribution of Aircraft Operations

	1998	2005	2010	2015	2020
King	47.2%	46.5%	45.9%	45.4%	44.9%
Kitsap	8.8%	9.0%	9.1%	9.2%	9.3%
Pierce	12.4%	12.6%	12.8%	13.0%	13.2%
Snohomish	31.6%	31.9%	32.2%	32.4%	32.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

* *Based on FAA 1% based aircraft forecast and FAA aircraft operations forecast*

The forecast shift tracks closely with the predicted changes in distribution of based aircraft. King County's share of the region's operations is predicted to decline from 47.2% in 1998 to 44.9% in 2020. Snohomish County is predicted to increase its regional share from 31.6% in 1998 to 32.6% in 2020. Both Kitsap and Pierce counties are should increase their shares slightly, with absolute numbers of operations increasing by 27,000 in Kitsap County and 39,000 in Pierce county between 1998 and 2020.

In actual numbers, Snohomish County will see the most growth, with some 80,000 additional operations in 2020, while King County will see about 50,000 additional annual aircraft operations by the year 2020. Consistent with its proportionally larger share of the region's business and corporate aircraft, King County will likely see higher growth rates for business aircraft, with less growth in light GA operations engaged in training activity. Snohomish County will experience growth in both corporate and business activity as well as training and light GA activity. A large portion of the operations growth in Kitsap and Pierce counties is predicted to be light GA, though there is potential for corporate and business activity growth at Tacoma Narrows, Pierce County/Thun Field, and Bremerton National Airport.

These forecast shifts in the distribution of aircraft operations across the region reflect the continued impacts of several forces which have historically caused shifts in activity. These include continued higher population and employment growth in Kitsap, Pierce, and Snohomish counties than in King County; increasing airspace complexity and landside congestion in the central portion of the region; pricing differentials; landside access issues; and airports' relative ability to accommodate increasing demand.

Allocation of Forecast Based Aircraft and Aircraft Operations to Airports

Using the forecast distribution of based aircraft and aircraft operations between the four counties, the aircraft and operations were then "allocated" to each airport in the system. These allocations are displayed in Exhibits 6-2 and 6-3 in the Capacity chapter. This allocation was based on each airport's current (1998) share of its county's total. That share was held constant for each airport through the forecast period, with the exceptions of Martha Lake Airport and Apex Airpark. Martha Lake Airport was closed in July 2000. The 51 aircraft currently based there and potential future based aircraft were allocated to other Snohomish County airports according to those airports' 1998 shares of Snohomish County aviation activity. Aircraft operations at Martha Lake Airport were similarly reallocated to other Snohomish County airports. For Apex Airpark, based aircraft were held constant at the 1998 number (50) because the airport is limited to that figure by an agreement with Kitsap County. Future based aircraft demand that would have been allocated to Apex Airpark were redistributed to Bremerton National Airport and Port Orchard Airport based on these two airports' current shares of the Kitsap County total. Forecast aircraft operations were allocated to Apex Airpark according to its current county share.

Passenger Forecasts

This forecast is a summary of the most recent passenger forecasts prepared for airports with commercial passenger service, either scheduled or unscheduled (charter). Airports with existing passenger service include American Lake, Boeing Field, Kenmore Air Harbor, Lake Union Air Service, Sea-Tac International Airport, and Will Rogers/Wiley Post Floatplane Base. Only Sea-Tac Airport and Boeing Field have scheduled passenger service. The other four airports listed below provide unscheduled/charter passenger service. Future passenger forecasts are available only for Sea-Tac International Airport and King County International Airport/Boeing Field. These forecasts are shown below.

The forecasts for Sea-Tac International Airport shown below were derived from the *Final Supplemental Environmental Impact Statement for the Proposed Master Plan Update Development Actions (May 1997)*. The forecasts for Boeing Field were taken from *Master Plan Working Paper One (September 1999).* As stated in the working paper, the "....unconstrained demand for commercial passenger activity at the airport recognizes that [while] .... there .... is demand for passenger services, ... at the present time, no airline is proposing a significant commercial passenger operation at the airport, and that no new facilities are programmed to accommodate such growth."

Passenger Forecasts
(includes both enplaning and deplaning passengers)

	1998	2005	2010	2015	2020
American Lake	7,140	N/A	N/A	N/A	N/A
Boeing Field	4,026	76,400	154,000	178,600	N/A
Kenmore Air Harbor	29,500	N/A	N/A	N/A	N/A
Lake Union Air Service	19,100	N/A	N/A	N/A	N/A
Sea-Tac International *	25,863,132	31,400,000	35,800,000	40,200,000	44,600,000
Will Rogers/Wiley Post	8,740	N/A	N/A	N/A	N/A
Total	**25,931,638**	**31,476,400**	**35,954,000**	**40,378,600**	**44,600,200**

* *Year 2015 passenger forecast for Sea-Tac Airport was interpolated by PSRC*

Air Cargo Forecasts

The following air cargo forecasts were taken from the most recent airport master plans and other supporting data for Sea-Tac International Airport and King County International Airport/Boeing Field. These include the Sea-Tac Airport Master Plan (1994), Sea-Tac Final Supplemental EIS (May 1997), Sea-Tac Airport *Air Cargo Facilities Development Study* (December 1999), and Boeing Field Master Plan Working Paper One (September 1999). Boeing Field's latest airport master plan forecast extends to 2015, while the Port of Seattle's official forecast for Sea-Tac Airport extends to the year 2010. That forecast was then extrapolated to 2019 for the Air Cargo Facilities Development Study in 1999. These forecasts translate into an average annual growth rate of 4.6% for the region. As a comparison, the Boeing Company's *World Air Cargo Forecast (1998-1999)* predicts total world air cargo volume will grow by an average of 6.4% per year between 1997 and 2017, with total U.S. cargo volumes growing by approximately 5% per year.

Air Cargo Forecasts (US tons)
(includes both enplaned and deplaned cargo)

	2000*	2005**	2010**	2015**	2019***
Boeing Field	143,425	194,540	243,595	305,000	N/A
Sea-Tac Int'l	501,597	683,100	805,200	N/A	1,057,100
Total:	**645,022**	**877,640**	**1,048,795**		

* *Actual 2000 numbers were derived from Sea-Tac Airport Activity Report (2000) and Boeing Field records..*

** *Forecasts for 2005, 2010, and 2015 were taken from the "Final Supplemental EIS for the Proposed Master Plan Update Development Actions at Sea-Tac Airport" (May 1997) and the Boeing Field "Master Plan Working Paper One" (September 1999)*

*** *Sea-Tac forecast for 2019 was extrapolated from the Airport Master Plan forecast for the 1999 "Air Cargo Facilities Development Study"*

Chapter 6 - System Capacity and Future Facility Requirements

The existing system capacity* and future facility requirements work element consists of two interrelated tasks. First, the capacity of the existing airport system is determined using information from the system inventory. The capacity information is then evaluated against existing and forecast aviation activity to determine the extent of additional facilities needed to meet future demand. The following sections describe these two related work efforts.

System Capacity and Requirements

Analysis of airport system capacity was done using existing facility information from the system inventory work task. The analysis identifies facility capacity for each system airport and for the total airport system. Analysis of system capacity (and future facility needs) includes the extent of facilities' ability to meet numeric demand, such as total annual or peak hour takeoffs and landings, as well as meeting the more specialized needs of the system, such as runway length or strength. The following airport facilities are included in the analysis of system capacity and requirements:

Aircraft parking capacity	• aircraft tie-downs (for based aircraft) • aircraft hangars (for based aircraft)
Airfield capacity	• annual capacity (measured as annual service volume, or "ASV")
Airport acreage	• acreage available for airport development
Pavements	• pavement condition index (PCI) • runway surface type
Airport standards	• runway length • runway width • runway safety areas (width and length beyond) • runway approaches and obstructions • approach lighting
Support facilities	• control towers • air cargo • aircraft fuel

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* "Capacity" as used in this regional airport system plan report refers to either airfield or landside capacity. Airfield capacity is generally measured as the number of takeoffs and landings an airport can accommodate over a given time period (typically peak hour or annual) given the layout of runways and taxiways, weather conditions, and mix of aircraft using the facility. Landside capacity as discussed here generally refers to the supply of aircraft parking (either tie-downs or hangars). Landside capacity as used here does not include future potential aircraft parking based on construction of new tie-downs or hangars, but is a measure of existing supply. Therefore, based aircraft capacity figures that appear in this report reflect the number of aircraft that could be accommodated with existing airport tie-downs and hangars, whether or not those parking spaces are currently occupied. For example, an airport that has 200 existing aircraft parking spaces but has 150 based aircraft would have a landside capacity of 200, and would be reported as currently using 75% of its capacity.

System Capacity

The analysis of existing system capacity and future facility requirements was done for five time periods: 1998 (current), 2005, 2010, 2015, and 2020. Exhibit 6-1, *Existing System Capacity (1999)* displays existing capacity compared with existing demand levels for the base year (1999). The table shows the capacity of existing aircraft parking inventory (tie-downs and hangars), current number of based aircraft, current waiting lists for aircraft parking, existing airport acreage devoted to aviation use plus additional acreage available for future development, existing (1998) aircraft operations, and annual operations capacity, measured as annual service volume (ASV).

Two critical ratios are also included in the table, which are calculated by comparing the existing demand and existing system capacity figures. These ratios are the "Landside Demand/Capacity (or D/C) Ratio" and the "Airside Demand/Capacity (D/C) Ratio." Both these ratios represent the portion of existing capacity that is being used. For the total airport system the demand for landside aircraft parking is 84% of existing capacity, while airside demand (annual operations) is at 36% of existing airfield capacity. These ratios are totals for the entire airport system.

Existing Based Aircraft Storage Capacity

Exhibit 6-1 displays a comparison of based aircraft with existing aircraft parking inventory for the region as a whole and for each airport. The inventory is divided into tie-down capacity and hangar capacity. As of 1999, the region had 2,002 aircraft tie-downs and 2,327 hangars for a total inventory of 4,329. This breakdown represents 46% tie-downs and 54% hangars. With 3,620 aircraft based in the region, the airport system has reached 84% of its existing aircraft parking capacity. Discussions with most airport managers in the region confirm that as of 1999 virtually all aircraft hangars in the region (2,327) are full, while 1,293 tie-downs (65%) are occupied, leaving 709 tie-downs (35%) vacant.

Individual airports' D/C ratios vary around the region. Several airports have reached or are nearing their existing based aircraft parking capacity. These include Apex Airpark (100%), Arlington (88%), Boeing Field (81%), Crest Airpark (94%), First Air Field (90%), Kenmore Air Harbor (100%), Martha Lake (98%), Pierce County Airport/Thun Field (82%), Renton Municipal (94%), Snohomish County Airport/Paine Field (86%), Spanaway (82%), Swanson (85%), Vashon Municipal (97%), and Will Rogers/Wiley Post Seaplane Base (100%). Several small airports, including Port Orchard, Darrington, and the four State-owned Airports, have few or no based aircraft, and are not approaching their capacity.

In addition to existing based aircraft, information on current waiting lists was collected from individual airports where available. As of August 1999 there were a total of approximately 817 names on documented waiting lists. All these waiting lists represent aircraft waiting for hangars, not tie-downs. Most people on the waiting list are current airport tie-down tenants hoping to upgrade to covered storage. A review of the waiting lists for Crest Airpark, Harvey Field, and Snohomish County Airport/Paine Field show approximately 90% are existing tie-down tenants inside the region, while 10% have aircraft located outside the Puget Sound Region. This smaller segment of the waiting list represents latent (unmet) demand, while the vast majority represents demand that is being met, though not of the type required.

These data, which are consistent with national trends, suggest that the region is providing enough total aircraft parking to meet demand, but those facilities are of the wrong type. Pilots and owners of increasingly expensive and sophisticated aircraft are demanding secure, weather-proof storage facilities for their airplanes. While the region's existing supply of aircraft parking is comprised of 54% hangars and 46% tie-downs, actual demand would appear to be split more toward hangars, with 87% demanding hangars and 13% requiring tie-downs. As the regional aircraft fleet expands in the future, with newer

aircraft and fractional ownership increasing, it is likely that the preference for hangars will continue, and perhaps even grow. The implications for future planning indicate that perhaps some existing tie-down space could be redeveloped for hangars to meet existing demand. In the longer term, if demand materializes as the forecasts predict, up to 90% of new aircraft parking facilities might be devoted to hangars. The feasibility of providing this high ratio of hangars would depend in part on whether hangar rents are affordable by most aircraft owners.

Unfortunately, the waiting list data area not sufficiently complete to allow detailed analysis. For example, it is also not known how many on waiting lists are trying to move their aircraft from one airport within the region to another. Given the historical trend of lower end GA away from congested, more expensive airports in the region toward less congested, less expensive airports, it's probable that some people on waiting lists are tenants of airports waiting for space to become available at other airports. An additional unknown is how many people have placed their names on more than one waiting list. A third unknown is the price these people on waiting lists would be willing to pay for hangar space. The lack of reliable, statistically significant data on waiting lists makes it difficult to develop solid plans to meet this undefined demand. Nevertheless, it is important to consider these expressions of need in planning for the future airport system.

Existing Airfield Capacity

In terms of airfield operations capacity, the analysis used here is based on "annual service volume" (ASV) as the measure of capacity. Annual service volume represents the airports' approximate annual runway capacity (total takeoffs and landings) with acceptable delay. Calculation of an airport's "ASV" considers items such as overall airfield geometry, number of runways, runway separation, runway utilization patterns, hourly capacity, airport capability during poor visibility conditions, and aircraft fleet mix. For the smaller airports, the ASV numbers used here were derived from FAA Advisory Circular AC 150/5060-5, "Airport Capacity and Delay." For the larger airports the annual service volume figures were taken from their most current airport master plans.

With the exception of Sea-Tac (at 89%) and Boeing Field (at 91%), most of the region's airports are operating well below their airfield capacity. Only eight airports are operating at or above half their annual runway capacity. These include Arlington (50%), Auburn (75%), Boeing Field (91%), Harvey Field (61%), Kenmore Air Harbor (53%), Land Union Seaplane Base (51%), Sea-Tac International (89%) and Snohomish County/Paine Field (67%). FAA airport planning guidelines suggest that airports with ASV ratios between 60 and 80% should begin planning for additional runway capacity, while those with ratios between 80 and 100% should be taking action to increase capacity. Sea-Tac (at 89%) is currently underway implementing its third runway project. Boeing Field (91%) has insufficient land to accommodate additional runway development. Therefore, excess demand at Boeing Field must be diverted to other airports in the region, a condition that been the case for many years.

Analysis of Future Capacity Requirements

To evaluate future system capacity requirements the information on existing system capacity was compared to the selected aviation demand forecasts developed in chapter 5 above. The two major measures of demand used to assess capacity were based aircraft and aircraft operations. These two measures were then used to derive other measures of demand, such as airfield access requirements and overall airport services, such as terminal requirements, demand for aircraft fuel, and other needs. Exhibits 6-2 and 6-3 below display the analysis of existing landside and airfield capacity compared with forecast demand for the years 1998 (existing), 2005, 2010, 2015, and 2020. The tables show the analysis for each airport as well as totals for the entire airport system.

Future Based Aircraft Storage Capacity Requirements

Exhibit 6-2 includes existing aircraft tie-down and aircraft hangar capacity figures for each airport, which are summed for the region. Existing capacity is then compared with future based aircraft demand for the years 2005, 2010, 2015, and 2020. Total capacity for the region is approximately 4,329 aircraft spaces compared with the existing 3,620 based aircraft. This puts 1998 demand at 84% of total regional supply. Future demand is forecast to grow to 4,439 based aircraft, while system capacity dropped by 52 spaces with the July 2000 closure of Martha Lake Airport. Thus, regional capacity has been reduced to 4,277 spaces compared with the 2020 forecast of 4,439 based aircraft, putting total demand at 104% of the region's capacity. At the regional level, this would put supply only 162 spaces short of projected demand. This assumes that all demand would locate where there is currently excess capacity (all of which is tie-downs). Future regional based aircraft demand shows a strong preference for hangars combined with uneven demand across the region. Exhibit 6-2 shows the distribution of future demand by airport, and also displays that future demand by its preference for hangars. According to these data, some 737 new aircraft hangars will be needed by the year 2020, while some 82 new aircraft will prefer tie-downs, virtually all of which can be accommodated by existing supply. As a result, no new tie-downs would be needed. If construction of new hangars were to displace a significant number of existing aircraft tie-downs, however, there could be a need for new tie-downs.

If future demand is distributed as predicted here, the following airports would reach or exceed their landside capacity by the year 2020: Apex, Arlington, Crest, First Air Field, Harvey Field, Kenmore Air Harbor, Pierce County Airport/Thun Field, Renton, Sea-Tac, Snohomish County Airport/Paine Field, Spanaway, Swanson, Vashon Island, and Will Rogers/Wiley Post. While several of these are small airports that might comfortably increase the number of aircraft parking spaces to meet modest increases in future demand, several others would require significant improvements to accommodate forecast landside demand. These include Arlington (needing 148 new hangars), Harvey Field (needing 104 new hangars), and Snohomish County Airport/Paine Field (requiring 140 new hangars).

The above calculations of future based aircraft demand (primarily new hangars) exclude the current hangar waiting lists, which are a measure of latent hangar demand. Though difficult to quantify, the waiting lists display a preference for upgraded aircraft storage facilities, and perhaps more importantly illustrate the trend toward more expensive, more sophisticated business and corporate aircraft. Though the large majority of these aircraft are currently tenants at the region's airports, they represent a growing market for hangars. When combined with the anticipated future hangar demand from new aircraft (737) the 817 aircraft on the region's hangar waiting lists brings the total potential hangar demand to over 1,500 hangars, a 64% increase over the current regional hangar supply.

Future Airfield Capacity Requirements

At most airports the region's airfield capacity is sufficient to accommodate future demand. However, several airports may begin to approach their annual airfield capacity (annual service volume) by the year 2020. These include Auburn (reaching 81% of its airfield capacity), King County International/Boeing Field (reaching 99%), Harvey Field (reaching 75%), and Snohomish County/Paine Field (reaching 82%). Not surprising, all these are reliever airports. As these airports approach their annual runway capacity, airport users may increasingly seek alternative airports that are less congested. Over the forecast period, the biggest jumps in operations activity (measured in percentage of annual runway capacity used) will occur at Arlington (increasing from 50% to 61%), Boeing Field (increasing from 91% to 99%), Harvey Field (increasing from 61% to 75%), and Snohomish County Airport (increasing from 67% to 82%). Because it is already approaching its practical landside and airfield capacities, aviation demand at Boeing Field will continue to be diverted to other general aviation airports that either have excess capacity or can provide it.

Auburn Airport, which is predicted to reach 81% of its annual airfield capacity by the year 2020, occupies a 107 acre site with approximately 25 acres available for expansion. The site is constrained by urban development on all sides. Expansion potential to accommodate a second runway is highly unlikely.

King County International Airport/Boeing Field sits on a 594 acre site bounded by Airport Way and major railroad tracks on the east, urban development on the north and south, and major industrial uses (including Boeing Company facilities and the Museum of Flight) on the west. There is no feasible way for Boeing Field to expand its airfield capacity.

Harvey Field in Snohomish County will reach 75% of its annual runway capacity by the year 2020. The airport maintained a second, turf crosswind runway until 1999, when it was closed to allow for construction of aircraft hangars. The owner plans to construct a new parallel runway in the future (also turf), and also plans to install ramps, docks, and other support facilities to serve float planes on the Snohomish River. These improvements would increase the airport's airfield capacity, and would likely serve projected demand beyond the year 2020.

Snohomish County Airport/Paine Field is expected to see airfield operations increase to over 235,000 by the year 2020. This would place the airport at approximately 82% of its annual airfield capacity (288,000 annual operations), second in the region to Boeing Field. According to the airport's most recent master plan (completed in July 1995), the existing airfield configuration will accommodate projected operations demand (the master plan projected 279,000 annual operations in the year 2014). This airport system plan forecasts aircraft operations to reach 235,000 at Paine Field by the year 2020, somewhat below the airport master plan forecast for the year 2014. While this operations level is lower than the airport's forecast, it is still above 80% of the airport's capacity, and raises the issue of long term capacity at Paine Field.

The analysis of how and where future landside and airfield capacity should be provided to meet demand will be discussed in the *Aviation System Strategies* portion (Chapter 7) of this plan.

Existing Acreage Available for Airport Development

The analysis of future airport system capacity enhancement to meet growing demand includes a review of existing acreage of the system's airports as well as the amount of existing airport land available for airport growth. Exhibit 6-1 includes both these figures. Excluding the two military airfields, the region's airports contain a current total of approximately 8,442 acres. Of this total, some 1,092 acres are available to accommodate airport development needs. 584 of the 1,092 available acres are located at Bremerton National Airport. Following is a display (derived form Exhibit 6-2) of the top ten airports facing the most significant future demand for new aircraft parking spaces and their land available for development. It identifies the amount of airport property potentially available for additional airport development to accommodate new based aircraft. In addition, it identifies standards for the airports' existing and/or future design aircraft that could require additional property.

Airport	Total new aircraft demand (2020)	Airport land available for development	Airport standards potentially affecting property needs
Arlington	164	40 acres	None
Snohomish County	156	170 acres	None
Harvey Field	116	117 acres	Runway length Runway width
Boeing Field	71	0 acres	RSA length beyond (Runway 13R)
Pierce County/Thun	56	16 acres	None
Crest Airpark	53	68 acres	Runway width
Tacoma Narrows	49	16 acres	RSA length beyond
Bremerton National	42	584 acres	Runway length RSA length beyond
Auburn	38	25 acres	None
Renton	38	0 acres	None

Pavements

Pavement condition index ("PCI")

Airport pavements (particularly runways) represent one of the most expensive investments in airport infrastructure. Maintenance and preservation of airport pavements is a cornerstone for aviation system planning. The FAA requires airport sponsors to collect and regularly update airport pavement condition information as a condition to remain eligible to receive Federal funding for pavement replacement and reconstruction projects. The national standard for monitoring the condition of airport pavements is the pavement condition index ("PCI") system. This pavement evaluation system establishes a pavement condition "index" number (between 1 and 100) for each section of pavement. Pavements in excellent condition have high PCI index numbers, while those in poor condition have low index numbers. Developing and maintaining PCI data for airports in a system, and for individual airports over time, helps in tracking pavement deterioration, and provides for comparative analysis of the pavement needs of airports in a system.

The Washington State DOT Aviation Division has developed a pavement maintenance and management program for most of the public use airports in the state, including 13 of the largest and busiest airports in the central Puget Sound region. The information presented here is derived from the WSDOT program.

Inventory information on airport system pavements, including current PCI numbers, was developed by the WSDOT and their consultants during 2000. In addition to the pavement inventory and PCI information in the pavement program database, the State's program includes development of a computerized pavement management and maintenance program utilizing "MicroPaver" software. The MicroPaver program allows for comparative analysis of pavement needs, helps to identify funding priorities for pavement investment, and can be used to predict future pavement performance given various pavement investment options. With this information, funding for airport pavements can be most effectively allocated to the airports of the system.

Exhibit 6-4 displays two separate assessments of pavement condition for the region's airports, both of which were developed by the WSDOT Aviation Division. The first, based on visual inspections performed during the 1998 statewide airport inventory, uses a scale of "good," "fair," and "poor" to describe airport pavements. According to the 1998 visual pavement inspections, the region's 28 land based runways scored reasonably well: 19 runways were considered in good condition, 7 were in fair condition, and only 2 were in poor condition. The two poor condition runways are located at Bandera (turf) and Spanaway. The fair condition runways were at Crest Airpark, First Air Field, Harvey Field, Martha Lake (now closed), Port Orchard, Skykomish State, and Tacoma Narrows.

The second set of pavement condition information was completed in 1999-2000 as part of the State DOT's pavement management program. This information (shown in Exhibit 6-4) displays pavement condition index (PCI) numbers for the 13 larger and busier airports in the system. Additional detail regarding pavement conditions is displayed on Exhibit 4-20 "Condition of Airport Pavement."

Runway surface type

The regional airport system currently has a variety of runway surface types, including concrete, asphaltic concrete, asphalt, turf/gravel, and water. Of the region's 34 active runways, 1 is concrete, 4 are asphaltic concrete, 20 are asphalt, 4 are turf/gravel (a fifth, Harvey Field's crosswind turf runway, has been closed), and 5 are water. These data are displayed in Exhibit 6-4. The existing airport system runway surface types are appropriate for current airport roles. All primary and reliever airports have either concrete, asphaltic concrete, or asphalt runways. Sea-Tac's runway 16R-34L is concrete. The four asphaltic concrete runways include those at Boeing Field (both), Renton, and McChord AFB. The remainder of the region's busier airports have runways constructed of asphalt (including Sea-Tac's runway 16L-34R). The system's turf and gravel runways are confined to three of the four state-owned airports plus Sky Harbor (Sultan) and Vashon Island. The five airports with turf/gravel runways serve the smallest GA aircraft (airport reference code A-1), have low numbers of annual operations (all served less than 6,000 annual operations in 1998), and have limited based aircraft fleets (Vashon has the most based aircraft, with 31). Based on the existing airport system runway surface types, existing airport roles, expected future roles, and forecasts of future aviation activity, no changes in runway surface types are anticipated. A life cycle cost analysis may be conducted by the airport owner prior to future runway reconstruction. The outcome of this analysis could affect a change in runway surface type.

Airport Standards

Airports are planned and designed to meet FAA standards based on the operational and physical characteristics of the aircraft using the airport, and the level of instrumentation at the airport. At the heart of these standards is the FAA's Airport Reference Code (ARC). Airport Reference Codes have two components (e.g. B-II). The first component (shown as a letter) is the *aircraft approach category*, and relates to aircraft approach speed (operational characteristics). The second component (shown as a roman numeral) is the *airplane design group*, and relates to the airplane's wing span (physical characteristics). An airport serving only small general aviation aircraft might have an ARC of A-I, while an airport serving large commercial aircraft up to a Boeing 747 would have an ARC of D-V.

Airport design standards based on airport reference codes include runway width, runway safety area width, and runway safety area length beyond the runway end. Runway length recommendations are not based on ARC, but are determined by the needs of each airport's design aircraft considering the airport's elevation and temperature. The following sections describe the extent to which the airport system meets recommended airport design standards, and identifies areas where the region's airports do not meet standards. Those deficiencies that are considered critical to the maintenance, preservation, and/or enhancement of the system are identified as priority system needs, and are addressed in the capital improvements program (CIP) in the Implementation chapter 9.

Runway length

Recommended runway length is largely determined by the performance requirements of each airport's current and future design aircraft, including its size, speed, and operating characteristics. In addition, airport elevation and average daily maximum temperature of the hottest month are used to calculate required runway length.

The runway length recommendations shown here were derived from two major sources. For small airports, the FAA's "Airport Design for Microcomputers" program, version 4.2 was used to determine recommended runway length. The recommended lengths for smaller GA airports shown below are based on accommodating either 95% or 75% of all small general aviation aircraft with less than 10 seats and approach speeds of less than 50 knots.

For the larger airports, the recommended future runway length contained in their airport master plan is shown. Several runway length recommendations show longer future runways, not because the existing length is inadequate, but because the airports are planning to accommodate future aircraft that require a longer runway. For the region's two military airfields and four seaplane bases no recommended runway length is shown.

Larger airports with greater then 100 based aircraft planning for longer runways

Airport	Existing Runway Length	Planned Runway Length
Arlington *	5,333 ft.	6,000 ft.
Bremerton *	6,200 ft.	7,400 ft.
Sea-Tac Int'l *	11,900 ft.	12,500 ft.

* *NPIAS airports*

Smaller Airports (less than 100 based aircraft) with less than recommended runway lengths to accommodate 95% and 75% of small GA aircraft of less than 10 seats

		Recommended runway length to accommodate small aircraft:	
Airport	Existing runway length	95% of fleet	75% of fleet
Apex	2,500 ft.	3,040 ft.	2,510 ft.
Bandera	2,342 ft.	3,440 ft.	2,890 ft.
Darrington	2,490 ft.	3,040 ft.	2,520 ft.
First Air	2,095 ft.	2,910 ft.	2,370 ft.
Harvey Field [1]	2,660 ft.	2,900 ft.	2,350 ft.
Martha Lake [2]	1,680 ft.	3,030 ft.	2,510 ft.
Port Orchard	2,460 ft.	3,000 ft.	2,460 ft.
Ranger Creek	2,700 ft.	3,980 ft.	3,250 ft.
Sky Harbor	1,930 ft.	2,970 ft.	2,440 ft.
Skykomish	2,050 ft.	3,190 ft.	2,690 ft.
Spanaway	2,720 ft.	3,000 ft.	2,470 ft.
Swanson	3,000 ft.	3,150 ft.	2,630 ft.
Vashon [3]	1,940 ft.	2,950 ft.	2,420 ft.

[1] *Harvey Field has 360 based aircraft and is a NPIAS airport*

[2] *Martha Lake has since been closed (July 2000)*

[3] *Vashon is a NPIAS airport*

Recommended runway lengths shown above for smaller general aviation airports are optimal lengths based on the FAA's airport design computer software program, and would accommodate either 95% or 75% of small GA aircraft less than 10 seats. Based on existing site constraints and other factors, it may not be practical for all small GA airports to accommodate 95% of these aircraft. In addition, current and projected activity levels and expected critical aircraft using these small GA airports may not require that they accommodate 95% of all small GA aircraft. All 13 airports listed above fall short of meeting this standard.

When compared with the 75% fleet standard, only 7 of the 14 airports have inadequate runway length. These include Bandera, FirstAir Field, Martha Lake (now closed), Ranger Creek, Sky Harbor, Skykomish, and Vashon. Given existing airport roles and projected activity levels, it is appropriate that Harvey Field meet the 95% fleet criterion (which would require an extension from 2,660 to 2,900 feet), and that FirstAir Field and Spanaway meet the 75% fleet criterion. Spanaway currently meets this runway length recommendation, while the runway at FirstAir Field would need to be lengthened from

2,095 to 2,370 feet. In addition, because Vashon is a NPIAS airport, the system plan should consider lengthening the Vashon runway from 1,940 to 2,450 feet to accommodate 75% of the small GA aircraft fleet.

Runway width

Runway width standards are determined using Airport Reference Codes for the airports' design aircraft and the airport's (or runway's) level of instrumentation (ability to handle landings in low visibility). The greater the capability to handle low visibility conditions, the wider the runway must be. According to the most recent airport inventory information obtained from current airport master plans and the State DOT's airport inventory database, the PSRC region's airport system has 12 airports with runways that do not meet FAA runway width standards based on their current airport reference code (ARC) and "design aircraft." These airports include Apex, Crest, Darrington, FirstAir Field, Harvey Field, Martha Lake, Pierce County/Thun Field, Port Orchard, Ranger Creek, Spanaway, Swanson, and Vashon. Existing runway width and FAA runway width standards are listed below for these airports.

Existing Runway Width and FAA Runway Width Standards Based on Recommended Airport Design Aircraft

Airport	Existing Runway Width	FAA Standard
Apex Airpark	28 feet	60 feet
Crest Airpark	40 feet	60 feet
Darrington	40 feet	60 feet
First Air Field	34 feet	60 feet
Harvey Field *	36 feet	60 feet
Martha Lake **	38 feet	60 feet
Pierce County/Thun *	60 feet	75 feet
Port Orchard	28 feet	60 feet
Ranger Creek	30 feet	60 feet
Spanaway	20 feet	60 feet
Swanson	50 feet	60 feet
Vashon *	50 feet	60 feet

* *NPIAS airports*
** *Closed in July 2000*

Since these airports serve a wide range of roles in the system, from reliever to State-owned (primarily emergency access), runway width is not equally critical for all airports. Most important on this list would be the reliever (Harvey Field) and those airports serving greater numbers of operations and/or larger, more demanding aircraft. Based on these criteria, deficiencies in runway width standards are most critical at Crest Airpark, Harvey Field, and Pierce County/Thun Field.

A second criterion for meeting runway width standards could be whether airport are included in the National Plan of Integrated Airport Systems (NPIAS). Harvey Field, Pierce County Airport/Thun Field, and Vashon Municipal fall into this category. In addition, the magnitude by which existing airport system runways fail to meet width standards should also be considered in evaluating future runway width needs. In this category, Spanaway is most critical, with a runway width of 20 feet compared with a 60 foot standard. All other airports in the regional airport system either meet or exceed current FAA runway width standards.

Runway safety area (width and length beyond)

Runway safety area standards are established to protect operating aircraft and persons and objects on the ground during take-offs and landings. Similar to runway width standards, runway safety areas (width and length beyond) are determined by the category of aircraft using the airport (a combination of approach speed and wing span) and the airport's (or runway's) level of instrumentation (ability to handle landings in low visibility). Runway safety areas include runway safety area width (symmetrical about the runway centerline) and runway safety area length beyond (length beyond the end of each runway). The entire runway safety area (a rectangle with the runway inside) should be kept clear of buildings, persons, and objects (including parked aircraft and vehicles) that would pose a hazard to the safe use of the runway. The airport system currently has 6 airports (listed below) with substandard runway safety area width and 12 airports with sub-standard runway safety area length beyond the runway end. Also included in the lists below are airports for which existing runway safety area width and length beyond data are not available. These two groups of airports are listed below.

Comparison of Runway Safety Area Width and FAA Standards

Airport	Existing Runway Safety Area Width	FAA Standard
Apex Airpark	42 feet	120 feet
Bandera	N/A	120 feet
Darrington	80 feet	120 feet
First Air Field	54 feet	120 feet
Martha Lake *	N/A	120 feet
Port Orchard	N/A	120 feet
Ranger Creek	N/A	120 feet
Sea-Tac **	180-500 feet	500 feet
Sky Harbor	N/A	120 feet
Skykomish	N/A	120 feet
Swanson	98 feet	120 feet
Vashon **	76 feet	120 feet

* *Closed in July 2000*

** *NPIAS airports*

The most critical of these substandard runway safety area widths are those at Sea-Tac (the region's primary commercial air carrier airport). The Port of Seattle identified these deficiencies in its most recent Master Plan, and is currently addressing them. Vashon Municipal, as a NPIAS airport, should be considered for upgrading to provide the full 120 feet RSA width. FirstAir Field in Monroe, while not a NPIAS airport, has 78 based aircraft and served just under 20,000 operations in 1998. Based on this level of activity, FirstAir Field might be a candidate for safety area width improvements. Twelve airports in the system fall short of meeting FAA standards for runway safety area (RSA) length beyond.

For most general aviation airports serving small aircraft, the RSA length beyond standard is 240 feet; for Tacoma Narrows and Renton Airports this standard is 600 feet; and for King County Airport/Boeing Field, Sea-Tac International Airport, and Snohomish County Airport/Paine Field this standard is 1,00 feet. Existing RSA length beyond measurements are shown below.

Comparison of Runway Safety Area Length Beyond and FAA Standards

Airport	Existing Runway Safety Area Length Beyond	FAA Standard
Apex Airpark	65 feet	240 feet
Bandera	N/A	240 feet
King County/Boeing Field *	120 feet	1,000 feet
Crest Airpark	150 feet	240 feet
Darrington	100 feet	240 feet
First Air Field	42 feet	240 feet
Martha Lake **	N/A	240 feet
Port Orchard	N/A	240 feet
Ranger Creek	N/A	240 feet
Sea-Tac *	535-700 feet	1,000 feet
Sky Harbor	N/A	240 feet
Skykomish	N/A	240 feet
Snohomish County/Paine *	205/235 feet	240/1,000 feet
Spanaway	155 feet	240 feet
Swanson	40 feet	240 feet
Tacoma Narrows *	330 feet	1,000 feet
Vashon *	50-160 feet	240 feet

* *NPIAS airports*

** *Closed in July 2000*

The most critical deficiencies in RSA length beyond are those that occur at the five larger NPIAS airports: Sea-Tac, Boeing Field, Paine Field, Renton, and Tacoma Narrows. In addition, Vashon Municipal is a NPIAS airport, and might be considered for upgrading its RSA length beyond to FAA standards. Crest Airpark, while not a NPIAS airport, has significant activity levels (334 based aircraft and nearly 100,000 aircraft operations in 1998), and may warrant improvement to meet FAA standards. Two other airports fall significantly short of RSA length beyond standards: FirstAir Field and Spanaway. Both these airports have moderate activity levels (each with nearly 20,000 annual operations and 60-80 based aircraft), and should be considered for RSA upgrades to meet standards. The remaining small airports shown above with sub-standard RSA length beyond (Apex, Darrington, and Swanson) have low activity levels and minimal demand in terms of aircraft size, and need not be seriously considered for RSA length beyond upgrades.

Runway Approaches and Obstructions

Establishing and maintaining the approaches to runways is critical to a safe and efficient airport system. Exhibit 6-4 displays a summary of the information available regarding the runway approaches at the region's airports. Listed in the exhibit are the existing approach slope, the required approach slope, objects that obstruct the airport's runway approaches (see obstructions section below), and the runways' visibility minimums. The approach surface listed in Exhibit 6-4 refers to the slope of the imaginary plane leading to the runway end. The goal of the approach slope is for no objects to penetrate the approach plane, leaving the area above the plane clear for unobstructed and safe landings. The slope is given as a ratio of horizontal distance to vertical distance. For example, a 20:1 approach slope rises 1 foot for each 20 feet horizontally. For most general aviation airports serving small GA aircraft, a 20:1 approach is required. Runway approach requirements increase to 34:1, 40:1, and 50:1 for airports serving

commercial aircraft and larger and more sophisticated general aviation aircraft that operate in low visibility conditions. The more strict approaches required at these airports allow for aircraft flying under instrument flight rules (IFR) to use instrument landing systems (ILS), global positioning systems (GPS), and other electronic navigation systems providing guidance to pilots. The more strict the approach slopes of the region's airports, the more flexibility the system has to meet demand in all weather conditions by a wide range of aircraft.

The airport approach surface information presented in Exhibit 6-4 was derived from the WSDOT's airport database and from current airport master plans, and represent conditions as of 1998 or the date of the last airport master plan. According to those data, the region currently has 72 runways ends. Of these, 56 are A-visual approach runways requiring 20:1 approaches; six runway ends are non precision instrument runways requiring 34:1 approaches; and ten are precision instrument runways requiring a 50:1 approach.

