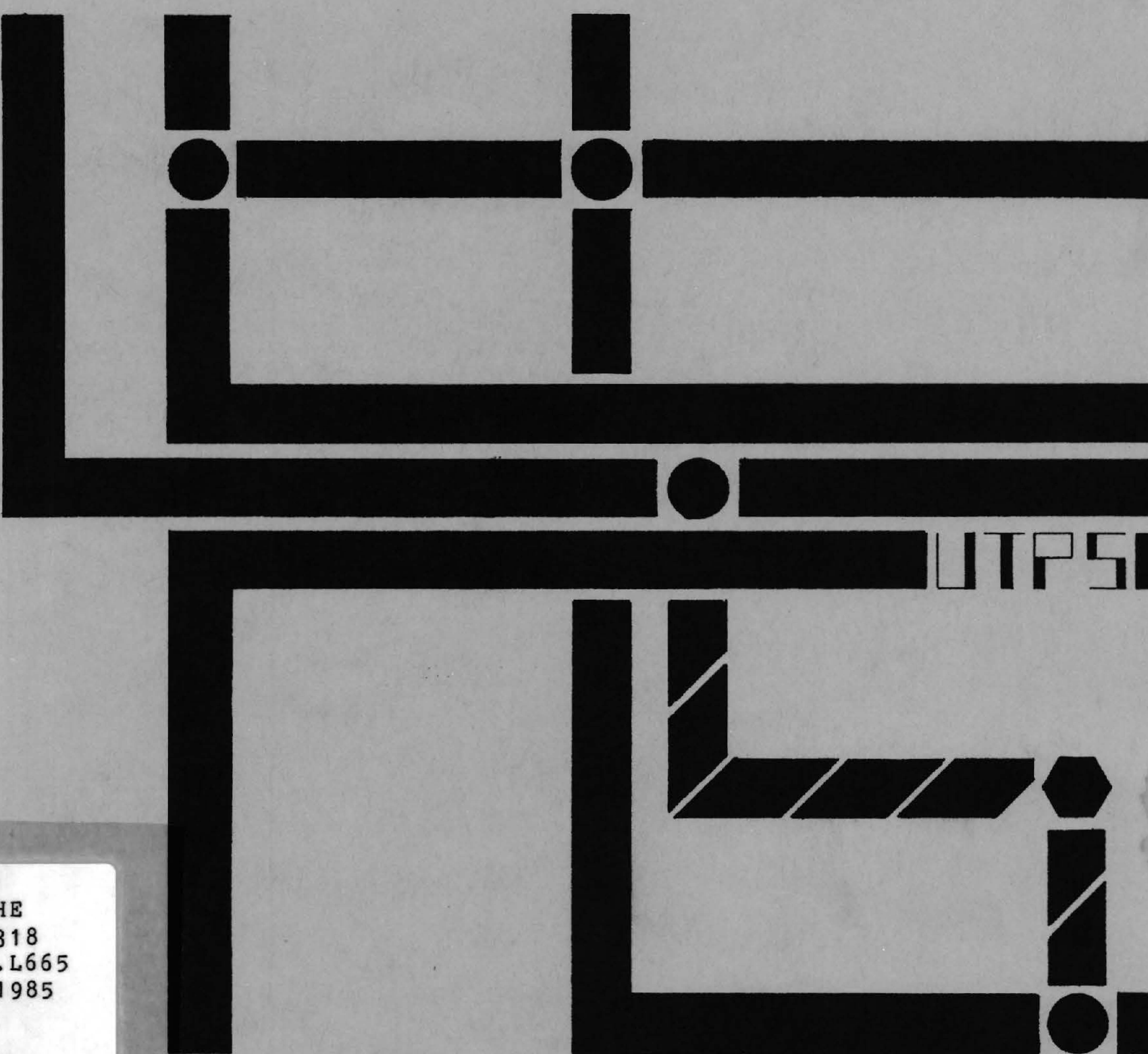
U.S. Department
of Transportation

Use of UTPS for Subarea Highway Analysis: A Case Study

January 1985



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16. Abstract

This case study illustrates the use of UTPS to analyze the potential traffic impacts of a proposed major subarea highway system change. Specifically, this analysis predicts the traffic flow changes resulting from a proposed conversion of a major CBD arterial street to a bus-only thoroughfare. This candidate transit improvement project was identified as a result of a preliminary sketch planning analysis utilizing a so-called pivot-point application of a logit mode choice model. This sketch planning analysis identified the transit street as a beneficial project in terms of reducing auto travel and increasing transit ridership and operational efficiency.

The focus of the analysis described in this case study is the estimation of the likely traffic flow impacts on automobiles in the CBD in the event that the major arterial is reserved for transit vehicles. Subarea analysis capabilities of UTPS for highway network analysis are illustrated, specifically network "windowing." The analysis time horizon is the medium term future, year 1990, when the candidate project may be deployed.

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PREFACE

This report was prepared to illustrate the use of Urban Transportation Planning System (UTPS) software in the analysis of a subarea transportation change. The application of UTPS to "window out" a portion of the regional highway network and trip-tables is described to show how the potential traffic impacts of a highway system change can be dtermined.

The report was prepared by the COMSIS Corporation for the Federal Highway Administration and the Urban Mass Transportation Administration, U.S. Department of Transportation. The project was accomplished under a contract to provide UTPS planner aids to assist MPO and State officials in utilizing techniques, methodologies and data.

The principal author of this report was David M. Levinsohn. The Federal Highway Administration contracting officers technical representative was William A. Martin. Other personnel who contributed significantly to the report include Christopher Fleet of the Federal Highway Administration and A. Joseph Ossi of the Urban Mass Transportation Administration. Special thanks goes to Dieter Klinger of COMSIS Corporation and to Ralph Hoar who did a notable job in editing the material.

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INTRODUCTION

This case study illustrates the use of UTPS to analyze the potential traffic impacts of a proposed major subarea highway system change. Specifically, this analysis predicts the traffic flow changes resulting from a proposed conversion of a major CBD arterial street to a bus-only thoroughfare. This candidate transit improvement project was identified as a result of a preliminary sketch planning analysis utilizing a so-called pivot-point application of a logit mode choice model. This sketch planning analysis identified the transit street as a beneficial project in terms of reducing auto travel and increasing transit ridership and operational efficiency.

The focus of the analysis described in this case study is the estimation of the likely traffic flow impacts on automobiles in the CBD in the event that the major arterial is reserved for transit vehicles. Subarea analysis capabilities of UTPS for highway network analysis are illustrated, specifically network "windowing." The analysis time horizon is the medium term future, year 1990, when the candidate project may be deployed.

OVERALL APPROACH

The overall approach to defining and analyzing the candidate transportation improvement measures was to first perform a sketch planning analysis which examined a large number of candidate transportation options to reduce the growth of auto travel in various subareas (including the CBD) of a large metropolitan area experiencing population and travel increases.

Once the sketch-planning analysis was completed, a relatively small set of most promising alternatives was proposed for more detailed analysis. The CBD transit-only arterial was one of these alternatives. Detailed analysis was required to estimate the auto traffic flow impacts. The highway network analysis capabilities of UTPS were used in this aspect of the analysis.

The overall approach used in both the sketch-planning and detailed UTPS analyses of the proposed transit-only CBD arterial are described in more detail in the remainder of this section.

SKETCH PLANNING APPROACH

Given a large set of transportation system management (TSM) measures to analyze, a sketch planning analysis framework was utilized to estimate the travel changes that would occur if each TSM measure was implemented. Sketch planning is a style of travel forecasting analysis that allows many alternatives to be analyzed, although at a relatively low level of detail.

Since the majority of proposed measures were aimed at reducing automobile travel to work, the analysis was confined to estimating each TSM measure's impact on work travel.

The planning horizon for the analysis was 1990 and regional travel forecasts served as the "base case" on which the effects of the TSM measures were estimated. Accepted regional travel forecasting models produced estimates of travel by mode in the region in 1990. The Regional 319 zone work production/attraction trip tables for 1990 were forecast for three modes of travel: transit, non-carpool (1-2 passenger autos), and carpool (3+

passenger autos). For sketch planning, these zone-to-zone trip tables were aggregated to 38 superdistricts for further analysis.

Table 1 defines the base case travel conditions, both the volume of trips and mode shares, for the CBD and the region. These forecasts were a definition of the travel "markets" that the TSM measures were designed to affect to reduce auto travel. Since the measures are primarily aimed at reducing auto travel for work purposes, it should be pointed out that 1990 work travel was forecast to comprise approximately 27 percent of total travel in the region and 46 percent of travel to the CBD. Therefore while certain TSM measures or packages of measures could be shown to have a substantial impact on the reduction of auto travel for work, the reduction of total daily travel would be greatly diluted.

The general analytical approach to estimate the travel changes (reduction in auto trips and vehicle miles of travel) of each of the TSM measures and the packages of measures was a "pivot point" approach using the regional mode choice model.

Pivot Point Model

The pivot point modeling approach is based on a study done for the Federal Energy Administration[1] which used a logit mode choice model to examine incremental changes in mode shares as a function of changes in modal levels of service from an existing

[1]Cambridge Systematics, Inc., **Guidelines for Travel Demand Analysis of Program Measures to Promote Carpools, Vanpools, and Public Transportation**, prepared for the Federal Energy Administration, Washington, D.C., 1976.

TABLE 1

1990 REGIONAL FORECASTS

Daily Work Travel

% Work Trips By:	To CBD	Total Region
Transit	44.4	11.0
Non-Carpool (1-2)	47.9	80.2
Carpool (3+)	7.7	8.8
Total Daily Work Trips	159,515	1,735,628
% of Daily Vehicle Trips that are Work Trips	46	27

or base condition. The use of a logit mode choice model in this incremental fashion is also termed a pivot point analysis as the existing mode shares are an observation point from which the model "pivots" to estimate changes in mode shares. The FEA report used a logit mode choice model calibrated on Washington, D.C. data. While the report (and subsequent others) demonstrate that this model is transferable to other urban areas, this case study used a pivot point procedure developed from the case study site's logit mode choice model. This mode choice model originally consisted of five modes for the work purpose: transit, auto drive alone, auto two person, auto three person, and auto four or more persons. The model was modified for use in the region and forecasts modal shares summarized into three modes: transit, non-carpool (1-2 person autos), and carpool (3+ person autos). These forecast shares are based on the relative times and costs of each mode for a given zone-to-zone trip. Model coefficients were calibrated to observed data and reflect the relative importance travelers place on travel time and cost components of their mode choice decision. The pivot point application of this model involved modifying the base work mode shares for a travel market (e.g., 1990 forecast work trips by mode destined to the CBD) by changes in times and costs for various modes caused by the implementation of a TSM measure. For example, the forecast base mode shares for work trips to the CBD were: transit, 0.444; non-carpool, 0.479; carpool, 0.077. If a hypothetical measure were to increase parking costs in the CBD by 25%, the pivot point model could be used by adjusting the cost component of both the non-carpool and carpool modes upward by 25% over the assumed 1990 base value. This would lead to a forecast change in mode shares to: transit, 0.531; non-carpool, 0.386; and carpool, 0.083. When these changes are applied to the total forecast work trips to the CBD, changes in total auto vehicle trips and, knowing trip lengths, changes in total auto work VMT could be calculated.

DETAILED UTPS-ANALYSIS APPROACH

This approach utilizes UTPS programs to " window" out the CBD portion of the regional highway network and associated trip-tables. The detail of both the network and triptable in the windowed area can be increased to analyze traffic flow changes at a finer level of detail than provided in the regional data bases. UTPS programs NAG, USQUEX, HNET, and UROAD are used and illustrated in this hypothetical analysis using an actual urban data base.

The concept of "windowing" is illustrated for subarea analysis under the supposition that successive investigation of subarea transportation problems are cheaper when run with a smaller, more detailed network and triptable than with the entire regional network and triptable.

UTPS Analysis of Network Change

The detailed analysis of the traffic flow impacts of the proposed bus-only arterial using UTPS is illustrated in Figure 1. The process was supposed to be applied twice, once to validate the approach using 1977 data and traffic counts, and then to the forecast year of 1990. As will be described later, only 1977 data were available and therefore the 1990 analysis was

