DOT/FAA/CT-TN97/5

NEWARK INTERNATIONAL AIRPORT

Data Package Number 2

Airport Capacity Enhancement Design Team Study

April 1997

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

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Information in this document is subject to change as Design Team analysis progresses.

16. Abstract

This interim report contains technical data pertaining to the Newark International Airport Capacity Enhancement Design Team Study.

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Newark International Airport (EWR)

Data Package Number 2

Airport Capacity Enhancement
Design Team Study

April 1997

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LIST OF EXHIBITS

1. POTENTIAL IMPROVEMENTS AND AIRPORT DIAGRAM

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

- Airfield
- Facilities and Equipment
- Operations
- User and Policy

The proposals for this Design Team study require detailed analysis of runways, taxiways, and gates. The Runway Delay Simulation Model (RDSIM) and/or Airfield Delay Simulation Model (ADSIM) will be used for simulating the Newark International Airport.

Exhibit 2 presents a diagram of the existing airport.

The Experimental Design will consist of three demand levels (daily aircraft schedules). The runway configurations and traffic distributions may change for each demand level dependent upon the time frame of the runway extension efforts.

The Experimental Design normally includes runs for VFR and IFR conditions and for operations in both directions on each runway. The Design Team may decide that some of these runs can be eliminated if, for example, analysis of north and south runway operations produce nearly equivalent results. Combining improvements into logical packages may also help reduce the required experiments to a manageable number.

EXHIBIT 1 - POTENTIAL IMPROVEMENTS

AIRFIELD IMPROVEMENTS	PROPOSED MODEL

- **Civil Tilt Rotor Separate Ingress/Egress to EWR Terminal Area.**
  Separate Terminal with connection to Central Terminal.
  Flights less than _00 miles and _0 passengers.
- **Taxiway System Improvements (Exits, Queuing, Hold Blocks, etc.).**
  Additional angled exits for reduced ROTs and reduced separations.
  Off-gate holding area in addition to BALL PARK.
  Additional access to Runway 11/29 across drainage ditch.
  Alternative departure queue schemes for extended 4L/22R.
- **Separate Commuter Terminal.**
  Segregate commuter ops.

FACILITIES AND EQUIPMENT IMPROVEMENTS

- DGPS
  GPS in combination with other capabilities and procedures such as FMS.
- LDA's
  or other procedures/technology to allow parallel arrival streams during arrival peaks in less than VFR weather.
- **PRM-with offset parallel approaches below VFR.**
- **MultiLateration/Squitter/Beacon Surveillance Improvements.**
- FMA.

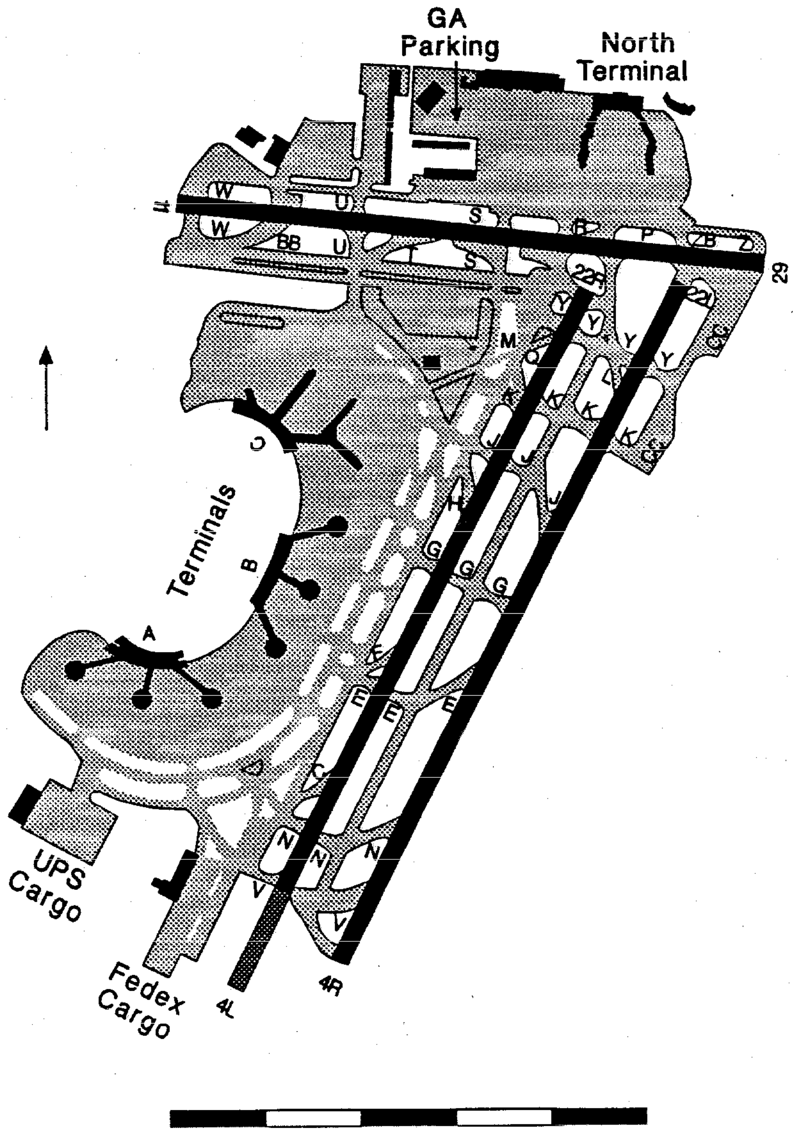
OPERATIONAL IMPROVEMENTS

- **Applications of Above Facilities (Plus: SCIA, DCIA, FMS Applications).**
- **Gate Sharing.**
- **Off-Gate Holding for Arrivals and Departures.**
- **Alternate Ground Flow and Feeds with Runway Extension.**
- **Alternate Runway Use Strategies.**
- **Arrival Push/Departure Push Strategies.**

USER OR POLICY IMPROVEMENTS

- **Minimum Size Aircraft.**
- **Effects of Fleet Mix Changes on EWR Capacity and/or Delay.**
- **Schedule or Banking Changes.**

EXHIBIT 2 - AIRPORT DIAGRAM (EWR)



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2. MODEL INPUTS

Model inputs developed for Newark consist of information regarding airfield, aircraft operational procedures, ATC procedures, aircraft traffic demand and aircraft gate assignments on the ground and in the terminal area.