Of the 56 runways requiring 20:1 approaches, 33 runway ends do not currently meet these standards. Of the 6 runways with 34:1 required approaches, three runways currently do not meet the standard. Of the ten 50:1 approach required runway ends, three currently do not meet the standard. In total, 39 of 72 runway end approaches fail to meet current approach slope standards, due to the presence of obstructions which penetrate the approach slope. Exhibit 6-5 lists both the required and existing approaches to the region's airport runways. In addition, it lists airports that can support 50:1 approaches, which allow for precision instrument approaches in poor visibility. These airports include those that currently have 50:1 approaches as well as those that could support them in the future. Those currently with 50:1 approaches include King County International/Boeing Field, McChord AFB, Seattle-Tacoma International, Snohomish County Airport/Paine Field, and Tacoma Narrows. Those airports that do not currently have 50:1 approaches, but could support them, include Arlington, Bremerton, and Will Rogers/Wiley Post seaplane base. In addition, runway 35 at Tacoma Narrows has the capability to support a 50:1 approach in the future, which would give both runway ends instrument approach capability.

Lighting, marking, trimming, and removal of obstructions is an important element of airport system maintenance and preservation. Man-made and natural obstructions near airport approach and departure paths can limit airports' ability to meet demand, and can compromise safety. Information regarding obstructions in the vicinity of the region's airports was collected from various sources, and is summarized in Exhibit 6-4. Nearly every airport in the region has some type of obstruction. The region's four seaplane bases are the only airport facilities free from obstructions. The majority of man-made obstructions include buildings, power lines, roads and railroads, poles, and fences. Natural obstructions are primarily trees. In some locations, such as near airports in the cascade foothills, terrain may create obstructions. Lighting, marking, and removal are typical approaches to resolving man-made obstructions. Tree trimming and removal are typically used to control or eliminate these natural obstructions. Where terrain acts as an obstruction, mitigation can include grading to lower hills, displacing runway thresholds, relocating runways, or, in extreme cases, airport relocation or closure.

Following is a tabulation of the airport system's existing runway approaches by obstruction type. Of the 72 runway ends in the system, 40 have obstructions while 32 do not. Of the 32 unobstructed approaches, 10 are located at seaplane bases, while 22 are located at the following land based airports: Arlington (both runways), Boeing Field (runway 13R-31L), Gray Army Airfield, McChord AFB, Pierce County Airport/Thun Field (runway 16), Renton (runway 15), Sea-Tac (runways 16L, 34R, and 16R), Snohomish County /Paine Field (all but runway 11), and Tacoma Narrows.

Current Airport System Runway Approaches and Obstructions

Obstruction type	Number
Trees	22
Roads, railroads, parking	7
Buildings	3
Brush	4
Fence/pole	2
Power lines	1
Aircraft	1
None	32
Total	72

Control of obstructing trees and brush can be a simple issue of trimming (if on airport property), or it can be more complex, involving the need for easements or property acquisition followed by tree trimming or removal. Roads, railroads, and parking lots may become obstructions due to encroachment on adjacent property, or they may be located on airports with highly constrained sites. Buildings, fences, poles, and power lines are likely to be located off airport, though they can also be located on constrained airports. Lighting and marking of these obstructions can be accomplished with relative ease, but removal may be difficult or impossible. Parked aircraft which are obstructions (such as at Crest Airpark) may be the result of site constraints or may indicate the need for improved planning or airport investment. Ground obstructions (occurring at Bremerton) may be the result of topographic or airport siting constraints. In either event, elimination of the obstruction may be infeasible.

Approach Lighting

Approach lighting is a key component to airports' ability to serve traffic at night and in low visibility conditions, and are used for both precision instrument and non-precision runway approaches. Approach lighting is used in conjunction with electronic and visual navigational aids to increase the safety of aircraft approaching a runway to land. Approach lighting systems ("ALS") consist of a row or rows of lights aligned along the extended runway centerline leading to the end of a runway, and provide visual guidance to pilots. ALS can have medium or high intensity lights, and often include sequenced flashing lights that provide visual guidance (both alignment and direction) to the runway end. When combined with other navigational aids, approach lighting significantly improves the safety and reliability of an airport, and when installed at several airports in a region provides increased system capability to accommodate a wide range of traffic in varying conditions.

Of the 28 airports in the regional airport system, eight have approach lighting systems. These systems are summarized below. McChord AFB, Sea-Tac International, and Snohomish County/Paine Field each have more than one set of runway approach lighting systems.

Existing Runway Ends Having Approach Lighting Systems

Airport	Runway Number	Approach Category	Approach Lighting
Arlington	34	B-NPI	MALS
Boeing Field	13R	D-PIR	SALSF
Bremerton	19	B-PIR	MALSR
Gray Army Airfield	33	B-NPI	ODALS
McChord AFB	16	PIR	SALS
	34	PIR	NSTD
Sea-Tac Int'l	34R	D-PIR	ALSF1
	16R	D-PIR	ALSF2
	34L	D-PIR	MALSR
Paine Field	16R	D-PIR	MALSR
	34L	A-visual	ODALS
Tacoma Narrows	17	B-PIR	MALSR

Notable airports without approach lighting include three reliever airports: Renton Municipal, Auburn Municipal, and Harvey Field. In addition, two other busy airports, Crest Airpark and Pierce County Airport/Thun Field, have no approach lighting. Together, these five airports are home to 1,400 aircraft (39% of the total region) and in 1998 served some 600,000 aircraft operations (35% of the regional total, excluding Sea-Tac).

Support Facilities

Control Towers

Air traffic control towers provide an increased level of safety and control over arriving and departing aircraft. This is especially important for airports serving commercial flights (passenger and cargo), airports with higher end general aviation activity, airports serving large numbers of aircraft operations, and airports located in regions with congested or complex air space. Within the four county PSRC region there are currently seven airports with control towers: King County International/Boeing Field, Gray Army Airfield (Ft. Lewis), McChord AFB, Renton Municipal, Sea-Tac International, Snohomish County/Paine Field, and Tacoma Narrows. Six of the top ten general aviation airports (including two of the region's five relievers) do not have control towers. These are Auburn, Harvey Field, Arlington, Bremerton, Crest Airpark, and Pierce County Airport/Thun Field. Renton, although it has a tower, does not have approach lighting, and has only a non-precision approach. Two of the top ten airports in the region (Arlington and Bremerton), while having no tower, currently have approach lighting supporting non-precision and precision instrument approaches. Both these airports can support 50:1 approaches.

Air cargo

The air cargo section of the aviation forecasts in chapter 5 above shows regional air cargo demand (combined air cargo at Sea-Tac Airport and Boeing Field) will increase from 645,022 US tons in 2000 to 1,048,795 US tons in 2010. This translates to a total increase of 71% and an average annual growth rate of 4.8% over the 10-year period. According to the two airports' most recent master plans, air cargo volumes will grow at nearly identical rates over the 12-year forecast period from 1998-2010. Beyond the

year 2010 the Boeing Field Master Plan has forecast air cargo activity to the year 2015, and the Port has extrapolated its official master plan forecast from 2010 to 2019 for its 1999 *Air Cargo Facilities Development Study*.

Boeing Field's current Master Plan (*Working Paper One*, September 1999) forecasts a need to increase air cargo space from 22 acres in 1998 to 43 acres in 2015 (the master plan's planning horizon). Given the fact that Boeing Field has no significant vacant property to accommodate expansion, the need for more air cargo facilities to meet growing demand would necessitate the development of underutilized property and/or redevelopment of existing airport property currently devoted to other uses. The airport master plan proposes to continue accommodating future cargo facility requirements along the east side of the airport to the south of the terminal building, using space that is currently underutilized. The draft airport master plan does not propose to displace existing general aviation facilities to accommodate air cargo growth.

Two sources of air cargo facility planning information for Sea-Tac Airport were reviewed: the 1994 *Airport Master Plan Update* and the December 1999 *Air Cargo Facilities Development Study*. According to the Master Plan Update for Sea-Tac Airport (1994) the airport will require significantly more air cargo space to accommodate forecast growth. As of 1993 the airport had approximately 81 acres of air cargo space. Of this, some 60 acres were developed and 21 acres were vacant. The airport master plan identified a total need for 176 acres of air cargo space by the year 2020, and recommended a two phase approach to meeting those needs. Between 1993 and 2010 air cargo needs were proposed to be met using a decentralized approach by expanding existing cargo areas north of the main passenger terminal and redeveloping the existing sites used for United Airlines aircraft maintenance and Port of Seattle maintenance functions. After 2010 projected air cargo demand would be met by developing the "south aviation support area ("SASA"), located south of the main passenger terminal across south 188th street. In addition, the airport master plan anticipated the possible need for additional air cargo warehousing at remote north locations.

After the airport master plan was completed, the Port began more detailed planning for the proposed new air traffic control tower and the new north passenger terminal. Because these two proposed facilities will displace existing air cargo facilities, the Port undertook a new study (the 1999 *Air Cargo Facilities Development Study*) to identify the potential impacts the new control tower and passenger terminal would have on existing and planned air cargo facilities. The 1999 *Air Cargo Facilities Development Study* focused on the short and medium term (1999-2010) time frame and reaffirmed the 1994 master plan forecasts for air cargo. Within these parameters, the study reached several important conclusions:

- The airport has limited land and financial resources, and may not be capable of accommodating all demand for both air cargo and passenger facilities
- Given this constraint, Sea-Tac Airport may need to make choices as to which type of demand to accommodate
- Two major projects which are planned to meet air passenger demand will have significant impacts on existing air cargo facilities. These projects are the new air traffic control tower and the north end aviation terminal ("NEAT")
- These proposed projects will displace over 800,000 square feet of existing air cargo facilities including apron for parking four air cargo aircraft
- Apart from the displacement of existing cargo facilities, forecast air cargo growth will require significant new facilities, including air cargo and air mail aircraft parking positions, freight warehousing, freight ground service equipment storage areas, and air mail processing facilities

- The combined effects of strong air cargo demand and the displacement of existing air cargo facilities will intensify the issue of how the airport will meet long term demand
- The study identifies facilities to meet short and medium term demand (1999-2009). Since completing the study in 1999 the Port has been examining options for meeting long range air cargo demand (2010-2020)
- While the 1994 airport master plan identifies the South Aviation Support Area (SASA) project to meet the airport's longer range needs, the Port has not yet committed to building the project
- There is a need for further planning to develop long range forecasts, identify facility needs, evaluate options for meeting those needs, and prepare a long range air cargo development plan for Sea-Tac

In summary, both Sea-Tac Airport (2,500 acres) and Boeing Field (594 acres) are constrained airports. Both are nearly fully developed, and neither has significant undeveloped land area available to accommodate all potential demand by all users. In planning for future airport development to meet growing demands, both airports may need to make choices between competing users. Neither airport has the ability to easily accommodate significant spikes in air cargo demand caused by a fluctuating market or major shifts in regional cargo share between the two airports. In order to meet some level of anticipated growth in air cargo activity both airports plan to develop existing vacant and underutilized property, both of which are in short supply. In addition, to meet cargo demand, Sea-Tac plans to redevelop property currently used for aircraft maintenance and airport maintenance functions, necessitating the relocation of these existing facilities.

From the users' standpoint, the issue of space availability (along with airfield and airspace congestion and delay, airport fee structure, airport access, and regional location) is an important component of air cargo carriers' decisions regarding how they serve the regional air cargo market. Planning for these regional needs should be comprehensive and long range, and should include contingencies to address unexpected changes in the market.

Aircraft fuel

Aircraft fuel is available at most airports in the region. Six airports do not offer fuel: the three state-owned airports (Bandera, Ranger Creek, and Skykomish), Apex Airpark, Swanson, and Vashon. The state-owned airfields have no based aircraft and low levels of activity (all under 300 annual aircraft operations). The other three airports have a combined 103 based aircraft (50 at Apex, 22 at Swanson, and 31 at Vashon). Total combined aircraft activity at these six airports for 1998 was 31,884 operations. Forecasts of future activity at these six airports shows based aircraft increasing to a combined total of 113 (50 at Apex, 27 at Swanson, and 36 at Vashon) by the year 2020, while aircraft operations is forecasts to grow to 36,709 in 2020. Given the low level of activity at these airports and the availability of fuel at many airports nearby, there appears to be no need for new aircraft fuel facilities at these seven airports.

Airport Standards and Support Facility Summary

Following is a summary of runway, runway safety area, runway approaches, obstruction, and approach lighting information for the region's 10 busiest general aviation airports. The general aviation airports include the five relievers and the five next busiest general aviation airports. The data for the top ten general aviation airports is displayed in summary form in Exhibit 6-7.

Arlington Airport meets runway length recommendations, though the current airport master plan includes a proposal to extend the main runway from 5,333 feet to 6,000 feet. The two runways are constructed of asphalt concrete, are in excellent condition (with a PCI of 97.40), and both are wider than required. All runway safety areas meet and exceed FAA standards. The airport has three 20:1 approaches and one 34:1 approach, all four of which meet standards. The airport master plan includes upgrades for runway 16 from visual to non-precision instrument and from a 20:1 approach to a 27:1 approach. The plan includes upgrades for runway 34 from a non-precision instrument runway to a precision instrument runway, improving its approach from 34:1 to 50:1. Runway 34 currently has a medium intensity approach lighting system (MALS) and precision approach path indicators (PAPI). All four runway ends are free of obstructions. Arlington is a NPIAS airport, has a beacon, but no tower. Forecasts show the airport will need to accommodate 164 new based aircraft by the year 2020, and has 53 on its hangar waiting list. The airport currently owns some 40 acres that could accommodate airport growth.

Auburn Airport (reliever) meets its planned runway length and width standards with its 3,400 foot asphalt concrete runway, which is in very good condition (PCI = 80.34). The airport meets all runway safety area standards. Its two runway approaches (18:1 and 15:1) come close to meeting its 20:1 approach standards. Obstructions to these approaches include buildings and a parking lot. Auburn is currently developing 25 acres for new aircraft hangars. The airport has medium intensity runway edge lights and vertical approach slope indicators (VASI) supporting its visual only approach. The airport has a beacon but no control tower. Forecasts show Auburn will need to accommodate 38 additional based aircraft by the year 2020, and has a hangar waiting list of 140.

Boeing Field (King County Int'l) meets runway length recommendations and both runways exceed runway width standards. Both runways are constructed of asphalt concrete, and are in good condition, with a PCI of 66.06. All runway safety areas meet standards with the exception of the length beyond runway end for runway 13R. This is caused by the presence of Airport Way and railroad tracks. Runway 13L-31R meets and exceeds its required 20:1 approach slope, while runway 13R-31L does not. The steam plant on the west side of the airport obstructs the west side transitional surface, and limits the airport's instrument capability. The airport has a control tower, airport beacon, both medium and high intensity runway edge lights, approach lighting system with sequenced flashers (SALSF), and precision approach path indicators (PAPI) supporting its precision instrument approach. Boeing Field is forecast to see 71 new based aircraft over the next 20 years, and currently has a hangar waiting list of approximately 75 aircraft.

Bremerton National is the region's fourth largest airport in land area (1,169 acres), behind Sea-Tac, Arlington, and Snohomish County/Paine Field. Bremerton National's asphalt concrete runway, which is in good condition, with a runway PCI of 64.19, is 6,200 feet long and 150 feet wide. The airport's crosswind runway is closed. While the main runway meets existing length standards to serve most existing aircraft, the 1,190 foot displaced threshold on runway 19 limits landing length. Therefore, the airport master plan includes a runway shift/ extension to bring the runway's useable length to 7,400 feet, which would serve increased operations by the Navy's C-9 aircraft. The existing 150 foot width of runway 1-19 exceeds the FAA's 100-foot standard. Bremerton meets runway safety area width and

length beyond standards. Bremerton has a precision instrument approach supported by high intensity runway edge lights, VASI, and a medium intensity approach lighting system (MALSR). The main runway has 34:1 and 50:1 approach slopes. Bremerton has significant available property to accommodate growth, and its based aircraft fleet is forecast to grow from 116 in 1998 to 158 in 2020. Bremerton National fulfills an important role in the regional airport system, being the only airport in Kitsap County with poor visibility instrument approach capability, and with a runway long enough to accommodate most general aviation aircraft.

Crest Airpark has a single asphalt concrete runway in very good condition, with a PCI of 78.39. The runway meets length recommendations, but at 40 feet wide, it falls short of the required 60 feet width. The runway safety area width meets standards. Runway safety area length beyond falls short of standards at one end by 90 feet, but exceeds standards by 170 feet at the other end. The airport's approaches are required to be 20:1. Neither runway end meets these standards due to obstructions in the form of parked aircraft and trees. Crest, a privately owned facility, is the only top ten airport not included in the NPIAS. It has an airport beacon but no tower. Crest has a visual only approach with no approach lighting, and has low intensity runway edge lighting. The airport has 8 acres available to accommodate future growth, and its based aircraft fleet is forecast to increase from 334 in 1998 to 387 in 2020. Crest currently has 95 aircraft on its hangar waiting list. It is likely that Crest will not be able to accommodate all future demand. It's possible that this demand could be met at neighboring airports such as Auburn Municipal and Pierce County Airport/Thun Field.

Harvey Field (reliever) has a single asphalt concrete runway in fair condition. The runway is 2,660 feet long compared with a recommended length of 2,900 feet (serving 95% of small aircraft under 10 seats). The runway falls significantly short of the required runway pavement width, with 36 feet of pavement compared to a standard of 60 feet. The runway safety areas meet both width and length beyond standards. The presence of trees and power lines near the runway causes obstructed approaches to both ends of runway 14-32. The airport's former turf runway (13-31) was closed in 1999 to make room for additional aircraft hangars. The airport has no tower and no approach lighting, but has a VASI system and non-standard runway edge lighting supporting visual approaches. A busy privately owned airport, Harvey Field currently has 360 based aircraft, is forecast to grow to 476 based aircraft by 2020, and has 186 aircraft on its hangar waiting list.

Pierce County/Thun Field has an asphalt concrete runway in very good condition, with a PCI of 87. The runway exceeds current length recommendations, but falls 15 feet short of meeting runway pavement width standards (60 feet compared to the 75 foot standard). The airport meets or exceeds runway safety area width and length beyond standards. One runway end exceeds its 20:1 approach standards while the other runway end is obstructed by trees in the approach. Thun Field will need to accommodate 56 additional aircraft by the year 2020, and currently has some 11 acres available to accommodate growth. Thun Field is a NPIAS airport with an airport beacon and no control tower. The airport has medium intensity runway edge lights and PAPI to support its visual approach.

Renton Municipal (reliever) has a single 5,379 foot long asphalt concrete runway in excellent condition, with a PCI of 94.67. The runway meets existing and planned length standards and exceeds by 100% the runway width standard (200 feet wide compared to the 100 foot standard). Runway safety area width meets standard, and runway safety area length beyond meets standard at the both ends. The north end of the runway adjoins Lake Washington, and since relocation of the runway threshold this runway end now meets runway safety area length beyond standards. While the north end approach meets the 34:1 approach standard, a road near the south runway end obstructs that 34:1 approach. Renton is forecast to see 38 new based aircraft by 2020, and currently has no unused property available to accommodate that

growth. When the Boeing Company's existing leases on the west side of the airport expire in 2010, and if Boeing chooses to relocate and consolidate these facilities with its other facilities on the east side of the airport, there is some potential for developing additional general aviation aircraft parking facilities on the west side.

Snohomish County Airport/Paine Field has three runways, all constructed of asphalt concrete, and all in excellent condition, with a PCI of 91.21. All three runways meet recommended length and width standards. All three runways meet safety area width standards, and five of the six runway ends meet runway safety area length beyond standards. Only one of the six runway approaches is obstructed, that being trees obstructing the approach to runway 11. The airport has five 20:1 approaches and one 50:1 approach (the main runway: 16R). Paine Field includes a precision instrument approach with PAPI, high intensity runway edge lights, and a medium intensity approach lighting system (MALSR). Based aircraft forecasts show demand at Paine Field increasing from 483 in 1998 to 674 in 2020. The airport currently has 170 acres of airport-owned undeveloped land available to accommodate future airport needs. There are currently some 96 aircraft on the airport's hangar waiting list.

Tacoma Narrows Airport has a single 5,002 foot long asphalt concrete runway in good condition, with a PCI of 66.29. The runway meets existing length standards and exceeds current runway width standards (150 feet compared with the 100 foot standard). Existing runway safety area width exceeds standard. Runway safety area length beyond significantly exceeds standards for runway 35 but falls short of standards for runway 17. The airport has no obstructed approaches, and maintains both a 34:1 approach to runway 35 and a 50:1 approach to runway 17. Tacoma Narrows has both a control tower and airport beacon, and has a precision instrument approach supported by a medium intensity approach lighting system (MALSR), medium intensity runway edge lights, and both PAPI and VASI vertical approach guidance. According to the regional airport system forecasts, Tacoma Narrows will need to accommodate nearly 50 new based aircraft by the year 2020. Tacoma Narrows also has a current hangar waiting list of 30 aircraft.

Exhibit 6-1 Existing System Capacity (1999)

Airport	Apron Tie-down Capacity	Aircraft Hangar Capacity	Total Aircraft Capacity	Existing Based Aircraft	Existing Landside D/C Ratio *	# on waiting list	Existing Airport Acreage	Airport property avail. for future aviation dev't (ac)	Existing Airport Operations	Airfield Operations Capacity **	Existing Airfield D/C Ratio ***
American Lake	15	4	19	15	79%	0	0	0	700	60,000	1%
Apex Airpark	5	45	50	50	100%	0	15	0	19,425	180,000	11%
Arlington Municipal	114	463	577	510	88%	53	1,202	40	135,000	270,000	50%
Auburn Municipal	225	105	330	238	72%	140	107	30	172,000	230,000	75%
Bandera State	0	0	0	0	-	0	25	0	300	150,000	0%
Boeing Field	350	200	550	443	81%	75	594	0	345,120	380,000	91%
Bremerton National	78	116	194	116	60%	31	1,169	584	108,800	240,000	45%
Crest Airpark	180	176	356	334	94%	95	62	8	95,222	240,000	40%
Darrington	15	0	15	4	27%	0	90	10	3,025	180,000	2%
FirstAir Field	25	62	87	78	90%	25	33	10	18,169	200,000	9%
Gray Army Airfield	-	-	-	-	-	-	-	-		180,000	0%
Harvey Field	53	362	415	360	87%	186	65	117	140,700	230,000	61%
Kenmore Air Harbor	77	2	79	79	100%	3	6	0	40,000	75,000	53%
Lake Union Seaplane	0	0	0	0	-	0	1	0	30,500	60,000	51%
Martha Lake	32	20	52	51	98%	0	32	0	40,400	180,000	22%
McChord AFB	-	-	-	-	-	-	-	-		180,000	0%
Pierce Co. / Thun Field	110	138	248	229	92%	30	144	15	86,710	240,000	36%
Port Orchard	12	16	28	15	54%	12	120	20	18,714	175,000	11%
Ranger Creek State	0	0	0	0	-	0	20	0	250	140,000	0%
Renton Municipal	170	85	255	240	94%	55	170	0	100,710	230,000	44%
Sea-Tac Int'l	4	2	6	6	N/A	0	2,500		407,597	460,000	89%
Sky Harbor	12	0	12	8	67%	0	10		1,000	140,000	1%
Skykomish State	0	0	0	0	-	0	35	0	300	150,000	0%
Sno. Co. / Paine Field	208	356	564	483	86%	96	1,243	170	192,612	288,000	67%
Spanaway	20	57	77	63	82%	0	24	4	19,380	140,000	14%
Swanson	12	14	26	22	85%	0	14		5,609	150,000	4%
Tacoma Narrows	200	82	282	200	71%	30	644	16	95,316	240,000	40%
Vashon Island	10	22	32	31	97%		20	2	6,000	160,000	4%
Will Rogers/Wiley Post	45	0	45	45	100%	0	1	0	2,387	60,000	4%
Total Airport System:	1,972	2,327	4,299	3,620	84%	831	8,346	1,026	2,085,946	5,608,000	37%

* Ratio of based aircraft to capacity (current airport inventory)

** Measured as Annual Service Volume ("ASV")

*** Ratio of aircraft operations to capacity (annual service volume)

Exhibit 6-2 Future Landside Capacity Requirements

	Existing Apron Tie-down Capacity	Existing Aircraft Hangar Capacity	Existing Total Aircraft Capacity	Forecast Based Aircraft Demand					Existing Landside D/C Ratio *	Projected Landside D/C Ratio *	Total new aircraft demand	Demand for new tie-downs	Demand for new hangars	Additional Aircraft Storage Req'ts
				1998	2005	2010	2015	2020	1998	2020	(1998-2020)	(10%)	(90%) ****	(acres) *****
American Lake	15	4	19	15	16	17	18	19	79%	98%	4	0	4	0.36
Apex Airpark **	5	45	50	50	50	50	50	50	100%	100%	0	0	0	0.00
Arlington Municipal	114	463	577	510	572	607	639	674	88%	117%	164	16	148	17.33
Auburn Municipal	225	105	330	238	252	261	269	276	72%	84%	38	4	34	4.55
Bandera State	0	0	0	0	0	0	0	0			0	0	0	0.00
Boeing Field	350	200	550	443	469	486	501	514	81%	93%	71	7	64	8.47
Bremerton National	78	116	194	116	131	139	151	158	60%	82%	42	4	38	4.20
Crest Airpark	180	176	356	334	353	367	377	387	94%	109%	53	5	48	6.39
Darrington	15	0	15	4	4	5	5	5	27%	35%	1	0	1	0.00
FirstAir Field	25	62	87	78	87	93	98	103	90%	119%	25	3	23	2.65
Gray Army Airfield					0	0	0	0			0	0	0	0.00
Harvey Field	53	362	415	360	404	428	451	476	87%	115%	116	12	104	12.24
Kenmore Air Harbor	77	2	79	79	84	87	89	92	100%	116%	13	1	11	1.51
Lake Union Seaplane			0	0	0	0	0	0			0	0	0	0.00
Martha Lake ***	32	20	52	51	0	0	0	0	98%	0%	-51	-5	-46	0.00
McChord AFB					0	0	0	0			0	0	0	0.00
Pierce Co. / Thun Field	110	138	248	229	245	260	271	285	92%	115%	56	6	51	5.89
Port Orchard	12	16	28	15	17	18	20	21	54%	75%	6	1	5	0.60
Ranger Creek State	0	0	0	0	0	0	0	0			0	0	0	0.00
Renton Municipal	170	85	255	240	254	263	271	278	94%	109%	38	4	35	4.59
Sea-Tac Int'l	4	2	6	6	6	7	7	7	100%	116%	1	0	1	0.00
Sky Harbor	12	0	12	8	9	10	10	11	67%	88%	3	0	2	0.27
Skykomish State	0	0	0	0	0	0	0	0			0	0	0	0.00
Sno. Co. / Paine Field	208	356	564	483	542	575	605	639	86%	113%	156	16	140	16.42
Spanaway	20	57	77	63	67	71	74	78	82%	102%	15	2	14	1.62
Swanson	12	14	26	22	24	25	26	27	85%	105%	5	1	5	0.57
Tacoma Narrows	200	82	282	200	214	227	236	249	71%	88%	49	5	44	5.14
Vashon Island	10	22	32	31	33	34	35	36	97%	112%	5	0	4	0.59
Will Rogers/Wiley Post	45	0	45	45	48	49	51	52	100%	116%	7	1	6	0.86
Total Airport System:	1,972	2,327	4,299	3,620	3,881	4,079	4,255	4,439	84%	105%	819	82	737	94.25

* With no new landside capacity.

** Based aircraft for Apex Airpark is limited to 50 by agreement with Kitsap County. Future demand has been redistributed to other Kitsap County airports.

*** Year 2020 D/C ratio is based on closure of Martha Lake Airport. Based aircraft forecasts for 2005, 2010, 2015, and 2020 show Martha Lake based aircraft redistributed to other Snohomish County Airports.

**** Future capacity requirements include replacement for 52 lost due to Martha Lake closure plus assumes 90% of all new aircraft demand (819 * 90% = 737) wants hangars (all of which would be new).

***** Based on forecast future fleet mix by county using an average space requirement (hangar and apron) of 300 sq. yd. per aircraft (tie-down); 325 sq. yd. per aircraft (t-hangars); and 600 sq. yd. (conventional hangar)
Future aircraft parking requirements were derived using airport master plans and FAA AC 150/5300-4B "Utility Airports."

Exhibit 6-3 Future Airfield Capacity Requirements

	Operations Capacity *	Forecast Aircraft Operations Demand					Existing Airfield D/C Ratio	Projected Airfield D/C Ratio ***
		1998	2005	2010	2015	2020	1998	2020
American Lake	60,000	700	731	756	781	807	1%	1%
Apex Airpark	180,000	19,425	20,678	21,436	21,977	22,780	11%	13%
Arlington Municipal	270,000	135,000	151,633	155,953	160,394	164,959	50%	61%
Auburn Municipal	230,000	172,000	176,521	179,818	183,566	186,982	75%	81%
Bandera State	150,000	300	308	314	320	326	0%	0%
Boeing Field	380,000	345,120	354,192	360,808	368,328	375,182	91%	99%
Bremerton National	240,000	108,800	115,819	120,063	123,095	127,590	45%	53%
Crest Airpark	240,000	95,222	97,725	99,550	101,625	103,516	40%	43%
Darrington	180,000	3,025	3,398	3,494	3,594	3,696	2%	2%
FirstAir Field	200,000	18,169	20,408	20,989	21,587	22,201	9%	11%
Gray Army Airfield	180,000						0%	0%
Harvey Field	230,000	140,700	158,036	162,537	167,166	171,924	61%	75%
Kenmore Air Harbor	75,000	40,000	41,051	41,818	42,690	43,484	53%	58%
Lake Union Seaplane	60,000	30,500	31,302	31,886	32,551	33,157	51%	55%
Martha Lake	180,000	40,400	0	0	0	0	22%	0%
McChord AFB	180,000						0%	0%
Pierce Co. / Thun Field	240,000	86,710	90,581	93,611	96,736	99,960	36%	42%
Port Orchard	175,000	18,714	19,921	20,651	21,173	21,946	11%	13%
Ranger Creek State	140,000	250	261	270	279	288	0%	0%
Renton Municipal	230,000	100,710	103,357	105,288	107,482	109,482	44%	48%
Sky Harbor	140,000	1,000	1,123	1,155	1,188	1,222	1%	1%
Skykomish State	150,000	300	308	314	320	326	0%	0%
Sno. Co. / Paine Field	288,000	192,612	216,344	222,506	228,842	235,356	67%	82%
Spanaway	140,000	19,380	20,245	20,922	21,621	22,341	14%	16%
Swanson	150,000	5,609	5,859	6,055	6,258	6,466	4%	4%
Tacoma Narrows	240,000	95,316	99,571	102,902	106,337	109,881	40%	46%
Vashon Island	160,000	6,000	6,158	6,273	6,403	6,523	4%	4%
Will Rogers/Wiley Post	60,000	2,387	2,450	2,496	2,548	2,595	4%	4%
Total GA Airport System:	5,148,000	1,678,349	1,737,980	1,781,866	1,826,861	1,872,991	33%	38%
Sea-Tac Int'l **	460,000	407,597	445,000	474,000	503,000	532,000	89%	116%
Total Airport System Including Sea-Tac:	5,608,000	2,085,946	2,182,980	2,255,866	2,329,861	2,404,991	37%	43%

* Measured as "Annual Service Volume"

** Forecasts prepared by the Port of Seattle

*** With no new runway capacity and loss of Martha Lake Airport

Exhibit 6-4 Airport Runway Standards

Airport	NPIAS Airport?	Runway Number	Runway Length (ft.)	Recommended Runway Length (ft.) *	Runway Surface	1998 Runway Pavement Condition	2000 Airport PCI	Airport Reference Code	Existing Runway Width (ft.)	Required Runway Width (ft.)	Runway Width Compliance
American Lake	No	02-20	5,500	-	Water	-	-	SP	500	-	-
Apex Airpark	No	17-35	2,500	3,040	Asphalt	Good	-	A-1	28	60	Sub-standard
Arlington Municipal	Yes	11-29	3,500	2,940	Asphalt	Good	77.14	A-1	75	60	Meets standard
	Yes	16-34	5,333	6,000 **	Asphalt	Good	77.14	B-1	100	60	Meets standard
Auburn Municipal	Yes	16-34	3,400	3,400	Asphalt	Good	80.90	B-II	75	75	Meets standard
Bandera State	No	08-26	2,342	3,440	Turf	Poor	-	A-1	100	60	Meets standard
Boeing Field	Yes	13L-31R	3,710	3,710 **	Asphalt/conc.	Good	72.30	B-1	100	60	Meets standard
	Yes	13R-31L	10,001	10,000 **	Asphalt/conc.	Good	72.30	D-V	200	150	Meets standard
Bremerton National	Yes	01-19	6,200	7,400 **	Asphalt	Good	74.01	B-II	150	100	Meets standard
Crest Airpark	No	15-33	3,267	3,020	Asphalt	Fair	70.81	B-1	40	60	Sub-standard
Darrington Municipal	No	10-28	2,490	3,040	Asphalt	Good	99.25	M/A	40	60	Sub-standard
FirstAir Field	No	07-25	2,095	2,910	Asphalt	Fair	50.01	A-1	34	60	Sub-standard
Gray Army Airfield	-	15-33	6,125	-	Asphalt	Good	-	ML	150	-	-
Harvey Field	Yes	14-32	2,660	2,900	Asphalt	Fair	-	B-1	36	60	Sub-standard
Kenmore Air Harbor	Yes	16-34	10,000	-	Water	-	-	SP	1,000	-	-
	Yes	18-36	3,000	-	Water	-	-	SP	1,000	-	-
Lake Union Chrysler Air	No	18-36	9,500	-	Water	-	-	SP	300	-	-
Martha Lake	No	16-34	1,680	3,030	Asphalt	Fair	-	A-1	38	60	Sub-standard
McChord AFB	-	16-34	10,100	-	Asphalt/conc.	Good	-	M	150	-	-
Pierce County / Thun Field	Yes	16-34	3,650	3,040	Asphalt	Good	83.99	B-II	60	75	Sub-standard
Port Orchard	No	18-36	2,460	3,000	Asphalt	Fair	-	A-1	28	60	Sub-standard
Ranger Creek State	No	17-35	2,700	3,980	Asphalt	Good	-	A-1	30	60	Sub-standard
Renton Municipal	Yes	15-33	5,379	5,379 **	Asphalt/conc.	Good	80.25	B-II	200	100	Meets standard
Sea-Tac Int'l	Yes	16L-34R	11,900	12,500 **	Asphalt	Good		D-V	150	150	Meets standard
	Yes	16R-34L	9,425	9,425 **	Concrete	Good		D-V	150	150	Meets standard
Sky Harbor	No	07-25	1,930	2,970	Turf	Good	-	A-1 (small)	100	60	Meets standard
Skykomish State	No	06-24	2,050	3,190	Turf	Fair	-	A-1	100	60	Meets standard
Snohomish Co. / Paine Field	Yes	11-29	4,514	4,514 **	Asphalt	Good	76.76	B-1	75	60	Meets standard
	Yes	16L-34R	3,000	3,000 **	Asphalt	Good	76.76	B-1	75	60	Meets standard
	Yes	16R-34L	9,010	9,010 **	Asphalt	Good	76.76	D-V	150	150	Meets standard
Spanaway	No	16-34	2,724	3,000	Asphalt	Poor	48.65	A-1	20	60	Sub-standard
Swanson	No	16-34	3,000	3,150	Asphalt	Good	98.16	B-1	50/100	60	Sub-standard
Tacoma Narrows	Yes	17-35	5,002	5,002	Asphalt	Fair	77.12	D-II	150	100	Meets standard
Vashon Island	Yes	17-35	1,940	2,450	Turf/gravel	Good	-	A-I (small)	50	60	Sub-standard
Will Rogers/Wiley Post	Yes	12-30	5,000	-	Water	-	-	SP	200	-	-

* Recommended runway length was derived from FAA's "Airport Design for Microcomputers" program, Version 4.2 using the standard of serving 95 percent of the small GA aircraft with less than 10 seats, and using actual airport elevation and a mean daily max. temperature of the hottest month = 75 degrees.