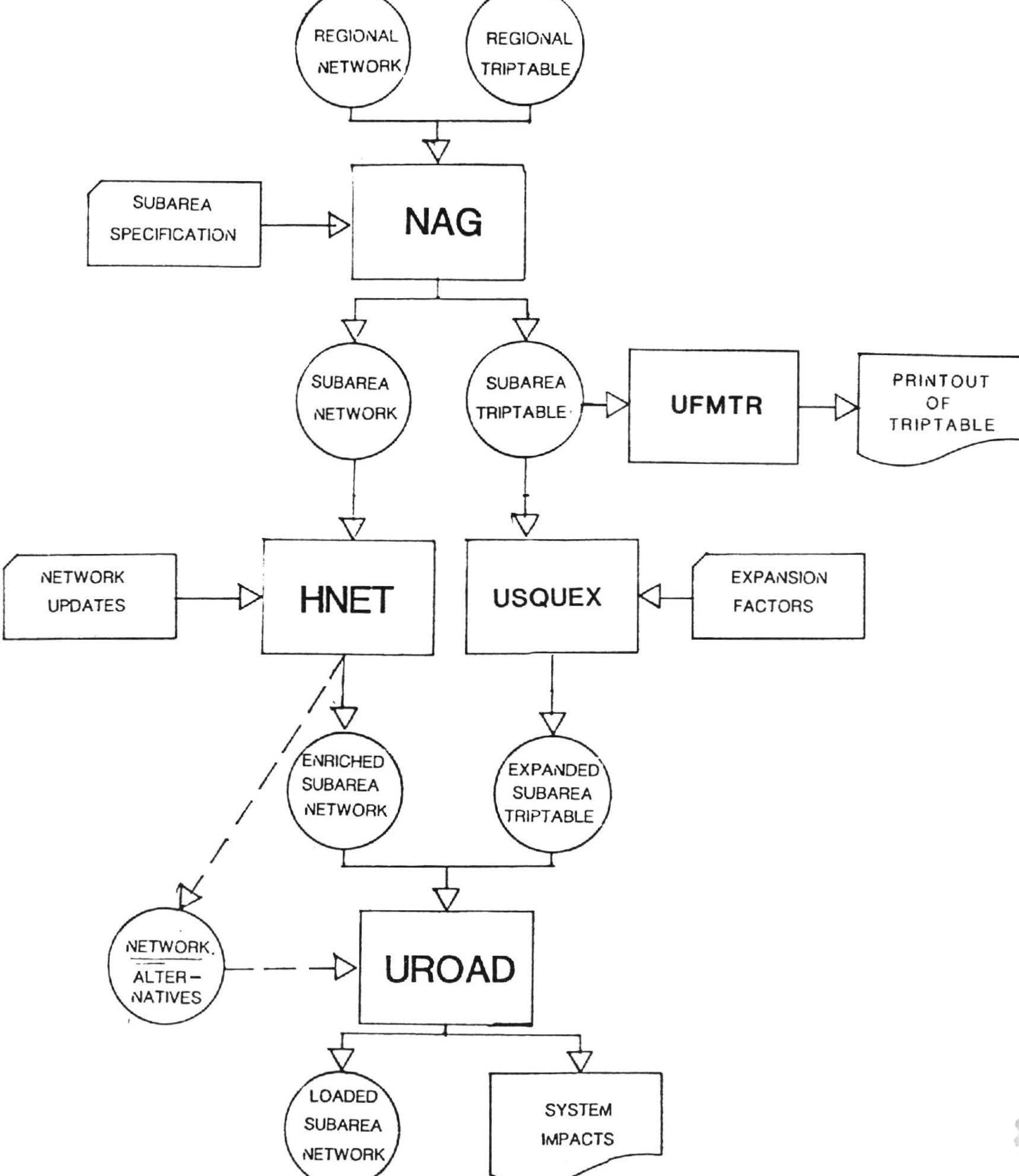


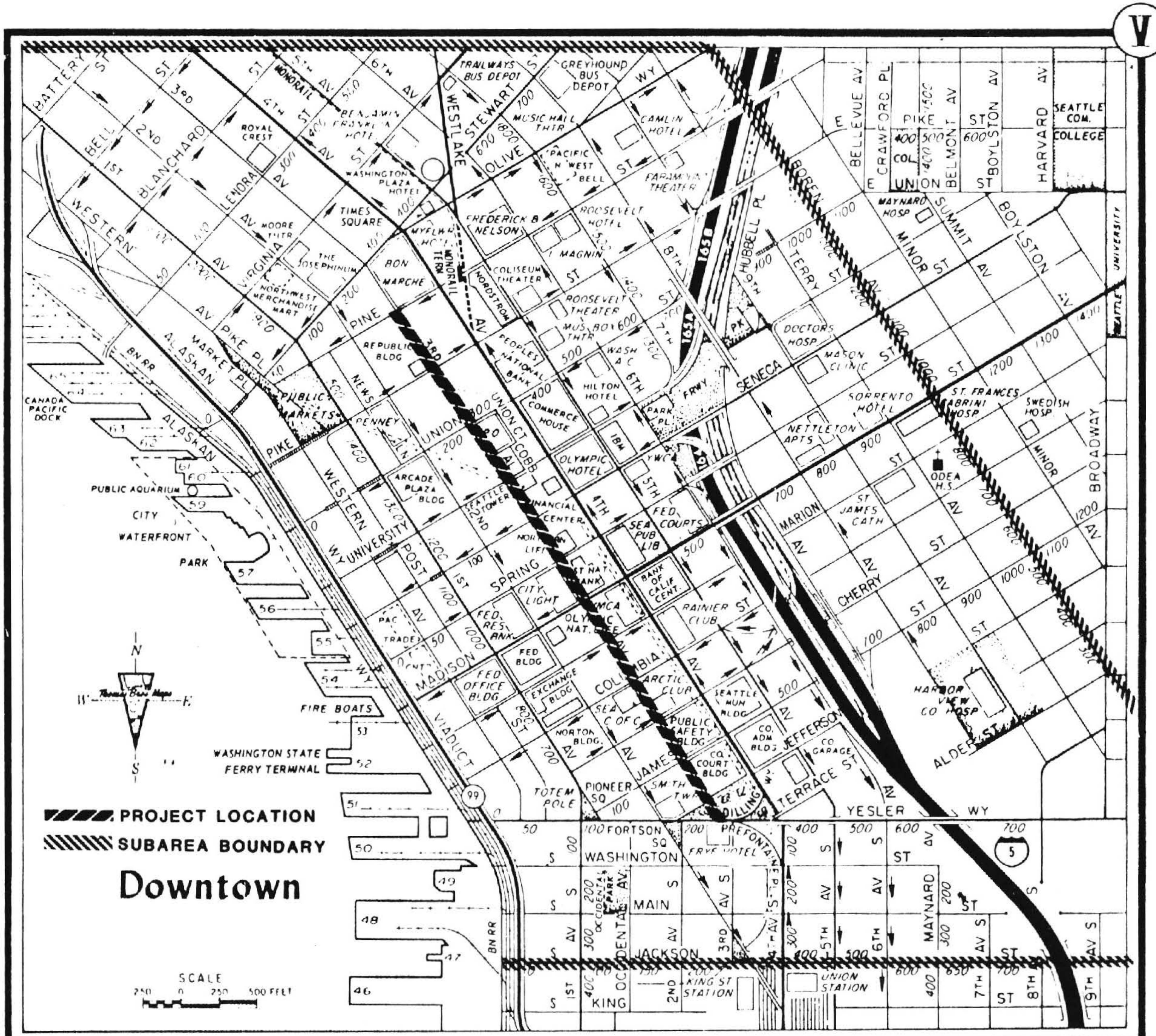
FIGURE 1

SUBAREA ANALYSIS PROGRAM FLOW

represented using 1977 data. The first step in each case is to "window" the CBD subarea from the regional network and triptable, using UTPS program NAG.

Windowing the Subarea

The rationale behind windowing, or "cutting-out" a subarea of the regional network and triptable is to save computing time and cost by applying subsequent analyses to only the subarea of interest. This approach presupposes that the project to be studied has travel demand and network effects that do not substantially extend beyond the subarea. The determination of the range and geographical scale of the travel effect of a network change is not a prescribed process, but rather a judgemental determination that can be confirmed by trial-and-error testing. Generally, if the subarea is defined to be "somewhat" larger than the immediate area of the proposed network change, sufficient space has been allocated. In the specific case of this example, that of the restriction of an arterial street for only a 0.8 mile length, travel changes in terms of O-D patterns, mode shifts, and regional scale highway path changes were not expected. Therefore, the windowing approach was deemed appropriate to analyze the expected subarea traffic routing changes associated with the proposed network change. The location of the proposed transit-only street, Third Avenue, is shown in Figure 2. The selected subarea boundary is also shown in the figure. The subarea boundary was chosen so as to allow "room" for the traffic within the subarea to be reassigned to alternative paths under the conditions where Third Avenue is removed from the highway network.



PROJECT LOCATION AND SUBAREA

FIGURE 2

The subarea of the regional network and traffic zones was "cut-out" from the regional zone and highway network system with UTPS program NAG. NAG takes as input the regional highway network and up to four associated triptables and outputs a subarea network and associated trip tables. The subarea network is defined as those links which lie within the subarea boundary. The subarea triptable(s) are defined as those trips which travel into, out of, or through the subarea. NAG creates new zone centroids along the subarea boundary which represent new "cordon zones" where particular trip movements enter or leave the subarea to/from zones inside the subarea boundary. (Refer to the UTPS Program NAG (12 December 82 version) writeup for a thorough discussion of this process.) NAG renumbers all zones inside the subarea and the new zones created at the subarea boundary consecutively from one to the new highest zone number and outputs subarea triptables numbered according to the new zone numbers. Centroid nodes and cordon nodes that are renumbered as new zones are correspondingly renumbered in the associated subarea network file. These concepts are best illustrated by reviewing the specifics of the NAG run used to create the case study subarea network and triptables.

NAG Application

Figure 3 displays the JCL and control card "set-up" used to apply NAG to window the subarea network defined above and the associated triptables from the 319 zone regional network and triptable. The input files consisted of the OLDHR file of the 1977 regional highway network and the J1 file containing the

FIGURE 3: NAG SET-UP

```
//NAG EXEC NAG,CORE=512K,
// OLDHR='DSN=UMTA.COMSIS.SEA77NET,VOL=SER=UMTA2',
// J1='DSN=UMTA.COMSIS.SEAUUTRP,VOL=SER=UMTA2',
// NEWHR='DSN=UMTA.SEA77.SUBNET, VOL=SER=UMTA2',
// UNITNEW='SYSDA,SPACE=(TRK,(10,5),RLSE)'
// UNITJ9='SYSDA,SPACE=(TRK,(5,5),RLSE)'
//NAG.SYSIN DD *
     NAG RUN TO WINDOW CBD 1977
 &PARAM TFIELD=32,TABLES=101,ZONES=150,NAME1='SEASUB77' &END
 &OPTION WINDOW=T,DRYRUN=F &END
 &SELECT FOCI=1609,1798,1806,1828,1862,1884,1890,1867,
     1899,1901,1873,1913,3237,3252,3227,3241,3232,3249,
     3247,3230,R=0.60,REPORT=3,4 &END
```

regional 1977 estimated a.m. peak hour vehicle triptable. This peak hour vehicle triptable was created by applying observed peak hour factors to the person triptables by purpose described earlier. The predominant purpose during the a.m. peak hour is work trips. The output files were the NEWHR which would contain the subarea network and the J9 file which would contain the associated subarea triptable.

The control cards indicate the specific functions NAG was to perform in the particular application. WINDOW=T on the &OPTION card indicates that the application was to create a subarea network and triptable. TABLES=101 says that the input triptable is on Table 1 of J-file 1. TFIELD=32 indicates that NAG is to use observed link speed (if coded on any links) from OLDHR half-word location 32 when building minimum time paths needed to determine subarea boundary crossing points for regional zone to zone trip movements. (Refer to UTPS program NAG writeup.) If no value was coded in that field of the OLDHR, NAG would use the UTPS link speed/capacity table as does the UTPS traffic assignment program UROAD. The table assigns a speed and capacity value to each link based upon its facility type, area type and number of lanes (see UTPS programs UROAD or HNET documentation available on the UTPS tape). ZONES=150 specifies that NAG will reserve space in the output NEWHR file for up to 150 zones. This was greater than the number estimated for the subarea and cordon to allow space in the file for additional zones to be added.

The &SELECT control card is where the location of the subarea to be windowed is defined. The earlier versions of NAG (prior to the December 1982 release) accommodated two ways of specifying the subarea. One way was to specify a list of highway network nodes that formed a closed, continuous boundary around the subarea, along with one or more "foci" nodes interior to the subarea. The alternative way, utilized in the case study, was to specify a set of foci nodes (FOCI=) and an over-the-network distance (R), in miles, which define a subarea by including all links within the shortest path link distance R of each foci node. Figure 4 locates the focal nodes in the regional network utilized to define the subarea for the case study in conjunction with a shortest link path distance of 0.60 miles (R=0.60). This foci list and distance was selected in order to define a subarea similar to the one shown in Figure 2. **(Note: A new version of NAG was released in December 1982. It differs from previous versions, as used in the case study, in two important ways. First, the new NAG reads/writes the highway network files in link Z-file format only. Second, the method of specifying the subarea has been changed. The newer version requires that the user specify the subarea by providing a list of a-nodes and b-nodes**

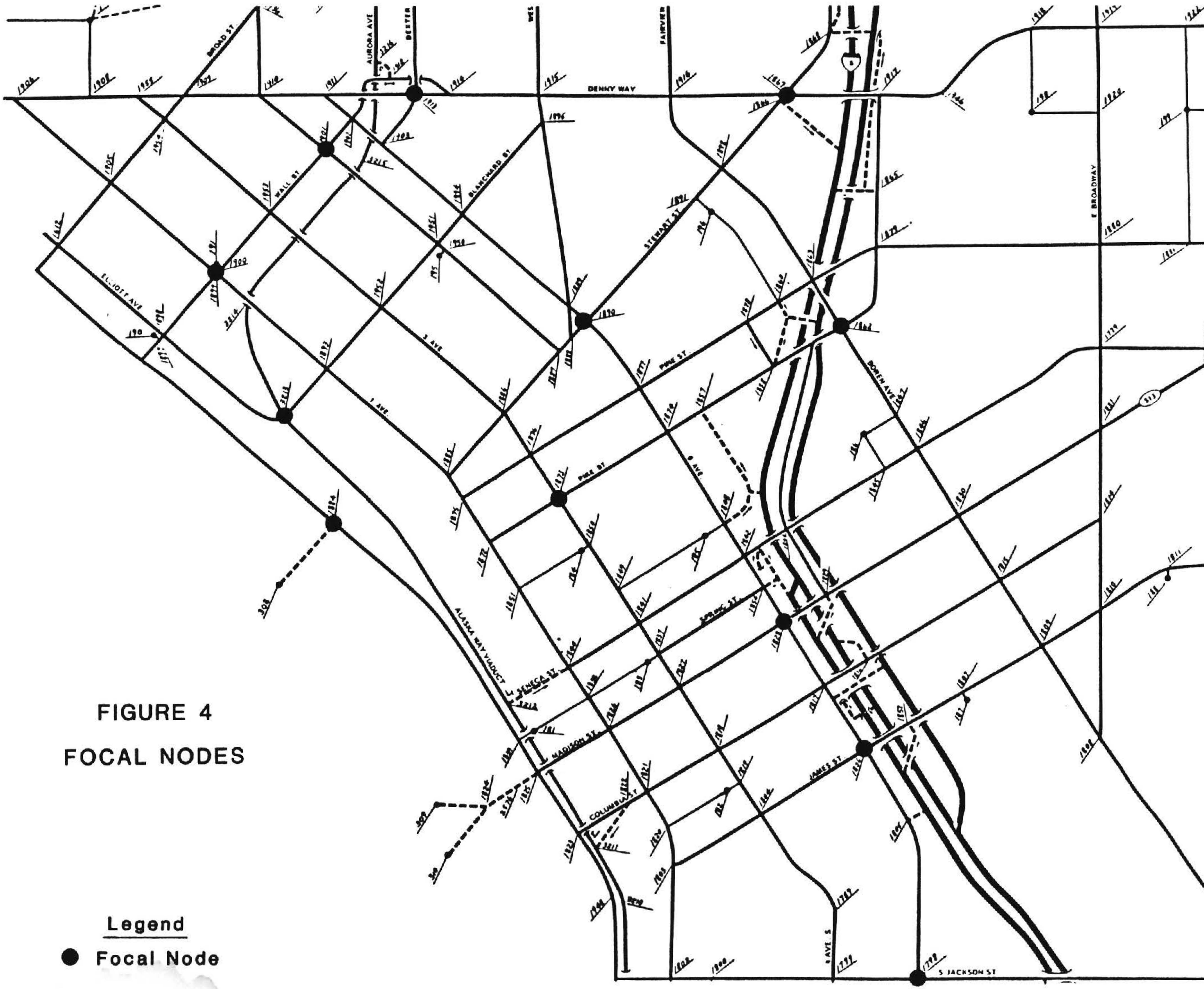


FIGURE 4

FOCAL NODES

Legend

● Focal Node

which define a set of links which are bisected by the subarea boundary. Refer to the current NAG (12 December 82) program writeup for more detail.)

