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PORTLAND

INTERNATIONAL AIRPORT

Summary Data Package

Airport Capacity Enhancement Plan Update

October 2001

Prepared by
Federal Aviation Administration
FAA William J. Hughes Technical Center
Atlantic City International Airport, New Jersey

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Portland International Airport (PDX)

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TABLE OF CONTENTS

LIST OF EXHIBITS

1. INTRODUCTION

Background

The initial Portland International Airport (PDX) Capacity Enhancement Plan, completed in 1996, identified and evaluated alternative means to enhance existing airport and airspace capacity. The current Design Team was formed in 1999 to provide an updated capacity study to assess the technical merits of potential airfield expansion as presented in the Portland Master Plan update of September 2000.

Annual and Daily Demand

The Design Team simulated 3 demand levels. The schedule for the 1999 demand level was developed from Tower counts and OAG data for Tuesday, July 27, 1999, and cargo schedules for August 2000.

Demand Level	Annual Operations	Daily Operations	Equivalent Days
1999(Baseline)	322,000	1,006	320
Future 1	484,000	1,512	320
Future 2	620,000	1,938	320

Note: (Annual Operations) / (Daily Operations) = Equivalent Days

Fleet Mix By Aircraft Classifications

H Heavy	757	LJ Large Jet	LTP Large Turboprop	S+ Small+	S Small	Total	
4.7%	5.2%	46.3%	17.6%	14.7%	11.5%	100.0%	1999 (Baseline)
4.9%	5.3%	47.6%	18.1%	14.0%	10.1%	100.0%	Future 1
5.0%	5.5%	48.5%	18.6%	13.5%	9.0%	100.0%	Future 2

Percentages are rounded to 1 decimal place.

Aircraft Classifications

Aircraft Classifications used were based on 1999 FAA separation standards.

VFR1/VFR2/IFR1 Simulations and VMC/IMC Conditions

The Design Team simulated 3 conditions (VFR1, VFR2, and IFR1), which reflect the runway operating conditions associated with specific ceiling and visibility minimums. They are defined in Appendix A.

VFR1 and VFR2 are VMC (Visual Meteorological Conditions). IFR1 is IMC (Instrument Meteorological Conditions).

IMC (IFR1 Simulations)

When arrival demand consistently exceeds its capacity, its associated delays escalate dramatically. This typically occurs in IMC conditions. In reality, flights are cancelled when delays are high. However, delay reporting systems do not capture the delays associated with cancelled flights. The costs of cancelled flights include: passenger costs; hotel costs; re-issued tickets; disruptions to the schedule and bank integrity; equipment; and crew re-positioning and re-scheduling. The actual delay costs of cancelled flights are very difficult to measure because most of the information is proprietary, and the costs of cancellations and deviations vary greatly between airlines. Therefore, to capture the costs associated with cancelled flights, the Design Team simulated a full schedule in all weather conditions.

IMC/IFR1 Factor

The Design Team also simulated full days of IMC conditions. Because of the climate and terrain along the Columbia River, PDX remains in IMC conditions most of the day. Therefore, the annual delay calculations used an IMC/IFR1 Factor of 1.

Operational Procedures and Minima Simulated

The Design Team simulated the following operational procedures and minima. The percentages of occurrence were the values used in the 1996 PDX Design Team Study.

Weather	VFR1	VFR2	IFR1	
MINIMA	VISUAL	<VIS & ≥IFR	CAT I	ALL WEATHER
Ceiling:	3500'	2000'	200'	
Visibility:	10 miles	5 miles	0.5 miles	
EAST FLOW (10s)	35.3%	9.2%	7.8%	52.3%
WEST FLOW (28s)	39.1%	5.0%	3.6%	47.7%
	-----	-----	-----	-----
TOTAL	74.4%	14.2%	11.4%	100.0%

Note: 10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.
10/15/01: VFR1, VFR2, and IFR1 refer to simulated procedures/conditions.

Fleet Mix Cost

The PDX Fleet Mix Cost is $ 1,660 per hour in the year 2000 dollars. It reflects the direct operating costs for the air carriers and non-scheduled aircraft operating at PDX.

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The costs do not consider lost passenger time, disruption to airline schedules, or any other intangible factor.

Simulation Model

ADSIM, the Airfield Delay Simulation Model, was used for the simulations.

Model Inputs and Tasks

The following is a list of the model inputs used and tasks performed during the study:

- ALPs, Improvements, Simulation Scenarios
- Aircraft Classifications
- ATC Separations
- Departure Noise Dependencies -- Same Runway
- Dependencies between Parallel Runways
- Other Runway Dependencies
- Operational Procedures and Minima (By Configuration)
- Lateness Distribution (Arrival Variability Distribution)
- Gate Service Times (Minimum Turn-Around Times)
- Other Model Inputs
- Annual Demand Levels (1999 and Future Demands)
- Demand Characteristics (1999 and Future Demands)
- OAG and Cargo Counts
- Hour Counts for All Demands
- Capacity Analysis (Existing Airport -- 1999 Fleet Mix)
- Experimental Design
- Simulation Results -- Calibration & Improvements
- Fleet Mix Costs
- Annual Delay Costs and Savings

Appendices

The appendices contain detailed information:

- Appendix A lists the accepted model inputs.
- Appendix B contains the accepted simulation results.
- Appendix C provides the annual delay calculations (in hours, dollars, & average delay per operation).
- Appendix D shows the calculations for the fleet mix cost.
- Appendix E contains the list of abbreviations and their definitions.

2. POTENTIAL IMPROVEMENTS AND AIRPORT DIAGRAM

The Portland International Airport Capacity Enhancement Plan was published in 1996. The current Design Team was formed to provide an updated study due to the impact of terminal and runway expansion.

Exhibit 1 summarizes proposed improvements for the Airport Capacity Enhancement Plan Update Study. The potential improvements are grouped as follows:

- Airfield.
- Facilities and Equipment.
- Operational.
- User and Policy.

The proposals for this Design Team study do not require detailed analysis of taxiways and gates. The simulations will focus on the runways and the immediate airspace. The Airfield Delay Simulation Model (ADSIM) and SIMMOD are capable of simulating the PDX departure procedures. However, the Runway Delay Simulation Model (RDSIM) cannot simulate the PDX departure procedures and will not be used. The Design Team agreed to use ADSIM for the simulations.

Exhibit 2 lists the proposed simulation scenarios.

Exhibit 3 presents a diagram of the existing airport.

Exhibit 4 presents PDX Do-Nothing runway configurations.

Exhibits 5 and 6 are the airspace maps for the West and East Flows.

Exhibit 7 shows the airfield map for the existing airport.

The Design Team combined improvements into logical packages and reduced the required experiments to a more manageable number.

EXHIBIT 1 - POTENTIAL IMPROVEMENTS (PDX)

(Updated 10/15/01)

Airfield Improvements

NARRATE -- PROP-ONLY Parallel Runway.

- Without departure noise restrictions.
- 3 independent arrival streams to parallel runways in VMC -- TRIPLES IN VFR1 and VFR2.
- 2 independent arrival streams to outboard runways in IMC – (IFR1).
- A runway, which is restricted to PROPS-ONLY, would provide limited benefit. In IMC, the two outer runways would have independent approaches, and the center runway would have staggered approaches dependent to each of the outer runways. With a prop-only runway, the greatest benefit would occur if turbo-prop and jet activity levels were similar. Based on information from the airlines, the Design Team expects the airlines to replace many of their Turbo Props with Regional Jets. The Team believes that at some point, Regional Jets will replace as many as 50% of the Large Turbo Props and 50% of the Small+ aircraft. As the demand increases, and the percentages of props are significantly reduced, the benefits of a PROP-ONLY runway would be reduced. Therefore, the Design Team did not consider a limited use runway to be a reasonable alternative.

SIMULATE -- FULL-LENGTH Parallel Runway.

- 12,000' long and 3250' south of existing 10R/28L.
- Without departure noise restrictions.
- 3 independent arrival streams to parallel runways in VMC -- TRIPLES IN VFR1 and VFR2.
- 2 independent arrival streams to outboard runways in IMC -- (IFR1).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.
- North/South Taxiways connecting the East ends of the new runway to 10R/28L -- Future 2.

SIMULATE -- N/S taxiway connecting East ends of the existing parallel runways.

- **Imp 4B in 1996 Data Pkg 13.**
- North/South taxiway would relieve ground congestion in the East and West Flows.
- In the East Flow, it would reduce taxi times for arrivals on 10L, which are gated in Terminals A, B, and C. By enabling more arrivals to land on 10L, it would let more southbound props depart on 10R. With the existing noise restrictions, the taxiway would give controllers more flexibility in departing aircraft, especially in the West Flow.
- With no noise restrictions, departure runways could be assigned based on direction of flight rather than gate location -- especially in the West Flow.

Facilities and Equipment Improvements

SIMULATE -- Install new technology to permit simultaneous approaches to the existing parallel runways in IMC.

- The benefit is primarily an operational one. During periods when there are mixed operations on both runways, the controllers cannot take advantage of the reduced arrival spacing. To release a departure between successive arrivals on the same runway, arrival spacing must be increased to approximately 4NM.

EXHIBIT 1 - POTENTIAL IMPROVEMENTS (PDX) (Cont.)

(Updated 10/15/01)

<u>Operational Improvements</u>

SIMULATE -- Simultaneous (independent) CAT I approaches to the existing parallel runways.

- **Imp 13 in 1996 Data Pkg 13.**
- **Requires PRM (Precision Runway Monitor), GPS, or other technologies.**
- The benefit is primarily an operational one. During periods when there are mixed operations on both runways, the controllers cannot take advantage of the reduced arrival spacing.

SIMULATE -- No departure noise restrictions for Turbo Props and Biz Jets in both flow directions.

- ***Immediate north divergent turns for Turbo Props and Biz Jets in both flow directions.***
- **Affects LTP and S+ aircraft.**
- **Similar to Imp 16 in 1996 Data Pkg 13.** Turbo Props that were treated as M (Medium) in the 1996 study are treated as LTP (Large Turbo Prop) or S+ (Small+) aircraft in this study.
- Currently, Turbo Props turn north at 3,000' (about 4 NM from the end of the runway). Because of noise restrictions, when a Turbo Prop is followed by a jet, the D/D separation is 2 minutes (instead of 1 minute).
- The improvement would allow northbound and eastbound Large Turbo Props and Biz Jets to diverge and avoid the same initial departure heading as larger jets. No departure noise restrictions would apply to these aircraft.
- Since Regional Jets are classified as Large Jets, Regional Jets will not be considered to have divergent headings.
- **Will increase departure capacity and give more direct routing.**
- **Will eliminate prop-to-jet departure penalty.**

SIMULATE -- No departure noise restrictions for any aircraft.

- ***Immediate divergent turns for all aircraft.***
- **Imp 19 in 1996 Data Pkg 13.**
- All aircraft could turn immediately after takeoff onto divergent courses.
- Will allow independent departures from both parallel runways in both flows.
- **Will increase departure capacity and give more direct routing.**
- **Will eliminate prop-to-jet departure penalty.**

<u>User and Policy Improvements/Options -- none</u>

Notes: DO-NOTHING (Baseline) assumes simultaneous straight-in visual approaches are permitted.
Existing runways are separated by 3,100'.
FAATC notes on 1999 instrument approaches at PDX:

CAT II/III ILS:	10R
CAT I ILS:	10R/L, 28R/L
LOC/DME:	21
VOR/DME:	21, 28R
NDB or GPS:	28L
NDB:	28R

EXHIBIT 2 - SIMULATION SCENARIOS (PDX)

(Updated 10/15/01)

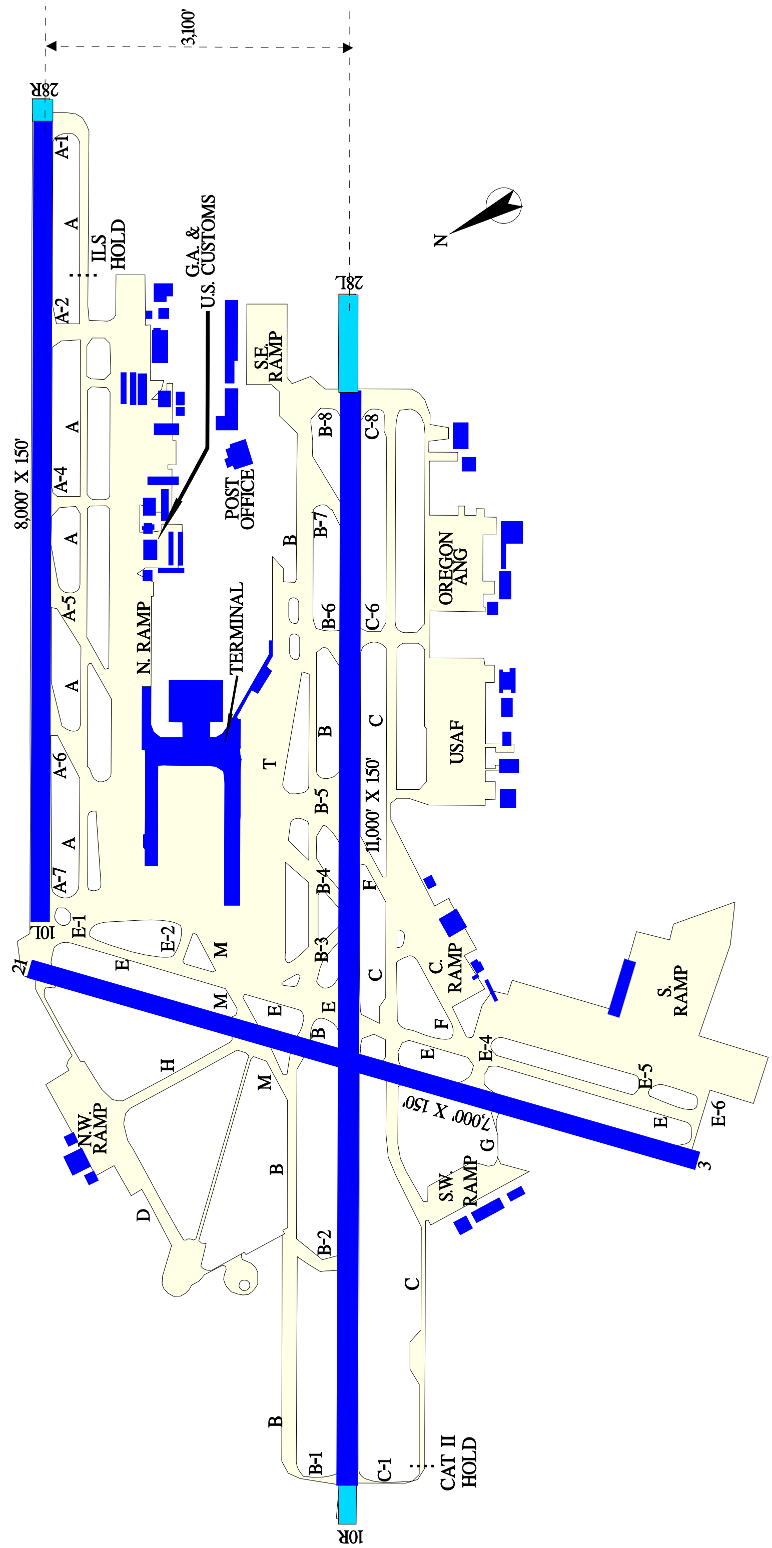
Pkg	Description of Package	Simulate at These Demand Levels 1999	F1	F2
(0)	**CALIBRATION (with 2.5 NM Minimum IFR Spacing) -- BASE-CASE** • ***1.5 NM Staggered Approaches in IFR1 (10L & 10R, 28L & 28R)***	Y	Y	Y
(A)	**No Departure Noise Restrictions for Turbo Props & Biz Jets** • ***All Turbo Props and Biz Jets Can Do Divergent Turns -- LTP & S+ aircraft***	Y	Y	Y
(B)	**No Departure Noise Restrictions for Any Aircraft** • ***All Aircraft Can Do Divergent Turns***	Y	Y	Y
(C)	**N/S Twy Connecting East Ends of Existing Parallels**	Not Simulated		
(C+B)	**N/S Twy Connecting East Ends of Existing Parallels & No Departure Noise Restrictions for Any Aircraft (*All Aircraft Can Do Divergent Turns*)**			
	(C1+B) Staggered Approaches to Existing Parallels in IFR1	N	Y	Y
	(C2+B) Independent Approaches to Existing Parallels in IFR1	N	Y	Y
(D)	**FULL LENGTH Parallel Runway**	Not Simulated		

(D+C1+B)	**FULL LENGTH Parallel Runway & No Departure Noise Restrictions for Any Aircraft *(All Departures Can Do Divergent Turns)***
	• ***N/S Twy Connecting East Ends of Existing Parallels -- all demands***
	• ***N/S Twys to East Ends of New Runway -- Future 2 demand***
	• ***3 Independent Arrival Streams to Parallels in VMC -- triple approaches in VFR1/VFR2***
	• ***2 Independent Arrival Streams to Outboards in IFR1***
	  • ***Staggered Approaches to 28L and 28R in IFR1***
	  • ***Staggered Approaches to 28L and New Runway in IFR1***
	  • ***Limited use of 28L for arrivals in IFR1***
		N	Y	Y

Notes:

- **Y/N/? -- Do/Do Not/Maybe Simulate at this demand level.**
- **PDX Do-Nothing case in 2000 study has CAT I ILS on 10R/L and 28R/L.**
  - **10/15/01: Staggered approaches in IFR1, and unrestricted arrivals on these runways.**
  - **Departure restrictions are still in effect.**
  - **Runway 3/21 will be considered an operational runway.**
- **No Departure Noise Restrictions = Divergent Turns.**
- **10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.**

EXHIBIT 3 - PORTLAND AIRPORT LAYOUT

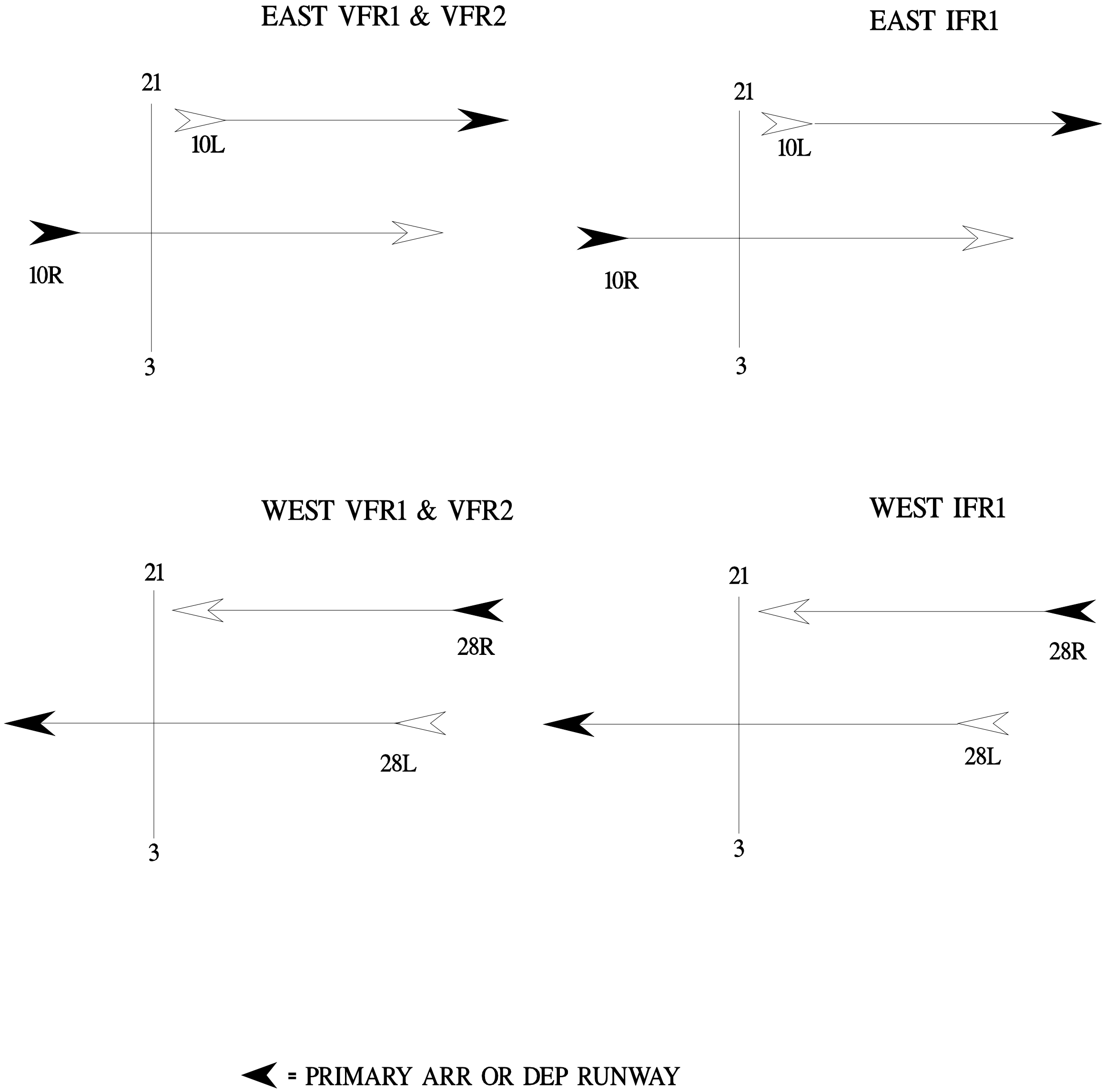


Updated 10/15/01: **Updated table to reflect the changes in Concourse C. Corrected CAT II.**

Updated 10/4/00: Exits B-3 & B-4 were added. Gate areas were updated.