Exhibit 3 defines the aircraft classifications.

Exhibit 4 depicts the runways and runway exits at the existing airport.

Exhibit 5 shows the runway exit usage and the arrival runway occupancy times (ROTs) by aircraft class. Each entry for an aircraft class in the tables is composed of three lines: the first line gives the percentage of time an aircraft of a given class used each exit, the second line contains the average arrival occupancy times for each exit, and third line contains the number of occurrences.

Exhibit 6 presents EWR Do-Nothing runway configurations.

Exhibit 7 describes Air Traffic Control (ATC) dependencies for parallel runway separations.

Exhibits 8 and 9, respectively, present the VFR and IFR aircraft separations based on FAA-EM-78-8A Report: Parameters of Future ATC Systems Relating to Airport Capacity/Delay, April 1978. The separations were modified to reflect new separation rules put into effect on August 17, 1996. The separations include:

arrival to arrival (A/A)
departure to departure (D/D)
departure to arrival (D/A)
arrival to departure (A/D)

Exhibit 10 presents a comparison of the standard VFR A/A separations and those observed during data collection.

Exhibit 11 describes miscellaneous input data such as length of common approach on final, approach speeds, and departure runway occupancy times.

Exhibit 12 describes the operational procedures and minima for the various weather categories at EWR.

Exhibit 13 presents gate service times at EWR.

Exhibit 14 depicts the arrival aircraft lateness distribution at EWR.

Exhibit 15 describes aircraft operations forecast for EWR.

Exhibit 16 presents the simulated demand characteristics.

Exhibits 17 shows the EWR airline gate assignments.

EXHIBIT 3 - AIRCRAFT CLASSIFICATIONS

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.** Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., DC9, B737, B727, MD80).
LC	= LARGE COMMUTER	**Large Commuters.** Large commuter aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., ATR-42*, DH8, DH7, SF34*).
M	= MEDIUM	**Small Commuters. Includes Business Jets.** Small commuter aircraft weighing more than 12,500 and less than 41,000 pounds (e.g., BA31, BA41, BE02, DA20, 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, BE90, C340, C441, AC21, BE20, C172, C210, DO27).

Notes:

After the last meeting, the Technical Center revised the aircraft class definitions. The new classes will enable us to define the model inputs more accurately and more clearly by distinguishing the key differences in operational characteristics. Large jets and large commuters are in separate classes because of differences in exit usage and occupancy times, their ability to land and hold short, minimum gate service times, etc. Small single and twin engine aircraft were combined because we are limited to 6 classes and EWR has very few of these aircraft.

Class names, rather than class numbers, will be used in the data packages. The following describes the new class names which will be used in the study and the class numbers used in previous documents.

HEAVY:	(old Class 1 in Data Pkg. 1)
757:	(old Class 2 in Data Pkg. 1)
LARGE JET:	(old Class 3 in Data Pkg. 1)
LARGE COMMUTER:	(old Class 3 in Data Pkg. 1)
MEDIUM:	(old Class 4 in Data Pkg. 1)
SMALL:	(old Class 5 & 6 in Data Pkg. 1)

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 "small" following a "heavy"). These definitions will be used to generate all data presented by aircraft class during this study. The Design Team must accept these values or agree to any modifications to them.

*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 LARGE COMMUTER in this study.

Weights refer to maximum certified takeoff weights.

EXHIBIT 4 - RUNWAYS AND RUNWAY EXITS (EWR)