NAG Reports 3 and 4 display the results of the windowing process. Report 3 (Figure 5) informs the user which nodes have been renumbered in the new subarea network relative to the old regional network. The nodes renumbered were those which were zone centroids within the subarea and those network nodes which became boundary centroids. Note that these are flagged with a "*" in Report 3. Figure 6 displays a portion of the regional highway network with the new subarea centroids highlighted. NAG Report 4 displays a listing of the subarea network link data referenced by both the old (regional network) and new (subarea network) node numbers. The data displayed for each link includes its distance, number of lanes, facility type and area type. Figure 7 displays a portion of Report 4 from the NAG case study output.

Once NAG was run to create the subarea highway network and subarea a.m. peak hour triptable, a run of UTPS program UFMTR was made to display the contents of the new subarea triptable. Figure 8 contains the UFMTR set-up used to display the subarea triptable. The input J1 file was the subarea triptable dataset created previously by NAG. Reports 1 and 4 were requested, portions of which are displayed in Figures 9 and 10. Report 1 displays the zone to zone trips (in this case a.m. peak hour vehicle trips) in ascending order by I-zone (origin zone) and by J-zone (destination zone) with a subtotal of trips originating in

FIGURE 5

NAG REPORT 3

S U B A R E A   N O D E   N U M B E R I N G
(* INDICATES RENUMBERED NODE/ZONE)

OLD NODE	NEW NODE	OLD NODE	NEW NODE	OLD NODE	NEW NODE	OLD NODE	NEW NODE	OLD NODE	NEW NODE
146	--	147	1*	148	--	149	--	150	--
181	2*	182	3*	183	4*	184	5*	185	6*
186	7*	187	8*	188	9*	189	--	190	10*
191	11*	192	12*	193	13*	194	14*	195	15*
196	16*	197	17*	198	18*	199	--	200	--
306	--	307	--	308	19*	309	20*	310	--
1591	1591	1592	21*	1593	--	1594	--	1595	--
1606	--	1607	22*	1608	23*	1609	1609	1610	1610
1611	24*	1612	25*	1613	26*	1614	--	1615	--
1636	--	1637	--	1638	1638	1639	27*	1640	--
1771	--	1772	28*	1773	--	1774	--	1775	--
1776	--	1777	--	1778	--	1779	29*	1780	--
1781	--	1782	--	1783	--	1784	30*	1785	1785
1786	1786	1787	31*	1788	1788	1789	1789	1790	--
1791	--	1792	--	1793	--	1794	32*	1795	1795
1796	1796	1797	1797	1798	1798	1799	1799	1800	1800
1801	1801	1802	1802	1803	1803	1804	1804	1805	1805
1806	1806	1807	1807	1808	1808	1809	1809	1810	1810
1811	1811	1812	33*	1813	--	1814	1814	1815	1815
1816	1816	1817	1817	1818	1818	1819	1819	1820	1820
1821	1821	1822	1822	1823	1823	1824	34*	1825	1825
1826	1826	1827	1827	1828	1828	1829	1829	1830	1830
1831	35*	1832	--	1833	--	1834	--	1835	--
1836	--	1837	1837	1838	1838	1839	1839	1840	36*
1841	1841	1842	1842	1843	1843	1844	1844	1845	1845
1846	1846	1847	1847	1848	1848	1849	1849	1850	1850
1851	1851	1852	1852	1853	1853	1854	1854	1855	1855
1856	1856	1857	1857	1858	1858	1859	1859	1860	1860
1861	1861	1862	1862	1863	1863	1864	1864	1865	1865
1866	1866	1867	1867	1868	1868	1869	1869	1870	1870
1871	1871	1872	1872	1873	1873	1874	1874	1875	1875
1876	1876	1877	1877	1878	1878	1879	1879	1880	37*
1881	--	1882	--	1883	--	1884	1884	1885	1885
1886	1886	1887	1887	1888	1888	1889	1889	1890	1890
1891	1891	1892	1892	1893	1893	1894	1894	1895	1895
1896	1896	1897	1897	1898	1898	1899	1899	1900	1900
1901	1901	1902	1902	1903	1903	1904	--	1905	1905

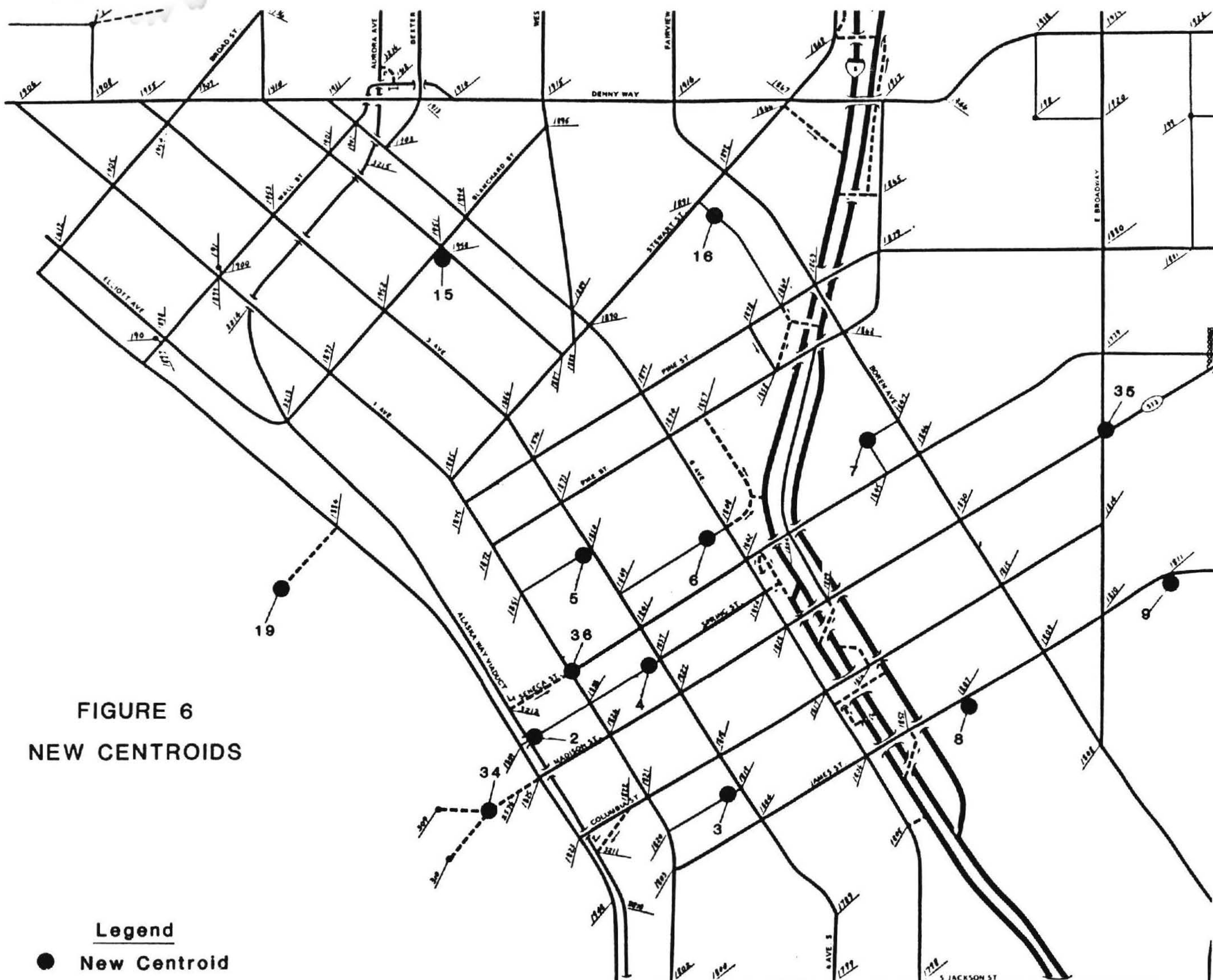


FIGURE 6
NEW CENTROIDS

Legend

● New Centroid

FIGURE 7

NAG REPORT 4

S U B A R E A   N E T W O R K   L I N K   D A T A

(* INDICATES RENUMBERED NODE/ZONE)

------NEW------ A NODE	B NODE	------OLD------ A NODE	B NODE	DIST (.00)	N L	F T	A T
	1861		1861	7	2	3	2
1859	1858	1859	1858	1WAY			
	3250		3250	2	9	5	2
1860	16*	1860	196	17	9	5	1
	1863		1863	6	2	3	1
1861	1844	1861	1844	28	2	3	2
	1862		1862	4	2	3	2
1862	1847	1862	1847	16	2	3	2
	1863		1863	6	2	3	2
1863	1860	1863	1860	6	2	3	1
	1879		1879	11	2	3	2
1864	1865	1864	1865	2	9	5	2
	3233		3233	1WAY			
1865	1864	1865	1864	2	9	5	2
	1917		1917	15	1	3	2
1866	1867	1866	1867	1	2	3	1
	3234		3234	12	9	5	2
1867	1866	1867	1866	1	2	3	1
	1916		1916	17	2	3	2
1868	1867	1868	1867	12	2	3	2
	1930		1930	15	2	3	2
1869	1864	1869	1864	1WAY			
	3236		3236	19	9	5	2
1870	1871	1870	1871	15	9	5	2
	51*		3252	10	9	5	2
1871	1870	1871	1870	15	9	5	2
	49*		3237	13	9	5	2
1872	1851	1872	1851	8	2	3	1
	1875		1875	8	2	3	1
1873	1850	1873	1850	8	2	3	1
	1874		1874	19	2	3	1
1874	1848	1874	1848	16	2	3	1
	1873		1873	19	2	3	1
1875	1872	1875	1872	8	2	3	1
	1885		1885	4	2	3	1
1876	1873	1876	1873	8	2	3	1
	1877		1877	19	2	3	1
1877	1874	1877	1874	8	2	3	1
	1878		1878	19	2	3	1
1878	1860	1878	1860	5	2	3	1
	1858		1858	8	9	5	1
1879	1862	1879	1862	15	2	3	2
	1865		1865	8	1	3	2
1884	19*	1884	308	12	9	5	2
	1896		1896	38	2	3	2

--NEW-- B NODE	--OLD-- B NODE	DIST (.00)	N L	F T	A T
1878	1878	1WAY			
1860	1860	3	9	5	2
1859	1859	1WAY			
1878	1878	5	2	3	1
1858	1858	7	2	3	2
1861	1861	4	2	3	2
1879	1879	15	2	3	2
1862	1862	8	2	3	2
1892	1892	22	2	3	2
1869	1869	32	9	5	2
1879	1879	8	1	3	2
1892	1892	14	2	3	1
1868	1868	12	2	3	2
1917	1917	14	2	3	2
1869	1869	11	9	5	2
3251	3251	7	9	5	2
1868	1868	11	9	5	2
3235	3235	28	9	5	2
1943	1943	16	9	5	2
1873	1873	12	2	3	1
1872	1872	12	2	3	1
1876	1876	8	2	3	1
1857	1857	6	2	3	1
1877	1877	8	2	3	1
1876	1876	12	2	3	1
1875	1875	12	2	3	1
1886	1886	7	2	3	1
1876	1876	19	2	3	1
1890	1890	13	2	3	1
1877	1877	19	2	3	1
1863	1863	11	2	3	2
37*	1880	33	2	3	2
1839	1839	44	2	3	2

```
//FMTR EXEC UFMTR,CORE=256K,
// J1='DSN=UMTA.SEA77.SUB.TRIPS,VOL=SER=UMTA2'
//UFMTR.SYSIN DD *
     UFMTR RUN TO PRINT 1977 SUBAREA TRIPTABLE FROM NAG
 &PARAM ZONES=51, TABLES=101, TITLE1='77SUBTRIPS' &END
 &SELECT REPORT=1,4 &END
```

