NEWARK

INTERNATIONAL AIRPORT

Data Package Number 1

Airport Capacity Enhancement Design Team Study

January 1997

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

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15. Supplementary Notes

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)

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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 an 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.

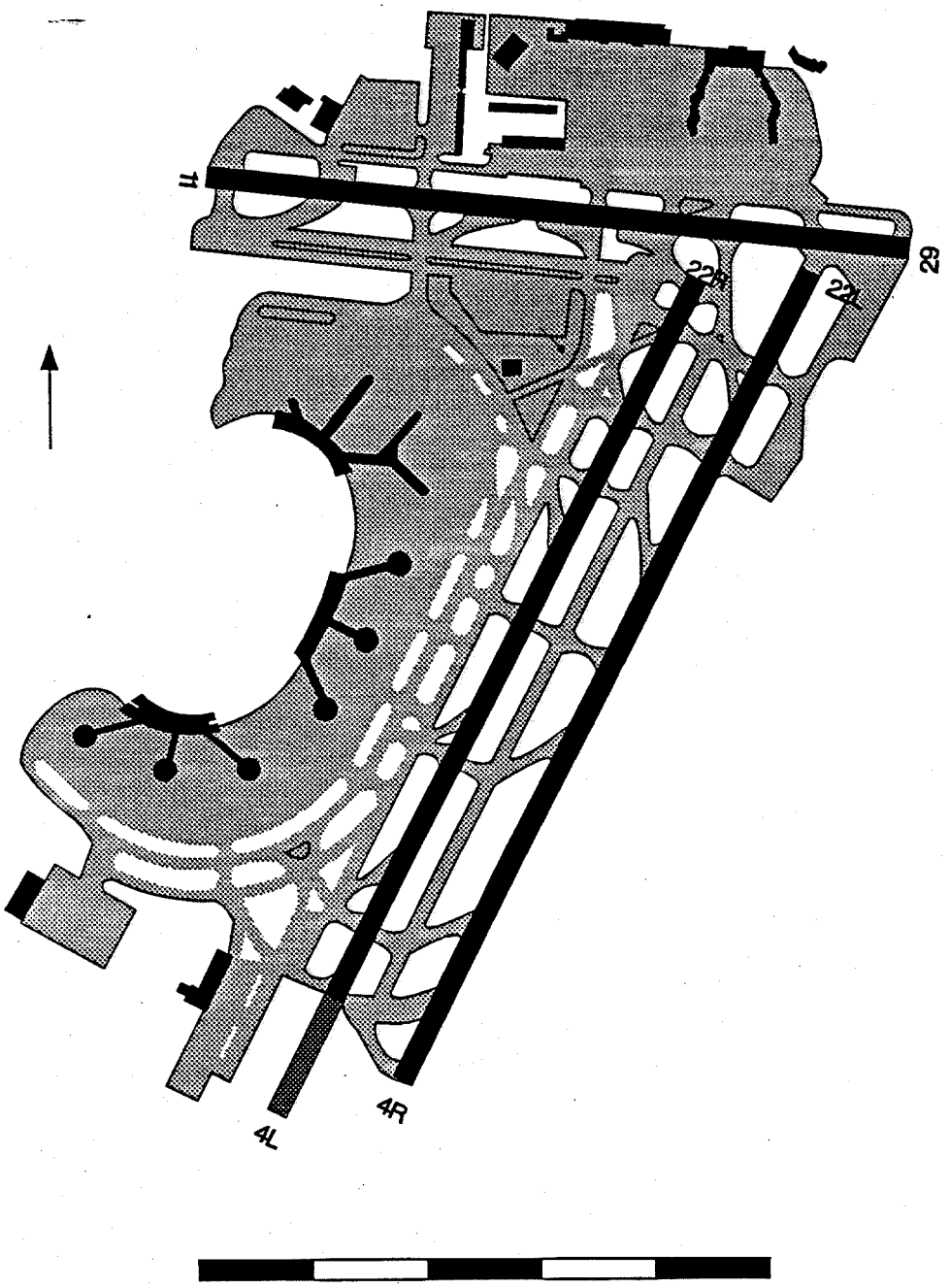
Coordination activities are underway with ATAC to insure comparability of the results of this study with the efforts on the airside. The experimental design should be constructed in a manner which minimizes any differences of input assumptions and reflects comparable results produced by both studies.