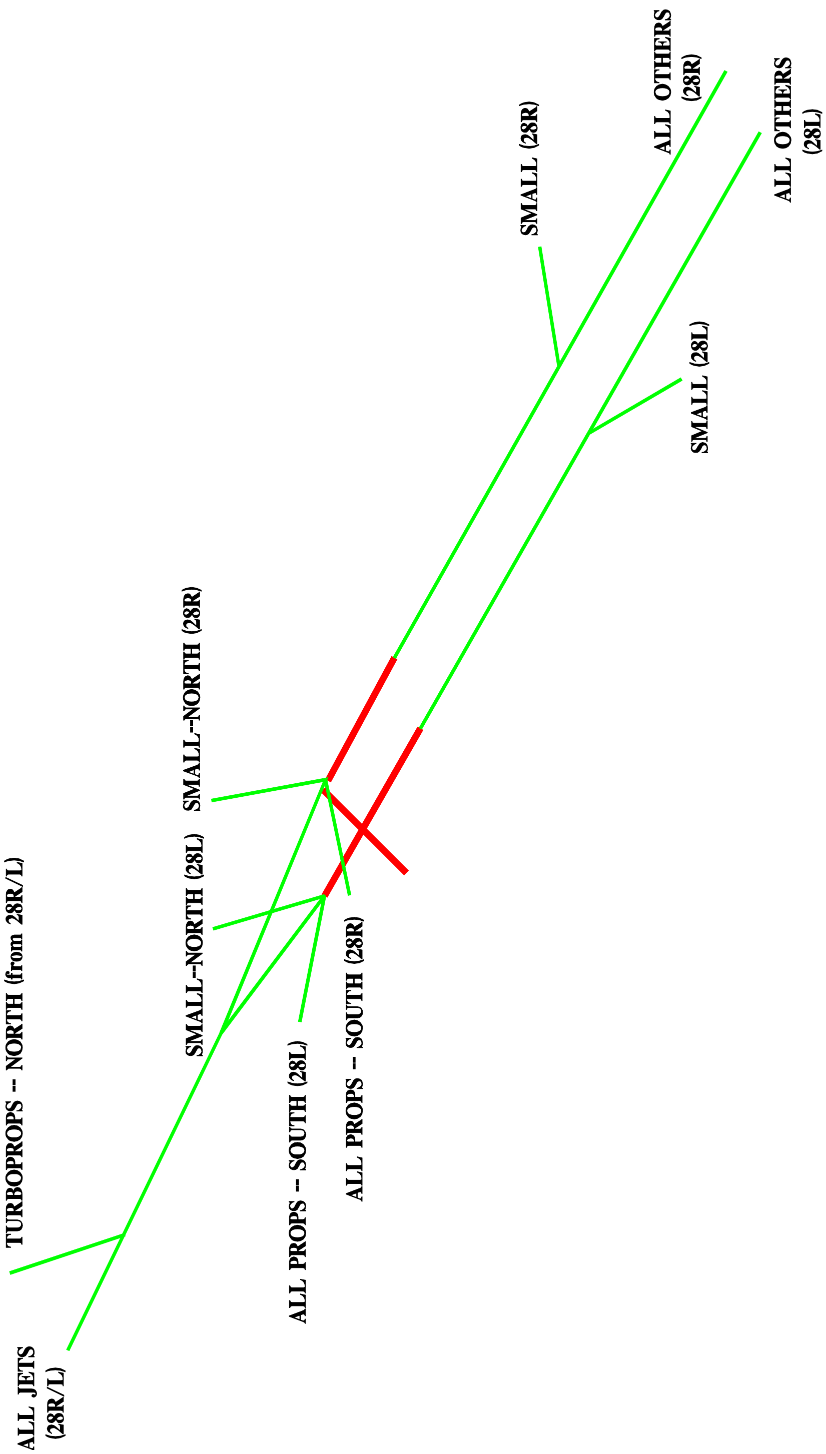
Taxiway T was extended west. Hold lines were moved. Exit A-3 was removed.

EXHIBIT 4 - RUNWAY CONFIGURATIONS (PDX DO-NOTHING)



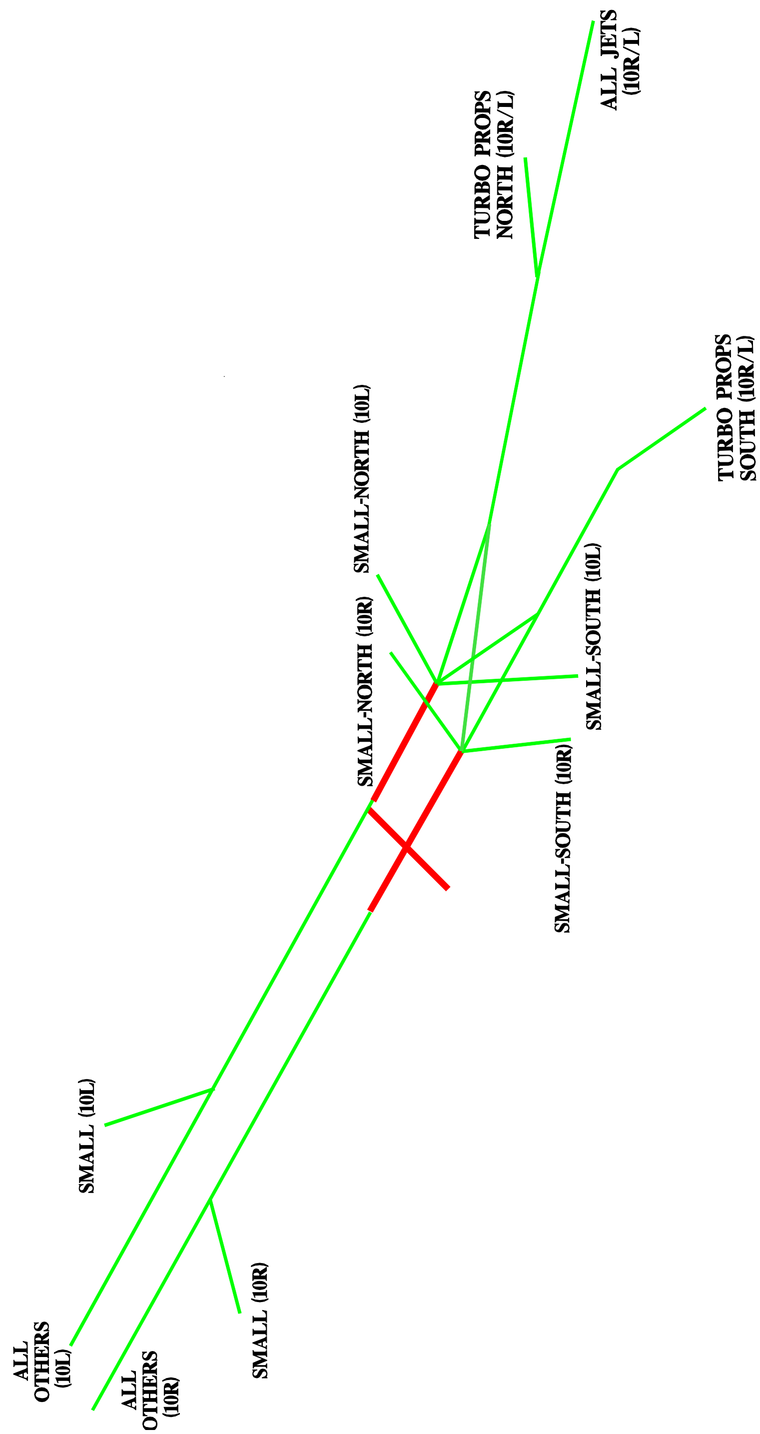
Note: **Accepted by the PDX Design Team at the meeting on July 20, 2000.**
Runway 3/21 will be considered an operational runway.
VFR2 -- any size aircraft can land on 10L and 28L.
10L & 28L have CAT I ILS -- with staggered approaches in IFR1.
10/15/01: Clarified the note on staggered approaches in IFR1.

EXHIBIT 5 - MODELING AIRSPACE MAP -- WEST FLOW (PDX DO-NOTHING)



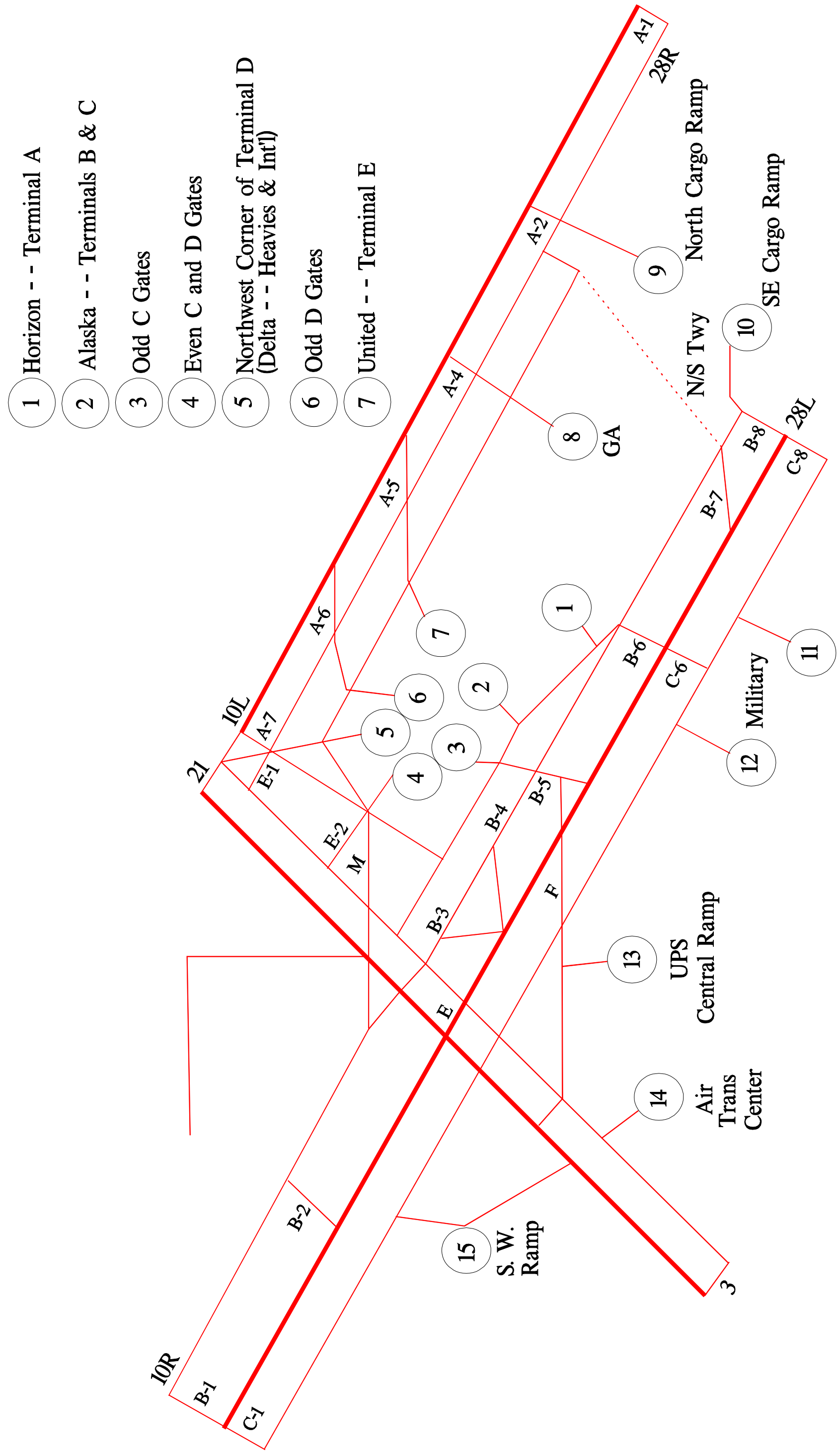
Accepted 10/12/00: **Departure restrictions still apply.**
LTP and S+ aircraft classes are considered Turbo Props in this study.

EXHIBIT 6 - MODELING AIRSPACE MAP -- EAST FLOW (PDX DO-NOTHING)



Accepted 10/12/00: **Departure restrictions still apply.**
LTP and S+ aircraft classes are considered Turbo Props in this study.

EXHIBIT 7 - MODELING AIRFIELD MAP (PDX DO-NOTHING)



Accepted 10/12/00: Runway 3/21 will be considered an operational runway.
VFR2 -- any size aircraft can land on 10L and 28L.
10L & 28L have CAT I ILS -- with staggered approaches in IFR1. (Updated 10/15/01)
Taxiway T was extended west and intersects with 3/21.
Exits B-3 & B-4 were added.

Updated 11/14/00: Alaska is at Terminals B & C.

Updated 8/8/01: Added label E-1 and corrected SE Cargo ramp label.

3. ADSIM SIMULATIONS AND RESULTS

Simulations and Results

Exhibit 8 shows the average annual delay per operation in minutes.

Exhibit 9 graphically shows the annual delay costs -- in dollars.

Exhibit 10 presents the annual delay costs and savings -- in hours and dollars.

Exhibit 11 provides a comparison of daily delays and savings.

The annual delay costs and savings are based on the 1999 fleet mix cost of $ 1,660 per hour in the year 2000 dollars.

PDX Experimental Design

Exhibit 12 describes the PDX Experimental Design. The Experimental Design will consist of three demand levels (daily aircraft schedules). The Experimental Design normally includes runs for VFR and IFR simulations and for operations in both directions on each runway. At the November 30, 2000 meeting, the Design Team decided that some of these simulations could be eliminated because the 1996 PDX Design Team Study showed the east and west runway operations produced nearly equivalent results. The West Flow will be simulated and the East Flow results will be considered identical to the West Flow results. Combining improvements into logical packages reduced the required experiments to a more manageable number.

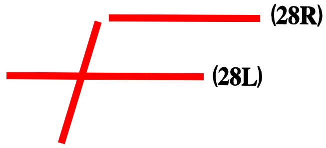
Discussion of Simulations and Results

(0) CALIBRATION (Do-Nothing)

The following table shows the use of Runway 28R in VFR1 for each demand level. At the 1999 demand, 46% of the *arrivals* used 28R (and 54% used 28L) and 36% of the *departures* used 28R (and 64% used 28L). As demand increased, more arrivals used 28R to reduce arrival or departure delay. At Future 2, 55% of the arrivals used 28R.

	VFR1 West Flow	
	Arrivals on 28R	Departures on 28R
1999 Demand	46 %	36 %
Future 1	52 %	39 %
Future 2	55 %	38 %

The following diagram shows the runways used in the Calibration (Do-Nothing) simulations:



PDX CALIBRATION (Do-Nothing) was simulated with the following assumptions:

- GA aircraft used 28R.
- Cargo and Military ops used 28L to reduce taxi time and the number of runway crossings.
- The Tracon and the Technical Center agreed to the following procedures to reduce delays:
  - To reduce arrival delay, we moved arrivals from *north fixes* to 28R. When necessary to reduce arrival delay further, we moved arrivals from *south arrival fix Moxee* to 28R.
  - To reduce departure delay, we moved arrivals from *north fixes* to 28R.
  - We did NOT move arrivals from *south fixes (eg Moxee)* to 28R to reduce departure delay. Doing so would not capture the *realistic* cost of the departure noise procedures. It would have also increased the controller workload and the number of air crossovers; "costs" associated with these issues could not be measured by the simulation.
- After applying the logic above, we tried to minimize taxi times when moving arrivals to 28R. Arrivals to Terminals A and B were moved only when necessary.
- Cargo and Military ops remained on 28L.
- Heavy aircraft requiring the longer runway remained on 28L.
- **For the same weather and operating conditions, the delays for the East and West Flows are considered equal.**

SUMMARY OF RESULTS FOR ALL DEMAND LEVELS

The *average annual delay* per operation was:

- **1.4 minutes at the 1999 demand**
- **6.4 minutes at Future 1**
- **42.1 minutes at Future 2**

The *annual delay Costs* for PKG (0), Calibration (Do-Nothing), were:

$ 12.3 million or 7,409 hours at the 1999 demand
$ 85.3 million or 51,376 hours at Future 1
$ 722.5 million or 435,257 hours at Future 2

Primary Cause of Delays at All Demands: Most PDX delays were departure delays due to the ATC procedures required to implement the departure noise restrictions. Those ATC procedures limited departure capacity and increased delay.

Narratives from Previous Data Packages – Detailed Results by Demand Level

1999 Demand -- 322,000 Ops

VFR1 *average daily delays* per operation were 0.6 minutes for arrivals, 1.8 minutes for departures, and 1.2 minutes for both. VFR2 delays were 0.9 minutes for arrivals, 2.4 minutes for departures, and 1.7 minutes for both. IFR1 delays were 1.6 minutes for arrivals, 3.0 minutes for departures, and 2.3 minutes for both.

The *average annual delay* per operation was 1.4 minutes at the 1999 demand. This correlated very well to the average delay per operation (1.5 minutes) for 322,000 ops from the 1996 Study, if one interpolated along the delay curve. (Reference PKG (E1+C1), Staggered IFR Approaches, pages 23 and 24 of Data Pkg 13, July 1996.)

The annual delay cost for Calibration (Do-Nothing) was $ 12.3 million or 7,409 hours at the 1999 demand.

Future 1 -- 484,000 Ops

VFR1 *average daily delays* per operation were 1.4 minutes for arrivals, 9.2 minutes for departures, and 5.3 minutes for both. VFR2 delays were 2.8 minutes for arrivals, 11.8 minutes for departures, and 7.3 minutes for both. IFR1 delays were 8.8 minutes for arrivals, 15.5 minutes for departures, and 12.1 minutes for both.

In IFR1, the departure delays were twice the arrival delays.

In VFR1 and VFR2, departure delays were significantly higher than arrival delays even though we moved many arrivals to 28R. We tried to minimize taxi time by moving arrivals going to Terminals A and B only when necessary. After 4pm, almost all the arrivals coming from the north fixes used 28R, including arrivals going to Terminals A and B (as well as Terminals C, D, and E). Between 10am and 4pm, we moved virtually all of the Terminal B arrivals (from north fixes) to 28R.

We moved some Terminal A arrivals during the midday period. It would be possible to move more of the Terminal A arrivals to reduce departure delay. Because the simulation would not show the increase in taxi time or the additional ground congestion, the Technical Center thought it was more reasonable to NOT MOVE these additional arrivals in order to capture the *realistic* cost of the departure noise procedures.

This method will capture delay costs associated with the current departure noise procedures; it will also enable one to appropriately determine the *incremental benefit* of high cost improvements such as the North/South Taxiway, PKG (C), and the Full Length Parallel Runway, PKG (D). The *incremental savings* for these improvements will be based on the delay costs associated with PKG (B), No Noise Restrictions for Any Aircraft.

The *average annual delay* per operation was 6.4 minutes at Future 1. For the 491,000 demand in the 1996 Study, the average delay per operation was 12.7 minutes, approximately double the average delay obtained in the current study. (See PKG (E1+C1), Staggered IFR Approaches, pages 23 and 24 of Data Pkg 13, July 1996.) There were several reasons why the delays in the current study are substantially lower:

- The Future 1 demand has different peaking characteristics. The arrival and departure peaks are flatter than those of the 1996 Study and the demand is distributed more evenly throughout the day. For example, the Future 1 demand has one hour in which the demand exceeds 100 ops while the 1996 Study has 4 hours in which demand exceeds 100 ops.
- For this study, the Tracon indicated we should put departures from the even C and even D gates on 28R at future demands. This was a change from the current method of assigning many of those departures to 28L. Therefore, the Future 1 demand had 39% of the departures and 52% of the arrivals on 28R.
- The 1996 Study used the current method of assigning departures -- departures from the even C and D gates used 28L. Thus, 25% of the departures and 74% of the arrivals used 28R.

The annual delay cost for Calibration (Do-Nothing) was $ 85.3 million or 51,376 hours at Future 1.

Future 2 -- 620,000 Ops

VFR1 *average daily delays* per operation were 6.3 minutes for arrivals, 69.1 minutes for departures, and 37.7 minutes for both. VFR2 delays were 16.9 minutes for arrivals, 76.0 minutes for departures, and 46.4 minutes for both. IFR1 delays were 58.7 minutes for arrivals, 72.3 minutes for departures, and 65.5 minutes for both.

In IFR1, the arrival and departure delays were balanced.

In VFR1 and VFR2, departure delays were significantly higher than arrival delays even though we moved many arrivals to 28R. We tried to minimize taxi time by moving arrivals going to Terminals A and B only when necessary. After 4pm, almost all the arrivals coming from the north fixes used 28R, including arrivals going to Terminals A and B (as well as Terminals C, D, and E). Between 10am and 4pm, we moved virtually all of the Terminal B arrivals (from north fixes) to 28R.

We moved some Terminal A arrivals during the midday period. It would be possible to move more of the Terminal A arrivals to reduce departure delay. Because the simulation would not show the increase in taxi time or the additional ground congestion, the Technical Center thought it was more reasonable to NOT MOVE these additional arrivals in order to capture the *realistic* cost of the departure noise procedures.

This method will capture delay costs associated with the current departure noise procedures; it will also enable one to appropriately determine the *incremental benefit* of high cost improvements such as the North/South Taxiway, PKG (C), and the Full Length Parallel Runway, PKG (D). The *incremental savings* for these improvements will be based on the delay costs associated with PKG (B), No Noise Restrictions for Any Aircraft.

The *average annual delay* per operation was 42.1 minutes at Future 2.

The annual delay cost for Calibration (Do-Nothing) was $ 722.5 million or 435,257 hours at Future 2.

(A) ALL TURBOS & BIZ JETS CAN DIVERGE

Current noise abatement procedures for turbo props allow for immediate south divergent turns in both flow directions. Removing the departure noise restrictions for turbo props and business jets would enable the tower to depart aircraft more efficiently. North and south divergent turns would allow the tower controller to turn turbo prop and business jet departures in a manner that would expedite departure situations. Based on the current fleet mix at Portland, there is a large number of aircraft that would be able to take advantage of this new rule. Any increase in the departure rate would improve efficiency for the entire airport. Departures leaving sooner would reduce the number of aircraft waiting for takeoff and subsequent taxiway congestion.

This improvement was simulated with the following assumptions:

- The runway assignments were the same as Calibration (0) -- for each weather, operating condition, and demand level.
- Northbound Turbo Props and Biz Jets turned north before they reached the end of the runway -- similar to Small props going northbound.
- **For the same weather and operating conditions, the delays for the East and West Flows are considered equal.**

The *average annual delay* per operation was:

- **1.1 minutes at the 1999 demand**
- **4.3 minutes at Future 1**
- **17.9 minutes at Future 2**

The *annual delay savings* for PKG (A), All Turbos & Biz Jets Can Diverge, were:

$ 2.2 million or 1,318 hours at the 1999 demand
$ 28.0 million or 16,865 hours at Future 1
$ 416.0 million or 250,629 hours at Future 2 (updated on 8/9/01)

Note: The above savings reflect the following change in Data Package 7: On 8/9/01, the Future 2 costs and savings for Pkg (A) changed due to a minor typing error in the annual delay calculations. Consequently, the incremental delay savings of Pkg (B) over Pkg (A) changed. The error was minor -- 14 hours for the year.

Narratives from Previous Data Packages – Detailed Results by Weather and Operating Conditions

VFR1: The *average daily delays* per operation were 1.0 minute at the 1999 demand, 3.2 minutes at Future 1, and 13.3 minutes at Future 2. This improvement significantly reduced VFR1 departure delays at all demands -- by 27% at the lowest demand and by 69% at the highest demand. The arrival delay reduction was negligible at the lower demands. At Future 2, arrival delays were reduced by 19%.