FIGURE 8: UFMTR SET-UP TO DISPLAY SUBAREA TRIPTABLES

FIGURE 9

UFMTR RUN TO PRINT 1977 SUBAREA TRIPTABLE FROM NAG

17SEP81 10.45.05 UFMTR REPORT 1 PAGE 3

I/J ZONAL INTERCHANGE VALUES

I	J	77 SUB
1	1	25
1	2	7
1	3	28
1	4	20
1	5	23
1	6	17
1	7	5
1	8	4
1	9	11
1	16	5
1	17	5
1	18	14
1	20	3
1	28	40
1	30	17
1	33	7
1	34	2
1	35	13
1	37	6
1	42	15
1	43	38
1	44	57
1	45	98
1	48	29
1	49	20
1	51	52
1		561
2	1	3
2	2	1
2	3	4
2	4	4
2	5	4
2	6	3
2	7	1
2	8	1
2	17	1
2	18	1
2	20	1
2	28	3
2	33	2
2	34	1
2	35	3
2	37	1
2	42	1
2	43	8
2	44	8
2	45	14
2	48	5
2	49	13
2	50	1
2		84
3	1	18
3	2	5
3	3	20
3	4	15
3	5	21
3	6	14
3	7	3
3	8	3
3	9	6
3	16	3
3	17	5
3	18	7
3	20	2
3	28	18
3	33	5
3	34	1
3	35	13
3	37	4
3	42	6
3	43	35
3	44	33
3	45	60
3	48	24
3	49	17
3	50	4
3	51	40
3		382
4	1	10
4	2	4
4	3	13
4	4	16
4	5	21
4	6	13
4	7	4
4	8	2
4	9	4
4	11	5
4	12	6
4	15	7
4	16	3
4	17	3
4	18	8
4	20	3
4	28	10
4	33	4
4	34	1
4	35	8
4	37	4
4	38	3
4	39	2
4	43	33
4	44	22
4	45	27
4	48	19
4	49	48
4	50	8
4	51	2
4		313
5	1	13
5	2	4
5	3	21
5	4	20
5	5	29
5	6	23
5	7	5
5	8	3
5	9	4
5	10	3
5	11	8
5	12	12
5	13	3
5	14	3
5	15	12
5	16	6
5	17	4
5	18	10
5	20	3
5	25	8
5	28	16
5	29	10
5	33	5
5	34	2
5	37	7
5	38	5
5	39	2
5	43	39
5	44	31
5	47	26
5	48	25
5	49	28
5	50	11
5	51	43
5		444
6	1	17
6	2	7
6	3	23
6	4	25
6	5	44
6	6	34
6	7	8
6	8	5
6	9	10
6	10	4
6	11	8
6	12	13
6	13	4
6	14	5
6	15	17
6	16	10
6	17	8
6	18	20
6	20	2
6	25	8
6	29	13
6	33	6
6	34	3
6	37	10
6	39	3
6	41	4
6	42	19
6	43	74
6	44	22
6	47	21
6	48	31
6	49	101
6	50	18
6	51	8
6		605
7	1	11

FIGURE 10

UFMTR RUN TO PRINT 1977 SUBAREA TRIPTABLE FROM NAG

17SEP81 10.45.05 UFMTR REPORT 4 PAGE 13

77 SUBTRIPS DATA SET J1 TABLE 1

I/J	39	40	41	42	43	44	45	46	47	48	49	50	51	ROW TOTAL
1	0	0	0	15	38	57	98	0	0	29	20	0	52	561
2	0	0	0	1	8	8	14	0	0	5	13	1	0	84
3	0	0	0	6	35	33	60	0	0	24	17	4	40	382
4	2	0	0	0	33	22	27	0	0	19	48	8	2	313
5	2	0	0	0	39	31	0	0	26	25	28	11	43	444
6	3	0	4	19	74	22	0	0	21	31	101	18	8	605
7	0	0	3	16	62	18	9	0	20	19	17	18	67	512
8	0	0	0	0	49	15	39	0	0	17	13	15	47	372
9	0	0	0	0	30	10	16	0	0	0	19	9	12	248
10	1	0	0	0	0	0	0	37	9	0	4	0	6	83
11	5	0	0	0	0	0	0	151	34	0	9	0	29	356
12	6	81	0	0	0	0	0	179	53	0	0	0	0	583
13	1	14	2	0	0	0	0	34	16	0	0	0	0	89
14	1	0	0	0	5	0	0	22	21	2	11	1	4	90
15	7	0	7	0	31	0	0	75	39	14	18	9	43	418
16	5	0	2	4	20	5	0	0	11	9	14	5	25	180
17	4	0	3	0	19	5	0	0	7	8	30	3	13	174
18	0	0	8	37	120	37	0	0	54	13	25	35	109	1113
19	0	0	0	0	2	1	0	0	1	0	1	0	1	11
20	0	0	0	25	117	87	183	0	0	63	143	6	7	1142
22	0	0	0	0	0	0	0	0	0	0	0	0	0	19
23	0	0	0	0	0	0	0	0	0	0	0	0	0	80
24	0	0	0	0	0	0	0	0	0	0	74	0	6	174
25	0	0	0	0	0	0	0	990	0	0	0	0	0	1226
26	20	0	0	0	0	0	0	0	0	0	0	0	0	349
28	0	0	0	0	0	0	105	0	0	0	0	0	34	209
29	0	0	2	0	0	0	0	0	10	0	0	0	0	553
30	0	0	0	46	0	0	54	0	0	0	0	0	0	181
31	1	0	0	0	0	0	0	0	0	11	139	0	11	401
32	0	0	0	0	0	0	0	0	0	0	0	0	0	34
33	0	0	0	0	58	22	39	0	0	0	25	13	9	772
34	0	0	0	9	39	35	68	0	0	22	96	2	2	472
35	0	0	0	0	341	122	55	0	0	0	0	22	0	927
36	0	0	0	0	610	0	0	0	0	175	118	178	0	3362
37	0	0	7	0	0	0	0	0	16	0	0	0	0	290
38	0	0	0	0	0	0	0	0	0	0	0	0	0	194

each zone. The zone numbers displayed represent the renumbered zones of the subarea as created by NAG. UFMTR Report 4 displays the triptable in tabular form over several pages of output which can be cut-and-pasted together to produce a "wall-paper" display of the triptable. Figure 10 contains a portion of Report 4. Origin (I) zones form the rows of the table and destination (J) zones form the columns. The largest number of trips originate from zones that correspond to subarea cordon nodes lying on the major facilities entering the subarea such as the interstate ("zones" 43,49,51). The total number of a.m. peak hour vehicle trips destined to, from or through the subarea network output by NAG was 63,382 which compared with the 319 zone regional total of 576,525 trips.

Increase Subarea Detail

Once the subarea highway network and triptable had been cut-out from the regional network and triptable, the next step in the analysis process was to increase the detail of the subarea both in terms of traffic zones and highway network. This increase in detail was necessary in order to more accurately model changes in traffic flow as a result of the proposed small geographic scale change in the highway network. The level of detail of the regional highway network in the subarea, while appropriate for regional analyses, was inadequate for the type of analysis described here. Comparison of the subarea street map shown in Figure 2 with the network map shown in Figure 4 illustrates the difference in detail between the actual highway system and its regional network representation. Many CBD arterials and collectors have been omitted from the regional network. Traffic on these streets would presumably be impacted by an operational change in traffic patterns such as prohibiting auto traffic on Third Avenue, therefore they should be included in the subarea network.

Correspondingly, the regional traffic zones needed to be disaggregated into smaller geographic units that would produce and attract trips at a finer geographic scale relative to the increased network detail. This would serve to "smooth" simulated traffic flow onto and off of the network links. These zones also needed to be defined in such a way that travel activity could be forecast for each zone as well. Figure 11 displays subarea zones that were used in the analysis of this case study problem. They were developed by the city planning agency for downtown transportation analyses and have associated population and employment forecasts. They are related to the regional transportation analysis zones as shown in the same figure.

To add this increased detail to the subarea for subsequent UTPS analysis required the application of program USQUEX to disaggregate the subarea triptable to the smaller zones and program HNET to increase the detail of the subarea highway network.

Expand Subarea Triptable

UTPS program USQUEX was used to expand the subarea trip table from the 51 internal and cordon zones created by NAG to the 89 disaggregated subarea internal and cordon zones used for

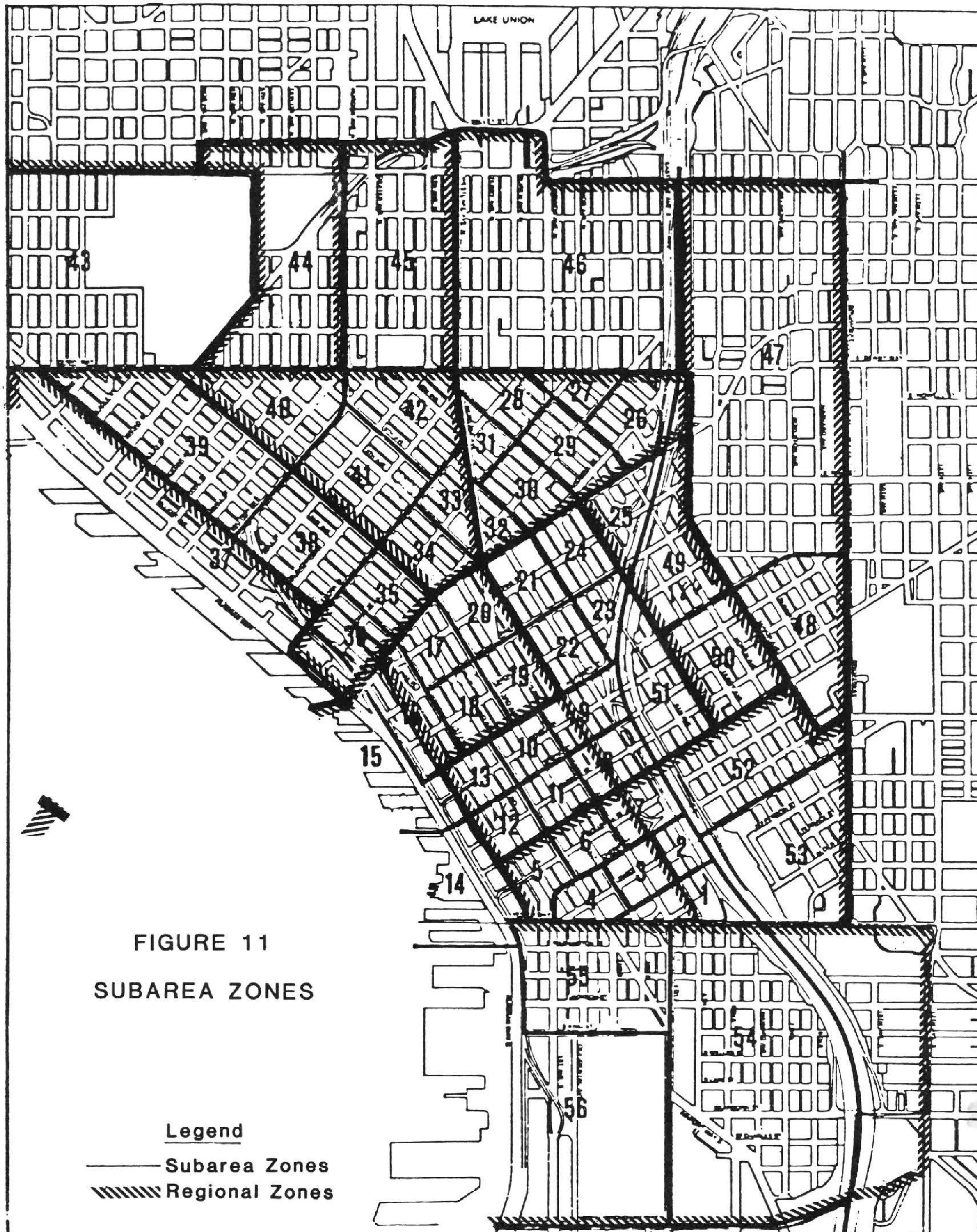


FIGURE 11

SUBAREA ZONES

subsequent detailed network analyses. The user provides USQUEX with a list of input zones and corresponding subzones to which each input zone is to be "split" (one &EQUIV card for each input zone). The analyst also must provide a set of "fraction card" data which instructs USQUEX how to apportion trips from each input zone to each associated subzone. This apportioning or "splitting" of zones should be based on the estimated proportion of trips each smaller subzone will attract and produce relative to the larger zone or zones of which it is a part. USQUEX accommodates different splitting fractions for production, or origin, ends of trips and attraction, or destination, ends. The ability to handle multiple fractions relates to the fact that a subzone may contain a different percentage of trip producers (e.g., households) relative to the "parent" zone than trip attractors (e.g., employment).

Apportioning fractions based upon subzone employment were developed in the case study to split the 12 regional subarea zones into the 50 new subzones. Employment was utilized for two reasons: first, it is closely related to the amount of work travel. Since a.m. peak hour travel conditions were being analyzed, which are primarily comprised of work trips, employment was assumed to be a good basis for apportioning trip ends. Second, forecasts of employment by subzone were available both for the base year of 1977 and for the study year of 1990. Table 2 displays the list of regional subarea zones (as created by NAG), their associated subzones (with new zone numbers as shown in Figure 11), and the fraction of 1977 employment in each new subzone relative to the regional, subarea zone.

TABLE 2

Relationship Between Subarea Zones and Subzones

Subarea Zone	Subzone*	Percent Employment
2	99	44
	80	23
	79	27
	104	6
3	94	33
	95	18
	91	24
	92	23
	94	2
4	90	10
	87	10
	86	26
	89	26
	88	23
	85	5
5	74	12
	81	37
	82	42
	75	9
6	90	13
	76	24
	83	20
	84	2
	77	24
	102	4
7	78	7
	7	31
	105	62
8	97	4
	96	1
	101	69
	100	26
10	10	100
11	69	16
	63	22
	60	62

Table 2 (Continued)

Subarea Zone	Subzone*	Percent Employment
15	68	10
	67	17
	61	20
	62	30
	64	23
16	73	1
	72	3
	65	7
	16	31
	71	16
	66	5
	70	37

*Note: Subzone numbers in this table do not correspond to those shown in Figure 11 for network coding reasons. The boundaries are the same, however.