EXHIBIT 1 - POTENTIAL IMPROVEMENTS

The potential improvements developed for the Design Team are listed by group as follows:

	Airfield Improvements	**Proposed Model**
(1)		
(2)		
(3)		
(4)		
(5)		
(6)		
(7)		
(8)		
(9)		
	Facilities and Equipment	
(10)		
(11)		
(12)		
(13)		
	Operations	
(14)		
(15)		
(16)		

EXHIBIT 2 - AIRPORT DIAGRAM (EWR)



Source : 1995 ACE Plan

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.

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 presents gate service times at EWR.

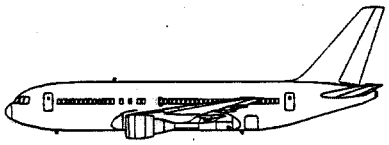
Exhibit 13 depicts the arrival aircraft lateness distribution at EWR.

Exhibit 14 describes aircraft operations forecast for Newark.

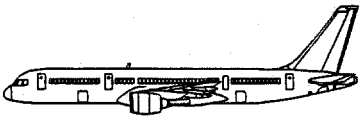
Exhibit 15 presents the simulated demand characteristics.

Exhibits 16 shows the EWR airline gate assignments.

EXHIBIT 3 - AIRCRAFT CLASSIFICATIONS

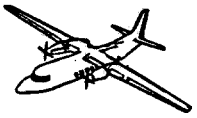


1 Heavy aircraft weighing more than 255,000 lbs.

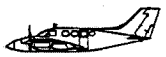


2 B757 aircraft

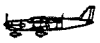
3 Large aircraft weighing more than 41,000 pounds and less than 255,000 pounds.



4 Small aircraft weighing more than 12,500 pounds and less than 41,000 pounds.



5 Small twin engine props weighing 12,500 lbs or less.



6 Small single engine props weighing 12,500 lbs or less.

EXHIBIT 3 - AIRCRAFT CLASSIFICATIONS (Cont.)

CLASS	TYPE OF AIRCRAFT[a]
6	Small, single engine aircraft weighing 12,500 pounds or less (e.g. AC21, BE20, C172, C210, DO27).
5	Small, twin-engine aircraft weighing 12,500 pounds or less (e.g BE58, BE90, C340, C441).
4	Small aircraft weighing more than 12,500 and less than 41,000 pounds[b] (e.g., BE02, DA20, E120, LR31, LR36).
3	Large aircraft weighing more than 41,000 pounds[b] and up to 255,000 pounds[b] (e.g., ATR-42*, DH7, DH8, CV58, DC9, B737, B727, MD80, SF34*,).
2	B757 only.
1	Heavy aircraft[c] weighing more than 255,000 pounds (e.g., L1011, DC10, B747, B767, DC8S, A300).

Notes:

[a] For aircraft designator, see FAA Handbook 7340.1E with changes.

[b] Weights refer to maximum certified takeoff weights.

[c] Heavy aircraft are capable of takeoff weights of 255,000 pounds or more, whether or not they are operating at this weight during a particular phase of flight (reference FAA Handbook 7110.65 with changes)

*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)

The critical factor in determining aircraft class should be approach speeds 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.