VFR2: The *average daily delays* per operation were 1.3 minutes at the 1999 demand, 5.2 minutes at Future 1, and 20.7 minutes at Future 2. This improvement significantly reduced VFR2 departure delays at all demands -- by 27% at the lowest demand and by 65% at the highest demand. The arrival delay reduction was negligible at the lower demands. At Future 2, arrival delays were reduced by 11%.

IFR1: The *average daily delays* per operation were 2.1 minutes at the 1999 demand, 10.0 minutes at Future 1, and 43.8 minutes at Future 2. This improvement significantly reduced IFR1 departure delays at all demands -- by 11% at the lowest demand and by 59% at the highest demand. The arrival delay reduction was small -- less than 0.5 minutes per arrival at all demands.

(B) ALL AIRCAFT CAN DIVERGE

Current noise abatement restrictions place all heavy and large turbojet departures on a single departure route regardless of the departing runway or destination. This forces the tower controller to wait for the required IFR separation before departing successive jet aircraft. The new procedure would enable the tower to turn all aircraft using the divergent turn rule. This would streamline the departure procedures, facilitate the tower controller's job, reduce departure delays, and allow for the most expeditious departure scenario at Portland.

This improvement was simulated with the following assumptions:

- The runway assignments were the same as Calibration and PKG (A) -- for each weather, operating condition, and demand level.
- All aircraft turned north before they reached the end of the runway -- similar to Small props going northbound.
- All aircraft turned south before they reached the end of the runway -- similar to Turbo Props and Small props going southbound.
- **For the same weather and operating conditions, the delays for the East and West Flows are considered equal.**

The *average annual delay* per operation was:

- **1.1 minutes at the 1999 demand**
- **3.9 minutes at Future 1**
- **14.7 minutes at Future 2**

The *annual delay savings* for PKG (B), All Aircraft Can Diverge, were:

$ 2.4 million or 1,450 hours at the 1999 demand
$ 33.4 million or 20,127 hours at Future 1
$ 471.0 million or 283,752 hours at Future 2

The *incremental benefits (annual delay savings)* of PKG (B) over PKG (A) were:

$ 0.2 million or 132 hours at the 1999 demand
$ 5.4 million or 3,262 hours at Future 1
$ 55.0 million or 33,123 hours at Future 2 (updated on 8/9/01)

Narratives from Previous Data Packages – Detailed Results by Weather and Operating Conditions & IFR1 Discussion

VFR1: The *average daily delays* per operation were 0.9 minutes at the 1999 demand, 2.8 minutes at Future 1, and 9.9 minutes at Future 2. The incremental benefit of this improvement over PKG (A) was significant at future demands. It incrementally reduced VFR1 departure delays by 16% at Future 1 and by 32% at Future 2. The incremental arrival delay reduction was negligible at all demands.

VFR2: The *average daily delays* per operation were 1.3 minutes at the 1999 demand, 4.5 minutes at Future 1, and 16.4 minutes at Future 2. The incremental benefit of this improvement over PKG (A) was significant at future demands. It incrementally reduced VFR2 departure delays by 18% at Future 1 and by 31% at Future 2. The incremental arrival delay reduction was negligible at lower demands and nominal at Future 2 -- 0.5 minutes per arrival at Future 2.

IFR1: The *average daily delays* per operation were the same as PKG (A), All Turbos & Biz Jets Can Diverge.

DISCUSSION ON IFR1 -- (B) ALL AIRCRAFT CAN DIVERGE

The Technical Center simulated IFR1 with the assumptions that all departures, including jets, would turn before the end of the runway. The results of the simulation showed that IFR1 delays were higher than those of PKG (A), Turbo Props & Biz Jets Can Diverge -- by approximately 500 minutes per day at the 1999 demand and 3,000 minutes per day at Future 2. The increase in delay was the result of the D/A and A/D dependencies for the jet departures, which crossed over an arrival runway in IFR1. For example, northbound cargo departures on 28L had to turn north and cross over 28R and be appropriately separated from arrivals to 28R. The Technical Center assumed that in IFR1, the jets flew straight out as they did in PKG (A). Therefore, we assumed that PKG (B) IFR1 delays were the same as PKG (A) IFR1 delays.

We ran additional IFR1 simulations for PKG (B) by removing the D/A and A/D separations associated with a jet crossing an arrival runway. We kept the dependencies of jets interfering with departures on the other runways. Even at the highest demand levels, this operation provided less than 300 minutes of incremental delay savings per day over PKG (A). That difference produced negligible annual delay savings -- less than $ 0.3 million per year.

(C) NORTH/SOUTH TAXIWAY

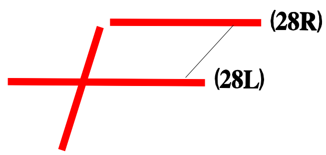
This new taxiway would provide PDX with a second crossfield taxiway between Runways 10R/28L and 10L/28R. It would reduce taxi times for arrivals and departures. The taxiway would also provide a more direct routing for aircraft taxiing between the north and south apron edge taxiways.

In the East Flow, the taxiway would primarily benefit aircraft arriving on Runway 10L destined for gates located on Terminals A, B, and C, and in the future, the East Terminal. In the West Flow, with the existing noise restrictions, the taxiway would give controllers more flexibility in departing aircraft.

With the existing noise restrictions, the North/South Taxiway would significantly increase flexibility in moving aircraft on the ground and greatly improve traffic flow.

To determine the full benefit of the taxiway, the Design Team simulated the taxiway with no departure noise restrictions for any aircraft. Departures could be assigned to the runways based on route of flight. In the West Flow, northbound departures from Terminals A, B, and C, as well as the future East Terminal, could depart on 28R independent of southbound departures on 28L. In the East Flow, southbound departures from those terminals could depart on 10R independent of northbound departures on 10L.

The following diagram shows the runways and taxiway used in the simulation of the N/S Taxiway:



(C1+B) NORTH/SOUTH TAXIWAY & ALL AIRCRAFT CAN DIVERGE
(No Departure Noise Restrictions for Any Aircraft)
-- Staggered Approaches to Existing Parallel Runways in IFR1

This improvement was simulated with the following assumptions:

- There were no departure noise restrictions for any aircraft.
  - All aircraft turned north before they reached the end of the runway -- similar to Small props going northbound.
  - All aircraft turned south before they reached the end of the runway -- similar to Turbo Props and Small props going southbound.
- IFR1 used the normal Departure/Arrival and Arrival/Departure separations associated with a jet crossing an active arrival runway.
- Departures were assigned by route of flight during busy hours. However, aircraft were not permitted to cross an active runway on the ground. Therefore, Military and Cargo departed 28L. Cargo from the SE Ramp could depart on 28R. During periods of high delay, some southbound United (Terminal E) and Delta (odd D gates) could depart on 28L.
- **For the same weather and operating conditions, the delays for the East and West Flows are considered equal.**

The following table shows the runway use for each demand level:

West Flow Runway Use

	Arrivals		Departures	
	28R	28L	28R	28L
Future 1	51%	49%	51%	49%
Future 2	52%	48%	50%	50%

The *average daily delays* per operation were:

VFR1: 2.1 minutes at Future 1 and 5.6 minutes at Future 2.
VFR2: 3.4 minutes at Future 1 and 10.7 minutes at Future 2.
IFR1: 7.8 minutes at Future 1 and 32.0 minutes at Future 2.

The *average annual delay* per operation was:

3.0 minutes at Future 1
9.3 minutes at Future 2

The *annual delay savings* for PKG (C1+B), N/S Taxiway and All Aircraft Can Diverge, were:

$ 45.7 million or 27,519 hours at Future 1
$ 562.9 million or 339,078 hours at Future 2

The *incremental benefits (annual delay savings)* of PKG (C1+B) over PKG (B) were:

$ 12.3 million or 7,392 hours at Future 1
$ 91.8 million or 55,326 hours at Future 2

(C2+B) NORTH/SOUTH TAXIWAY & ALL AIRCRAFT CAN DIVERGE
(No Departure Noise Restrictions for Any Aircraft)
-- Independent Approaches to Existing Parallel Runways in IFR1

This improvement was simulated with the following assumptions:

- The runway use was the same as Pkg (C1+B), N/S Taxiway with Staggered Approaches in IFR1.
- All model inputs were the same as Pkg (C1+B) with one exception. This improvement had independent approaches to the parallel runways.
- **For the same weather and operating conditions, the delays for the East and West Flows are considered equal.**

The *average daily delays* per operation were:

VFR1 & VFR2: same as PKG (C1+B), N/S Taxiway with Staggered Approaches in IFR1.
IFR1: 4.4 minutes at Future 1 and 14.5 minutes at Future 2.

The *average annual delay* per operation was:

2.6 minutes at Future 1
7.3 minutes at Future 2

The *annual delay savings* for PKG (C2+B), N/S Taxiway and All Aircraft Can Diverge, were:

$ 50.9 million or 30,668 hours at Future 1
$ 597.1 million or 359,718 hours at Future 2

The *incremental benefits (annual delay savings)* of PKG (C2+B) over PKG (B) were:

$ 17.5 million or 10,541 hours at Future 1
$ 126.1 million or 75,966 hours at Future 2

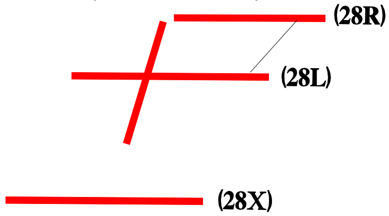
The *incremental benefits (annual delay savings)* of PKG (C2+B) over PKG (C1+B) were:

$ 5.2 million or 3,149 hours at Future 1
$ 34.3 million or 20,640 hours at Future 2

(D) NEW RUNWAY

A new runway, 12,000' long and 3250' south of existing 10R/28L, would provide 3 independent arrival streams to the parallel runways in VMC and 2 independent arrival streams to the outboard runways in IMC.

To determine the full benefit of the taxiway, the Design Team agreed to simulate the runway in combination with the North/South Taxiway and no departure noise restrictions. The following diagram shows the runways and taxiway used in the simulation of the New Runway and the N/S Taxiway:



(D+C1+B) NEW RUNWAY & N/S TAXIWAY & ALL AIRCRAFT CAN DIVERGE (No Departure Noise Restrictions for Any Aircraft)

This improvement was simulated with the following assumptions:

- There were no departure noise restrictions for any aircraft.
- IFR1: Independent Arrivals to Outboards; Staggers to 28R & 28L; and Staggers to 28X and 28L. Limited use of 28L for arrivals.
- IFR1 used the normal Departure/Arrival and Arrival/Departure separations associated with a jet crossing an active arrival runway.
- Departures were assigned by route of flight during busy hours. However, departures were not permitted to cross an active runway on the ground. Therefore, Military and Cargo departed 28L. Cargo from the SE Ramp could depart on 28R. During periods of high delay, some southbound United (Terminal E) and Delta (odd D gates) could depart on 28L.
- Cargos arrived on 28X except the Box-Haulers, which arrived on 28L.
- Limited use of 28L for arrivals. Runway 28L was used for arrivals from Midnight to 6am. Cargo Box-Haulers arrived on 28L. During the day, a few arrivals were placed on 28L to reduce arrival delay on 28R. During the late afternoon arrival push, a few arrivals were placed on 28L to reduce arrival delay on 28X.
- **For the same weather and operating conditions, the delays for the East and West Flows are considered equal.**

The following table shows the runway use for each demand level:

West Flow Runway Use

	Arrivals			Departures	
	28R	28L	28X	28R	28L
Future 1	51%	6%	43%	51%	49%
Future 2	49%	8%	43%	49%	51%

The *<u>average daily delays</u>* per operation were:

VFR1: 1.6 minutes at Future 1 and 3.6 minutes at Future 2.
VFR2: 2.5 minutes at Future 1 and 6.1 minutes at Future 2.
IFR1: 3.0 minutes at Future 1 and 8.2 minutes at Future 2.

The *<u>average annual delay</u>* per operation was:

1.9 minutes at Future 1
4.5 minutes at Future 2

(D+C1+B) NEW RUNWAY & N/S TAXIWAY & ALL AIRCRAFT CAN DIVERGE (Cont.)

The *annual delay savings* for PKG (D+C1+B), New Runway & N/S Taxiway & All Aircraft Can Diverge, were:

$ 60.1 million or 36,184 hours at Future 1
$ 645.7 million or 388,954 hours at Future 2

The *incremental benefits (annual delay savings)* of PKG (D+C1+B) over PKG (C1+B) were:

$ 14.4 million or 8,665 hours at Future 1
$ 82.8 million or 49,876 hours at Future 2

The *incremental benefits (annual delay savings)* of PKG (D+C1+B) over PKG (C2+B) were:

$ 9.2 million or 5,516 hours at Future 1
$ 48.5 million or 29,236 hours at Future 2

NOTES: ***These numbers represent a conservative estimate of delay savings for the New Runway.*** As previously noted in the assumptions, some southbound United (Terminal E) and Delta (odd D gates) departed on 28L during periods of high delay. Moving these departures to 28L was done when the delay savings would more than offset the increase in taxi times. Minimizing potential ground congestion around Terminals A, B, C, and D was another reason for limiting the number of these departures being reassigned to the south departure runway 28L.

A second North/South Taxiway would enable those departures to quickly and easily taxi to 28L and avoid ground congestion around the terminals. With the addition of the second North/South Taxiway, more departures would use 28L. This taxiway would provide delay savings with or without the New Runway. Therefore, it would increase the delay savings and incremental delay savings of the New Runway.

The benefit of a second North/South Taxiway will be studied at a later date.

EXHIBIT 8 – PDX AVERAGE ANNUAL DELAY PER OPERATION (in minutes) -- TABLE

(Updated 8/9/01)

IMPROVEMENT STUDIED	322,000 (1999) Minutes	484,000 (F1) Minutes	620,000 (F2) Minutes
(0) CALIBRATION (Do-Nothing)	1.4	6.4	42.1
(A) All Turbos & Biz Jets Can Diverge	1.1	4.3	17.9
(B) All Aircraft Can Diverge	1.1	3.9	14.7
(C1+B) N/S Taxiway (Stag. IFR1 Approaches)	-----	3.0	9.3
(C2+B) N/S Taxiway (Indep. IFR1 Approaches)	-----	2.6	7.3
(D+C1+B) New Runway	-----	1.9	4.5

EXHIBIT 9 – PDX ANNUAL DELAY COSTS (in millions of dollars) -- GRAPH

(Updated 8/9/01)

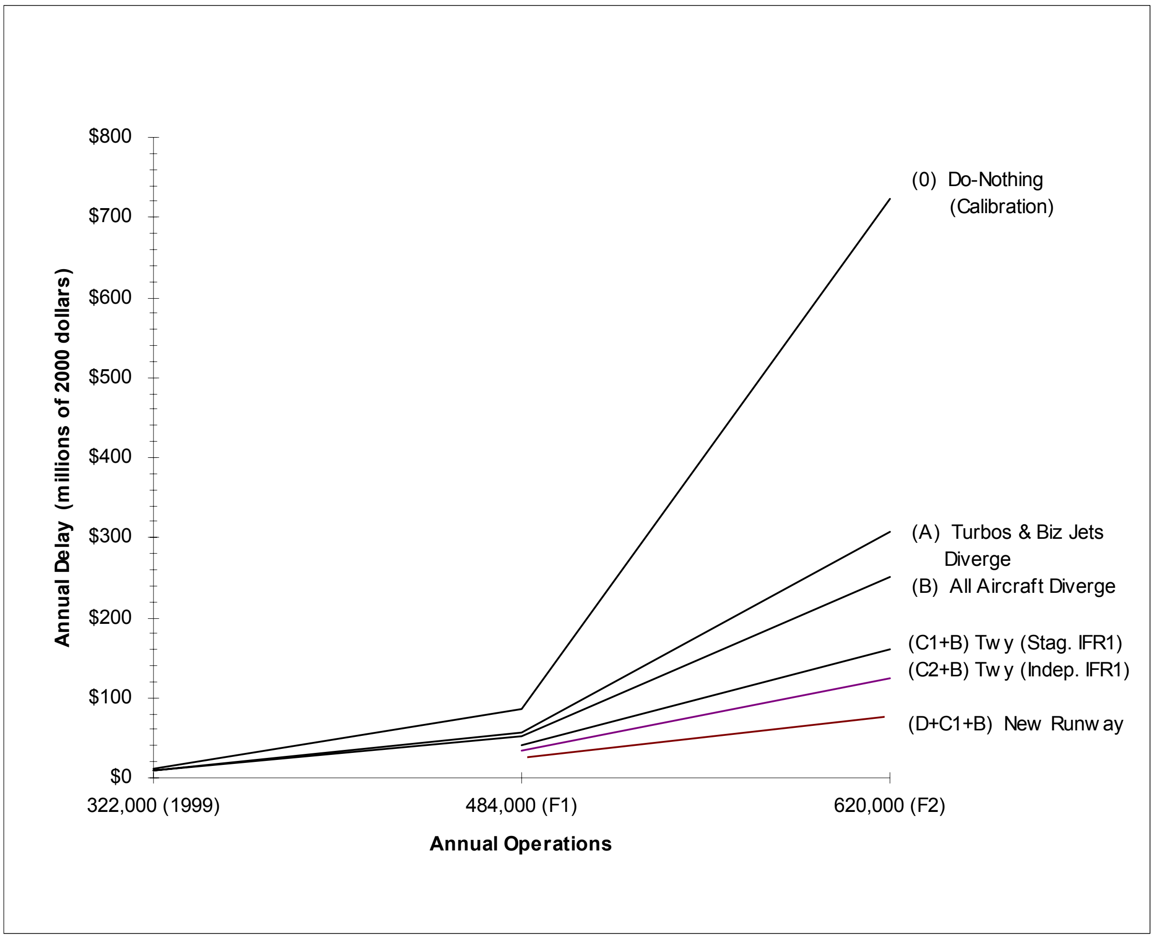


EXHIBIT 10 – PDX ANNUAL DELAY COSTS AND SAVINGS

(HOURS OF DELAY PER YEAR, MILLIONS OF YEAR 2000 DOLLARS)

(Updated 10/15/01)

	-- C O S T S --		--S A V I N G S--		-- C O S T S --		--S A V I N G S--		-- C O S T S --		--S A V I N G S--	
IMPROVEMENT STUDIED	HOURS	MILL $	HOURS	MILL $	HOURS	MILL $	HOURS	MILL $	HOURS	MILL $	HOURS	MILL $
(0) CALIBRATION (Do-Nothing)	**7,409**	**$12.3**	**--**	**--**	**51,376**	**$85.3**	**--**	**--**	**435,257**	**$722.5**	**--**	**--**
(A) All Turbos & Biz Jets Can Diverge	6,091	$10.1	1,318	$2.2	34,511	$57.3	16,865	$28.0	184,628	$306.5	250,629	$416.0
(B) All Aircraft Can Diverge	5,959	$9.9	1,450	$2.4	31,249	$51.9	20,127	$33.4	151,505	$251.5	283,752	$471.0
Savings over PKG (A)			*132*	*$0.2*			*3,262*	*$5.4*			*33,123*	*$55.0*
(C1+B) N/S Taxiway (Stag. IFR1 Approaches)	*Not Simulated at this Demand*				23,857	$39.6	27,519	$45.7	96,179	$159.7	339,078	$562.9
Savings over PKG (B)							*7,392*	*$12.3*			*55,326*	*$91.8*
(C2+B) N/S Taxiway (Indep. IFR1 Approaches)	*Not Simulated at this Demand*				20,708	$34.4	30,668	$50.9	75,539	$125.4	359,718	$597.1
Savings over PKG (B)							*10,541*	*$17.5*			*75,966*	*$126.1*
Savings over PKG (C1+B)							*3,149*	*$5.2*			*20,640*	*$34.3*
(D+C1+B) New Runway	*Not Simulated at this Demand*				15,192	$25.2	36,184	$60.1	46,303	$76.9	388,954	$645.7
Savings over PKG (C1+B)							*8,665*	*$14.4*			*49,876*	*$82.8*
Savings over PKG (C2+B)							*5,516*	*$9.2*			*29,236*	*$48.5*

ALL SAVINGS ARE RELATIVE TO PKG (0), CALIBRATION (Do-Nothing), UNLESS OTHERWISE NOTED.
NOTE: 10/15/01: These dollar savings are computed from the hours of annual delay savings.
Because of rounding to one decimal place, these numbers may differ slightly from those obtained from taking the differences in annual delay costs.

Note: **The above savings reflect the following change in Data Package 7: On 8/9/01, the Future 2 costs and savings for Pkg (A) changed due to a minor typing error in the annual delay calculations. Consequently, the incremental delay savings of Pkg (B) over Pkg (A) changed. The error was minor -- 14 hours for the year.**

EXHIBIT 11 – PDX COMPARISON OF DAILY DELAYS & SAVINGS

(Updated 10/15/01)

Notes: Experiment numbers: 100s & 200s correspond to 322,000 demand; 300s & 400s to 484,000 demand; 500s & 600s to 620,000 demand.
10/15/01: All savings are relative to PKG (0).