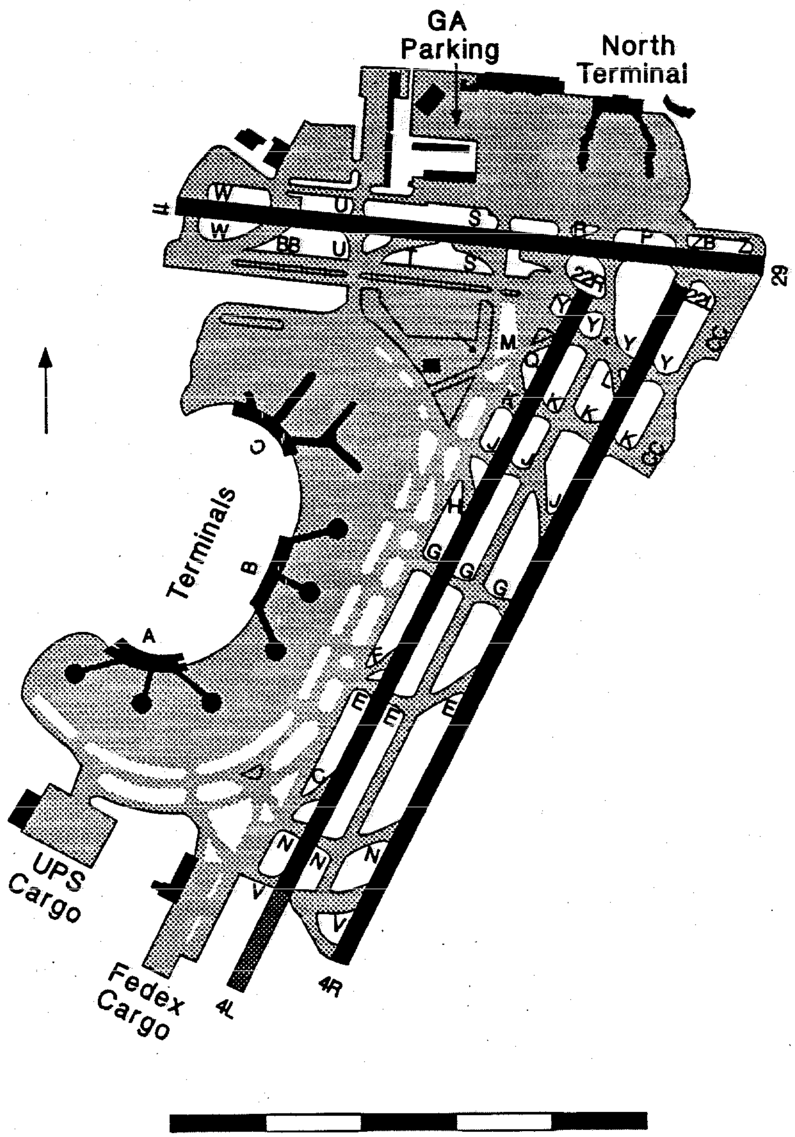

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EXHIBIT 5 - RUNWAY EXIT DATA OBSERVED

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 4R

	Exit Distance	G 3600'	J 4400' hs	K 5900'	L 6450' hs	Y 6750'	TOTAL
(H)	Utilization			42%	50%	8%	100%
	ROT			59	56	74	59 sec
	Count			5	6	1	12
(757)	Utilization		9%	56%	35%		100%
	ROT		34	60	56		56 sec
	Count		2	13	8		23
(LJ)	Utilization		17%	51%	31%	1%	100%
	ROT		33	54	52	71	50 sec
	Count		14	43	26	1	84
(LC)	Utilization	6%	69%		25%		100%
	ROT	36	35		56		40 sec
	Count	1	11		4		16
(M)	Utilization	7%	73%		20%		100%
	ROT	33	39		56		42 sec
	Count	1	11		3		15
(S)	Utilization						
	ROT						
	Count						

Runway 4L

	Exit Distance	E 1950'	G 3600'	H 4500' hs	J 5150'	K 5950'	O 5950' hs	M 6750' rhs	Y 6750'	W 7400'	TOTAL
(H)	Utilization										
	ROT										
	Count										
(757)	Utilization										
	ROT										
	Count										
(LJ)	Utilization			25%	75%						100%
	ROT			E	50						E
	Count			1	3						4
(LC)	Utilization										
	ROT										
	Count										
(M)	Utilization										
	ROT										
	Count										
(S)	Utilization										
	ROT										
	Count										

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

EXHIBIT 5 - RUNWAY EXIT DATA OBSERVED (Cont.)

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway-22R

	Exit Distance	G 3400'	F 4600' hs	E 5000'	C 6350' hs	N 6950'	V 7700'	TOTAL
(H)	Utilization							
	ROT							
	Count							
(757)	Utilization							
	ROT							
	Count							
(LJ)	Utilization	10%	20%		70%			100%
	ROT	36	40		49			46 sec
	Count	1	2		7			10
(LC)	Utilization		50%		50%			100%
	ROT		E		E			E sec
	Count		1		1			2
(M)	Utilization							
	ROT							
	Count							
(S)	Utilization							
	ROT							
	Count							

Runway 22L

	Exit Distance	G 3400'	E 4200' hs	N 6100' hs	V 7300' hs	TOTAL
(H)	Utilization			87%	13%	100%
	ROT			49	56	50 sec
	Count			13	2	15
(757)	Utilization		10%	90%		100%
	ROT		42	47		47 sec
	Count		3	28		31
(LJ)	Utilization		12%	85%	3%	100%
	ROT		34	44	53	43 sec
	Count		22	159	6	187
(LC)	Utilization	24%	56%	20%		100%
	ROT	36	32	45		36 sec
	Count	10	23	8		41
(M)	Utilization	2%	46%	52%		100%
	ROT	36	33	47		40 sec
	Count	1	20	23		44
(S)	Utilization		100%			100%
	ROT		35			35 sec
	Count		1			1

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

EXHIBIT 5 - RUNWAY EXIT DATA OBSERVED (Cont.)

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 11

	Exit Distance	U 1950'	S 3650'	R 4350'	P 4900'	ZA/ZB 5900'	Z 6600'	TOTAL
(H)	Utilization							
	ROT							
	Count							
(757)	Utilization							
	ROT							
	Count							
(LJ)	Utilization							
	ROT							
	Count							
(LC)	Utilization			100%				100%
	ROT			44				44 sec
	Count			1				1
(M)	Utilization		100%					100%
	ROT		43					43 sec
	Count		1					1
(S)	Utilization							
	ROT							
	Count							

Runway 29

	Exit Distance	R 2000'	S 2750'	T 3700' hs	U 4550'	BB 5400'	W 6400'	TOTAL
(H)	Utilization							
	ROT							
	Count							
(757)	Utilization							
	ROT							
	Count							
(LJ)	Utilization							
	ROT							
	Count							
(LC)	Utilization			100%				100%
	ROT			37				37
	Count			13				13
(M)	Utilization			100%				100%
	ROT			39				39
	Count			4				4
(S)	Utilization							
	ROT							
	Count							

Notes:

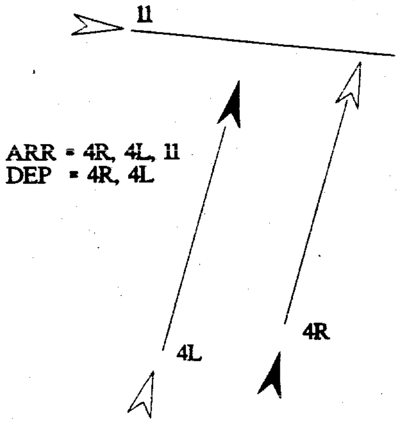
Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