EXHIBIT 4 - RUNWAYS AND RUNWAY EXITS (EWR)

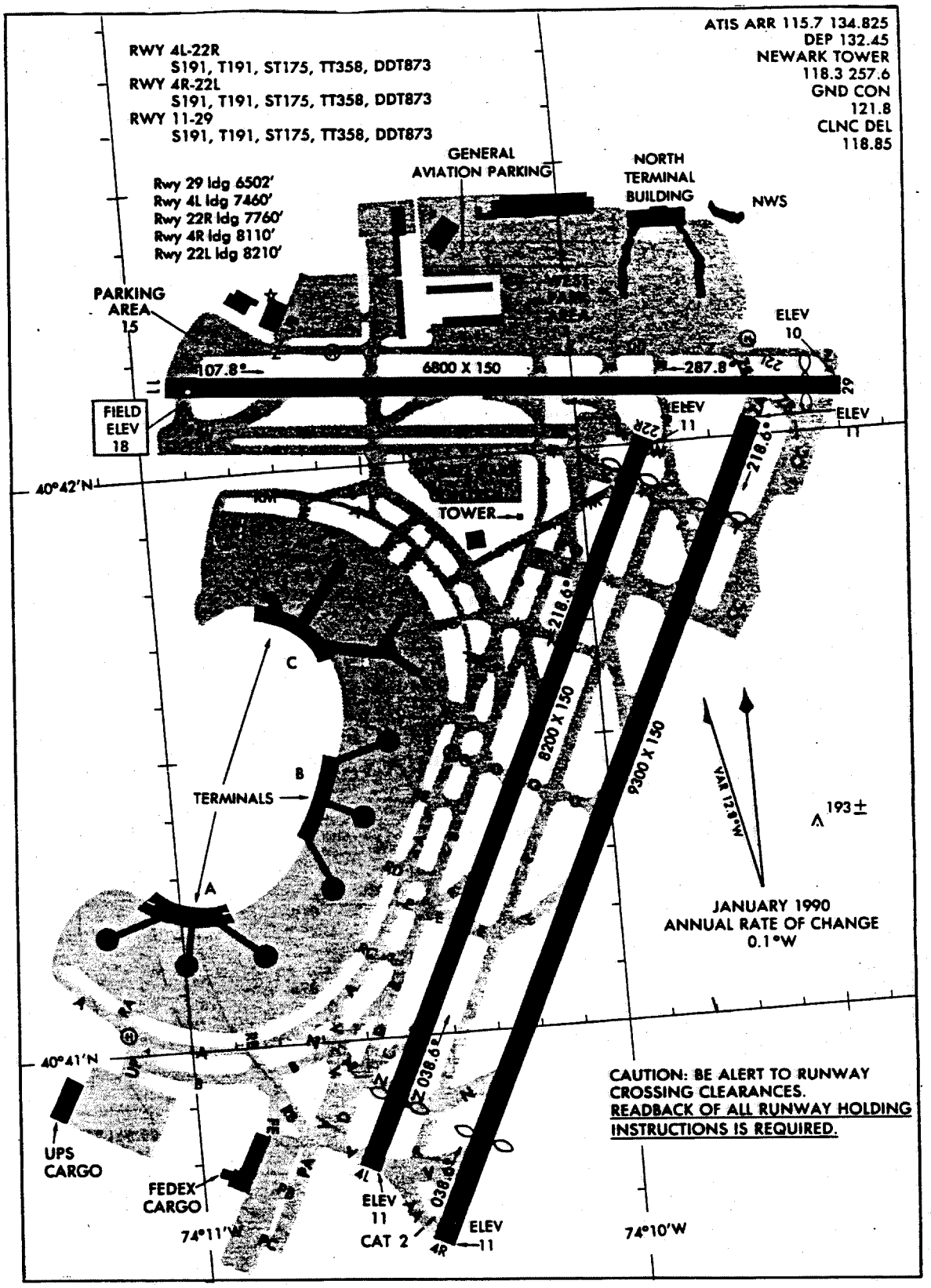


EXHIBIT 5 - RUNWAY EXIT DATA OBSERVED

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

Runway 4R

Exit Distance	G 3600'	J 4400'	K 5900'	L 6450'	Y(M?) 6950'	TOTAL
1 Utilization			42%	50%	8%	100%
ROT			59	56	74	59 sec
Count			5	6	1	12
2 Utilization		9%	56%	35%		100%
ROT		34	60	56		56 sec
Count		2	13	8		23
3 Utilization		25%	46%	28%	1%	100%
ROT		34	54	52	71	49 sec
Count		23	43	26	1	93
4 Utilization	7%	57%		36%		100%
ROT	33	42		57		47 sec
Count	1	8		5		14
5 Utilization	12%	63%		25%		100%
ROT	36	31		54		37 sec
Count	1	5		2		8
6 Utilization						
ROT						
Count						