** Recommended in airport master plan.

Exhibit 6-5 Runway Safety Areas, Approaches, Obstructions, and Visibility Minimums

Airport	Runway Number	Existing RSA Width	Required RSA Width	RSA Width Compliance	Existing RSA Length Beyond	Required RSA Length Beyond	RSA Length beyond Compliance
American Lake	02	-	-	-	-	-	-
	20	-	-	-	-	-	-
Apex Airpark	17	42	120	Sub-standard	65	240	Sub-standard
	35	42	120	Sub-standard	330	240	Meets standard
Arlington Municipal	11	360	120	Meets standard	1,900	240	Meets standard
	29	360	120	Meets standard	630	240	Meets standard
	16	540	120	Meets standard	767	240	Meets standard
	34	540	120	Meets standard	930	240	Meets standard
Auburn Municipal	16	150	150	Meets standard	300	300	Meets standard
	34	150	150	Meets standard	300	300	Meets standard
Bandera State	08		120	Sub-standard		240	Sub-standard
	26		120	Sub-standard		240	Sub-standard
Boeing Field	13L	150	120	Meets standard	300	240	Meets standard
	31R	150	120	Meets standard	300	240	Meets standard
	13R	500	500	Meets standard	120	1,000	Sub-standard
	31L	500	500	Meets standard	1,000	1,000	Meets standard
Bremerton National	01	150	150	Meets standard	300	300	Meets standard
	19	150	150	Meets standard	300	300	Meets standard
Crest Airpark	15	120	120	Meets standard	410	240	Meets standard
	33	120	120	Meets standard	150	240	Sub-standard
Darrington Municipal	10	80	120	Sub-standard	100	240	Sub-standard
	28	80	120	Sub-standard	300	240	Meets standard
FirstAir Field	07	54	120	Sub-standard	420	240	Meets standard
	25	54	120	Sub-standard	42	240	Sub-standard
Gray Army Airfield	15	-	-	-	-	-	-
	33	-	-	-	-	-	-
Harvey Field	14	120	120	Meets standard	240	240	Meets standard
	32	120	120	Meets standard	240	240	Meets standard
Kenmore Air Harbor	16	-	-	-	-	-	-
	34	-	-	-	-	-	-
	18	-	-	-	-	-	-
	36	-	-	-	-	-	-
Lake Union Chrysler Air	18	-	-	-	-	-	-
	36	-	-	-	-	-	-

Exhibit 6-5 Runway Safety Areas, Approaches, Obstructions, and Visibility Minimums

Airport	Runway Number	Existing RSA Width	Required RSA Width	RSA Width Compliance	Existing RSA Length Beyond	Required RSA Length Beyond	RSA Length beyond Compliance
Martha Lake	16	0	120	Sub-standard	0	240	Sub-standard
	34	0	120	Sub-standard	0	240	Sub-standard
McChord AFB	16	-	-	-	-	-	-
	34	-	-	-	-	-	-
Pierce County / Thun Field	16	150	150	Meets standard	470	300	Meets standard
	34	150	150	Meets standard	300	300	Meets standard
Port Orchard	18		120	Sub-standard		240	Sub-standard
	36		120	Sub-standard		240	Sub-standard
Ranger Creek State	17		120	Sub-standard		240	Sub-standard
	35		120	Sub-standard		240	Sub-standard
Renton Municipal	15	150	150	Meets standard	300	300	Meets standard
	33	150	150	Meets standard	300	300	Meets standard
Sea-Tac Int'l	16L	180	500	Sub-standard	700	1,000	Sub-standard
	34R	500	500	Meets standard	535	1,000	Sub-standard
	16R	180	500	Sub-standard	645	1,000	Sub-standard
	34L	500	500	Meets standard	1,000	1,000	Meets standard
Sky Harbor	07		120	Sub-standard		240	Sub-standard
	25		120	Sub-standard		240	Sub-standard
Skykomish State	06		120	Sub-standard		240	Sub-standard
	24		120	Sub-standard		240	Sub-standard
Snohomish Co. / Paine Fielc	11	120	120	Meets standard	140	240	Sub-standard
	29	120	120	Meets standard	240	240	Meets standard
	16L	120	120	Meets standard	240	240	Meets standard
	34R	120	120	Meets standard	240	240	Meets standard
	16R	500	500	Meets standard	470	1,000	Sub-standard
	34L	500	500	Meets standard	1,000	1,000	Meets standard
Spanaway	16	120	120	Meets standard	275	240	Meets standard
	34	120	120	Meets standard	155	240	Sub-standard
Swanson	16	98	120	Sub-standard	50	240	Sub-standard
	34	98	120	Sub-standard	40	240	Sub-standard
Tacoma Narrows	17	500	500	Meets standard	450	1,000	Sub-standard
	35	500	500	Meets standard	1,000	1,000	Meets standard
Vashon Island	17	76	120	Sub-standard	160	240	Sub-standard
	35	76	120	Sub-standard	50	240	Sub-standard
Will Rogers/Wiley Post	12	-	-	-	-	-	-
	30	-	-	-	-	-	-

Exhibit 6-5 Runway Safety Areas, Approaches, Obstructions, and Visibility Minimums

Airport	Runway Number	Existing Approach Surface Slope	Required Approach Surface Slope	Obstructed Approach (Object)	Approach Category	Approach Lights	Visibility Minimums	Supports 50:1 Approach?
American Lake	02	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	20	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
Apex Airpark	17	10:1	20:1	Hangar, trees	A-visual	None	Greater than 1 mile	No
	35	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Arlington Municipal	11	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	29	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	16	20:1	20:1	None	B-visual	None	Greater than 1 mile	No
	34	34:1	34:1	None	B-NPI	MALS	Not less than 3/4 mile	Yes
Auburn Municipal	16	18:1	20:1	Building	A-visual	None	Greater than 1 mile	No
	34	15:1	20:1	Parking lot	A-visual	None	Greater than 1 mile	No
Bandera State	08	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	26	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Boeing Field	13L	50:1	20:1	None	A-visual	None	Greater than 1 mile	Yes
	31R	22:1	20:1	None	A-visual	None	Greater than 1 mile	No
	13R	3:1	50:1	Fence	D-PIR	SALSF	Greater than 1 mile	No
	31L	0:1	34:1	Railroad	D-PIR	PAPI	Greater than 1 mile	No
Bremerton National	01	0:1	34:1	Ground	B-NPI	None	Greater than 1 mile	Yes
	19	0:1	50:1	Ground, SR-3	B-PIR	MALSR	Not less than 3/4 mile	Yes
Crest Airpark	15	0:1	20:1	Aircraft	A-visual	None	Greater than 1 mile	No
	33	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Darrington Municipal	10	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	28	0:1	20:1	Trees, road	A-visual	None	Greater than 1 mile	No
FirstAir Field	07	17:1	20:1	Tree	A-visual	None	Greater than 1 mile	No
	25	1:1	20:1	Pole	A-visual	None	Greater than 1 mile	No
Gray Army Airfield	15	-	-	None	-	None	-	
	33	-	-	None	-	ODALS	-	
Harvey Field	14	0:1	20:1	Power line	A-visual	None	Greater than 1 mile	No
	32	8:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Kenmore Air Harbor	16	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	34	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	18	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	36	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
Lake Union Chrysler Air	18	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	36	20:1	20:1	None	A-visual	None	Greater than 1 mile	No

Exhibit 6-5 Runway Safety Areas, Approaches, Obstructions, and Visibility Minimums

Airport	Runway Number	Existing Approach Surface Slope	Required Approach Surface Slope	Obstructed Approach (Object)	Approach Category	Approach Lights	Visibility Minimums	Supports 50:1 Approach?
Martha Lake	16	0:1	20:1	Brush	A-visual	None	Greater than 1 mile	No
	34	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
McChord AFB	16	-	-	None	PIR	SALS	-	Yes
	34	-	-	None	PIR	NSTD	-	Yes
Pierce County / Thun Field	16	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	34	20:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Port Orchard	18	0:1	20:1	Road	A-visual	None	Greater than 1 mile	No
	36	0:1	20:1	Brush	A-visual	None	Greater than 1 mile	No
Ranger Creek State	17	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	35	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Renton Municipal	15	34:1	34:1	None	B-NPI	PAPI	Greater than 1 mile	No
	33	0:1	34:1	Road	B-visual	PAPI	Greater than 1 mile	No
Sea-Tac Int'l	16L	50:1	50:1	None	D-PIR	None	Greater than 1 mile	Yes
	34R	50:1	50:1	None	D-PIR	ALSF1	CAT I	Yes
	16R	50:1	50:1	None	D-PIR	ALSF2	CAT III	Yes
	34L	37:1	50:1	Tree	D-PIR	MALSR	CAT I	Yes
Sky Harbor	07	0:1	20:1	Tree	A-visual	None	Greater than 1 mile	No
	25	0:1	20:1	Brush	A-visual	None	Greater than 1 mile	No
Skykomish State	06	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	24	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Snohomish Co. / Paine Fielc	11	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	29	23:1	20:1	None	A-visual	None	Greater than 1 mile	No
	16L	22:1	20:1	None	A-visual	None	Greater than 1 mile	No
	34R	20:1	20:1	None	A-visual	None	Greater than 1 mile	No
	16R	50:1	50:1	None	D-PIR	MALSR	CAT I	Yes
	34L	30:1	20:1	None	A-visual	ODALS *	Greater than 1 mile	No
Spanaway	16	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	34	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Swanson	16	0:1	20:1	Access road	A-visual	None	Greater than 1 mile	No
	34	0:1	20:1	Tree, hill, hous	A-visual	None	Greater than 1 mile	No
Tacoma Narrows	17	50:1	50:1	None	B-PIR	MALSR	CAT I	Yes
	35	34:1	34:1	None	B-NPI	None	Greater than 1 mile	Yes
Vashon Island	17	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
	35	0:1	20:1	Trees	A-visual	None	Greater than 1 mile	No
Will Rogers/Wiley Post	12	50:1	20:1	None	A-visual	None	Greater than 1 mile	Yes
	30	50:1	20:1	None	A-visual	None	Greater than 1 mile	Yes

* *As of September 2001 this ODALS will be upgraded to a MALSF*

Exhibit 6-6 Airport Support Facility Requirements

	Runway Number	Runway Length	Electronic Navaids	Visual Navaids	Approach Lights	Runway Lighting	Tower	FBO	Fuel	Aircraft Maint./Repair	Terminal	Weather Reporting
American Lake	02-20	5,500	No	No	None	None	No	Yes	Yes	Major		-
Apex Airpark	17-35	2,500	No	No	None	LIRL	No	No	No	Major		
Arlington Municipal	11-29	3,500	No	Yes	None	None	No	Yes	Yes	Major		AWOS
	16-34	5,333	Yes	Yes	MALS	MIRL	No	Yes	Yes	Major		AWOS
Auburn Municipal	16-34	3,400	Yes	Yes	None	MIRL	No	Yes	Yes	Major		
Bandera State	08-26	2,342	No	Yes	None	None	No	No	No	None		
Boeing Field	13L-31R	3,710	No	Yes	None	MIRL	Yes	Yes	Yes	Major	Yes	
	13R-31L	10,001	Yes	Yes	SALSF	HIRL	Yes	Yes	Yes	Major	Yes	
Bremerton National	01-19	6,200	Yes	Yes	MALSR	HIRL	No	Yes	Yes	Major	Yes	AWOS
Crest Airpark	15-33	3,267	No	Yes	None	LIRL	No	Yes	Yes	Major		
Darrington Municipal	10-28	2,490	No	Yes	None	MIRL	No	No	Yes	None		
FirstAir Field	07-25	2,095	No	Yes	None	None	No	Yes	Yes	Major		
Gray Army Airfield	15-33	6,125	Yes	Yes	ODALS	HIRL	Yes	-	?	-		
Harvey Field	14-32	2,660	No	Yes	None	NSTD	No	Yes	Yes	Major		
Kenmore Air Harbor	16-34	10,000	No	No	None	None	No	No	Yes	Major	Yes	
	18-36	3,000	No	No	None	None	No	No	Yes	Major	Yes	
Lake Union Chrysler Air	18-36	9,500	No	No	None	None	No	No	Yes	None	Yes	
Martha Lake	16-34	1,680	?	?	None	LIRL	No	No	Yes	None		
McChord AFB	16-34	10,100	Yes	Yes	SALS	HIRL	Yes	-	Yes	Major		
Pierce County / Thun Field	16-34	3,650	No	Yes	None	MIRL	No	Yes	Yes	Major		
Port Orchard	18-36	2,460	No	No	None	LIRL	No	Yes	Yes	None		
Ranger Creek State	17-35	2,700	No	No	None	None	No	No	No	None		
Renton Municipal	15-33	5,379	Yes	Yes	None	MIRL	Yes	Yes	Yes	Major		ASOS
Sea-Tac Int'l	16L-34R	11,900	Yes	Yes	ALSF1	HIRL	Yes	No	Yes	None	Yes	ASOS
	16R-34L	9,425	Yes	Yes	MALSR	HIRL	No	No	Yes	None	Yes	ASOS
Sky Harbor	07-25	1,930	No	No	None	None	No	Yes	Yes	None		
Skykomish State	06-24	2,050	No	Yes	None	None	No	No	No	None		
Snohomish Co. / Paine Field	11-29	4,514	Yes	Yes	None	MIRL	Yes	Yes	Yes	Major		LAWRS
	16L-34R	3,000	No	Yes	None	MIRL	Yes	Yes	Yes	Major		LAWRS
	16R-34L	9,010	Yes	Yes	MALSR	HIRL	Yes	Yes	Yes	Major		LAWRS
Spanaway	16-34	2,724	No	Yes	None	LIRL	No	Yes	Yes	Major		
Swanson	16-34	3,000	No	Yes	None	NSTD	No	Yes	No	Major		
Tacoma Narrows	17-35	5,002	Yes	Yes	None	MIRL	Yes	Yes	Yes	Major	Yes	LAWRS
Vashon Island	17-35	1,940	No	Yes	None	NSTD	No	Yes	No	Minor		
Will Rogers/Wiley Post	12-30	5,000	No	No	None	None	No	Yes	Yes	Major		ASOS

Exhibit 6-7 Summary of Top Ten System Airports

Relievers	NPIAS Airport	Control Tower	Airport Beacon	Existing Based Aircraft	New Based Aircraft	Existing Airport Acreage	Land (ac) Available for Dev't *
Auburn	Yes	No	Yes	238	38	107	30
Harvey Field	Yes	No	No	360	116	65	117
King County / Boeing Field	Yes	Yes	Yes	443	71	634	0
Renton	Yes	Yes	Yes	240	38	170	0
Snohomish Co. / Paine Field	Yes	Yes	Yes	483	156	1,243	170
Others							
Arlington	Yes	No	Yes	510	164	1,202	40
Bremerton	Yes	No	Yes	116	42	1,169	584
Crest	No	No	Yes	334	53	62	8
Pierce County / Thun Field	Yes	No	Yes	229	56	144	11
Tacoma Narrows	Yes	Yes	Yes	200	49	644	16
				3,153	783	5,440	976

* Currently in airport ownership

Exhibit 6-7 Summary of Top Ten System Airports

Relievers	Meets Standards? Runway Length	Runway Width	RSA Width	RSA Length Beyond	1998 Pavement Condition	2000 Pavement Condition Index **
Auburn	Yes	Yes	Yes	Yes	Good	80.90
Harvey Field	No	No	Yes	Yes	Fair	-
King County / Boeing Field	Yes	Yes	Yes	No	Good	72.30
Renton	Yes	Yes	Yes	Yes	Good	80.25
Snohomish Co. / Paine Field	Yes	Yes	Yes	No	Good	76.76
Others						
Arlington	Yes *	Yes	Yes	Yes	Good	77.14
Bremerton	Yes *	Yes	Yes	Yes	Good	74.01
Crest	Yes	No	Yes	No	Fair	70.81
Pierce County / Thun Field	Yes	No	No	Yes	Good	83.99
Tacoma Narrows	Yes	Yes	Yes	No	Fair	77.12

* Master Plan includes longer runway

** Pavement Condition Index numbers are airport averages (source: 2000 WSDOT statewide airport pavement managemtn program)

Exhibit 6-7 Summary of Top Ten System Airports

Relievers	**Precision or Non-precision Approach**	**Approach Lighting**	**VASI or PAPI**	**Current Approach Slope**	**Support 50:1 Approach?**	**Runway Edge Lighting**
Auburn	No	No	Yes	18:1	No	MIRL
Harvey Field	No	No	No	8:1	No	NSTD
King County / Boeing Field	Yes	SALSF	Yes	3:1 *	Yes	MIRL/HIRL
Renton	Yes	No	Yes	34:1	No	MIRL
Snohomish Co. / Paine Field	Yes	MALSR	Yes	50:1	Yes	MIRL/MIRL/HIRL
Others						
Arlington	Yes	MALS	Yes	34:1	Yes	None/MIRL
Bremerton	Yes	MALSR	Yes	20:1	Yes	HIRL
Crest	No	No	No	0:1	No	LIRL
Pierce County / Thun Field	No	No	Yes	23:1	No	MIRL
Tacoma Narrows	Yes	MALSR	Yes	50:1	Yes	MIRL

* Main runway

Chapter 7 - Aviation System Strategy

The aviation system strategy chapter presents airport system development needs and strategic options, system improvement priorities, and a recommended system improvement program which responds to projected future demand (presented in chapter 5) and to identified system needs (presented in chapter 6). Using the aviation activity forecasts, chapter 6 presented the existing and future needs of the regional airport system in several categories, including airfield and landside capacity, airport pavements, safety and standards, and support facilities. Airfield and landside capacity analysis focused on existing and future demand, and the timing, type, location, and amount of facilities needed to accommodate that demand. The system capacity and future facility requirements chapter also identified existing airport system deficiencies related to FAA safety and standards criteria and documented potential opportunities for system enhancement. The aviation system strategy chapter is designed to organize these system needs, present a series of strategic options, and then to apply a set of system improvement priorities to develop a capital improvement program for the airport system. Also included in the system strategies chapter is a discussion of the region's existing reliever airports and possible enhancements that could respond to future needs. The chapter also includes a set of aviation system policy addressing four major categories: commercial passenger service, air cargo, airport compatible land use, and general aviation airports.

System Needs and Strategic Options

The aviation system strategies are built around eight major categories of need: (1) airfield capacity; (2) aircraft parking capacity; (3) pavements; (4) safety and standards; (5) potential system enhancements; and (6) support facilities. In addition, this section of the system plan discusses opportunities for enhancement of the regional reliever airports to meet forecast demand, address existing deficiencies, and provide enhancements. The section also includes a discussion of the region's critical privately owned airports. For each category of need, several strategic options are presented below. These options provided a palate of choices from which the airport system improvement program was developed.

Reliever Airports

Existing Reliever Airports

Relievers are general aviation airports designated in the FAA's *National Plan of Integrated Airport Systems (NPIAS)*. One of their primary functions is to relieve general aviation traffic from large or medium hub airports in a metropolitan area. In the Central Puget Sound Region, the five reliever airports accommodate virtually all general aviation traffic that might want to use Sea-Tac International Airport. To illustrate, general aviation activity comprises less than 2% of Sea-Tac Airport's annual operations. The regional airport system currently includes five reliever airports: Auburn, Harvey Field, King County International Airport / Boeing Field, Renton, and Snohomish County Airport / Paine Field. Information on these relievers is displayed in Exhibit 7-1. The FAA has recently revised its criteria for general aviation reliever status. To qualify as a reliever an airport must now have at least 100 based aircraft or 25,000 annual itinerant operations. The previous reliever criteria were at least 50 based aircraft or 25,000 annual itinerant operations. All five existing reliever airports meet the new criteria. In addition, Arlington, Bremerton, Crest Airpark, Pierce County/Thun Field, and Tacoma Narrows airports meet the new criteria. These five potential reliever airports are summarized in Exhibit 7-2.

Exhibit 7-1 Summary of Reliever Airports

	Existing Reliever Airports				
	Auburn	**Boeing Field**	**Harvey Field**	**Paine Field**	**Renton**
County	King	King	Snohomish	Snohomish	King
Ownership	Public	Public	Private	Public	Public
Runway length	3,400	10,001 / 3,710	2,660	9,010 / 4,514 / 3,000	5,379
Recommended runway length *	3,400	10,000 / 3,710	2,900	9,010 / 4,514 / 3,000	5,379
Runway width	75	200 / 100	36	150 / 75 / 75	200
Runway width standard	75	150 / 60	60	150 / 60 / 60	100
Meets all runway safety area stds?	Yes	No	Yes	No	No
Runway pavement condition	Good	Good / Good	Fair	Good / Good / Good	Good
Annual operations (1997)	172,000	345,120	140,700	192,612	100,710
Forecast 2020 operations	186,982	375,182	171,924	235,356	109,482
Annual runway capacity (ASV)	230,000	380,000	230,000	288,000	230,000
Based aircraft (1997)	238	443	360	483	240
Forecast 2020 based aircraft	276	514	476	639	278
Based aircraft capacity (1997)	330	550	415	564	255
Airport growth constrained?	Yes	Yes	No	No	Yes
Air traffic control Tower	No	Yes	No	Yes	Yes
Instrument approach **	No	Yes/ILS	No	Yes/ILS/GPS	Yes
Supports 50:1 approach?	No	Yes	No	Yes	No
Approach lighting	No	MALSF/R	No	MALSR	No
Runway edge lights	MIRL	MIRL/HIRL	Non-standard	MIRL/MIRL/HIRL	MIRL
Visual approach aids	VASI/PAPI REIL Beacon	VASI/PAPI REIL Beacon	VASI/PAPI	VASI/PAPI REIL Beacon	VASI/PAPI REIL Beacon
Weather observation/reporting	No	Yes	No	Yes	No
Airport highway access Distance	SR 167 1 mile	I-5 1 mile	SR 9 1/2 mile	SR 525/SR 99 1 mile/2 miles	1-405 1 mile

* Longer runway length is included in airport master plan
** Either precision or non-precision instrument

Exhibit 7-2 Potential Reliever Airports

	Potential Relievers				
	Arlington	**Bremerton**	**Crest Airpark**	**Pierce Co.**	**Tacoma Narrows**
County	Snohomish	Kitsap	King	Pierce	Pierce
Ownership	Public	Public	Private	Public	Public
Runway length	5,333 / 3,500	6,200	3,267	3,650	5,002
Recommended runway length *	6,000 / 2,940	7,400	3,020	3,650	5,002
Runway width	100 / 75	150	40	60	150
Runway width standard	60	100	60	75	100
Meets all runway safety area stds?	Yes	No	No	Yes	No
Runway pavement condition	Good	Good	Fair	Good	Fair
Annual operations (1997)	135,000	108,800	95,222	86,710	95,316
Forecast 2020 operations	164,959	127,590	103,516	99,960	109,881
Annual runway capacity (ASV)	270,000	240,000	240,000	213,200	240,000
Based aircraft (1997)	510	116	334	229	200
Forecast 2020 based aircraft	674	158	387	285	249
Based aircraft capacity (1997)	577	194	356	278	282
Airport growth constrained?	No	No	No	No	No
Air traffic control Tower	No	No	No	No	Yes
Instrument approach **	Yes	Yes/ILS	No	Non-precision	Yes/ILS
Supports 50:1 approach?	Yes	Yes	No	No	Yes
Approach lighting	MALS	MALSR	No	No	MALSR
Runway edge lights	MIRL	HIRL	LIRL	MIRL	MIRL
Visual approach aids	PAPI Beacon	VASI Beacon	 Beacon	PAPI REIL Beacon	PAPI/VASI REIL Beacon
Weather observation/reporting	Yes	Yes	No	No	Yes
Airport highway access Distance	I-5 2-1/2 miles	SR 3 1/16 mile	SR 18 2 miles	SR 512 4 miles	SR 16 1 mile

* Longer runway length is included in airport master plan
** Either precision or non-precision instrument

The FAA re-authorization act ("AIR-21"), adopted by the U.S. Congress in January 2000, has established a set-aside program to fund "super-reliever" airports that meet the following criteria: more than 75,000 annual operations, a runway with a minimum usable landing distance of 5,000 feet, a precision instrument landing procedure, and a minimum of 100 based aircraft. Only four of the region's airports currently meet these criteria: Boeing Field, Paine Field, Bremerton National Airport, and Tacoma Narrows Airport. While Boeing Field and Paine Field are eligible to compete for these super-reliever funds, Bremerton and Tacoma Narrows would have to be designated as relievers by the FAA before they could become eligible.

This system plan has evaluated the existing reliever airports in terms of their ability to accommodate existing and forecast activity levels and provide a safe and reliable regional system of reliever airports. While the existing five relievers provide an excellent foundation for the regional airport system, it has several shortcomings. The system plan is therefore assessing whether the existing relievers can accommodate future needs or whether additional reliever airports should be identified. Exhibit 7-1 displays a summary of both the strengths and weaknesses of the reliever airports. Three of the five relievers are constrained by adjacent urban development that limits their ability to expand. These airports are Auburn, Boeing Field, and Renton. Both Harvey Field and Paine Field have more readily available property to accommodate landside growth, though both will need to provide new aircraft parking (either tie-downs or hangars) to meet future demand. On the airside, Boeing Field is approaching its annual runway capacity. This, combined with its landside constraints, limits its ability to expand its regional role as a reliever.

All five existing reliever airports have visual vertical approach guidance (VASI or PAPI) and runway edge lights. Three of the five reliever airports (Boeing Field, Paine Field, and Renton) have towers and instrument approaches, with Boeing Field and Paine Field also having approach lighting and weather observation/reporting facilities. While Auburn, Boeing Field, and Renton airports are located in close proximity to Sea-Tac, allowing them to conveniently provide "relief," their proximity also puts them within congested air space. In addition, these three relievers are located in congested ground transportation corridors, reducing their overall effectiveness as relievers.

Auburn and Harvey do not have low visibility capability, with no tower, no instrument approach, no approach lighting, and no weather observation or reporting. Neither airport can support a future 50:1 approach. These two airports therefore have limited ability to provide relief to the system during poor visibility conditions, although both airports have visual approach guidance in the form of VASI and PAPI lighting systems. Harvey Field is privately owned and to date has not accepted any public funding for airport improvements. This may be partially responsible for the fact that the airport has less than recommended runway length, sub-standard runway width, close in obstructions (power lines), and runway pavements rated only "fair."

As the regional airport system moves ahead into the new millennium, the user community will place increasing demands on the system. These demands will include growing numbers of aircraft and aircraft activity plus an increasing need for higher quality facilities and services to meet more sophisticated user needs and accommodate a more expensive and technologically advanced aircraft fleet. The airport system's capability to meet these needs translates into a demand for enhanced airfield facilities, additional aircraft storage facilities (primarily enclosed hangars), improved pavements, investments to improve safety and meet standards, improved electronic and visual navigation aids, additional instrument approaches and approach lighting systems, and better ground access. As future investments result in system improvements, there will be a corresponding need to protect and preserve the system from incompatible land uses. Those needs are addressed in the *Land Use Compatibility* section of this plan.

Potential Additional Reliever Airports

Nearly 90% of the based aircraft and aircraft activity in the region is concentrated at ten airports. This concentration is expected to intensify in the future, with 95% of the future growth (between 1999 and 2020) occurring at these ten airports. To accommodate these growing demands, the system must respond with capacity, safety, and service improvements, not only at the existing reliever airports, but at existing large non-reliever airports. One of the strategic options for accommodating future airport system needs and preserving the more critical airports is to designate new relievers. The following speaks to the rationale for expanding the number of reliever airports.

- The existing reliever airport system already accommodates 1,764 based aircraft (almost half the regional total) and over 950,000 annual operations (57% of the regional total), and will reach or approach their airfield and/or landside capacity within the next 20 years.

- The existing reliever airport system is somewhat constrained in terms of its air space interactions with Sea-Tac (primarily Boeing Field and Renton), and by congestion on the regional surface transportation system providing landside access (Boeing Field, Renton, and Auburn).

- The existing reliever airports in the region are somewhat constrained in terms of their ability to accommodate landside growth. Auburn, Boeing Field, and Renton all have limited land resources, and are closely surrounded by dense urban development that reduces the feasibility of developing new property for airport expansion.

- Distributing general aviation growth to additional airports (in the form of airport investments to attract and accommodate that growth) may reduce system-wide air space congestion and improve overall ground access to the regional airport system.

- While focusing limited funds at a few airports has merit, the existing five relievers cannot physically accommodate the growth forecast for the airport system.

- Projected system growth and increasing user demands (larger, more demanding aircraft, growing numbers of business and corporate users, demand for more access to more airports in low visibility conditions) require that airport system improvements be spread to a larger number and more varied type of airports in the region.

- Existing and forecast geographic distribution of population, employment, and airport system users indicate airport system investments should be geographically distributed more broadly, providing easier access to major system airports.

- Several existing non-reliever airports have attributes that would make them very good choices for improvements. These include large numbers of based aircraft and aircraft operations, long runways (over 5,000 feet), meeting runway safety area standards, instrument approaches, approach lighting, available land to accommodate growth, and relatively compatible surrounding land uses. Making improvements at these airports and designating all or some as relievers would recognize and enhance their existing market roles, would provide support to the existing reliever airports in meeting the growing aviation needs in the region, and would establish the regional policy basis for the maintenance and preservation of an expanded reliever system. In addition, establishing proactive compatible land use programs adjoining reliever airports could help address the issue of land use encroachment.

This section discusses the attributes of five airports that have the potential to become relievers and compares them with the existing five reliever airports. Comparative data for the existing reliever airports is contained in Exhibit 7-1, and data for the potential relievers is shown in 7-2. The five potential reliever airports (Arlington, Bremerton, Crest Airpark, Pierce County/Thun Field, and Tacoma Narrows) are well distributed throughout the region, with two located in Pierce County, one in Kitsap, one in King, and one in Snohomish County.

Geographically, these locations could provide a good balance of airport locations to meet the projected regional distribution of future demand. In addition, these five airports are somewhat removed from the air space congestion at Sea-Tac and Boeing Field. Of these five potential reliever airports, Arlington, Bremerton, and Tacoma Narrows have particularly strong potential to serve in reliever roles. All have the following attributes:

- meet runway length recommendations (all runways over 5,000 feet)
- meet runway width standards
- meet RSA width and length beyond standards
- approach lighting
- VASI or PAPI
- either precision or non-precision approaches
- can support 50:1 approaches
- Tacoma Narrows has a tower
- airport beacons
- available land for growth
- nearly unobstructed approaches
- meet both existing and currently proposed FAA criteria for reliever status (more than 50 or 100 based aircraft and over 25,000 annual itinerant operations)

Strategic Options for Reliever Airports

- Retain existing five relievers; invest in all according to needs, and take steps to preserve existing relievers: maintain/improve pavement, enhance safety, meet standards, expand aircraft parking supply to meet demand, minimize land use encroachment. See Exhibit 7-4 for recommended improvements at each airport.
- Retain existing five relievers; focus investment on Boeing Field, Paine Field, and Renton.
- Public acquisition of Harvey Field combined with improvement plan to up-grade to FAA standards, including runway length and width, mark/light/move/remove obstructions (power lines), improve pavement condition. Expand aircraft parking to meet demand.
- Add Arlington, Bremerton, and/or Tacoma Narrows as relievers; invest in all according to needs, and take steps to preserve these new relievers: maintain/improve pavement, enhance safety, meet standards, expand aircraft parking to meet demand, minimize land use encroachment (this is more a policy statement to publicize the importance of these airports to the system. It may not have a significant impact on funding.) See Exhibit 7-4 for improvements at each airport.

Airfield Capacity

Based on the results of the aviation demand forecasts and analysis of system capacity and future facility requirements, five airports will reach 60% or more of their annual airfield capacity during the planning period (1998-2020). These airports include Boeing Field (91-99%); Paine Field (67-82%); Auburn (75-81%); Harvey (61-75%); and Arlington (50-61%) [shown in parentheses are demand-capacity ratios for 1998 and 2020]. FAA airport planning guidelines recommend that airports begin planning for additional runway capacity when they reach 60% of their annual airfield capacity. When airports reach 80% of their annual airfield capacity the FAA suggests airports should be moving into construction of new runways. These guidelines are based on the typically long lead time necessary between identifying major airport improvement needs (such as new runways) and actual implementation of runway projects. These FAA guidelines are commonly used in planning for airside capacity improvements at individual airports, when there may be no reasonable alternative available to the airport sponsor to meet forecast demand at that airport. When engaged in planning for a regional airport system, these guidelines are less relevant, since the capacity of the entire system can be used to accommodate regional demand. At the system planning level, actions can be taken at neighboring airports to attract activity away from congested airports, thus leading to a regional balancing of supply and demand.

King County International / Boeing Field (BFI) is the only system airport with critical airfield capacity concern, currently at 91% of its annual airfield capacity, and forecast to reach 99% of its annual service volume in the year 2020. Boeing Field has limited ability to expand its airfield capacity. Regional aviation system management (in the form of attracting activity to other regional airports) may be the only feasible approach to meeting future need at Boeing Field. The Regional Airport System Plan therefore includes system enhancements to encourage growth at other airports that have the airfield and landside capacity to accommodate growth. These airports may include Arlington, Auburn, Bremerton, Paine Field, Tacoma Narrows, and Thun Field.

While Paine Field and Auburn can accommodate growth in based aircraft, both airports are expected to reach over 80% of their annual airfield capacity by 2020. Investment in aircraft parking at Arlington, Tacoma Narrows, Thun Field, and Bremerton, where airfield capacity is available, may help divert traffic away from Paine Field and Auburn, and help redistribute regional demand in the 10-20 year time frame. All four of these top ten airports are expected to be operating well below their annual runway capacity through 2020. In addition, both Crest Airpark and Harvey Field have the capacity to accommodate some degree of regional growth to relieve Boeing Field, and eventually could relieve Auburn and Paine Field as they approach their annual airfield capacity. While Crest has runway capacity to accommodate operations growth, it is site constrained, and can support only a limited amount of growth in based aircraft and other landside support facilities. Therefore, Crest may not be able to realize its theoretical airfield capacity. Both Harvey and Crest may be somewhat financially constrained by their private ownership.

Strategic Options for Airfield Capacity

- No major airfield capacity actions are needed before 2010
- Between 2000 and 2010, plan for improved safety and all-weather capability at reliever airports and other top ten airports to increase effective peak hour capacity in low visibility conditions, thereby increasing annual capacity of the system, and relieving pressure from Boeing Field, and ultimately at Auburn and Paine Field

- Designate airports with capacity and airspace improvement needs and cooperate with FAA, airport sponsors, State DOT to implement GPS / LAAS / WAAS approaches to increase airport capability, safety, and marginal airside capacity
- Provide marginal increases in peak hour airside capacity at Paine Field and Auburn by 2020 to address demand through strategic airside improvements
- Plan for additional capacity at Arlington, Bremerton, Tacoma Narrows, and Thun Field to accommodate growth that cannot be accommodated at Boeing Field, Renton, Auburn, and Paine Field. Provide airfield capacity, additional based aircraft parking, safety and standards improvements, and other support facilities at these alternate airports to attract and accommodate the diverted demand. This may include the following:
  - Tower at Arlington
  - Runway extension at Arlington
  - New GPS approach, approach lighting, REIL, and navaids at Arlington
  - New hangars at Arlington
  - Runway extension at Bremerton
  - New GPS approach and REIL at Bremerton
  - New hangars at Bremerton
  - New hangars at Tacoma Narrows
  - Runway extension and widening at Thun Field
  - New GPS approach and navaids at Thun Field
  - New hangars at Thun Field

Aircraft Parking Supply

The regional airport system will need to accommodate 819 total new based aircraft (by 2020). This demand will be concentrated at the top ten airports. Some 96% of the region's forecast growth (783 new aircraft) is expected to occur at these ten airports. In addition, user preferences indicate the vast majority of new aircraft (90% of new demand, or 737 aircraft) will prefer to base their aircraft in hangars. The user preference for hangar aircraft storage is also apparent in existing airport waiting list data, which show over 800 based aircraft are currently stored in tie-downs but waiting for hangars. As of 1999 virtually all aircraft hangars in the region were occupied, and newly constructed hangars have been filling as soon as construction is complete. Therefore, according to forecast figures and waiting list data, the region will see demand for 737 additional aircraft hangars from pure growth plus latent demand for 800 hangars from existing tenants wishing to upgrade from tie-downs.

Strategic Options for Aircraft Parking

- Accommodate new based aircraft at each airport without regard for storage type. This would require additional tie-downs at Arlington, Crest, FirstAir Field, Harvey Field, Kenmore Air Harbor, Pierce County Airport/Thun Field, Renton, and Snohomish County Airport/Paine Field.
- Plan for (and invest in) specific new based aircraft needs at each airport (preference for hangars). This would require new hangars at most airports, including 737 new hangars at top ten airports Total additional aircraft hangar space needed would reach 94 acres (see exhibit 6-2).
- Plan for upgrades from tie-downs to hangars to accommodate waiting lists. This would require some 817 new hangars at 13 system airports, with about 88 acres of new hangar development (see Exhibit 6-1).

- Plan for additional landside facilities only at top 10 airports, which account for 783 new aircraft by 2020 (96% of all growth in the system).
- Plan to accommodate based aircraft growth only at public owned airports. This would leave based aircraft parking supply shortfalls at Crest Airpark and Harvey Field, which could be addressed by airport owner or other private investment in additional aircraft parking.
- Plan for additional landside facilities at specified airports that:
  - Can accommodate growth
  - Where applicable design standards can be met
  - Where enhancements can be made to improve level of service
  - Where land use encroachment goals are most likely to be successful
- Implementation option 1: plan for public investment in hangar development
- Implementation option 2: build partnerships to encourage private investment in hangar development

Pavements

The following discussion of pavement needs and possible strategic improvement options is based primarily on two airport pavement analyses done by the WSDOT Aviation Division. The first was a visual pavement inspection done in 1998 as part of a statewide airport conditions analysis for the Washington State Airport System Plan ("WSASP"). The second was a more comprehensive statewide airport pavement management program completed in 2000 (see Chapter 4: Airport Facilities - Airport Pavements, including Exhibit 4-20).

System needs:

Based on the 1998 visual inspections done by WSDOT, existing generalized runway pavement condition (includes 29 runways at the 24 land based airports):

Good:	21	
Fair:	6	(include Harvey, Crest, Tacoma Narrows)
Poor:	2	(Bandera and Spanaway)

Based on the 2000 detailed airport pavement management program done by WSDOT, the following airports have Pavement Condition Indices that fall below regional averages: Arlington's apron; Bremerton's runway; apron and taxiway at Crest Airpark; runway at Boeing Field; all pavement types at FirstAir Field; taxiway at Renton; apron (marginally) at Paine Field; apron, runway, and taxiway at Spanaway; and runway at Tacoma Narrows. These airport pavements are in varying states of need for investment in maintenance and management programs in order to maintain safety and operations. Numerous other pavements are slightly above regional averages, but will require investment in pavement maintenance programs to keep airport pavements safe and serviceable.

Possible Strategic Options for Pavements

- Set a minimum "PCI" of 70 for the five existing reliever airports. This would likely require pavement improvements at Harvey Field.
- Set a minimum "PCI" of 70 for top ten airports, including relievers (all airports above 95,000 annual operations or 100 based aircraft). This would likely require pavement improvements at Harvey Field. All other top ten airports have total airport PCI indices above 70.
- Set a minimum "PCI" of 70 for 13 NPIAS airports. This would likely require pavement improvements at Harvey Field.

- Set a minimum "PCI" of 70 for all public use airports. This would require pavement improvements at FirstAir Field and Spanaway.
- Set a minimum "PCI" of 70 for all runways at the region's relievers and other top ten airports (all airports above 95,000 annual operations or 100 based aircraft). This would require runway pavement improvements at Bremerton, Boeing Field, and Tacoma Narrows.
- Develop policy framework, pavement improvement program, and implementation program to address selected option above.
- Plan for pavement improvements based on level and type of activity (focus investment at airports with larger aircraft and/or business activity).

Safety and Standards

Chapter 6 contained a thorough discussion and analysis of the safety and standards of the system. The following are highlights of those system needs and a series of strategic options for addressing airport system needs in the area of safety and standards. Many of the needed safety and standards projects shown here are already being addressed in current airport improvement programs, and most are included on airport layout plans (ALPs) as planned improvements.