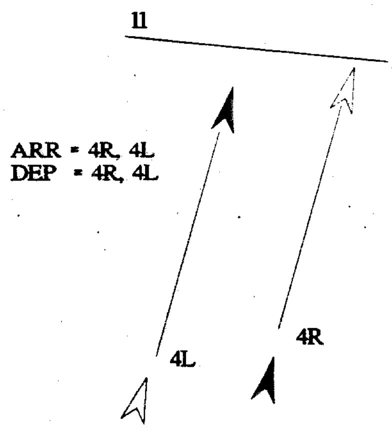
hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

EXHIBIT 6 - RUNWAY CONFIGURATIONS (EWR DO-NOTHING)

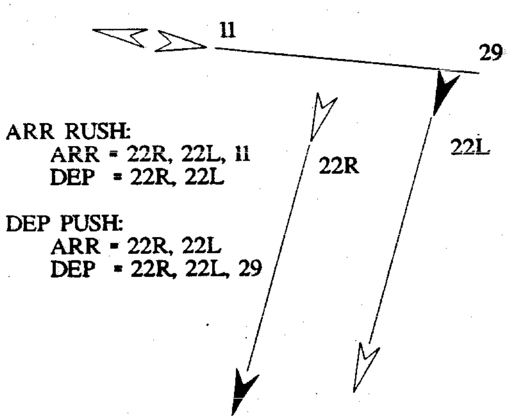
NORTH — VFR1 & VFR2



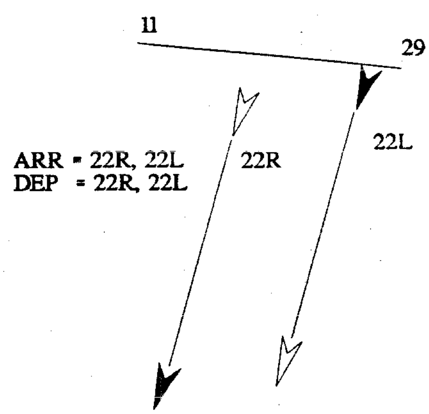
NORTH — IFR1



SOUTH — VFR1 & VFR2

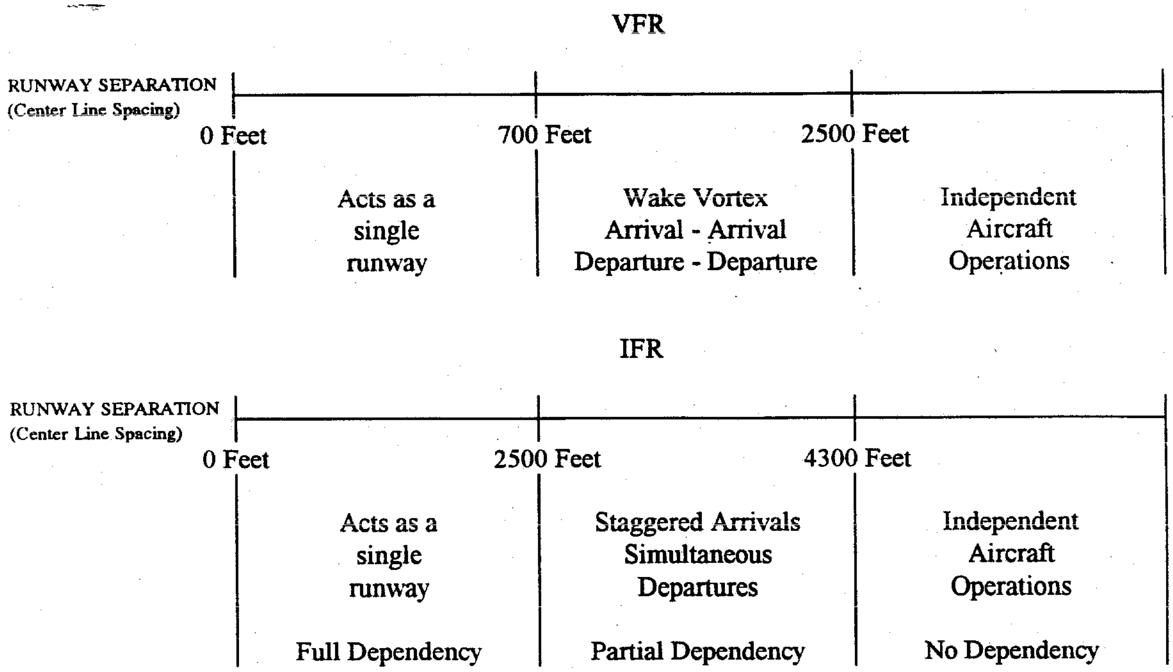


SOUTH — IFR1



= PRIMARY ARR OR DEP RUNWAY

EXHIBIT 7 - ATC DEPENDENCIES FOR PARALLEL RUNWAYS



Source: Based on the "Interpretation of Air Traffic Control Handbook" (7110.65F).

EXHIBIT 8 - STANDARD VFR SEPARATIONS (MODIFIED)

Based on Report FAA-EM-78-8A and modified to reflect new separation rules put in effect on 8/17/96.

A/A (NM)*		TRAIL A/C						
		H	757	LJ	LC	M	S	
LEAD A/C	H	3.86	4.67	4.67	4.67	5.57	5.49	
	757	3.86	4.25	4.25	4.25	4.25	4.25	(Based on PDX 1996)
	LJ	3.06	2.97	2.97	2.97	4.04	3.69	
	LC	3.06	2.97	2.97	2.97	4.04	3.69	
	M	3.06	2.97	2.97	2.97	2.97	2.89	
	S	3.06	2.97	2.97	2.97	2.97	2.89	

D/D (MIN.)		TRAIL A/C						
		H	757	LJ	LC	M	S	
LEAD A/C	H	1.50	2.00	2.00	2.00	2.00	2.00	
	757	1.50	1.50	1.50	1.50	1.50	1.50	(Based on PDX 1996)
	LJ	1.00	1.00	1.00	1.00	1.00	0.83	
	LC	1.00	1.00	1.00	1.00	1.00	0.83	
	M	1.00	1.00	1.00	1.00	1.00	0.58	
	S	0.83	0.75	0.75	0.75	0.75	0.58	

D/A (NM)		TRAIL A/C					
		H	757	LJ	LC	M	S
LEAD A/C	H	1.51	1.41	1.41	1.41	1.41	1.30
	757	1.51	1.41	1.41	1.41	1.41	1.30
	LJ	1.51	1.41	1.41	1.41	1.41	1.30
	LC	1.51	1.41	1.41	1.41	1.41	1.30
	M	1.51	1.41	1.41	1.41	1.41	1.30
	S	1.32	1.23	1.23	1.23	1.23	1.13

A/D (Min.) separations are the Runway Occupancy Times (ROTs) from Observed Field Data of December 1996.