Runway 4L

Exit Distance	E 1950	G 3600	H 4500	J 5150	K/O 5950	M/Y 6900	W 7400	TOTAL
1 Utilization								
ROT								
Count								
2 Utilization								
ROT								
Count								
3 Utilization			25%	75%				100%
ROT			45	49				48 sec
Count			1	3				4
4 Utilization								
ROT								
Count								
5 Utilization								
ROT								
Count								
6 Utilization								
ROT								
Count								

Note: Distance in FT. from Threshold. Conditions were VFR and dry.

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
1 Utilization							
ROT							
Count							
2 Utilization							
ROT							
Count							
3 Utilization							
ROT							
Count							
4 Utilization							
ROT							
Count							
5 Utilization		50%	50%				100%
ROT		43	44				44 sec
Count		1	1				2
6 Utilization							
ROT							
Count							

Runway 29

Exit Distance	R 2000	S 2750	T 3700	U 4550	BB 5400	W 6400	TOTAL
1 Utilization							
ROT							
Count							
2 Utilization							
ROT							
Count							
3 Utilization							
ROT							
Count							
4 Utilization							
ROT							
Count							
5 Utilization							
ROT							
Count							
6 Utilization							
ROT							
Count							

Note: Distance in FT. from Threshold. Conditions were VFR and dry.

EXHIBIT 5 - RUNWAY EXIT DATA OBSERVED (Cont.)

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

Runway 22R

Exit Distance	G 3400	F 4600	E 5000	C 6350	N 6950	V 7700	TOTAL
1 Utilization							
ROT							
Count							
2 Utilization							
ROT							
Count							
3 Utilization	9%	18%		73%			100%
ROT	36	40		47			45 sec
Count	1	2		8			11
4 Utilization							
ROT							
Count							
5 Utilization		100%					100%
ROT		60					60 sec
Count		1					1
6 Utilization							
ROT							
Count							

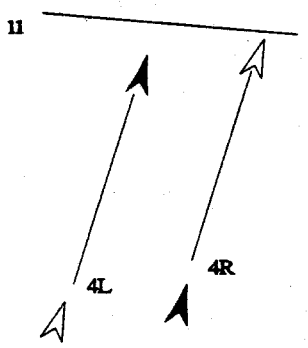
Runway 22L

Exit Distance	G 3400	E 4200	B 6100	A 7300	TOTAL
1 Utilization			93%	7%	100%
ROT			49	54	49 sec
Count			13	1	14
2 Utilization		12%	88%		100%
ROT		39	47		46 sec
Count		4	28		32
3 Utilization	3%	17%	77%	3%	100%
ROT	36	33	44	54	42 sec
Count	7	37	165	7	216
4 Utilization		50%	50%		100%
ROT		33	48		41 sec
Count		16	16		32
5 Utilization	12%	50%	38%		100%
ROT	36	32	46		38 sec
Count	3	12	9		24
6 Utilization	100%				100%
ROT	36				36 sec
Count	1				1

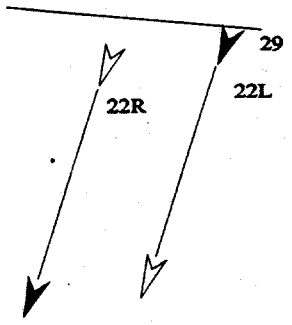
Note: Distance in FT. from Threshold. Conditions were VFR and dry.