- Runway length
  - Arlington, Bremerton, and Sea-Tac airports are each planning longer runways to accommodate increasing aircraft requirements (all meet current requirements)
  - 13 airports (including Harvey Field and Crest Airpark) have runways shorter than FAA's recommended runway length needed to serve 95% of the small GA fleet (under 10 seats). This is based on the FAA 's "Airport Design for Microcomputers" program.
  - 9 have runways shorter than FAA's recommended runway length needed to serve 75% of the small GA fleet (under 10 seats)

- Runway width
  - 12 airports have runway widths less than standard, including three NPIAS airports (Harvey Field, Pierce County Airport/Thun Field, and Vashon)
  - 3 top ten airports (including 1 reliever) have sub-standard runway width: Crest Airpark, Harvey Field, and Thun Field

- RSA width
  - 12 system airports do not meet FAA runway safety area width standards.

- RSA length beyond
  - 17 system airports do not meet RSA length beyond standards, including five NPIAS airports, 2 relievers, Sea-Tac, and Tacoma Narrows Airport

- Obstructions
  - Three top ten airports (including 2 relievers) have close in obstructions resulting in significant deficiency in meeting required approach slopes
  - Two top ten airports (Auburn and Bremerton) have more distant obstructions having modest affect on approach slope

- Approaches and approach lighting
  - Of the system's five reliever airports, only Boeing Field and Paine Field have instrument approaches. In addition, of the remaining top ten airports, Bremerton and Tacoma Narrows have instrument approaches.
  - According to FAA criteria, airports with over 200 annual instrument operations or 1,825 annual scheduled passenger originations qualify for a non-precision approach.
  - Five of the top ten airports have approach lighting. These are Boeing Field, Paine Field, Arlington, Bremerton, and Tacoma Narrows.
  - Only eight of the system's 28 airports have approach lighting. These include the five listed above plus Sea-Tac, McChord AFB, and Gray Army Airfield.
  - According to FAA criteria, airports with over 300 annual instrument operations or 2,725 annual passenger originations qualify for medium intensity approach lighting systems (MALS). Of the top ten airports without approach lighting systems, only Renton qualifies under these FAA criteria.

Strategic Options for Safety and Standards (see Exhibit 7-4)

- Meet all standards and recommendations at all reliever airports. This would require the following:
  - Runway extension and runway widening at Harvey Field
  - Runway safety area length beyond improvements at Boeing Field, Paine Field, and Renton
  - Removal of power lines at Harvey Field (or the equivalent)
  - Obstruction programs at Auburn, Boeing Field, Harvey Field, and Paine Field

- Meet standards and recommendations at top ten airports. In addition to the items listed above at the reliever airports, meeting this recommendation would require the following at other top ten airports:
  - Runway widening at Crest Airpark and Pierce County Airport/Thun Field
  - Runway safety area length beyond improvements at Crest Airpark and Tacoma Narrows
  - Obstruction program improvements at Bremerton and Crest Airpark

- Meet standards at NPIAS airports. This would include above improvements plus:
  - Runway extension and widening, runway safety area width and length beyond, and obstruction program improvements, all at Vashon

- Meet standards at airports above certain size and/or levels of activity. The FAA's *Regional Airport Plan*, published in Spring 2000, recommends all safety areas be brought up to current standards at all general aviation airports with more than 100 based aircraft. This would include the region's top ten airports. FAA Northwest Mountain Regional Airport Plan goal is to meet runway safety area standards at primary, commercial service, and GA airports with more than 100 based aircraft. Applying this criterion would yield the need for safety area improvements at the following airports: Sea-Tac, Boeing Field, Bremerton, Crest, Paine Field, and Tacoma Narrows.

Potential System Enhancements

In addition to meeting the demands of regional growth and other identified system needs, there are needs for, and opportunities to provide numerous airport system enhancements to improve the level of service provided by the system. The business and corporate aviation market is placing growing demands on the regional airport system to accommodate a GA fleet that is increasingly comprised of high performance turbine powered aircraft. System users are requesting increased capacity, capability, reliability, and safety in an increasingly congested region. Many of these system needs could be addressed by enhancements such as longer, stronger runways, new GPS and/or instrument approaches, improved approach lighting and navigational facilities for low visibility flying, and various other safety-related improvements. The following provide a brief summary of system enhancements and current criteria and standards that would apply to each. Standards and criteria are taken from FAA Advisory Circular AC 150/5300-13 (through draft change 6) and FAA Order 7031.2C (through change 11, 3/17/97).

- Runway Length
  - Four of the top ten system airports are planning for longer runways to accommodate increasing demands by their users. These include Boeing Field, Harvey Field, Arlington, and Bremerton. Currently, all but Harvey Field meet runway length recommendations to accommodate their existing critical/design aircraft.

- Instrument Landing System (ILS)
  - Boeing Field, Bremerton, Paine Field, and Tacoma Narrows currently have ILS
  - No criteria are given by the FAA for new instrument landing systems. FAA is now planning to replace instrument landing systems with GPS

- Microwave Landing System (MLS)
  - FAA Minimum runway standards are 4,200 feet long by 75 feet wide
  - Qualifying activity levels are sustained turbojet operations and between 900 and 2,700 annual GA instrument operations (Annual Instrument Approaches - “AIA” criteria)
  - Airports meeting these criteria include Sea-Tac, Boeing Field, Paine Field, Renton, Arlington, and Tacoma Narrows
  - MLS technology has been overtaken by GPS technology, and the FAA is no longer planning to install MLS approaches or equipment

- Future Global Positioning System (GPS) approaches
  - Several system airports currently have GPS approaches, and nine of the region’s top ten airports are currently planning for new GPS approaches. This will improve their capability in low visibility conditions. GPS capability will provide the region with ten airports with at least non-precision approaches (up from the current six airports)
  - FAA minimum runway length for GPS precision instrument approach is 4,200 feet
  - FAA minimum runway length for GPS non-precision approach with visibility minima of less than 3/4 statute mile is 4,200 feet; minimum runway length with visibility of less than 1 statute mile, equal to 1 statute mile, or greater than 1 statute mile is 3,200 feet
  - Depending on the visibility minima sought, GPS approaches at all of the top ten airports could require runway extensions at Auburn, Crest Airpark, Harvey Field, and Thun Field

- Non-precision instrument approaches
  - Of the system's top ten airports, Auburn, Harvey, Crest, and Thun Field have only visual approach capability
  - FAA qualifying activity levels are 200 annual instrument approaches or more than 1,825 annual scheduled passenger originations

- Visual approach slope indicators (VASI) and/or precision approach profile indicators (PAPI) for non-precision approach
  - Of the system's top ten airports, Crest and Harvey do not have VASI/PAPI or equivalent
  - FAA qualifying activity levels are greater than 28,000 annual operations or greater than 120 annual instrument operations. Both Crest and Harvey would meet this criterion.

- Approach lights (MALS) for non-precision approach
  - Currently Auburn, Harvey Field, Renton, Crest, and Thun Field do not have approach lighting for even a non-precision approach
  - FAA qualifying activity levels are greater than 300 annual instrument approaches or 2,725 annual passenger originations

- Runway end identifier lights (REIL)
  - Boeing Field, Harvey Field, Paine Field, Arlington, Bremerton, and Crest Airpark do not have REIL to provide visual guidance to runway ends in lower visibility conditions
  - Boeing Field and Arlington plan to install REIL where it does not now exist

- Approach protection
  - Airports with ILS/MLS capability, and those planning for new GPS approaches, must protect the approaches to the runway ends from land uses and physical objects that would encroach upon the airplane's path to the runway end. Several airport master plans include recommendations for the airport sponsor to obtain positive control (through ownership, avigation easements, or other means) over airport approaches to protect future capability
  - All airports with ILS, MLS, or GPS capability should be planning for approach protection

- Runway edge lighting
  - Crest Airpark and Harvey Field currently do not have standard runway edge lighting

Strategic Options for System Enhancements

- Support planned runway extensions at Boeing Field, Harvey Field, Arlington, and Bremerton

- Provide ILS or GPS landing systems at all reliever airports. This would require installation of systems at Auburn, Harvey, and Renton, and new relievers. This would also require runway extensions to 3,200 or 4,200 feet at Auburn and Harvey Field (depending on visibility minima)

- Provide ILS or GPS landing systems at all top ten airports. This would require installation of systems at Auburn, Harvey Field, Renton, Arlington, Crest, and Thun Field. This would also require runway extensions to 3,200 or 4,200 feet at Auburn, Harvey Field, Crest Airpark, and Thun Field (depending on visibility minima)

- Provide instrument approach (either precision or non-precision) and approach lighting at all relievers. This would require installation of instrument approaches at Auburn and Harvey, and possible approach lighting at Renton

- Provide instrument approach (either precision or non-precision) and approach lighting at top ten airports. This would require installations at Auburn, Harvey Field, Crest Airpark, Renton, and Thun Field

- Provide for GPS approaches at all relievers. This would necessitate runway extensions to 3,200 feet at Harvey Field or 4,200 feet at Auburn and Harvey Field (depending on visibility minima)

- Provide for GPS approaches at top ten airports. This would necessitate runway extensions to 3,200 feet at Harvey Field or 4,200 feet at Auburn and Harvey Field, and extensions to 4,200 feet at Crest Airpark and Thun Field (to achieve lower minima)

- Provide beacon and VASI or PAPI at top ten airports. This would require installation of a beacon at Harvey Field and VASI or PAPI at Harvey Field and Crest Airpark.

- Provide runway edge lighting at airports without such lighting. This would include new lighting at Harvey Field and Crest Airpark

- Retain, preserve, and improve at least one airport in each county that can serve major business aviation needs. These airports would need the following facilities:
  - Runway at least 5,000-6,000 feet long and 100 feet wide
  - Meet all runway safety area standards
  - Precision instrument runway with approach lighting and able to support a 50:1 approach
  - Air traffic control tower
  - Adequate covered/enclosed aircraft storage
  - Adequate support facilities (including aircraft maintenance, aircraft fuel, ground access)
  - Pavement condition rating of "very good" or above and a Pavement Condition Index (PCI) above 70
  - Airports that would qualify are Sea-Tac, Boeing Field, Renton, Paine Field, Arlington, Bremerton, and Tacoma Narrows. Arlington would be the second such airport in Snohomish County. Bremerton and Tacoma Narrows would be the first such airports in Kitsap and Pierce Counties, respectively. In addition to planned improvements at Tacoma Narrows airport, access improvements to SR 16, including the Tacoma Narrows bridge, would likely be needed to support future airport development. Without these access improvements, aviation activity growth in Pierce County may more likely be accommodated at Thun Field.

Support Facilities

System needs:

Control towers

- Of the five relievers, only Boeing Field and Paine Field have control towers

- Of the top ten GA system airports, only Boeing Field, Paine Field, Renton, and Tacoma Narrows have control towers

- Control Tower criteria
  - Open to the public
  - NPIAS airport
  - Assurances to operate into the future
  - FAA must be given land at no cost for the tower
  - B/C ratio is greater than 1

Air cargo

- Combined cargo volume at Sea-Tac Airport and Boeing Field is forecast to increase from 645,022 tons in 2000 to 1,048,795 tons in 2010. These forecasts translate to an average annual growth rate of 4.8%. The Boeing Company's *Current Market Outlook (2000)* predicts total world air cargo volume will grow by an average of between 6% and 7% per year between 1999 and 2019, with U.S. growth slightly lower.

- At Boeing Field, on-airport cargo processing requirements will increase from 22 acres (existing) in 1998 to 43 acres in 2015. It is <u>not</u> certain whether the airport can accommodate all forecast cargo demand after 2015.

- At Sea-Tac Airport, air cargo processing requirements will increase from 81 acres (1993) to 176 acres in 2020. The airport has a plan to accommodate forecast cargo demand to the year 2009, and is developing plans to meet longer term needs, but similar to the Boeing Field situation, it is not clear how the Port will accommodate long range air cargo demand at Sea-Tac.

Aircraft fuel

- All system airports (except seven very small airports) have fuel facilities

- Airports without fuel are state-owned/emergency airfields or are within 15 air miles of other system airports that have fuel

Strategic Options for Support Facilities

Control towers

- Consider provision of control towers at all reliever airports
- Consider provision of control towers at all top ten airports
- Consider provision of control towers at all airports with approach lighting
- Consider provision of control towers at all airports with non-precision or precision instrument approaches
- Consider provision of control towers at all airports which exceed defined based aircraft and/or aircraft activity levels

Air Cargo

- Develop facilities (on airport and needed ground access improvements) at Sea-Tac and Boeing Field to meet demand as forecast in master plans, and as published in this *2001 RASP* (which would potentially meet need to 2009 at Sea-Tac and 2015 at Boeing Field)
- Undertake a regional air cargo demand analysis and compare with individual airport master plans. Based on results of this analysis, develop and evaluate regional air cargo improvement options. This may include Sea-Tac, Boeing Field, Paine Field, and/or other airports.

Fuel Facilities

- No action needed on aircraft fuel facilities

Critical Privately Owned Airports

Of the 28 public use airports in the regional airport system, 10 are privately owned. The privately owned public use airports provide a major contribution to the regional system in terms of airfield capacity, aircraft parking, support facilities, and access to the region, state, nation's air transportation system. These 11 airports are currently home to over 1,000 based aircraft and have a total landside supply of nearly 1,200 aircraft parking spaces. Although all these airports are important to the system, two have critical regional significance: Crest Airpark and Harvey Airfield. These two airports alone house 690 based aircraft, nearly 20% of the total aircraft in the region. In addition, Crest and Harvey (together with Renton) fill a critical need for airport facilities by accommodating aviation demand from the east side of Lake Washington. According to the *2001 RASP* forecasts, the region is projected to reach its total based aircraft parking capacity between 2015 and 2020. The loss of either Crest Airpark or Harvey Field would have serious affects on the rest of the airport system. If both were lost today, there would be no excess capacity, and any new growth anywhere in the system would require construction of tie-downs and or hangars. This would severely limit choice on the part of aircraft owners, would place major financial burdens on many airport sponsors, and could also compromise the efficiency and safety of the system. It is in the interest of the entire airport system to preserve and maintain the region's critical privately owned public use airports.

Strategic Options for Critical Privately Owned Airports

- Allow the market to determine the future of privately owned airports. Take actions in the public sector as needed to respond to overall system needs, and in response to changes at private airports.

- Monitor the status of the region's critical privately owned public use airports (Crest Airpark and Harvey Field), and if either airport is threatened with closure, coordinate with the WSDOT Aviation Division, the FAA, and other appropriate public agencies, to evaluate public acquisition of the airport.

Regional Airport System Improvement Priorities

Historically, the regional aviation system's improvement needs have been greater than available funding. Given the level of growth forecast for the regional airport system in the next 20 years, and the magnitude of system needs identified here, future system needs are likely to exceed available funding. Planning for system improvements is therefore based on a set of system improvement priorities that are intended to provide policy guidance regarding the relative importance among four categories of improvement programs. These groups in order of priority are: (1) safety and standards, (2) maintenance and preservation, (3) enhancement, and (4) capacity.

In developing these improvement program priority categories we reviewed similar investment and funding policies and priority systems developed by the Washington Department of Transportation and the Federal Aviation Administration. These policies and project priority systems are summarized in Exhibit 7-3 along with recommended PSRC aviation system improvement priorities. The WSDOT policies provide overall direction for the Aviation Division's aviation system planning process. WSDOT's policy emphasis areas as listed in Exhibit 7-3 are consistent with the Washington Transportation Plan, which shows system preservation, maintenance, and operation as key investment priorities.

The FAA priorities are used to allocate funds to a wide range of competing projects, and are rigorously applied. Given that the Regional Council has no direct funding authority, the PSRC aviation system improvement priorities are meant to provide general guidance to airport sponsors and state and federal funding agencies regarding regional priorities. Exhibit 7-3 displays for comparative purposes the Washington DOT Aviation Division's five major aviation policy focus areas that were adopted by the Transportation Commission in 1998. While these policy areas have not been prioritized, they identify major categories of state airport system improvements that are consistent with those of both the FAA and the Regional Council. The FAA Northwest Mountain Region funding priorities shown in Exhibit 7-3 were derived from the *FAA Northwest Mountain Regional Airport Plan* [5], published in spring 2000. That plan puts safety as its highest priority, and focuses a significant proportion of funds to resolving existing safety deficiencies (especially runway safety areas) at the region's airports. The plan recommends all runway safety areas meet standards at all general aviation airports with more than 100 based aircraft. This would include the top ten airports in the Puget Sound Regional Airport System.

[5] The FAA Northwest Mountain Region includes the states of Washington, Oregon, Idaho, Montana, Utah, Colorado, and Wyoming.

Priority 1: Safety and Standards

Consistent with FAA national and regional airport system priorities, the Puget Sound Regional Airport System Plan has identified numerous airport improvements that will enhance the overall safety of the airport system. This group of system improvements primarily addresses deficiencies in the existing airport system as measured against FAA standards, and includes projects to eliminate existing system deficiencies in runway width, runway safety area width, and runway safety area length beyond, and to enhance existing obstruction programs. Safety and standards are considered the top priority in system improvements. Airport sponsors and funding agencies should focus a significant proportion of available funds on projects and programs which address these safety and standards issues at critical airports in the regional airport system. Several airports are already planning to resolve these safety and standards issues.

Priority 2: Maintenance and Preservation

Second level priority improvements include programs to preserve, maintain, and improve airport pavements and programs to address land use encroachment, including height hazards, safety, and noise. Both these airport improvement programs focus on preserving the airport system's ability to meet existing and future needs, and help airports fulfil their role as essential public facilities. After safety and standards, maintenance and preservation of the system is the next highest priority for system improvements. Preserving, maintaining, and improving the condition of airport pavements is a high priority at both the federal and state levels, and pavement maintenance and management programs are eligible for federal and state funding. This high degree of state and national interest should ensure an appropriate level of investment in pavement programs. The WSDOT Aviation Division's latest pavement maintenance and management program, completed in 2000, provides the baseline data and analysis required to define the pavement needs of the state and regional airport systems.

While land use encroachment and compatible land use programs are a high priority in preserving the regional airport system, these programs do not necessarily have high costs. Rather, they require communication and cooperation between airport sponsors and local governments with land use planning and zoning authority over properties surrounding airports. Compatible land use planning programs are a critical component in preserving the regional airport system by maintaining the safety of aircraft using the system, reducing the risk of aircraft accidents involving people in areas adjoining airports, and providing for improved relations between airports and their neighboring communities [see also Chapter 8].

Exhibit 7-3 Comparison of Aviation System Improvement Policies and Priorities

	WSDOT State Aviation Policy *	PSRC Aviation System Airport Improvement Priorities	FAA NW Mountain Region Airport Funding Priorities **	
HIGHEST	Preservation	Safety and Standards	Safety	HIGHEST
	Safety	Maintenance and Preservation	Environment (noise)	
	Capacity	Enhancement	Capacity	
	Environmental Protection	Capacity	Pavement Rehabilitation	
	Public Outreach	Economic Development	Special Emphasis	
LOWEST				LOWEST

* These policies (adopted in March 1998) are consistent with the WTP, which considers preservation its top priority

** From FAA Northwest Mountain Regional Airport Plan -- 2000

Priority 3: System Enhancements

Assuming that the regional airport system is safe, and that it is being preserved and maintained, the next priority is to enhance the system's ability to serve the public. System enhancement projects are those that provide an increased level of service for airport system users, respond to changing requirements of the aircraft fleet, and enhance airport system access and reliability in poor visibility conditions. In short, system enhancements would provide increased access to more users at more airports using a wider range of aircraft more often during a wider range of weather conditions. System enhancement should also produce the indirect benefits of increased safety and capacity.

System enhancement projects include runway extensions, new and improved instrument/GPS approaches, approach lighting systems, visual aids, airport and runway lighting, and approach protection programs. Enhancements are third priority after safety and standards improvements and maintenance and preservation improvements. Nearly all top ten airports in the regional system are currently planning to implement some type of improved instrument or GPS approach to provide enhanced access to their airports.

Priority 4: System Capacity

Fourth priority improvements are those that increase system capacity and are not related to system safety and standards, maintenance and preservation, or system enhancements. Capacity improvements include airfield projects that increase airport operations capacity and landside capacity projects such as new aircraft tie-downs and hangars. While system capacity is important, existing airfield capacity is generally sufficient to accommodate forecast demand for the next 20 years. The lone exception is Boeing Field, and numerous initiatives contained in this *2001 RASP* are designed to accommodate growth to relieve the pressure at Boeing Field. No new runways (except the third runway at Sea-Tac) are planned in this RASP. On the landside, the airport system has sufficient existing aircraft parking supply to meet total regional forecast demand until the year 2015, though not necessarily the type required (hangars) or at the locations where market demand is greatest. Demand for additional aircraft parking at certain airports is strong, and many existing tenants on waiting lists are seeking improved storage in hangars. Half the region's airports are currently at or above 80% of their landside supply, and several top ten airports (Arlington, Auburn, Bremerton, Harvey Field, Tacoma Narrows, and Thun Field) are planning or developing additional aircraft hangars (with both public and private funds) to accommodate these demands. While not the highest priority in the region, additional aircraft parking should be provided to meet regional demand, and where financially feasible, hangar storage should be provided to fulfill user preferences.

Recommended Regional Airport System Improvement Program

The recommended regional airport system improvement program is comprised of three components: system policy; system strategy, and system improvements. The policy component states the Regional Council's overall policy regarding the regional airport system. These include statements of how the region will address its long term air transportation needs related to commercial passenger service, air cargo, airport compatible land use, and the general aviation airport system. The strategy component documents overall system strategies grouped by priority category (safety and standards, maintenance and preservation, system enhancements, and system capacity). The improvements component lists more specifically the airport improvement projects and programs recommended for each airport in the system.

Regional Airport System Policy

Commercial Passenger Service

The following re-states existing policy as originally contained in the 1995 MTP and subsequent resolutions adopted by the Regional Council:

- The region will meet its long term commercial passenger air transportation needs through expansion of Sea-Tac International Airport (as identified in its most recent Airport Master Plan Update and related EIS), and consistent with the Puget Sound Regional Council General Assembly's Resolution A-96-02 (including Appendix G). The Regional Council will continue to coordinate with all agencies responsible for implementing Resolution A-96-02, and will continue to monitor and report on progress related to the noise reduction steps contained in the Resolution.

- The Regional Council will coordinate with the state to enact legislation allowing for substantial and equitable incentives and compensation for communities impacted by the proximity of essential public facilities.

- The Regional Council will coordinate with the state and local jurisdictions to implement a comprehensive process for evaluating all options to meet the State of Washington's long-term air travel and inter-regional ground transportation needs including high speed rail.

- The Regional Council will coordinate with the Port of Seattle, WSDOT, the FAA, and other appropriate agencies to identify and implement improvements to the region's surface transportation system to provide improved multi-modal access to Sea-Tac Airport and to mitigate the airport's transportation impacts on surrounding communities.

Air Cargo

The following are new recommended policies related to meeting the region's air cargo needs:

- The region will meet short and medium term air cargo demand (2009-2015) through planned improvements at Sea-Tac International Airport and King County International Airport / Boeing Field (as outlined in their most recent airport master plans and related planning documents). The Regional Council will also plan for and support funding of improvements to the regional surface access system to support the regional movement of air cargo shipments.

- The region's longer term air cargo demand (after 2015) will be addressed in future updates to the Sea-Tac Airport and Boeing Field master plans in coordination with regional airport system planning being done by the Regional Council. This coordinated planning for regional air cargo needs will address total regional air cargo demand, the regional distribution of air cargo facilities, the potential for additional regional air cargo activity at airports other then Sea-Tac and Boeing Field, and additional need for surface access improvements.

Airport Compatible Land Use

The following are recommended new policies relative to the Regional Council's authority under the State Growth Management Act:

- Building upon its Policy and Plan Review and Certification authority under the Growth Management Act, the Regional Council will continue and expand its efforts to improve land use compatibility adjacent to public use general aviation airports. These efforts will include the following actions:
  - Refine the policy and plan review process to clarify the airport land use compatibility criteria to be used in plan review and certification process.
  - Establish airport compatible land use guidelines.
  - Provide compatible land use guidelines and technical assistance to local jurisdictions.
  - Monitor regional trends in airport compatible land use to assess the effectiveness of the programs.

- The Regional Council encourages cities and counties with public use general aviation airports to pro-actively use their planning and zoning authority to prevent further land use encroachment and incompatible land use adjacent to these airports.

General Aviation Airports

The following recommended policies include refinements to existing policy contained in the 1988 RASP and the 1995 MTP, plus recommended new policies developed in the *2001 RASP* planning process:

- The region will preserve, maintain, and enhance its general aviation airport system as detailed in the *2001 Regional Airport System Plan (2001 RASP)*. The region will support a program of aviation facility and service improvements to allow each airport to fulfill its regional role as defined in the *2001 RASP*. The region will support investments in the airport system to meet growing demand, provide increased access to the airport system, meet the broadening needs of the business and corporate aviation sectors, and to improve system safety and reliability.

- The region will apply the definition of "essential public facilities" as contained in Washington's Growth Management Act (RCW 36.70A) to the region's public use airports as needed to provide a planning process for addressing airport compatible land use in communities adjacent to all system airports.

- The region will support strategic investments in the regional airport system as identified in the *2001 RASP* to address airport system safety and standards, maintenance and preservation, system enhancements, aircraft storage expansion, and related economic development.

- The region will encourage and support airport sponsors and other appropriate agencies to undertake the following action strategies to implement the *2001 RASP*:
  - The Regional Council will work with the FAA, WSDOT Aviation Division, airport sponsors, other appropriate public agencies, and the private sector, to identify additional financial resources required to meet the investment needs of the regional airport system and to help mitigate the impacts of airports on adjacent communities. The Regional Council will also explore the potential of using public funds for critical projects at privately owned public use airports.
  - The region will monitor the status of major privately owned public use general aviation airports throughout the region (particularly Harvey Field and Crest Airpark). If any of these airports are threatened with closure, the Regional Council will coordinate with the WSDOT Aviation Division, the FAA, the current airport owner, and other appropriate public agencies, to evaluate options for public acquisition of these airports.
  - Bremerton National and Tacoma Narrows airports should take steps as outlined in the *2001 RASP* to accommodate growth in corporate and business aviation. These steps should include safety and standards programs, obstruction programs, pavement maintenance programs, compatible land use programs, runway extensions, protection of runway approaches, improved approach lighting systems, development of newer technology instrument approaches (such as GPS), and landside facility enhancements.
  - Arlington should take steps to capitalize on its regional niche as a center for experimental, glider, and ultralight activity. In addition, it should improve its all weather capability to provide increased access to the northern portion of the region.
  - Airport system investment priorities identified in the *2001 RASP* will be used to communicate the Regional Council's policy concerning funding priorities for airport system improvements. The Regional Council will communicate these priorities with the WSDOT Aviation Division, the FAA, and airport management, and encourage airports to include these investments in their individual airport master plans and capital improvement programs.
  - The Regional Council will support airport master plan proposals that are consistent with the *2001 RASP*.
  - Concurrent with its planning for the region airport system, the Regional Council will work with the WSDOT Aviation Division, the FAA, and other appropriate agencies to identify and document the economic benefits of aviation to local communities and to the region.

Regional Airport System Strategy

The regional airport system needs to respond to the growing and widening needs of its users. It should be safe and reliable. The system should provide for compatibility with surrounding communities. It needs to provide facilities and services that are efficiently located relative to demand. And the system should be preserved and maintained to capitalize on the existing system investment. The system strategy and priorities below are designed to meet these multiple goals for the regional airport system.

System Strategy - Reliever Airports

- The five existing reliever airports will be preserved, maintained, and enhanced as described herein to meet existing and forecast regional needs.
- Paine Field and Harvey Field should make improvements to maintain and enhance their roles as reliever airports serving the northern part of the region. Both could be expanded to meet growing demand.
- Boeing Field, Renton, and to a lesser extent Auburn, have growth constraints, and cannot accommodate significant increases in landside demand. Notwithstanding these constraints, the region will face a growing need for general aviation reliever airport services and facilities in the south and west parts of the region. There are no reliever airports in either Kitsap or Pierce counties. In order to meet these future demands, Bremerton National and Tacoma Narrows airports should be designated as additional general aviation relievers, and maintained and enhanced to accommodate this need. Auburn and Renton will be enhanced and expanded within their capability to address demand in King County. Renton cannot provide additional aircraft hangars until the Boeing company's leases expire and their lease properties on the west side of the airport can be vacated and redeveloped. At that time, Renton will be able to accommodate between 50 and 80 new aircraft hangars. Auburn has recently built 40 new aircraft hangars and is studying the feasibility of additional hangars on recently purchased property. With these proposed expansions, Auburn can accommodate approximately 150 new aircraft hangars.

System Strategy - Safety and Standards

Because of their importance to the system, all top ten airports should be improved to eliminate existing safety and standards deficiencies as shown in Exhibit 7-4. This strategy is consistent with the FAA's *Northwest Mountain Regional Airport Plan - 2000*, which recommends the elimination of current safety area deficiencies at airports with over 100 based aircraft. This strategy will necessitate runway widening at three airports, five runway safety area projects, and six expanded programs to address obstructions. At non-top ten airports safety and standards projects are recommended at Darrington, Swanson, and Vashon airports. These improvements will retain system access in the northeast and southernmost areas of the region, as well as Vashon Island. Other safety and standards improvements are shown at several busier privately owned airports (Apex Airpark, FirstAir Field, Port Orchard, and Spanaway). These improvements are shown at the discretion of the airport owners. Lastly, several safety and standards projects are shown for Sea-Tac International Airport. These projects are included in the airport master plan, and are currently being implemented. Numerous safety and standards projects are currently underway at several airports, and will possibly be complete when this *2001 RASP* is published. Those projects are indicated by use of *italics* in Exhibit 7-4.

System Strategy - Maintenance and Preservation

The airport system's pavements are an expensive and irreplaceable asset. They will be preserved, maintained, and improved as needed to protect the region's airport infrastructure, to maintain the safety, capacity, and reliability of the airport system, and to reduce the long-term system-wide cost of pavement improvements. Using the results of the WSDOT Aviation Division's 2000 statewide airport pavement maintenance/management program, the region will identify existing and future airport pavement needs and focus funding to address those needs. The Regional Council will use its Growth Management Act authority (including its comprehensive plan review and certification process) to improve compatibility between airports and their surrounding communities. This strategy is important for the long term preservation of the region's airports.

Airport capital improvement programs for many of the region's airports (see Chapter 9, exhibit 9-1) show the need for significant investment in pavement maintenance projects that is consistent with the levels recommended in the State's 2000 Pavement Management Program.

While the region's existing airport pavements are in relatively good condition, existing funding levels will not keep pace with future pavement maintenance needs. The 2000 WSDOT analysis predicts the average PCI for the state airport system would decline from its current 73 to approximately 65 over the next 8 years if funding for pavement maintenance programs is limited to the existing levels provided by state and federal sources ($3,350,000 per year).

In order to maintain the existing condition of the region's airport pavements, considerable additional funding will be required. At the 13 airports included in the regional pavement analysis, existing funding levels will meet just under half the amount required to maintain existing pavement conditions. Over the next 8 years, the region would need to generate over $14 million in additional funds to maintain and preserve the existing pavements at their current level (PCI = 76.19).

Airport sponsors, the Regional Council, State DOT Aviation Division, FAA, and others should work together to document the importance of airports to the state and the region, identify the airport system's pavement management funding needs, and pursue existing and new funding sources.

The State's Pavement Management Program has established an excellent baseline of information, and will be an extremely valuable ongoing resource to assist airport sponsors in identifying and planning for their pavement needs. Airport sponsors should work closely with the State DOT Aviation Division and their pavement management consultants in developing their ongoing airport specific pavement maintenance and management programs.

System Strategy - System Enhancements

Currently, some 87% of the region's based aircraft fleet and 88% of the region's aircraft operations are concentrated at the top ten airports. According to the *2001 RASP* forecasts, this concentration is expected to continue, with some 96% of future growth occurring at the top ten airports. The forecasts also predict strong growth in the corporate and business sector, with increasing numbers of higher performance turbine powered aircraft (both fixed wing and helicopter) entering the regional fleet, again almost exclusively at top ten airports. As a result, the region will experience growing demand for higher quality facilities and services to accommodate this shifting fleet.

A wide variety of system enhancements are recommended at the region's top ten airports, as displayed in Exhibit 7-4. The majority of the airport system enhancements displayed in Exhibit 7-4 have been identified as recommended improvements in both this *2001 RASP* and in airport master plans. Notable among these enhancements are 5 runway extensions (runway shifts at Bremerton and Boeing Field), new or improved instrument/GPS approaches at nine of the top ten airports, plus numerous improvements to approach and other airport lighting systems. At non-top ten airports very few enhancements are recommended other than runway extensions at FirstAir Field and Sky Harbor, whose current runways are between 500 and 1,000 feet short of recommended length to serve 75-95% of the small general aviation fleet. At Sea-Tac Airport numerous enhancement projects are planned, including the third runway, runway lengthening, new instrument/GPS approach, approach lighting, and approach protection programs are shown both in the *2001 RASP* and the Sea-Tac Airport Master Plan. At the other non-top ten airports, the regional airport system strategy is to preserve and maintain those facilities to provide safe access to the airport system. One notable exception is RASP support for proposed modest improvements to accommodate float plane passengers at the Will Rogers / Wiley Post Memorial Seaplane Base connected to Renton Municipal Airport.

System Strategy - System Capacity

Over the life span of this *2001 RASP* (2000-2020), most system airports will have adequate airfield capacity to accommodate forecast activity with acceptable levels of delay. The exceptions are Boeing Field (which will reach 99% of its annual capacity), and Paine Field and Auburn, both of which will reach over 80% of their annual runway capacity by 2020. Several airfield improvements are recommended for these three airports in the safety and standards and enhancements categories (see above and Exhibit 7-4). These airfield improvements will reduce peak hour delay, increase capacity during low visibility conditions, and squeeze marginal gains out of the airports' existing runway systems. But no additional runway capacity is planned. Rather, the system plan seeks to maximize the existing capacity of the system. The strategy related to airfield capacity is to provide landside facilities and service improvements at airports which have the ability and willingness to accommodate growth. The intent of this strategy is for these landside facility improvements to serve as an incentive to attract activity away from congested facilities.

On the landside, regional airport system strategy is to plan for facility expansion at the region's top ten airports, where 95% of the region's future growth is expected to occur. Most of this increased landside expansion is planned as hangars (90%) in response to user preferences. In addition, the system plan strategy is to provide additional aircraft storage facilities at top ten airports to accommodate existing airport tenants seeking to upgrade from tie-downs to hangars. The figures in Exhibit 7-4 (Regional Airport System Improvements) are based on accommodating all forecast new tenants (90% in hangars) plus 50% of existing tenant waiting list (except at Crest Airpark). Because of growth constraints at Crest Airpark, the *2001 RASP* recommends aircraft parking expansion at Auburn, Renton, and Pierce County/Thun Field to accommodate a portion of the demand that cannot be met at Crest. Auburn is currently building new aircraft hangars and is planning additional expansion on newly purchased property. Renton can provide between 50 and 80 new aircraft hangars after the Boeing company's current leases expire and they vacate their leaseholds on the west side of the airport. Since this is a longer term action (between 2010 and 2020) the current Renton Master Plan does not include any new hangars. Pierce County/Thun Field is planning new hangars to accommodate strong future demand, and the *2001 RASP* is recommending aircraft parking expansion at Thun Field to accommodate their forecast growth as well as a portion of the demand that cannot be accommodated at Crest.

With no airports east of Lake Washington, none in north King County (except Kenmore Air Harbor), and with Martha Lake Airport now closed, Harvey Field and Paine Field will be enhanced and expanded to help meet demand from these areas of King County. In support of designating Bremerton and Tacoma Narrows as new reliever airports, the *2001 RASP* strategy includes the provision of aircraft hangar upgrades for all current tenants on waiting lists at Bremerton and Tacoma Narrows.

System Strategy - Airport Roles

Historical trends and aviation forecast for the region confirm the dynamic nature of aviation, and the changing roles of airports within the regional airport system. In addition to responding to the needs expressed in sections immediately above, the regional airport system improvement program will be designed to support the designated roles of system airports. The following expresses the overall roles for airports in the *2001 RASP*.

Sea-Tac International Airport will continue to fulfill its role as the region's ***Primary Commercial Air Carrier Airport***. The *2001 RASP* supports improvements at Sea-Tac as identified in the 1994 Airport Master Plan and related environmental documents. The Regional Council will continue to coordinate with the Port, the FAA, the WSDOT Aviation Division, and other agencies to address the impacts of Sea-Tac Airport on neighboring communities.

Air Cargo activity will continue to be accommodated at Sea-Tac International Airport and King County International Airport/Boeing Field for the next 10-15 years. Air cargo forecasts have been prepared for each airport, and improvements are planned to accommodate all or much of that demand through 2009 at Sea-Tac and 2015 at Boeing Field. In the longer term, additional air cargo activity, and the necessary airport and ground access support facilities to accommodate that activity, will require additional planning at the airport and regional levels to determine appropriate roles for the region's airports.

Reliever Airports will provide alternative landing fields, aircraft basing, and support facilities to relieve Sea-Tac of pressure from general aviation users. Auburn, Boeing Field, Harvey Field, Paine Field, and Renton will continue to fulfill this role. Paine Field and Harvey Field will be expanded to accommodate continued growth in the north part of the region. Bremerton National and Tacoma Narrows will become designated reliever airports, and will be enhanced to accommodate growth in the south portion of the region. Renton and Auburn will also be expanded and enhanced within their physical ability to accommodate growth, to meet a portion of the future demand in King County. Renton is more constrained than Auburn, and can accept some 50-80 new hangars, while Auburn can accommodate up to 150 new aircraft hangars on existing and newly purchased property.