*Values include missed approach buffer.

The A/A and D/A separations are based on the standard approach speeds 140, 130, 130, 130, 130, 120. The D/D separations are based on departure occupancy times. D/A separations are based on departure occupancy times and arrival approach speeds. Therefore, Medium (Small Commuters) have the same separations as LC (Large Commuters). The A/A separations for Medium are based on the minimum separations of a Small and the missed approach buffer for a Medium, which has an approach speed of 130 knots.

<u>Classes:</u>

H	=	Heavy
757	=	757
LJ	=	Large Jets
LC	=	Large Commuters
M	=	Small Commuters & Business Jets **(treated as Small for separations purposes)**
S	=	Small twin & single engine props

EXHIBIT 9 - STANDARD IFR SEPARATIONS (MODIFIED)

Based on Report FAA-EM-78-8A and modified to reflect new separation rules put into effect on 8/17/96.

A/A (NM)*		TRAIL A/C						
		H	757	LJ	LC	M	S	
LEAD A/C	H	5.16	6.07	6.07	6.07	7.07	6.99	
	757	5.16	5.07	5.07	5.07	6.07	5.99	(Based on PDX 1996)
	LJ	4.16	4.07	4.07	4.07	5.07	4.99	
	LC	4.16	4.07	4.07	4.07	5.07	4.99	
	M	4.16	4.07	4.07	4.07	4.07	3.99	
	S	4.16	4.07	4.07	4.07	4.07	3.99	

D/D (MIN.)		TRAIL A/C						
		H	757	LJ	LC	M	S	
LEAD A/C	H	1.50	2.00	2.00	2.00	2.00	2.00	
	757	1.50	1.50	1.50	1.50	1.50	1.50	(Based on PDX 1996)
	LJ	1.00	1.00	1.00	1.00	1.00	1.00	
	LC	1.00	1.00	1.00	1.00	1.00	1.00	
	M	1.00	1.00	1.00	1.00	1.00	1.00	
	S	1.00	1.00	1.00	1.00	1.00	1.00	

D/A (NM)		TRAIL A/C					
		H	757	LJ	LC	M	S
LEAD A/C	H	2.00	2.00	2.00	2.00	2.00	2.00
	757	2.00	2.00	2.00	2.00	2.00	2.00
	LJ	2.00	2.00	2.00	2.00	2.00	2.00
	LC	2.00	2.00	2.00	2.00	2.00	2.00
	M	2.00	2.00	2.00	2.00	2.00	2.00
	S	2.00	2.00	2.00	2.00	2.00	2.00

A/D (Min.) separations are the Runway Occupancy Times (ROTs) from Observed Field Data of December 1996.

*Values include missed approach buffer.

The A/A and D/A separations are based on the standard approach speeds 140, 130, 130, 130, 130, 120.

Classes:

H	=	Heavy
757	=	757
LJ	=	Large Jets
LC	=	Large Commuters
M	=	Small Commuters & Business Jets Jets (**treated as Small for separations purposes**)
S	=	Small twin & single engine props

EXHIBIT 10 - COMPARISON OF VFR A/A SEPARATIONS

STANDARD VS. OBSERVED -- Updated 4/7/97

LEAD/TRAIL AIRCRAFT	STANDARD SEPARATION (SEC)--AVG	OBSERVED SEPARATION (SEC)--MIDPOINT	OBSERVED SEPARATION (SEC)--AVG	DATA POINTS	
LJ - LJ	***82***	***82***	***88***	***156***	**
757 - LJ	117	104	104	29	
LJ - 757	82	90	90	28	
M - LJ	***82***	***82***	***90***	***27***	**
LJ - M	112	104	103	27	
LC - LJ	82	70	76	23	
LJ - LC	82	83	87	22	**
LJ - H	79	83	91	14	*
H - LJ	130	110	116	13	
LC - M	112	72	78	10	
LC - LC	***82***	***82***	***82***	***9***	**
757 - 757	117	109	109	9	
M - LC	82	84	93	9	**
757 - M	117	114	112	7	*
M - 757	82	86	88	7	*
M - M	82	78	74	6	*
LC - H	79	75	77	5	*
H - LC	130	117	111	5	
H - 757	130	103	122	4	
757 - LC	117	124	124	3	
LC - 757	82	100	89	3	
757 - H	99	81	109	3	
M - H	79	62	66	3	
H - M	154	149	153	3	
S - LJ	82	99	99	1	
LC - S	111	54	54	1	
H - H	99	0	0	0	
H - S	165	0	0	0	
757 - S	139	0	0	0	
LJ - S	111	0	0	0	
M - S	87	0	0	0	
S - H	79	0	0	0	
S - 757	82	0	0	0	
S - LC	82	0	0	0	
S - M	82	0	0	0	
S - S	87	0	0	0	

NOTE: ** The Midpoint of the observed separation is within 2 seconds of the standard separation.
* The Midpoint of the observed separation is within 4 seconds of the standard separation.
In most cases, the Midpoints of the observed separations are close to the standard separations.
The 757 standard separations were based on the 1996 PDX Study.

EXHIBIT 10 - COMPARISON OF VFR A/A SEPARATIONS (Cont.)