EXHIBIT 6 - RUNWAY CONFIGURATIONS (EWR DO-NOTHING)

NORTH – VFR1 & VFR2 & IFR1

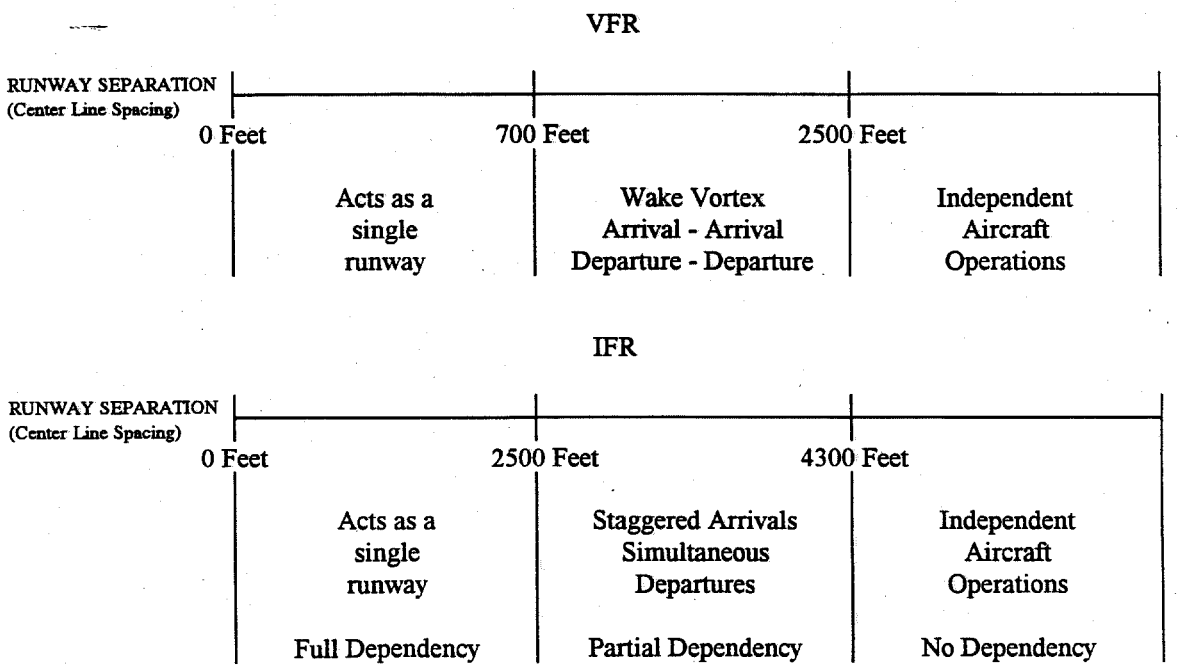


SOUTH – VFR1 & VFR2 & IFR1



◄ - 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

Report FAA-EM-78-8A

A/A (NM)*		TRAIL A/C						
		1	2	3	4	5	6	
LEAD A/C	1	3.86	4.67	4.67	4.67	5.49	5.34	
	2	3.86	4.25	4.25	4.25	4.25	4.25	(Based on PDX 1996)
	3	3.06	2.97	2.97	2.97	3.69	3.53	
	4	3.06	2.97	2.97	2.97	3.69	3.53	
	5	3.06	2.97	2.97	2.97	2.89	2.73	
	6	3.06	2.97	2.97	2.97	2.89	2.73	

D/D (MIN.)		TRAIL A/C						
		1	2	3	4	5	6	
LEAD A/C	1	1.50	2.00	2.00	2.00	2.00	2.00	
	2	1.50	1.50	1.50	1.50	1.50	1.50	(Based on PDX 1996)
	3	1.00	1.00	1.00	1.00	0.83	0.83	
	4	1.00	1.00	1.00	1.00	0.83	0.83	
	5	0.83	0.75	0.75	0.75	0.58	0.58	
	6	0.83	0.75	0.75	0.75	0.58	0.58	

D/A (NM)		TRAIL A/C					
		1	2	3	4	5	6
LEAD A/C	1	1.51	1.41	1.41	1.41	1.30	1.30
	2	1.51	1.41	1.41	1.41	1.30	1.30
	3	1.51	1.41	1.41	1.41	1.30	1.30
	4	1.51	1.41	1.41	1.41	1.30	1.30
	5	1.32	1.23	1.23	1.23	1.13	1.13
	6	1.32	1.23	1.23	1.23	1.13	1.13

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

The A/D and D/A separations were based on the standard approach speeds 140, 130, 130, 130, 120, 90.