		3 2 2 (1999)							4 8 4 (F1)							6 2 0 (F2)						
		ARR		DEP		ARR & DEP			ARR		DEP		ARR & DEP			ARR		DEP		ARR & DEP		
	EXP #	TOT	AVG	TOT	AVG	TOT	AVG	SAVINGS	TOT	AVG	TOT	AVG	TOT	AVG	SAVINGS	TOT	AVG	TOT	AVG	TOT	AVG	SAVINGS
CON-1 (WEST) -- VFR-1																						
(0) CALIBRATION	**101**	**284**	**0.6**	**917**	**1.8**	**1,201**	**1.2**		**1,058**	**1.4**	**6,977**	**9.2**	**8,035**	**5.3**		**6,142**	**6.3**	**66,929**	**69.1**	**73,071**	**37.7**	
(A) Turbos Turn	111	285	0.6	673	1.3	958	1.0	243	982	1.3	3,887	5.1	4,869	3.2	3,166	5,004	5.2	20,844	21.5	25,848	13.3	47,223
(B) All Turn	121	285	0.6	641	1.3	926	0.9	275	988	1.3	3,266	4.3	4,254	2.8	3,781	4,822	5.0	14,274	14.7	19,096	9.9	53,975
(C1+B) Twy	131	Not Simulated at This Demand							933	1.2	2,285	3.0	3,218	2.1	4,817	3,321	3.4	7,438	7.7	10,759	5.6	62,312
(D+C1+B) Runway	151	Not Simulated at This Demand							742	1.0	1,677	2.2	2,419	1.6	5,616	2,015	2.1	4,994	5.2	7,009	3.6	66,062
CON-1 (WEST) -- VFR-2																						
(0) CALIBRATION	**102**	**474**	**0.9**	**1,188**	**2.4**	**1,662**	**1.7**		**2,087**	**2.8**	**8,924**	**11.8**	**11,011**	**7.3**		**16,362**	**16.9**	**73,612**	**76.0**	**89,974**	**46.4**	
(A) Turbos Turn	112	483	1.0	868	1.7	1,351	1.3	311	1,993	2.6	5,899	7.8	7,892	5.2	3,119	14,549	15.0	25,637	26.5	40,186	20.7	49,788
(B) All Turn	122	472	0.9	873	1.7	1,345	1.3	317	1,996	2.6	4,811	6.4	6,807	4.5	4,204	14,019	14.5	17,807	18.4	31,826	16.4	58,148
(C1+B) Twy	132	Not Simulated at This Demand							1,813	2.4	3,306	4.4	5,119	3.4	5,892	10,576	10.9	10,191	10.5	20,767	10.7	69,207
(D+C1+B) Runway	152	Not Simulated at This Demand							1,449	1.9	2,303	3.0	3,752	2.5	7,259	4,845	5.0	6,882	7.1	11,727	6.1	78,247
CON-1 (WEST) -- IFR-1																						
(0) CALIBRATION	**103**	**794**	**1.6**	**1,486**	**3.0**	**2,280**	**2.3**		**6,626**	**8.8**	**11,719**	**15.5**	**18,345**	**12.1**		**56,836**	**58.7**	**70,093**	**72.3**	**126,929**	**65.5**	
(A) Turbos Turn	113	763	1.5	1,319	2.6	2,082	2.1	198	6,343	8.4	8,812	11.7	15,155	10.0	3,190	56,423	58.2	28,494	29.4	84,917	43.8	42,012
(B) All Turn	123	RESULTS = (A) TURBOS TURN							RESULTS = (A) TURBOS TURN							RESULTS = (A) TURBOS TURN						
(C1+B) Twy-Stagger	133	Not Simulated at This Demand							5,695	7.5	6,166	8.2	11,861	7.8	6,484	47,270	48.8	14,833	15.3	62,103	32.0	64,826
(C2+B) Twy-Indep	143	Not Simulated at This Demand							2,002	2.6	4,679	6.2	6,681	4.4	11,664	14,035	14.5	14,122	14.6	28,157	14.5	98,772
(D+C1+B) Runway	153	Not Simulated at This Demand							1,673	2.2	2,853	3.8	4,526	3.0	13,819	7,230	7.5	8,576	8.9	15,806	8.2	111,123

EXHIBIT 12 - PDX EXPERIMENTAL DESIGN

(Updated 10/15/01)

PKG	ADSIM SIMULATIONS	----- WEST FLOW ----- ARR = **28R**, 28L DEP = 28R, **28L**			----- EAST FLOW ----- ARR = **10R**, 10L DEP = 10R, **10L**			
PKG	**1999 DEMAND 322,000 ANNUAL OPS**	**VFR-1 39.1%**	**VFR-2 5.0%**	**IFR-1 3.6%**	**VFR-1 35.3%**	**VFR-2 9.2%**	**IFR-1 7.8%**	
(0)	CALIBRATION (Do-Nothing)	101	102	103	=	WEST	FLOW	
(A)	All Turbos & Biz Jets Can Diverge	111	112	113	=	WEST	FLOW	
(B)	All Aircraft Can Diverge	121	122	=113	=	WEST	FLOW	
(C+B)	N/S Twy Connecting East Ends of Parallels & All Aircraft Can Diverge							**Not simulated at this demand.**
	(C1+B) Stag Approaches in IFR1	-----	-----	-----	-----	-----	-----	
	(C2+B) Indep Approaches in IFR1	-----	-----	-----	-----	-----	-----	
(D+C1+B)	Full Length Parallel Runway & N/S Twy & All Aircraft Can Diverge	-----	-----	-----	-----	-----	-----	**Not simulated at this demand.**
PKG	**FUTURE 1 484,000 ANNUAL OPS**	**VFR-1 39.1%**	**VFR-2 5.0%**	**IFR-1 3.6%**	**VFR-1 35.3%**	**VFR-2 9.2%**	**IFR-1 7.8%**	
(0)	CALIBRATION (Do-Nothing)	301	302	303	=	WEST	FLOW	
(A)	All Turbos & Biz Jets Can Diverge	311	312	313	=	WEST	FLOW	
(B)	All Aircraft Can Diverge	321	322	=313	=	WEST	FLOW	
(C+B)	N/S Twy Connecting East Ends of Parallels & All Aircraft Can Diverge							
	(C1+B) Stag Approaches in IFR1	331	332	333	=	WEST	FLOW	
	(C2+B) Indep Approaches in IFR1	=331	=332	343	=	WEST	FLOW	
(D+C1+B)	Full Length Parallel Runway & N/S Twy & All Aircraft Can Diverge	351	352	353	=	WEST	FLOW	
PKG	**FUTURE 2 620,000 ANNUAL OPS**	**VFR-1 39.1%**	**VFR-2 5.0%**	**IFR-1 3.6%**	**VFR-1 35.3%**	**VFR-2 9.2%**	**IFR-1 7.8%**	
(0)	CALIBRATION (Do-Nothing)	501	502	503	=	WEST	FLOW	
(A)	All Turbos & Biz Jets Can Diverge	511	512	513	=	WEST	FLOW	
(B)	All Aircraft Can Diverge	521	522	=513	=	WEST	FLOW	
(C+B)	N/S Twy Connecting East Ends of Parallels & All Aircraft Can Diverge							
	(C1+B) Stag Approaches in IFR1	531	532	533	=	WEST	FLOW	
	(C2+B) Indep Approaches in IFR1	=531	=532	543	=	WEST	FLOW	
(D+C1+B)	Full Length Parallel Runway & N/S Twy & All Aircraft Can Diverge	551	552	553	=	WEST	FLOW	

Note: =WEST FLOW: Results equal those of the West Flow for the corresponding weather condition.

4. AIRFIELD CAPACITY

Exhibit 13 presents the airfield capacity for Portland International Airport. These values were developed for the East and West Flow runway configurations, under VFR1, VFR2, and IFR1 conditions, with a 50/50 split of arrivals and departures and balanced flow rates. The Do-Nothing capacities were based on the PDX 2001 acceptance rates. The capacities for the New Runway were based on Future 2 ADSIM flow rates and expected values.

Page A-10, in Appendix A, illustrates the hourly profile of daily demand for the 1999 activity level of 322,000 annual operations, the Future 1 level of 484,000 annual operations, and the Future 2 level of 620,000 annual operations.

Comparing the information in the two exhibits shows that:

- The IFR1 arrival capacity of 40 arrivals for the Do-Nothing case is not exceeded at the 1999 activity level.
- The IFR1 arrival capacity for the Do-Nothing case is exceeded during 9 hours of the day at the Future 1 activity level and 15 hours of the day at Future 2.
- The IFR1 arrival capacity of 60 arrivals for the New Runway (& N/S Taxiway & All Aircraft Can Diverge), Pkg (D+C1+B), is not exceeded at Future 1 and is exceeded 4 hours of the day at Future 2.

EXHIBIT 13 - PDX AIRFILED CAPACITY (50/50 Split and Balanced Flow Rates)

(Number of Operations per Hour)

(Updated 8/9/01)

(0) Calibration (Do-Nothing) -- PDX 2001 published acceptance rates

VFR1	60 arrivals	60 departures
VFR2	48 arrivals	48 departures
IFR1	40 arrivals	40 departures

(D+C1+B) New Runway & N/S Taxiway & All Aircraft Can Diverge

- based on ADSIM simulations and expected values.
- assumes limited use of 28L for arrivals.

VFR1	70 arrivals	70 departures
VFR2	64 arrivals	64 departures
IFR1	60 arrivals	60 departures

5. DESIGN TEAM SCHEDULE

Exhibit 14 lists the meetings concerning the completion of significant tasks, outputs, and target dates of the PDX Design Team schedule. These milestones and meetings were held at key decision points, and helped the Design Team monitor the progress of the study.

EXHIBIT 14 - DESIGN TEAM SCHEDULE

(Updated 10/15/01)

Date	Event	Objective	Task	Responsibility	Output
3/16/00	1.	Preliminary Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Potential Improvements & Data Package 13 from 1996 Study. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
4//25/00 thru 4/27/00 & 5/17/00	2.	Perform Data Collection.	On-Site Data Collection.	Tech Center.	Establish Parameters for Analysis.
5/18/00	3.	Kick Off Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Technical Plan, & Potential Improvements. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements. Review & Agree on Purpose and Inputs.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
7/20/00	4.	Determine Scope of Study, Select Model. Review Results of Data Collection.	Review Results of Data Collection. Review Data Package 1.	Entire Design Team.	Agree on Inputs & Direction.
10/12/00	5.	Review Results of Data Collection, Model Inputs, & Potential Improvements.	Review Data Package 2.	Entire Design Team.	Agree on Inputs & Direction.
11/30/00	6.	Review Model Inputs & Potential Improvements.	Review Data Package 3.	Entire Design Team.	Agree on Inputs & Direction.
2/1/01	7.	Review Initial Calibration Results & Potential Improvements.	Review Data Package 4.	Entire Design Team.	Agree on Inputs & Direction.
4/5/01	8.	Review Calibration Results & Potential Improvements.	Review Data Package 5.	Entire Design Team.	Agree on Inputs & Direction.
5/31/01 scheduled 6/14/01 actual	9.	Review Results & Potential Improvements.	Review Data Package 6. Review draft of final report.	Entire Design Team.	Agree on Inputs & Direction.
7/26/01 scheduled 8/14/01 actual	9.	Review Results & Potential Improvements.	Review Data Package 7. Review draft of final report.	Entire Design Team.	Agree on Inputs & Direction.
9/27/01 scheduled 9/26/01 actual	9.	Review Results & Potential Improvements.	Review draft of final report.	Entire Design Team.	Agree on Inputs & Direction.
10/30/01	10.	Complete & Publish Final Report.	Publish & Distribute Final Report.	FAA HQ.	Final Report.
10/30/01	10.	Complete & Publish Summary Data Package.	Publish & Distribute Summary Data Package.	Tech Center.	Summary Data Package

* Number of meetings and target dates are tentative and may be adjusted as progress is achieved.

APPENDIX A

ACCEPTED MODEL INPUTS

NOTE: The PDX Tower owns a 5 NM ring around PDX.

AIRCRAFT CLASSIFICATIONS (UPDATED 8/11/00) **Accepted by PDX Team on 10/12/00**

H	**= HEAVY**	**Heavy aircraft.** Heavy aircraft weighing more than 255,000 pounds (e.g., L1011, DC10, B747, B767, DC8S, A300).
757	**= 757**	**B757.** B757 only**.**
LJ	**= LARGE JET**	**Large Jets. Includes Regional Jets.** Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., DC9, B737, B727, MD80, CRJ).
LTP	**= LARGE TURBO PROP**	**Large Turbo Props.** Large commuter aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., ATR-42*, DH8, DH7, BA41*, SF34*).
S+	**= SMALL+**	**Small Commuters. Includes Business Jets.** Small commuter aircraft weighing more than 12,500 and less than 41,000 pounds (e.g., BA31, BE02, E120, LR31, LR36).
S	**= SMALL**	**Small twin & single engine props.** Small, single or twin engine aircraft weighing 12,500 pounds or less (e.g. BE58, C340, C441, AC21, BE20, C172, C210, DO27).

Notes: **For wake turbulence application, FAA Handbook 7110.65 considers LJ & LTP as "large" and S+ & S as "small".**

- * The aircraft ATR-42 and SF34 are exempt from the small category and are classified as large aircraft for separation purposes. (Source: FAA memo from ANM-531.4). They are classified as LTP (Large Turbo Prop) in this study.
- The critical factor in determining aircraft class should be <u>approach speeds</u> and how arrivals are separated at the point of closest approach (at threshold, except for a faster aircraft followed by a slower aircraft).
- Weights refer to maximum certified takeoff weights.
- These aircraft classes will enable us to define the model inputs more accurately and more clearly by distinguishing the key differences in operational characteristics.

Notes: **At the July 20th meeting, the Design Team agreed on the following:**

- **Regional Jets have the same departure noise procedures and prop-to-jet penalties as Large Jets. Regional Jets will be in the same class as Large Jets.**
- **Turbo Props that were treated as M (Medium) in the 1996 study will be treated as LTP (Large Turbo Props or S+ (Small+) for this study.**

LENGTH OF COMMON APPROACH (NAUTICAL MILES) -- 1996 PDX STUDY (WITH 2000 CLASSES)

Accepted by PDX Team on 10/12/00

For the simulations, it is defined as the length of the final common approach, along which speed control *cannot* be used to separate aircraft. This differs from the 8 NM final associated with Noise Abatement procedures. The Tracon can use speed control to separate aircraft, which are at least 5 NM away from the runway end.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
VFR	NM	5	5	5	5	5	3
IFR	NM	5	5	5	5	5	5

Source: 1996 PDX STUDY

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

APPROACH SPEEDS (KNOTS) -- 1996 PDX STUDY (WITH 2000 CLASSES)

Accepted by PDX Team on 10/12/00

The speed is given in knots for each class of aircraft flying along the common approach defined above. The standard deviation is 5 knots. The model uses three standard deviations in selecting approach speeds. Therefore, the speeds may vary by 15 knots, plus or minus.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
VFR	Knots	155	140	140	130	130	110
IFR	Knots	155	140	140	130	130	110

Source: 1996 PDX STUDY (Based on Arts data for 7/20/94.)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

1999 PDX FLEET MIX (UPDATED 8/11/00)

Accepted by PDX Team on 10/12/00

Aircraft Class	1999 Fleet Mix
Heavy	4.7%
B-757	5.2%
Large Jet	46.3%
Large Turbo Prop	17.6%
Small+	14.7%
Small	11.5%
TOTAL	100.0%

Source: Data provided by Port of Portland.

Notes: At the July 20, 2000 meeting, the Design Team agreed to the following:

- **Use the fleet mix presented in Data Package 1. Since that meeting, the mix was modified to reflect the change in an aircraft class definition -- Large Turbo Prop instead of Large Commuter.**
- **Regional Jets are included in the aircraft class Large Jet because they have the same departure noise restrictions, prop-to-jet penalties, approach speeds, and separations.**
- **Business Jets will be simulated as Small+/Small props, with the same departure procedures as the Small+/Small props. This was also done in the 1996 PDX Study because the percentage of Business Jets was small. Because we are limited to 6 aircraft classes in ADSIM, the Design Team agreed that it was still reasonable to treat Business Jets as Small+/Small props.**

SIMULATED DEMAND CHARACTERISTICS -- PDX **Accepted by PDX Team on 10/12/00**

ANNUAL & DAILY DEMAND

DEMAND LEVEL	ANNUAL OPERATIONS	DAILY OPERATIONS	EQUIVALENT DAYS
1999--Baseline	322,000	1,006	320
FUTURE 1	484,000	1,512	320
FUTURE 2	620,000	1,938	320

NOTE: (Annual Operations) / (Daily Operations) = Equivalent Days

PDX DEMAND CHARACTERISTICS

Annual Distribution of Traffic--(GA & MI annual ops increase according to Port's 2020 forecasts)

DEMAND	COMMERCIAL		GA		MILITARY		TOTAL	
1999-- Baseline	275,000	85.4%	38,000	11.8%	9,000	2.8%	322,000	100.0%
FUTURE 1	429,000	88.6%	45,000	9.3%	10,000	2.1%	484,000	100.0%
FUTURE 2	565,000	91.1%	45,000	7.3%	10,000	1.6%	620,000	100.0%

NOTES: **1999 distribution was based on the 1999 Port statistics.**
Commercial counts include Air Carrier, Commuter, and Air Taxis.
FAA Technical Center developed the FUTURE 1 & FUTURE 2 distributions based on the following growth assumptions of the Port's forecasts for PDX:

- FUTURE 1 represents the Port's expected forecast for 2020.
- FUTURE 2 represents the Port's high growth forecast for 2020.
- FUTURE 1 and FUTURE 2 have 45,000 annual GA operations.
- FUTURE 1 and FUTURE 2 have 10,000 annual MILITARY operations.

Daily Distribution of Traffic

DEMAND	COMMERCIAL		GA		MILITARY		TOTAL	
1999-- Baseline	860	85.5%	118	11.7%	28	2.8%	1,006	100.0%
FUTURE 1	1,342	88.8%	140	9.3%	30	2.0%	1,512	100.0%
FUTURE 2	1,768	91.2%	140	7.2%	30	1.5%	1,938	100.0%

NOTES: **Daily counts for Commercial, GA, and MI have an even number of ops per day in order to have equal numbers of arrivals and departures.**
Percentages are rounded to 1 decimal place.

SIMULATED FLEET MIXES – PDX **Accepted by PDX Team on 11/30/00**

Overall -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
47	4.7%	52	5.2%	466	46.3%	177	17.6%	148	14.7%	116	11.5%	1,006	100.0%	Baseline
74	4.9%	80	5.3%	720	47.6%	274	18.1%	212	14.0%	152	10.1%	1,512	100.0%	Future 1
97	5.0%	106	5.5%	940	48.5%	360	18.6%	261	13.5%	174	9.0%	1,938	100.0%	Future 2

Commercial -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
47	5.5%	52	6.0%	444	51.7%	173	20.1%	100	11.6%	44	5.1%	860	100.0%	Baseline
74	5.5%	80	6.0%	694	51.7%	270	20.1%	156	11.6%	68	5.1%	1342	100.0%	Future 1
97	5.5%	106	6.0%	914	51.7%	356	20.1%	205	11.6%	90	5.1%	1768	100.0%	Future 2

GA -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
0	.0%	0	.0%	2	1.7%	0	.0%	48	40.7%	68	57.6%	118	100.0%	Baseline
0	.0%	0	.0%	4	2.9%	0	.0%	56	40.0%	80	57.1%	140	100.0%	Future 1
0	.0%	0	.0%	4	2.9%	0	.0%	56	40.0%	80	57.1%	140	100.0%	Future 2

Military -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
0	.0%	0	.0%	20	71.4%	4	14.3%	0	.0%	4	14.3%	28	100.0%	Baseline
0	.0%	0	.0%	22	73.3%	4	13.3%	0	.0%	4	13.3%	30	100.0%	Future 1
0	.0%	0	.0%	22	73.3%	4	13.3%	0	.0%	4	13.3%	30	100.0%	Future 2

NOTES: **Baseline Demand Characteristics developed from 1999 Port data as follows:**
Overall fleet mix – from Port data, Calendar Year 1999.
GA and MI fleet mixes -- from Port data, Calendar Year 1999.
GA fleet mix -- revised by Design Team on 10/12/00.
Commercial fleet mix -- computed from the other Baseline fleet mixes.
Future 1 and Future 2 Demand Characteristics developed as follows:
GA fleet mix -- same as GA fleet mix in Baseline Demand.
MI fleet mix -- same as MI fleet mix in Baseline Demand -- as close as possible.
Commercial mix – same as Commercial fleet mix in Baseline Demand.
Overall fleet mix – computed from the other fleet mixes for that future demand.
Percentages are rounded to 1 decimal place.

BASELINE DEMAND -- HOUR COUNT SUMMARY

Accepted by PDX Team on 11/30/00

HOUR	ARR	DEP	ARR+DEP
0	6	5	11
1	4	3	7
2	2	1	3
3	5	1	6
4	4	4	8
5	8	9	17
6	12	48	60
7	19	46	65
8	26	33	59
9	27	25	52
10	29	22	51
11	34	22	56
12	27	33	60
13	29	35	64
14	21	26	47
15	26	22	48
16	33	27	60
17	40	30	70
18	28	22	50
19	34	23	57
20	31	26	57
21	20	18	38
22	23	14	37
23	15	8	23
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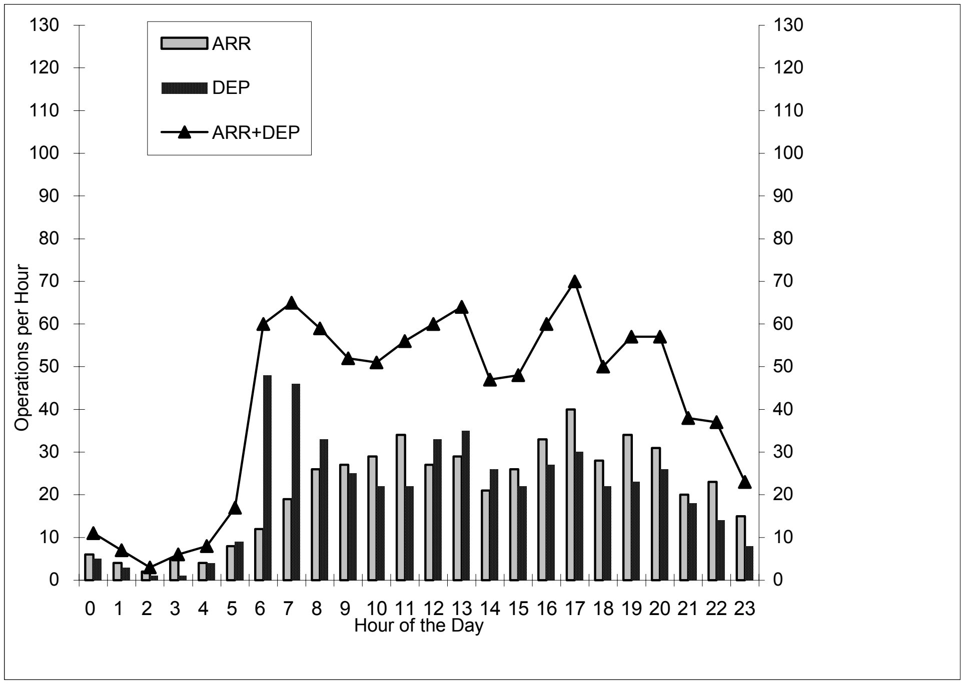
	503	503	1006



Hour Counts -- Baseline demand

The Technical Center used the Tower Counts and OAG from Tuesday, July 27, 1999, and cargo schedules for August 2000, to develop hour counts. July 1999 was selected because it is one of the months for which we have OAG data and July is a busy month at PDX. Tuesday the 27th was selected because we wanted a good VFR1 day with low airline-reported delays obtained from CODAS (Consolidated Operations and Delay Analysis System) on APO-130's web site.
Note: 10/15/01: VFR was changed to VFR1.