Top Ten Airports accommodate nearly 90% of the region's total based aircraft fleet and aircraft operations, serve nearly all regional activity by turbo jets and rotorcraft, and accommodate all the region's glider, experimental, and ultra-light industry (Arlington). In addition, these airports are forecast to see over 90% of the region's future growth. As such, the region's top ten airports must accommodate a growing amount of traffic and an increasingly rigorous set of user needs. The region's top ten airports will be preserved, maintained, and enhanced to meet the multiple needs of the region, including the growing corporate sector, business aviation, and traditional general aviation users. Arlington will make improvements to enhance its regional niche in the aviation market (gliders, ultra-ultra-lights, and experimental aircraft). In addition, several improvements at Arlington are included in both the *2001 RASP* and the airport master plan (runway extension, instrument approach, and approach lighting) to enhance its ability to meet overall demand in the north part of the region.

Non-Top Ten Airports make up 2/3 of the system's landing fields, and provide an important transportation resource for communities throughout the region. Regional airport system strategy is to maintain and preserve these community airports through selective funding of improvement projects, support for obstruction programs, and on-going airport compatible land use programs. Strategic safety and standards and enhancements projects are also included in the *2001 RASP* at several non-top ten general aviation airports were existing deficiencies are considered to be significant, and where improvements will provide improved safety and access.

The ***State-Owned Emergency Airports*** (Bandera, Ranger Creek, and Skykomish) will be preserved and maintained, and will receive limited funding as needed to maintain their roles as emergency airfields.

Private Airports Open to Public Use will continue to be an important component of the regional airport system. The region's privately owned public use airports will continue to focus primarily on private pilot user groups, training programs, and discretionary/recreational flyers. These airports will continue to fund most of their improvement needs, but the Regional Council will explore the potential for providing public funds for critical projects at major privately owned public use airports (such as Crest Airpark and Harvey Field). The Regional Council will also support maintenance and preservation of the region's private airports by identifying pavement needs and through its ongoing airport compatible land use program (see Chapter 8 below).

Seaplane bases are a unique resource and an important component of the regional airport system. The region will support the preservation and enhancement of privately owned seaplane bases through identification of facility needs and through the Regional Council's role in supporting compatible land use. At Will Rogers/Wiley Post Memorial Airport, the region will support the City of Renton's plans for modest seaplane base improvements (new docks and a passenger terminus) as identified in the Renton Municipal Airport Master Plan.

The region's ***heliport system*** has not been addressed in this update of the *2001 RASP*. The region generally supports the recommendations contained in the *Puget Sound Heliport System Plan* published by the Washington State DOT Aviation Division in 1995. The Regional Council will support the WSDOT Aviation Division in efforts to implement that plan, and would support additional planning studies as required to further clarify the region's heliport system needs.

Regional Airport System Improvements

Exhibit 7-4 (contained on three successive sheets) displays recommended regional airport system improvements grouped by priority for each of the system's public use airports (excluding McChord AFB and Gray Army Airfield at Ft. Lewis). These system improvements are categorized by priority groups: (1) safety and standards; (2) maintenance and preservation; (3) system enhancements; and (4) system capacity.

Part 1 of Exhibit 7-4 displays recommended airport system improvements at the top ten system airports. Part 2 shows improvements recommended at the system's general aviation airports. Part 3 displays improvements recommended at Sea-Tac Airport, the four sea-plane bases, and the three state-owned emergency airfields. The system improvement recommendations are shown for each airport as "X" if the improvement or program is recommended only in the *2001 RASP* and as "MP" if it is recommended in both the *2001 RASP* and the airport master plan. Several improvement projects at Sea-Tac Airport and Snohomish County Airport/Paine Field, and shown in the exhibit, are already being implemented by airport sponsors. These projects are shown in *italics*. Many of the smaller general aviation airports in the

system do not have current master plans. In these cases the *2001 RASP*-proposed improvements were discussed with airport management before the recommendation was included in the *2001 RASP*.

Under system enhancements, improvements listed in Exhibit 7-4 show the runways or runway ends where the improvement is proposed. Many of these were derived from the airport master plans and reconfirmed in the *2001 RASP* planning process. For many private airports, improvements listed in Exhibit 7-4 are noted with a "P". In these cases, airport improvements are recommended in the *2001 RASP*, but are within the sole discretion and control of the private operator. Therefore, implementation of these improvements is uncertain, and the recommendations are meant as a way to communicate regional system priorities and needs to private airport owners and operators. In many of these cases, the improvements are shown in the *2001 RASP* because these airports have not completed a master plan process in recent years, if at all, and the airport improvement information may be beneficial to airport sponsors.

A comparison of new hangars recommended in the *2001 RASP* and those identified in airport master plans shows a fairly close correlation (see Exhibit 7-4). Because current master plan recommendations for new aircraft storage facilities are generally available only for the larger airports, the exhibit displays master plan numbers only for the top-ten airports. At these airports, the *2001 RASP*-recommended numbers are generally higher because they include new hangars to accommodate a portion of the airports' current waiting lists, while the master plans do not. This is the case for Auburn, Boeing Field, Harvey Field, Paine Field, Thun Field, and Tacoma Narrows. Due to the lack of available property for additional hangars, the numbers recommended in the *2001 RASP* for Renton and Crest do not include a significant share of their current waiting lists. Renton's current master plan shows no new aircraft hangars until the existing Boeing Company leases expire. At Arlington, the master plan assumes future hangar demand will be addressed by private developers. To meet these needs, the Arlington master plan sets aside adequate acreage to meet forecast demand but does not specify the number of hangar units.

Exhibit 7-4 Regional Airport System Improvements (part 1)

	Top Ten System Airports									
	Existing Reliever Airports					*Other Top Ten Airports*				
		Boeing	Harvey	Paine				Crest	Pierce Co.	Tacoma
System Improvement Priorities *	**Auburn**	**Field**	**Field**	**Field**	**Renton**	**Arlington**	**Bremerton**	**Airpark**	**Thun Field**	**Narrows**
1. Safety and Standards										
Runway Widening			**MP**					**MP**	**MP**	
RSA Width										
RSA Length Beyond		**MP**		*MP*				**P**		**MP**
Obstruction Program	**MP**	**X**	**P**	*MP*			**MP**	**MP**	**MP**	
2. Maintenance and Preservation										
Pavement Improvements	**MP**	**MP**	**P**	**X**	**X**	**MP (Apron)**	**MP**	**P**	**MP**	**MP**
Compatible Land Use Program	**X**	*MP*	**P**	**X**	**MP**	**MP**	**X**	**P**	**MP**	**MP**
3. System Enhancements **										
Runway Extension		**MP**	**P**			**MP**	**MP**			
New Instrument/GPS Approach	**X**	**MP**	**P**	**16L, 34L / MP**	**15 / MP**	**34 / MP**	**19 / MP**	**P**	**16 / MP**	
New Approach Lighting / Navaids	**X**		**P**		**X**	**MP**		**P**	**34 / X**	
New VASI/PAPI		**13L-31R / MP**	**MP**			**MP**		**MP**		**MP**
Install REIL		**13L-31R / MP**	**P**	**11-29 / MP**		**34 / MP**	**X**	**P**	**MP**	**MP**
New Airport Beacon			**P**							
Approach Protection	**MP**					**34 / MP**		**MP**		
Runway Edge Lighting			**MP**			**MP**		**P**		
Terminal Building Remodel		**MP**								
Air Traffic Control Tower				***MP***						
4. System Capacity										
New Aircraft Hangars (RASP) ***	**144**	**102**	**197**	**188**	**63**	**175**	**69**	**48**	**113**	**74**
New Aircraft Hangars (MP) ***	**119**	**72**	**144**	**100**	**0**	**Unspecified**	**70**	**50**	**121**	**49**
Additional Air Cargo Facilities		**MP**								
*** Airport improvements shown with "X" are recommended in the RASP; those shown with "MP" are recommended in the RASP and airport master plans; those shown with "P" are recommended at private airports. Projects that are underway are shown in *italics*.**										
**** Numbers indicate runway ends where enhancements are planned.**										
***** Numbers indicate new based aircraft hangars. RASP hangar numbers represent 90% of all new demand plus 50% of existing waiting lists. Master plan numbers generally do not include waiting lists.**										

Exhibit 7-4 Regional Airport System Improvements (part 2)

	General Aviation Airports								
	Apex	Darrington	FirstAir	Martha	Port	Sky	Spanaway	Swanson	Vashon
System Investment Priorities *	Airpark		Field	Lake	Orchard	Harbor			
				Marthe Lake Airport is Closed					
1. Safety and Standards									
Runway Widening	P	X	P		P		P	X	X
RSA Width	P	X	P					X	X
RSA Length Beyond	P	X	P				P	X	X
Obstruction Program	P	X	P		P	P	P	X	X
2. Maintenance and Preservation									
Pavement Improvements			P		P		P		
Compatible Land Use Program			P						
3. System Enhancements **									
Runway Extension			P			P			
New Instrument/GPS Approach									
New Approach Lighting									
New VASI/PAPI	MP		P						
Install REIL									
Runway Edge Lighting			P						
New Airport Beacon			P						
Approach Protection									
4. System Capacity									
New Aircraft Hangars ***	0	1	23		6	3	14	5	5

* Airport improvements shown with "X" are recommended in the RASP; those shown with "MP" are recommended in the RASP and airport master plans; those shown with "P" are recommended at private airports. Projects that are underway are shown in *italics.*

** Numbers indicate runway ends where enhancements are planned.

*** Numbers indicate new based aircraft hangars. RASP hangar numbers represent 90% of all new demand plus 50% of existing waiting lists.

Exhibit 7-4 Regional Airport System Improvements (part 3)

	Commercial	Sea-Plane Bases				State-Owned Emergency Airfields		
	Sea-Tac	American	Kenmore	Lake	Will	Bandera	Ranger Creek	Skykomish
System Investment Priorities *	Int'l	Lake	Air	Union	Rogers	State	State	State
1. Safety and Standards								
Runway Widening								
RSA Width	*MP*							
RSA Length Beyond	*MP*							
Obstruction Program	*MP*					X		
2. Maintenance and Preservation								
Pavement Improvements	MP							
Compatible Land Use Program	*MP*							
3. System Enhancements **								
New Runway	*MP*							
Runway Extension	MP							
New Instrument/GPS Approach	16L / MP							
New Approach Lighting	MP							
New VASI/PAPI								
Install REIL								
New Airport Beacon								
Approach Protection	*MP*							
Terminal Facilities	*MP*				MP			
Air Traffic Control Tower	*MP*							
4. System Capacity								
New Aircraft Hangars ***	0	4	13	0	7	0	0	0
Additional Air Cargo Facilities	MP							

* Airport improvements shown with "X" are recommended in the RASP; those shown with "MP" are recommended in the RASP and airport master plans; those shown with "P" are recommended at private airports. Projects that are underway are shown in *italics.*

** Numbers indicate runway ends where enhancements are planned.

*** Numbers indicate new based aircraft hangars. RASP hangar numbers represent 90% of all new demand plus 50% of existing waiting lists.

Summary of Airport System Improvements (see also Exhibit 7-4)

Top Ten General Aviation Airports

The large majority of recommended improvements are focused at the top-ten system airports. These include significant projects in all four categories (safety and standards, maintenance and preservation, system enhancements, and system capacity). Consistent with system strategy, airport system improvements are proposed to address current safety and standards at all top-ten system airports. These include the following:

- Runway widening at Harvey Field, Crest Airpark, and Thun Field
- Runway safety area length beyond improvements at Boeing Field, Paine Field, Crest Airpark, and Tacoma Narrows
- Pavement improvements at all top-ten airports
- Compatible land use programs at all top-ten airports (several programs are already in place)
- Numerous system enhancements, including five runway extensions (or runway shifts), several improved approaches, new approach lighting and navaids, runway lighting, VASI/PAPI, and other projects. New Global Positioning System (GPS) approaches are shown for several top-ten system airports. The feasibility of these improvements, including costs, potential benefits, and necessary support actions (equipment, airport requirements, approach protection, and property acquisition needs) have not yet been evaluated. That evaluation is recommended as a follow on project to clarify and implement this *2001 RASP*.
- New aircraft hangars to meet future demands at each airport plus aircraft hangar upgrades to accommodate waiting lists (due to severe space constraints, some hangar demand at Crest will be accommodated by providing new hangars at Renton, Auburn, and Pierce County/Thun Field, within their ability to expand)

Other General Aviation Airports

- Numerous safety and standards improvements to address existing deficiencies and to maintain safe access to all parts of the region
- Several pavement improvements
- Compatible land use program at FirstAir Field
- Runway extensions at FirstAir Field and Sky Harbor to address existing runways significantly shorter than recommended length
- New hangars to meet forecast demand, primarily at FirstAir Field and Spanaway

Seattle-Tacoma International Airport

- Numerous safety and standards, pavement, compatible land use, capacity, and enhancement projects as outlined in the airport's current master plan. These include a third runway, runway extension, runway safety area improvements, passenger terminal expansion (including a new north terminal), additional passenger and employee parking, ground transportation center, Sound Transit "LINK" light rail station, new air traffic control tower, air cargo facility improvements, and airport south access road.

Sea-plane Bases

- New docks and passenger terminus at Will Rogers/Wiley Post Memorial seaplane base

Chapter 8 - Land Use Compatibility

Land use compatibility around airports is an important issue for the preservation, maintenance, and enhancement of the regional airport system. Zoning, planning, and development decisions on properties adjacent to airports can affect an airport's ability to fulfill its role as a regional transportation facility. Development of incompatible land uses adjacent to airports can expose neighboring development to airport noise, can create height hazards that compromise the safety of aircraft in the air, and can subject off-airport properties to potential safety risks and liability in known hazard areas. The basic goal of this chapter of the Regional Airport System Plan is to construct a baseline of information on land use compatibility around the region's airports to identify the extent of the issue. This baseline program provides a building block for additional future work in the area of airport compatible land use. This chapter of the *2001 RASP*:

- Describes the three dimensions of airport land use compatibility
- Provides sources of technical guidance in planning for airport compatible land use
- Summarizes the Regional Council's mandates for dealing with airport compatible land use
- Reviews existing and planned future land uses adjacent to the region's airports, and identifies the types of critical areas affected (height hazard, safety zones, and noise contours)
- Identifies the status of ordinances and plans dealing with airport compatible land use, height hazard, and safety concerns around system airports
- Presents analysis and findings relative to airport land use compatibility in the region

Three Dimensions of Airport Land Use Compatibility

Noise and compatible land use. Aircraft noise and its effect on surrounding land use is perhaps the most contentious issue in the aviation industry, particularly for airport operation and management. The political and technical dimensions of airport noise have been studied exhaustively and documented in hundreds of plans, studies, environmental reports, and government regulations. The central issues in the discussion of airport noise and land use compatibility are: (1) what level of airport noise constitutes "significant" impact to surrounding communities, (2) how does this noise affect different types of land uses, and (3) how can communities establish effective programs to reduce the impacts of airport noise? These issues have received considerable attention, particularly from the FAA. Recognizing that high levels of airport noise are generally not compatible with residential land uses, schools, hospitals, and other noise sensitive uses, the FAA has established criteria that outline the level of noise which is considered to be compatible with various types of land uses. These criteria are displayed in Table 1 on the following page. In addition, the FAA has established guidelines and procedures to assist airport sponsors and local planning agencies conduct noise and land use compatibility planning efforts (see FAA Advisory Circular AC 150/5020-1, *Noise Control and Compatibility Planning for Airports*).

In concert with Federal programs addressing compatible land use around airports, both the State of Washington and the Puget Sound Regional Council are developing and expanding programs to address these issues at the state and regional levels. These coordinated efforts by the WSDOT Aviation Division and the Regional Council are founded in 1996 amendments to the State's Growth Management Act. Both programs build upon the foundation laid down in the FAA's Part 150 Program, including the FAA guidelines for defining which land uses are compatible with varying levels of airport noise. Table 1 below, which was taken from the FAA's FAR Part 150 program, outlines these land use compatibility guidelines concerning airport noise. Additional guidelines related to height hazards and safety are discussed later in this chapter.

Exhibit 8-1
Land Use Compatibility* With Yearly Day-Night Average Sound Levels (DNL)

Land use	Yearly day-night average sound level (DNL) in decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodgings,	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE						
Offices, business, and professional	Y	Y	25	30	N	N
Wholesale and retail-building materials, hardware and farm equipment.	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade-general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction.	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

This exhibit was taken from FAA Advisory Circular AC 150/5020-1 “Noise Control and Compatibility Planning for Airports.”

See next page for key to abbreviations and notes for numbers in parenthesis.

* The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Key to Exhibit 8-1

SLUCM	Standard Land Use Coding Manual.
Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35	Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

Notes for Exhibit 8-1

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Planning for noise and land use compatibility around airports is primarily focused in two areas: (1) "remedial" programs (such as acquisition of noise-impacted properties and redevelopment with compatible uses, and provision of noise insulation for existing and new structures inside noise contour areas); and (2) "preventive" programs (planning and zoning programs which prevent the construction of land uses that are incompatible with airport noise). Remedial programs are primarily used by airport sponsors and the FAA to address noise problems. Local land use planning agencies, however, are in a position to effectively develop and implement "preventive" approaches to avoid future land use development that is incompatible with airport activity.

Information used to identify potential noise compatibility concerns adjacent to the region's airports included existing airport noise programs (where available), noise contour information from airport master plans, generalized existing land use, aerial photography, and planned future land use as included in currently adopted comprehensive plans. This information is summarized in Exhibits 8-2.1 and 8-2.2.

Height hazard / obstructions to navigable airspace (safety in the air). In addition to addressing airplane noise, communities surrounding airports can establish and maintain zoning and development regulations dealing with height hazard and obstructions. By limiting the height and location of structures and other obstructions to navigation in the vicinity of airports (buildings, towers, trees, etc.), these regulations can protect the safety of aircraft during takeoff and landing in the immediate vicinity of the airport.

The Federal Aviation Administration (FAA) has developed regulations and standards for dealing with height hazard, obstructions, and objects affecting navigable airspace. Cities and counties wishing to establish programs dealing with these issues should refer to the FAA's official guidelines: Code of Federal Regulations ("CFR"), Title 14, Part 77 ("Objects Affecting Navigable Airspace") and FAA Advisory Circular AC 150/5190-4A, *A Model Zoning Ordinance to Limit Height of Objects Around Airports*. Part 77 defines a system of imaginary surfaces (three dimensional space) around airports through which no fixed object or structure (including trees) should penetrate. These imaginary surfaces are designed to protect the critical airspace around airports and allow for safe operation of aircraft.

Public agencies or private developers proposing to construct structures or locate objects that would penetrate the Part 77 imaginary surfaces must notify the FAA using FAA Form 7460-1, "Notice of Proposed Construction or Alteration." FAA review will then determine whether the object should be allowed, and if so, how it should be marked and/or lighted so it can be seen by pilots. Of course, the best approach to maintaining the safety of navigable airspace around airports is to prohibit the construction of tall structures, regulate their location in relation to the extended runway centerline, and/or strictly limit their height. With technical assistance from airport sponsors, the FAA, WSDOT Aviation Division, and the Regional Council, local governments can develop regulations that address these issues, allowing for new development and providing for aviation safety.

One of the difficult challenges in the Puget Sound region is the proliferation of hazard trees in the vicinity of airports. Because they grow so rapidly, trees that were not hazards one year can penetrate Part 77 surfaces the next, and thus become navigation hazards. In order to protect airports from these "growing" height hazards, airports and surrounding land use agencies must regularly survey tree heights and either trim or remove them. Unfortunately, airports face challenges to tree trimming and removal, both on and off airport property, including tree cutting ordinances, difficult access to trees on steep slopes, regulations concerning cutting trees in or near wetlands, opposition to tree removal in required airport buffers, and general community activism. Maintaining a safe regional airport system relative to the height hazards of trees is a constant battle.

Safety and potential risk / liability (safety on the ground/accident potential). This dimension of compatible land use involves protecting the safety of people and structures on the ground, particularly beneath approaches to runways and along the sides of runways, where there is a higher probability for aircraft accidents. These areas, which are strictly defined by the FAA, include the runway protection zone (RPZ), runway safety area (RSA), object free area (OFA), obstacle free zone (OFZ), approach transition zone (ATZ), and for military airfields, accident potential zone (APZ). At civil airports the issues of safety and potential risk have traditionally been addressed through the application of FAA standards and recommendations related to airport design, as contained in the FAA Advisory Circular AC 150/5300-13 ("Airport Design"). These standards prescribe the dimensions of airport safety-related zones, and are tailored to the specific conditions at each airport, such as the type of aircraft typically using the airport and the type of runway approach (visual, non-precision, or precision). Outside these strictly defined airport safety zones, FAA encourages airport sponsors to engage in compatible land use planning to address noise, height hazard, and safety issues, both on and off airport property. It is here,

outside the FAA-defined safety zones, where technical guidance, communication, and cooperation between airport sponsors and land use planners is needed to address compatible land use issues.

While it is preferable for airports to acquire and control these safety zones, in some cases they fall on properties outside the airport. In these cases it is important for airport sponsors to work with local agencies to address the relevant airport compatibility issues in their local land use planning process.

The U.S. Department of Defense recognizes the need to actively plan for these potential safety risk zones in its *Air Installation Compatible Use Zones (*or "AICUZ"*)* program, which addresses noise compatibility issues and safety concerns around military airfields. The objective of the AICUZ program is to encourage compatible uses of public and private lands in the vicinity of military airfields through the local communities' comprehensive planning process. The military's studies of historical aircraft accidents shows that most aircraft accidents happen on or near the extended runway centerline. Based on this historical data, the AICUZ program defines clear zones and accident potential zones off the ends of military airfield runways, and outlines appropriate land uses in these areas.

Studies of aircraft accident patterns at U.S. civil airports (notably those done by the National Transportation Safety Board) have confirmed the military's experience, and have provided the foundation for many of the FAA's airport design standards. Communities can reduce potential risk to life and property, and exposure to possible liability, by limiting the types of land uses and minimizing the number of people and the height of structures (including trees) allowed in known aircraft accident safety zones adjacent to civil airports and in defined accident potential zones adjoining military airfields.

While on-airport safety has been addressed by FAA and military airport design standards, only in recent years have local land use planners begun to address the issues of airport-related safety, risk, and liability in potential safety zones outside airport property. Local land use planners are now beginning to include provisions to address airport safety concerns in their comprehensive land use planning process, and are relying on existing technical guidance materials for their planning efforts. The following describes the more notable sources of technical guidance to support airport safety, height hazard, and noise compatibility planning.

Technical Guidance in Planning for Airport Compatible Land Use

Federal guidance on land use compatibility related to airport noise is contained primarily in technical materials published by the FAA. The FAA's Advisory Circular AC 150/5020-1, *Noise Control and Compatibility Planning for Airports* provides technical information regarding airport noise and compatible land use, and outlines the Federally prescribed "Part 150" airport noise compatibility planning process.

FAA guidelines related to height hazard are contained in Federal Aviation Regulation Part 77 - "Objects Affecting Navigable Airspace". Known as Part 77, these regulations define a set of three-dimensional operating surfaces above and around airports, establish federal standards for determining obstructions in these navigable airspaces, outline an FAA notification, review, and hazard determination process for construction that might affect navigable airspace, and provide for lighting, marking, and removal of identified obstructions. Part 77 is the primary source of technical guidance on height hazard around civil airports in the U.S., and is commonly used in zoning and land use planning for areas around airports.

FAA standards and requirements related to safety are primarily found in FAA Advisory Circular AC 150/5300-13 (Airport Design). This circular provides a comprehensive set of FAA standards and recommendations for the design of civil airports, including overall airport geometry, runway and taxiway design, navigational aids, and air traffic control facilities.

The WSDOT Aviation Division published the first in a series of technical guidelines on airport compatible land use in February 1999 with its technical handbook titled *Airports and Compatible Land Use - Volume I.* Volume I provides an introduction and overview for decision makers in addressing airport compatible land use issues at the local government level. Future volumes are planned to provide additional technical assistance for local agencies, including comprehensive plan and zoning language, model ordinances, overlay zones, and other compatible land use planning tools.

The *Airport Land Use Planning Handbook*, prepared in December 1993 (and currently being revised) by California Department of Transportation (CalTrans) Division of Aeronautics, also contains useful information for agencies interested in developing regulations or taking land use actions to reduce risk and potential liability associated with incompatible land uses adjoining airports. Much of the technical analysis contained in the CalTrans handbook was incorporated into the 1999 WSDOT land use guidelines. In addition, the Denver Regional Council of Governments has produced a summary document ("Airport Compatible Land Use Design Handbook", May 15, 1998) which contains an excellent discussion of these issues and how local governments can address them.

The Washington, California, and Colorado airport compatible land use guidelines each recognize the three primary dimensions of compatible land use: height hazard, safety, and noise. These guidelines are all built upon the foundations contained in the FAA's Part 77, Airport Design advisory circular, and Part 150 noise compatibility planning process. The Washington State DOT Aviation Division and CalTrans Aeronautics airport compatible land use guidelines both identify aircraft accident safety zones derived from general aviation aircraft accident statistics collected by the National Transportation Safety Board (NTSB). These zones, displayed in Exhibit 8-3, show the areas of relative risk associated with possible aircraft accidents around typical general aviation airports. The aircraft accident safety zones information, supported by the underlying NTSB research, provides the basic foundation for airport compatible land use planning related to safety of persons and structures on the ground near airports. The WSDOT and CalTrans land use guidelines provide recommendations for population density, residential and non-residential land use, and special function land use, and provide a list of land use planning strategies to guide local land use planners for each of these safety zones.

The WSDOT, CalTrans, and Denver Regional Council of Governments guidance materials are not intended to be proscriptive, but are meant to guide the development of comprehensive land use plans and associated land use regulations. None of these agencies controls land use, zoning, or development permits. These guidance materials were developed, and are presented here, to serve as guidance for any local land use planning agency that wishes to use it in planning for compatible land use around airports.

Mandates Supporting the Regional Council's Involvement in Airport Compatible Land Use

Several Regional, State, and Federal laws provide support for the Regional Council's interest and involvement in the issue of airport compatible land use. The most relevant of these are the state's Growth Management Act (Chapter 36.70A RCW) and Planning Enabling Act (Chapter 36.70 RCW), state law governing Regional Transportation Planning Organizations (RCW 47.80), Regional Council policies and procedures implementing these laws, and FAR Part 150 of the Federal Aviation Regulations (FAR Part 150) governing Noise Control and Compatibility Planning for Airports. These are each described briefly

below. In addition, RCW 36.70A.200 of the Growth Management Act defines airports as essential public facilities, and requires cities and counties to have a comprehensive planning process for siting them.

Growth Management Act (Chapter 36.70A RCW) and Planning Enabling Act (Chapter 36.70 RCW). In 1996 substitute senate bill *SSB-6422* amended the Growth Management Act (GMA) and the Planning Enabling Act to protect public use general aviation airports from encroachment by incompatible land uses. The new law requires cities and counties planning under GMA, through their local comprehensive plans and development regulations, to "discourage" the siting of incompatible land uses adjacent to such airports. Formal consultation with the aviation community is required, and all plans and regulations must be filed with the WSDOT Aviation Division. The Regional Council has worked with the WSDOT Aviation Division and other state agencies in developing guidelines for implementing the law. Using their respective authority under SSB-6422, relevant sections of the Planning Enabling Act (Chapter 36.70 RCW), the Growth Management Act (Chapter 36.70A RCW), and RTPO legislation (see below), the state and the Regional Council are developing airport compatible land use recommendations.

In late 1998 the Regional Council began implementing its mandated GMA provisions by incorporating the review of compatible land use around airports into its comprehensive plan review and certification criteria. In 1999, the Regional Council began using these criteria in its review and certification of all local comprehensive plans. The Regional Council relies on FAA guidance, as well as the CalTrans and WSDOT Aviation Division materials, in its review process. Both WSDOT Aviation Division and CalTrans Aeronautics are working on revised guidance materials. As the new technical information becomes available the Regional Council may incorporate the data into its plan review and certification process.

Chapter 47.80 RCW (Regional Transportation Planning Organizations) instructs regional transportation planning organizations ("RTPOs") to prepare Regional Transportation Plans ("RTPs") and authorizes RTPOs to review and certify that the transportation elements of comprehensive plans adopted by counties, cities, and towns within the region reflect state guidelines and are consistent with the Regional Transportation Plan ("RTP"). In addition, all local comprehensive plans are expected to be consistent with the aviation component of the RTP. The Regional Council has produced guidance materials for local agencies concerning how aviation facilities should be addressed in local comprehensive plans.

Chapter 14.12 RCW ("Airport Zoning"). Chapter 14.12 of the RCW provides cities and counties with the authority to establish airport zoning. The act declares airport hazards to be a nuisance, states the public interest in preventing airport hazards, and provides the authority of police power to implement the provisions. The act finds that airport hazards endanger the lives and property of users of the airport and of occupants of land in its vicinity, and also finds that the existence of hazards impairs the utility of the airport and the public investment therein. The act states "....It is further declared that both the prevention of the creation or establishment or airport hazards and the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards are public purposes for which political subdivisions may raise and expend public funds and acquire land or property interests therein." Among other things, these provisions of RCW 14.12 establish the authority to limit the height of buildings, towers, smoke stacks, and transmission lines, as well as the authority to implement height (avigation) easements around the state's airports.

Federal Aviation Regulation (FAR) Part 150 (Noise Control and Compatibility Planning for Airports). This FAA program provides airport sponsors and local communities with technical guidance and outlines the planning process used to document existing airport noise, predict future noise exposure, help reduce airport noise at the source, and reduce impacts in communities exposed to aircraft noise. The program also provides guidelines for determining what types of land uses are compatible with various levels of noise exposure. Following successful completion of the specified process, the Part 150 program provides access to FAA noise funds, which can be used to install noise insulation, purchase property, and implement other eligible programs designed to reduce airport noise impacts. For more information see FAA Advisory Circular AC 150/5020-1, *Noise Control and Compatibility Planning for Airports*.

Existing and Planned Land Use Adjacent to System Airports (from comprehensive land use plans)

One of the objectives of this chapter is to provide a baseline of information on airport compatible land use around the region's airports. In order to assess the condition of the regional airport system related to compatible land use, data was collected from a variety of sources to document both existing and planned future land uses around system airports. Data sources included county current use taxation files and aerial photography to document generalized current land use, and city and county comprehensive plans and airport master plans to identify future planned land use. In addition, inventory data collected by the WSDOT Aviation Division in 1998 for the Washington State Aviation System Plan update was used. The State's airport inventory included a discussion of existing land uses and structures in the vicinity of airports, and a listing of compatible land use planning programs adjoining the state's airports. The Regional Council's geographic information system (GIS) was employed to document, display, and analyze the land use data. Land uses were documented according to FAA land use compatibility criteria. The uses of most critical concern related to aircraft noise and safety include residential units, schools, churches, hospitals, libraries, and public sites which congregate people, either indoors or outdoors (such as theaters and amphitheaters, playgrounds, zoos, and amusement parks). These uses and their relative compatibility with airport noise are displayed in Exhibit 8-1 above.

Exhibits 8-2.1 and 8-2.2 display a summary of land use compatibility conditions for the 28 airports in the system. Exhibit 8-2.1 displays each system runway, its length, and identifies which airports are located within the urban growth boundary. In addition, this shows the types of land uses which currently exist around the region's airports, and identifies the type of compatibility issue (height hazard, safety, or noise) that may be affected by the proximity of those land uses to the airport. The presence of an asterisk (*) in these columns indicates any of the following: (1) there are currently height hazard obstructions which affect the airport approaches; (2) there are objects or land uses located within existing known critical safety zones which might be considered incompatible (these zones include existing runway safety areas, runway protection zones, runway object free areas, and approach transition zones); and/or (3) there are existing identified noise sensitive land uses located within existing 65 DNL noise contours.

Exhibit 8-2.2 displays whether known compatible land use plans and/or height hazard ordinances are in place in neighboring communities adjoining the region's airports. This also shows future planned land uses as identified in currently adopted comprehensive land use plans, including the range of densities allowed for future residential uses. Lastly, the exhibit shows for each airport whether future land use plans would allow additional development of potentially incompatible land uses (primarily residential) in future noise contours and/or near airport runway ends or under runway approaches.

For airports where noise contour information is available, existing and planned future land use inside the existing and projected future 65 DNL noise contours was reviewed. For airports without documented noise contour information, the size and shape of aircraft noise impact areas was estimated based on the amount and type of aircraft traffic. In many cases at the smaller airports, the noise contours remain within airport boundaries, and noise is not a significant compatibility issue. In several cases at small privately

owned airports, residential units immediately adjoin the airport. While these residences may be exposed to airport noise in the 60-70 DNL level, many are owned by pilots and airport users, and are considered to be compatible with airport operation.

The existence of airport height hazards was determined using existing obstruction data from airport master plans, FAA Airport Master Records, and WSDOT's obstruction database. Obstructions take the form of trees, fences, towers, buildings, and other natural and man made objects, and are located both on airport property and on adjoining public and private property. Obstructions located off airport property are generally more difficult to address, particularly when they affect aircraft navigation at privately owned airports. In these cases, the airport owner has limited ability to effectively remove, cut (in the case of trees), light, and mark the obstruction. A more detailed accounting of obstruction information is included in Chapter 6 (see Exhibit 6-5).

The potential for incompatible land uses in airport safety zones was generally reviewed using existing and future planned land use information prepared by the Regional Council. That land use information was compared with aircraft accident safety planning guidelines developed by the WSDOT Aviation Division using National Transportation Safety Board (NTSB) data, as well as information developed by the California Department of Transportation (CalTrans) Aeronautics Program. The basic foundation for the WSDOT and CalTrans safety zone planning guidelines was derived using annual NTSB aircraft accident statistics collected from over 7,000 aircraft accidents between 1964 and 1989. In addition, CalTrans performed a more detailed evaluation of NTSB accident data for 400 general aviation aircraft accidents from 1983 and 1991. The aircraft accident database used by CalTrans includes all types of general aviation airplanes, but does not include accidents involving airline aircraft, military aircraft, helicopters, or ultralights. The complete aircraft accident database covers a broad range of conditions, including arrivals and departures, aircraft type, weather conditions (IFR and VFR), time of day, pilot control, approach type, and accident location relative to the runway.

In 1993 the California Department of Transportation Division of Aeronautics incorporated the NTSB data into its *Airport Land Use Planning Handbook*. Using the database of 400 general aviation aircraft accidents which occurred between 1983 and 1991, the number and geographic distribution of accidents relative to airport runways was mathematically analyzed to capture aircraft accident clusters based on their geographic distribution near the runway. Based on the accident cluster data, CalTrans developed six aircraft accident safety zones which represent relative accident risk probabilities. CalTrans then developed compatible land use guidelines for each of the six safety zones. These same six zones were used in the WSDOT Aviation Division's Airports and Compatible Land Use handbook. The size and shape of safety zones varies based on airport runway length, with safety zone dimensions grouped into three classes: runways less than 4,000 feet; those between 4,000 and 5,999 feet; and those longer than 6,000 feet. The geometric shapes and dimensions of the six aircraft safety zones for each runway length are displayed in Exhibit 8-3. The total area contained within the combined six aircraft safety zones equals 935 acres for runways less than 4,000 feet long, 1,700 acres for runways between 4,000 and 5,999 feet long, and 2,183 acres for runways of 6,000 feet and longer.

Because of the number of variables included in the NTSB accident database, it is difficult to apply standardized planning templates such as the safety zones to multiple airports across the region. One difficulty relates to applying uniform guidelines to airports which have a wide variety of operating conditions, including aircraft traffic mix, control towers, topographic features, air traffic patterns, and approach types. These details could have a significant affect on airport safety, but are not factored into the guidelines. In addition, there are limitations involved in grouping airports based solely on three categories of runway length. Another difficulty relates to the size of the combined 6 safety zones, which can encompass over 2,100 acres (for airports with runways over 6,000 feet). In some locations in the region, these combined zones would cover urban areas that are largely developed. This is particularly

true around the larger reliever airports such as Boeing Field, Paine Field, Renton Airport, and Auburn Airport.

Applying new land use guidelines in such areas may not be effective in reducing existing risk, and would likely be difficult to equitably apply, given property rights issues. On the other hand, for airports which are currently surrounded by open space or otherwise compatible land uses, applying the entire six safety zones may be appropriate in preventing long term land use encroachment. In such cases, effective implementation of the WSDOT and CalTrans guidelines can possibly prevent future development of incompatible land uses and structures. The variety of conditions which exist across the region underscores the need for flexibility in the application of compatible land use guidelines.
This analysis of land use adjoining the 28 system airports is focused on land uses inside the three most critical safety zones: zones 1, 2, and 5. While these three zones encompass less than 20% of the entire area contained within the six safety zones, they account for nearly half of all accidents occurring in the six zones. Due to their location along the sides of the runway, and adjoining the runways ends, these three zones represent the highest aircraft accident risk areas surrounding an airport, according to the CalTrans analysis. Zone 1 roughly corresponds to the Runway Protection Zone (RPZ) according to FAA airport planning and design standards (FAA Advisory Circular No. AC 150-5300-13). Relative to its size, zone 1 has between 4 and 6 times more potential for aircraft accidents than the other five zones.

Because of the higher probability for accidents in zones 1, 2, and 5, the land use guidelines for these three zones as contained in both the CalTrans and WSDOT compatible land use programs recommend prohibition of all residential development and special function land uses in these zones. Focusing on these three zones is analogous to planning for noise compatibility inside the 65 DNL noise contour. While there is evidence that noise impacts do occur outside the 65 DNL contour, most noise compatibility planning is focused on those areas most significantly affected, i.e., the 65, 70, and 75 DNL noise contours. Similarly, while there are some safety concerns associated with land uses located in safety zones 3, 4, and 6, those concerns are significantly lower than those for safety zones 1, 2, and 5.

Because of the number and variety of airports and runways in the regional airport system, this analysis is somewhat generalized. The intent of the analysis is to identify major region-wide issues related to airport compatible land use so future actions to address them can be taken. Future more detailed analysis is needed to evaluate the larger zones (3, 4, and 6) for each airport, including evaluation of their relative safety potential, and development of appropriate land use guidelines for use by local planners. Both CalTrans and WSDOT are preparing revised analysis and updated technical guidance materials. When this new information becomes available it may provide improved airport compatible land use guidance to local land use planners.