Figure 12 displays the USQUEX input used to split the subarea regional zones into smaller subzones. The subarea a.m. peak hour vehicle trip table created by NAG was input on file J1 while the new expanded subarea trip table was output on file J9. The highest zone number for the output subarea triptable would be 105 (ZONES=105) while the highest input subarea zone number from NAG was 51 (DISTS=51). By definition, NAG considers input zones for splitting, or expansion to be "Districts" while output subzones are "Zones." The &OPTION card indicates that the USQUEX run will be to expand (split) a triptable (EXPAND=T) and that the program should check to insure that all fractions sum to one (ONE=T), that is, that each input zone's trips are fully apportioned to equivalent subzones. The &EQUIV card defines the correspondence between input regional subarea zones (from NAG) and output subarea zones. For example, DIST=2, Z=99,80,79,104 indicates that regional subarea zone 2 is to be split by USQUEX into more detailed subarea zones 79,80,99, and 104. The last &EQUIV card image with SAME=9,10,12,-14,17,19,-51 indicates that the input zones listed are not to be split but are to remain constant in the output triptable. These zones represented the subarea cordon centroids created by NAG.

An additional data requirement of USQUEX in the expand function is the fraction of trip productions and attractions that are to be allocated from the input zones to output subzones. The fractions displayed in Table 2 were input to USQUEX via "zone/district fractions cards" which enter the input stream following an &DATA card. The &DATA card and fraction cards come

FIGURE 12: USQUEX SET-UP TO EXPAND SUBAREA ZONES

```
//STEP EXEC USQUEX,CORE=256K,
// J1='DSN=UMTA.SEA77.SUB.TRIPS,VOL=SER=UMTA2',
// J9='DSN=UMTA.SEA77.XSUB.TRIPS,VOL=SER=UMTA2',
// UNITJ9='SYSDA,SPACE=(TRK,(10,5))'
//USQUEX.SYSIN DD *
     EXPAND ZONE MATRIX
 &PARAM ZONES=105,DISTS=51,TABLES=101 &END
 &OPTION EXPAND=T,ONE=T &END
 &SELECT REPORT=1,-3 &END
 &EQUIV DIST=1, Z=1,98 &END
 &EQUIV DIST=2, Z=99,80,79.104 &END
 &EQUIV DIST=3, Z=94,95,91,92,93 &END
 &EQUIV DIST=4, Z=87,86,89,88,85 &END
 &EQUIV DIST=5, Z=74,81,82,75 &END
 &EQUIV DIST=6, Z=90,76,83,;84,77,102 &END
 &EQUIV DIST=7, Z=78,7,105 &END
 &EQUIV DIST=8, Z=97,96,101,100 &END
 &EQUIV DIST=11, Z=69,63,60 &END
 &EQUIV DIST=15, Z=68,67,61,62,64 &END
 &EQUIV DIST=16, Z=73,72,65,16,71,66,70 &END
 &EQUIV DIST=18, Z=18,103 &END
 &EQUIV SAME=9,10,12,-14,17,19,-51 &END
 &DATA
```

after the set of &EQUIV cards in the USQUEX set-up and are displayed in Figure 13. Finally, USQUEX prints out a message which indicates the sum of the cell values of the output matrix. In the case study, this sum represents the total number of a.m. peak hour vehicle trips traveling to, from, or through the subarea. This sum should match the number of trips on the input triptable created by NAG and in the case study run it does at 62,382 trips.

Increase Subarea Network Detail

Once the subarea detailed zones and triptable were created with USQUEX the next step undertaken was to increase the detail of the subarea highway network. This detail was required in order to more accurately model the changes in traffic volumes that might occur due to the proposed elimination of auto traffic from Third Avenue. This detailing required major changes to the subarea regional scale highway network. As illustrated earlier in Figure 6, many CBD streets were not included in the regional highway network. Due to expected "small-scale" changes in traffic flows within the CBD due to the proposed restriction of Third Avenue (e.g., vehicles shifting over one or two streets around Third Avenue) it was necessary to include these additional facilities in the network. In addition, the regional network simplified and abstracted network characteristics by representing one-way pairs of streets as a single two-way street, and representing the number of through lanes of travel as a composite of all-day conditions rather than accounting for differences in peak versus off-peak capacity. Finally, additional network links were

FIGURE 13

EXPAND ZONE MATRIX

19OCT81 17.53.20 USQUEX PAGE 3

Z O N E / D I S T R I C T F R A C T I O N C A R D S

```
+-----  +-------+-------+-------+-------+-------+-------+-------+-------+-------
1---5---10---15---20---25---30---35---40---45---50---55---60---65---70--
```

ZONE	P(1)	A(1)	P(2)	A(2)	P(3)	A(3)	P(4)	A(4)
1	.50	.50						
7	.31	.31						
16	.31	.31						
18	.70	.70						
60	.62	.62						
61	.20	.20						
62	.30	.30						
63	.22	.22						
64	.23	.23						
65	.07	.07						
66	.05	.05						
67	.17	.17						
68	.10	.10						
69	.16	.16						
70	.37	.37						
71	.16	.16						
72	.03	.03						
73	.01	.01						
74	.12	.12						
75	.09	.09						
76	.24	.24						
77	.24	.24						
78	.07	.07						
79	.27	.27						
80	.23	.23						
81	.37	.37						
82	.42	.42						
83	.20	.20						
84	.02	.02						
85	.05	.05						
86	.26	.26						
87	.20	.20						
88	.23	.23						
89	.26	.26						
90	.26	.26						
91	.24	.24						
92	.23	.23						
93	.02	.02						
94	.33	.33						
95	.18	.18						

```
1---5---10---15---20---25---30---35---40---45---50---55---60---65---70--
```

required as "centroid connectors" between the new, smaller subarea zones and the more detailed subarea highway network.

The process followed in increasing the detail of the subarea network can be summarized as follows:

- o Run HNET to convert subarea OLDHR to N-file
- o Run HNET to delete regional network links from N-file
- o Run HNET to add subarea network links to N-file
- o Run HNET to create link Z-file from N-file

This process can be considered "conservative" since fewer HNET runs could have been made (e.g., adding and deleting links in the same run). However, due to the increased complexity of the subarea highway network, it was felt that this four-step approach to network updating made detection of coding errors easier and hence may have saved additional runs at a later stage of the analysis. Each of these HNET runs is described briefly below.

The first HNET run was made to convert the NAG subarea OLDHR file into an N-file. This represent an interim conversion that allowed the subsequent use of HNET and the newer version of UROAD. The current version of NAG (12 December 82) would eliminate this step by directly outputting a subarea N-file, which is the most current UTPS highway network file structure, replacing the PLANPAC/UTPS "historical record" (OLDHR) file structure. All current UTPS programs only process the N-file and link and node Z-file highway network file structures (with the exception of HNET which converts OLDHR files into N-files, as illustrated here). The HNET set-up to convert is straightforward in that the UTPS format OLDHR file is read in and the N-file is written out.

The only keyword necessary to effect the conversion is coding OLDHR=T on the &OPTION card. The subarea regional scale network contained 218 nodes and 325 links.

Once the subarea regional scale highway network was converted into N-file format, HNET was run again to delete links in the subarea that were to be replaced with the more detailed set of subarea links. This was accomplished by coding a set of link data cards which listed the links to be deleted from the network. Figure 14 contains a listing of the job set-up used for the run. Note that there is only one network file, N1, which is modified (as compared with OLDHR and NEWHR files utilized by older UTPS program HR). Also input are the link data cards in the input stream following the //HNET.LINKS DD * card. HNET Report 5 (Figure 15) displays the updates that occurred to the N-file in that particular run. In this example, it is a listing of those links that were deleted from the N-file during that run of HNET.

FIGURE 14: HNET SET-UP TO DELETE LINKS

```
//HNET EXEC HNET,CORE=256K,
// N1='DSN=UMTA.SEA77.SUBAREA.NFILE,VOL=SER=UMTA2'
//HNET.LINKS DD *
//HNET.SYSIN DD *
     HNET RUN TO UPDATE SUBAREA N-FILE
 &SELECT REPORT 1,-5,7,14 &END
```

The next run of HNET added the more detailed, subarea highway links to the subarea N-file. The intent was to code into the highway network the CBD streets that were omitted from the regional scale network. In addition, the geometric and capacity characteristics of these facilities in the a.m. peak period, for

FIGURE 15

HNET RUN TO UPDATE SUBAREA N-FILE

5JAN82 15.20.01 HNET REPORT 5

N - F I L E U P D A T E A C T I O N R E P O R T

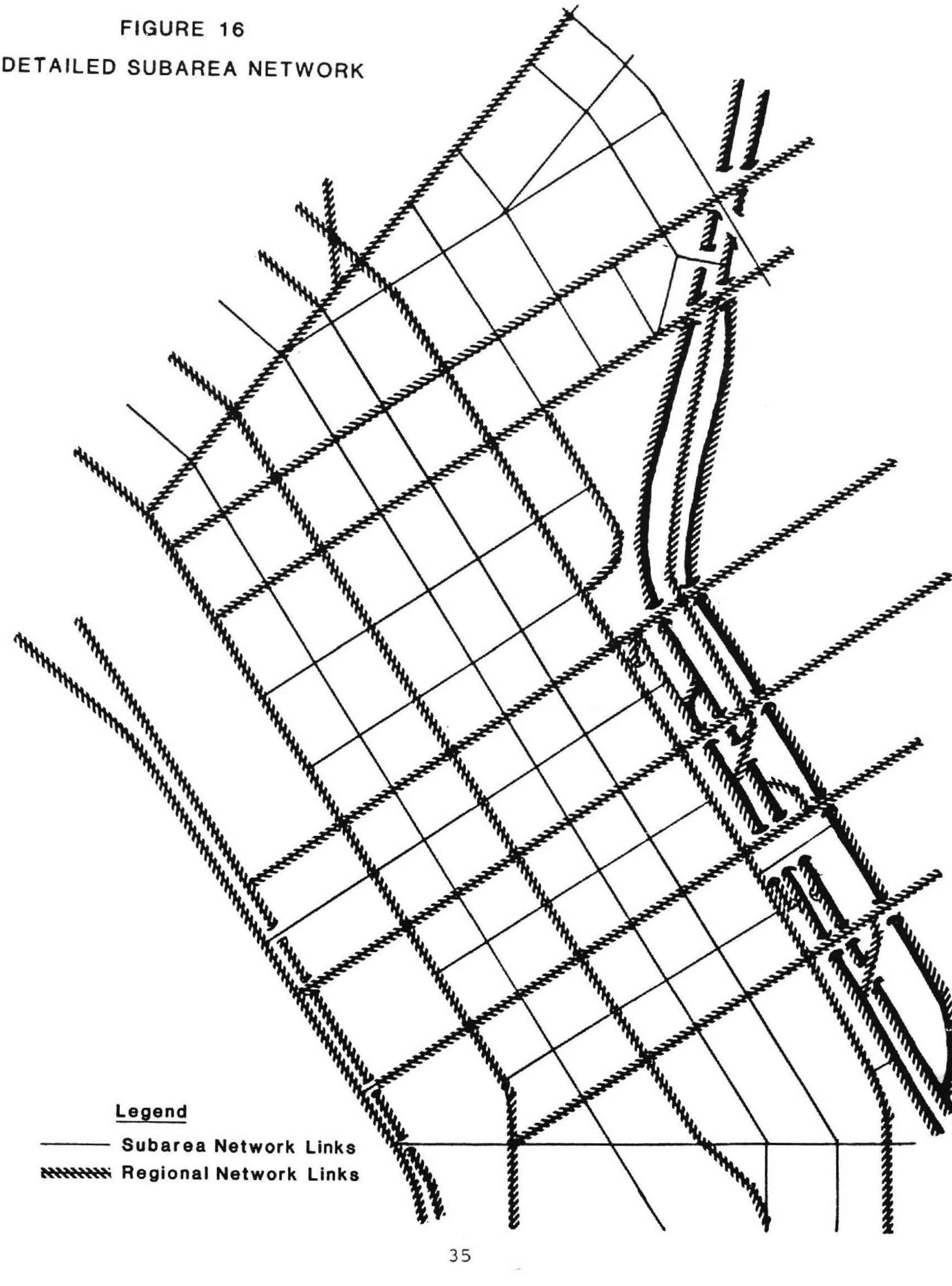
ANODE	BNODE	ACTION TAKEN
1854	1842	LINK DELETED
1854	1837	LINK DELETED
1857	1858	LINK DELETED
1859	1860	LINK DELETED
1860	1878	LINK DELETED
1863	1892	LINK DELETED
1866	1892	LINK DELETED
1872	1851	LINK DELETED
1873	1872	LINK DELETED
1874	1877	LINK DELETED
1874	1873	LINK DELETED
1875	1872	LINK DELETED
1876	1875	LINK DELETED
1877	1890	LINK DELETED
1877	1876	LINK DELETED
1878	1860	LINK DELETED
1884	1839	LINK DELETED
1885	1855	LINK DELETED
1886	1885	LINK DELETED
1887	1950	LINK DELETED
1888	1889	LINK DELETED
1889	1895	LINK DELETED
1889	1888	LINK DELETED
1890	1889	LINK DELETED
1891	1890	LINK DELETED
1892	1856	LINK DELETED
1893	1885	LINK DELETED
1894	1903	LINK DELETED
1894	1839	LINK DELETED
1895	1894	LINK DELETED
1901	1910	LINK DELETED
1901	1953	LINK DELETED
1902	1903	LINK DELETED
1903	1894	LINK DELETED
1906	1905	LINK DELETED
1909	1910	LINK DELETED
1910	1909	LINK DELETED
1914	1915	LINK DELETED
1916	1892	LINK DELETED
1950	1887	LINK DELETED
1951	1901	LINK DELETED
1951	1952	LINK DELETED
1952	1893	LINK DELETED
1953	1954	LINK DELETED
1953	1901	LINK DELETED
1954	1905	LINK DELETED