We used cargo schedules for August 2000 because the cargo operators could not provide us with schedules for 1999.

We will simulate 1,006 ops at the baseline demand -- 860 air carrier (commercial), 118 GA, and 28 Military ops.

HOUR COUNTS -- 1999 DEMAND (SCD-322)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	6	0	0	6	2	3	0	5	8	3	0	11
1	4	0	0	4	3	0	0	3	7	0	0	7
2	2	0	0	2	1	0	0	1	3	0	0	3
3	5	0	0	5	1	0	0	1	6	0	0	6
4	4	0	0	4	4	0	0	4	8	0	0	8
5	7	1	0	8	9	0	0	9	16	1	0	17
6	12	0	0	12	48	0	0	48	60	0	0	60
7	16	3	0	19	42	4	0	46	58	7	0	65
8	19	7	0	26	28	3	2	33	47	10	2	59
9	21	3	3	27	18	4	3	25	39	7	6	52
10	24	3	2	29	19	2	1	22	43	5	3	51
11	31	3	0	34	19	2	1	22	50	5	1	56
12	24	2	1	27	28	3	2	33	52	5	3	60
13	19	7	3	29	27	6	2	35	46	13	5	64
14	17	3	1	21	21	4	1	26	38	7	2	47
15	20	5	1	26	15	7	0	22	35	12	1	48
16	29	4	0	33	22	4	1	27	51	8	1	60
17	34	6	0	40	27	3	0	30	61	9	0	70
18	24	3	1	28	15	6	1	22	39	9	2	50
19	30	4	0	34	20	3	0	23	50	7	0	57
20	27	2	2	31	25	1	0	26	52	3	2	57
21	19	1	0	20	16	2	0	18	35	3	0	38
22	23	0	0	23	13	1	0	14	36	1	0	37
23	13	2	0	15	7	1	0	8	20	3	0	23
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	430	59	14	503	430	59	14	503	860	118	28	1006

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

AC -- **Tower Counts & OAG counts were supplemented to get AC counts. The counts include all cargo ops.**

GA/MI -- **The 1999 counts were based on the hourly PDX Tower counts for 7/27/99 and the cargo schedules obtained from the cargo operators.**

HOUR COUNTS -- FUTURE 1 DEMAND (SCD-484)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	9	0	0	9	3	3	0	6	12	3	0	15
1	6	0	0	6	5	0	0	5	11	0	0	11
2	3	0	0	3	2	0	0	2	5	0	0	5
3	8	0	0	8	2	0	0	2	10	0	0	10
4	6	0	0	6	6	0	0	6	12	0	0	12
5	11	1	0	12	14	0	0	14	25	1	0	26
6	19	0	0	19	75	0	0	75	94	0	0	94
7	25	4	0	29	65	5	0	70	90	9	0	99
8	30	8	0	38	44	4	3	51	74	12	3	89
9	33	4	4	41	28	5	3	36	61	9	7	77
10	38	4	2	44	30	2	1	33	68	6	3	77
11	48	3	0	51	30	2	1	33	78	5	1	84
12	37	2	1	40	44	4	2	50	81	6	3	90
13	30	8	3	41	42	7	2	51	72	15	5	92
14	27	4	1	32	33	5	1	39	60	9	2	71
15	31	6	1	38	23	8	0	31	54	14	1	69
16	45	5	0	50	34	5	1	40	79	10	1	90
17	53	7	0	60	42	4	0	46	95	11	0	106
18	37	4	1	42	23	7	1	31	60	11	2	73
19	47	5	0	52	31	4	0	35	78	9	0	87
20	42	2	2	46	39	1	0	40	81	3	2	86
21	30	1	0	31	25	2	0	27	55	3	0	58
22	36	0	0	36	20	1	0	21	56	1	0	57
23	20	2	0	22	11	1	0	12	31	3	0	34
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	671	70	15	756	671	70	15	756	1342	140	30	1512

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

Future 1 hour counts are 50% higher than 1999 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

HOUR COUNTS – FUTURE 2 DEMAND (SCD-620)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	12	0	0	12	4	3	0	7	16	3	0	19
1	8	0	0	8	7	0	0	7	15	0	0	15
2	4	0	0	4	3	0	0	3	7	0	0	7
3	10	0	0	10	3	0	0	3	13	0	0	13
4	8	0	0	8	8	0	0	8	16	0	0	16
5	14	1	0	15	18	0	0	18	32	1	0	33
6	25	0	0	25	99	0	0	99	124	0	0	124
7	33	4	0	37	86	5	0	91	119	9	0	128
8	40	8	0	48	58	4	3	65	98	12	3	113
9	43	4	4	51	37	5	3	45	80	9	7	96
10	50	4	2	56	40	2	1	43	90	6	3	99
11	63	3	0	66	40	2	1	43	103	5	1	109
12	49	2	1	52	58	4	2	64	107	6	3	116
13	40	8	3	51	55	7	2	64	95	15	5	115
14	36	4	1	41	43	5	1	49	79	9	2	90
15	41	6	1	48	30	8	0	38	71	14	1	86
16	59	5	0	64	45	5	1	51	104	10	1	115
17	70	7	0	77	55	4	0	59	125	11	0	136
18	49	4	1	54	30	7	1	38	79	11	2	92
19	62	5	0	67	41	4	0	45	103	9	0	112
20	55	2	2	59	51	1	0	52	106	3	2	111
21	40	1	0	41	33	2	0	35	73	3	0	76
22	47	0	0	47	26	1	0	27	73	1	0	74
23	26	2	0	28	14	1	0	15	40	3	0	43
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	884	70	15	969	884	70	15	969	1768	140	30	1938

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

Future 2 hour counts are 28% higher than the Future 1 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS -- PDX

LOCAL HOUR	SCD-322 (1999) HOUR COUNTS				SCD-484 (FUTURE 1) HOUR COUNTS				SCD-620 (FUTURE 2) HOUR COUNTS			
	ARR	DEP	TOTAL		ARR	DEP	TOTAL		ARR	DEP	TOTAL	
0	6	5	11		9	6	15		12	7	19	
1	4	3	7		6	5	11		8	7	15	
2	2	1	3		3	2	5		4	3	7	
3	5	1	6		8	2	10		10	3	13	
4	4	4	8		6	6	12		8	8	16	
5	8	9	17		12	14	26		15	18	33	
6	12	48	60	*	19	75	94	**	25	99	124	***
7	19	46	65	*	29	70	99	**	37	91	128	***
8	26	33	59		38	51	89		48	65	113	
9	27	25	52		41	36	77		51	45	96	
10	29	22	51		44	33	77		56	43	99	
11	34	22	56		51	33	84		66	43	109	
12	27	33	60	*	40	50	90	**	52	64	116	***
13	29	35	64	*	41	51	92	**	51	64	115	***
14	21	26	47		32	39	71		41	49	90	
15	26	22	48		38	31	69		48	38	86	
16	33	27	60	*	50	40	90	**	64	51	115	***
17	40	30	70	*	60	46	106	**	77	59	136	***
18	28	22	50		42	31	73		54	38	92	
19	34	23	57		52	35	87		67	45	112	
20	31	26	57		46	40	86		59	52	111	
21	20	18	38		31	27	58		41	35	76	
22	23	14	37		36	21	57		47	27	74	
23	15	8	23		22	12	34		28	15	43	
	------	------	--------		------	------	--------		------	------	--------	
	503	503	1006		756	756	1512		969	969	1938	

NOTES: **Counts include AC (Air Carrier/Commuter/Air Taxi), GA, and MI.**

1999 -- **Highest hour count is 70 -- at 5pm (1700 hrs).**
6 hours have counts of at least 60. See *.
Between 5pm and 8pm, the number of hourly ops ranges from 50 to 70.

Future 1 -- **Highest hour count is 106 -- at 5pm (1700 hrs).**
6 hours have counts of at least 90. See **.
Between 5pm and 8pm, the number of hourly ops ranges from 73 to 106.

Future 2 -- **Highest hour count is 136 -- at 5pm (1700 hrs).**
6 hours have counts of at least 115. See *.**
Between 5pm and 8pm, the number of hourly ops ranges from 92 to 136.

HOUR COUNT SUMMARY **Accepted by PDX Team on 11/30/00**

PDX CHART -- HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS

HOUR	1999	F1	F2
0	11	15	19
1	7	11	15
2	3	5	7
3	6	10	13
4	8	12	16
5	17	26	33
6	60	94	124
7	65	99	128
8	59	89	113
9	52	77	96
10	51	77	99
11	56	84	109
12	60	90	116
13	64	92	115
14	47	71	90
15	48	69	86
16	60	90	115
17	70	106	136
18	50	73	92
19	57	87	112
20	57	86	111
21	38	58	76
22	37	57	74
23	23	34	43
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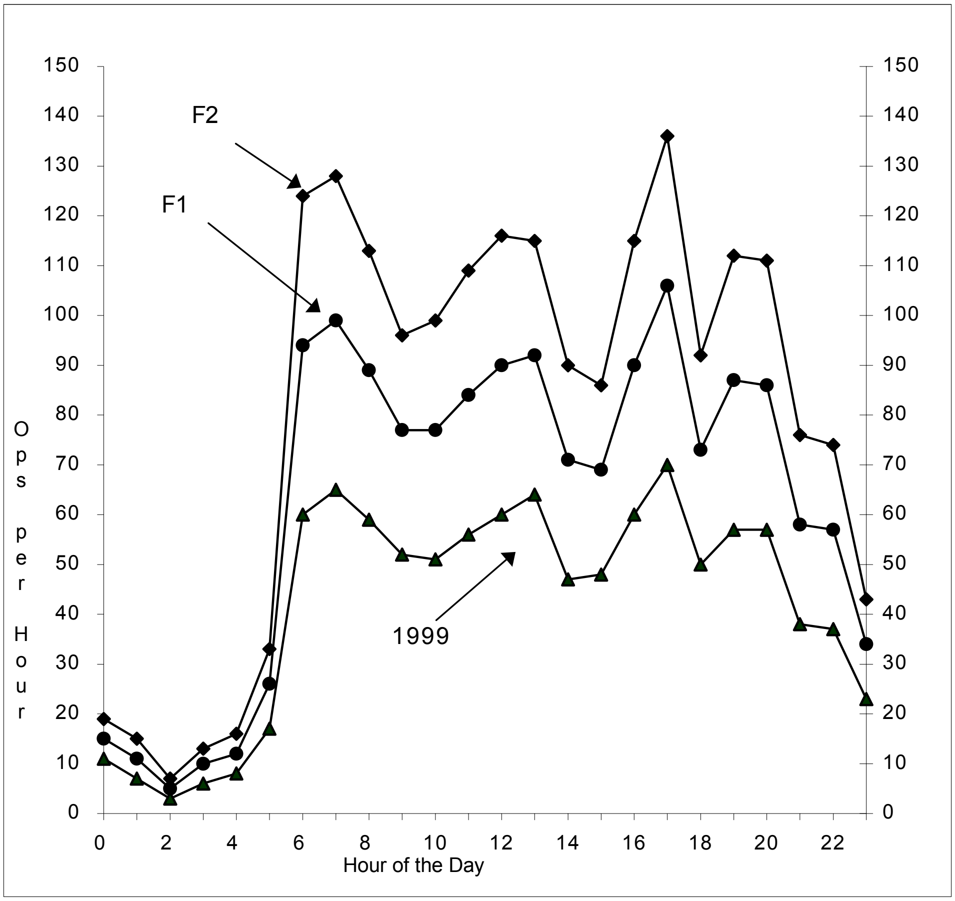
	1006	1512	1938



NOTES: **Future 1 hour counts are 50% higher than 1999 hour counts.**
Future 2 hour counts are 28% higher than the Future 1 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

OAG COUNTS -- July 27, 1999
CARGO COUNTS -- August 2000

Accepted by PDX Team on 11/30/00

OAG & CARGO COUNTS -- BY AIRLINE

Airlines (Passenger Carriers)	OAG/FAATC	FAA Code	ARR	DEP	TOTAL
Air Canada (AirBc, Ltd.)--Large Turbos	ZX	ABL	5	5	10
Alaska Airlines	AS	ASA	49	49	98
American Airlines	AA	AAL	4	2	6
America West Airlines	HP	AWE	6	6	12
Canadian Airlines (CX -- Large Turbos)	CP/CX	CDN	3	3	6
Continental Airlines	CO	COA	3	2	5
Delta Airlines (D1--HVY&Intl, DL--Other Jets)	DL/DL&D1	DAL	25	25	50
Frontier Airlines	F9	FFT	----	----	----
Hawaiian Airlines	HA	HAL	1	1	2
Horizon Airlines (HZ--Large Jets)	QX/HZ	QXE	30	30	60
Horizon Airlines (QX--Large Turbos)	QX	QXE	65	65	130
Northwest Airlines	NW	NWA	3	3	6
Reno Air	QQ	ROA	5	5	10
Skywest (DL Connection)	OO/DL	SKW/DAL	2	2	4
Skywest (UA Express) (UX--Large Turbos)	OO/UA/UX	SKW/UAL	39	39	78
Southwest Airlines	WN	SWA	31	31	62
Trans World Airlines	TW	TWA	3	3	6
United Airlines	UA	UAL	31	31	62
TOTAL PASSENGER OPS			**305**	**302**	**607**

Airlines (Cargo Carriers)	OAG/FAATC Code	FAA Code	ARR	DEP	TOTAL
Airborne Express	1F/C3	ABX	2	2	4
Ameriflight--Box-Haulers	B4	AMF	12	12	24
BAX Global / Burlington--Jets	H1/8W/C3	ATN	1	1	2
DHL Airways (via KHA in 1999)--Jets	ER/C1	DHL/KHA	1	1	2
Emery Worldwide--Jets	EB/C3	EWW	1	1	2
Federal Express--Box-Haulers	FM/B3	FDX	10	8	18
Kitty Hawk Airlines (supports DHL)--Jets	1K	KHA/DHL	----	2	2
Nippon Cargo Airlines--Jets	1N	NCA	1	----	1
UPS--Box-Haulers via Ameriflight	5X/B2	UPS	12	12	24
UPS--Jets	5X/C2	UPS	5	5	10
TOTAL CARGO OPS			**45**	**44**	**89**
GRAND TOTALS			**350**	**346**	**696**

Source: **OAG of July 27,1999 and cargo operations for August 2000. The Tech Center modified the cargo operations in order to conform to the fleet mix of the Baseline demand.**

Note: **The Tech Center added some codes to assist us in our schedule generation. We want to easily identify Large Turbo Props and Box-Haulers from the Jet operations. Therefore, we used some codes that help us; but these codes do not mean anything to the rest of the Design Team:**

- **B1, B2, B3, and B4 represent Box-Haulers by gate ramp areas: South Ramp, Central Ramp (UPS), Air Trans Center, and SW Ramp (Ameriflight), respectively.**
- **Similarly, C1, C2, C3, and C4 represent Jet operations at those ramp areas.**
- **CX, QX, UX, ZX represent Large Turbo Props for CP, QX, UA/Skywest, and ZX.**
- **HZ represents Horizon jets.**

GATE ASSIGNMENTS **Accepted by PDX Team on 10/12/00**

Airline (Passenger Carriers)	OAG Code	FAA Code	Terminal/Gates
Air Canada (AirBc, Ltd.)	ZX	ABL	E6
Alaska	AS	ASA	B2-B4, C2, C9, C13, C20-C23
American	AA	AAL	C4, C6
America West	HP	AWE	D3, D5
Canadian Airlines	CP	CDN	
Columbia Pacific	7C	COL	
Continental Airlines	CO	COA	D1,D4
Delta	DL	DAL	D5-D15
Frontier Airlines	F9	FFT	D6
Harbor Airlines	HG	HAR	A5-A12
Hawaiian Airlines	HA	HAL	D14
Horizon Air	QX	QXE	A1-A12, B4
Northwest	NW	NWA	C17, C19
Reno Air	QQ	ROA	C11
Skywest (DL Connection)	OO/DL	SKW/DAL	E7
Skywest (UA Express)	OO/UA	SKW/UAL	E6
Southwest	WN	SWA	C14-C16, C18
Trans World	TW	TWA	D2, D8
United Airlines	UA	UAL	E1-E5

Airline (Cargo Carriers)	OAG Code	FAA Code	Terminal/Gates
ABX Air, Inc.	W0	------	
Aeroflight		TTY	
Airborne Express	1F	ABX	Air Trans Center
AirPac (supports Airborne & Aeroflight)	------	APC	Air Trans Center
Ameriflight	------	AMF	South West Ramp
BAX Global (via Air Transport Intl)	H1	ATN	Air Trans Center
Burlington Air Express	8W	ASW	Air Trans Center
Cargolux Airlines (began service-2000)	S1	CLX	Air Trans Center
DHL Airways (via KHA in 1999)	ER	DHL/KHA	South Air Cargo Ramp
Emery Worldwide	EB	EWW	Air Trans Center
Empire Airlines (supports FedEx)	----	CFS	Air Trans Center
Evergreen Airlines (supports USPS)	1E	EIA	South Air Cargo Ramp
Federal Express	FM	FDX	Air Trans Center
Kitty Hawk Airlines (supports DHL)	1K	KHA/DHL	South Air Cargo Ramp
Korean Air	KE	KAL	Air Trans Center
Nippon Cargo Airlines	1N	NCA	Air Trans Center
UPS (& Box-Haulers via Ameriflight)	5X	UPS	UPS -- Central Ramp
Western Air Express (supports UPS)	----	WAE	UPS -- Central Ramp

Source: **Airlines were taken from the OAG of July 27, 1999, 2000 data collection, and the Port. Added Aeroflight (TTY) on 10/30/00.**

Comments:

- **Gate usage is based on July 1999, when PDX Terminals B & C were undergoing construction.**
- **Box-Haulers -- Ameriflight, UPS and Airborne (via Ameriflight), Federal Express (via Western Air Express).**

CARGO LOCATIONS

Accepted by PDX Team on 11/30/00
FAATC added cargo codes on 12/11/00

North Cargo Ramp:		None
South Cargo Ramp:	C1/B1	DHL (Operated by Kitty Hawk in 1999 and Reliant in 2000) Evergreen (contracted by USPS--US Postal Service) Kitty Hawk
Central Cargo Ramp:	C2/B2	UPS (& Box-Haulers via Ameriflight & Western Air Express)
Air Trans Center:	C3/B3	Airborne, AirPac, BAX, Burlington, Cargolux, Emery, Federal Express (& Box-Haulers by Empire), Korean Air, Nippon Cargo Airlines
South West Cargo Ramp:	C4/B4	Ameriflight (& Ameriflight courier Box-Haulers)

Comments:

- **Gate usage is based on July 1999, when PDX Terminals B & C were undergoing construction.**
- **Box-Haulers are Small/Small+ cargo feeders. Some Small aircraft (SW3, BE9/BE99, and BE90) were reclassified as Small+ because they are Turbo Props and cannot diverge to the North. The Box-Haulers are associated with the following cargo carriers:**
  - **Ameriflight**
  - **UPS and Airborne (via Ameriflight)**
  - **Federal Express (via Western Air Express)**
- **Box-Hauler statistics -- provided by the Port for 1999 -- updated on 11/14/00:**
  - **5:30am - 8:00am: 24 Box-Hauler Departures per day -- on average**
  - **4:30pm - 6:00pm: 23 Box-Hauler Arrivals per day -- on average**
  - **7:00pm - 8:30pm: 14 Box-Hauler Arrivals per day -- on average**
- **The number of Box-Haulers simulated is similar, but not identical, to the above numbers.**

FLEET MIX COST

Accepted by PDX Team on 6/24/01

DEMAND	**FLEET MIX COST (Direct Operating Cost per Hour) in year 2000 dollars**
1999	**$ 1,660**

NOTE:

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The Technical Center used the cost for each airline and aircraft type at PDX.

AIRCRAFT GATE SERVICE TIMES **Accepted by PDX Team on 11/30/00**

To simulate more realistic conditions, the departure time of a continuing arrival is adjusted to assure the aircraft meets its minimum gate service time (minimum turn-around time). These times represent the minimum time it takes to service an aircraft -- from the time it arrives at the gate until pushback. If an aircraft arrives late, the model will delay its departure in order to insure that the minimum gate service time is met.

Minimum Turn-Around Times in Minutes -- with a cumulative probability distribution

Heavy		757		LJ		LTP		S+		Small	
Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.
60	0.79	45	0.92	20	0.20	20	0.07	20	1.00	10	0.16
90	1.00	50	1.00	25	0.25	30	0.97			15	0.56
				30	0.50	40	1.00			20	0.64
				35	0.64					25	1.00
				40	1.00						

Source:

Heavy, 757, LJ, LTP, S+ -- Based on November 2000 values provided by the airlines serving PDX and their minimum turn-around times at PDX.

Small -- Values were from the 1996 PDX Design Team. Values for Small were weighted by percent of small-twins and small-singles in the 1996 study. The maximum gate service time at PDX was then reduced to 25 minutes (from 35 minutes). The original values for small-twins and small-singles were developed during the Newark Study (before 1990) and were used in the Charlotte, Dulles, and Cincinnati Design Team studies.

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION **Accepted by PDX Team on 7/20/00**

(ARRIVAL VARIABILITY DISTRIBUTION) -- 1996 PDX DESIGN TEAM STUDY

To simulate more realistic conditions, a lateness distribution (arrival variability distribution) is added to the OAG scheduled arrival time. The distribution should represent the average deviation from the scheduled arrival time, excluding delays at the destination airport (PDX).

The arrival aircraft lateness distribution is shown as a cumulative probability. For each arrival, the lateness distribution is sampled and the resulting time is added to the scheduled arrival time. This input varies the arrival time of an aircraft during each iteration of the simulation.

Amount by which actual arrival time at threshold would exceed scheduled arrival time at threshold	Distribution of aircraft lateness (cumulative %)
-20	0.0 %
-15	4.7 %
- 2	31.5 %
0	52.6 %
5	70.3 %
10	83.6 %
15	94.3 %
30	95.9 %
45	98.4 %
60	100.0 %

This table reads as follows:

0% arrive at the threshold more than 20 minutes early
4.7% (4.7% - 0%) arrive between 15 and 20 minutes early
26.8% (31.5% - 4.7%) arrive between 2 and 15 minutes early

Source: Values used in the 1994 & 1989 Seattle Design Team studies.