Land Use Compatibility Findings

The regional airport system is large, busy, and complex. It serves a great variety of users who place large and growing levels of demand on the system. In order to meet these needs, most of the region's airports are located within easy access of its major users. They are close to the regional highway system, and are largely located within the urban growth area ("UGA"). Many of the region's airports are also located conveniently to serve the region's population and employment base. Those that are not are strategically located to serve emergency response and natural resource needs.

Unfortunately, all these characteristics of the airport system also mean that compatible land use is a major issue facing the regional airport system. Of the 28 airports in the system, 20 are located within the UGA. Land use and development within the urban growth area is increasing the pressure for encroachment around airports. Residential, commercial, and industrial development is creeping ever closer to airports that are at the same time getting busier, and needing more space to meet airport needs. Of the 8 airports outside the UGA, six serve emergency response or rural aviation needs. The other two, Tacoma Narrows and Crest Airpark, are busy airports meeting important regional needs, and are currently located outside the UGA. Development of urban services to serve both airport growth and development in surrounding communities is an issue at Tacoma Narrows. Crest Airpark is located in a rapidly growing region of southeast King County with the newly incorporated city of Covington located immediately to its north.

The fact that most of the region's airports are within the urban growth area creates two inherent conflicts. On the one hand, location inside the UGA offers benefits: airports have access to urban utility and transportation services; growth planning in the urban area offers potential avenues to address compatible land use issues; and economic development supports airports financially. On the other hand, the rapid growth and expanding urban development that is encouraged inside the UGA gives rise to many of the land use encroachment problems that now face many of the region's airports. The growth management act encourages regions to contain development within the urban growth area boundary, which stimulates increased densities and urban infill development. The indirect result can be more people are exposed to aircraft noise, and more people and structures are potentially affected by the issues of height hazard and aircraft safety. Evaluating the extent of these issues begins with an inventory of existing and planned future land uses surrounding the region's airports.

Existing land uses adjoining the region's airports vary from forest to residential to commercial to industrial. Only three airports are surrounded by non-noise sensitive land uses: Bandera, Ranger Creek, and Skykomish, all being State-owned emergency airfields located in the Cascade foothills. To some degree all other system airports have residential and other non-compatible land uses (such as schools, libraries, churches, and hospitals) nearby. Nevertheless, because their existing noise contours are largely contained within airport property, most of the system's airports are not considered to be incompatible with surrounding land use. Only three system airports (Boeing Field, McChord AFB, and Sea-Tac) generate off-airport 65 DNL noise contours that are known to affect adjoining non-compatible land uses. Each of these airports has prepared, or is currently preparing, airport compatible land use programs to address airport noise issues.

Although existing 65 DNL noise contours may not extend beyond airport boundaries at many regional airports, noise from aircraft overflights is a common and growing issue throughout the region. With total regional aircraft activity forecast to continue growing, and with larger business aircraft expected to lead that growth, the aircraft overflight issue will continue to be an important one. Planning for non-noise sensitive land uses and lower densities of noise sensitive land uses under known aircraft flight paths is one approach that might be effective in reducing future problems related to overflights. Such planning would also begin to address the related issues of height hazard and safety.

Exhibit 8-2.1 Airport Compatible Land Use - - Part 1

					Critical Areas Affected by Existing Land Use		
			Airport Inside		In The Airport Vicinity **		
	Runway	Runway	Urban Growth	Existing Land Uses in the Airport Vicinity	Height	Safety	Noise
Airport	Number	Length (ft.)	Boundary		Hazard	Zones	Contour
American Lake	02-20	5,500	*	Residential			
Apex Airpark	17-35	2,500		Residential, industrial	*	*	
Arlington Municipal	11-29	3,500	*	Commercial, industrial, residential			
	16-34	5,333	*	Commercial, industrial, residential			
Auburn Municipal	16-34	3,400	*	Commercial, industrial		*	
Bandera State	08-26	2,342		Forest	*		
Boeing Field	13L-31R	3,710	*	Commercial, industrial			
	13R-31L	10,001	*	Residential, commercial, industrial	*	*	*
Bremerton National	01-19	6,200	*	Commercial, industrial, residential			
Crest Airpark	15-33	3,267		Residential	*	*	
Darrington Municipal	10-28	2,490	*	Cemetery, bus barn, residential	*	*	
FirstAir Field	07-25	2,095	*	Fairgrounds, residential, commercial	*	*	
Gray Army Airfield	15-33	6,125	*	Residential (on base), commercial (on base)			
Harvey Field	14-32	2,660	*	Rural	*	*	
Kenmore Air Harbor	16-34	10,000	*	Industrial, commercial, residential			
	18-36	3,000	*	Industrial, commercial, residential			
Lake Union Chrysler Air	18-36	9,500	*	Industrial, commercial			
McChord AFB	16-34	10,100	*	Residential, commercial	*	*	*
Pierce County / Thun Field	16-34	3,650	*	Residential, commercial, landfill (south)	*		
Port Orchard	18-36	2,460		Light industrial			
Ranger Creek State	17-35	2,700		Forest	*		
Renton Municipal	15-33	5,379	*	Commercial, industrial, residential, high school		*	
Sea-Tac Int'l	16L-34R	11,900	*	Residential, schools, churches			*
	16R-34L	9,425	*	Residential, schools, churches			*
Sky Harbor	07-25	1,930	*	Forest, residential	*		
Skykomish State	06-24	2,050		Forest	*		
Snohomish County / Paine Field	11-29	4,514	*	Commercial, industrial, residential	*	*	
	16L-34R	3,000	*	Industrial, residential		*	
	16R-34L	9,010	*	Residential, industrial, commercial, SR525/526	*	*	
Spanaway	16-34	2,724	*	Residential, commercial, industrial	*	*	
Swanson	16-34	3,000	*	Residential, forest	*	*	
Tacoma Narrows	17-35	5,002		Residential			
Vashon Island	17-35	1,940		Residential	*	*	
Will Rogers/Wiley Post	12-30	5,000	*	Commercial, residential			
* At some privately owned airports adjacent residential development (typically aircraft owners living next to the airport) is considered to be compatible with airport noise. Residential use on military bases is considered compatible with airport noi							
Existing land uses are not considered incompatible unless they are noise sensitive and occur within noise contours; pose a potential height hazard; or are located in airport safety zones.							
** Height hazard includes known natural and man-made obstructions based on FAR Part 77 (see Exhibit 6-5).							
Safety zones include runway safety area, RPZ, ATZ, runway OFA, and Aircraft Accident Safety Zones 1, 2, and 5 from WSDOT's "Airports and Compatible Land Use" handbook.							
Noise includes uses inside noise contours or near runway ends.							

Exhibit 8-2.2 Airport Compatible Land Use - - Part 2

Airport	Runway Number	Compatible Use Plan or Zoning?	Height Restriction Ordinance?	Future Planned Land Uses in the Airport Vicinity	Planned Residential Density (Units/ac)	Potential future incompatible land use allowed inside future noise contour? ***	Potential future incompatible land use allowed inside airport safety zones? ****
American Lake	02-20			Residential	2 - 6	No	No
Apex Airpark	17-35			Residential, airport	0 - .2	No	Yes
Arlington Municipal	11-29	Yes	Yes	Industrial, commercial, agriculture, residential	.1 - 24	No	No
	16-34	Yes	Yes	Industrial, commercial, agriculture, residential	.1 - 24	No	No
Auburn Municipal	16-34		Yes (per ALP)	Commercial, industrial, parks/open space	0	No	No
Bandera State	08-26			Forest	0	No	No
Boeing Field	13L-31R	On-going		Commercial, industrial	N/A	No	No
	13R-31L	On-going		Commercial, industrial, mixed use, residential	4 - 20	Yes	Yes
Bremerton National	01-19	Yes	Yes	Commercial, industrial, residential, parks & open space, airport	0 - .2	Yes	No
Crest Airpark	15-33		No	Residential	.1 - 12	Yes	No
Darrington Municipal	10-28			Light industrial, parks/open space, forest service, residential	1 - 1.35	No	No
FirstAir Field	07-25			Fairgrounds, residential, commercial, industrial, open space	3 - 7	Yes	Yes
Gray Army Airfield	15-33			Government (military base)	NA	No	No
Harvey Field	14-32			Commercial, industrial, agriculture, parks/open space	.4 - 6	No	Yes
Kenmore Air Harbor	16-34			Residential, mixed use	4 - 24	No	No
	18-36			Residential, mixed use	4 - 24	No	No
Lake Union Chrysler Air	18-36			Industrial, commercial, mixed use, parks/open space	4 - 30	No	No
McChord AFB	16-34	Yes		Residential, commercial, industrial, government (military base)	2 - 30	Yes	Yes
Pierce County / Thun Field	16-34		No	Industrial, mixed use, residential	2 - 25	No	Yes
Port Orchard	18-36	Yes		Light industrial, residential	0 - .2	No	No
Ranger Creek State	17-35			Forest	0	No	No
Renton Municipal	15-33			Center/downtown, industrial, residential, mixed use	8 - 25	No	Yes
Sea-Tac Int'l	16L-34R	Yes	Yes	Residential, parks/open space, industrial, commercial	3 - 87	Yes	Yes
	16R-34L	Yes	Yes	Residential, parks/open space, industrial, commercial	3 - 87	Yes	Yes
Sky Harbor	07-25			Residential, office/industrial, agriculture	1 - 12	No	No
Skykomish State	06-24			Forest	0	No	No
Snohomish County / Paine Field	11-29			Industrial	3 - 29	No	Yes
	16L-34R			Industrial, residential	3 - 29	No	Yes
	16R-34L			Residential, industrial, commercial, mixed use	3 - 29	No	Yes
Spanaway	16-34			Residential, commercial, mixed use, military	2 - 25	No	Yes
Swanson	16-34	Yes	Yes	Airport, forest, commercial, residential	.1 - 12	No	Yes
Tacoma Narrows	17-35	Yes *****		Residential, rural airport/essential public facility	0 - 4	No	Yes
Vashon Island	17-35		No	Residential, agriculture	.1 - 12	No	Yes
Will Rogers/Wiley Post	12-30			Industrial, residential	8 - 20	No	No

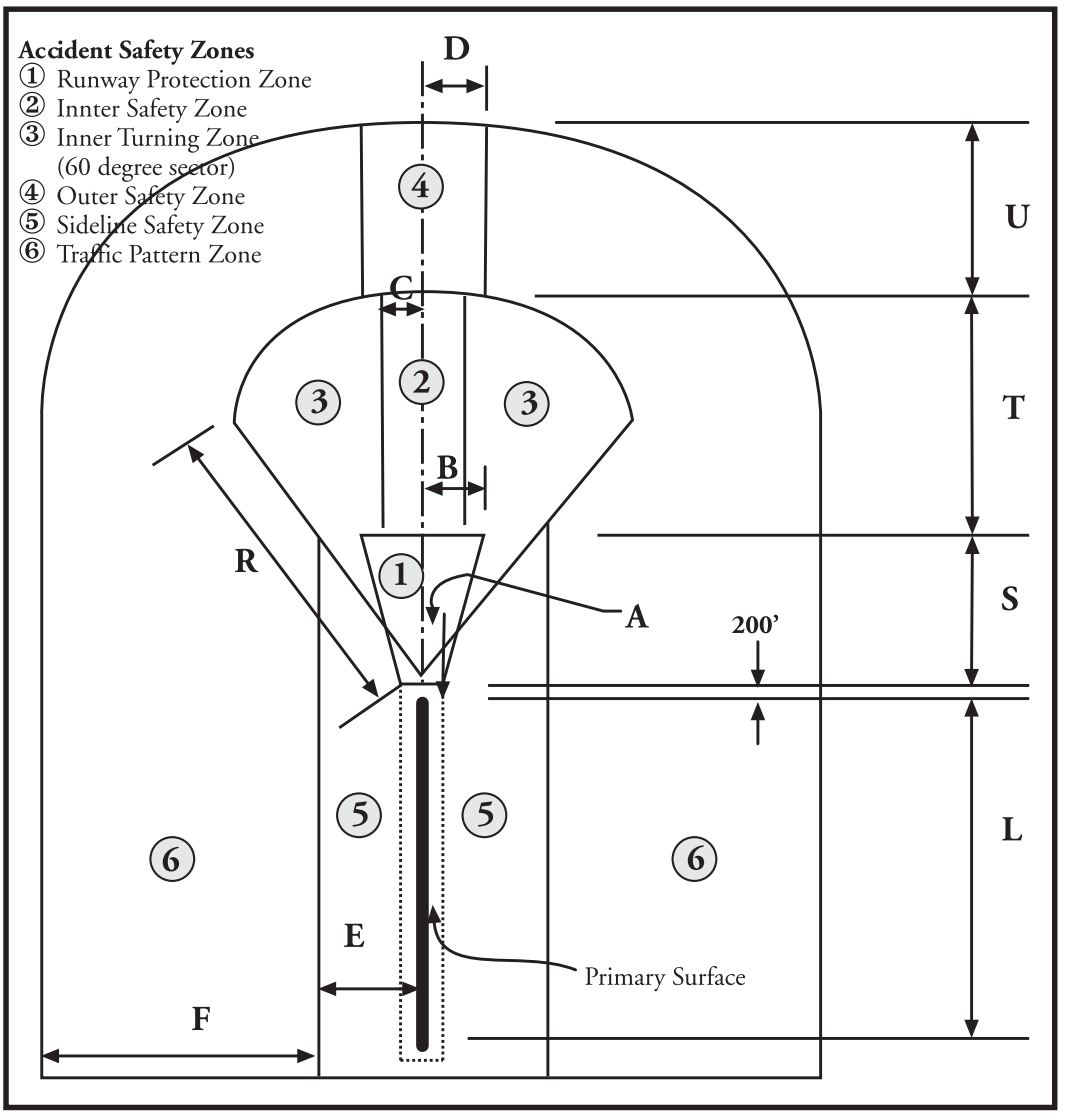
*** Future planned land uses are not considered incompatible unless they are noise sensitive and occur within 65 DNL noise contours; pose a potential height hazard; or are located in airport safety zones.

**** Height hazard includes obstructions based on FAR Part 77. Safety zones include runway safety area, RPZ, ATZ, runway OFA, and Aircraft Accident Safety Zones 1, 2, and 5 from WSDOT's " *Airports and Compatible Land Use* Handbook."

***** Plan designation is "Rural airport - essential public facility overlay."

Exhibit 8-3

Aircraft Accident Safety Zone Diagram



Note:
Data Source: NTSB accident investigations 1984-1991. Illustration Source: Hodges and Shutt, Institute of Transportation Studies, University of California, Berkley, 1993.

Dimension	Runway Length Category (L)		
	Runway less than 4,000	Runway 4,000 to 5,999	Runway 6,000 or more
A	125	250	500
B	225	505	875
C	225	500	500
D	225	500	500
E	500	1,000	1,000
F	4,000	5,000	5,000
R (60°Sector)	2,500	4,500	5,000
S	1,000	1,700	2,500
T	1,500	2,800	2,500
U	2,500	3,000	5,000

While relatively few of the region's airports are experiencing significant noise-related issues, several system airports are facing compatible land use issues related to height hazards and safety zones. Of the 28 airports in the system, some 16 have existing height hazard concerns related to obstructions (see also Exhibit 6-5 and Chapter 6 for more information about obstructions). Of the system's 36 runways and 72 runway ends, 40 runway ends have some type of obstructed approach as of late 1999. Of these, 22 were trees and 18 were either buildings, poles, fences, power lines, or other man-made objects.

Height hazards near airports are addressed by the FAA's Part 77 obstruction notification and review process, which requires that anyone proposing to place or construct objects that would penetrate an airport's Part 77 surfaces must notify the FAA using FAA form 7460-1, "Notice of Proposed Construction or Alteration." The FAA's review will determine whether there is a potential hazard to navigation, and if so, what form of action is needed (e.g. lighting, marking, redesign, relocation, or denial of the application). In addition, by authority of the state's "Airport Zoning" law (Chapter 14.12 RCW), public agencies may enact airport zoning provisions which limit the height of objects near airports and provide for the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards. A preliminary review of existing zoning ordinances shows that local jurisdictions adjoining five airports in the region have adopted zoning provisions addressing height hazards near airports.

Both height hazards and aircraft safety are important elements of airport compatible land use. According to NTSB aircraft accident data for the years 1982-1989, over 42% of all general aviation accidents involved objects on the ground. Of these, 42% involved trees; 38% involved fences, poles, towers and wires; and only 3% involved homes or other buildings.

While future noise impacts can be estimated using computer modeling and noise monitoring techniques and using existing and planned land use data, predicting future height hazards is more difficult. The best way to provide some degree of certainty and protection is for communities adjacent to airports to adopt and enforce height hazard planning and zoning ordinances, and to coordinate the implementation of these requirements with the FAA. At present, only 5 airports in the region are known to have some kind of height hazard zoning in place in adjoining communities. These airports include Arlington, Auburn, Bremerton, Sea-Tac, and Swanson. These facts combined with the information discussed above illustrate the need for additional cooperative planning between airports and their neighbors to establish airport zoning protection related to height hazards.

Related to safety, thirteen system airports have existing land uses or structures located within airport safety zones (see Exhibit 8-2.1). These include uses and structures located in existing runway safety areas and runway protection zones. Of these, the majority are related to airport layout and lack of sufficient airport property rather than land use encroachment, per se. Others may have adjoining land uses or structures located in the airports' aircraft accident safety zones. For example, Harvey Field is listed in Exhibit 8-2 as having critical areas affected by existing adjacent land use because of the power lines traversing the airport off the end of runway 14, which constitute both height hazard and safety zone compatibility concerns.

In addition to reviewing the status of existing land uses and structures related to airport height hazard, safety, and noise, future land use plans were reviewed to assess the potential for additional new development (land uses or structures) within areas affected by airport noise and within each airport's aircraft accident safety zones. This information is reported in Part 2 of Exhibit 8-2. Adopted land use plans for areas adjacent to the region's airports allow a wide range of residential densities, from a low of about 1 unit per 10 acres to a high of 87 units per acre in the city of SeaTac's downtown urban center on the east side of Sea-Tac Airport.

Six airports have currently adopted adjoining community land use plans that would allow additional development of residential uses within future 65 DNL noise contours. These include Boeing Field, Bremerton, Crest Airpark, FirstAir Field, McChord Air Force Base, and Sea-Tac Airport. Of these, planned densities adjoining Bremerton Airport would allow only 1 unit per 5 acres, while those in King County around Crest Airpark would allow development of between 1 unit per 10 areas and 12 units per acre. Slightly farther to the north of Crest Airpark, but still under the approach to runway 15, planned residential densities in the city of Covington would allow up to 24 units per acre.

Around FirstAir Field in Monroe, future residential densities allow a range from 3 to 7 units per acre. The other three larger airports, Boeing Field, McChord AFB, and Sea-Tac Airport, would allow for much higher residential densities ranging up to 20 units per acre near Boeing Field, up to 30 units per acre in Lakewood adjoining McChord AFB, and up to 87 units per acre in the City of SeaTac. In response to existing development trends, forecast future noise contours, and the potential for new residential development adjoining these three airports, all three airport sponsors are actively involved in airport compatible land use planning programs with their neighboring communities. Sea-Tac completed its FAR Part 150 Update process in late 2000; McChord AFB completed an updated AICUZ study in 1998; and Boeing Field is currently undertaking its first FAR Part 150 study. The City of Lakewood, in its first comprehensive plan since the city's incorporation, has adopted the compatible land use planning recommendations related to noise and aircraft safety contained in the McChord AFB AICUZ study.

Related to aircraft accident safety zones, nine system airports have no future planned incompatible land uses in any of the six aircraft accident safety zones. These include the four seaplane bases, the three state-owned emergency airfields, Sky Harbor, and Gray Army Airfield at Fort Lewis. Of the remaining 19 system airports, 13 have adjoining community land use plans which allow new potentially incompatible development (primarily residential) within the aircraft accident safety zones 1, 2, or 5 (see Exhibit 8-3). These three zones total between 96 acres for airports with shorter runways (less than 4,000 feet) and 370 acres for airports with runways longer than 6,000 feet. The total area encompassed by these combined zones for the entire airport system is 7,110 acres (11 square miles). For those 13 airports with future planned incompatible land uses inside these zones the total area within the zones is 3,226 acres, or just over 5 square miles. Given the size of these areas, and their location largely inside the urban growth area, it's not surprising that many currently adopted land use plans might allow for future residential and other potentially incompatible uses there.

The larger zones farther removed from the runways (zones 3, 4, and 6) comprise a significantly larger area than zones 1, 2, and 5. Together, zones 3, 4, and 6 comprise between 839 (for runways less than 4,000 feet) and 1,813 acres (for runways over 6,000 feet). For the region as a whole these zones total over 40,000 acres, or 63 square miles. A large part of the area within these zones is contained within airport property or is governed by avigation easements. However, there is some potential for new construction and urban development to occur within these zones, further compromising airports' ability to maintain safe approaches to the runway ends and minimize risk to the general public. Additional more detailed analysis would be required in order to evaluate the location and extent of this issue throughout the region, and to identify appropriate measures to address the issue.

Based on the results of this preliminary airport compatible land use analysis the following findings have been prepared:

- Airport growth combined with future urban development surrounding the region's airports will keep the pressure on to effectively address compatible land use issues.

- The region's most significant compatible land use issues related to airport noise are largely focused at three large airports: Sea-Tac, Boeing Field, and McChord AFB. These airports are addressing these issues through FAR Part 150 and AICUZ planning programs.
- Height hazard and safety related compatible land use issues are prevalent throughout the region. Existing land uses encroach on several airports' safety zones, and obstructions currently affect some 40 of the region's 72 runway ends.

- Currently adopted land use plans for communities surrounding the region's airports will allow for additional noise-sensitive development, as well as potential incompatible structures and land uses in the more critical airport aircraft accident safety zones (safety zones 1, 2, and 5). In addition, construction of new structures affecting airport height hazard zones is a continuing issue in maintaining the safety and function of the regional airport system. While some communities near airports have developed airport compatible land use and height hazard zoning programs, there is a clear need for more progress in this arena.

- Airport master planning, airport system planning, and coordination between airport sponsors and local land use planners can and should be a forum to more effectively address these issues.

- The state's Growth Management Act (GMA) provides a good foundation for beginning to address airport compatible land use issues around the region's general aviation airports. The Regional Council is already using GMA authority in its plan review and certification process, and plans to expand upon this process.

- The WSDOT Aviation Division and several other states have developed technical guidance materials which can be very useful to local land use planners in planning for compatible land use around airports. The WSDOT has an active program which provides technical assistance in this arena, and coordinates closely with the Regional Council on the two related programs.

- There is the potential for the regional airport system to be compromised by new development in surrounding communities if the issue of airport compatible land use is not more effectively addressed in a comprehensive and collaborative way by all parties involved. These include airport sponsors, the FAA, local communities, the State DOT Aviation Division, the State Department of Community, Trade, and Economic Development, and the Regional Council. An additional challenge is created by an inconsistency of the growth management act: while the law defines airports as essential public facilities and recognizes the need for compatible land use planning, the clear intent of the law is also to focus urban development inside the urban growth boundary in areas which can serve additional development. This fundamental provision of the growth management act creates inherent conflict between the region's airports and the rapidly growing communities that surround them. The region will need to find creative ways to address these issues, particularly given the significant development that already exists at many airports' doors.

Chapter 9 - Implementation Plan

The future improvement needs of the regional airport system are both varied and significant. They span a broad range of program types, from maintenance and preservation to system enhancement, from safety and standards to aircraft parking expansion, from obstruction removal to airfield lighting, and from pavement rehabilitation to compatible land use. The improvement program also spans a broad range of airport types, including a large hub commercial service airport, two air cargo airports, five major relievers, four seaplane bases, several medium and small general aviation facilities, and three emergency airfields. Nearly half the region's public use airports are privately owned, and face a unique set of financial constraints as well as opportunities.

Three of the region's largest airports support the manufacture, testing, certification, and ultimate client delivery of Boeing heavy jet aircraft which currently capture over 60% of the world's passenger and cargo market. These three airports (Boeing Field, Paine Field, and Renton Airport) are home to some 90,000 jobs, of which over 62,000 are aerospace-related. The region's primary air carrier airport, Seattle-Tacoma International, served over 28,000,000 passengers in the year 2000 on over 440,000 flights. These numbers are forecast to grow to 44,600,000 passengers on 532,000 flights by the year 2020. Sea-Tac Airport and Boeing Field will process over 650,000 tons of air cargo in 2001, and will process over 1 million tons of air cargo by the year 2010.

The region's general aviation airports will be home to over 800 new based aircraft by 2020, and total regional take-offs and landings will grow by nearly 200,000 in the coming 20 years. While some of the system airports' needs are very different in scale, many needs are similar. Large and small airports throughout the region face the challenge of maintaining their pavements, improving their lighting systems, addressing obstructions, meeting FAA airport design standards, improving safety, and working with neighboring jurisdictions to address compatible land use issues. Meeting these long range needs of the regional airport system will require an investment program that can meet the many different needs and conditions of the region's airports.

AIRPORT CAPITAL IMPROVEMENT PROGRAM ("ACIP")

This regional airport capital improvement program ("ACIP") is based on the system improvements outlined in Chapter 7 (System Strategy), in particular those projects listed in Exhibit 7-4. Many of the improvement projects shown in Exhibit 7-4 are also included in currently adopted airport master plans. Of the 85 system improvements listed in Exhibit 7-4 for the top ten system airports, some 58 airport improvement projects are also included in current airport master plans. The improvement projects shown in Exhibit 7-4, and included here in the ACIP, represent a regional level planning effort which identifies regionally significant system needs. These system improvement projects are considered critical to the maintenance, preservation, and enhancement of the regional airport system. These projects do not, however, represent a comprehensive list of all improvements needed at the region's airports. Individual airport master plans and capital improvement programs, as well as the Washington State Aviation System Plan (SASP), contain comprehensive capital improvement programs that in sum would represent the total system-wide investment needs of the regional and state airport systems. The objective of this regional airport capital improvement program is to provide a regional framework for airport system improvements within which major projects can be funded, and within which individual airport improvement programs will occur. Smaller airport improvement projects which enhance individual airports but do not substantially contribute to the entire system are not included in this regional ACIP. This in no way detracts from their importance to each airport.

Exhibit 9-1 Airport System Capital Improvement Program

Airport	Project	Type *	2000-2004	2005-2009	2010-2020	Total
American Lake	N/A		$0	$0	$0	$0
	American Lake Total:		***$0***	***$0***	***$0***	***$0***
Apex	Install PAPI	E	$10,000	$0	$0	$10,000
	Apex Total:		***$10,000***	***$0***	***$0***	***$10,000***
Arlington	Obstruction removal	S	$7,500			$7,500
	Install PAPI	S	$167,640			$167,640
	Install REIL	S	$105,980			$105,980
	Upgrade beacon / compass rose	S	$63,808			$63,808
	Taxiway extension	C	$320,040			$320,040
	Apron construction	C	$920,540			$920,540
	ODALS for runway 16	S	$135,690			$135,690
	MIRL/threshold lights runway 11/29	S	$251,950			$251,950
	Upgrade runway lights to MIRL	S	$239,580			$239,580
	Taxiway lighting	S	$465,840			$465,840
	Security improvements	S	$584,510			$584,510
	Construct partial taxiway	C	$1,235,200			$1,235,200
	Apron lighting	E	$77,540			$77,540
	Pavement maintenance	P	$2,267,613			$2,267,613
	Master Plan	O	$100,000			$100,000
	Reconstruct various taxilanes	P	$1,341,925			$1,341,925
	Approach lighting runway 34	S				$0
	New aircraft hangars	C				$0
	Miscellaneous equipment	O	$236,670			$236,670
	Overlay taxiway C	P	$184,670			$184,670
	Taxiway signage	E	$73,390			$73,390
	Constuct new taxiway	C	$1,382,650			$1,382,650
	Arlington Total:		***$10,162,736***	***$0***	***$0***	***$10,162,736***
Auburn	Runway Rehab./Overlay	P	$388,889			$388,889
	Runway Rehab./Overlay	P	$277,778			$277,778
	Taxiway overlay	P	$210,000			$210,000
	GPS approach/lighting	E				$0
	Approach protection	S	$100,000			$100,000
	Runway Rehab./Overlay	P		$300,000		$300,000
	New Hangars	C	$150,000	$300,000		$450,000
	Auburn Total:		***$1,126,667***	***$600,000***	***$0***	***$1,726,667***
Bandera State	no projects					$0
	Bandera State Total:		***$0***	***$0***	***$0***	***$0***
Bremerton	Avigation easements	S	$350,000			$350,000
	NE Access Road	C	$275,000			$275,000
	Master Plan Update	O	$100,000			$100,000
	Runway Extension	E		$1,184,000		$1,184,000
	Taxiway Extension	E		$398,300		$398,300
	Widen/strengthen taxiway	S		$792,000		$792,000
	Runway/taxiway rehab.	P		$2,310,000		$2,310,000
	GPS approach	E				$0
	Install REIL	E	$50,000			$50,000
	Runway shift	E	$3,940,000			$3,940,000
	Aviation business building	C	$500,000			$500,000
	Bremerton Total:		***$5,215,000***	***$4,684,300***	***$0***	***$9,899,300***

Exhibit 9-1 Airport System Capital Improvement Program

Airport	Project	Type *	2000-2004	2005-2009	2010-2020	Total
Crest Airpark	Avigation easements	S	$20,000			$20,000
	Install MIRL	E	$74,000			$74,000
	Install PAPI/VASI	E	$5,000			$5,000
	Install REIL	E				$0
	Widen Runway	S	$109,000			$109,000
	Runway safety area	S				$0
	Obstruction removal	S				$0
	Apron expansion	C	$95,000			$95,000
	New tie-downs	C	$120,000			$120,000
	Pavement crack sealing	P	$30,000			$30,000
	Crest Airpark Total:		***$453,000***	***$0***	***$0***	***$453,000***
Darrington	Pavement maintenance	P	$30,000			$30,000
	Runway widening	S				$0
	Runway safety area	S				$0
	Obstruction removal	S				$0
	Darrington Total:		***$30,000***	***$0***	***$0***	***$30,000***
FirstAir Field	Install MIRL	E		$47,000		$47,000
	Install NDB	E		$4,000		$4,000
	Install PAPI	E	$10,000			$10,000
	Obstruction removal	S	$2,000			$2,000
	Runway widening	S				$0
	Runway extension	E				$0
	Runway safety area	S				$0
	Parallel taxiway	C		$50,000		$50,000
	Runway overlay	P		$50,000		$50,000
	New hangars	C	$200,000	$300,000		$500,000
	FirstAir Field Total:		***$212,000***	***$451,000***	***$0***	***$663,000***
Harvey Field	Runway widening	S	$150,000			$150,000
	Runway extension	E				$0
	Apron expansion/taxiway ext'n	C		$350,000		$350,000
	Land acq'n/obstruction removal	S	$1,725,000			$1,725,000
	Pavement maintenance	P	$40,000			$40,000
	GPS approach / lighting	E				$0
	Runway and taxiway lighting	E	$35,000			$35,000
	Install MIRL	E	$56,000			$56,000
	Navaids (wind cone, circle)	E	$25,000			$25,000
	Install NDB	E				$0
	Install PAPI/VASI	E	$25,000			$25,000
	Install REIL	E				$0
	New helipad	E	$50,000			$50,000
	New tie-downs	C	$50,000	$50,000		$100,000
	New hangars	C	$500,000	$550,000		$1,050,000
	New airport terminal building	E		$300,000		$300,000
	Harvey Field Total:		***$2,656,000***	***$1,250,000***	***$0***	***$3,906,000***
Kenmore Air Harbor	no projects					$0
	Kenmore Air Harbor Total:		***$0***	***$0***	***$0***	***$0***

Exhibit 9-1 Airport System Capital Improvement Program

Airport	Project	Type *	2000-2004	2005-2009	2010-2020	Total
King County Int'l/	Pavement mgmt. Program	P	$60,000			$60,000
Boeing Field	Resurface runway 13L-31R	P	$1,650,000			$1,650,000
	Reconstruct runway 13R-31L	P	$6,025,000			$6,025,000
	Construct taxiway A-3	P	$1,185,000			$1,185,000
	Widen taxiway B-2	E	$745,000			$745,000
	Terminal building remodel	E	$6,120,000			$6,120,000
	Pavement rehab. (various)	P	$4,171,000	$5,000,000	$5,000,000	$14,171,000
	Overlay taxiway B	P	$1,646,000			$1,646,000
	West side redevelopment	C	$10,670,000			$10,670,000
	Transponder landing system	E	$1,500,000			$1,500,000
	Runway shift	S	$6,200,000			$6,200,000
	Noise remedy program	P	$20,000,000			$20,000,000
	Maintenance facility	P	$379,000			$379,000
	Install REIL runway 13L-31R	E				$0
	Install PAPI runway 13L-31R	E				$0
	New hangars	C				$0
	Airport Master Plan	O		$350,000		$350,000
	FAR Part 150 Update	P		$300,000		$300,000
	Miscellaneous utilities and equipment	O	$2,931,000	$4,593,000	$3,500,000	$11,024,000
	Land acquisition	S			$10,000,000	$10,000,000
	Boeing Field Total:		***$63,282,000***	***$10,243,000***	***$18,500,000***	***$92,025,000***
Lake Union	no projects					$0
	Lake Union Total:		***$0***	***$0***	***$0***	***$0***
Pierce County/Thun	Property acquisition - BRL/Twy OFA	S	$714,000	$2,755,000	$0	$3,469,000
	Realign parallel taxiway	S	$111,000			$111,000
	Access improvements	C	$58,000	$175,000	$27,000	$260,000
	Taxilane rehab./overlay/crack seal	P	$128,000	$64,000		$192,000
	Main apron rehab./overlay/crack seal	P	$172,000			$172,000
	New T-hangars / taxilanes	C	$642,000	$344,000	$371,000	$1,357,000
	T-hangar roofs	P	$100,000			$100,000
	Airport terminal/maintenence bldg.	C	$90,000	$68,000		$158,000
	Widen runway	S		$440,000		$440,000
	Obstruction program	S		$60,000		$60,000
	GPS approach	E	$250,000			$250,000
	Approach lighting	E	$100,000			$100,000
	Install REIL	E	$20,000			$20,000
	Pavement maintenance	P	$95,000	$95,000	$487,000	$677,000
	Fencing and security access	E	$40,000			$40,000
	Install AWOS	S		$77,000		$77,000
	New parallel taxiway	C		$698,000		$698,000
	Install taxiway lighting	E			$207,000	$207,000
	Utilities, misc., contingency	O	$702,000	$1,420,500	$273,000	$2,395,500
	Pierce County/Thun Total:		***$3,222,000***	***$6,196,500***	***$1,365,000***	***$10,783,500***
Port Orchard	Runway widening					$0
	Pavement improvements					$0
	Obstruction program					$0
	Port Orchard Total:		***$0***	***$0***	***$0***	***$0***
Ranger Creek State	no projects					$0
	Renger Creek State Total:		***$0***	***$0***	***$0***	***$0***

Exhibit 9-1 Airport System Capital Improvement Program

Airport	Project	Type *	2000-2004	2005-2009	2010-2020	Total
Renton	Drainage improvements	O	$555,556			$555,556
	Taxiway A reconstruction	P	$867,500			$867,500
	Seal and mark pavements	P	$650,000	$650,000		$1,300,000
	Pavement overlay	P	$2,787,500		$2,787,500	$5,575,000
	GPS approach / lighting	E				$0
	New hangars	C				$0
	Renton Total:		***$4,860,556***	***$650,000***	***$2,787,500***	***$8,298,056***
Sea-Tac	Third runway	C	$773,362,000			$773,362,000
	Airfield improvements	C	$248,172,000			$248,172,000
	South terminal expansion	C	$378,372,000			$378,372,000
	Terminal	C	$183,581,000			$183,581,000
	Satellite transit system	C	$161,139,000			$161,139,000
	Ground access	C	$166,909,000			$166,909,000
	Infrastructure	C	$296,488,000			$296,488,000
	Division-wide	O	$50,753,000			$50,753,000
	Noise abatement	P	$90,882,000			$90,882,000
	Miscellaneous projects	O	$195,662,000			$195,662,000
	Airfield improvements	C		$62,400,000		$62,400,000
	Terminal	C		$162,145,000		$162,145,000
	Ground access	C		$548,226,000		$548,226,000
	Infrastructure	C		$85,600,000		$85,600,000
	Division-wide	O		$2,876,000		$2,876,000
	Noise abatement	P		$33,931,000		$33,931,000
	Sea-Tac Total:		***$2,545,320,000***	***$895,178,000***	***$0***	***$3,440,498,000***
Sky Harbor	Obstruction program	S				$0
	Runway extension	E				$0
	Sky Harbor Total:		***$0***	***$0***	***$0***	***$0***
Skykomish State	no projects					$0
	Skykomish State Total:		***$0***	***$0***	***$0***	***$0***
Snohomish County/	Obstruction program	S	$1,200,000	$300,000	$200,000	$1,700,000
Paine Field	GPS approach	E				$0
	Install REIL runway 11-29	E				$0
	Safety area	S	$2,500,000			$2,500,000
	Terminal building remodel	E	$1,000,000	$2,000,000	$3,000,000	$6,000,000
	New corporate hangars	C	$20,000,000	$15,000,000	$10,000,000	$45,000,000
	New T-hangars	C	$2,500,000	$2,500,000	$2,500,000	$7,500,000
	Hangar pads/access/utilities	C	$11,000,000	$3,000,000	$3,000,000	$17,000,000
	North ramp hangar condo	C	$100,000			$100,000
	C-84 hangar repairs	E	$100,000			$100,000
	Building purchase (Crown)	E	$250,000			$250,000
	Outer ramp addition	C	$1,800,000	$2,000,000	$5,000,000	$8,800,000
	Airfield pavement maintenance	P	$3,000,000	$2,000,000	$2,000,000	$7,000,000
	Landside pavement maintenance	P	$650,000	$400,000	$500,000	$1,550,000
	Airfield repairs	P	$675,000	$5,000,000	$5,000,000	$10,675,000
	Fire station replacement	S	$2,400,000			$2,400,000
	Equipment (fire trucks, sweeper)	E	$2,160,000	$825,000	$1,525,000	$4,510,000
	Miscellaneous (access, noise berms)	O	$4,800,000	$1,900,000	$2,300,000	$9,000,000
	Paine Field Total:		***$54,135,000***	***$34,925,000***	***$35,025,000***	***$124,085,000***

Exhibit 9-1 Airport System Capital Improvement Program

Airport	Project	Type *	2000-2004	2005-2009	2010-2020	Total
Spanaway	Runway widening	S				$0
	Runway extension	E				$0
	Runway safety area	S				$0
	Obstruction program	S				$0
	Sealcoat runway	P	$12,000			$12,000
	Spanaway Tottal:		***$12,000***	***$0***	***$0***	***$12,000***
Swanson	Taxiway/apron paving	P	$47,000			$47,000
	Parallel taxiway	C		$30,000		$30,000
	Runway widening	S				$0
	Runway safety area	S				$0
	Obstruction/approach program	S	$100,000			$100,000
	Swanson Total:		***$147,000***	***$30,000***	***$0***	***$177,000***
Tacoma Narrows	Acquire land - - compatible land use	P	$650,000			$650,000
	RPZ easement	S	$137,500			$137,500
	Runway safety area	S	$6,000,000			$6,000,000
	Runway/taxiway overlay	P		$230,000		$230,000
	New t-hangars plus apron	C	$579,000	$538,000	$641,000	$1,758,000
	New conventional hangars	C	$587,000	$851,000	$744,000	$2,182,000
	Runway / parking / ramp slurry seal	P	$826,000	$475,000	$826,000	$2,127,000
	Install REIL	E			$115,000	$115,000
	Install VASI	E			$118,000	$118,000
	Miscellaneous projects/equipment	O	$1,113,000	$480,000		$1,593,000
	Tacoma Narrows Total:		***$9,892,500***	***$2,574,000***	***$2,444,000***	***$14,910,500***
Vashon	Taxiway reflectors	E	$4,000			$4,000
	Install MIRL	E		$63,000		$63,000
	Runway widening	S				$0
	Runway safety area	S				$0
	Obstruction program	S				$0
	Vashon Total:		***$4,000***	***$63,000***	***$0***	***$67,000***
Will Rogers/						
Wiley Post Mem.	U.S. customs temporary structure	C	$75,000			$75,000
	Seaplane beaching area	E	$793,750			$793,750
	Will Rogers/Wiley Post Total:		***$868,750***	***$0***	***$0***	***$868,750***

Exhibit 9-1 Airport System Capital Improvement Program

Airport	Project	Type *	2000-2004	2005-2009	2010-2020	Total
Airport Capital Improvement Program Summary						
			2000-2004	**2005-2009**	**2010-2020**	**Total**
	System Totals		**$2,701,609,209**	**$956,844,800**	**$60,121,500**	**$3,718,575,509**
	Sea-Tac International Airport:		***$2,545,320,000***	***$895,178,000***	***$0***	***$3,440,498,000***
	General Aviation Airports:		***$156,289,209***	***$61,666,800***	***$60,121,500***	***$278,077,509***
	Paine Field:		***$54,135,000***	***$34,925,000***	***$35,025,000***	***$124,085,000***
	Rest of GA Airport System:		***$102,154,209***	***$26,741,800***	***$25,096,500***	***$153,992,509***
Summary of Airport Capital Improvement Program Project Types **						
					Other	
			Sea-Tac	**Paine**	**General**	**Total**
			Airport	**Field**	**Aviation**	**Airport**
	Project Type				**Airports**	**System**
	Safety and Standards	Costs	$0	$6,600,000	$31,864,998	$38,464,998
		% of total	0%	5%	21%	1%
	Maintenance and Preservation	Costs	$124,813,000	$19,225,000	$64,796,375	$208,834,375
		% of total	4%	15%	42%	6%
	System Enhancement	Costs	$0	$10,860,000	$16,439,980	$27,299,980
		% of total	0%	9%	11%	1%
	System Capacity	Costs	$3,066,394,000	$78,400,000	$24,536,430	$3,169,330,430
		% of total	89%	63%	16%	85%
	Other	Costs	$249,291,000	$9,000,000	$16,354,726	$274,645,726
		% of total	7%	7%	11%	7%
			100%	100%	100%	100%
	TOTALS:		**$3,440,498,000**	**$124,085,000**	**$153,992,509**	**$3,718,575,509**

* Project types:

Safety and Standards projects include runway safety areas, runway widening, and obstruction programs.