ANODE	BNODE	ACTION TAKEN
1854	1828	LINK DELETED
1857	1874	LINK DELETED
1858	1857	LINK DELETED
1860	16	LINK DELETED
1860	1863	LINK DELETED
1863	1860	LINK DELETED
1872	1875	LINK DELETED
1872	1873	LINK DELETED
1873	1874	LINK DELETED
1874	1848	LINK DELETED
1874	1857	LINK DELETED
1875	1876	LINK DELETED
1876	1877	LINK DELETED
1877	1874	LINK DELETED
1877	1878	LINK DELETED
1878	1877	LINK DELETED
1885	1893	LINK DELETED
1886	1952	LINK DELETED
1886	1887	LINK DELETED
1887	1886	LINK DELETED
1889	1890	LINK DELETED
1889	1894	LINK DELETED
1890	1877	LINK DELETED
1890	1891	LINK DELETED
1892	1863	LINK DELETED
1892	1916	LINK DELETED
1893	1952	LINK DELETED
1894	1895	LINK DELETED
1895	1889	LINK DELETED
1900	1953	LINK DELETED
1901	1951	LINK DELETED
1902	1911	LINK DELETED
1903	1902	LINK DELETED
1905	1954	LINK DELETED
1905	1906	LINK DELETED
1910	1901	LINK DELETED
1911	1902	LINK DELETED
1915	1914	LINK DELETED
1948	1823	LINK DELETED
1950	1951	LINK DELETED
1951	1950	LINK DELETED
1952	1886	LINK DELETED
1952	1951	LINK DELETED
1953	1900	LINK DELETED
1954	1953	LINK DELETED

which the analysis was performed, were coded into the network. This required the net addition of 358 links and 229 nodes to the subarea network (including the additional centroid connector links). Figure 16 shows the detailed subarea network. Subarea zonal centroid connections were made at "mid-blocks" so that assigned volumes at intersections would be more accurate and one-way street pairs have been accurately represented rather than abstracted as single two-way links. The number of through lanes of traffic on each street segment represented the conditions in the CBD in the a.m. peak period where certain curb lanes were reserved for transit while others allowed peak period curb parking. Also, the appropriate facility type and area type codes were developed for each new link (based on the UTPS default classifications) as well as the link distance, which was scaled from available maps of the subarea. The job set-up used for this run is almost identical to the HNET set-up in the previous run shown in Figure 14. The difference is in the link card file which, in this run, contains a list of links to be added along with their attributes. HNET Report 7, a portion of which is shown in Figure 17, displays the link contents of the N-file after the updates have been processed. Link speed and time are not typically displayed as they are generally not included in the N-file but are written into the link Z-file based upon the speed/capacity table values coded into HNET. These speed and capacity values are a function of each link's area type, facility type, and number of lanes. (See UTPS programs HNET and UROAD writeups for more detailed discussion of speed and capacity table values). The coded values on the subarea links for facility type and area

FIGURE 16

DETAILED SUBAREA NETWORK



N - F I L E L I N K C O N T E N T S

A NODE	B NODE	D	DIST	IC	FFS	OBSERVED SPD	OBSERVED TIME	CAP	COUNT	N L	ZONE	LG	L U	U C	CC	F T	A T	GL
1862	1847	B	0.16			15				2		99				3	2	49
1862	1861	B	0.04			15				2		99				3	2	7
1862	1863	B	0.08			15				2		99				3	2	49
1862	1879	B	0.15			15				2		99				3	2	49
1863	470	B	0.10							2						3	2	
1863	537	O	0.03							3						4	1	
1863	1862	B	0.08			15				2		99				3	2	49
1863	1879	B	0.11			15				2		99				3	2	49
1864	1865	B	0.02			15				9		99				5	2	49
1864	1869	O	0.32			20				9		99				5	2	49
1864	3233	I																
1865	1864	B	0.02			15				9		99				5	2	49
1865	1879	B	0.08			15				1		99				3	2	49
1865	1917	B	0.15			15				1		99				3	2	49
1866	516	B	0.07							2						3	2	
1866	1867	B	0.01			15				2		99				3	1	49
1866	3234	O	0.12			20				9		99				5	2	49
1867	1866	B	0.01			15				2		99				3	1	49
1867	1868	B	0.12			20				2		99				3	2	49
1867	1916	B	0.17			15				2		99				3	2	49
1867	1917	B	0.14			15				2		99				3	2	49
1868	467	I																
1868	1867	B	0.12			20				2		99				3	2	49
1868	1869	B	0.11			20				9		99				5	2	49
1868	1930	B	0.15			20				2		99				3	2	49
1868	3251	B	0.07			45				9		99				5	2	49
1869	1864	I																
1869	1868	B	0.11			20				9		99				5	2	49
1869	3236	B	0.19			20				9		99				5	2	49
1870	51	B	0.10				0.30*			9		99				5	2	49
1870	1871	B	0.15			20				9		99				5	2	49
1870	3235	B	0.26			20				9		99				5	2	49
1871	49	B	0.13				0.39*			9		99				5	2	49
1871	1870	B	0.15			20				9		99				5	2	49
1871	1943	B	0.16			20				9		99				5	2	49
1872	408	O	0.06							2						4	1	
1872	540	B	0.04							2						3	1	
1872	541	B	0.04							1						3	1	
1873	408	I																
1873	429	O	0.06							3						4	1	
1873	1850	B	0.08			15				2		99				3	1	49
1873	1876	B	0.08			15				2		99				3	1	49
1874	442	I																
1874	530	O	0.04							3						4	1	
1874	552	I																
1874	1857	O	0.06							3						4	1	

FIGURE 17

HNET RUN TO UPDATE SUBAREA N-FILE

type presumed the use of default values provided in HNET and corresponded as closely as possible to the operating conditions of those streets in the a.m. peak hour. These default values could be changed during calibration of the assignment process to better reflect traffic volumes by street. Note that the "in-bound" direction of one-way links (an "I" displayed under the "D" column in Report 7) contains no additional data which signifies that HNET considers the A-node, B-node link to be the "wrong way" of a one-way street.

The final HNET run was made to create the UTPS link Z-file which contains the complete set of highway network information needed by program UROAD to perform traffic assignments. All network attributes contained in the N-file are copied by HNET into the Z-file along with the speed and capacity values from the tables in HNET. Alternatively, speed and capacity values could be coded directly onto the link data cards. As described previously, this case study analysis made use of the speed and capacity tables in HNET to assign those values to each link. Figure 18 shows the HNET set-up which created the subarea link Z-file. Note that the N-file (N1) created in the previous HNET run

FIGURE 18: HNET SET-UP TO CREATE SUBAREA LINK Z-FILE

```
//HNET EXEC HNET,CORE=256K
// N1='DSN=UMTA.SEA77.SUBAREA.NFILE,VOL=SER=UMTA2',
// Z1='DSN=UMTA.SEA77.SUBAREA.ZFILE,VOL=SER=UMTA2',
// SPACEZ1='(TRK,25)',DISPZ1='(NEW,KEEP)'
//HNET.SYSIN DD *
 &PARAM ZONES=105 &END
 &SELECT REPORT=9,14,-16 &END
```

was input and the link Z-file (Z1) was output. The HNET control cards specified the highest zone number in the subarea network and which reports were requested.

Figure 19 displays an excerpt from HNET Report 9 which shows the link data contained in the link Z-file of the enriched subarea network. Note that the freeflow time (minutes) and speed (mph), the link capacity (in vehicles/hour) and the link length ("DIS" column) to the nearest tenth of a mile are displayed. The subarea centroid connectors were assigned a uniform time of 1 minute, a capacity of 90,000 vehicles per hour, and no distance. These parameters reflect the nature of zonal centroid connectors which are fictitious links that provide connectivity between trip ends represented by zone centroid nodes and the street network.

Calibrate Subarea Traffic Assignment

Once the subarea detail of both zones and highway network was increased, the next step in the analysis process was to calibrate a traffic assignment technique such that subarea traffic volume estimates reasonably matched 1977 observed traffic count data. Since a.m. peak hour traffic conditions were being simulated, some sort of traffic dispersion method was thought to be needed, either stochastic multipath assignment or some variation of capacity restraint, or some combination of those assignment methods. UTPS program UROAD provides the capabilities of performing a variety of traffic assignment methods including all-or-nothing, incremental (CATS), stochastic multipath, and iterative capacity restraint. (See the UTPS UROAD program writeup and the **UROAD Lecture Guide** for further details.)

HNET RUN TO CREATE SUBAREA Z-FILE

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L I N K D A T A W I T H L O A D S

A NODE	B NODE	U C	FREEFLOW TIME	SP	---OBSERVED CAP	VOL	(BASE TIME	SP	)-- DIS	---ASSIGNED IMP	VOL	(LOAD TIME	1)-- SP	V/C
95	599				90000		1.00*							
96	600				90000		1.00*							
97	601				90000		1.00*							
97	602				90000		1.00*							
98	603				90000		1.00*							
98	604				90000		1.00*							
99	1823				90000		1.00*							
100	605				90000		1.00*							
100	606				90000		1.00*							
101	607				90000		1.00*							
102	608				90000		1.00*							
102	609				90000		1.00*							
103	610				90000		1.00*							
104	611				90000		1.00*							
105	612				90000		1.00*							
401	402		0.22	32	2700				0.1					
401	1906		0.17	28	1100				0.1					
401	1908		0.06	28	1100				0.0					
402	401													
402	501		0.21	32	2700				0.1					
402	1905		0.13	28	1100				0.1					
402	1954		0.13	28	1100				0.1					
403	405		0.46	29	1650				0.2					
403	501													
403	1900		0.14	25	1100				0.1					
403	1953		0.14	25	1100				0.1					
405	403													
405	505		0.08	22	1200				0.0					
405	514		0.44	22	2100				0.2					
405	1893		0.16	22	1200				0.1					
406	514													
406	520		0.08	22	2100				0.0					
406	1885		0.19	22	1200				0.1					
406	1886		0.16	22	1200				0.1					
407	520													
407	521													
407	522		0.11	22	2100				0.0					
407	523		0.08	22	1400				0.0					
408	522													
408	544		0.11	22	2100				0.0					
408	1872													
408	1873		0.16	22	2100				0.1					
409	544													
409	545													
409	546		0.11	22	2100				0.0					
409	547		0.08	22	1400				0.0					

FIGURE 19

The first assignment method tested was a single iteration of stochastic multipath assignment. Stochastic multipath, or probabilistic traffic assignment, assigns traffic to multiple paths between zone pairs based upon the relative impedance of each path as compared to the lowest impedance path. The dispersion of assigned traffic to these competing paths is also a function of a parameter, theta, which varies the likelihood of the dispersion function allocating traffic to the competing paths. (See UTPS Report, **The UROAD Stochastic Assignment Algorithm: A Sample Application Using Hand Calculation.**) The assignment method acts to "spread around" the traffic to the links in the network rather than concentrating assigned trips to the links comprising the minimum impedance paths between zones as would occur in an all-or-nothing loading. Figure 20 displays the UROAD set-up used to

FIGURE 20: UROAD SET-UP TO PERFORM MULTIPATH ASSIGNMENT

```
//UROAD EXEC UROAD,CORE=336K
// Z1='DSN=UMTA.SEA77.SUBAREA.ZFILE,VOL=SER=UMTA2',
// J1='DSN=UMTA.SEA77.XSUB,TRIPS,VOL=SER=UMTA2',
// UNITJ1='3330-1'
//UROAD.SYSIN DD *
     UROAD STOCHASTIC ASSIGNMENT
 &PARAM TABLES=101,THETA=.0015,CONFAC=1.0,LAVN=1,
  ASSIGN='SEASUBSTOCH' &END
 &SELECT REPORT=4,6,I=1,7,9,10,12,-14,16-51,60,-105,
  J=1,7,9,10,12,-14,16,-51,60,105 &END
```

perform a single iteration multipath assignment. The input files were the link Z-file on file Z1 created by HNET and the subarea peak hour expanded vehicle triptable created by USQUEX. UROAD outputs the results of an assignment (e.g., link volumes, speeds, v/c ratio, etc.) to the link Z-file (Z1) as new LAVs, as well as providing information through reports. The &PARAM card controls most UROAD functions. TABLES=101 indicates that the input trip table to be assigned was on Table 1 of J-file 1. THETA=0.0015 indicates that UROAD was to perform a stochastic multipath assignment (since 0<THETA<10) with a dispersion parameter of 0.0015. (See UTPS Report, **The UROAD Stochastic Assignment Algorithm: A Sample Application Using Hand Calculation** for a discussion of the effect of theta on the multipath assignment results.) CONFAC=1.0 instructs UROAD to consider the input vehicle trips to be in terms of a peak hour table. (UROAD multiplies input vehicle trip volumes by CONFAC to estimate hourly volumes to compare with link capacity, which is in terms of vehicles per hour.) LAVN=1 indicates that when UROAD outputs the results of the assignment to the link Z-file, each resultant link LAV will have a "1" appended to its LAV name (e.g., CT1, congested travel-time for assignment number 1, etc.). The ASSIGN keyword permits the labeling of the assignment results in the link Z-file with up to a 24 character name to better identify results in subsequent reports. The &SELECT card denotes reports which were desired in the UROAD assignment run and which zones for trip assignment were selected (with the I and J keywords). Zone selection was required because the subarea zones were not numbered consecutively when created in USQUEX (though they could have been). The UROAD reports provided an indication of how the trial multipath assignment technique performed on the subarea network. Report 12 (Figure 21) is a summary of the assignment results relative to network supply-demand equilibrium (see UTPS program UROAD write-up). The subarea multipath assignment results summary indicated that the network was overly congested (Congestion Index=0.9173

FIGURE 21

MULTIPATH ASSIGNMENT

```
   UROAD - STOCHASTIC ASSIGNMENT

 8JAN82   9.15.12           UROAD    REPORT 12  -                   PAGE     4

  V E H I C L E   C O S T - O F - T R A V E L   S U M M A T I O N S

                  S1=             S2=           ERROR=
ITERATION  V(LINK)*I(LINK)  V(O-D)*I(O-D)  (S1-S2)/S1  LAMBDA  FRACTION
---------  ---------------  -------------  ----------  ------  --------
    0             --            1784.          --       1.000     1.000
    1           21580.           --            --

IC = IMPEDANCE DUE TO CONGESTION = S1(1)-S2(0) =   19796.
RI = CONGESTION INDEX            = IC/S1(1)    =   0.9173

ROA37 2900 (INFORMATION): END ASSIGNMENT AT TIME:  9.15.23

ROA37 2910 (INFORMATION): TRIP ASSIGNMENT SUMMARY

                             ASSIGNED INTERZONAL TRIPS     60426
                           UNASSIGNED INTERZONAL TRIPS      1577
                                      INTRAZONAL TRIPS       379
                                                        --------
                             TOTAL INPUT TRIPS SELECTED    62382

ROA6 8600 (INFORMATION): TOTAL VEHICLE MILES=       81236.15 VEH-MI
                         TOTAL VEHICLE HOURS=       35966.58 VEH-H
                         TOTAL TOLL REVENUE =             0.  DOLLARS
                         TOTAL TOLL VHT     =            0.0  VEH-H
                         AVERAGE SPEED      =           2.26 MI/H
```

and Average Speed=2.26 mph). That is, the single multipath loading assigned too many trips to a selected number of links resulting in unrealistically low speeds and high v/c ratios. This was confirmed by examining UROAD Report 4 (Figure 22) which shows many links with v/c ratios greater than 1.25 and loaded speeds under 10 mph. These results indicated that some form of capacity restrained assignment was needed to "move around" the traffic on the network and better balance volume and capacity to produce more reasonable link loadings. Therefore, the next assignment method tested was one iteration of multipath assignment followed by two additional iterations of all-or-nothing assignment with capacity restraint recalculating link traveltimes between each iteration.