VFR SEPARATIONS

Accepted by PDX Team on 11/30/00

STANDARD VFR1 (VISUAL) ARR/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds
At Point of Closest Approach <<with missed approach buffer>>

ARR/ARR (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	4.26	5.06	5.06	4.69	5.56	5.04
757	*Treat as Heavy*	4.26	5.06	5.06	4.69	5.56	5.04
LJ	*(7110.65--Large)*	3.40	3.19	3.19	2.96	3.76	3.39
LTP	*(7110.65--Large)*	3.40	3.19	3.19	2.96	3.76	3.39
S+	*(7110.65--Small)*	3.40	3.19	3.19	2.96	2.96	3.39
SM	*(7110.65--Small)*	3.40	3.19	3.19	2.96	2.96	2.66

Expected VFR1 ARR/ARR separations for PDX: 3.4 NM 1.52 minutes
Expected VFR1 Arrival Flow Rates for PDX: 39 arrivals/runway (max thruput)

STANDARD VFR1 (VISUAL) DEP/DEP SEPARATIONS (in Minutes) -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+

D/D (Minutes)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00
757	*Treat as Heavy*	1.50	2.00	2.00	2.00	2.00	2.00
LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83
LTP	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83
S+	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	0.83
SM	*(7110.65--Small)*	0.83	0.83	0.75	0.75	0.75	0.58

Expected VFR1 D/D separations for PDX: 1.05 minutes
Expected VFR1 Departure Flow Rates for PDX: 57 departures/runway (max thruput) -- with no mixed ops

STANDARD VFR1 (VISUAL) DEP/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

D/A (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	1.68	1.52	1.52	1.41	1.41	1.19
757	*Treat as Heavy*	1.68	1.52	1.52	1.41	1.41	1.19
LJ	*(7110.65--Large)*	1.68	1.52	1.52	1.41	1.41	1.19
LTP	*(7110.65--Large)*	1.68	1.52	1.52	1.41	1.41	1.19
S+	*(7110.65--Small)*	1.68	1.52	1.52	1.41	1.41	1.19
SM	*(7110.65--Small)*	1.46	1.32	1.32	1.23	1.23	1.04

Expected VFR1 D/A separations for PDX: 1.43 NM
When departure starts to roll, arrival must be at least this far from threshold: 0.64 minutes

NOTES: **VFR A/D Separations (minutes) are the Runway Occupancy Times (ROTs).**
Approach Speeds in Knots: Heavy--155; 757--140; LJ --140; LTP--130; S+--130; SM--110
Expected PDX approach speed: 134 knots (2.23 NM/minute)

Notes on Sigmas:

In general, the models will vary the separations by ± 3 sigmas (standard deviations).
Separations will be within ± 1 sigma approximately 68.3% of the time.
Separations will be within ± 2 sigmas approximately 91% of the time.
Separations will be within ± 3 sigmas approximately 99.7% of the time.
ARR/ARR Standard Sigma = 18 Seconds. (Source: FAA-EM-78-8A)
Critical Function: The 18-second sigma is used to calculate the buffer, which is added to the minimum IFR separations, to generate the average IFR separations.
For a pair of arrivals, the average separation = (minimum separation in NM) + (1.65 * sigma in NM).

IFR SEPARATIONS **Accepted by PDX Team on 11/30/00**

STANDARD IFR ARR/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

At Point of Closest Approach <<with 2.5 NM minimum spacing on a Runway>>

ARR/ARR (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	5.29	6.16	6.16	6.07	7.07	6.91
757	*Treat as Heavy*	5.29	6.16	6.16	6.07	7.07	6.91
LJ	*(7110.65--Large)*	3.79	3.66	3.66	3.57	5.07	4.91
LTP	*(7110.65--Large)*	3.79	3.66	3.66	3.57	5.07	4.91
S+	*(7110.65--Small)*	3.79	3.66	3.66	3.57	3.57	4.91
SM	*(7110.65--Small)*	3.79	3.66	3.66	3.57	3.57	3.41

Expected IFR ARR/ARR separations for PDX: 4.15 NM 1.86 minutes
Expected IFR Arrival Flow Rates for PDX: 32 arrivals/runway (max thruput)

STANDARD IFR DEP/DEP SEPARATIONS (in Minutes) -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+

DEP/DEP (Minutes)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00
757	*Treat as Heavy*	1.50	2.00	2.00	2.00	2.00	2.00
LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00
LTP	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00
S+	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	1.00
SM	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	1.00

Expected IFR DEP/DEP separations for PDX: 1.10 minutes
Expected IFR Departure Flow Rates for PDX: 55 departures/runway (max thruput) -- with no mixed ops

STANDARD IFR DEP/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

DEP/ARR (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
ALL CLASSES		2.00	2.00	2.00	2.00	2.00	2.00

Expected IFR DEP/ARR separations for PDX: 2.00 NM
When departure starts to roll, arrival must be at least this far from threshold: 0.90 minutes

NOTES: **IFR A/D Separations (minutes) are the Runway Occupancy Times (ROTs).**
Approach Speeds in Knots: Heavy--155; 757--140; LJ --140; LTP--130; S+--130; SM--110
Expected PDX approach speed: 134 knots (2.23 NM/minute)

Notes on Sigmas:

In general, the models will vary the separations by ± 3 sigmas (standard deviations).
Separations will be within ± 1 sigma approximately 68.3% of the time.
Separations will be within ± 2 sigmas approximately 91% of the time.
Separations will be within ± 3 sigmas approximately 99.7% of the time.
ARR/ARR Standard Sigma = 18 Seconds. (Source: FAA-EM-78-8A)
Critical Function: The 18-second sigma is used to calculate the buffer, which is added to the minimum IFR separations, to generate the average IFR separations.
For a pair of arrivals, the average separation = (minimum separation in NM) + (1.65 * sigma in NM).

DEPARTURE PUSH -- 1996 PDX STUDY **Accepted by PDX Team on 7/20/00**

Departure Push = 5

Arrivals are usually given priority over departures. However, during a departure push, spacing between arrivals may be increased in order to reduce departure delay.

When five departures initiate their pushback, the Tower would space out arrivals in order to allow an aircraft to depart between two arrivals. At the current demand level, with both parallels operating, this would seldom occur. As demand increases, the Tower would increase the frequency of the departure pushes.

D/D Noise Dependency for Turboprop/Jet -- 1996 PDX STUDY **Accepted by PDX Team on 7/20/00**

VFR & IFR: 2 minutes (unless the 2 aircraft have divergent turns).

Without the noise restrictions, the standard VFR D/D separation for a Turboprop followed by a Jet would be 1 minute in VFR and 2 minutes in IFR.

With the PDX Noise restrictions, when a Turboprop departure is followed by a Jet departure, the Departure-to-Departure (D/D) separation is 2 minutes in both VFR and IFR. The additional 1-minute separation in VFR prevents the Jet from overtaking the Turboprop, which is a slower aircraft. This 2-minute separation in VFR does not apply when the Turboprop and the Jet have divergent turns.

Note: 10/15/01: VFR refers to VFR *separations*. IFR refers to IFR *separations*.

DEPARTURE RUNWAY OCCUPANCY TIMES (SECONDS) -- STANDARD (WITH 2000 CLASSES): **Accepted by PDX Team on 7/20/00**

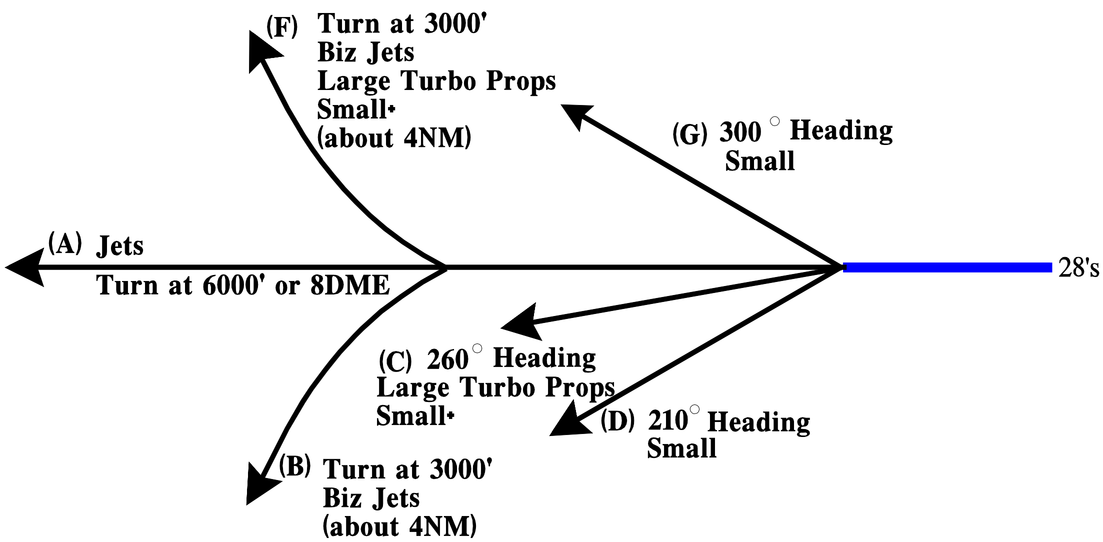
These are the minimum times a departure is on the runway. Runway crossing times and aircraft separations cannot violate these minimums.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
Standard	Seconds	39	39	39	39	39	34

Source: Standard values used in all design team studies. These values were used in the 1996 PDX STUDY.

PDX NOISE DEPENDENCIES -- WEST FLOW (Same Runway)   Accepted by PDX Team on 7/20/00
(Updated 8/2/00)

(B) & (C) & (D) -- Totally independent WRT noise
(A) & (C) & (D) -- Totally independent WRT noise
(C) & (D) & (G) -- Independent of everyone WRT noise
(A) South & (A) North -- Full noise dependency
(A) & (B) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(A) & (F) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(F) & (B) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)



WEST FLOW: There are no departure fix restrictions for 2 dis-similar jets going to the same exit fix at the center. Updated 12/94.

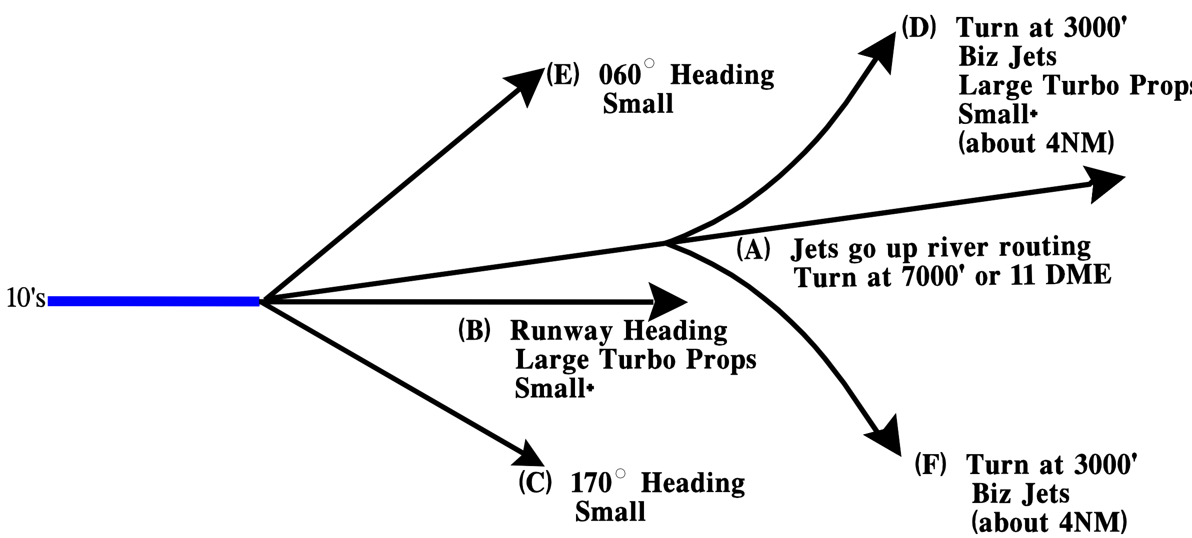
VFR FLIGHT PLAN -- Small aircraft can do an immediate turn onto any of several departure paths. Updated 12/94.

Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

Notes: **Headings for Southbound Small are now 210° (instead of 240° in 1996 Study).**
Small+ aircraft follow the same heading as Large Turbo Props.
Regional Jets have the same procedures as Large Jets (A).

PDX NOISE DEPENDENCIES -- EAST FLOW (Same Runway) **Accepted by PDX Team on 7/20/00**
(Updated 8/2/00)

(A) & (B) & (C) & (E) -- Totally Independent WRT Noise
(B) & (C) & (E) -- Independent of Everyone WRT Noise
VFR Flight Plans -- No Noise Dependency
(A) South & (A) North -- Full Noise Dependency
(A) & (D) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(A) & (F) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(F) & (D) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 miute, Turbine / Jet = 2 minutes)



EAST FLOW: To depart 2 dis-similar jets (when the trail aircraft is a smaller jet) going to the same exit fix at the center -- controllers must add 30 seconds to trail departure, if they cannot insert a different type of departure. However, they can usually insert a different type of departure, thereby eliminating the need to add the extra separation. Updated 12/94.

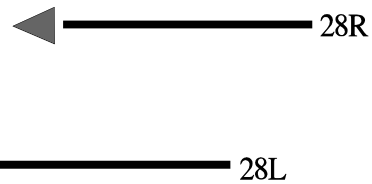
VFR FLIGHT PLAN -- Small aircraft can do an immediate turn onto any of several departure paths. Updated 12/94.

Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

Notes: **Headings for Southbound Small are now 170° (instead of 120° in 1996 Study).**
Small+ aircraft follow the same heading as Large Turbo Props.
Regional Jets have the same procedures as Large Jets (A).

<u>D/D Rwy Dependencies due to Noise for Offset Departure Thresholds</u>

WEST FLOW -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-14)



Departure on 28R followed by a Departure on 28L -- VFR & IFR Noise Dependency:

<u>28R/28L</u>

Jet/Jet:	Use 1.25 minutes (0.25 minutes added to std Jet/Jet) When Heavy is lead aircraft, add 0.25 minutes to std Heavy/Jet When 757 is lead aircraft, add 0.25 minutes to std 757/Jet
Turboprop/Turboprop:	Use 1.25 minutes (0.25 minutes added to std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes added to std Turboprop/Jet)
Jet/Turboprop:	Use 1.00 minute (0.00 minutes added to std Jet/Turboprop) When Heavy is lead aircraft, add 0.00 minutes to std Heavy/Turboprop When 757 is lead aircraft, add 0.00 minutes to std 757/Turboprop

Departure on 28L followed by a Departure on 28R -- VFR & IFR Noise Dependency:

<u>28L/28R</u>

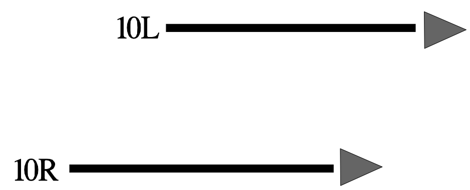
Jet/Jet:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.25 minutes from std Heavy/Jet When 757 is lead aircraft, subtract 0.25 minutes from std 757/Jet
Turboprop/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std Turboprop/Jet)
Jet/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Turboprop) When Heavy is lead aircraft, subtract 0.25 minutes from std Heavy/Turboprop When 757 is lead aircraft, subtract 0.25 minutes from std 757/Turboprop (Adjusted format on 1/17/01)

Note: Turboprop can be LTP or S+.
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

<u>OTHER DEPARTURE DEPENDENCIES</u> **Accepted by PDX Team on 7/20/00**

<u>D/D Rwy Dependencies due to Noise for Offset Departure Thresholds</u>

EAST FLOW -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-15)



Departure on 10R followed by a Departure on 10L -- VFR & IFR Noise Dependency:

<u>10R/10L</u>

Jet/Jet:	Use 2.00 minutes (1.00 minute added to std Jet/Jet) When Heavy or 757 is lead aircraft, use 2.00 minutes
Turboprop/Turboprop:	Use 2.00 minutes (1.00 minute added to std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes added to std Turboprop/Jet)
Jet/Turboprop:	Use 1.25 minutes (0.25 minutes added to std Jet/Turboprop) When Heavy is lead aircraft, add 0.25 minutes to std Heavy/Turboprop When 757 is lead aircraft, add 0.25 minutes to std 757/Turboprop

Departure on 10L followed by a Departure on 10R -- VFR & IFR Noise Dependency:

<u>10L/10R</u>

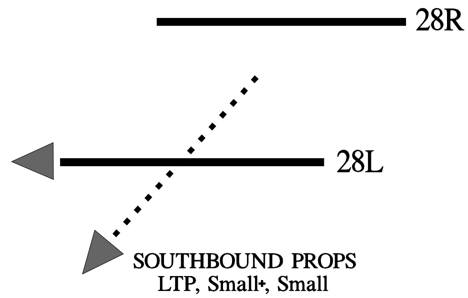
Jet/Jet:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.34 minutes from std Heavy/Jet When 757 is lead aircraft, subtract 0.34 minutes from std 757/Jet
Turboprop/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std Turboprop/Jet)
Jet/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/Turboprop) When Heavy is lead aircraft, subtract 0.34 minutes from std Heavy/Turboprop When 757 is lead aircraft, subtract 0.34 minutes from std 757/Turboprop (Adjusted format on 1/17/01)

Note: Turboprop can be LTP or S+.
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

WEST FLOW -- SOUTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-10)



SOUTHBOUND PROPS (LTP or S+ or Small) departing 28R are permitted to turn south as soon as they are airborne. Therefore, there is a dependency between a southbound departure on 28R and a departure on 28L. Under the existing noise restrictions, any prop (LTP or S+ or Small) can turn south immediately.

28R/28L: Southbound Departure on 28R Followed by Departure on 28L

28R/28L		
LTP or S+ or Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28L
	IFR1:	70 seconds for Prop to cross 28L & be verified by radar

28L/28R: Departure on 28L Followed by Southbound Departure on 28R

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, *pages A-14 & A-22*)

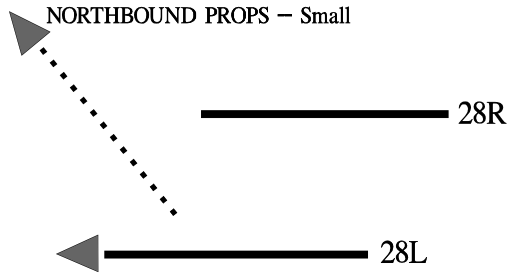
28L/28R		
Heavy or 757/LTP or S+ or Small:	VFR:	1.75 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.75 minutes (due to wake vortex & offset thresholds) **Updated 757 info on 10/30/00.**
LJ/LTP or S+ or Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
LTP or S+ northbound/LTP or S+:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
LTP or S+ southbound/LTP or S+:	VFR:	45 seconds (due to offset thresholds)
	IFR1:	45 seconds (due to offset thresholds)
LTP or S+/Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
Small/LTP or S+ or Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

WEST FLOW -- NORTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-11)



SMALL NORTHBOUND PROPS departing 28L are permitted to turn north as soon as they are airborne. Therefore, there is a dependency between a northbound departure on 28L and a departure on 28R. Under the existing noise restrictions, any Small can turn north immediately.

28R/28L: Departure on 28R Followed by Northbound Departure on 28L

(D/D Separations in the 1996 Study, Data Pkg 13, Appendix A, page A-22)

28R/28L		
Heavy or 757/Small:	VFR:	2 minutes (due to wake vortex)
	IFR1:	2 minutes (due to wake vortex) (D/D separations) **Updated 757 info on 10/30/00.**
LJ/Small:	VFR:	50 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)
LTP or S+/Small:	VFR:	50 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)
Small/Small:	VFR:	20 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)

28L/28R: Northbound Departure on 28L Followed by Departure on 28R

28L/28R		
Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28R
	IFR1:	70 seconds for Prop to cross 28R & be verified by radar

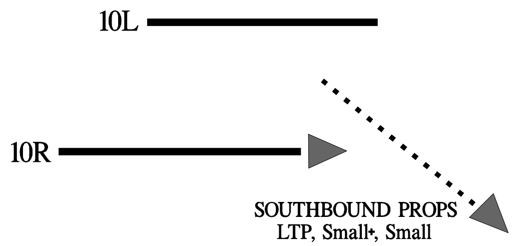
Note: Improvement Package (A), All Turbo Props and Biz Jets Can Do Divergent Turns, will permit LTP or S+ aircraft to turn north immediately. For that simulation, the separation for a LTP or S+ aircraft will be the same as that of a Small.

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

EAST FLOW -- SOUTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-12)



SOUTHBOUND PROPS (LTP or S+ or Small) departing 10L are permitted to turn south as soon as they are airborne. Therefore, there is a dependency between a southbound departure on 10L and a departure on 10R. Under the existing noise restrictions, any prop (LTP or S+ or Small) can turn south immediately.

10L/10R: Southbound Departure on 10L Followed by Departure on 10R

10L/10R

LTP or S+ or Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 10R
	IFR1:	70 seconds for Prop to cross 10R & be verified by radar

10R/10L: Departure on 10R Followed by Southbound Departure on 10L

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, pages A-15 & A-22)

10R/10L

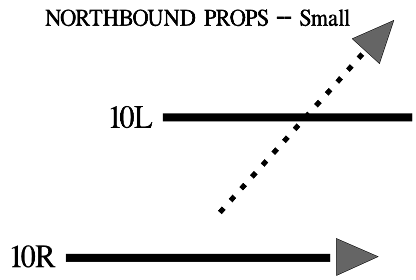
Heavy or 757/LTP or S+ or Small:	VFR:	2.25 minutes (due to wake vortex & offset thresholds)
	IFR1:	2.25 minutes (due to wake vortex & offset thresholds)
		Updated 757 info on 10/30/00.
LJ/LTP or S+:	VFR:	1.25 minutes (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
LJ/Small:	VFR:	1 minute (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
LTP or S+ northbound/LTP or S+:	VFR:	2 minutes (due to offset thresholds)
	IFR1:	2 minutes (due to offset thresholds)
LTP or S+ southbound/LTP or S+:	VFR:	1.25 minutes (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
LTP or S+ northbound/Small:	VFR:	2 minutes (due to offset thresholds)
	IFR1:	2 minutes (due to offset thresholds)
LTP or S+ southbound/Small:	VFR:	1.08 minutes (due to offset thresholds & diverging paths)
	IFR1:	1.25 minutes (due to offset thresholds & diverging paths)
Small northbound/Small:	N/A:	Small aircraft on 10R usually go southbound
Small southbound/Small:	VFR:	30 seconds (due to offset thresholds & diverging paths)
	IFR1:	45 seconds (due to offset thresholds & diverging paths)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES — **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

EAST FLOW -- NORTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-13)



SMALL NORTHBOUND PROPS departing 10R are permitted to turn north as soon as they are airborne. Therefore, there is a dependency between a northbound departure on 10R and a departure on 10L. Under the existing noise restrictions, any Small can turn north immediately.