*Values include missed approach buffer.

EXHIBIT 9 - STANDARD IFR SEPARATIONS

Report FAA-EM-78-8A

A/A (NM)*		TRAIL A/C 1	2	3	4	5	6	
LEAD A/C	1	5.16	6.07	6.07	6.07	6.99	6.82	
	2	5.16	5.07	5.07	5.07	5.99	5.82	(Based on PDX 1996)
	3	4.16	4.07	4.07	4.07	4.99	4.82	
	4	4.16	4.07	4.07	4.07	4.99	4.82	
	5	4.16	4.07	4.07	4.07	3.99	3.99	
	6	4.16	4.07	4.07	4.07	3.99	3.82	

D/D (MIN.)		TRAIL A/C 1	2	3	4	5	6	
LEAD A/C	1	1.50	2.00	2.00	2.00	2.00	2.00	
	2	1.50	1.50	1.50	1.50	1.50	1.50	(Based on PDX 1996)
	3	1.00	1.00	1.00	1.00	1.00	1.00	
	4	1.00	1.00	1.00	1.00	1.00	1.00	
	5	1.00	1.00	1.00	1.00	1.00	1.00	
	6	1.00	1.00	1.00	1.00	1.00	1.00	

D/A (NM)		TRAIL A/C 1	2	3	4	5	6
LEAD A/C	1	2.00	2.00	2.00	2.00	2.00	2.00
	2	2.00	2.00	2.00	2.00	2.00	2.00
	3	2.00	2.00	2.00	2.00	2.00	2.00
	4	2.00	2.00	2.00	2.00	2.00	2.00
	5	2.00	2.00	2.00	2.00	2.00	2.00
	6	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.

The A/A separation were based on the standard approach speeds 140, 130, 130, 130, 120, 90.

* Values include missed approach buffer.

EXHIBIT 10 - COMPARISON OF VFR A/A SEPARATIONS

(STANDARD VS. OBSERVED)

LEAD/TRAIL AIRCRAFT	STANDARD SEPARATION (SEC)	OBSERVED SEPARATION (SEC)	OBSERVED SEPARATION (NMI)	DATA POINTS	
1-1	99	0	0		
1-2	130	88	3.18	4	
1-3	130	99	3.58	16	
1-4	130	101	3.65	3	
1-5	165	117	3.9	1	
1-6	165	0	0		
2-1	99	70	2.72	3	
2-2	117	80	2.89	9	
2-3	**117**	**87**	**3.14**	**32**	**
2-4	117	103	3.72	4	
2-5	139	69	2.3	4	
2-6	139	0	0		
3-1	79	59	2.29	18	
3-2	**82**	**74**	**2.67**	**31**	**
3-3	**82**	**68**	**2.46**	**192**	**
3-4	**82**	**64**	**2.31**	**27**	**
3-5	111	73	2.43	13	
3-6	111	115	3.03	1	
4-1	79	48	1.87	3	
4-2	82	71	2.56	4	
4-3	**82**	**70**	**2.53**	**25**	**
4-4	82	48	1.73	5	
4-5	111	78	2.6	4	
4-6	111	0	0		
5-1	79	62	2.41	1	
5-2	82	71	2.56	4	
5-3	82	65	2.35	16	
5-4	82	69	2.49	3	
5-5	87	54	1.8	3	
5-6	87	0	0		
6-1	79	0	0		
6-2	82	0	0		
6-3	82	0	0		
6-4	82	0	0		
6-5	87	84	2.8	1	
6-6	87	0	0		

NOTE: ** There is a large difference between the standard and observed separations in seconds.
The observed separations in NM were calculated using the 1986 EWR approach speeds.
The Class 2 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	1	2	3	4	5	6
Standard	Knots	140	130	130	130	120	90
EWR	Knots	140	130	130	130	120	95

Source : 1986 EWR Study

Length of 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	1	2	3	4	5	6
STANDARD	VFR	6	6	6	6	3	3
STANDARD	IFR	6	6	6	6	6	6

Departure Runway Occupancy Times (Seconds):

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

Source: Standard values used in all design team studies.