The only difference in the UROAD set-up to test this second assignment method was the coding of the keyword THETA which controls both the type of loading and the iterations of capacity restraint. In this run, it was coded as THETA=.0015,0,0 which indicated to UROAD that an initial stochastic multipath loading was to be followed by two additional all-or-nothing loadings with UROAD automatically applying capacity restraint between each loading. A review of Report 12 (Figure 23) from this UROAD run indicates major differences from the previous run of multipath assignment. Note that the congestion index has dropped to 0.4846 and the weighted average speed of all traffic assigned to the network increased to 14.59 mph. These statistics indicate that the network assignment is less "congested" than the previous assignment test. Comparing individual link volumes in Report 4 (Figure 24), it was observed that, in general, assignment volumes

L I N K   A N D   T U R N   V O L U M E S

A NODE	B NODE	A-TO-B VOLUME	SPD	2-WAY VOLUME	AV. SPD	B NODE	A-TO-B VOLUME	SPD	2-WAY VOLUME	AV. SPD
(461)	(457)	755	21	796	21	(462)	0	0	610	22
	(516)	93	23	290	23					
(462)	(458)	477	22	611	22	(461)	610	22	610	22
	(465)	75	22	75	22	(469)	217	22	694	22
	(532)	0	0	768	22					
(463)	(532)	780	22	780	22	(533)	0	0	581	23
	(534)	0	0	1193	20	(535)	984	23	984	23
(464)	(534)	1322	20	1322	20	(1857)	0	0	1456	20
	(1858)	134	22	134	22					
(465)	(16)	189	0	189	0	(462)	0	0	75	22
	(466)	1433	20	1433	20	(469)	0	26	1547*	9
(466)	(465)	0	0	1433	20	(470)	2040*	4	3934*	4
	(519)	497	30	497	30	(1892)	2184*	3	3578*	7
(467)	(519)	0	0	495	30	(1868)	495	29	495	29
(469)	(410)	915	21	915	21	(462)	477	22	694	22
	(465)	1547*	9	1547*	9	(470)	1478+	11	2563+	14
	(536)	71	25	3237*	2	(557)	73	23	654	23
	(1851)	757	20	1026	21					
(470)	(414)	2409*	4	2409*	4	(466)	1894*	5	3934*	4
	(469)	1085-	17	2563+	14	(571)	534	23	891	23
	(581)	2570*	0	4152*	3	(1863)	433	25	3901*	4
(471)	(1803)	1558*	1	1644*	2	(1823)	313	26	1418-	19
	(1948)	0	26	680	24					
(472)	(605)	53	25	99	25	(606)	41	26	114	26
	(1795)	60	26	95	26					
(473)	(450)	0	0	287	23	(1806)	629	23	629	23
	(1853)	0	0	342	23					
(474)	(448)	0	0	952	23	(1817)	958	23	958	23
	(1828)	0	0	6	23					
(501)	(60)	263	0	410	0	(402)	0	0	402	31
	(403)	286	31	286	31					
(502)	(60)	532	0	597	0	(1953)	54	25	752	24
	(1954)	297	25	417	25					
(503)	(61)	354	0	435	0	(423)	269	32	269	32
	(424)	0	0	542	32					
(504)	(62)	540	0	661	0	(1901)	0	0	702	29
	(1951)	283	29	283	29					
(505)	(63)	281	0	355	0	(405)	149	23	617	23
	(1952)	332	23	552	23					
(506)	(64)	197	0	270	0	(1914)	1010-	19	1993-	19
	(1915)	951-	19	2053-	18					
(507)	(64)	213	0	233	0	(1894)	179	22	283	22
	(1895)	41	22	350	22					

- = VOLUME/CAPACITY RATIO FROM 0.75 TO 1.00
+ = VOLUME/CAPACITY RATIO FROM 1.00 TO 1.25
* = VOLUME/CAPACITY RATIO 1.25 AND OVER
$ = TOLL LINKS (VOLUME=REVENUE, SPD=CONGESTED TIME)

FIGURE 22

MULTIPATH ASSIGNMENT
UROAD REPORT 4

V E H I C L E   C O S T - O F - T R A V E L   S U M M A T I O N S

ITERATION	S1= V(LINK)*I(LINK)	S2= V(O-D)*I(O-D)	ERROR= (S1-S2)/S1	LAMBDA	FRACTION
0	--	1823.	--	1.000	0.148
1	9168.	2962.	0.67689	0.646	0.811
2	3688.	2844.	0.22864	0.041	0.041
3	3538.	--	--		

IC = IMPEDANCE DUE TO CONGESTION = S1(3)-S2(0) = 1714.
RI = CONGESTION INDEX = IC/S1(3) = 0.4846

ROA37 2900 (INFORMATION): END ASSIGNMENT AT TIME: 17.46.04

ROA37 2910 (INFORMATION): TRIP ASSIGNMENT SUMMARY

ASSIGNED INTERZONAL TRIPS	60524
UNASSIGNED INTERZONAL TRIPS	1479
INTRAZONAL TRIPS	379
TOTAL INPUT TRIPS SELECTED	62382

ROA6 8600 (INFORMATION): TOTAL VEHICLE MILES= 85989.58 VEH-MI
TOTAL VEHICLE HOURS= 5895.21 VEH-H
TOTAL TOLL REVENUE = 0. DOLLARS
TOTAL TOLL VHT = 0.0 VEH-H
AVERAGE SPEED = 14.59 MI/H

FIGURE 23

UROAD REPORT 12

MULTIPATH CAPACITY RESTRAINED ASSIGNMENT

L I N K   A N D   T U R N   V O L U M E S

A NODE	B NODE	A-TO-B VOLUME	SPD	2-WAY VOLUME	AV. SPD	B NODE	A-TO-B VOLUME	SPD	2-WAY VOLUME	AV. SPD
(457)	(458)	32	23	32	23	(461)	266	23	836	23
	(515)	564	23	857	23					
(458)	(454)	1505*	10	1529+	10	(457)	0	0	32	23
	(459)	22	22	22	22	(462)	31	22	1533+	10
(459)	(458)	0	0	22	22	(529)	2155+	15	2155+	15
	(535)	0	0	2169+	15	(1857)	36	22	36	22
(461)	(457)	570	23	836	23	(462)	0	0	1366	20
	(516)	1247+	14	1432-	15					
(462)	(458)	1502*	10	1533+	10	(461)	1366	20	1366	20
	(465)	31	22	31	22	(475)	39	22	122	22
	(532)	0	0	2673*	9					
(463)	(532)	2789	9	2789*	9	(533)	0	0	2443+	12
	(534)	0	0	2443+	11	(535)	2098-	15	2098-	15
(464)	(534)	2693*	10	2693*	10	(1857)	0	0	2973*	8
	(1858)	279	22	279	22					
(465)	(16)	23	0	23	0	(462)	0	0	31	22
	(466)	202	23	202	23	(475)	0	23	194	23
(466)	(465)	0	0	202	23	(476)	584	24	1060	25
	(519)	42	30	42	30	(1892)	605	24	1158	25
(467)	(519)	0	0	35	30	(1868)	35	29	35	29
(469)	(410)	2614*	3	2614*	3	(557)	14	23	3020*	1
	(1851)	412	22	416	22					
(470)	(414)	1148-	18	1148-	18	(571)	34	23	1302*	3
	(581)	210	23	333	23					
(471)	(1803)	554-	17	605-	19	(1823)	347	26	557	26
	(1948)	0	26	439	26					
(472)	(605)	31	25	40	25	(606)	1	26	12	26
	(1795)	16	26	44	26					
(473)	(450)	0	0	41	23	(1806)	3059*	7	3059*	7
	(1853)	0	0	3018*	8					
(474)	(448)	0	0	1218	23	(1817)	1225	21	1225	21
	(1628)	0	0	7	23					
(475)	(462)	83	22	122	22	(465)	194	23	194	23
	(476)	88	23	115	23	(536)	10	25	319	25
(476)	(466)	476	26	1060	25	(475)	27	23	115	23
	(1863)	626	24	1083	24					
(501)	(60)	107	0	221	0	(402)	0	0	379	31
	(403)	385	31	385	31					
(502)	(60)	686	0	786	0	(1953)	79	25	707	24
	(1954)	70	25	180	25					
(503)	(61)	354	0	437	0	(423)	494	32	494	32
	(424)	0	0	765	32					
(504)	(62)	540	0	663	0	(1901)	0	0	836	28
	(1951)	419	29	419	29					

- = VOLUME/CAPACITY RATIO FROM 0.75 TO 1.00
+ = VOLUME/CAPACITY RATIO FROM 1.00 TO 1.25
* = VOLUME/CAPACITY RATIO 1.25 AND OVER
$ = TOLL LINKS (VOLUME=REVENUE, SPD=CONGESTED TIME)

FIGURE 24

UROAD REPORT 4
MULTIPATH CAPACITY RESTRAINED ASSIGNMENT

were spread over more links, with fewer links being over assigned. Comparison of assigned link volumes with peak hour traffic counts indicated a reasonably close correspondence. Major arterials in the CBD, for which a.m. peak hour counts were available, were generally within 10-15 percent of assigned volumes for those links. Therefore the assignment method of one iteration of stochastic multipath followed by two iterations of all-or-nothing loading with capacity restraint was deemed acceptable for further use in subarea assignments.

Once the windowing process and assignment method was validated on 1977 data, the next step in the analysis process was to apply the procedures to the forecast year to test the effects of the restriction of Third Avenue to auto traffic. Unfortunately, as was indicated earlier, 1990 forecast year data were not available for testing in this case study analysis. However, the analysis concepts could still be illustrated using the 1977 triptables and network. If forecast year data were used, then the same process described in the previous section would have been applied: window the subarea network and triptable; expand subarea zones based upon forecast year expansion factors; increase future year network detail in the subarea; and assign traffic to the subarea network to obtain base condition or "do nothing" results. The next steps illustrate the remainder of the analysis process: creating subarea network alternatives and then assigning traffic to evaluate the results.

Developing Network Without Third Avenue

In order to create the representation of the CBD street system with access to Third Avenue prohibited to auto traffic, the base subarea highway network was modified by deleting those links representing Third Avenue from the network. HNET facilitates the creation of highway network alternatives by allowing for the copying of N-files with the ability to then make network modifications to the network copy without disturbing the original network representation. A run of HNET was made to copy the base, detailed subarea network in preparation for creating a network without Third Avenue. Figure 25 displays the HNET set-up used to copy the subarea network N-file. Note there are two N-files coded in the run, N2, which was the existing subarea network, and N1, to which the copied network was written. The copy function was invoked by the coding of the "N=" keyword on the &SELECT card. N specifies a list of nodes, and, by implication, associated links, to be copied from the N2 file to the N1 file. Since a copy of the entire subarea network was desired, N was equated with all nodes in the subarea network (e.g., 1-3256).

FIGURE 25: HNET SET-UP TO COPY N-FILE

```
//HNET EXEC HNET,CORE=256K,
// N2='DSN=UMTA.SEA77.SUBAREA.NFILE,VOL=SER=UMTA2',
// N1='DSN=UMTA.SEA77.EXP.NFILE,VOL=SER=UMTA2',
// SPACEN1='(TRK,20),DISPN1=(NEW,KEEP)',UNITN1='SYSDA'
//HNET.SYSIN DD *
     HNET RUN TO COPY N FILE
 &SELECT N=1,-3256,REPORT=1,5,7,14, &END
```

Once the copy of the detailed subarea network was created, the next step was to modify the network to delete Third Avenue from the a.m. peak highway network to reflect the proposed restriction of that street to bus only traffic.

An alternative approach, not taken in the case study, would have been to code use codes on the links in the subarea network to facilitate the restriction of traffic during assignment. HNET and UROAD now allow the designation of a use code (UC) on links in the network. Then, by coding the UC keyword in UROAD during an assignment run, the user can restrict the assignment to only those links coded with the designated use codes. In the case study example, the subarea network links could have been assigned a use code of 1, except for those links representing Third Avenue, which could have been assigned a different use code value of say, 2. Then, when an assignment was desired in which auto use of Third Avenue was prohibited, a "UC=1" would have been coded on the &SELECT card of the UROAD assignment run. UROAD would then have effectively deleted those links with a use code other than 1 (e.g., Third Avenue) from the network during its assignment.