Maintenance and Preservation projects include runway, taxiway, and apron overlays: pavement rehabilitation and reconstruction; runway friction surface treatments; crack and slurry sealing; noise studies; and compatible land use programs.

System enhancement projects include runway extensions; lighting and navaids; approach protection; and airport terminals.

System capacity projects include aircraft tie-downs and hangars; passenger terminals; parking and access roads; and air cargo projects.

Other projects include planning, utilities, drainage, equipment, and other miscelleneous projects.

** Percentages do not add to 100% due to rounding

Exhibit 9-2 Airport System Capital Improvement Program Summary

	2000-2004	2005-2009	2010-2020	Total
Capital Improvements at Air Carrier Airport (Sea-Tac)	$2,545,320,000	$895,178,000	$0	$3,440,498,000
Capital Improvements at Existing Relievers	$126,060,223	$47,668,000	$56,312,500	$230,040,723
Capital Improvements at New Relievers	$15,107,500	$7,258,300	$2,444,000	$24,809,800
Capital Improvments at General Aviation Airports	$14,252,736	$6,740,500	$1,365,000	$22,358,236
Capital Improvments at Seaplane Bases	$868,750	$0	$0	$868,750
Capital Improvments at Emergency Airfields	$0	$0	$0	$0
System Totals:	***$2,701,609,209***	***$956,844,800***	***$60,121,500***	***$3,718,575,509***

Exhibit 9-1 displays the regional airport capital improvement program (ACIP), showing projects by type at each airport, and indicating the time frame (short, medium, and long range) for each project. Lastly, the exhibit displays generalized costs for the ACIP.

Due to the uncertainty in forecasting airport activity levels beyond 10 years, and the difficulty in predicting costs associated with facility needs to meet longer range forecasts, most airports in the region have not developed comprehensive capital facility programs beyond 2010. This is true of the figures quoted above for Sea-Tac Airport. For these reasons, the airport capital improvement program costs shown for Phase III (2010-2020) should be considered preliminary. As mentioned above, the projects represented in these figures do not include all projects being planned for the region's airports, but only those projects considered to have significance to the regional airport system.

Because of the magnitude of improvements planned at Sea-Tac International Airport, and because those improvements are funded by the Port of Seattle, the capital improvement program needs for Sea-Tac Airport have been separated from the rest of the airport system (see Exhibit 9-1). The total airport system improvement program is estimated to be $ 3.7 billion for all three phases. Of this total, Sea-Tac Airport comprises $3.4 billion, while the remaining airport system improvements total approximately $278 million. Broken down by phase, the total system improvement program will cost $2.7 billion in phase I (2000-2004), $957 million in phase II (2005-2009) and $60 million in phase III (2010-2020). Excluding Sea-Tac, these improvements would total some $156 million in phase I, approximately $62 million in phase II, and $60 million in phase III.

Exhibit 9-1 includes a summary of airport capital improvement program costs by project type (see page 6 of the exhibit). For clarity the system cost information separates Sea-Tac International Airport from the rest of the general aviation airport system. In addition to Sea-Tac, significant facility improvements are planned for Snohomish County Airport/Paine Field in the form of aircraft hangars. Because of the magnitude of these improvements ($52 million), Paine Field capital costs are separated from the rest of the general aviation airport system on page 6 of Exhibit 9-1. The 20-year airport system capital projects displayed in Exhibit 9-1 are grouped into five categories: (1) safety and standards; (2) maintenance and preservation; (3) system enhancement; (4) system capacity; and (5) other. "Other" projects include planning, utilities, drainage, equipment, and miscellaneous improvements. For the entire system, capacity projects comprise 85% of the total, with Sea-Tac projects accounting for most of these costs. Other projects comprise 7% of total system improvements, while maintenance and preservation account for 6%, and safety and standards and maintenance and preservation each account for 1%.

When Sea-Tac and Paine Field are separated from the rest of the system, the breakdown of improvement projects changes. At Sea-Tac alone, maintenance and preservation makes up 4% of the total program, other projects comprise 7%, while capacity-related projects account for 89%. At Paine Field, safety and standards projects comprise 5%, maintenance and preservation 15/%, enhancements 9%, capacity (aircraft hangars) 63%, and other comprise 7%.

For the rest of the general aviation airport system (excluding Sea-Tac Airport and Paine Field), safety and standards projects account for 21% of the total CIP; maintenance and preservation accounts for 41%; system enhancement comprises 11%; system capacity projects (aircraft hangars) account for 16%; and "other" projects account for 11% of the total improvement program. For the general aviation system (excluding Sea-Tac and Paine Field) the program's emphasis on airport system safety, preservation, and maintenance is apparent in the CIP figures, with fully 3/5 of the total program funds going to these categories of projects. These figures support the system plan's recommended priorities for system investment, which put safety and standards, and maintenance and preservation as high priorities for system funding. In addition, the significant investments in enhancement projects and capacity

improvements (aircraft hangars) at Paine Field, Boeing Field, Harvey Field, Bremerton, and Tacoma Narrows Airport illustrate the program's additional focus on strategic system improvements.
Exhibit 9-2 displays a summary of the airport system capital improvement program costs divided into the six airport types. The existing five reliever airports are programmed for $230 million in improvements over the 20-year planning horizon, while improvements at the two airports recommended for designation as new relievers (Bremerton National and Tacoma Narrows) total $33 million. The remaining general aviation airports will receive $22 million in improvements, and the seaplane bases are scheduled for just under $1 million. Currently, no capital improvements are shown for the three state-owned emergency airfields.

IMPLEMENTATION PLAN

Future actions

In addition to the airport capital improvement program (ACIP) projects described above and displayed in Exhibit 9-1, a number of non-project actions are being recommended in this *2001 RASP*. They include updated airport master plans and/or airport layout plans, airport compatible land use programs at several airports, analysis of the region's long range air cargo facility needs, and a Global Positioning System ("GPS") feasibility and implementation study at regional airports. While this plan contains several recommended system improvements to address a variety of airport system needs, more detailed project planning and analysis, project design and costing, and environmental impact analysis is required before those improvements can be implemented. The objective of this section of the *2001 RASP* is to highlight the additional project-defining actions which should be undertaken before actual projects are implemented.

Funding options

A variety of funding alternatives are presented here to stimulate discussions and exploration on the part of airport sponsors, state DOT, FAA, the Regional Council, and others in evaluating the feasibility of the airport system improvements included here. Traditional and non-traditional funding sources are included, especially because system needs have historically been greater than system revenues. As is true of many components of the nation's transportation system, available revenues for aviation system improvements have shrink in the past 10 years, and new and innovative financing mechanisms are being sought to bridge the growing gap between system needs and available funds. Several public agencies, user groups, and aviation advocacy groups have identified a variety of innovative financing concepts to help airports meet their financial goals. These are summarized below.

Existing Funding Sources

FAA

FAA funding is available to the region's NPIAS airports to finance AIP-eligible projects. These airports include Sea-Tac International, King County International/Boeing Field, Snohomish County Airport/Paine Field, Renton Municipal, Auburn Municipal, Arlington Municipal, Bremerton National, Tacoma Narrows, Pierce County Airport/Thun Field, Kenmore Air Harbor, Harvey Field, and Vashon Municipal. Funds available at the NPIAS airports include passenger entitlement funds, cargo entitlement funds, passenger facility charges ("PFCs"), grants for airport noise compatibility planning, state apportionment funds, discretionary funding, general aviation airport entitlement funds, cargo-only airport funds, and grants for reliever airports (authorized by the AIP bill adopted by U.S. Congress in spring 2000).

Washington State Airport Aid Program

The State's airport aid program provides grants to smaller airports throughout the state to fund a broad range of projects. State funds generally are not granted to larger general aviation reliever airports, such as Paine Field and Boeing Field, since these airports generate revenues to meet much of their own need, and they receive funding from FAA. Smaller general aviation airports are more dependent on State grants, and may even have difficulty raising the necessary local match (typically 80-90%) required to accept state grants. State airport aid grants have traditionally been dedicated to safety-related projects, pavement maintenance and rehabilitation projects; runway, taxiway, and apron programs; airfield lighting and navaids; obstruction programs; airport fencing; roadways; and airfield signs.

The state's airport aid program is funded primarily through aviation system user fees such as annual aircraft registration fees, pilot registration fees, and taxes collected on the sale of aircraft fuel at the state's airports. While these funds are user-fee based, the majority of revenues collected under these programs are diverted to the state's general fund and to the Department of Revenue to finance a variety of non-aviation programs. At current levels of revenue capture, these airport user-fee programs can not meet the airport system's full funding needs.

Potential Funding Programs

Several options are available for enhancing aviation system revenues. These include capturing a larger share of existing aviation user fees (such as aircraft and pilot registration fees and aviation fuel taxes) and creating new revenue sources, such as a dedicated aviation fuel tax (as was recently done in Oregon). These initiatives would likely require action by the state legislature. In addition, there a numerous programs across the country that provide food for thought as ideas for enhancing aviation revenues. The National Association of State Aviation Officials (NASAO) has surveyed its membership to collect information on innovative and effective funding and revenue programs. Some take the form of tax relief. The list below highlights these programs as a way to stimulate a dialog on approaches to increase the revenues available to finance the airport system improvements contained in this plan.

Tax Relief for Privately Owned Public Use Airports

- Indiana - - all public areas on airports are exempted from property tax.
- Maryland - - airfield must be exempt from state and local property tax before a grant is received.
- Michigan and Tennessee - - state law exempts airfields from property tax.
- Pennsylvania - - state provides grants to airports for taxes paid.
- North Dakota - - taxes hangars as real estate and the airfield as farmland.

State and Local Match Programs

- Arkansas - - runway improvements are matched at 90/10 or 80/20, and matches 50/50 for hangars with not-to-exceed funding limits.
- Florida - - the state funds revenue-producing projects such as fuel farms and t-hangars, plus offers 50/50 seed grants for non-aeronautical projects, such as airport industrial parks.

State-Sponsored AIP Grant for General Aviation Airports

- Maine - - offers state-sponsored grants for GA airport projects
- Oklahoma - - offers tax credit on aircraft purchase over $5 million.
- Kansas - - dedicates $30 million over next 10 years for runway improvements, safety, and economic development. Offers 75/25 match for towns of less than 10,000 people, 50/50 match for larger towns.
- Georgia - - installs MALSR and AWOS under state contract.

Pavement Maintenance/Management Programs

- Montana - - pavement preservation program uses 25% aviation fuel taxes from air carriers.
- Louisiana - - offers 50/50 grants to a $10,000 maximum.
- Wisconsin - - grants 100% for runway marking projects and 80% for seal coat and crack sealing.
- Oregon - - aviation users developed House Bill 2199, which was approved by the legislature in 1999. The program, which covers 40 airports statewide, is funded by an increase in aviation fuel tax. The bill raised Avgas taxes by 3 cents a gallon in 1999 and another 3 cents in 2000, and raised jet fuel taxes from ½ cent to 1 cent per gallon in 1999. Funding levels will begin at $1.9 million per year in 1999-2001, and is forecast to grow to $2.6 million thereafter. The fuel tax revenues are earmarked for airport pavement projects.

Airport Infrastructure Development Banks

- Ohio - - bank provides loans and backs bonds for transportation projects, with $3 million in 1998 and $1 million in 1999 for aviation. Will finance up to 100% of eligible project with maximum term of 25 years at 2/3rds prime interest rate.
- Minnesota - - administers hangar construction revolving fund with 80% interest-free loans.
- Nebraska - - offers no-interest loans for fuel storage facilities, hangars, and aerial applicator aprons.
- Florida - - offers revolving loans for land acquisition.
- Virginia - - revolving loan program offers loans for eligible projects once a year base on project ranking system.

Innovative Policy

- New Hampshire - - state law requires all airports for sale be offered to the state in first instance.

Chapter 10 - Airport Access Plan

The regional airport system access plan was developed by identifying the components of airport access demand, evaluating the location of these demand components in relation to the region's airports, documenting existing and forecasting airport access demand in these locations, comparing demand with existing and planned airport access routes and modes, and translating that future demand into a set of recommended airport access improvements.

Components of Airport Access Demand

Airport access facilities and services serve a variety of users, including airline passengers, air cargo operators, general aviation airport users, airport employees, and airport businesses. In addition, airport ground access systems serve aerospace businesses such as the Boeing Commercial Airplane Company's aircraft production facilities located adjoining King County International Airport/Boeing Field, Renton Municipal Airport, and Snohomish County Airport/Paine Field. Resources for the *2001 RASP* study did not allow for a detailed or comprehensive region-wide analysis of airport access needs. Therefore, this chapter is primarily focused on outlining the major categories of airport access need at Sea-Tac International Airport, King County International Airport/Boeing Field, Snohomish County Airport/Paine Field, and Renton Municipal Airport. These four airports accommodate virtually all the region's passengers and air cargo, and a large share of the region's aerospace, airport, airline, and air cargo employment.

In order to identify airport access needs, several measures of airport access demand were examined. These included the following:

- Number of based aircraft
- Annual aircraft operations
- Annual passengers
- Annual air cargo volume
- Airport-related employment (airport, airline, air cargo, air traffic control, aircraft service and repair) located at the region's airports
- Aerospace employment (aircraft, aircraft engine, and aircraft parts production) located at or adjoining the region's airports
- Total employment (within the traffic analysis zones containing or adjoining the region's airports)

Based aircraft, annual aircraft operations, passenger, and air cargo information was derived from a variety of data sources, including FAA 5010 Master Records, airport master plans, WSDOT's *Washington State Aviation System Plan*, and direct contact with airport sponsors. Employment data was derived from the Regional Council's geo-coded employment data base using data from the Washington Employment Security Department.

Airport Access Demand from Existing and Projected Airport Activity Levels

The number of aircraft based at an airport, and the amount of aircraft takeoffs and landings affect the level of ground access demand at airports. The following data display existing and forecast conditions related to these indicators at the largest regional airports:

Airport	1999 Based Aircraft	2020 Based Aircraft	1999 Aircraft Operations	2020 Aircraft Operations
Boeing Field	443	514	345,120	375,182
Paine Field	483	639	192,612	235,356
Renton Airport	255	278	100,710	109,482
Sea-Tac Airport	6	6	434,425	532,000
	1,187	1,437	1,072,867	1,252,020

Regional Passenger and Air Cargo Activity

Two major components of airport ground access demand are air passengers and air cargo. Information on existing and forecast passenger and cargo activity has been obtained directly from the Port of Seattle for Sea-Tac Airport and from King County for Boeing Field. Estimates of airport ground access demand, as well as proposed access improvements, were also derived from those sources.

Passenger Forecasts
(includes both enplaning and deplaning passengers)

	1998	2005	2010	2015	2020
Boeing Field	4,026	76,400	154,000	178,600	N/A
Sea-Tac International *	25,863,132	31,400,000	35,800,000	40,200,000	44,600,000
Total	**25,931,638**	**31,476,400**	**35,954,000**	**40,378,600**	**44,600,200**

* *Year 2015 passenger forecast for Sea-Tac Airport was interpolated by PSRC*

Air Cargo Forecasts (US tons)
(includes both enplaned and deplaned cargo)

	2000*	2005**	2010**	2015**
Boeing Field	143,425	194,540	243,595	305,000
Sea-Tac Int'l	501,597	683,100	805,200	N/A
Total:	**645,022**	**715,264**	**877,640**	**1,048,795**

* *2000 numbers were derived from Sea-Tac Airport Activity Report (2000) and Boeing Field records.*
** *Forecasts for 2000, 2005, 2010, and 2015 were taken from the "Final Supplemental EIS for the Proposed Master Plan Update Development Actions at Sea-Tac Airport" (May 1997) and the Boeing Field "Master Plan Working Paper One" (September 1999).*

Airport Access Demand from Airport-Related Employment

Three measures of employment were analyzed in determining the airport employment component of airport access demand. These data are displayed in Exhibit 10-1. First, total employment in the vicinity of the region's airports was collected from Regional Council records. These data were derived from the Washington State Employment Security Department (ESD). For each airport, the total employment was reported for traffic analysis zones ("TAZs") which either encompassed or adjoined the airport. Total employment in these zones was used as a general measure of economic activity around each airport, even though it is recognized that some of this employment was not directly related to the airports.

Exhibit 10-1 Airport Related Employment

Airport	Total 1998 Employment	Forecast 2020 Employment	1998 Aerospace Employment *	1998 Airport, Airline and Air Cargo Employment **	Traffic Analysis Zone (s) ***
Paine Field	46,444	49,757	35,078	68	506/522/524
Sea-Tac	25,661	37,259	369	12,090	342/351/355/356 357/358/362
Boeing Field	25,480	33,183	11,230	165	192/193/330
Ft. Lewis	17,307	39,238	0	5	761
Renton	16,925	12,506	15,961	33	309
Auburn	7,220	10,415	130	0	406
Arlington	5,462	7,941	370	10	596
Tacoma N.	3,555	4,002	2	20	749
Martha Lake	3,078	5,540	0	0	515
FirstAir Field	2,917	2,650	85	0	573
Vashon	2,066	2,270	0	0	346
Bremerton	1,773	2,395	0	33	823
McChord	1,390	2,498	0	0	758
Spanaway	1,230	2,003	0	1	715
Sky Harbor	1,114	1,500	0	0	601
Swanson	920	1,018	0	0	772
Thun Field	803	2,206	0	4	767
Crest	647	966	0	11	427
Harvey Field	611	707	0	24	567
Darrington	566	573	0	4	600
Apex	528	589	0	0	815
Port. Orchard	487	379	0	13	832
Kenmore Air	350	502	0	0	232
Amer. Lake	260	313	0	0	737
Totals:	**166,794**	**220,410**	**63,225**	**12,481**	

* Aerospace employment includes the following standard industrial classification ("sic") categories:
- 3721: aircraft manufacturing
- 3724: aircraft engine and engine parts manufacturing
- 3728: aircraft parts and sub-assemblies

** Airport, airline, and air cargo employment includes the following "sic" categories:
- 4512: Scheduled air passenger and air freight transportation
- 4513: Air courier services
- 4522: Non-scheduled air passenger and air freight transportation (charter flights)
- 4581: Airports, flying fields, airport terminals, air traffic control, air freight handling, aircraft service and repair

*** Employment located in traffic analysis zones (TAZs) encompassing or adjoining the airport

source: Washington Employment Security Department

As shown in Exhibit 10-1, total 1998 employment in traffic analysis zones encompassing or adjoining the region's airports was 166,794. Of this, Paine Field had the highest total, with 46,444 followed by Sea-Tac with 25,661 and Boeing Field with 25,480. Fort Lewis placed fourth, with 17,307, and Renton was fifth, with total employment of 16,925. Auburn, Arlington, and Tacoma Narrows airports had fairly high numbers of employees on and near those airports. Also included in Exhibit 10-1 are Regional Council employment forecasts for the year 2020 for the transportation analysis zones encompassing and adjoining the region's airports. Total employment at and near the region's airports is forecast to increase from 166,794 in 1998 to 220,410 in 2020. This is a total increase of 32% for an average annual growth rate of 1.3%.

The second measure of airport access demand related to employment is total aerospace employment located on or adjacent to the region's airports. This includes the manufacture of aircraft, aircraft engines, and aircraft parts. The vast majority of this employment type (standard industrial classification codes 3721, 3724, and 3728) occurs at Boeing Company facilities on and adjoining Paine Field, Boeing Field, and Renton Airport. These three airports, with total combined aerospace employment of 62,269, account for nearly all aerospace employment adjoining the region's airports (63,225). Only four other airports (Sea-Tac, Auburn, Arlington, and FirstAir Field) had any reported aerospace employment.

The third component of airport-related employment includes jobs more directly related to airports. These include employment for scheduled passenger and cargo airlines; freight forwarders and handlers; aircraft repair, servicing, and cleaning; air traffic control; aircraft charters and sightseeing; and airport operators. These jobs would include airport management and operations, airline and air cargo personnel, FAA air traffic control staff, and employees related to servicing and repair of aircraft while on the airport. Whereas total employment and aerospace employment includes jobs that might be located either on or off the airport itself, airport, airline, and air cargo employment in these categories tends to be located on the airport. Total airport, airline, and air cargo-related employment at the region's airports was 12,481 as of 1998. Of this, nearly all was located at Sea-Tac Airport, where airport-related employment totaled 12,090.

Aerospace is the major single component of total employment at three of the four airports. At Renton Airport aerospace jobs comprise 94% of total employment, at Paine Field they comprise 75%; and at Boeing Field they comprise 44%. At Sea-Tac Airport, airport-related employment is the single largest component of employment, comprising 47%, while aerospace employment (1%) is negligible.

Regionally Significant Transportation Routes and Services Serving the Region's Major Airports

Seattle-Tacoma International Airport

Several regionally significant transportation facilities serve Sea-Tac Airport and the vicinity. These include SR-518, a 4-6 lane limited access freeway connecting the airport area with I-5 to the east, and SR-509, a four-lane freeway connecting the west side of the airport with downtown Seattle. In addition, SR-99/International Boulevard provides direct access to the airport terminal area. International Boulevard is a 6-lane arterial with high occupancy vehicle (HOV) lanes on each side.

In addition to these surface highways, the airport is served by numerous regional express bus routes operated by Sound Transit. A regional light rail route is currently being planned and designed by Sound Transit. The light rail line will serve the east side of the airport and will include an airport station to be located in the vicinity of the proposed new north passenger terminal and/or the planned future ground transportation center. Regional bus service operated by Metro is available to the airport. Major routes serving the passenger terminal include 174 and 194 (serving downtown Seattle), and 340 serving

Shoreline, north King County, Bothell, and the east side. In addition, Sound Transit now operates two routes serving the airport: 570 connecting to downtown Seattle, and 574 serving Tacoma.

Snohomish County Airport/Paine Field

Several major routes serve the Paine Field area, including SR-526, SR-525, Airport Road, and the recently completed Paine Field Boulevard. SR-526 is a 4-6 lane limited access freeway providing access to the north end of Paine Field and the Boeing Company's 747 / 777 assembly plant to the north. SR-526 provides direct access to Paine Field via a full interchange at Airport Road at the northeast corner of the airport. SR-525, also known as Mukilteo Speedway, is a 3-lane arterial that connects the west side of Paine Field with SR-99 and I-5 to the south and with Mukilteo to the north. Airport Road, a five lane arterial, is provides several entrances to Paine Field, serving the east side of the airport, and connecting to SR-526 to the north and SR-99 to the south. Paine Field Boulevard is a recently completed 4-lane arterial serving the northwestern quadrant of the airport, connecting SR-525 and SR-526.

Several Community Transit commuter bus routes serve the Paine Field/Boeing Plant vicinity: 207 serves Smokey Point, 217 and 227 serve Arlington, 247 serves Stanwood, and 727 serves Gold Bar. Each of these routes provides service via SR-526, Seaway Boulevard, Airport Road, and 94th Street S.W. In addition, King County Metro operates the following Boeing Metro Custom bus routes serving the Boeing Everett Plant: 949, 950, 951, 952, and 965. Everett Transit also provides local bus service serving the Boeing Plant. This service includes routes 2, 3, 8, and 25. Routes 2, 8, and 25 use Casino Road to access the Boeing Plant, while route 3 serves Airport Road along the east side of Paine Field.

King County International Airport/Boeing Field

Boeing Field is located near the west side of I-5, and is served by two I-5 interchanges at S. Boeing Access Road to the south and Albro Place to the north. East Marginal Way, a five lane arterial, provides access along the west side of the airport, serving airport users, major Boeing Company facilities, and the Museum of Flight. On the east side, Airport way provides a four lane arterial serving the main terminal building, airport offices, and several major airport tenants.

Several King County Metro bus routes serve Boeing Field and adjoining Boeing Company facilities. These include route 60, 130, 154, 170, 173, and 174. Sound Transit's proposed "Link" light rail and "Sounder" commuter rail systems will provide a combined Boeing South Access Road station located south of Boeing Access Road and east of Airport Way. This station, south of the airport, will be the closest light or commuter rail station to Boeing Field and the Boeing Company's aerospace facilities located on the west side of the airport.

Renton Municipal Airport

Renton airport is bounded on the north by Lake Washington, on the east by the Cedar River, on the south by Airport Way, and on the west by Rainier Avenue South. The airport's two primary entrances are from Airport Way and Rainier Avenue South. Both Airport Way and Rainier Avenue South are six-lane arterials. Access between the airport and the nearest interstate freeway (I-405) is via these two arterials plus Logan Avenue South through downtown Renton. Limited bus service is available at Renton Airport. The Renton Transit Center serves 15 transit routes, and is located at S. 2nd Street, approximately 1 mile south of the airport. Several bus routes serve the Renton Boeing plant, located on the east side of the airport. These include routes 110, 167, and 340. Sound Transit also serves the Renton Boeing Plant with route 565 and 970.

Airport Trip Generation Data Produced by the Regional Travel Demand Model

The Regional Council uses its regional travel demand model as a major technical tool in planning for the regional transportation system. The model uses population, employment, and land use data (existing and forecast); trip generation data; information about regional travel patterns, mode choice, and travel behavior; distributes trips by mode choice; assigns trips by mode to the regional transportation network; and models the performance of the regional transportation system. The model produces output for each of 832 regional traffic analysis zones (TAZs) showing AM peak hour, PM peak hour, and average daily trips to and from each TAZ.

Much of the information discussed above regarding airport activity levels and employment on and around the region's airports is included in the regional travel model. Data about existing (baseline) traffic is collected from a variety of sources, and provides a wealth of knowledge about the region's current travel behavior. Future forecasts of population, employment, and other trip generators is combined with assumptions about mode choice, trip generation rates, and the affects of cost, to produce estimates of future traffic and how it will be accommodated on the regional transportation system.

In order to simulate the regional transportation network, the travel demand model simulates both trip ends. To accomplish this, the model uses both trip generation and trip attraction rates. Residential trip ends are modeled primarily as trip generators. For residential trips, the model produces five types of home-based trips: work trips, shopping trips, school trips, college trips, and other trips. Non-residential trip ends are modeled as both trip generators and trip attractors. These are grouped into six employment categories: (1) retail; (2) financial, insurance, real estate, and other service employment; (3) manufacturing; (4) wholesale, transportation, communication, and utilities; (5) government; and (6) education. Airports are typically included in the "transportation" category, while Boeing and other related aerospace employment is normally classed as "manufacturing." In addition, the model uses a post-distribution process for special trip generators. Key among these is Sea-Tac Airport. In order to capture the unique trip-generating nature of the airport, estimates of trip making activity to and from Sea-Tac Airport were developed using historical data and future forecasts provided by the Port of Seattle. Airport trip generation rates were based on average weekday trips, not weekend or seasonal averages.

The regional travel demand model produced the following trip generation numbers for the four airports in the region with the greatest access demand (Sea-Tac, Boeing Field, Paine Field, and Renton). These trips include all airport, aerospace, airport-related, and other trips not related to airports or aerospace are included because all these trips are generated within the airport traffic analysis zones (TAZs), and contribute to access needs in the vicinity of the airports.

	Existing 1998 Surface Trips		Forecast 2020 Surface Trips	
Airport	Average Daily	Peak Hour *	Average Daily	Peak Hour *
Sea-Tac	231,816	54,034	327,081	77,220
Boeing Field	132,696	30,076	168,382	38,502
Paine Field	295,190	67,913	344,051	79,767
Renton	97,192	22,170	77,896	18,035
Totals:	756,894	174,193	917,410	213,524

* *Combined AM and PM peak hour trips*

According to the regional travel demand model, these four airports, combined with other trip generators contained in their traffic analysis zones (TAZs), currently generate over 750,000 daily surface trips and 175,000 peak hour surface trips. In the case of Sea-Tac Airport, the airport alone generates about half the total trips generated within the relevant traffic analysis zones (see below). The remaining trips can be attributed to residents, hotels, and businesses not directly associated with the airport. For the combined four airports, the current 750,000 daily trips are forecast to increase to over 900,000 daily trips and 213,000 peak hour trips by the year 2020. This level of activity, in terms of both average daily traffic and peak hour trips, places significant demands on the surface transportation system. These airports generate a high percentage of demand during peak hours (23% of total daily demand for the region). When combined with the large overall numbers of trips, these peaking characteristics create both demand for and opportunities to provide alternative forms of transportation, such as transit, car pools and van pools, TDM and ITS, and other approaches to address demand. As described above under existing transportation services and below under planned improvements, these four airports are already engaged in significant roadway and multi-modal transportation improvement programs in coordination with local government, transit agencies, the State DOT, and the Regional Council.

For the regional airport system, the analysis contained in the regional travel demand model is combined with site specific airport master planning to develop recommendations for roadway and other airport access improvements serving the access needs of the region's airports. This information and the related recommendations is summarized in this chapter. While not an exhaustive or comprehensive traffic analysis, the information generated by the travel model is useful in planning for the surface access needs of the region's airports, and integrating these needs into the regional transportation system plan.

Planned Access Improvements to Major Regional Airports

Planned Seattle-Tacoma International Airport Access Improvements

For Sea-Tac Airport, baseline and future airport access forecasts were derived from the *Sea-Tac International Airport Master Plan* (1994) and the *Final Supplemental EIS for the Proposed Master Plan Update Development Actions for Seattle-Tacoma International Airport* (May 1997). These included access demand generated by passengers, air cargo activity, and airport, airline, and related employees. In 1994, the airport generated 72,510 average annual daily trips ("AADT"). According to the Final Supplemental EIS, Appendix D (Table D-2), this number is forecast to increase to 141,100 average annual daily trips (AADT) by the year 2020. When non-airport trips are added, the total traffic generated within the Sea-Tac Airport area (seven TAZs) increases to 327,000 daily trips in the year 2020. The following percentages show seven major trip generators at the airport, average daily trips forecasts for the year 2010, and the percentage of the airport total for each:

Trip generator	Daily Trips	Percent of daily trips
Passengers	88,700	78.3 %
Passengers (off-site parking)	1,320	1.2 %
Airport employees	7,200	6.4 %
Air cargo	7,490	6.6 %
Airfield operations	1,740	1.8 %
Maintenance	2,010	5.5 %
General aviation & other	300	< 1 %
Totals	113,290	100 %

To accommodate this airport access demand growth to the year 2010, and mitigate the impacts of airport growth on surrounding communities, the following airport access improvement projects are being advanced by a cooperative group of sponsors including the Port of Seattle, the State DOT, King County, adjoining cities, Sound Transit, and the Regional Council. These access improvements include:

- SR-509 extension project
- SR-518 corridor study from I-5 to SR509
- South Access Roadway project
- Improvements along SR-99/International Boulevard from S. 153rd Street to S.170th Street
- Sound Transit's *Link* Light Rail connection to the airport plus additional regional Sound Transit express bus routes serving the airport
- Interchange near S. 20th/SR-518 for access to air cargo complex
- Relocation of S. 154th/156th around the end of the new runway
- Temporary construction of a new interchange off SR-509 and SR-518 for delivery of runway fill
- Proposed intermodal center
- Proposed consolidated rental car facility
- Improved access and circulation roadway improvements at the main passenger terminal
- Construction of remote employee parking connected by shuttle bus to the terminal area
- S. 28th / S. 24th Avenues improvement program
- "Pay-on-foot" system for pre-paying parking fees
- Commute trip reduction program
- Employee car pool program
- Flex pass program
- Automatic Vehicle Identification ("AVI") program for billing commercial vehicles

The Regional Council has supported most of these projects in its Regional TIP program and in the Metropolitan Transportation Plan (MTP).

The Port of Seattle and the city of SeaTac signed an inter local agreement ("ILA") on September 4, 1997. The agreement provides for coordination of planning, land use and zoning, and transportation in the vicinity of the airport, including financial support for the planning and implementation of transportation improvement projects. The agreement provides specific support for the SR-509 extension project, South Access project, Sound Transit's LINK light rail project, SR-99/International Boulevard improvements, Transportation Demand Management ("TDM") programs, and a pedestrian link between the airport and the SeaTac city center.

Planned King County Int'l Airport/Boeing Field Access Improvements

The September 1999 draft master plan for King County International Airport / Boeing Field does not include any specific recommendations for surface access improvements (see below for projects included in the MTP).

Planned Snohomish County Airport/Paine Field Access Improvements

The July 1995 *Snohomish County Airport/Paine Field Master Plan* anticipates continued strong airport growth, which will generate increased surface access to and near the airport. In addition, the airport master plan refers to forecasts of growth at the Boeing 747/777 assembly plant, TRAMCO's major aircraft maintenance facility, and other employers in the airport vicinity that will all place additional demands on the regional surface access transportation system. The regional travel demand model, as described above, forecasts significant traffic growth in the Paine Field area (three TAZs), from 295,190 daily trips in 1998 to 344,051 in the year 2020. In order to accommodate this level of activity, the airport

master plan, as well as other transportation planning documents, identifies several major surface access improvement projects to meet future airport access needs and those of the greater airport area. These projects, which are also supported by Snohomish County, the WSDOT, and the Regional Council, include the following:

- New arterial roadway (to be called Paine Field Boulevard) to connect SR-525 near Harbour Point Boulevard N. with SR-526 near 40th Avenue W (this project was completed in 1999)
- Widening of Airport Road between SR-526 and I-5 to an ultimate 7-lane section, including one new high occupancy vehicle (HOV) lane in each direction (this project was underway between the main airport entrance and SR-526 in 1999)
- New four-lane east-west roadway connecting 112th Street SW and SR-525 (Mukilteo Speedway)
- Upgrades to SR-525 (Mukilteo Speedway) between SR-99 and SR-526
- Additional turn lanes, traffic signals, and intersection design improvements at the following intersections: Airport Road and 100th Street SW, Airport Road and Beverly Park-Edmonds Road, Airport Road and 112th Street SW, and Airport Road and Pacific Highway (SR-99).
- Eventual grade separation of the Airport Road/SR-99 intersection
- Improvements to the I-5/128th Street SW interchange

With proposed improvements to all major existing arterial streets on the west and east sides of the airport, plus two new arterial roadways, numerous major intersection improvements planned, and new HOV lanes, the access improvement program for Paine Field is ambitiously seeking a broad range of upgrades to match forecast needs.