STANDARD VS. OBSERVED -- Average Separations -- Updated 4/7/97

LEAD/TRAIL AIRCRAFT	STANDARD SEPARATION (SEC)--AVG	OBSERVED SEPARATION (SEC)--MIDPOINT	OBSERVED SEPARATION (SEC)--AVG	DATA POINTS	
Heavy - H	99	0	0	0	
" - 757	130	103	122	4	
" - LJ	130	110	116	13	
" - LC	130	117	111	5	
" - M	154	149	153	3	
" - S	165	0	0	0	
757 - H	99	81	109	3	
" - 757	117	109	109	9	
" - LJ	117	104	104	29	
" - LC	117	124	124	3	
" - M	117	114	112	7	*
" - S	139	0	0	0	
LJ - H	79	83	91	14	*
" - 757	82	90	90	28	
" - LJ	*82*	*82*	*88*	*156*	**
" - LC	82	83	87	22	**
" - M	112	104	103	27	
" - S	111	0	0	0	
LC - H	79	75	77	5	*
" - 757	82	100	89	3	
" - LJ	82	70	76	23	
" - LC	*82*	*82*	*82*	*9*	**
" - M	112	72	78	10	
" - S	111	54	54	1	
M - H	79	62	66	3	
" - 757	82	86	88	7	*
" - LJ	*82*	*82*	*90*	*27*	**
" - LC	82	84	93	9	**
" - M	82	78	74	6	*
" - S	87	0	0	0	
S - H	79	0	0	0	
" - 757	82	0	0	0	
" - LJ	82	99	99	1	
" - LC	82	0	0	0	
" - M	82	0	0	0	
" - S	87	0	0	0	

NOTE: ** The Midpoint of the observed separation is within 2 seconds of the standard separation.
* The Midpoint of the observed separation is within 4 seconds of the standard separation.
In most cases, the Midpoints of the observed separations are close to the standard separations.
The 757 standard separations were based on the 1996 PDX Study.

EXHIBIT 11 - MISCELLANEOUS INPUT DATA FOR EWR

APPROACH SPEEDS (Knots):

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	H	757	LJ	LC	M	S*
Standard	Knots	140	130	130	130	130	120 or 90
EWR - 1986 Study	Knots	140	130	130	130	130	120 or 95
EWR - 1995 Study	Knots	140	130	130	120	120	95

Note (*): Standard: 120 knots for small twin props and 90 knots for single engine props.
1986 Study: 120 knots for small twin props and 95 knots for single engine props.
1995 Study: 95 knots for small twin and single engine props.

LENGTH OF FINAL COMMON APPROACH (Nautical Miles):

For the simulations, it is defined as the length of the final common approach, along which speed control *cannot* be used to separate aircraft.

	Class	H	757	LJ	LC	M	S
EWR	VFR	8	8	8	8	8	8
EWR	IFR	8	8	8	8	8	8

Source: EWR Tower, 1997.

QUESTION FOR EWR TOWER: Do all classes to all runways have final common approach lengths in VFR and IFR? Is it possible to use different approach lengths for different runways? For instance, can small GA aircraft or commuters have shorter approach lengths to Runway 11? That is, can they turn onto final less than 8 NM from Runway 11's threshold?

DEPARTURE RUNWAY OCCUPANCY TIMES (Seconds):

These are the minimum times a departure is on the runway. They are the times when the aircraft has wheels off and is 6,000' from threshold (i.e., wheels off and airborne). Runway crossing times and aircraft separations can't violate these minimums.

	Class	H	757	LJ	LC	M	S
Standard	Seconds	39	39	39	39	39	34

Source: Standard values used in most design team studies.

H = Heavy
757 = 757
LJ = Large Jet
LC = Large Commuter
M = Medium (Small Commuters & Business Jets.)
S = Small twin & single engine props

EXHIBIT 12 - WEATHER CATEGORIES AND MINIMA

(Operational Procedures and Minima -- EWR)

The weather categories, minimums, and percent occurrence are based on EWR Study, 1995. The percentages were developed by Leigh Fisher Associates (LFA) for the 1995 Study. LFA tabulated the hourly weather data for January 1, 1981, through December 31, 1993, from the National Climatic Data Center, Asheville, North Carolina. The tabulations reflect percent of occurrence during daytime hours, 6am to 11pm.

Other information estimated by FAA Technical Center.

Design Team should supply the missing information and make changes where appropriate.

VFR-1: 77.5 %
Ceiling ≥ 3,500' *and* Visibility ≥ 5 miles.
Visual (VFR-1) separations.
Simultaneous visual approaches to 11 and either 4R or 4L.
Simultaneous visual approaches to 11 and either 22R or 22L.

VFR-2a: **12.7 %**
Less than VFR-1, *and*, Ceiling ≥ 1,000' *and* Visibility ≥ 4 miles.
IFR separations for A/A. Visual (VFR1) separations for others.
Simultaneous approaches may be permitted to 11 and either 4R or 4L.
Simultaneous approaches may be permitted to 11 and either 22R or 22L.

VFR-2b: **1.5 %**
Less than VFR-2a, *and*, Ceiling ≥ 1,000' *and* Visibility ≥ 3 miles.
IFR separations are required.
How do VFR-2b operations differ from VFR-2a and IFR-1 operations?

IFR-1: **4.1 %**
Less than VFR-2b, *and*, Ceiling ≥ 600' *and* Visibility ≥ 2 miles.
IFR separations.

IFR-2: **4.2 %**
Less than IFR-1.
IFR separations.

EXHIBIT 13 - EWR AIRCRAFT GATE SERVICE TIMES

(Minimum Turn-Around Times in Minutes)

The gate service times (minimum turn-around times) represent the minimum time it takes to service an aircraft -- from the time it arrives at the gate until pushback.

To simulate more realistic conditions, the departure time of a continuing arrival is adjusted to assure the aircraft meets its minimum turn-around time. If an aircraft arrives on time, its departure time is not adjusted.