10L/10R: Departure on 10L Followed by Northbound Departure on 10R

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, pages A-15 & A-22)

10L/10R		
Heavy or 757/Small:	VFR:	1.66 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.66 minutes (due to wake vortex & offset thresholds)
		Updated 757 info on 10/30/00.
LJ/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
LTP or S+/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
Small/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)

10R/10L: Northbound Departure on 10R Followed by Departure on 10L

10R/10L		
Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 10L
	IFR1:	70 seconds for Prop to cross 10L & be verified by radar

Note: Improvement Package (A), All Turbo Props and Biz Jets Can Do Divergent Turns, will permit LTP or S+ aircraft to turn north immediately. For that simulation, the separation for a LTP or S+ aircraft will be the same as that of a Small.

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

Additional IFR1 Dependencies due to Departure Air Crossovers

A/D IFR1 Runway Dependencies due to Departure Air Crossovers

-- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-9)

In IFR1, there is an additional runway dependency for an aircraft departing the north runway, turning south, and crossing over the south runway. The arrival on the south runway must have landing assured before the southbound departure can be released.

Similarly, in IFR1, there is an additional runway dependency for an aircraft departing the south runway, turning north, and crossing over the north runway. The arrival on the north runway must have landing assured before the southbound departure can be released.

Arrival/Departure Turning and Crossing the Arrival Runway

South Runway/North Runway:	IFR1:	5 seconds (for arrival to have landing assured)
North Runway/South Runway:	IFR1:	5 seconds (for arrival to have landing assured)

D/A IFR1 Runway Dependencies due to Departure Air Crossovers

-- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-9)

In IFR1, there is an additional runway dependency for an aircraft departing the north runway, turning south, and crossing over the south runway. The arrival on the south runway must be at least 2 NM in-trail behind the southbound departure when the southbound departure is released.

Similarly, in IFR1, there is an additional runway dependency for an aircraft departing the south runway, turning north, and crossing over the north runway. The arrival on the north runway must be at least 2 NM in-trail behind the departure when the northbound departure is released.

The D/A separation of 2 NM must be adjusted to reflect the offsets of the runway thresholds.

Departure/Arrival (when departure turns and crosses the arrival runway)

28R/28L:	IFR1:	2.3 NM (distance of arrival from its threshold) (2 NM + 0.3 NM offset)
28L/28R:	IFR1:	1.7 NM (distance of arrival from its threshold) (2 NM - 0.3 NM offset)
10R/10L:	IFR1:	2.9 NM (distance of arrival from its threshold) (2 NM + 0.9 NM offset)
10L/10R:	IFR1:	1.1 NM (distance of arrival from its threshold) (2 NM - 0.9 NM offset)

Note: These A/D and D/A dependencies protect *for* a missed approach.
Note: 10/15/01: IFR1 refers to IFR1 simulations.

IFR1 -- Staggered Approaches to Parallel Runways with Offset Thresholds (from PDX 1996 Study) **Accepted by PDX Team on 2/1/01**

In IFR1, PDX conducts staggered approaches to the parallel runways. PDX must use at least a 1.5 NM stagger. To insure that minimum separations are not violated, a 2 NM longitudinal stagger will be simulated. Because the thresholds are offset, we will simulate the stagger as follows:

Arrival/Arrival

28R/28L:	IFR1:	2.3 NM (distance of trailing arrival from its threshold) (2 NM + 0.3 NM offset)
28L/28R:	IFR1:	1.7 NM (distance of trailing arrival from its threshold) (2 NM - 0.3 NM offset)
10R/10L:	IFR1:	2.9 NM (distance of trailing arrival from its threshold) (2 NM + 0.9 NM offset)
10L/10R:	IFR1:	1.1 NM (distance of trailing arrival from its threshold) (2 NM - 0.9 NM offset)

Note: 10/15/01: IFR1 refers to IFR1 simulations.

OPERATIONAL PROCEDURES AND MINIMA -- DEFINITIONS **Accepted by PDX Team on 11/30/00**

These were developed from the 1996 PDX Study -- based on the PDX Airside Capacity Study (final report), March 1991, pgs A-9 thru A-13. They were revised in July 2000 to reflect current conditions and assumptions:

- **1.5 NM staggered approaches to parallel runways in IFR for Do-Nothing case.**
- **Runway 3 will not be used for arrivals**. Current ATC rules for LAHSO (Land and Hold Short Operations) have such severe restrictions that they effectively do not permit simultaneous arrivals to Runway 3 and 10R/28L.

VFR1: Ceiling ≥ 3,500' *and* Visibility ≥ 10 miles.
Visual (VFR1) separations.
Simultaneous visual approaches to both parallel runways by all aircraft types.
Runway 3 not used for arrivals in VFR1.
Although not permitted under noise abatement procedures, ATC rules would permit certain small aircraft to make visual **dependent** approaches to Runway 3. Current LAHSO rules do not permit small aircraft to make simultaneous approaches to Runway 3 and 10R/28L, even when the runways are dry and there is no tailwind.

VFR2: Less than VFR1, *and*, Ceiling ≥ 2,000' *and* Visibility ≥ 5 miles.
IFR separations for A/A. Visual (VFR1) separations for others.
Simultaneous approaches may be permitted to the parallel runways.
10/26/95 Update: Small_as_Trail can use Visual A/A separations.
Runway 3 not used for arrivals in VFR2.
ATC rules would permit certain small aircraft to make **dependent** approaches to Runway 3 when the runways are dry. VFR2 usually occurs in the winter when the runways are wet. In addition, current LAHSO rules do not permit small aircraft to make simultaneous approaches to Runway 3. In reality, Runway 3 cannot and would not be used for arrivals in VFR2.

IFR1: Less than VFR2, *and*, Ceiling ≥ 200' *and* Visibility ≥ 0.5 miles.
IFR separations are required.
1.5 NM staggered approaches to existing parallel runways in West and East flows.
Visual approaches are not allowed to any runway.

IFR2: Less than IFR1, *and*, Ceiling ≥ 100' *and* Visibility ≥ 0.25 miles.
IFR separations. Arrive on 10R. Depart on 10R & 10L.

IFR3: Visibility < 0.25 miles *and* ≥ 0.125 miles.
IFR separations. Arrive on 10R. Depart on 10R & 10L.
SMGCS is expected in Fall 2001. The expected departure minimums are 300' RVR for SMGCS participants and 500' RVR for all others. **Updated 1/18/01.**

Minimums obtained from approach plates:

- **10R: CAT I minimums are 200'AGL and 3/8 mile.**
- **10L: CAT I minimums are 450' AGL and 1 mile.**
- **28R: CAT I minimums are 300 AGL and 1 mile. Updated 10/30/00.**
- **28L: CAT I minimums are 400' AGL and 1/2 mile. Updated 10/30/00.**

OPERATIONAL PROCEDURES AND MINIMA -- SIMULATED (UPDATED 8/11/00)

Accepted by PDX Team on 10/12/00

At the July 20, 2000 meeting, the Design Team agreed it was reasonable to use the values from the 1996 PDX Study. With the addition of the new tower and CAT I ILS approaches to 10R and 28L, the minimums changed from 1996 minimums. However, the Design Team agreed that the percentages of VFR1, VFR2, and IFR1 were still reasonable to use in the annual delay calculations.

Weather	VFR1	VFR2	IFR1	
MINIMA	VISUAL	<VIS & ≥IFR	CAT I	ALL WEATHER
Ceiling:	3500'	2000'	200'	
Visibility:	10 miles	5 miles	0.5 miles	
EAST FLOW (10s)	35.3%	9.2%	7.8%	52.3%
WEST FLOW (28s)	39.1%	5.0%	3.6%	47.7%
	-----	-----	-----	-----
TOTAL	74.4%	14.2%	11.4%	100.0%

Note: 10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.
10/15/01: VFR1, VFR2, and IFR1 refer to simulated procedures/conditions.

1996 PDX Study -- PDX Tower:

- All aircraft usually do or can operate in IFR1 & IFR2.
- Fog usually occurs from sunrise to 10am.
- VFR3 is not needed.
- VFR2 usually occurs in full days; thus, the VFR2 Factor = 1.
- IFR1 usually occurs in full days; thus, the IFR1 Factor = 1.

1996 PDX Study -- Design Team:

- At the January 18, 1995 meeting, the Design Team agreed to simulate only VFR1, VFR2, and IFR1 based on the list of improvements.
- The Technical Center compared the Port of Portland's 4 years of runway use data (1990-1993), presented at the May 1995 meeting, to the 10 years of runway use data (1979-1988) summarized above. For all weather conditions, both sets of data showed the East Flow usage was 52.3% and the West Flow usage was 47.7%. At the July 1995 meeting, the Design Team agreed to use the above values, *Operational Procedures and Runway Utilization Simulated*, for the SIMMOD annualizations**.**

RUNWAY EXIT DATA -- 1996 STUDY (WITH 2000 CLASSES)   Accepted by PDX Team on 10/12/00
(UPDATED 8/11/00)

Note: ***At the July 20th meeting, the Design Team agreed to use the 1996 exit data for this study. The tables were updated to reflect the changes in the aircraft class definitions.***

<u>Runway 10R -- 1996 PDX STUDY (With 2000 Classes)</u>

Exit / Distance	E 4600'	---	B5/F 6900'*	B6/C6 8500'	TOTAL	
Heavy Usage			70%	30%	100%	Adjusted by
ROT			53	64	56 sec	Tower & FAATC 12/94
757 Usage	17%		81%	2%	100%	
ROT	40		53	64	51 sec	
Large Jet Usage	17%		81%	2%	100%	
ROT	40		53	64	51 sec	
LTP Usage	41%		54%	5%	100%	LTP treated
ROT	40		55	57	49 sec	as Medium in 1996 Study
Small+ Usage	41%		54%	5%	100%	Small+ treated
ROT	40		55	57	49 sec	as Medium in 1996 Study
Small Usage	93%		7%		100%	
ROT	47		60		48 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
Exits B3/B4 have been added about 5,600' from the 10R threshold.
Most of the 2000 data collection had a key taxiway closed that affected exit usage.
At the July 2000 meeting, the Design Team agreed to use the 1996 exit data for this study.

<u>Runway 10L -- 1996 PDX STUDY (With 2000 Classes)</u>

Exit / Distance	A5 3400'rhs	A4 4200'	A2/A3 5900'*	A1/END 8000'	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			51	65	54 sec	
757 Usage	5%	5%	74%	16%	100%	
ROT	37	37	51	65	52 sec	
Large Jet Usage	5%	5%	74%	16%	100%	
ROT	37	37	51	65	52 sec	
LTP Usage	28%	50%	22%		100%	LTP treated
ROT	37	42	58		44 sec	as Medium in 1996 Study
Small+ Usage	28%	50%	22%		100%	Small+ treated
ROT	37	42	58		44 sec	as Medium in 1996 Study
Small Usage	16%	84%			100%	
ROT	42	47			46 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.

Legend:
% - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

Runway 28R -- 1996 PDX STUDY (With 2000 Classes)

Exit Distance	A2/A3 2100’	A4 3800’	A5 4600’hs	A6 5900’hs	A7/END 8000	TOTAL	
Heavy Usage				80%	20%	100%	
ROT				44	63	48 sec	
757 Usage		1%	21%	60%	18%	100%	
ROT		35	39	44	63	46 sec	
Large Jet Usage		1%	21%	60%	18%	100%	
ROT		35	39	44	63	46 sec	
LTP Usage		27%	64%	9%		100%	LTP treated
ROT		37	41	50		41 sec	as Medium in 1996 Study
Small+ Usage		27%	64%	9%		100%	Small+ treated
ROT		37	41	50		41 sec	as Medium in 1996 Study
Small Usage	5%	84%	11%			100%	
ROT	24	43	42			42 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
ADSIM links for the 28R exits are 311 through 315. 1/11/01--FAATC.
For the NEW RUNWAY, ADSIM will use 28R occupancy times and probabilities. 1/11/01-- FAATC.
ADSIM links for the NEW RUNWAY exits are 331 through 335. 1/11/01--FAATC.

Runway 28L -- 1996 PDX STUDY (With 2000 Classes)

Exit Distance	B6/C6 2500’	B5/F 4100’*	CE/E 6400’	B2 8500’	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			57	61	58 sec	
757 Usage		18%	80%	2%	100%	
ROT		39	49	61	47 sec	
Large Jet Usage		18%	80%	2%	100%	
ROT		39	49	61	47 sec	
LTP Usage	18%	78%	4%		100%	LTP treated
ROT	31	40	60		39 sec	as Medium in 1996 Study
Small+ Usage	18%	78%	4%		100%	Small+ treated
ROT	31	40	60		39 sec	as Medium in 1996 Study
Small Usage	12%	80%	8%		100%	
ROT	34	42	48		42 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
Exits B3/B4 have been added about 5,400' from the 28L threshold.
Most of the 2000 data collection had a key taxiway closed that affected exit usage.
At the July 2000 meeting, the Design Team agreed to use the 1996 exit data for this study.
ADSIM links for the 28L exits are 321 through 324. 1/11/01--FAATC.

Runway 3 -- Runway 2 in 1996 PDX STUDY (With 2000 Classes)

Exit Distance	E4 2200’	C/CE 3100’	B 4400’	M 4800’hs	TOTAL	
LTP Usage			50%	50%	100%	LTP treated
ROT			45	47	46 sec	as Medium in 1996 Study
Small+ Usage			50%	50%	100%	Small+ treated
ROT			45	47	46 sec	as Medium in 1996 Study
Small Usage	75%	25%			100%	
ROT	34	43			36 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by FAATC.

APPENDIX B

ACCEPTED RESULTS

PDX DEMAND LEVELS:

Demand Level	Annual Ops	Daily Operations (in all weather conditions) ARR	DEP	TOTAL
1999	322,000	503	503	1,006
Future 1	484,000	756	756	1,512
Future 2	620,000	969	969	1,938

NOTE: Simulated 320 Equivalent Days.

PDX CALIBRATION (Do-Nothing) CONFIGURATIONS:

CON-1 (WEST) VFR1:	2 ARR/2 DEP	A = **28R, 28L**	D = 28R, **28L**	Independent Arrival Streams
CON-1 (WEST) VFR2:	2 ARR/2 DEP	A = **28R, 28L**	D = 28R, **28L**	Independent Arrival Streams
CON-1 (WEST) IFR1:	1 ARR/2 DEP	A = **28R, 28L**	D = 28R, **28L**	Staggered Approaches
CON-2 (EAST) VFR1:	2 ARR/2 DEP	A = **10R, 10L**	D = 10R, **10L**	Independent Arrival Streams
CON-2 (EAST) VFR2:	2 ARR/2 DEP	A = **10R, 10L**	D = 10R, **10L**	Independent Arrival Streams
CON-2 (EAST) IFR1:	1 ARR/2 DEP	A = **10R, 10L**	D = 10R, **10L**	Staggered Approaches

NOTE: Departure Push was not needed at the 1999 demand. Departure Push was used at the Future demands.

The following table shows the use of Runway 28R in VFR1 for each demand level. At the 1999 demand, 46% of the *arrivals* used 28R (and 54% used 28L) and 36% of the *departures* used 28R (and 64% used 28L). As demand increased, more arrivals used 28R to reduce arrival or departure delay. At Future 2, 55% of the arrivals used 28R.

	VFR1 West Flow Arrivals on 28R	Departures on 28R
1999 Demand	46 %	36 %
Future 1	52 %	39 %
Future 2	55 %	38 %

(0) CALIBRATION (Do-Nothing)

	ARR Delay Total	**(Avg)**	**DEP Delay Total**	**(Avg)**	**ARR+DEP Delay Total**	**(Avg)**
1999 Demand -- West Flow						
101G -- VFR1	284	(0.6)	917	(1.8)	1,201	(1.2)
102F -- VFR2	474	(0.9)	1,188	(2.4)	1,662	(1.7)
103F -- IFR1	794	(1.6)	1,486	(3.0)	2,280	(2.3)
Future 1 Demand -- West Flow						
301D – VFR1	1,058	(1.4)	6,977	(9.2)	8,035	(5.3)
302D -- VFR2	2,087	(2.8)	8,924	(11.8)	11,011	(7.3)
303E -- IFR1	6,626	(8.8)	11,719	(15.5)	18,345	(12.1)
Future 2 Demand -- West Flow						
501D -- VFR1	6,142	(6.3)	66,929	(69.1)	73,071	(37.7)
502D -- VFR2	16,362	(16.9)	73,612	(76.0)	89,974	(46.4)
503C -- IFR1	56,836	(58.7)	70,093	(72.3)	126,929	(65.5)

(A) ALL TURBOS & BIZ JETS CAN DIVERGE

Configurations and runway use were the same as (0) Calibration.

	ARR Delay Total	ARR Delay (Avg)	DEP Delay Total	DEP Delay (Avg)	ARR+DEP Delay Total	ARR+DEP Delay (Avg)
1999 Demand -- West Flow						
111B -- VFR1	285	(0.6)	673	(1.3)	958	(1.0)
112B -- VFR2	483	(1.0)	868	(1.7)	1,351	(1.3)
113B -- IFR1	763	(1.5)	1,319	(2.6)	2,082	(2.1)
Future 1 Demand -- West Flow						
311A – VFR1	982	(1.3)	3,887	(5.1)	4,869	(3.2)
312A -- VFR2	1,993	(2.6)	5,899	(7.8)	7,892	(5.2)
313A -- IFR1	6,343	(8.4)	8,812	(11.7)	15,155	(10.0)
Future 2 Demand -- West Flow						
511B -- VFR1	5,004	(5.2)	20,844	(21.5)	25,848	(13.3)
512B -- VFR2	14,549	(15.0)	25,637	(26.5)	40,186	(20.7)
513A -- IFR1	56,423	(58.2)	28,494	(29.4)	84,917	(43.8)

(B) ALL AIRCAFT CAN DIVERGE

Configurations and runway use were the same as (0) Calibration.

	ARR Delay Total	ARR Delay (Avg)	DEP Delay Total	DEP Delay (Avg)	ARR+DEP Delay Total	ARR+DEP Delay (Avg)
1999 Demand -- West Flow						
121B -- VFR1	285	(0.6)	641	(1.3)	926	(0.9)
122B -- VFR2	472	(0.9)	873	(1.7)	1,345	(1.3)
=113B -- IFR1	RESULTS = (A) TURBOS TURN					
Future 1 Demand -- West Flow						
321A – VFR1	988	(1.3)	3,266	(4.3)	4,254	(2.8)
322A -- VFR2	1,996	(2.6)	4,811	(6.4)	6,807	(4.5)
=313A -- IFR1	RESULTS = (A) TURBOS TURN					
Future 2 Demand -- West Flow						
521A -- VFR1	4,822	(5.0)	14,274	(14.7)	19,096	(9.9)
522A -- VFR2	14,019	(14.5)	17,807	(18.4)	31,826	(16.4)
=513A -- IFR1	RESULTS = (A) TURBOS TURN					

(C1+B) NORTH/SOUTH TAXIWAY & ALL AIRCRAFT CAN DIVERGE
(No Departure Noise Restrictions for Any Aircraft)
Staggered Approaches to Existing Parallel Runways in IFR1

Configurations and runway use were the same as (0) Calibration.

	ARR Delay Total	ARR Delay (Avg)	DEP Delay Total	DEP Delay (Avg)	ARR+DEP Delay Total	ARR+DEP Delay (Avg)
Future 1 Demand -- West Flow						
331B – VFR1	933	(1.2)	2,285	(3.0)	3,218	(2.1)
332B -- VFR2	1,813	(2.4)	3,306	(4.4)	5,119	(3.4)
333D -- IFR1	5,695	(7.5)	6,166	(8.2)	11,861	(7.8)
Future 2 Demand -- West Flow						
531C -- VFR1	3,321	(3.4)	7,438	(7.7)	10,759	(5.6)
532C -- VFR2	10,576	(10.9)	10,191	(10.5)	20,767	(10.7)
533A -- IFR1	47,270	(48.8)	14,833	(15.3)	62,103	(32.0)

(C2+B) NORTH/SOUTH TAXIWAY & ALL AIRCRAFT CAN DIVERGE
(No Departure Noise Restrictions for Any Aircraft)
Independent Approaches to Existing Parallel Runways in IFR1

Configurations and runway use were the same as (0) Calibration.

	ARR Delay Total	ARR Delay (Avg)	DEP Delay Total	DEP Delay (Avg)	ARR+DEP Delay Total	ARR+DEP Delay (Avg)
Future 1 Demand -- West Flow						
VFR 1 = VFR1 Delays for Pkg (C1+B) N/S Taxiway & All Aircraft Can Diverge & *Staggered Approaches in IFR1*						
VFR 2 = VFR2 Delays for Pkg (C1+B) N/S Taxiway & All Aircraft Can Diverge & *Staggered Approaches in IFR1*						
343A -- IFR1	2,002	(2.6)	4,679	(6.2)	6,681	(4.4)
Future 2 Demand -- West Flow						
VFR 1 = VFR1 Delays for Pkg (C1+B) N/S Taxiway & All Aircraft Can Diverge & *Staggered Approaches in IFR1*						
VFR 2 = VFR2 Delays for Pkg (C1+B) N/S Taxiway & All Aircraft Can Diverge & *Staggered Approaches in IFR1*						
543A -- IFR1	14,035	(14.5)	14,122	(14.6)	28,157	(14.5)

PDX (D+C1+B) New Runway & N/S Taxiway & No Noise Restrictions -- West Flow CONFIGURATIONS:

CON-1 (WEST) VFR1:	3 ARR/2 DEP	A = **28R,** 28L**, 28X**	D = 28R, **28L**	Independent Arrival Streams
CON-1 (WEST) VFR2:	3 ARR/2 DEP	A = **28R,** 28L**, 28X**	D = 28R, **28L**	Independent Arrival Streams
CON-1 (WEST) IFR1:	3 ARR/2 DEP	A = **28R,** 28L**, 28X**	D = 28R, **28L**	Indep. Arrivals to Outboards

NOTE: Departure Push was used at the Future demands.
Runway 28L was used for arrivals from Midnight to 6am. Cargo Box-Haulers arrived on 28L.
During the day, a few arrivals were placed on 28L to reduce arrival delay on 28R.
During the late afternoon arrival push, a few arrivals were placed on 28L to reduce arrival delay on 28X.
IFR1: Independent Arrivals to Outboards; Staggers to 28R & 28L; and Staggers to 28X and 28L.