Planned Renton Airport Access Improvements

The airport master plan anticipates traffic volumes on Rainier Avenue South will increase by 40% between 1993 and 2013, while volumes on Airport Way are expected to double in the same time frame. The city of Renton is planning multi-modal improvements to accommodate this and other traffic growth in the airport vicinity, including improved transit service, new HOV facilities, Transportation Demand Management (TDM) programs, and Commute Trip Reduction (CTR) programs.

PSRC's Regional Transportation Plan ("Destination 2030") and Transportation Improvement Program ("TIP")

The Puget Sound Regional Council is mandated to develop and maintain a Regional Transportation Plan (known as "Destination 2030") and Transportation Improvement Plan ("TIP"). *Destination 2030* is the region's long range multi-modal plan for providing transportation improvements in support of the region's *Vision 2020* growth management plan. *Destination 2030* was adopted on May 24, 2001. The regional TIP is the ongoing process that provides state and federal funding to projects that implement the region's transportation plan.

The following transportation projects are contained in *Destination 2030*, and will provide improved access to the region's four major airports:

Sea-Tac International Airport (vicinity)

- SR-509 from 1st Avenue South Bridge to Des Moines Memorial Way S. - - Widen for two new HOV lanes
- SR-509 from Des Moines Memorial Way S. to I-5 - - New 4-6 lane limited access freeway (SR-509 extension)
- SR-518 from I-5 to SR-509 - - Major widening for two new HOV lanes
- South Access Project from SR-509 extension to airport terminal - - New arterial
- S. 188th Street from International Boulevard (SR-99) to 16th Avenue S. - - Minor widening
- International Boulevard (SR-99) from S. 170th to S. 188th - - Major widening for two HOV lanes
- S. 176th Street from International Boulevard to Military Road - - Minor widening
- Military Road South from S. 160th Street to S. 186th Street - - Minor widening
- Sound Transit "LINK" Light Rail connection to the airport

King County International Airport/Boeing Field (vicinity)

- East Marginal Way S. from Boeing Access Road to Tukwila north city limit - - Major widening from 4 to 6 lanes
- Sound Transit commuter and light rail systems will pass the airport, with a combined commuter rail and light rail station (with park and ride lot) located at Boeing Access Road at the south end of Boeing Field. This station provide access to the regional commuter and light rail systems, but because of its location, will require a bus connection to provide convenient access to major activity areas at Boeing Field or to Boeing Company's employment center on the west side of the airport.

Snohomish County Airport/Paine Field (vicinity)

- Airport Road from SR-99 to SR-526 - - Major widening for two new HOV lanes
- SR-525 (Mukilteo Speedway) from SR-99 to SR-526 - - Major widening to 5 lanes
- Beverly Park-Edmonds Road/112th Street SW from SR-525 to 3rd Avenue SE - - Major widening to 5 lanes
- Evergreen Way from 112th Street SW to Airport Road - - Major widening to 3 lanes
- 112th Street SW-Beverly Park Road Corridor from SR-525 to SR-527 - - Major widening to 5 lanes
- 100th Street SW from Airport Road to Evergreen Way - - Major widening to 3 lanes
- SR-99 from SR-525 to Evergreen Way - - Major widening for HOV lanes

Renton Municipal Airport (vicinity)

- Downtown Renton transit signal priority system
- Bronson Way from I-405 to S.E. 2nd Street - - Major widening from 4 to 6 lanes
- Sound Transit regional express bus service connecting the Renton Transit Center and I-405
- Sound Transit light rail, commuter rail, or other rail technology (long range) serving downtown Renton and connecting with the regional light rail/commuter rail network

Future Issues and System Planning Needs

While significant amounts of funding will be spent on the projects identified above, and many of these projects will result in improved access to the region's busiest airports, there are additional issues that can be addressed at the regional level. These include more integrated planning for the region's airport access needs, adoption of a multi-modal approach that provides airport access alternatives, more cost-effective project planning and implementation to stretch available funding further, more environmentally sound solutions to providing access to airports, and recognition of the emerging issue of air quality and its affect on planning for airport access. An August 2000 report by the U.S. General Accounting Office entitled *Aviation and the Environment* includes the results of a survey of the 50 busiest commercial service U.S. airports. The survey asked airport sponsors about the key environmental concerns and challenges associated with existing airport operations and future growth of the airport system. Nearly 40% of the airports listed air quality as a major concern in planning for future airport growth. When asked what were the most critical issues related to air quality, 82% reported the growing demand for parking was either a major or moderate concern; 76% listed the high number of auto trips to and from the airport; 54% said road congestion was limiting airport growth; and 46% were concerned about the lack of funds for transit serving airports.

While these issues may be most critical at many of the nation's top 50 commercial service airports, including Sea-Tac, they're also relevant to the region's busiest airports that have significant levels of aviation activity and support major amounts of airport and aerospace-related employment. Sea-Tac Airport is beginning to address each of these issues with a program that includes additional parking, ground access improvements, transportation demand management (TDM) and intelligent transportation system (ITS) programs, and coordinated planning for new and expanded transit services provided by Sound Transit. Over time these programs promise to improve access by addressing demand with a multi-modal approach, and providing access choices for both air passengers and airport-related employees.

This type of approach is needed at the regional level, and can be integrated into both the ongoing Metropolitan Transportation Plan, or "MTP" (called *Destination 2030*) and WTP (Washington Transportation Plan) planning programs. Similar to the multi-year process that has been addressing the region's freight mobility issues, the first step in beginning to address the region's airport access needs is raising the region's consciousness of the airport system, its economic importance to the region, and how it connects with the rest of the regional transportation system. Additional work in this arena should begin to identify the more specific access needs related to air cargo activity at both Sea-Tac Airport and Boeing Field, and then start to identify multi-modal options and needs serving Paine Field and Renton Municipal Airport. The next step is to merge these needs with those of the neighboring communities and the region as a whole to increase the value of investments in the surface transportation system.

In addition to planning and implementation of airport access improvement projects, future planning efforts should begin to identify specific airport access system performance measures to evaluate the benefits of investments in access projects. These measures could assess how access improvements are benefitting the region's air travelers, air cargo shippers and their customers, general aviation users, airport and aerospace employees, and could also measure environmental indicators, such as air quality reduction and congestion relief.

Chapter 11 - Agency and Public Involvement

Agency and public involvement was accomplished through a Regional Airport System Plan advisory committee, which provided continuing advice and comments throughout the airport system planning process. The committee was formed at the beginning of the planning effort in August 1998. Members included representatives from the FAA, WSDOT, Airport Owners and Pilots Association (AOPA), Washington Pilots Association, several airport sponsors, the U.S. Air Force, local planning agencies, airport user groups, Boeing, and the University of Washington. The following people were members of the *2001 RASP* Advisory Committee (a more detailed list is attached):

Member	Agency
Stan Allison	WSDOT Aviation Division
John Anderson	Auburn Municipal Airport
Tom Ballard	Pierce County
Rikki Birge	Crest Airpark
Jess Browning	University of Washington (Global Trade and Transportation Logistics)
Steve Butler	City of SeaTac
Dan Cardwell	Pierce County Planning and Land Services
Jim Combs	Washington Pilots Association (WPA)
Ray Costello	Aircraft Owners and Pilots Association (AOPA)
John Current	FAA
King Cushman	Puget Sound Regional Council
Rod DeVol	Snohomish County Airport/Paine Field
Cory Duskin	Arlington Municipal Airport
Frank Figg	Boeing Commercial Airplane Company
Jamelle Garcia	Auburn Flight Services
Kandace Harvey	Harvey Field
Clare Impett	King County International Airport/Boeing Field
Nancy Jensen	NW Section, Ninety Nines
Stephen Kiehl	Puget Sound Regional Council
Steve Lancaster	City of Tukwila Department of Community Development
Ralph Lawson	Spanaway Airport
Mike Lunenschloss	Washington Seaplane Pilots Association
Jack McGoldrick	Washington Pilots Association
Cayla Morgan	FAA
Jonathon Morrow	USAF
Rob Putnam	Arlington Municipal Airport
Jeff Robb	Port of Bremerton/Bremerton National Airport
Fred Salisbury	Port of Bremerton/Bremerton National Airport
John Sessions	Washington Seaplane Pilots Association
Theresa Smith	WSDOT Aviation Division
Bob Snyder	Pierce County Airport/Thun Field
Cynthia Stewart	King County International Airport/Boeing Field
Mary Vargas	FAA
Dave Waggoner	Snohomish County Airport/Paine Field

In addition to formal advisory committee members, the following people served as alternates or participated in committee meetings as interested parties:

Peter Beaulieu	Puget Sound Regional Council
Dick Brandenburg	Port of Bremerton
Bill Brubaker	WSDOT Aviation Division
Carol Key	FAA
Ron Seymour	Port of Seattle
Michelle Whitfield	WSDOT Aviation Division
Julie Rodwell (alt.)	City of SeaTac

Committee meetings were held throughout the *2001 RASP* planning process between August 1998 and December 2000. Approximately two weeks prior to committee meetings, committee members were mailed a meeting packet containing minutes from the previous meetings, the agenda for the upcoming meeting, a draft report chapter for review and comment and discussion at the upcoming meeting, and various support materials. Committee meetings were held on the following dates:

December 3, 1998
April 1, 1999
September 30, 1999
October 20, 1999 (sub-committee meeting)
January 27, 2000
June 7, 2000
September 28, 2000
December 14, 2000
April 4, 2001

In addition to the formal advisory committee meetings and other informal meetings with many committee members, the *2001 RASP* team held three airport "fly-in" tours to collect information about system airports and to discuss issues with airport sponsors. The tours were conducted using a Cessna 205 supplied and piloted by Dave Waggoner, manager of Snohomish County Airport/Paine Field. The fly-in tours took place on August 26, 1999, September 8, 1999, and September 22, 2000. The following airports were included in the fly-in tours: Harvey Field, Arlington Municipal Airport, Darrington Municipal Airport, Bremerton National Airport, Tacoma Narrows Airport, Pierce County Airport/Thun Field, Renton Municipal Airport, and Crest Airpark.

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APPENDIX A - GLOSSARY OF TERMS

Air Carrier Airport - Airports serving certificated air carrier airlines offering scheduled service. These airports accommodate passenger and cargo airlines, and most also provide facilities for general aviation and military users.

Air Carrier Operation - A scheduled aircraft operation (either a landing or a take-off) performed by a certificated air carrier airline involving transport of passengers or cargo.

Air Taxi Operation - An unscheduled aircraft operation (either a landing or a take-off) involving transport of passengers or cargo for hire (such as a charter flight).

Airport Master Plan (AMP) - The document which lays out the short, medium, and long range (usually 5-, 10-, and 20-year) development plan for an airport. The AMP document usually includes the data and logic upon which the development program was based, a 5-year capital improvement program (CIP), and an airport layout plan (ALP), which is a set of detailed drawings displaying existing and future airport facilities.

Airport System Plan (or aviation system plan) - The document which lays out the airport and airport-related facilities required to meet existing and future needs for a system of airports (national, state-wide, metropolitan, or regional). Airport system plans are less specific than individual airport master plans, and focus on regional issues, needs, and priorities.

Airside (or airfield) - The term used to describe the runways, taxiways, apron, navigational aids, approach lighting, runway protection zones, runway and taxiway safety areas, and other airport facilities which provide for the landing, takeoff, and taxiing of aircraft.

Clear Zone - Clear zone (or runway clear zone) means an area at ground level underlying a portion of the Part 77 imaginary runway approach surface. The zone extends to a point on the ground where the approach surface reaches fifty (50) feet above the runway end elevation. The "clear zone" is always related to the runway end regardless of the landing threshold location. The FAA has replaced the term "clear zone" with the term Runway Protection Zone (see).

DME (Distance Measuring Equipment) - DME is electronic equipment located at an airport which assists pilots to measure their distance from the airport. DME is often used with VOR equipment, which provides pilots with directional information for navigating to an airport. When used together these navigational aids are referred to as VOR/DME, and provide both distance and directional information for pilots when navigating to land.

FAA (Federal Aviation Administration) - The organization in the United States Department of Transportation with primary responsibility for the nation’s airspace and air traffic control system; administering the airport improvement program (AIP); regulating the development and operation of public use airports; promoting aviation safety; providing airport noise standards; airline regulation; and aircraft certification.

Federal Aviation Regulation (F.A.R.) - The "Part" numbers identify specific subject areas. All FARs are contained in Title 14, CFR. (F.A.R. Part 77 deals with "Objects Effecting Navigable Airspace").

FHWA (Federal Highway Administration) - The organization in the United States Department of Transportation that has primary responsibility for the USDOT's ITS program.

General Aviation Airport - All airports not designated as "Air Carrier" airports are considered to be general aviation ("GA") airports. Typically, GA airports are smaller, have shorter runways, and primarily serve recreational, business, and corporate users who fly small piston-powered, twin engine turbo-prop, business jet aircraft.

IFR (Instrument Flight Rules) - Rules and procedures established under FAR Part 91.115 governing aircraft flight where the pilot controls the aircraft by reference to instruments within the cockpit as opposed to visual references to the ground outside of the aircraft. The term is also used by pilots to indicate how they are actually flying the aircraft and weather conditions are such they must fly the aircraft by instrument reference instead of visual references.

ILS (Instrument Landing System) - A ground based radio navigation system which provides pilots very precise cockpit instrument readings for landing on a runway in conditions of very low clouds and visibility. (See: precision Approach)

ITI (Intelligent Transportation Infrastructure) - The technological infrastructure (including computer chips, fiber-optic cables, and software programs) that is the overall system umbrella. The ITI represents the initial construction or acquisition of fully integrated public sector ITS components.

ITS (Intelligent Transportation Systems) - The particular applications of electronics, communications, or information processing used singly or in combination to improve the efficiency and safety of surface transportation systems within the ITI. ITS examples include systems used to meter freeway ramps, disseminate real-time information about traffic conditions, or provide priority to transit vehicles at traffic signals.

Itinerant Operation - An aircraft operation (either a landing or a take-off) performed by a general aviation aircraft which usually originates at one airport and terminates at another.

Joint Use Airport - An airport used by both military and civilian aircraft. These airports usually separate military from civil aviation activities, and operate based on a "Joint Use Agreement" between all the civilian and military users.

Landside - The term used to describe aircraft aprons, hangars, passenger terminals, cargo buildings, aircraft maintenance facilities, aircraft fuel areas, roadways and auto parking, and other non-airfield airport facilities.

Local Operation - An aircraft operation (either a landing or a take-off) performed by a general aviation aircraft usually within sight of the airport or air traffic control tower. Most "local" operations are training flights, sightseeing flights, and 'touch-and-go" landings.

Military Airport - An airport which is primarily used to serve military aircraft, including those flown by the Air Force and aviation units of the Army, Navy, Marine Corps, and National Guard.

MPO (Metropolitan Planning Organization) - An association of local, regional, and state government agencies that serves as a forum for developing policies and making decisions about regional growth and transportation issues. Most MPOs prepare and maintain long range regional plans which display the region's vision for land use development and transportation system improvements. MPOs also channel federal ISTEA funds to transportation projects throughout the region by means of the regional Transportation Improvement Program(TIP) process.

MTP (Metropolitan Transportation Plan) - The long-range transportation plan for the central Puget Sound region prepared by the Puget Sound Regional Council, the MPO for the region. The region's current MTP, adopted May 24, 2001, is called *Destination 2030.*

Non-Precision Approach - A specified series of instrument flight maneuvers and procedures established by the FAA to allow a pilot to land an aircraft in moderate weather conditions of reduced visibility and/or cloud heights. These approaches are supported by electronic and/or visual navigation aids.

PSRC (Puget Sound Regional Council) - The Metropolitan Planning Organization (MPO) and Regional Transportation Planning Organization (RTPO) for the central Puget Sound region.

Precision Approach - A specified series of instrument flight maneuvers and procedures established by the FAA to allow a pilot to land an aircraft in severe weather conditions of significantly reduced visibility and cloud ceilings. These approaches are supported by electronic and visual navigation aids.

RASP (Regional Airport System Plan) - The plan for the region's public airports. The RASP addresses the existing and future need for airport and related improvements from a regional, system-wide perspective.

Regional Council - Another term used for the Puget Sound Regional Council.

Reliever Airport - A "reliever" airport is a type of general aviation airport used as an alternate landing field when an air carrier airport cannot accommodate activity for reasons such as inclement weather or capacity constraints.

RPZ (Runway Protection Zone) - An area off the runway landing threshold used to enhance the protection of people and property on the ground. The landing threshold may not always correspond to the end of a runway.

STPP (Surface Transportation Policy Plan) - The State of Washington's transportation policy plan.

TDM (Transportation Demand Management) - Strategies that help to shift travel demand to non-SOV modes of travel or to off-peak periods of travel. These techniques are also called "Smart Travel."

TSM (Transportation Systems Management) - Strategies to maximize the efficiency of the current transportation system without adding significant capacity (e.g., freeway ramp metering, access control on arterials, etc.).

VFR (Visual Flight Rules) - Rules and procedures established under FAR Part 91.105 governing aircraft flight where the pilot may fly his aircraft by using only visual positioning references outside of the aircraft. The term is also used to imply a pilot is actually flying in or the weather conditions are such he is able to fly his aircraft only by visual references outside of the aircraft.

VOR (Very High Frequency (VHF) Omni-directional Range) - A ground located radio transmitting station used to provide accurate directional information to aircraft for navigation including non-precision instrument approaches to an airport runway.

VORTAC (VHF Omni-directional Range/Tactical Air Navigation) - A VOR air navigation radio with a Distance Measuring Equipment (DME) system co-located to provide both accurate directional and distance information to aircraft for navigation including non-precision instrument approaches to an airport runway.

APPENDIX B - REGIONAL AIRPORT SYSTEM DATABASE

Section 1 ***Airport Background Information*** . . . . . .
(sources: "Washington State Continuous Airport System Plan,"
WSDOT Aviation Division, 1993, 1998; FAA Form 5010 Airport Master Records, 1997)

Section 2 ***Based Aircraft*** . . . . . .
(sources: "Washington State Continuous Airport System Plan,"
WSDOT Aviation Division, 1993, 1998; FAA Form 5010 Airport Master Records, 1997)

Section 3 ***Airport Operations Information (1995 est.)*** . . . . . .
(sources: airport master plans; FAA Form 5010 Airport Master Records, 1997)

Section 4 ***Airport Layout Information*** . . . . . .
(sources: FAA Form 5010 Airport Master Records, 1997;
"Washington State Continuous Airport System Plan,"
WSDOT Aviation Division, 1993, 1998)

Section 5 ***Airport Capacity Information*** . . . . . .
(sources: airport master plans and PSRC)

Section 6 ***Airport Landing/Navaids Information (Part 1)*** . . . . . .
(sources: "Washington State Continuous Airport System Plan,"
WSDOT Aviation Division, 1993, 1998; FAA Form 5010 Airport Master Records, 1997)

Section 7 ***Airport Landing/Navaids Information (Part 2)*** . . . . . .
(sources: "Washington State Continuous Airport System Plan,"
WSDOT Aviation Division, 1993, 1998 FAA Form 5010 Airport Master Records, 1997)

Section 8 ***Airport Passenger/Cargo Activity*** . . . . . .
(source: airport master plans)

Section 9 ***Airport Runway Strength Data*** . . . . . .
(source: FAA Form 5010 Airport Master Records, 1997)

Section 10 ***Airport Surface Access Information*** . . . . . .
(sources: PSRC; "Washington State Continuous Airport System Plan,"
WSDOT Aviation Division, 1993, 1998)

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Section 1 Airport Background Information

Airport	FAA Site Number	FAA Airport I.D.	Location (County)	Planning Jurisdiction	Airport Ownership	Airport Reference Code (ARC)	Airport Acreage
American Lake	26433.C	W37	Pierce	American Lake	Private	M/SP	
Apex Airpark	26408.A		Kitsap	Silverdale	Private	GA/	15
Arlington Municipal	26099.A	AWO	Snohomish	Arlington	City	GA/	1,202
Auburn Municipal	26103.11A	S50	King	Auburn	City	RL	107
Bandera State	26104.A	WA04	King	Bandera	State	S/A	25
Boeing Field	26396.A	BFI	King	Seattle, Tukwila	County	RL	594
Bremerton National	26120.A	PWT	Kitsap	Bremerton	Port	GA/	1,169
Crest Airpark	26252.1A	S36	King	Kent	Private	GA/	62
Darrington Municipal	26180.A	1S2	Snohomish	Darrington	City	M/A	90
FirstAir Field	26304.21A	WA38	Snohomish	Monroe	Private		33
Gray Army Airfield	26216.A	-	Pierce	Ft. Lewis/Tacoma	U.S. Army	ML	
Harvey Field	26411.A	S43	Snohomish	Snohomish	Private	RL/	65
Kenmore Air Harbor	26248.C	S60	King	Kenmore	Private	GA/SP	6
Lake Union Chrysler Air	26393.C	WA57	King	Seattle	Private	GA/SP	1
Martha Lake	26094.2A	S13	Snohomish	Alderwood Manor	Private	PP/A	32
McChord AFB	26432.A	-	Pierce	Tacoma	U.S.A.F.	ML	
Pierce Co. / Thun Field	26374.1A	1S0	Pierce	Puyallup	County	GA/	144
Port Orchard	26361.A	-	Kitsap	Port Orchard	Private	PP/A	120
Ranger Creek State	26230.A	6WA8	Pierce	Greenwater	State	S*/A*	20
Renton Municipal	26381.A	RNT	King	Renton	City	RL	170
Sea-Tac Int'l	26395.A	SEA	King	SeaTac	Port	PR	2,500
Sky Harbor	26425.8A	WA64	Snohomish	Sultan	Private	GA	10
Skykomish State	26409.A	WA60	King	Skykomish	State	S/A	35
Snoh. Co. / Paine Field	26210.A	PAE	Snohomish	Everett	County	RL/	1,243
Spanaway	26415.A	S44	Pierce	Spanaway	Private	PP/A	24
Swanson	26191.1A	WA20	Pierce	Eatonville	City	M/A	14
Tacoma Narrows	26434.4A	TIW	Pierce	Tacoma	City	GA/	644
Vashon Island	26448.A	2S1	King	Vashon	County	GA/	20
Will Rogers/Wiley Post	26381.01C	WA47	King	Renton	City	GA/SP	1
System Total:							8,346

Airport Reference Codes: PR=primary; RL=reliever; CM=commercial; GA=general aviation; S=state-owned; M=municipally-owned; PP=privately-owned/open to the public; A=airport ; SP=seaplane base

Section 2 Based Aircraft (1998)

Airport	Single Engine	Multi-Engine	Turbo Jet	Rotor Craft	Other Aircraft	Total Based Aircraft	Ops per Based Aircraft
American Lake	15	0	0	0	0	15	47
Apex Airpark	50	0	0	0	0	50	389
Arlington Municipal	396	12	12	7	71	498	271
Auburn Municipal	228	9	0	1	0	238	723
Bandera State	0	0	0	0	0	0	0
Boeing Field	283	104	38	31	0	456	757
Bremerton National	100	5	0	0	0	105	1,036
Crest Airpark	322	10	0	2	0	334	285
Darrington Municipal	2	0	0	1	1	4	756
FirstAir Field	68	2	0	0	0	70	260
Gray Army Airfield						0	0
Harvey Field	325	8	0	16	7	356	395
Kenmore Air Harbor	100	0	0	0	0	100	400
Lake Union Chrysler Air	0	0	0	0	0	0	0
Martha Lake	50	1	0	0	0	51	792
McChord AFB						0	0
Thun Field	221	8	0	0	0	229	379
Port Orchard	15	0	0	0	0	15	1,248
Ranger Creek State	0	0	0	0	0	0	0
Renton Municipal	217	21	0	2	0	240	420
Sea-Tac Int'l	0	2	3	1	0	6	67,933
Sky Harbor	5	3	0	0	0	8	125
Skykomish State	0	0	0	0	0	0	0
Snohomish Co. / Paine Field	415	47	13	10	2	487	396
Spanaway	59	1	0	0	0	60	323
Swanson	21	1	0	0	0	22	255
Tacoma Narrows	162	31	7	0	0	200	477
Vashon Island	30	0	0	0	1	31	194
Will Rogers/Wiley Post	45	0	0	0	0	45	53
System Total:	3,129	265	73	71	82	3,620	576

Section 3 Airport Operations Information (1998 est.) *

Airport	General Aviation Operations: Local Operations	General Aviation Operations: Itinerant Operations	General Aviation Operations: Air Taxi Operations	Air Carrier, Commuter & Mil. Operations	Total Annual Operations
American Lake	50	650	0	0	700
Apex Airpark	15,000	4,400	0	25	19,425
Arlington Municipal	75,860	55,950	2,640	550	135,000
Auburn Municipal	65,565	98,339	7,996	100	172,000
Bandera State	0	300	0	0	300
Boeing Field	120,259	166,674	44,279	13,908	345,120
Bremerton National	65,000	42,000	400	1,400	108,800
Crest Airpark	9,500	85,700	22	0	95,222
Darrington Municipal	525	2,500	0	0	3,025
FirstAir Field	5,044	13,125	0	0	18,169
Gray Army Airfield					0
Harvey Field	44,352	93,223	1,879	1,246	140,700
Kenmore Air Harbor	7,200	800	8,000	24,000	40,000
Lake Union Chrysler Air	7,500	2,500	20,500	0	30,500
Martha Lake	12,500	27,000	900	0	40,400
McChord AFB					0
Thun Field	30,149	53,173	3,388	0	86,710
Port Orchard	5,500	13,000	0	214	18,714
Ranger Creek State	0	0	0	250	250
Renton Municipal	62,591	36,704	980	435	100,710
Sea-Tac Int'l	0	5,183	180,563	221,851	407,597
Sky Harbor	900	100	0	0	1,000
Skykomish State	0	300	0	0	300
Snohomish Co. / Paine Field	99,418	84,125	3,508	5,561	192,612
Spanaway	4,080	15,000	250	50	19,380
Swanson	594	5,000	0	15	5,609
Tacoma Narrows	45,283	47,292	2,168	573	95,316
Vashon Island	1,000	5,000	0	0	6,000
Will Rogers/Wiley Post	1,737	650	0	0	2,387
System Total:	679,607	858,688	277,473	270,178	2,085,946

* Operations figures are estimates for non-towered airports.

Section 4 Airport Layout Information

Airport	Runway Number	Runway Length (ft.)	Runway Width (ft.)	Runway Surface	Runway Pavement Condition
American Lake	02-20	5,500	500	Water	-
Apex Airpark	17-35	2,500	28	Asphalt	Good
Arlington Municipal	11-29	3,500	75	Asphalt	Good
	16-34	5,333	100	Asphalt	Good
Auburn Municipal	16-34	3,400	75	Asphalt	Good
Bandera State	08-26	2,342	100	Turf	Poor
Boeing Field	13L-31R	3,710	100	Asphalt	Good
	13R-31L	10,001	200	Asphalt	Good
Bremerton National	01-19	6,200	150	Asphalt	Good
Crest Airpark	15-33	3,267	40	Asphalt	Fair
Darrington Municipal	10-28	2,490	40	Asphalt	Good
FirstAir Field	07-25	2,095	34	Asphalt	Fair
Gray Army Airfield	15-33	6,125	150	Asphalt	
Harvey Field	14-31	2,660	36	Asphalt	Fair
Kenmore Air Harbor	16-34	10,000	1,000	Water	-
	18-36	3,000	1,000	Water	-
Lake Union Chrysler Air	18-36	9,500	300	Water	-
Martha Lake	16-34	1,680	38	Asphalt	Fair
McChord AFB	16-34	10,100	150	Asphalt/conc.	
Thun Field	16-34	3,650	60	Asphalt	Good
Port Orchard	18-36	2,460	28	Asphalt	Fair
Ranger Creek State	17-35	2,700	30	Asphalt	
Renton Municipal	15-33	5,379	200	Asphalt/conc.	Good
Sea-Tac Int'l	16L-34R	11,900	150	Asphalt	Good
	16R-34L	9,425	150	Concrete	Good
Sky Harbor	07-25	1,930	100	Turf	Good
Skykomish State	06-24	2,050	100	Turf	Fair
Snohomish Co. / Paine Field	11-29	4,514	75	Asphalt	Good
	16L-34R	3,000	75	Asphalt	Good
	16R-34L	9,010	150	Asphalt	Good
Spanaway	16-34	2,724	20	Asphalt	Poor
Swanson	16-34	3,000	36	Asphalt	Good
Tacoma Narrows	17-35	5,002	150	Asphalt	Fair
Vashon Island	17-35	1,940	50	Turf/gravel	Good
Will Rogers/Wiley Post	12-30	5,000	200	Water	
System Total:		1,680-11,900	20-1,000		

Section 5 Airport Capacity Information

Airport	Annual Operations	Runway Capacity (ASV) *	Demand-Capacity Ratio *	Based Aircraft	Based Aircraft Capacity *	Demand-Capacity Ratio *
American Lake	700	60,000	1%	15	19	79%
Apex Airpark	19,425	180,000	11%	50	50	100%
Arlington Municipal	135,000	270,000	50%	498	577	86%
Auburn Municipal	172,000	230,000	75%	238	330	72%
Bandera State	300	150,000	0%	0	0	0%
Boeing Field	345,120	380,000	91%	456	550	83%
Bremerton National	93,345	240,000	39%	105	194	54%
Crest Airpark	95,222	240,000	40%	334	356	94%
Darrington Municipal	3,025	180,000	2%	4	15	27%
FirstAir Field	18,169	200,000	9%	70	87	80%
Gray Army Airfield	0	180,000	0%	-		
Harvey Field	140,700	230,000	61%	356	415	86%
Kenmore Air Harbor	40,000	75,000	53%	100	100	100%
Lake Union Chrysler Air	30,500	60,000	51%	0	0	0%
Martha Lake	40,400	180,000	22%	51	52	98%
McChord AFB	0	180,000	0%	-		
Thun Field	86,710	240,000	36%	229	278	82%
Port Orchard	18,714	175,000	11%	15	28	54%
Ranger Creek State	250	140,000	0%	0	0	0%
Renton Municipal	100,710	230,000	44%	240	255	94%
Sea-Tac Int'l	407,597	460,000	89%	6	6	100%
Sky Harbor	1,000	140,000	1%	8	12	67%
Skykomish State	300	150,000	0%	0	0	0%
Snohom. Co. / Paine Field	192,612	288,000	67%	487	564	86%
Spanaway	19,380	140,000	14%	60	77	78%
Swanson	5,609	150,000	4%	22	26	85%
Tacoma Narrows	95,316	240,000	40%	200	282	71%
Vashon Island	6,000	160,000	4%	31	32	97%
Will Rogers/Wiley Post	2,387	60,000	4%	45	45	100%
System Total:	2,085,946	5,608,000	37%	3,620	4,350	83%

* Capacity figures are preliminary, and are evaluated in more detail in the capacity analysis.

Section 6 Airport Landing / Navaids Information (Part 1)

Airport	VOR/ DME	VOR	NDB	ILS	LOC	TOWER	FSS
American Lake							
Apex Airpark							
Arlington Municipal	X		X		X		
				X	X		
Auburn Municipal							
Bandera State							
Boeing Field	X		X	X	X	X	X
Bremerton National			X	X			
Crest Airpark							
Darrington Municipal							
FirstAir Field							
Gray Army Airfield						X	
Harvey Field							
Kenmore Air Harbor							
Lake Union Chrysler Air							
Martha Lake							
McChord AFB						X	
Thun Field							
Port Orchard							
Ranger Creek State							
Renton Municipal			X			X	
Sea-Tac Int'l	X	X	X	X	X	X	
				X	X		
Sky Harbor							
Skykomish State							
Snohomish Co. / Paine Field		X	X			X	
			X	X	X	X	
	X		X	X	X	X	
Spanaway		X					
Swanson							
Tacoma Narrows			X	X	X	X	
Vashon Island							
Will Rogers/Wiley Post							

Section 7 Airport Landing / Navaids Information (Part 2)

Airport	REIL	ALS	VASI/ PAPI	Weather Observ.	UNICOM	Airport Beacon
American Lake						
Apex Airpark						
Arlington Municipal		X	X	AWOS		
			X			
Auburn Municipal	X		X		X	X
Bandera State						
Boeing Field	X	X	X			
Bremerton National				AWOS		
Crest Airpark					X	X
Darrington Municipal						
FirstAir Field						
Gray Army Airfield						
Harvey Field			X		X	
Kenmore Air Harbor					X	
Lake Union Chrysler Air						
Martha Lake						
McChord AFB			X			
Thun Field			X		X	X
Port Orchard					X	
Ranger Creek State						
Renton Municipal	X		X	ASOS		
Sea-Tac Int'l		X	X	ASOS		X
						X
Sky Harbor						
Skykomish State						
Snohomish Co. / Paine Field	X	X	X	LAWRS		
			X			
			X			
Spanaway						
Swanson			X			X
Tacoma Narrows	X	X	X	LAWRS		
Vashon Island						
Will Rogers/Wiley Post						

Section 8 Airport Passenger/Cargo Activity

Airport	2000 Total Annual Passengers	2000 Total Annual Cargo (lbs)	Runway Edge Lights	Runway Approach Lights
American Lake (1997 data)	7,140		None	
Apex Airpark			None	
Arlington Municipal			None	
			MIRL	MALS
Auburn Municipal			MIRL	
Bandera State			None	
Boeing Field (1997 passenger data)	4,026	286,850,000	MIRL	
			HIRL	MALSF
Bremerton National			HIRL	MALSR
Crest Airpark			LIRL	
Darrington Municipal			MIRL	
FirstAir Field			None	
Gray Army Airfield			HIRL	ODALS
Harvey Field			NSTD	
Kenmore Air Harbor (1997 data)	29,500		None	
			None	
Lake Union Air Service (1997 data)	19,100		None	
Martha Lake			LIRL	
McChord AFB			HIRL	SALS/ALSF1
Thun Field			MIRL	
Port Orchard			LIRL	
Ranger Creek State			None	
Renton Municipal			MIRL	
Sea-Tac Int'l	28,408,553	1,007,336,000	HIRL	MALSF/ALSF1
			HIRL	ALSF2/MALSR
Sky Harbor			None	
Skykomish State			None	
Snohomish Co. / Paine Field			MIRL	
			MIRL	
			HIRL	MALSR/ODALS
Spanaway			LIRL	
Swanson			NSTD	
Tacoma Narrows			MIRL	MALSR
Vashon Island			NSTD	
Will Rogers/Wiley Post (1997 data)	18,850		None	
System Total:	28,487,169	1,294,186,000		

Runway data: LIRL=low-intensity runway edge lights; MIRL=medium-intensity runway edge lights; HIRL=high-intensity runway edge lights; NSTD=non-standard runway edge lights (NSTD lighting does not meet FAA standards per AC 150/5340-24)

Section 9 Airport Runway Strength Data

Airport	Runway Strength (gross weight in 1,000 lbs.) Single Wheel	Dual Wheel	Dual Tandem Wheel	Double Dual Tandem Wheel
American Lake	-	-	-	-
Apex Airpark	-	-	-	-
Arlington Municipal	32	34	59	-
	114	150	270	-
Auburn Municipal	12.5	-	-	-
Bandera State	-	-	-	-
Boeing Field	30	-	-	-
	100	125	330	-
Bremerton National	50	68	200	-
Crest Airpark	12	-	-	-
Darrington Municipal				-
FirstAir Field				-
Gray Army Airfield	65	200	330	-
Harvey Field	10	-	-	-
Kenmore Air Harbor	-	-	-	-
	-	-	-	-
Lake Union Chrysler Air	-	-	-	-
Martha Lake	16	-	-	-
McChord AFB	155	220	390	800
Pierce County / Thun Field				-
Port Orchard				-
Ranger Creek State				-
Renton Municipal	100	130	340	-
Sea-Tac Int'l	100	200	357	888
	100	200	350	800
Sky Harbor				-
Skykomish State				-
Snohomish Co. / Paine Field	30	-	-	-
	12.5	-	-	-
	100	200	350	830
Spanaway	12	-	-	-
Swanson				-
Tacoma Narrows	50	80	80	150
Vashon Island				-
Will Rogers/Wiley Post	-	-	-	-

Section 10 Airport Surface Access Information

Airport	Access Highway	Hwy. name or Route #	Nearest Ltd. access Highway	Distance
American Lake	Local	Veteran's Drive	I-5	1/2 mile
Apex Airpark	Local	NW Apex Airport Rd.	SR-3	1-1/2 miles
Arlington Municipal	Local	Edgecomb Road	I-5	2-1/2 miles
Auburn Municipal	Local	Auburn Way N.	SR 167	1 mile
Bandera State	Local	Interstate 90	I-90	1 mile
Boeing Field	Local	Airport Way	I-5	1 mile
Bremerton National	State	3	SR 16	3 miles
Crest Airpark	Local	179th Pl. S.E.	SR 18	2 miles
Darrington Municipal	State	530	-	-
FirstAir Field	U.S.	2	US 2	1/4 mile
Gray Army Airfield	County	41st Division Drive	I-5	1-1/2 mile
Harvey Field	County	Airport Way	SR 9	1/2 mile
Kenmore Air Harbor	State	522	I-5	3 miles
Lake Union Chrysler Air	Local	Fairview Avenue	I-5	1/2 mile
Martha Lake	County	Martha Lake Rd.	I-5	1 mile
McChord AFB	County	Bridgeport Way	I-5	1 mile
Pierce County / Thun Field	State	161	SR 512	4 miles
Port Orchard	Local?	Chandell Dr. S.W.	SR 16	3-1/2 mi.
Ranger Creek State	State	410	-	-
Renton Municipal	Local	Rainier Ave.	I-405	1 mile
Sea-Tac Int'l	State	99	SR 518	1 mile
Sky Harbor	US	2	US 2	1/4 mile
Skykomish State	County	Stevens Pass Hwy	US 2	1 mile
Snohomish Co. / Paine Fiel	County	Airport Road	SR 525/SR 99	2 miles
Spanaway	State	7	SR 512	5 miles
Swanson	State	161	-	-
Tacoma Narrows	-	Stone Drive N.E.	SR 16	1 mile
Vashon Island	Local	115th Ave. S.W.	-	-
Will Rogers/Wiley Post	State	Rainier Ave.	I-405	2 miles