	Class	1	2	3	4	5	6
Standard	Seconds	39	39	39	39	34	34

Class 1 - Heavy
Class 2 - B757's
Class 3 - Large
Class 4 - New Small
Class 5 - Old Small (Twin Engine)
Class 6 - Old Small (Single Engine)

EXHIBIT 12 - EWR AIRCRAFT GATE SERVICE TIMES

(Minimum Turn-Around Times in Minutes)

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 times).

These times represent the minimum time it takes to service an aircraft -- from the time it arrives a 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.

Class 1		Class 2 & 3		Class 4		Class 5		Class 6	
Cumulative		Cumulative		Cumulative		Cumulative		Cumulative	
Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.
30	0.01	20	0.03	20	0.03	15	0.40	10	0.40
40	0.02	30	0.30	30	0.30	20	0.47	15	0.80
50	0.30	40	0.60	40	0.60	25	0.56	20	0.90
60	0.60	60	1.00	60	1.00	30	0.60	25	1.00
80	1.00					35	1.00		

Source: Information from 1986 EWR Study.

EXHIBIT 13 - EWR ARRIVAL AIRCRAFT LATENESS DISTRIBUTION

(ARRIVAL VARIABILITY DISTRIBUTION)

Amount by which actual arrival time at threshold exceeds scheduled arrival time (Minutes)	Distribution of aircraft lateness (%)	Cumulative (%)	
-30:00	0.3	0.3	Early
-15.00	2.0	2.3	
- 0.01	11.3	13.3	On Time
0:00	26.6	40.2	
5.00	20.0	60.2	Late
10.00	15.6	75.8	
15.00	8.3	84.1	
30.00	7.7	91.5	
45.00	4.0	95.8	
60.00	4.2	100.0	

This table is read as follows: 0.3% of the aircraft arrived at the threshold more than 30 minutes early, 2% arrived between 15-30 minutes early, 2.3% arrived more than 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).

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.

Source: 1986 EWR Study

EXHIBIT 14 - EWR AIRCRAFT OPERATIONS FORECAST

Aircraft Operations (Itinerant)

Year	Air Carrier	Air Taxi Comm	GA	Military	Total
Actual:					
1994	304,782	116,249	20,544	422	441,997
Forecast:					
1995	309,483	118,358	20,544	422	448,807
1996	314,184	120,467	20,544	422	455,617
2000	332,988	128,905	20,544	422	482,859
2005	356,494	139,452	20,544	422	516,912
2010	380,000	150,000	20,544	422	550,966

Source: FAA Terminal Area Forecast System, Jan., 1996 , Table AE-6 Airport Detail - NJ, NEWARK from APO TAF Instrument Operations Data.

Note:

1995 Annual Operations :
1996 Annual Operations :
Peak Month: August
Average day of peak month :
Daily traffic:
Equivalent Days: (Annual Operations) / (Daily Operations)

EXHIBIT 15 - SIMULATED DEMAND CHARACTERISTICS

Annual & Daily Demand:	TOTAL
Baseline	xxx,000
Future 1	xxx,000
Future 2	xxx,000

Annual distribution of Traffic:

	AC	AT	GA	MIL	Total
Baseline					xxx,000
Future 1					xxx,000
Future 2					xxx,000

Overall Fleet Mix by Class:

Class	1	2	3	4	5	6
Percent						

EXHIBIT 16 - EWR AIRLINE GATE ASSIGNMENTS

AIRLINE(S)	OAG CODE	FAA CODE	TERMINAL/GATES
American	AA		
Continental	CO		
Continental Commuter			
TWA	TW		
United	UA		
United Commuter			
USAir	US		
USAir Commuter			

Note: The Design Team will provide the necessary information.

3. DESIGN TEAM SCHEDULE

Exhibit 17 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 17 - 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.	Entire Design Team	Agreement on inputs and direction.
/ /97	4.	□ □ □			
/ /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.