Newark has many international flights which require lengthy turn-around times. Over half of the Heavies have minimum turn-around times which are at least 2 hours (120 minutes).

Five percent (5%) of the Large Jets are International flights which have minimum turn-around times of 90 minutes. For simulation purposes, we will assume these aircraft have minimum turn-around times of 45 minutes. This will eliminate the possibility of domestic Large Jets having excessive turn-around times and will more realistically simulate Newark gate-service times.

Similarly, 4% of the Large Commuters are Air Canada flights which have minimum turn-around times of 55 minutes. For simulation purposes, we will assume these aircraft have minimum turn-around times of 30 minutes. This will more realistically simulate Newark gate-service times.

For Small aircraft (small twin and single engine props), the Technical Center will obtain the minimum turn-around times for Small cargo operations.

H		757		LJ		LC		M		S	
Cumulative		Cumulative		Cumulative		Cumulative		Cumulative		Cumulative	
Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.
45	0.19	45	0.22	30	0.31	20	0.16	15	0.29		
50	0.29	50	0.87	35	0.88	30	1.00	20	0.41		
60	0.45	60	1.00	40	0.91			30	1.00		
90	0.47			45	1.00						
120	0.54										
140	0.59										
150	1.00										

Source: Provided by the Airlines Serving EWR in March 1997.

EXHIBIT 14 - EWR ARRIVAL AIRCRAFT LATENESS DISTRIBUTION

(Arrival Variability Distribution)

Amount by which actual arrival time at threshold exceeds scheduled OAG arrival time (Minutes)	Distribution of aircraft lateness (%)	Cumulative (%)	
-30	2.2 %	2.2 %	Early
-20	7.7 %	9.9 %	Early
-15	9.6 %	19.5 %	Early
-10	13.1 %	32.6 %	Early
-5	13.4 %	46.0 %	Early
- 2	6.9 %	52.9 %	On Time
0	4.1 %	57.0 %	On Time
5	8.3 %	65.3 %	Late
10	6.1 %	71.4 %	Late
15	4.3 %	75.7 %	Late
30	8.1 %	83.8 %	Late
45	4.5 %	88.3 %	Late
60	2.9 %	91.2 %	Late
120	8.8 %	100.0 %	Late

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. This table is read as follows: 2.2% of the aircraft arrived at the threshold at least 30 minutes early, 7.7 arrived between 20-30 minutes early, 9.6% arrived at least 15 minutes early, etc.

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 (EWR). Using Cater data, the distribution includes the delays into EWR, nominal taxi times, and delays on the ground.

After reviewing the data, the Technical Center has some concerns. It is unusual to have 52.9% of the flights arrive at least 2 minutes early; 46% arrive at least 5 minutes early; and 32.6% arrive at least 10 minutes early. The Technical Center believes this distribution could be skewed 5 or 10 minutes towards the early side because the OAG time represented scheduled time at the gate, rather than the expected time at threshold (OAG time minus the ground travel time from threshold to gate). It is also unusual for 8.8% of the flights to arrive more than 1 hour late. *The Technical Center will obtain the CATER III program and refine the lateness distribution by adjusting for taxi times.*

Source: 1996 EWR Cater Data -- Actual Time at Threshold versus OAG Time.

EXHIBIT 15 - EWR AIRCRAFT OPERATIONS FORECAST

Itinerant Aircraft Operations

YEAR	AIR CARRIER	AIR TAXI COMM	GA	MILITARY	TOTAL	
Actual:						
1994	313,515	94,883	31,040	623	440,061	
1995	298,389	88,647	36,178	674	423,888	
1996	323,139	98,441	32,380	501	454,461	
Forecast:						
2000	332,988	128,905	20,544	422	482,859	(6.2% increase over 1996)
2005	356,494	139,452	20,544	422	516,912	(13.7% increase over 1996)
2010	380,000	150,000	20,544	422	550,966	(21.2% increase over 1996)
2015						
2020						

Source: Actual Operations obtained from CATER data for 1994, 1995, and 1996. Forecasts obtained from FAA Terminal Area Forecast System, Jan., 1996 , Table AE-6 Airport Detail - NJ, NEWARK, from APO TAF Instrument Operations Data. The Port Authority's Forecasts were not used because the 1996 operations exceeded the Port's forecast for the year 2000.

Note: Average Day of Peak Month : August 22, 1996 -- 1,451 Operations
Equivalent Days: (Annual Operations) / (Daily Operations)

The EWR Tower said the operations on August 22, 1996 represented an average day in the peak month. Therefore, that date will be used to generate the hourly arrival and departure counts for a 24-hour schedule.

To simulate 454,000 annual operations for the Baseline demand level, the FAA Technical Center recommends simulating 1,452 daily operations for 313 equivalent days.

For each future activity level to be simulated, The Design Team must determine the total number of operations and the annual number of each type of operation (Air Carrier, Scheduled Commuter, GA, and Military). As an example, this report shows Future 1 with 517,000 annual operations. The team may select a different operational level, but the level should be high enough such that Future 1 is near the knee of the delay curve, where the delays start to rise sharply. Selecting activity levels which are too low will not be useful to the Design Team in performing their cost-benefit analysis.

EXHIBIT 16 - SIMULATED DEMAND CHARACTERISTICS

ANNUAL & DAILY DEMAND

DEMAND LEVEL	ANNUAL OPERATIONS	DAILY OPERATIONS	EQUIVALENT DAYS
1996	454,000	1452	313
FUTURE 1	517,000	1652	313
FUTURE 2	xxx,xxx	xxxx	313

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

EWR DEMAND CHARACTERISTICS

Annual Distribution of Traffic

DEMAND	AIR CARRIER		SCHED. COMMUTER		GA & MILITARY		TOTAL	
1996	323,000	71.1%	98,000	21.6%	33,000	7.3%	454,000	100.0%
FUTURE 1								
FUTURE 2								

Daily Distribution of Traffic

AIR CARRIERS & SCHED. COMMUTERS		GA & MILIARY		TOTAL		
1,347	92.8%	105	7.2%	1,452	100.0%	1996 (BASELINE)
						FUTURE 1
						FUTURE 2

EXHIBIT 16 - SIMULATED DEMAND CHARACTERISTICS (Cont.)