(D+C1+B) NEW RUNWAY & N/S TAXIWAY & ALL AIRCRAFT CAN DIVERGE
(No Departure Noise Restrictions for Any Aircraft)

	ARR Delay		**DEP Delay**		**ARR+DEP Delay**	
	Total	**(Avg)**	**Total**	**(Avg)**	**Total**	**(Avg)**
Future 1 Demand -- West Flow						
351B – VFR1	742	(1.0)	1,677	(2.2)	2,419	(1.6)
352B -- VFR2	1,449	(1.9)	2,303	(3.0)	3,752	(2.5)
353B -- IFR1	1,673	(2.2)	2,853	(3.8)	4,526	(3.0)
Future 2 Demand -- West Flow						
551C -- VFR1	2,015	(2.1)	4,994	(5.2)	7,009	(3.6)
552C -- VFR2	4,845	(5.0)	6,882	(7.1)	11,727	(6.1)
553C -- IFR1	7,230	(7.5)	8,576	(8.9)	15,806	(8.2)

Arrival Delays: The above table shows the Total and Average Arrival Air Delays in Minutes.

Departure Delays: The above table shows the Total and Average Departure Ground Delays in Minutes. In addition to the runway delays, it includes taxi-out and gate-hold delays because the taxi-out and gate-hold delays are associated with departure queues. **The *short-form* of ADSIM has an abbreviated taxi-structure and produces taxi-out queuing delays.**

Note: **The 1999 calibration was simulated with an arrival priority. A departure push was not implemented at that demand because PDX seldom implements a departure push and testing with a departure push had little affect on the results.**

A departure push was implemented at Future demand levels in order to reduce departure delay. During a departure push, spacing between arrivals was increased to 4 NM (1.8 minutes) to allow an aircraft to depart between successive arrivals.

APPENDIX C

ANNUAL DELAY CALCULATIONS

PDX - Annual Delay Costs (East Flow Delays = West Flow Delays)

(0) PDX CALIBRATION (Base-Case--Do-Nothing) --1999 DEMAND 04-30-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
101	WEST	VFR1	1,201	320	0.391	60	2,504		
102	WEST	VFR2	1,662	320	0.050	60	443		
103	WEST	IFR-1	2,280	320	0.036	60	438		
=101	EAST	VFR1	1,201	320	0.353	60	2,261		
=102	EAST	VFR2	1,662	320	0.092	60	815		
=103	EAST	IFR-1	2,280	320	0.078	60	948		
					1.000		**7,409**	**Hours**	**$12.3 MILLION (East = West)**
									1.4 minutes -- avg delay per op

(0) PDX CALIBRATION (Base-Case--Do-Nothing) -- FUTURE 1 04-30-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
301	WEST	VFR1	8,035	320	0.391	60	16,756		
302	WEST	VFR2	11,011	320	0.050	60	2,936		
303	WEST	IFR-1	18,345	320	0.036	60	3,522		
=301	EAST	VFR1	8,035	320	0.353	60	15,127		
=302	EAST	VFR2	11,011	320	0.092	60	5,403		
=303	EAST	IFR-1	18,345	320	0.078	60	7,632		
					1.000		**51,376**	**Hours**	**$85.3 MILLION (East = West)**
									6.4 minutes -- avg delay per op

(0) PDX CALIBRATION (Base-Case--Do-Nothing) -- FUTURE 2 04-30-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
501	WEST	VFR1	73,071	320	0.391	60	152,377		
502	WEST	VFR2	89,974	320	0.050	60	23,993		
503	WEST	IFR-1	126,929	320	0.036	60	24,370		
=501	EAST	VFR1	73,071	320	0.353	60	137,568		
=502	EAST	VFR2	89,974	320	0.092	60	44,147		
=503	EAST	IFR-1	126,929	320	0.078	60	52,802		
					1.000		**435,257**	**Hours**	**$722.5 MILLION (East = West)**
									42.1 Minutes -- avg delay per op

(A) ALL TURBOS AND BIZ JETS CAN DIVERGE -- 1999 DEMAND 06-01-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS	
111	WEST	VFR1	958	320	0.391	60	1,998	
112	WEST	VFR2	1,351	320	0.050	60	360	
113	WEST	IFR-1	2,082	320	0.036	60	400	
=111	EAST	VFR1	958	320	0.353	60	1,804	
=112	EAST	VFR2	1,351	320	0.092	60	663	
=113	EAST	IFR-1	2,082	320	0.078	60	866	
					1.000		6,091 Hours	**$10.1 MILLION (East = West)**
								1.1 Minutes -- avg delay per op

(A) ALL TURBOS AND BIZ JETS CAN DIVERGE -- FUTURE 1 06-01-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS	
311	WEST	VFR1	4,869	320	0.391	60	10,153	
312	WEST	VFR2	7,892	320	0.050	60	2,105	
313	WEST	IFR-1	15,155	320	0.036	60	2,910	
=311	EAST	VFR1	4,869	320	0.353	60	9,167	
=312	EAST	VFR2	7,892	320	0.092	60	3,872	
=313	EAST	IFR-1	15,155	320	0.078	60	6,304	
					1.000		34,511 Hours	**$57.3** MILLION (East = West)
								4.3 Minutes -- avg delay per op

(A) ALL TURBOS AND BIZ JETS CAN DIVERGE -- FUTURE 2 08-09-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS	
511	WEST	VFR1	25,848	320	0.391	60	53,902	
512	WEST	VFR2	40,186	320	0.050	60	10,716	
513	WEST	IFR-1	84,917	320	0.036	60	16,304	
=511	EAST	VFR1	25,848	320	0.353	60	48,663	
=512	EAST	VFR2	40,186	320	0.092	60	19,718	
=513	EAST	IFR-1	84,917	320	0.078	60	35,325	
					1.000		184,628 Hours	**$306.5 MILLION (East = West)**
								17.9 minutes -- avg delay per op

(B) ALL AIRCRAFT CAN DIVERGE -- 1999 DEMAND **06-01-01**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
121	WEST	VFR1	926	320	0.391	60	1,931		
122	WEST	VFR2	1,345	320	0.050	60	359		
=113	WEST	IFR-1	2,082	320	0.036	60	400		***IF IFR RESULTS = TURBOS TURN***
=121	EAST	VFR1	926	320	0.353	60	1,743		
=122	EAST	VFR2	1,345	320	0.092	60	660		
=113	EAST	IFR-1	2,082	320	0.078	60	866		***IF IFR RESULTS = TURBOS TURN***
					1.000		5,959	Hours	**$9.9 MILLION (East = West)**
									1.1 minutes -- avg delay per op

(B) ALL AIRCRAFT CAN DIVERGE -- FUTURE 1 **06-01-01 check numbers**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
321	WEST	VFR1	4,254	320	0.391	60	8,871		
322	WEST	VFR2	6,807	320	0.050	60	1,815		
=313	WEST	IFR-1	15,155	320	0.036	60	2,910		***IF IFR RESULTS = TURBOS TURN***
=321	EAST	VFR1	4,254	320	0.353	60	8,009		
=322	EAST	VFR2	6,807	320	0.092	60	3,340		
=313	EAST	IFR-1	15,155	320	0.078	60	6,304		***IF IFR RESULTS = TURBOS TURN***
					1.000		31,249	Hours	**$51.9** MILLION (East = West)
									3.9 minutes -- avg delay per op

(B) ALL AIRCRAFT CAN DIVERGE -- FUTURE 2 **07-30-01**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
521	WEST	VFR1	19,096	320	0.391	60	39,822		
522	WEST	VFR2	31,826	320	0.050	60	8,487		
=513	WEST	IFR-1	84,917	320	0.036	60	16,304		***IF IFR RESULTS = TURBOS TURN***
=521	EAST	VFR1	19,096	320	0.353	60	35,951		
=522	EAST	VFR2	31,826	320	0.092	60	15,616		
=513	EAST	IFR-1	84,917	320	0.078	60	35,325		***IF IFR RESULTS = TURBOS TURN***
					1.000		151,505	Hours	**$251.5 MILLION (East = West)**
									14.7 minutes -- avg delay per op

(C1+B) N/S TAXIWAY (Staggered IFR1 Approaches) -- 1999 DEMAND **08-01-01** **NOT SIMULATED AT THIS DEMAND**

(C1+B) N/S TAXIWAY (Staggered IFR1 Approaches) -- FUTURE 1 **08-01-01**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
331	WEST	VFR1	3,218	320	0.391	60	6,711		
332	WEST	VFR2	5,119	320	0.050	60	1,365		
333	WEST	IFR-1	11,861	320	0.036	60	2,277		***Staggered IFR1 Approaches***
=331	EAST	VFR1	3,218	320	0.353	60	6,058		
=332	EAST	VFR2	5,119	320	0.092	60	2,512		
=333	EAST	IFR-1	11,861	320	0.078	60	4,934		***Staggered IFR1 Approaches***
					1.000		23,857	Hours	**$39.6 MILLION (East = West)**
									3.0 minutes -- avg delay per op

(C1+B) N/S TAXIWAY (Staggered IFR1 Approaches) -- FUTURE 2 **08-01-01**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
531	WEST	VFR1	10,759	320	0.391	60	22,436		
532	WEST	VFR2	20,767	320	0.050	60	5,538		
533	WEST	IFR-1	62,103	320	0.036	60	11,924		***Staggered IFR1 Approaches***
=531	EAST	VFR1	10,759	320	0.353	60	20,256		
=532	EAST	VFR2	20,767	320	0.092	60	10,190		
=533	EAST	IFR-1	62,103	320	0.078	60	25,835		***Staggered IFR1 Approaches***
					1.000		96,179	Hours	**$159.7 MILLION (East = West)**
									9.3 minutes -- avg delay per op

(C2+B) N/S TAXIWAY (Indep IFR1 Approaches) -- 1999 DEMAND **08-01-01** **NOT SIMULATED AT THIS DEMAND**

(C2+B) N/S TAXIWAY (Indep IFR1 Approaches) -- FUTURE 1 **08-01-01**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
=331	WEST	VFR1	3,218	320	0.391	60	6,711		
=332	WEST	VFR2	5,119	320	0.050	60	1,365		
343	WEST	IFR-1	6,681	320	0.036	60	1,283		***Indep IFR1 Approaches***
=331	EAST	VFR1	3,218	320	0.353	60	6,058		
=332	EAST	VFR2	5,119	320	0.092	60	2,512		
=343	EAST	IFR-1	6,681	320	0.078	60	2,779		***Indep IFR1 Approaches***
					1.000		20,708	Hours	**$34.4 MILLION (East = West)**
									2.6 minutes -- avg delay per op

(C2+B) N/S TAXIWAY (Indep IFR1 Approaches) -- FUTURE 2 **08-01-01**

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
=531	WEST	VFR1	10,759	320	0.391	60	22,436		
=532	WEST	VFR2	20,767	320	0.050	60	5,538		
543	WEST	IFR-1	28,157	320	0.036	60	5,406		***Indep IFR1 Approaches***
=531	EAST	VFR1	10,759	320	0.353	60	20,256		
=532	EAST	VFR2	20,767	320	0.092	60	10,190		
=543	EAST	IFR-1	28,157	320	0.078	60	11,713		***Indep IFR1 Approaches***
					1.000		75,539	Hours	**$125.4 MILLION (East = West)**
									7.3 minutes -- avg delay per op

(D+C1+B) NEW RUNWAY (N/S Twy & All Aircraft Can Diverge)--1999 Demand 08-03-01 **NOT SIMULATED AT THIS DEMAND**

(D+C1+B) NEW RUNWAY (N/S Twy & All Aircraft Can Diverge)--FUTURE 1 08-03-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
351	WEST	VFR1	2,419	320	0.391	60	5,044		
352	WEST	VFR2	3,752	320	0.050	60	1,001		
353	WEST	IFR-1	4,526	320	0.036	60	869		
=351	EAST	VFR1	2,419	320	0.353	60	4,554		
=352	EAST	VFR2	3,752	320	0.092	60	1,841		
=353	EAST	IFR-1	4,526	320	0.078	60	1,883		
					1.000		15,192	Hours	**$25.2 MILLION (East = West)**
									1.9 minutes -- avg delay per op

(D+C1+B) NEW RUNWAY (N/S Twy & All Aircraft Can Diverge)--FUTURE 2 08-03-01

EXPERIMENTS			DELAY MIN PER DAY	* EQUIV DAYS	* ANNUAL USE	/ MINUTES PER HR	= ANNUAL DELAY COSTS		
551	WEST	VFR1	7,009	320	0.391	60	14,616		
552	WEST	VFR2	11,727	320	0.050	60	3,127		
553	WEST	IFR-1	15,806	320	0.036	60	3,035		
=551	EAST	VFR1	7,009	320	0.353	60	13,196		
=552	EAST	VFR2	11,727	320	0.092	60	5,754		
=553	EAST	IFR-1	15,806	320	0.078	60	6,575		
					1.000		46,303	Hours	**$76.9 MILLION (East = West)**
									4.5 minutes -- avg delay per op

APPENDIX D

FLEET MIX COST CALCULATIONS

PDX - Aircraft Operating Costs
(1st Quarter 2000 Costs unless Noted Otherwise)

Updated 4/30/01

1999 Demand Level and Year 2000 Dollars

CLASS	NUMBER OF COMPUTED A/C	RATIO	COST/HOUR EACH A/C	AVERAGE COST/MIN	WEIGHTED COST PER HOUR	NOTES
HEAVY OAG	29	0.029	$4,486	$74.76	$130.08	
HEAVY CARGO	18	0.018	$5,430	$90.50	$97.74	
757 OAG	46	0.046	$2,386	$39.77	$109.76	
757 CARGO	6	0.006	$4,081	$68.02	$24.49	
LARGE non-Military	446	0.443	$2,094	$34.90	$927.64	
LARGE Military	20	0.020	$1,891	$31.52	$37.82	
LTP OAG & Military	177	0.176	$1,079	$17.98	$189.90	
SMALL+ OAG & CARGO	100	0.099	$962	$16.03	$95.24	
SMALL+ GA	48	0.048	$502	$8.37	$24.10	
SMALL CARGO	44	0.044	$441	$7.35	$19.40	
SMALL GA & Military	72	0.072	$57	$0.95	$4.10	
totals	1006	1.001			$1,660.27	
			Fleet Mix Cost Per Hour:		**$1,660.00**	
			Fleet Mix Cost Per Minute:		**$27.67**	

COST OF PDX 1999 FLEET MIX IN 2000 DOLLARS = $ 1,660 PER HOUR

NOTE:

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The Technical Center used the cost for each airline and aircraft type at PDX.

Form 41 Filings: The direct operating costs are based on: flight crew salaries and other expenses, depreciation, leases, insurance, maintenance, fuels, and oils. **They do not include indirect operating costs:** passenger service and insurance, ticketing, commissions, ground equipment, station costs, cabin crew salaries and other expenses, landing fees, navigation charges, lost passenger time, disruption to airline schedules, or any other intangible factors.

GA Costs: The direct operating costs are based on: purchase price, maintenance cost, and operating cost. **They do not include indirect operating costs:** pilot salaries, passenger service and insurance, ground equipment, station costs, other expenses, landing fees, navigation charges, lost passenger time, disruption to airline schedules, or any other intangible factors.

HEAVY - OAG

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
	763	D1/DL	2	DL	$3,258	$6,516	
DC-10	D10	HA	2	INDUSTRY	$5,541	$11,082	Avg. cost for DC-10-10/30/40
L1011	L10	D1/DL	2	DL	$4,187	$8,374	Delta cost for L1011-500
MD11	M11	D1/DL	12	DL	$4,564	$54,768	
totals			18			$80,740	

Average Aircraft Cost Per Hour : $4,486

HEAVY - CARGO

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
B747 FREIGHTER	74F	1N	1	5X/UPS	$6,218	$6,218	1999 avg. cost for 747-100/200/300
B767 FREIGHTER	B76F	C3/1F	4	5X/UPS	$3,633	$14,532	1999 B767-300 cargo cost used
DC-8 FREIGHTER	D8F	C2/UPS	4	5X/UPS	$5,755	$23,020	1999 avg. cost for DC-8-71/73
DC-8 FREIGHTER	D8F	C3/EB	2	EMERY	$7,654	$15,308	1999 cost for DC-8-73
DC-8 FREIGHTER	D8F	C3/8W	2	5X/UPS	$5,755	$11,510	
totals			13			$70,588	

Average Aircraft Cost Per Hour : $5,430

757 - OAG

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
B-757-200	757	DL	16	DL	$2,318	$37,088	
B-757-200	757	UA	4	UA	$2,660	$10,640	
totals			20			$47,728	

Average Aircraft Cost Per Hour : $2,386

757 - CARGO

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
B757 FREIGHTER	75F	5X/C2	6	5X/UPS	$4,081	$24,486	1999--4th quarter cargo cost
totals			6			$24,486	

Average Aircraft Cost Per Hour : $4,081

LARGE - OAG & CARGO

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
AIRBUS-319	319	UA	2	INDUSTRY	$2,058	$4,116	
AIRBUS-320	320	NW	6	NW	$2,153	$12,918	
AIRBUS-320	320	UA	4	UA	$3,202	$12,808	A320-200 cost used
B-727-200	72S	DL	18	DL	$2,227	$40,086	A320-200 cost used
B-727-200	72S	UA	4	UA	$2,937	$11,748	
B-727 FREIGHTER	72F	1K	1	5X/UPS	$5,331	$5,331	1999--avg. of B727-100 & 200
B-737-200	73S	HP	4	HP	$2,673	$10,692	
B-737-300	733	CO	2	CO	$1,712	$3,424	B737-300/700 cost used
B-737-300	733	HP	8	HP	$2,301	$18,408	B737-300/700 cost used
B-737-300	733	UA	30	UA	$2,524	$75,720	B737-300/700 cost used
B-737-300	733	WN	50	WN	$1,606	$80,300	B737-300/700 cost used
B-737-400	734	AS	40	AS	$2,082	$83,280	
B-737-500	735	CO	1	CO	$2,159	$2,159	
B-737-500	735	UA	18	UA	$2,207	$39,726	
B-737-500	735	WN	10	WN	$1,585	$15,850	
B-737-700	73G	CO	2	CO	$1,712	$3,424	B737-300/700 cost used
B-737-700	73G	WN	2	WN	$1,606	$3,212	B737-300/700 cost used
DC9-FREIGHTER	D9F	1K	1	EVERGREEN	$3,146	$3,146	1999--Avg. cost for DC-9-15/30
DC9-FREIGHTER	D9F	C1/DHL	2	EVERGREEN	$3,146	$6,292	1999--Avg. cost for DC-9-15/30
FOKKER-28	F28	HZ	60	QX	$1,863	$111,780	
MD-80	M80	AA	6	AA	$2,163	$12,978	
MD-80	M80	AS	58	AS	$2,280	$132,240	
MD-80	M80	QQ	2	INDUSTRY	$2,285	$4,570	
MD-80	M80	TW	6	TW	$2,485	$14,910	
MD-87	M87	QQ	6	INDUSTRY	$1,820	$10,920	
MD90	M90	QQ	2	INDUSTRY	$2,736	$5,472	
CARJ	CRJ	DL	4	INDUSTRY	$1,290	$5,160	Avg. cost for CRJ-100/200 used
totals			349			$730,670	

Average Aircraft Cost Per Hour : $2,094

LARGE - Military

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
DC-9-30	DC9-30	MI	20	INDUSTRY	$1,891	$37,820	Avg. cost for DC-9-10/30/40/50
totals			20			$37,820	

Average Aircraft Cost Per Hour : $1,891

LTP - OAG

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
DASH-8	DH8	CP/CX	6	INDUSTRY	$1,079	$6,474	Cost for Dash8-100 used
DASH-8	DH8	QX	130	QX	$1,079	$140,270	Cost for Dash8-100 used
DASH-8	DH8	ZX	10	INDUSTRY	$1,079	$10,790	Cost for Dash8-100 used
totals			146			$157,534	

Average Aircraft Cost Per Hour : $1,079

SMALL+ - OAG & CARGO

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
EMBRAER 120	EM2	UA/UX	78	INDUSTRY	$1,047	$81,666	
BEECH 1900	BE1	UPS/B2	2	AMF	$865	$1,730	Cost from AMF at PDX on 4/4/01
BEECH 99	BE9	UPS/B2	8	AMF	$543	$4,344	Cost from AMF at PDX on 4/4/01
BEECH 1900	BE1	AMF/B4	4	AMF	$865	$3,460	Cost from AMF at PDX on 4/4/01
BEECH 99	BE9	AMF/B4	2	AMF	$543	$1,086	Cost from AMF at PDX on 4/4/01
SWEAR. METRO	SW3	AMF/B4	6	AMF	$658	$3,948	Cost from AMF at PDX on 4/4/01
totals			100			$96,234	

Average Aircraft Cost Per Hour : $962

SMALL+ - GA

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
GA Lear Jets	LJ	GA	48	AP0 & TC	$502	$24,096	PDX 1994 cost increased 18%
totals			48			$24,096	

Average Aircraft Cost Per Hour : $502

SMALL - CARGO

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
C402	CN4	UPS/B2	12	AMF	$275	$3,300	Cost from AMF at PDX on 4/4/01
C402	CN4	AMF/B4	12	AMF	$275	$3,300	Cost from AMF at PDX on 4/4/01
C208	CNN	FDX/B3	18	FEDEX	$676	$12,168	1999--FDX C208 cost used
PA31	PAH	UPS/B2	2	AMF	$318	$636	Cost from AMF at PDX on 4/4/01
totals			44			$19,404	

Average Aircraft Cost Per Hour : $441

SMALL - GA & Military

SPECIFIC TYPE USED	TYPE	AIRLINE	COUNT	SOURCE	COST	TOTAL COST/HOUR	COMMENTS
SMALL GA	LT	GA	43	AP0-110	$78	$3,354	PDX 1994 cost increased 18%
SMALL GA	SE-4	GA	29	AP0-110	$27	$783	PDX 1994 cost increased 18%
totals			72			$4,137	

Average Aircraft Cost Per Hour : $57

APPENDIX E

LIST OF ABBREVIATIONS

ADSIM	Airfield Delay Simulation Model
ALP	Airport Layout Plan
ARR	Arrival
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
A&D	Arrival and Departure
Biz Jets	Business Jets
CAT	Category -- of instrument landing system
DEP	Departure
FAA	Federal Aviation Administration
GA	General Aviation
GPS	Global Positioning System
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
LDA	Localizer Directional Aid
NM	Nautical Miles
N/S	North/South
OAG	Official Airline Guide
PDX	Portland International Airport
PRM	Precision Runway Monitor
ROT	Runway Occupancy Times
RWY	Runway
SM	Statute Miles
TWY	Taxiway
TRACON	Terminal Radar Approach Control
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions