SHORT HAUL HELICOPTER DEMONSTRATION PROJECT
The Feasibility of New York Airways Expansion to Nassau County

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ABSTRACT

A short-haul helicopter service demand analysis on journey to work trips between Nassau and Suffolk counties and the New York central business district was performed over several operational policy/scenario combinations. Results indicated that there was sufficient demand to support multiple rotorcraft additions to the New York Airways Fleet.

Market penetrations ranged from 1.9% to 6.0% over the policies/scenarios envisioned. Sensitivity analyses were performed on level of service parameters including fare, frequency, service patterns, and heliport location indicating a high degree of flexibility to be possible in any demonstration program.

Fleet requirements were calculated as a function of overall level of service and a sample fleet assignment and schedule proposed. The proposal - to handle the mean demand forecast - consists of three 25 passenger helicopters, 150 flight segments, 2100 route miles/day and a utilization approaching 8.5 hours/aircraft/day. System averages are 13.8 mile stage lengths and 9 minute block times.

Sixteen peak hour round trip frequencies flown to Wall Street from three suburban heliport locations include twelve nonstop and four one-stop services. Eight peak hour round trip frequencies are offered to 59th Street (Vic. Central Park), LaGuardia and Kennedy. Load building multistop routes were flown between the outer suburban heliports and the innermost transfer point location in western Nassau County. System planning for off peak use was not examined, but will add to flight utilization and latent demand stimulation in the non-business sector.

The overall utility of the proposed addition to the NYA route structure could be maximized by careful interfacing with the currently operated routes.

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Ø. Problem Definition and the Role of Short Haul Air Transport

The growth and development of the suburban labor force has caused a dichotomy between the transportation needs of the commuting population and the ability of the current transportation systems to satisfy those needs.

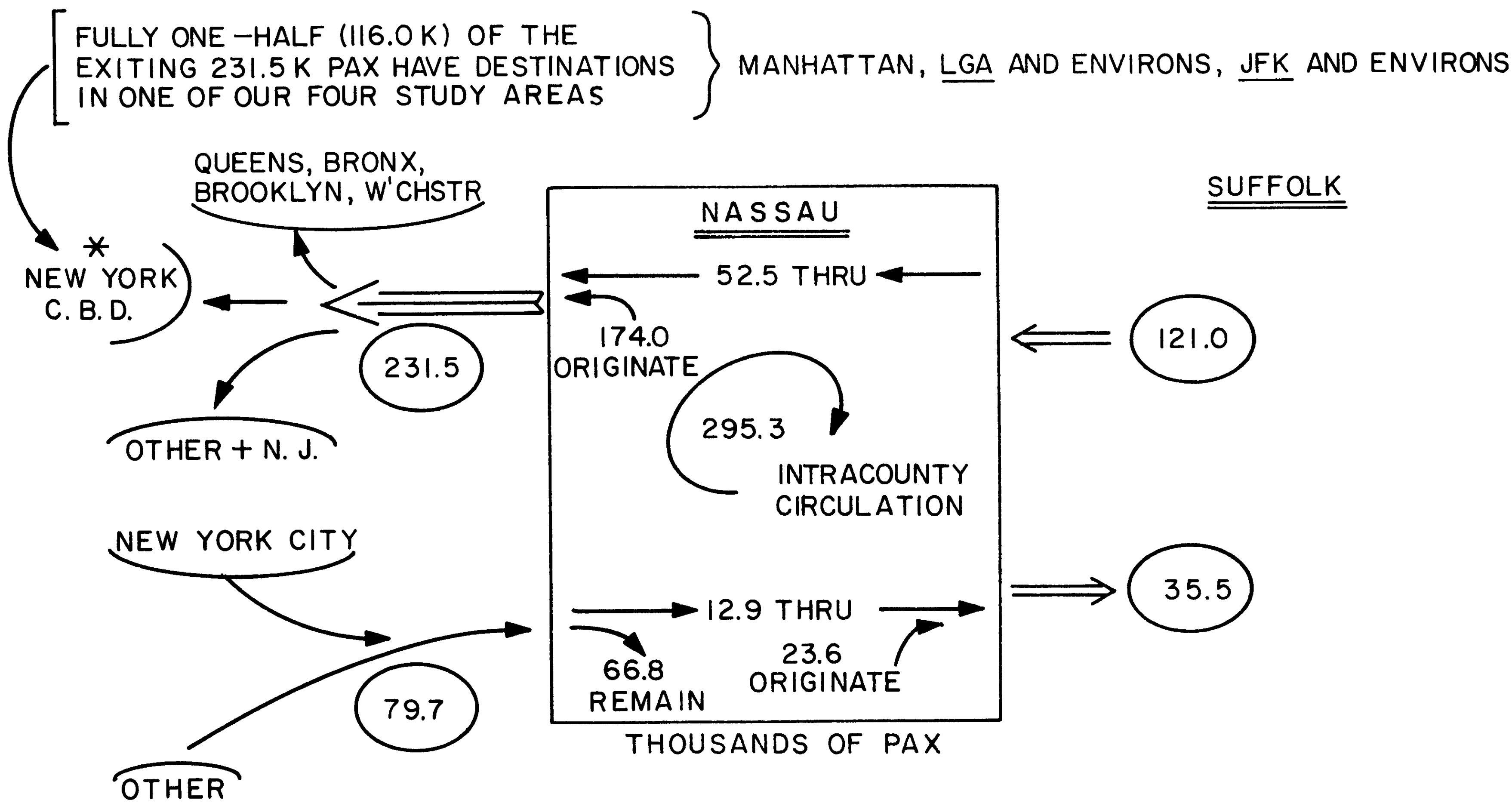
In the first stages of development, central cities contained both hubs and labor force. The employment centers were aggregated into central business districts and were well served by mass transit. As suburbanization occurred, suburban residents continued to hold central city jobs, and commuted over a developing network of arterial and radial highways. This network developed to a point where further expansion meant population displacement and then was, for this reason and others, curtailed.

As the suburban employment centers developed, worktrips involving intra-suburban area transport quickly overtaxed existing suburban transit facilities and sent suburbanites heading for the highways. Large numbers of suburban residents continued to commute to central city CBD areas while increasing numbers of ultra short haul intra-community trips were generated.

Illustrative of this situation is an analysis of the work trip passenger movements on Long Island presented in Figure 1. Tables 1 and 2 show origin-destination matrices for portions of Nassau and Suffolk Counties to destinations in the New York SMSA. The magnitudes of these flows - on the order of 600,000 - regularly saturate what transportation services currently exist. The low level of service offered on fixed-line technologies induces intermodal trip itineraries and shifts towards automobile usage. Congestion effects yield unacceptably long trip times - uncharacteristically almost independent of mode or technology. In short, saturation exists and there is need for an evaluation of transportation alternatives.

FIGURE 1

PICTORIAL OF DAILY ONE-WAY PASSENGER MOVEMENTS [JOURNEY-TO-WORK], NASSAU AND SUFFOLK COUNTIES



REFERENCES: 1970 CENSUS, 1973 TRISTATE REGIONAL PLANNING COUNCIL "J-T-W" REPORT, E.C.I. SYSTEMS STAFF.

TABLE 1

ORIGINS - PLACE OF RESIDENCE

	W. Nassau County	E. Nassau County	W. Suffolk County	Totals
Nassau Co.	125858	122401	28074	276333
Suffolk Co.	3726	9733	101530	114989
Queens Co.	24139	17728	8527	50394
Brooklyn	17458	11258	5188	33904
Manhattan 59th St. So.	57726	26684	15168	99570
Manhattan 59th St. No.	8306	4429	1924	14659
Bronx	2060	1466	641	4167
Westchester	934	397	253	1584
Conn., N.J.	3201	1968	1163	6332
Totals	243408	196074	162458	601940

FROM: "Long Island Journey to Work Report," New York Office of Transportation, 1970)

TABLE 2

Daily Passenger Volume

to Metropolitan Airports (JFK, LGA)

From / To	W. Nassau Co.	E. Nassau Co.	W. Suffolk Co.	Totals
JFK	642	556	109	1307
LGA	994	776	272	2042
Totals	1636	1332	381	3349

A short haul air transportation system is defined as servicing inter-city and urban trips by passengers and cargo over distances less than 500 miles. Advantages of air include higher block speed and freedom from geographical constraints. Air systems use small percentages of the land and noise impact areas affected by ground systems. New high technology ground systems require large, high risk initial public investments yet are far less flexible than air systems. Finally, air systems offer better travel services to the passenger.

In this light, the feasibility of a demonstration project - expansion of New York airways operations to Nassau county - is to be analyzed. While transportation systems analysis and studies do much to outline feasible regions within alternatives, they are not sufficient to make policy decisions. The proposed demonstration project is an opportunity to experiment and to perform market research to determine what the public wants and needs in terms of new and improved transportation systems.

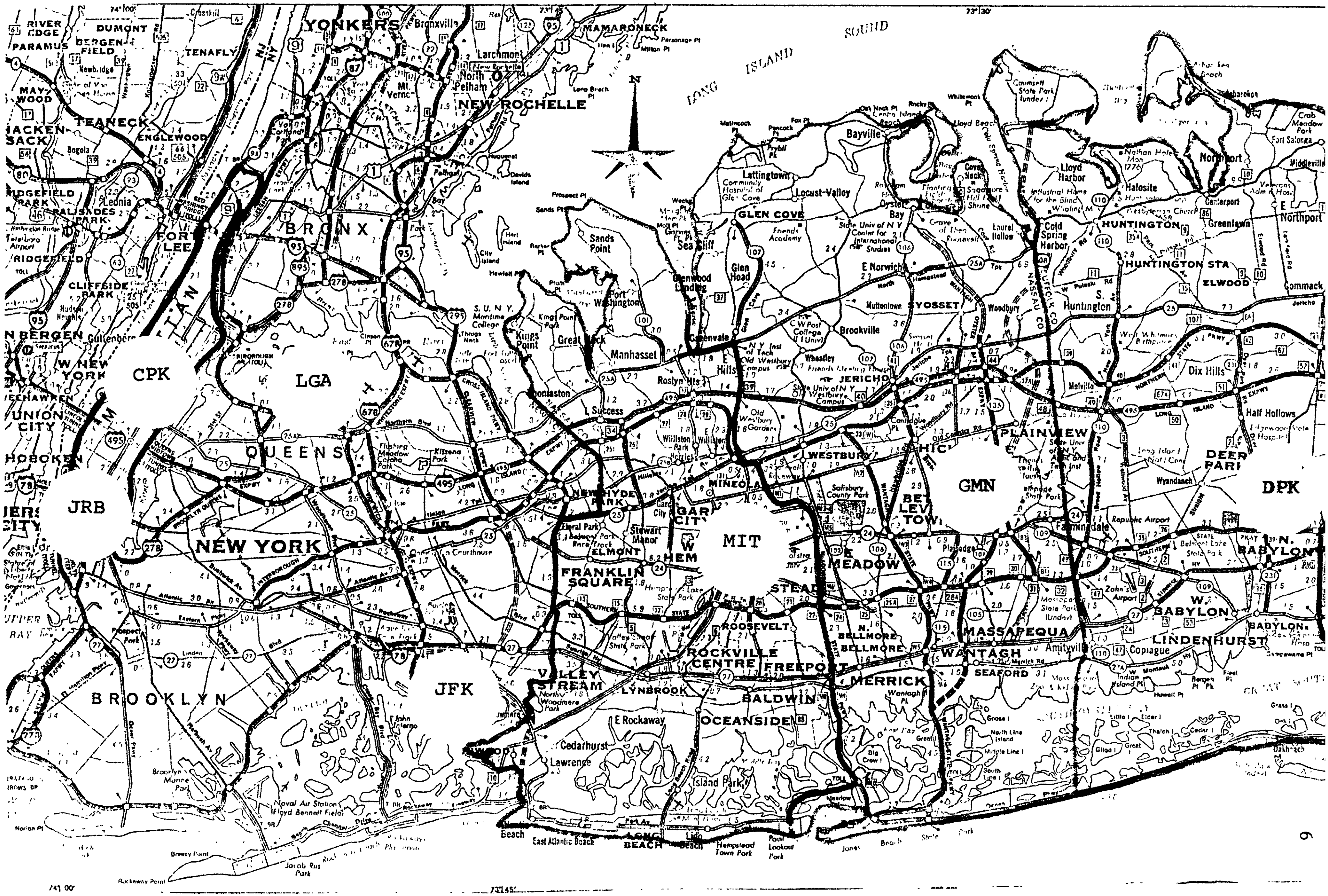
I. The Background for the Feasibility Study

This project was undertaken to assess the feasibility and impact of the extension of New York Airways Helicopter service to Nassau County on Long Island. In order to view the situation in the most objective manner possible, the current state of transportation systems on Long Island was assessed, and then modelled. The proposed alternative - short haul helicopter service - was then added to the model in order to assess the impact on a captive volume of travel -- the journey to work trips.

In the general case, a change in the network (and hence presumably in level of service) will change demand and flow. Ideally, the proper analysis requires the use of both demand and modal choice models. By choosing to analyze work trips, however, we analyze a portion of the total trips with a relatively long reaction time and high impedance to mode change. Total volumes are not likely to be altered significantly by L.O.S. changes. At a later point in this study, activity shifts and other than work trips will be studied, but presently a fixed total demand is hypothesized for the journey-to-work case.

The modelling technique chosen consists of a transportation alternatives evaluation package - TTP1 - developed in the Transportation Systems Division, Civil Engineering Department at M.I.T. This package forecasts network flow volumes and travel times by maximizing user utility. The package actually minimizes a generalized "price", a disutility based on travel time, wait time and out of pocket cost.

Incremental assignment is used to "build" flow volumes and best utilize preprogrammed volume/delay (link congestion) statistics. Assignment is based on a minimum path algorithm, and continues until flow volumes are satisfied. In analyzing the work trips - a captive flow volume -this modal split type model is ideal, and activity shift predictions are not required.



THE STUDY AREA - COUNTY DIVISIONS AND FACILITY LOCATIONS

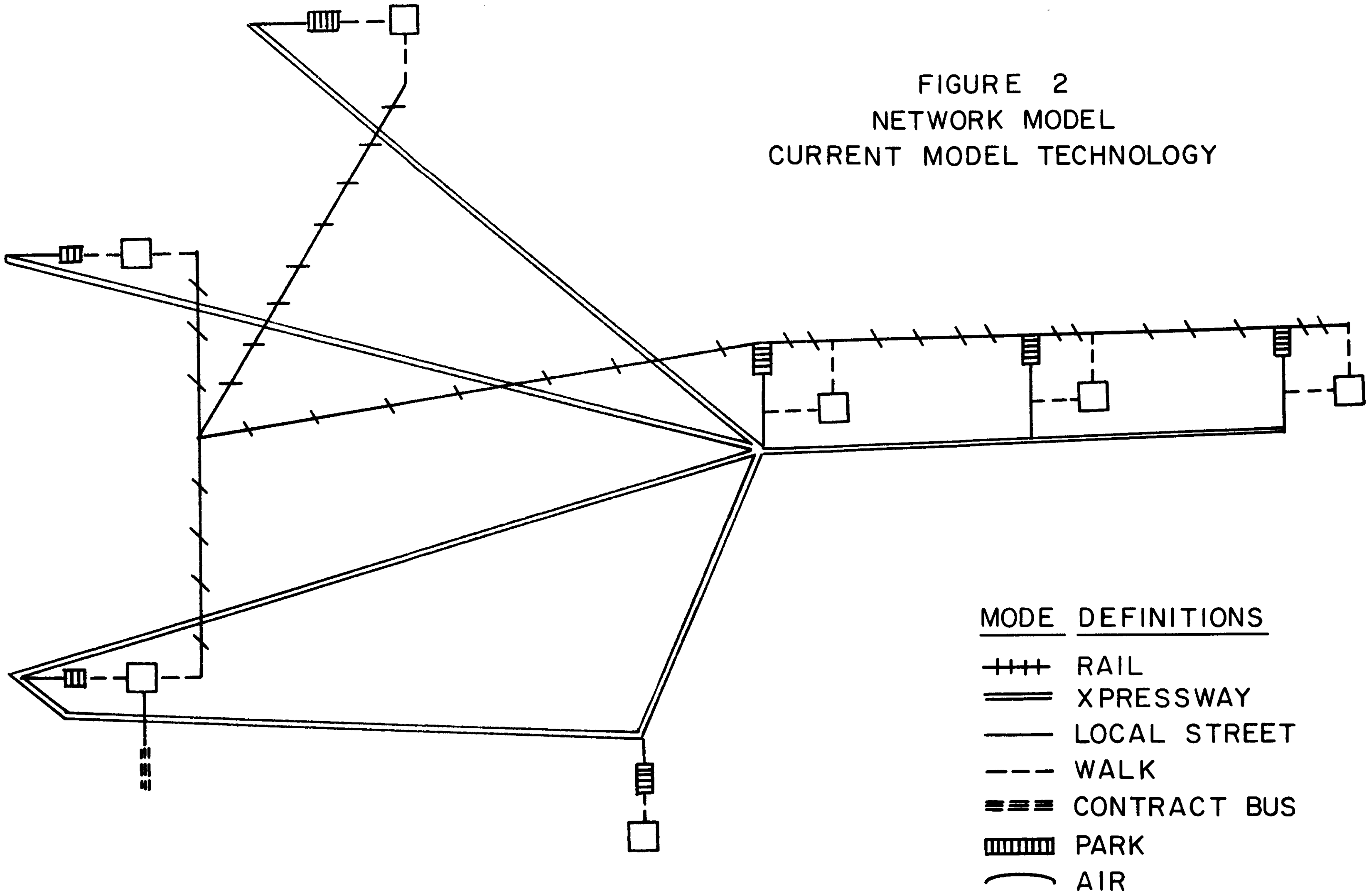
The study area - essentially the eastern portion of the New York SMSA - consists of Manhattan, portions of Queens County, Nassau County and the western half of Suffolk County. Seven zones were identified in the study, those being: 1) Manhattan CBD, 2) Upper Manhattan/southwest Westchester County, 3) Laguardia Airport and environs, 4) J.F. Kennedy Airport and environs, 5) western Nassau County, 6) eastern Nassau County 7) western Suffolk County.

Zones were chosen on the basis of commuting trip volumes, income levels, and degree of interfaceability with the current NYA route system. Considering now the journey to work trip, the O-D matrix is primarily from out-Island to downtown during the morning commute. A daily return from work flow would in general be similar with respect to flow magnitudes and directions (inverse). This de-commute was not analyzed, but should be modally, and volumetrically symmetrical to the morning pattern.

These seven zones were linked up into a baseline network and then a proposed phase two network. The baseline network used in the model is a stylized representation of the expressway network serving the Nassau and Suffolk County areas of Long Island. The road "sizes" (in terms of lanes and volume/delay characteristics per lane) have been scaled down to account for the portion of total trip volumes not represented by the study at present. (Non - work trips, intracounty trips, reverse commuting, and trip volumes generated in regions not modelled but normally flowing through the stylized network.)

Four modes are identified. They are - auto, rail, park-ride (rail and auto), and the helicopter alternative. While the rail and park-ride paths are well represented by the model, there could be other stations. For the auto user, the paths open to him are comparable to actual usage patterns. For the preliminary

FIGURE 2
NETWORK MODEL
CURRENT MODEL TECHNOLOGY



case, nonstop air service is offered from a location modelled as Grumman-Bethpage Field, in eastern Nassau county. Local street and expressway access is employed to Grumman-Bethpage, parking is provided on-site, and direct services are offered to JRB (Wall Street), LGA, and JFK. (If price is lowered, upper Manhattan is identified as a likely spot for expansion of service, but in the base case, there is no offering to upper Manhattan.)

The phase two network identifies that with a single facility, travel time is still mostly dependent on expressway travel time. Each Long Island origin zone is provided a heliport, and multistop service is offered to each of the four CBD destination zones. Other modes are unchanged, and phase two demonstrates that through load-building multistop service, the short haul expansion is feasible.

Sample fleet requirements and routing are proposed based on optimal headways in the final portion of the proposal. Fleet expansions of three aircraft could handle the mean forecast travel volumes based on thirty minute headways; seven aircraft would be required at fifteen minute headways.

II. Demand Forecast Background

In making the demand forecast, several policies were envisioned, and within each policy, several scenarios explored. Policies common to all cases are:

1. The current Nassau County and regional transportation systems
2. Reference journey-to-work travel volumes
3. Demand elasticities with respect to time and cost

In the case of the elasticities, so called "gravity" elasticities were chosen for both time and cost. Within the time parameter, two components were identified - wait time and in-vehicle travel time - with "bothersome" wait time weighted double that of in-vehicle travel time. Gravity ($\alpha_{cost} = \beta_{time} = -2$) values were chosen as baseline reference points. While not statistically tailored to this particular market, they represent valid benchmarks with which to model demand. (Historically, such "fitted" elasticities vary enormously from market to market and mode to mode. Statistically justifiable cost elasticities ranging from -13 to +2 have been identified in other studies in other markets, so "gravity" values are certainly sound.)

A fixed volume of traffic is treated in this case in consideration of its being journey-to-work traffic. Supporting studies dealing with pleasure traffic, a group more sensitive to cost and more likely less sensitive to travel time as a level of service parameter indicate a smaller market penetration on a percentage basis, but due to its larger total volume, a flow of approximately similar magnitude to business travel. Considering the non-peak hour demand characteristics for this group, they provide potential for higher equipment utilization figures.

The reference transportation network is for all cases the same. Only differences in short-haul air transportation policy show up as tangible differences in the physical network. Travel times in the equilibrium network match closely the reported travel times during the peak hour, as does the modal split.

Three basic policies were identified; all relate to whether or not, and to what degree subsidy may be offered:

1. fares based on NYA published OAG fares
2. 33% subsidy
3. 66% subsidy

(2 and 3: in light of current Amtrak subsidies)

Scenarios within the policies relate to physical level of service offerings and include:

1. a single Nassau county heliport
2. a three heliport case with optimized locations
3. and 4. sub cases of 1 and 2 with reduced headways.

Network representations and sample inputs are presented below and in Appendix A respectively for each policy/scenario/headway combination. Policy decisions are reflected in path costs (fares), scenarios are identifiable through link and path descriptions, and headway variations are located within the line descriptions.

III. Results of Demand Forecasts

Forecast unconstrained helicopter service demand matrices for each of the policy/scenario/headway combinations explored are presented following a short analysis of relevant details. Accompanying each are Level of Service parameters and indicators.

Locations of downtown heliports in the study include:

JRB - Wall Street

CPK - 59th Street (vicinity of Central Park, Upper Manhattan)

LGA - Laguardia Airport

JFK - John F. Kennedy International Airport

Heliports in Nassau and Suffolk Counties were (for the present time) modelled as if located as follows:

MIT - Mitchell Field (eastern Nassau County heliport location)

GMN - Grumman/Bethpage Field (western Nassau County and single heliport location)

DPK - Deer Park (eastern Suffolk County heliport location)

In actuality, the modelled heliports were optimally located with respect to service area passenger accessibility as a function of both trip cost and access/egress time. The above physical locations do however, approximate these optimal sites.

The Base Case

Four policy/scenario/headway examples were investigated. Air service was provided along three nonstop routes: GMN-JFK, GMN-JRB, GMN-LGA. The single heliport was modelled as if located at Grumman-Bethpage Field. The four cases were:

1. Fares based on NYA's December 1975 published OAG fare formula (Figure 3, Table 3)

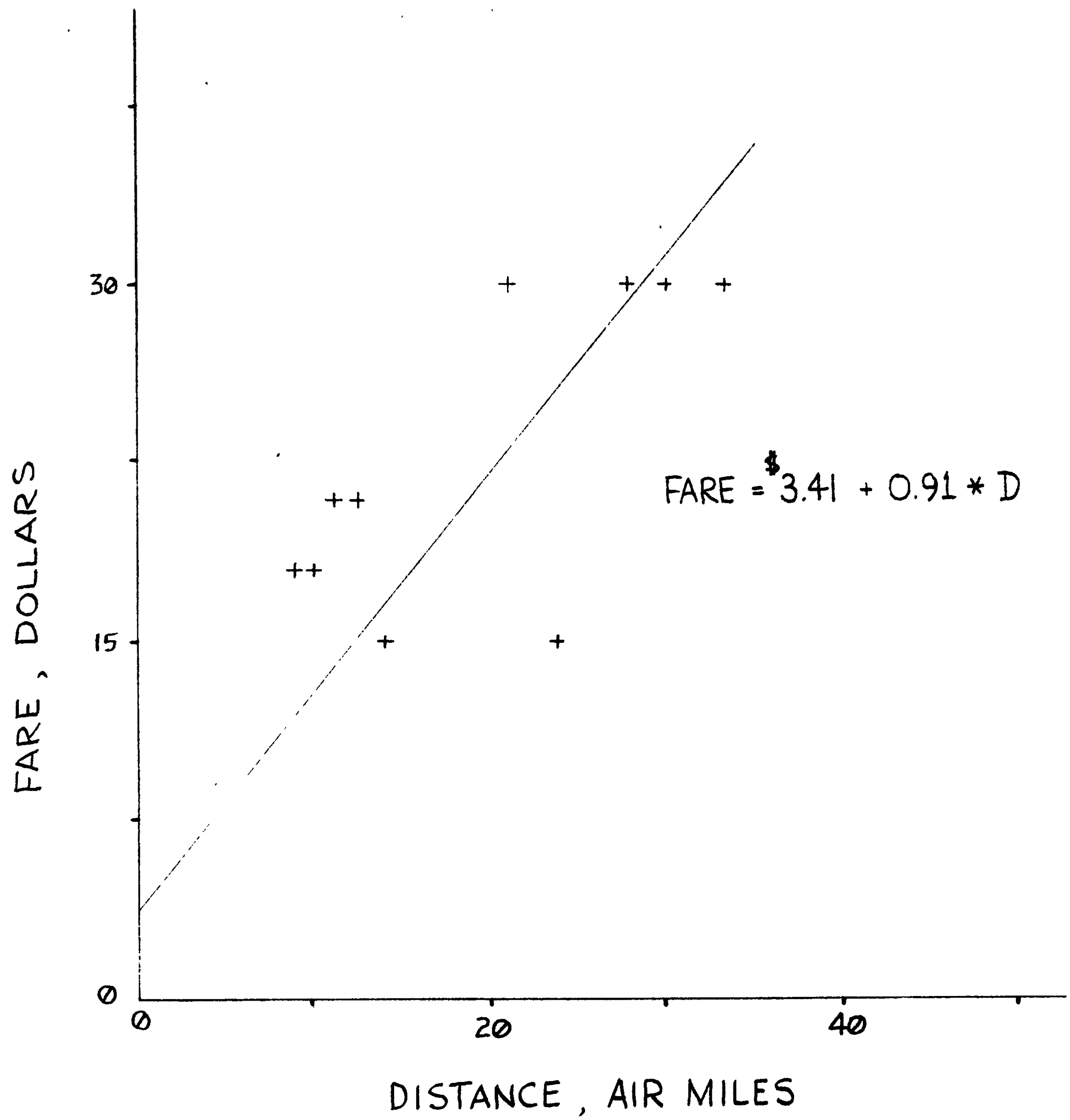
2. Helicopter proportional fares to JFK, LGA to avail users of interline "joint fares." These average approximately 40% lower than point to point OAG fares and are described in Table 4 .

3. Decreased headway (15 → 10 minutes)

4. Level of service increases by combining effects in 2. and 3.

Market demand forecasts, penetrations and level of service variables are given in Table 6.

The network representation is described in Figure 4.



NEW YORK AIRWAYS FARE FORMULA

FROM PUBLISHED O.A.G.

"A" CLASS FARES

DECEMBER 1975

FIGURE 3

TABLE 3

POINT TO POINT FULL FARES

BASED ON 1975 FARE FORMULA

SINGLE HELIPORT CASES

	Wall Street (JRB)	59th Street (CPK)	LaGuardia (LGA)	J.F. Kennedy International (JFK)
Grumman/Bethpage	27.29	N/A	21.60	19.55

THREE HELIPORT CASES

	Wall Street (JRB)	59th Street (CPK)	LaGuardia (LGA)	J.F. Kennedy International (JFK)
Mitchell Field (MIT)	22.80	28.05	20.40	15.45
Grumman/Bethpage (GMN)	34.80	40.05	32.65	27.45
Deer Park (DPK)	47.45	52.80	45.30	40.20

NOTE: Air link only. Does not include costs of auto access, and other ground charges.

TABLE 4

JOINT INTERLINE FARES

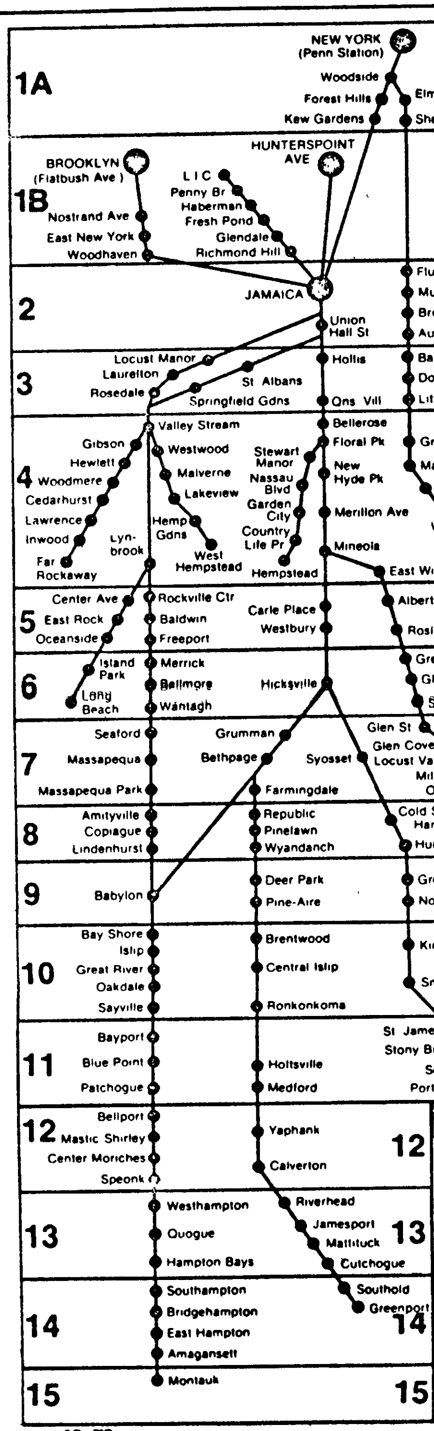
BASED ON JOINT INTERLINE FARE SCHEDULE

	LGA	JFK
GMN	10.80	9.80

(fares noted for single heliport case only)

TABLE 5

The Long Island Rail Road FARE ZONES



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Zone	New York Monthly	New York Weekly	New York One Way or S.S.T.	New York Weekend Excur.	Brooklyn Monthly	Brooklyn Weekly	Brooklyn One Way or S.S.T.	Brooklyn Weekend Excur.	N.Y. One Way RAIL-BUS MONT	N.Y. One Way RAIL-BUS GRNPT
1A	$39.50	$11.45	$1.45	$2.20						
1B					$34.85	$10.10	$1.30	$1.95		
2	44.95	13.05	1.65	2.50	40.25	11.70	1.50	2.25		
3	46.65	13.55	1.70	2.55	42.00	12.20	1.55	2.30		
4	50.75	14.70	1.85	2.80	46.10	13.35	1.70	2.55		
5	52.50	15.25	1.90	2.85	47.85	13.90	1.75	2.60		
6	54.85	15.90	2.00	3.00	50.20	14.55	1.85	2.75		
7	56.00	16.25	2.20	3.30	51.35	14.90	2.05	3.05		
8	58.35	16.90	2.30	3.45	53.70	15.55	2.15	3.20		
9	60.10	17.45	2.50	3.75	55.45	16.10	2.35	3.50		
10	62.40	18.10	3.00	4.50	57.75	16.75	2.85	4.25		
11	66.50	19.30	3.35	5.05	61.85	17.95	3.20	4.80		
12	70.00	20.30	4.00	6.00	65.35	18.95	3.85	5.75	$3.35	–
13	81.00	23.50	4.65	7.00	76.35	22.15	4.50	6.75	3.95	$3.95
14	92.50	26.85	5.50	8.25	87.85	25.50	5.35	8.00	4.40	4.25
15	108.00	31.35	6.00	9.00	103.35	30.00	5.85	8.75	5.00	–

FIGURE 3A

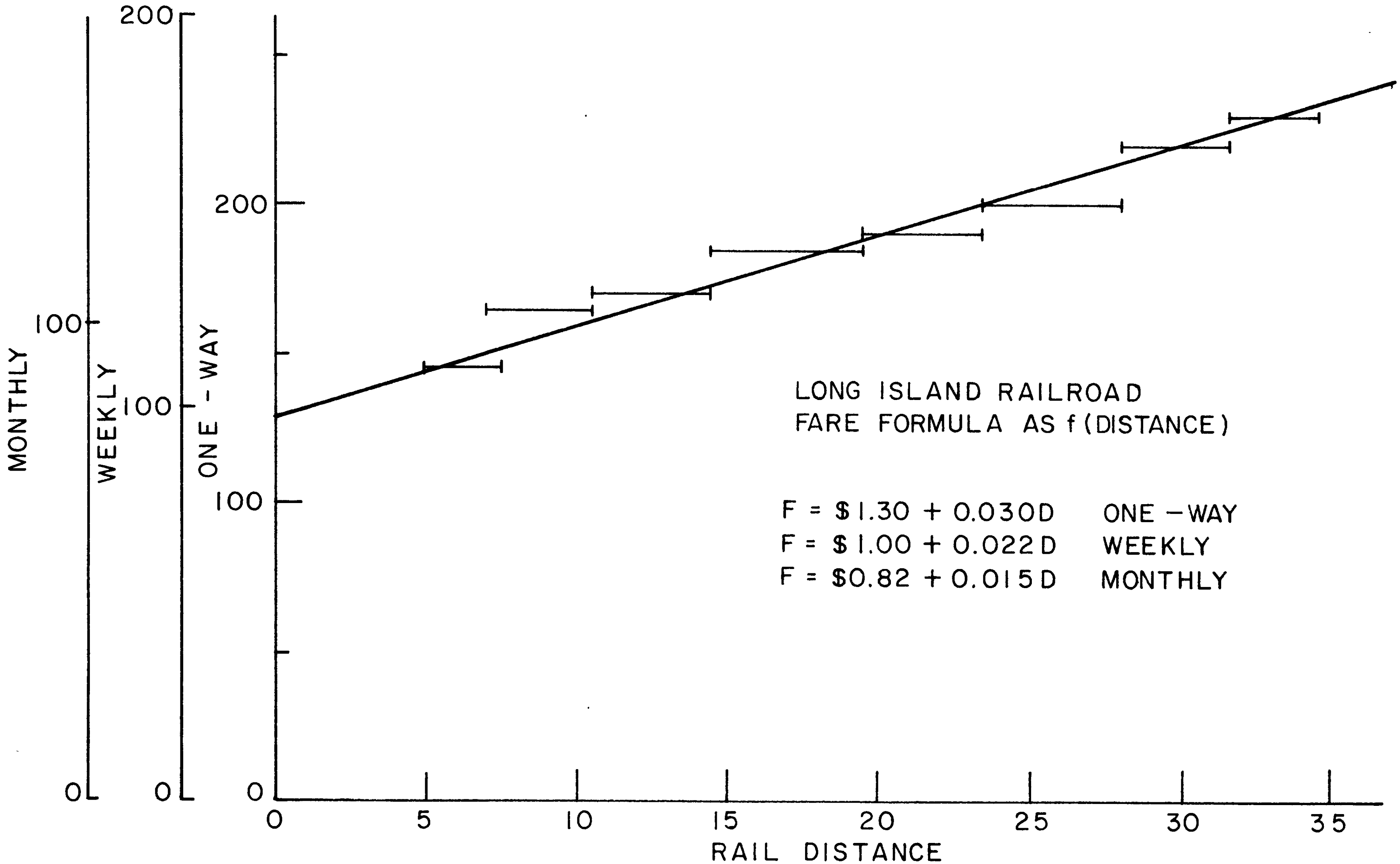

MONTHLY
WEEKLY
ONE - WAY
200
100
0
200
100
0
200
100
0
0
5
10
15
20
25
30
35
RAIL DISTANCE
LONG ISLAND RAILROAD
FARE FORMULA AS f (DISTANCE)
F = $1.30 + 0.030D ONE - WAY
F = $1.00 + 0.022D WEEKLY
F = $0.82 + 0.015D MONTHLY

FIGURE 4
NETWORK MODEL
BASE AND SINGLE HELIPORT CASES

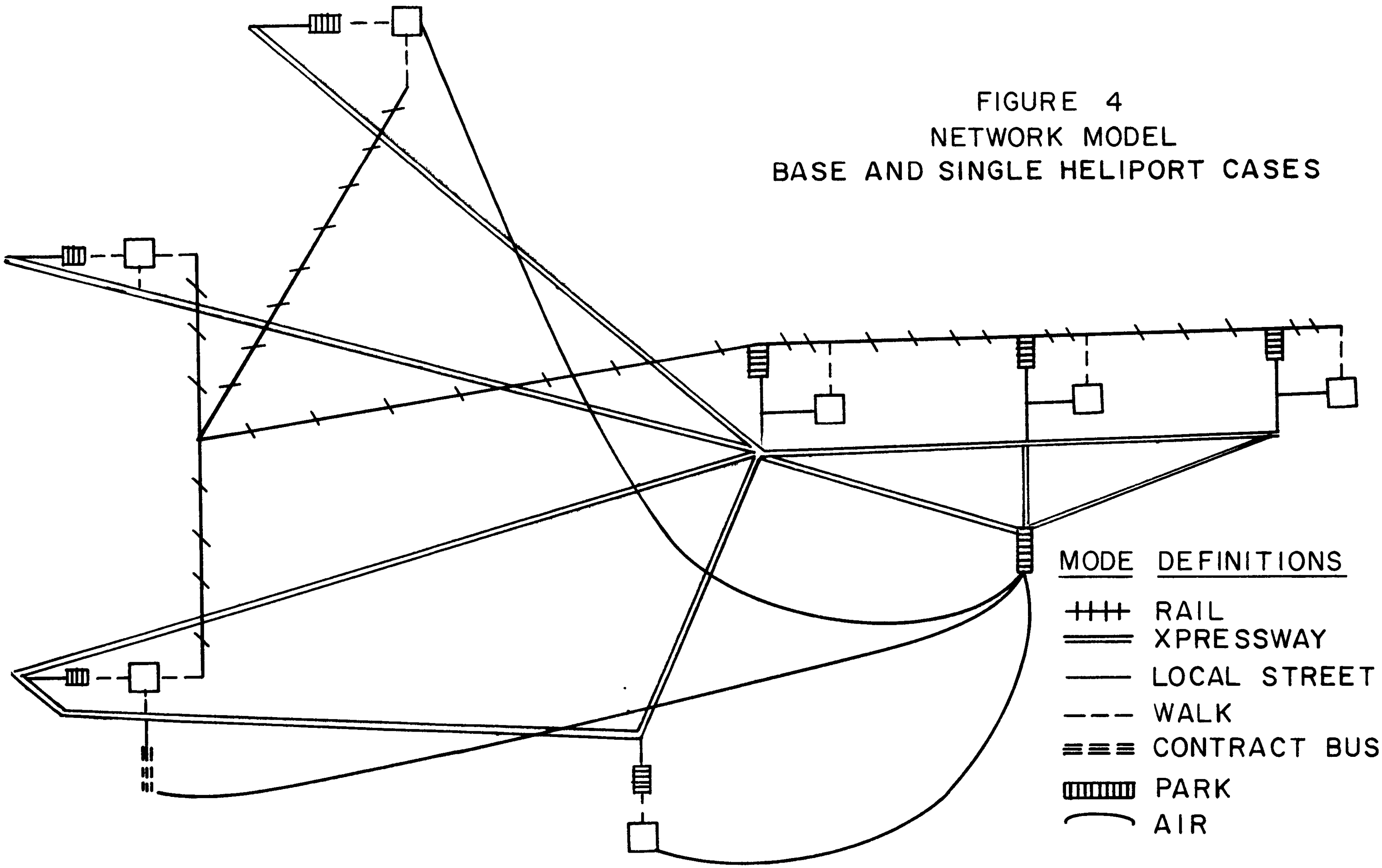


TABLE 6

Unconstrained Helicopter Service

Demand Forecast - Base Cases

FROM \ TO	Wall Street	Upper Manhattan	LGA	JFK	Totals	
W. Nassau	1870	19	1	1	1891	
E. Nassau	260	4	1	1	266	NYA Fare Formula
W. Suffolk	10	4	0	0	14	
Totals	2140	27	2	2	2171	P = .0187
W. Nassau	1870	19	6	1	1896	
E. Nassau	260	4	22	1	287	Joint Interline Fares
W. Suffolk	10	4	0	0	14	P = .0189
Totals	2140	27	28	2	2197	
W. Nassau	1940	19	1	1	1961	
E. Nassau	260	47	1	1	309	10 Minute Headway
W. Suffolk	10	23	0	0	33	P = .0198
Totals	2200	89	2	2	2303	
W. Nassau	1950	18	6	1	1975	
E. Nassau	260	75	34	1	370	Joint Interline and 10 Minute Head-
W. Suffolk	10	24	0	0	34	ways
Totals	2220	117	40	2	2379	P = .0205

Note: Total one-way trips in zones analyzed = 116,000

We see that in the full fare one heliport case, the market penetrations and total travel volumes are substantially similar. The advantage of interline joint fare agreements is substantial compared to the total volume of travel to the metropolitan airports, but small if viewed in the light of the 116,000+ daily work trips. Had Newark been modelled in the network, it is probable that such a joint fare agreement would have greatly stimulated air traffic to that hub which, lying a greater distance from the study area, accentuates the travel time advantage enjoyed by air. The headway decrease from 15 to 10 minutes (4 → 6 hourly frequencies) shows up as a demand increase in the two origin zones closest to the GMN heliport. The western Nassau county region does not indicate demand increases due to relatively lengthy travel time during auto access. This fact will show up again and again:

If auto access times can be reduced, the air speed advantage can be more fully enjoyed.

The final case included both reduced joint fares and reduced headways. This level of service yielded approximately 2.0% market penetration and 2400 passengers per peak AM period inbound.

From analysis of the base case, several management decisions could be made:

- attempt to minimize access and egress times
- work towards interline or other fare subsidy
- concentrate on stimulating traffic to airports, as demand exists to Wall Street, and upper Manhattan (if served).

Policies identified in this case as being issues show up in the two subsequent policy/scenario/headway investigations that follow.

Average trip times for each modal choice are translated in Table 7 along with modal splits in the Base Case.

TABLE 7

BASE CASE

REPRESENTATIVE TOTAL TRIP TIMES (MINUTES) AS A FUNCTION OF TRAVEL MODE

Mode	From \ To	Wall Street	Upper Manhattan	LGA	JFK	Mean Modal Split, MS_{Base}
Auto	W. Nassau	56.9	63.1	46.3	43.2	.238
	E. Nassau	68.3	74.5	57.7	55.0	
	W. Suffolk	87.3	93.5	76.7	74.0	
Rail	W. Nassau	44.5	45.4	55.3	N/A	.408
	E. Nassau	63.0	63.7	73.8	N/A	
	W. Suffolk	77.5	83.1	93.2	N/A	
Park/Ride	W. Nassau	45.5	46.5	65.3	N/A	.335
	E. Nassau	63.8	64.5	74.6	N/A	
	W. Suffolk	83.8	89.4	99.5	N/A	
Air	W. Nassau	50.0	N/A	39.9	38.7	.019
	E. Nassau	40.3	N/A	30.1	28.9	
	W. Suffolk	45.4	N/A	35.3	34.1	

N/A - Denotes modes not available in this case for specified origin-destination pair.

TABLE 8

Unconstrained Helicopter Service Demand Forecast

Single Heliport Case with Subsidy

FROM \ TO	Wall Street	Upper Manhattan	LGA	JFK	Totals	
W. Nassau	3140	116	3	6	3265	33% Subsidy 15 Minute Headway
E. Nassau	520	10	1	1	532	
W. Suffolk	200	1	0	0	201	P = .0344
Totals	3860	167	4	7	3998	
W. Nassau	4840	58	15	6	4919	
E. Nassau	960	46	1	10	1017	66% Subsidy 15 Minute Headway
W. Suffolk	400	27	0	0	407	P = .0543
Totals	6200	131	16	16	6363	
W. Nassau	3290	198	11	11	3490	33% Subsidy 10 Minute Headway
E. Nassau	520	14	1	1	536	
W. Suffolk	200	4	0	0	204	P = .0365
Totals	4010	216	12	13	4251	
W. Nassau	5290	248	16	6	5550	
E. Nassau	870	54	9	7	940	66% Subsidy 10 Minute Headway
W. Suffolk	380	22	0	0	402	
Totals	6540	924	26	13	6892	P = .0594

Note: Total one-way trips in zones analyzed = 116,000

From the demand forecasts, we see that the headway change from 15 to 10 minutes provides an approximate ten percent increase in demand at both the 33% and 66% subsidy levels. The source of the demand appears to be the western Nassau county zone, and the designations most stimulated are the airports.

Unfortunately, the headway change makes little impact due to the overriding contribution of auto access time to the disutility. The demand increment does not overtax the contract bus egress system. This is offered on a vehicle-for-vehicle basis.

The subsidy increment from base case to 33% subsidy yielded a demand increase of ~77-79% on the base case travel volumes. Substantial gains occurred in all markets but mostly in the outlying origin zone to Wall Street and upper Manhattan markets. Airport traffic was stimulated, but not to the extent that other market segments were.

The increase to 66% subsidy produced an increment of demand of from 57% to 58% over 33% subsidy volumes. A substantial diminishing return to scale is noticed here over the zero to 33% subsidy volume increments. Larger gains in demand occurred to airports and Wall Street for the fifteen minute headway case, and just to Wall Street in the ten minute headway case.

The diminishing return provided by the extra subsidy increment to 66% with the one heliport case must be noted with concern. This is certainly an atypical market reaction and should be explored further, should the one heliport scenario be undertaken.

With level of service changes as large as the proposed in the 66% subsidy cases, an activity shift model should be used to assess the impact of latent demand even in the business sector.

The Three Heliport Case

The same four subsidy/headway combinations were identified and analyzed as in the one heliport case. Multistop helicopter service was provided from three "local" heliports optimally located in each of the three origin zones. A load building route structure was assumed in order that average segment and route load factors could be adjusted according to demand. The subcases considered were:

1. 33% subsidy - 15 minute headway
2. 66% subsidy - 10 minute headway
3. 33% subsidy - 15 minute headway
4. 66% subsidy - 10 minute headway

Corresponding demand forecasts, market penetration and L.O.S. variables are listed in Tables 9, 10, network representation is described in Figure 5.

FIGURE 5
NETWORK MODEL
THREE HELIPORT CASES

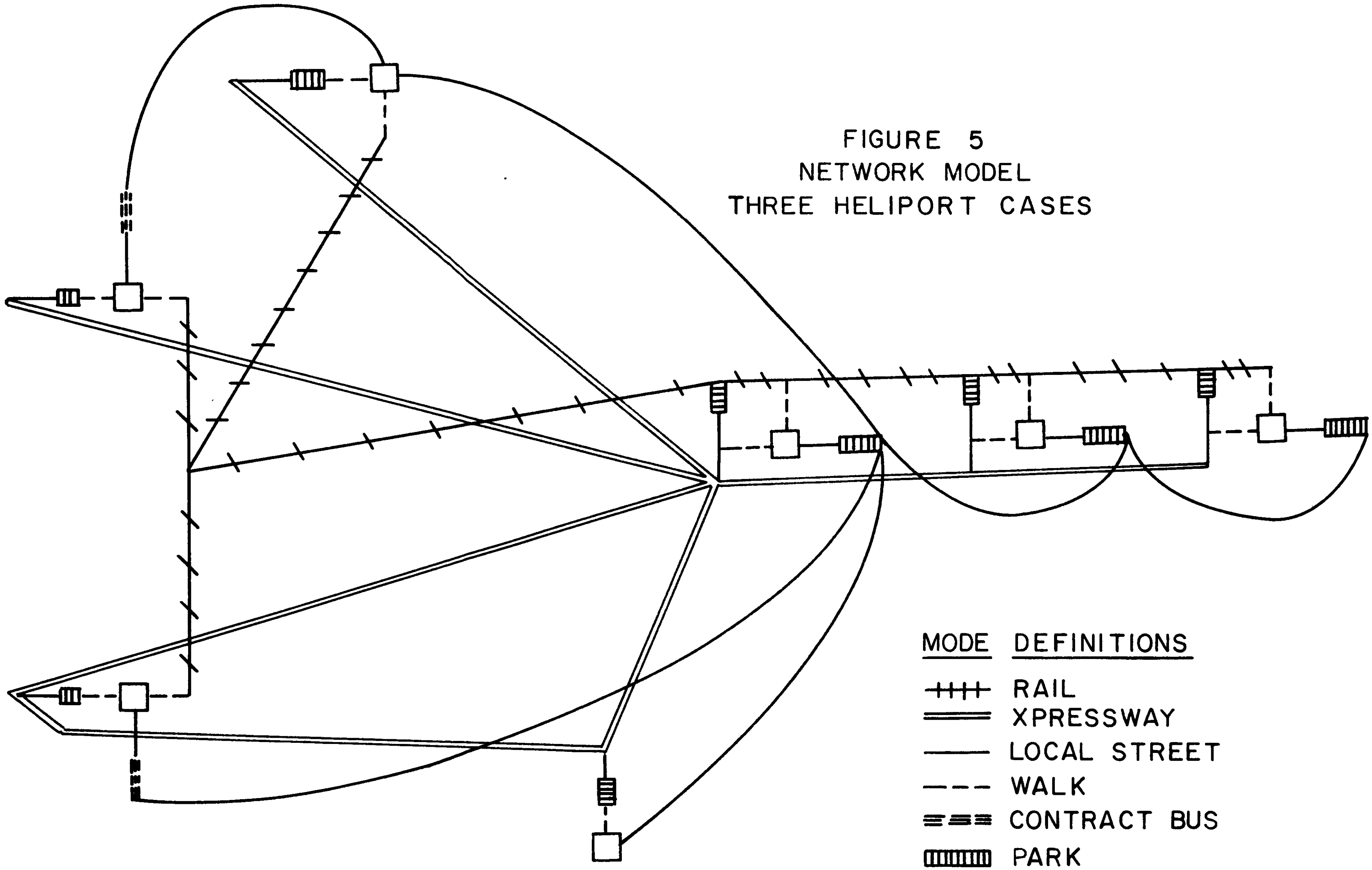


TABLE 9

Unconstrained Helicopter Service Demand Forecast

Three Heliport Cases with Subsidy

FROM \ TO	Wall Street	Upper Manhattan	LGA	JFK	Totals	
W. Nassau	4050	98	1	1	4150	33% Subsidy
E. Nassau	390	4	1	1	396	15 Minute Headway
W. Suffolk	10	22	0	0	32	P = .0394
Totals	4450	124	2	2	45 73	
W. Nassau	5810	138	6	6	5960	
E. Nassau	770	47	2	2	821	66% Subsidy
W. Suffolk	280	4	6	0	284	15 Minute Headway
Totals	6860	189	8	8	7065	P = .0609
W. Nassau	4760	107	15	6	4348	
E. Nassau	390	16	1	1	408	33% Subsidy 10 Minute
W. Suffolk	10	11	0	0	21	Headway
Totals	4660	134	16	7	4817	P = .0415
W. Nassau	6080	110	15	6	6211	
E. Nassau	780	49	2	2	833	66% Subsidy 10 Minute Headway
W. Suffolk	360	8	0	0	368	
Totals	7220	167	17	8	7412	P = .0603

Note: Total one-way trips in zones analyzed = 116,000

TABLE 10

Three Heliport Case, 33% Subsidy
Representative Trip Times (Minutes) as a
Function of Travel Mode

Mode						Mean Modal Split, MS_{33}
Auto	Trip times substantially unchanged due to small volume of mode change with respect to total trip volumes. (ref. Table 7)					.234
Rail						.418
Park/Ride						.311

	From \ To	Wall Street	Upper Manhattan	LGA	JFK	Mean Modal Split, MS_{33}
Air	W. Nassau	28.9	36.7	20.9	17.9	.0404
	E. Nassau	37.1	45.0	29.2	26.2	
	W. Suffolk	49.4	57.3	41.5	38.5	

NOTE: All origin-destination pairs served by air; other mode limitations served as in base case.

As total level of service increases, we see that any one policy has a smaller effect on total L.O.S., hence a smaller demand stimulation.

The reduction of headways in the three heliport case accounts for only a 5 - 6% increase in demand. This is surprising since with the three port case, access time is minimized and is reflected in total trip time. Some point-to-point fare levels are higher however, due to decentralized helicopter mode access. Clearly, if Grumman-Bethpage is the benchmark, Mitchell Field would be a lower fare, and Deer Park correspondingly higher. This is reflected in trip distribution among origins with increases in demand at close-in origins, and declines in Suffolk County originating traffic.

Subsidy increases from 33% to 66% show demand increments of 52 - 54%. (There was no full fare three heliport case modelled.) These are comparable to the single port case and are - as expected - lower due to overall higher L.O.S.

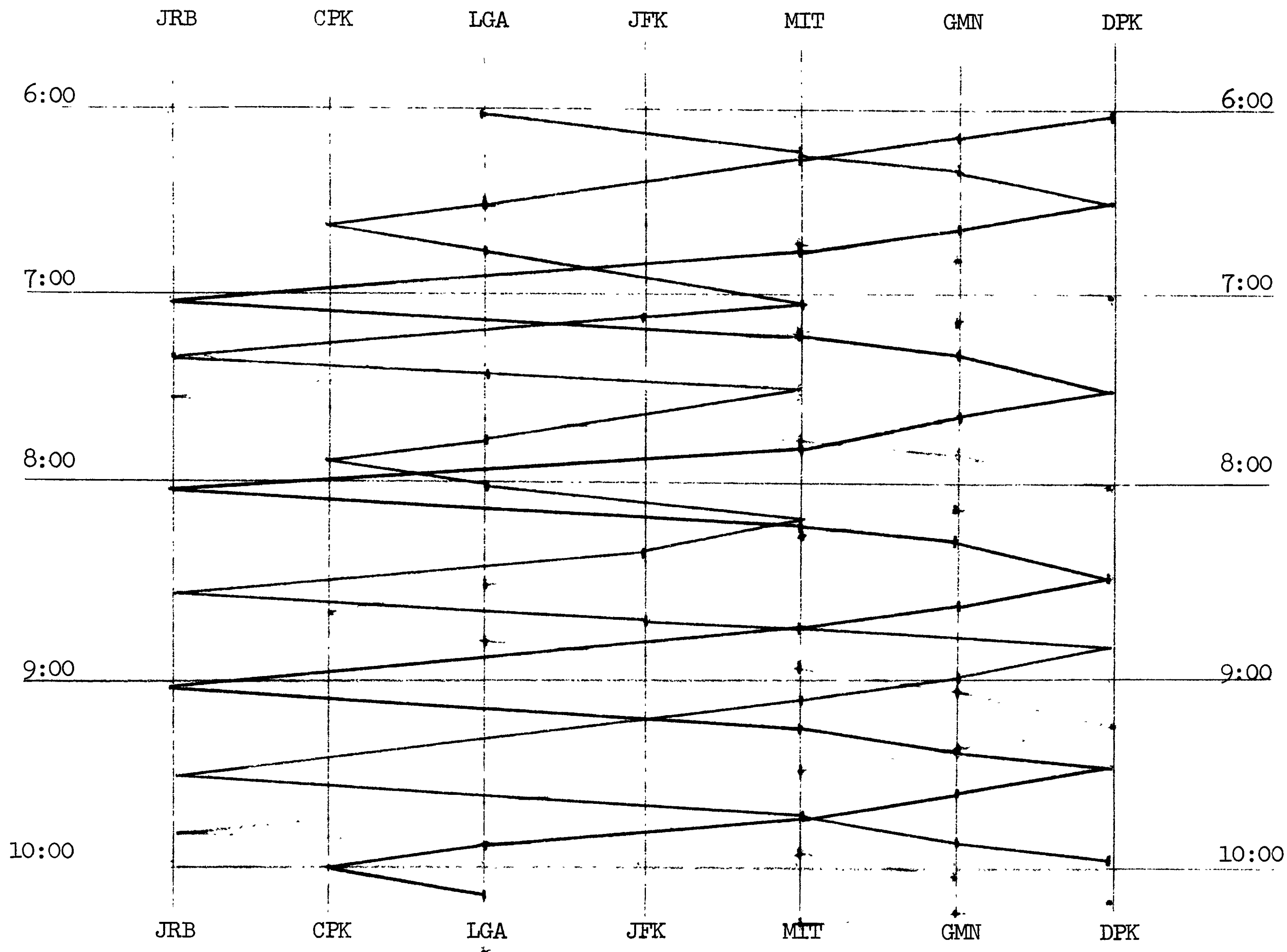
Localized gains in traffic are all comparable, with no areas recording demand increments out of line with the average figures on the destination end, but incremental demands by origin show greater than 100% increases for both outlying origin zones. This again reflects the disparity in the point-to-point fares charged at the eastern Nassau and western Suffolk facilities.

An interesting point to ponder is that of multi-heliport common fare service. In effect, cross-subsidization of outlying heliport operations by closer in facilities. This could be the answer to small origination volumes at the Deer Park facility. Note, however, that this runs absolutely contrary to the current CAB approved cross-subsidation of short haul routes by long haul routes.

Decreased headways will only become greater stimuli for demand when heliports are so numerous so as to offer effectively "door to door" access availability - and hence absolute minimum access times.

FIGURE 6

THREE AIRCRAFT, THREE HELIPORT CASE



MORNING PEAK HOUR SCHEDULE MAP

TABLE 11

Three Heliport Case, 66% Subsidy

Modal Split and Trend

	MS_{66}	$(MS_{66} - MS_{33})$	$(MS_{33} - MS_{Base})$
Auto	.222	-.012	-.004
Rail	.404	-.014	+.010
Park/Ride	.311	0	-.024
Air	.0624	+.0220	+.0214

TABLE 12

Out of 116,000 total area one-way journey to work trips, the following numbers of trips would utilize the air mode at the indicated service levels:

No. of Heliports	D.O.C. Subsidy Level	Trips Generated	Required Fleet Size
1	0%	2171	3
1	33%	3998	4
1	66%	6363	4
3	0%	~3400	6
3	33%	4573	7
3	66%	7065	7

Fleet Size Requirement is for 15-minute headways

IV. Supplementary Findings and Conclusions

The demand forecasts, then dictate that (with a nominal three helicopter addition to the NYA operation) New York Airways expansion to Nassau county is feasible, but likely unable to satisfy peak hour demand. At full fare, demand is such that at least a fifteen minute headway during the peak AM/PM hours would be required to accomodate business travel alone.

The addition of three S-61/65 rotorcraft plus more intensive utilization of the existing fleet could come close to meeting peak hour demand while increasing the fleet utilization overall. A sample AM peak aircraft routing schedule assuming 3 minute turnaround is presented in Figure 6. Such routings add 1035 route miles per morning peak and consist of 75 flight segments comprising 8.50 rotor hours and 12.25 aircraft hours. System averages are 13.8 mile stage lengths, 9 minute block times. A potential 15000 RPM could be generated at 60% load factor (15,000 ASM) per morning peak, over 30,000 RPM per day.

Sensitivity analyses show that for the scheduled 30 minute headways (the best possible with three aircraft) demand will not soften proportionately to the doubled headway if standard reserved seats are offered. With a no-backup shuttle, however, the longer headways will diminish the attractiveness of such a system.

An analysis of incurred costs will be undertaken at a later stage to include:

1. Direct operating costs of demonstration vehicles.
2. Station creation and operating costs for suburban heliports.
3. Allocation of indirect operating costs to the New York Airways.

At this point, having identified service parameters, such as fare structure, schedule frequency, trip time and accessibility, and having shown their effects - on paper - on demand for helicopter service, it is time to consider the demonstration project.

The main objective has been to demonstrate short-haul air transport to the travelling public. An equally important aspect, however, is to demonstrate the improved environmental aspects of noise, pollution, and access traffic patterns to the non-travelling public for the purpose of obtaining the required level of commuting acceptance. Finally, demonstration of the operational and economic feasibility of the proposed service to the potential operator and their financial backers is required.

To satisfy all these constraints in a demonstration program will require time and will not be inexpensive, yet the market research aspects of such a project cannot be overstated. Lacking a unified national plan for development of such systems, here is an excellent opportunity to provide meaningful input into the fomulation of such policy level decisions.

APPENDIX A -

SAMPLE INPUT SPECIFICATION FOR A THREE HELIPORT CASE

NETWORK ZONES = 7 MODES = 4 LINES = 9 LINKS = 62

LINKS NO. OF LINKS = 62

NO.	ORIGIN	DEST	DIST	LANES	V/D IVTT	V/D OVTT	COST	
71	7	711	200	2	3	0	16	1
72	711	712	335	2	3	0	27	2
73	711	713	335	2	3	0	27	3
74	713	714	100	2	8	0	25	4
75	7	715	75	1	0	1	0	5
76	715	714	300	1	2	0	0	6
61	6	611	200	2	3	0	16	7
62	611	612	120	2	3	0	10	8
63	611	613	120	2	3	0	10	9
64	613	614	100	2	8	0	25	10
65	6	615	75	1	0	1	0	11
66	615	614	300	1	2	0	0	12
51	5	511	200	2	3	0	16	13
52	511	512	95	2	3	0	8	14
53	511	513	95	2	3	0	8	15
54	513	514	100	2	8	0	25	16
55	5	515	75	1	0	1	0	17
56	515	514	300	1	2	0	0	18
41	414	4	50	1	0	5	0	19
42	415	414	100	2	9	0	150	20
43	416	415	100	2	3	0	8	21
31	314	3	33	1	0	5	0	22
32	315	314	100	2	9	0	150	23
33	316	315	100	2	3	0	8	24
34	311	3	50	1	0	5	0	25
21	214	2	33	1	0	5	0	26
22	215	214	100	2	10	0	100	27
23	216	215	230	2	3	0	18	28
24	211	2	50	1	0	5	0	29
11	114	1	33	1	0	5	0	30
12	115	114	100	2	10	0	100	31
13	116	115	167	2	3	0	14	32
14	111	1	50	1	0	5	0	33
15	112	1	25	1	0	5	0	34
16	113	112	110	2	7	0	0	35
97	714	615	800	1	2	0	0	36

96	614	515	725	2	2	0	0	37
95	514	900	1810	2	2	0	0	38
93	900	311	910	1	2	0	50	39
92	900	211	360	1	2	0	50	40
91	900	111	300	1	2	0	50	41
79	718	618	1399	1	6	0	0	42
88	712	612	1099	3	4	0	88	43
19	518	113	2430	1	6	0	0	44
69	618	518	1324	1	6	0	0	45
87	612	512	1024	3	4	0	82	46
86	512	416	1389	3	4	0	112	47
85	416	116	1340	4	4	0	107	48
84	512	116	2265	4	4	0	181	49
83	512	216	2830	4	4	0	227	50
82	512	316	1940	4	4	0	155	51
49	518	4	1689	1	6	0	0	52
39	518	3	2240	1	6	0	0	53
29	3	213	850	1	6	0	0	54
57	511	517	295	2	3	0	24	55
58	517	518	50	1	8	0	50	56
67	611	617	320	2	3	0	26	57
68	617	618	50	1	8	0	50	58
77	711	717	535	2	3	0	43	59
78	717	718	50	1	8	0	50	60
25	212	2	25	1	0	5	0	61
26	213	212	205	2	7	0	0	62

LINES NO. OF LINES = 9

NO.	HEAD	LINKS	SEQUENTIAL ORDER									
1	600	4	79	69	19	16	0	0	0	0	0	0
2	600	5	79	69	39	29	26	0	0	0	0	0
3	600	3	79	69	49	0	0	0	0	0	0	0
4	600	6	76	97	66	96	56	95	0	0	0	0
5	600	4	66	96	56	95	0	0	0	0	0	0
6	600	2	56	95	0	0	0	0	0	0	0	0
7	180	1	91	0	0	0	0	0	0	0	0	0
8	180	1	92	0	0	0	0	0	0	0	0	0
9	180	1	93	0	0	0	0	0	0	0	0	0

PATHS NO. OF PATHS = 50

ORIG	DEST	MODE	NO.	COST	LINK-LINE PAIRS																			
7	1	1	1	260	75	0	76	4	97	4	66	4	96	4	56	4	95	4	91	7	14	0	0	0
7	1	2	1	230	71	0	73	0	74	0	97	4	66	4	96	4	56	4	95	4	91	7	14	0
7	1	3	1	0	71	0	72	0	88	0	87	0	84	0	13	0	12	0	11	0	0	0	0	0
7	1	4	1	3170	71	0	77	0	78	0	79	1	69	1	19	1	16	1	15	0	0	0	0	0
6	1	1	1	200	65	0	66	5	96	5	56	5	95	5	91	7	14	0	0	0	0	0	0	0
6	1	2	1	170	61	0	63	0	64	0	96	5	56	5	95	5	91	7	14	0	0	0	0	0
6	1	3	1	0	61	0	62	0	87	0	86	0	85	0	13	0	12	0	11	0	0	0	0	0
6	1	3	2	0	61	0	62	0	87	0	84	0	13	0	12	0	11	0	0	0	0	0	0	0
6	1	4	1	2320	61	0	67	0	68	0	69	1	19	1	16	1	15	0	0	0	0	0	0	0
5	1	1	1	140	55	0	56	0	95	6	91	7	14	0	0	0	0	0	0	0	0	0	0	0
5	1	2	1	110	51	0	53	0	54	0	95	6	91	7	14	0	0	0	0	0	0	0	0	0
5	1	3	1	0	51	0	52	0	86	0	85	0	13	0	12	0	11	0	0	0	0	0	0	0
5	1	3	2	0	51	0	52	0	84	0	13	0	12	0	11	0	0	0	0	0	0	0	0	0
5	1	4	1	1520	51	0	57	0	58	0	19	1	16	1	15	0	0	0	0	0	0	0	0	0
7	2	1	1	260	75	0	76	4	97	4	66	4	96	4	56	4	95	4	92	7	24	0	0	0
7	2	2	1	230	71	0	73	0	74	0	97	4	66	4	96	4	56	4	95	4	92	8	24	0
7	2	3	1	0	71	0	72	0	88	0	87	0	83	0	23	0	22	0	21	0	0	0	0	0
7	2	4	1	3520	71	0	77	0	78	0	79	0	69	2	39	2	29	2	26	2	25	0	0	0
6	2	1	1	200	65	0	66	5	96	5	56	5	95	5	92	7	24	0	0	0	0	0	0	0
6	2	2	1	170	61	0	63	0	64	0	96	5	56	5	95	5	92	8	24	0	0	0	0	0
6	2	3	1	0	61	0	62	0	87	0	83	0	23	0	22	0	21	0	0	0	0	0	0	0
6	2	4	1	2670	61	0	67	0	68	0	69	2	39	2	29	2	26	2	25	0	0	0	0	0
5	2	1	1	140	55	0	56	6	95	6	92	7	24	0	0	0	0	0	0	0	0	0	0	0
5	2	2	1	110	51	0	53	0	54	0	95	6	92	8	24	0	0	0	0	0	0	0	0	0
5	2	3	1	0	51	0	52	0	83	0	23	0	22	0	21	0	0	0	0	0	0	0	0	0
5	2	4	1	1870	51	0	57	0	58	0	39	2	29	2	26	2	25	0	0	0	0	0	0	0
7	3	1	1	260	75	0	76	4	97	4	66	4	96	4	56	4	95	4	93	9	34	0	0	0
7	3	2	1	230	71	0	73	0	74	0	97	4	66	4	96	4	56	4	95	4	93	9	34	0
7	3	3	1	0	71	0	72	0	88	0	87	0	82	0	33	0	32	0	31	0	0	0	0	0
7	3	4	1	3015	71	0	77	0	78	0	79	2	69	2	39	2	0	0	0	0	0	0	0	0
6	3	1	1	200	65	0	66	5	96	5	56	5	95	5	93	9	34	0	0	0	0	0	0	0
6	3	2	1	170	61	0	63	0	64	0	96	5	56	5	95	5	93	9	34	0	0	0	0	0
6	3	3	1	0	61	0	62	0	87	0	82	0	33	0	32	0	31	0	0	0	0	0	0	0
6	3	4	1	2155	61	0	67	0	68	0	69	2	39	2	0	0	0	0	0	0	0	0	0	0
5	3	1	1	140	55	0	56	6	95	6	93	9	34	0	0	0	0	0	0	0	0	0	0	0
5	3	2	1	110	51	0	53	0	54	0	95	6	93	9	34	0	0	0	0	0	0	0	0	0
5	3	3	1	0	51	0	52	0	82	0	33	0	32	0	31	0	0	0	0	0	0	0	0	0
5	3	4	1	1360	51	0	57	0	58	0	39	2	0	0	0	0	0	0	0	0	0	0	0	0

7	4	1	1	9999	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	4	2	1	9999	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	4	3	1	0	71	0	72	0	88	0	87	0	86	0	43	0	42	0	41	0	0	0	0	0
7	4	4	1	2680	71	0	77	0	78	0	79	3	69	3	49	3	0	0	0	0	0	0	0	0
6	4	1	1	9999	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	4	2	1	9999	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	4	3	1	0	61	0	62	0	87	0	86	0	43	0	42	0	41	0	0	0	0	0	0	0
6	4	4	1	1830	61	0	67	0	68	0	69	3	49	3	0	0	0	0	0	0	0	0	0	0
5	4	1	1	9999	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4	2	1	9999	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	4	3	1	0	51	0	52	0	86	0	43	0	42	0	41	0	0	0	0	0	0	0	0	0
5	4	4	1	1035	51	0	57	0	58	0	49	3	0	0	0	0	0	0	0	0	0	0	0	0

DEMAND   DEMAND GROUPS = 2   MODES = 4   ZONAL VARIABLES = 0   DEMAND OPTION = 1

GROUP	MODE	CON	IVTT	OVTT	OPTC	OTHER	OTHER	OTHER	OTHER
1	1	0.0	-0.00020	-0.00040	-0.00060	0.0	0.0	0.0	0.0
1	2	0.20000	-0.00020	-0.00040	-0.00060	0.0	0.0	0.0	0.0
1	3	0.45000	-0.00020	-0.00040	-0.00060	0.0	0.0	0.0	0.0
1	4	0.33000	-0.00020	-0.00040	-0.00060	0.0	0.0	0.0	0.0
2	1	0.0	-0.00045	-0.00045	-0.00120	0.0	0.0	0.0	0.0
2	2	0.20000	-0.00045	-0.00045	-0.00120	0.0	0.0	0.0	0.0
2	3	0.45000	-0.00045	-0.00045	-0.00120	0.0	0.0	0.0	0.0
2	4	0.33000	-0.00045	-0.00045	-0.00120	0.0	0.0	0.0	0.0

O-D DATA   GROUPS = 2   ZONES = 7

GROUP 1 VOLUMES

FROM \ TO	1	2	3	4	5	6	7
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	57000	8000	1000	640	0	0	0
6	26600	4400	800	550	0	0	0
7	15000	1900	270	110	0	0	0

VOLUME/DELAY   NUMBER OF CURVES = 10

CURVE	PTS.	COORDINATES (TRIPS,SEC.)							
1	2	0	1200	50000	1200				
2	3	0	108	50000	120	75000	128		
3	3	0	150	12500	180	37500	420		
4	3	0	75	12500	90	37500	240		
5	3	0	1200	50000	1320	75000	1620		
6	3	0	30	5000	30	10000	35		
7	2	0	108	50000	300				
8	4	0	180	12500	300	37500	900	75000	1800
9	3	0	180	50000	300	75000	480		
10	3	0	300	50000	480	500000	900		

INCREMENT IS 1 PERCENT   ASSIGNMENT OPTION IS 1