Overall -- Daily Fleet Mix By Class

H	757	LJ	LC	M	S	Total	
124 8.5%	116 8.0%	770 53.0%	264 18.2%	150 10.3%	28 1.9%	1,452 100.0%	Baseline
							Future 1
							Future 2

Air Carrier & Scheduled Commuters -- Daily Fleet Mix By Class

H	757	LJ	LC	M	S	Total	
124 9.2%	116 8.6%	766 56.9%	221 16.4%	118 8.8%	2 .1%	1,347 100.0%	Baseline
							Future 1
							Future 2

GA & Military -- Daily Fleet Mix By Class

H	757	LJ	LC	M	S	Total	
0 .0%	0 .0%	4 3.8%	43 41.0%	32 30.5%	26 24.8%	105 100.0%	Baseline
							Future 1
							Future 2

Source: Baseline Demand Characteristics developed from CATER data, Calendar Year 1996.

EXHIBIT 16 - SIMULATED DEMAND CHARACTERISTICS (Cont.)

Overall -- Daily Fleet Mix By Class

H	757	LJ	LC	M	S	Total	
124 8.5%	116 8.0%	770 53.0%	264 18.2%	150 10.3%	28 1.9%	1,452 100.0%	Baseline
							Future 1
							Future 2

Air Carrier & Scheduled Commuters -- Daily Fleet Mix By Class

H	757	LJ	LC	M	S	Total	
124 9.2%	116 8.6%	766 56.9%	221 16.4%	118 8.8%	2 .1%	1,347 100.0%	Baseline
							Future 1
							Future 2

GA & Military -- Daily Fleet Mix By Class

H	757	LJ	LC	M	S	Total	
0 .0%	0 .0%	4 3.8%	43 41.0%	32 30.5%	26 24.8%	105 100.0%	Baseline
							Future 1
							Future 2

Source: Baseline Demand Characteristics developed from CATER data, Calendar Year 1996.

EXHIBIT 17 - EWR AIRLINE GATE ASSIGNMENTS

AIRLINE(S)	OAG CODE	FAA CODE	TERMINAL/GATES
Air Alliance		AAQ	C100-C115
AirBC	ZX	ABL	
Air Canada	AC	ACA	C100-C115
Air Canada Commuters	AC	ACA	C100-C115
Air Nova	QK	ARN	C100-C115
Alitalia	AZ	AZA	C70*-C79
American	AA	AAL	A30-A35
America West	HP	AWE	C120
America West Commuters	HP	AWE	C120
Carnival	KW	CAA	B40-B42
Chautauqua			A25-A26
Colgan Air	9X	CJC	A36-A39
Comair		COM	B43-B48
Continental	CO	COA	C70*-C115
Continental Express	CO	COA	C70*-C115
Delta	DL	DAL	B43-B48
Delta Business Express	DL	DAL	B43-B48
International Departures only			B51-B57 (Int'l)
International Facility			B60-B68 (Int'l)
Jet Express	JI	YPX	
Jet Train Corporation	LF		
Kiwi International	KP	KIA	A30-A35
Midway			A30-A35
Midwest Air Express	YX	MEP	B40-B42
Monarch			A36-A39
Myrtle Beach			B40-B42
Northwest	NW	NWA	A40-A42
Trans World Airlines	TW	TWA	A36-A39
Scandinavian Airlines	SK	SAS	
Sun Country (Charter)	SY	SCX	A36-A39
Sun Jet		SJI	A36-A39
SwissAir	SR	SWR	B43-B48, B51-57
United	UA	UAL	A10-A18
United Express (Atlantic Coast)	UA	UAL	A10-A18
USAir	US	USA	A20-A24, A27-A28
USAir Express (Allegheny, Commutair, Henson)	US	USA	A25-A26
Western Pacific		KMR	B43-B48

Notes: **The Design Team will provide additions and corrections.**
Does UA also use gates A20-A24, A27, and A28?
Does USAir also use gates A25-A26?
* Gate C70 is not operational.
The International Facility is located in Terminal B.
Cargo operators: EB (Emery), ER (DHL), FX, 1A, 1F (Airborne), 1V, 5X (UPS), 8W.

3. DESIGN TEAM SCHEDULE

Exhibit 18 lists the meetings concerning the completion of significant tasks, outputs, and target dates of the EWR Design Team schedule. These milestones and meetings will be held at key decision points, and will help the Design Team monitor the progress of the study.

EXHIBIT 18 - DESIGN TEAM SCHEDULE

Date	Event	Objective	Task	Responsibility	Output
11/18/96	1.	Kick Off Meeting. Review Design Team Purpose. Identify Objectives and Possible Improvements.	Review Technical Plan, and Potential Improvements. Agree on General Parameters of Scope of Work, Assumptions, Forecasts and Data Requirements. Review and Agree on Purpose and Inputs.	Entire Design Team	Initial List of Potential Improvements. Agreement on study direction.
12/9/96 thru 12/13/96	2.	Perform Data Collection.	On-Site Data Collection.	Tech. Ctr.	Agreement on establishing of parameters for Analysis.
1/14 /97	3.	Determine Scope of Study, Select Model, and Review Results of Data Collection.	Review Results. Review Data Package 1.	Entire Design Team	Agreement on inputs and direction.
4/10/97	4.	Review results of Data Collection, model inputs, and potential improvements.	Review Data Package 2.	Entire Design Team	Agreement on inputs and direction.
/ /	5.	• • •			
/ /98	?.	Complete and Publish Final Report.	Publish and Distribute Final Report.	FAA HQ.	Final Report.

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