The case study approach, however, was to create a network N-file copy as described above, and then run HNET again to update the network N-file by deleting those links representing the portion of Third Avenue to be restricted to bus only traffic. The HNET update run was made with a set of link card updates which deleted Third Avenue between Steward and Yesler (see Figure 26). Then HNET was run to create a new link Z-file of this alternative network for input to UROAD for traffic assignment. The set-up for this run is not shown as it is similar to update runs described earlier.

```
       HNET RUN TO UPDATE          SUBAFE N-FILE

20JAN82  17.05.11          HNET     REPORT  1                    PAGE    4

        I N P U T   L I N K   D A T A   C A R D   I M A G E S

+++----+----+---+-++++-+-+---+-+++-+--+---+-----+-----++-++-+---+----+-----++-
1---5---10---15---20---25---30---35---40---45---50---55---60---65---70-
D2 1886 1876
D2 1876 1873
D2 1873 1850
D2 1850 1849
D2 1849  561
D2  561 1841
D2 1841  563
D2  563 1837
D2 1837  573
D2  573 1827
D2 1827  575
D2  575  420
D2  420  584
D2  584 1818
D2 1818  586
D2  586 1819
D2 1819 1804
D2 1804  421
HNT500 8200 (WARNING):NO NODE CARDS EXIST ON THE NODE UP DATE CARD FILE
1---5---10---15---20---25---30---35---40---45---50---55---60---65---70-

HNT020 120 (INFORMATION): N-FILE UPDATING BEGINNING

HNT020 120 (INFORMATION): N-FILE UPDATING COMPLETED
```

FIGURE 26

Analyzing Network Alternative

Once the subarea network without Third Avenue was created, the next step was to assign the a.m. peak hour vehicle triptable and compare the results with the base subarea network with Third Avenue. UROAD was run again with the link Z-file without Third Avenue as input and applying the same, calibrated assignment method of one iteration of stochastic multipath followed by two iterations of all-or-nothing capacity restraint. The set-up of the UROAD assignment is identical to the run described earlier. The following paragraphs describe the results of the assignment and compare it to the base case results. While comparisons of 1977 assignments with and without Third Avenue are being made, the typical application would have been to compare these assignments for 1990 conditions. Lack of regional forecast data prevented this future year analysis.

UROAD Report 12 (Figure 27) is the first basis for comparison as to the potential effects on traffic of prohibiting autos from using Third Avenue. Note that total vehicle-miles of travel (VMT) on the subarea network was estimated at 86,153 and total vehicle hours of travel (VHT) as 5964, with a resultant average speed of 14.44 mph. Comparing these statistics with Report 12 from the base network assignment (Figure 23) indicates that the assignment for the network without Third Avenue produced an estimated increase in VMT of 0.2 percent, and an increase in VHT of 1.2 percent, while subarea network-wide estimated average speed decreased 0.15 mph. It can be concluded from this subarea-wide analysis that the proposed prohibition of auto traffic on Third Avenue would not have an overall significant impact on auto

V E H I C L E   C O S T - O F - T R A V E L   S U M M A T I O N S

ITERATION	S1= V(LINK)*I(LINK)	S2= V(O-D)*I(O-D)	ERROR= (S1-S2)/S1	LAMBDA	FRACTION
0	--	1826.	--	1.000	0.128
1	9986.	2972.	0.70237	0.667	0.831
2	3738.	2849.	0.23794	0.042	0.042
3	3579.	--	--		

IC = IMPEDANCE DUE TO CONGESTION = S1(3)-S2(0) = 1753.
RI = CONGESTION INDEX = IC/S1(3) = 0.4899

ROA37 2900 (INFORMATION): END ASSIGNMENT AT TIME: 17.42.27

ROA37 2910 (INFORMATION): TRIP ASSIGNMENT SUMMARY

ASSIGNED INTERZONAL TRIPS	60524
UNASSIGNED INTERZONAL TRIPS	1479
INTRAZONAL TRIPS	379
TOTAL INPUT TRIPS SELECTED	62382

ROA6 8600 (INFORMATION): TOTAL VEHICLE MILES= 86152.74 VEH-MI
TOTAL VEHICLE HOURS= 5964.32 VEH-H
TOTAL TOLL REVENUE = 0. DOLLARS
TOTAL TOLL VMT = 0.0 VEH-H
AVERAGE SPEED = 14.44 MI/H

FIGURE 27

UROAD REPORT 12

SUBAREA ASSIGNMENT WITHOUT THIRD AVENUE

travel. The next step was to look at the assignment results in more detail, to see if link or intersection specific problems may have been created or exacerbated.

Figures 28 and 29 show the assigned volumes on selected subarea arterials with and without Third Avenue, respectively. Note that traffic flow was shifted, by the assignment model, primarily to the parallel one-way arterials of 2nd and 4th Avenues. Additionally 1st and 5th Avenues absorbed some additional vehicles. However, the v/c ratios on those facilities did not appreciably change in the assignment.

More detailed analysis of intersection performance could be performed by using the so-called micro-analysis options within UROAD which allows the user to examine in more detail the performance of specified intersections. Detailed information must be provided to the program on intersection geometry, approach lanes and signal phasing, and outputs include details of average and peak delay by approach and total delay. Refer to the UTPS program UROAD (12 December 82) writeup and the "UROAD Micro-Assignment: User's Guide."

Additionally, more detailed analysis could be performed using techniques available in the recent updates to the Highway Capacity Manual (NCHRP Circular 212) such as critical movement summation (CMS) which computes an intersection level of service based upon intersection geometry and approach and turn volume information. The inputs can be produced by UROAD as an optional output to the assignment results.

If problems are discovered as a result of these analyses, alternative network improvements can be tested using HNET to code

FIGURE 28

SUBAREA LINK VOLUMES WITH THIRD AVENUE

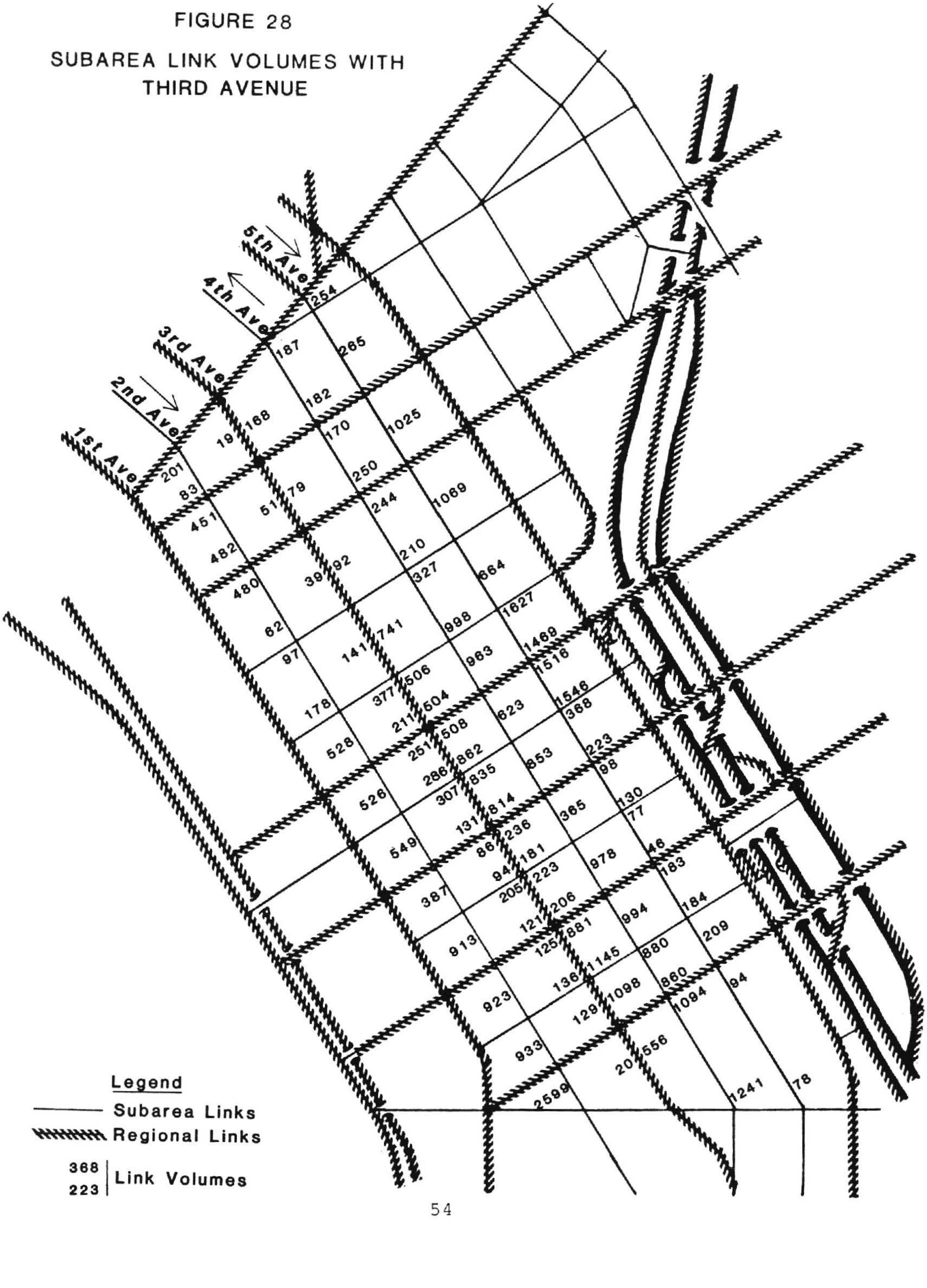
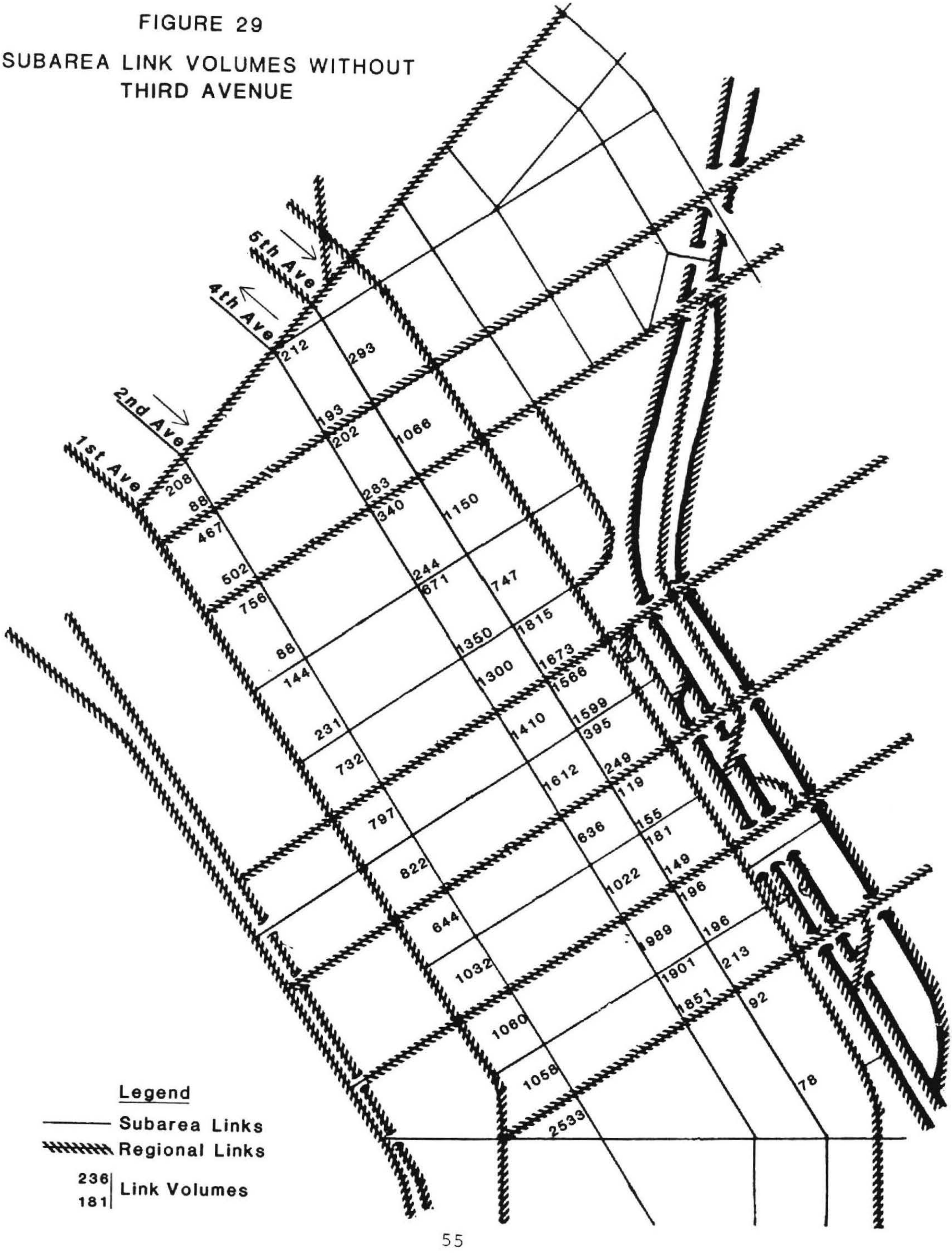


FIGURE 29

SUBAREA LINK VOLUMES WITHOUT THIRD AVENUE



the network changes and UROAD to reassign traffic and produce network performance information or volumes to be used in the more detailed analysis techniques indicated above. This analysis can be done in an iterative fashion until a preferred alternative is identified.

SUMMARY

This case study has illustrated the application of UTPS software to the analysis of a proposed subarea highway network change. The use of programs NAG, USQUEX, HNET and UROAD to "window" the subarea affected by the proposed elimination of a CBD arterial from the regional network, increase subarea detail and assign traffic to determine street system performance changes was illustrated. The application of UTPS software and complementary analysis techniques to these types of problems was demonstrated.

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