Application of O-D Data in the Baltimore Region

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In seeking a quick and inexpensive way to locate an efficient freeway system for the Baltimore area, a comparison was made of the existing street capacity with the travel desires over a series of screen lines. The origin and destination of traffic desiring to cross at the points of capacity deficiency were examined to give clues as to the type of freeway pattern required. The freeway system delineated by this technique stood up under various traffic assignments. Tests indicate that the method was sound. In addition, a method was developed that was helpful in locating and designing arterial streets.

●USE OF origin and destination data to determine highway needs and design factors presented some unique problems in the Baltimore transportation study. First, the study was under the general auspices of the Baltimore Regional Planning Council, a purely advisory group of officials from the various jurisdictions concerned. Therefore, the freeway plan had to be developed on a cooperative basis. Second, the local jurisdictions wanted the information prepared in such a manner that it would be helpful to them in determining their arterial and local street needs. Consequently, the program was developed into two phases, the first dealing with the delineation of the basic freeway system and the second being concerned with local street needs.

DETERMINING FREEWAY NEEDS

To eliminate the need of testing many freeway systems to find one with adequate capacity, it was felt that by properly analyzing the O-D data and available capacity information it should be possible to select a system initially that would not have bottlenecks. In attempting to do this, the following program was set up:

1. Scaling the problem.
2. Screen line analysis.
3. Delineating the plan.

Once these steps were completed the freeways were located more specifically and traffic assigned to them.

Scaling the Problem

The Baltimore Regional Planning Council had forecast a population growth of more than 800,000 in the Baltimore Region by 1980. Analyses of automobile ownership trends reveal that by 1980 the motoring population should be approximately 850,000. Both of these factors, when combined, would naturally bring about a rapid increase in vehicle travel. As indicated by Table 1, in 1957 more than 12,000,000 vehicle-miles were driven each day in the Baltimore Region.

It is estimated that by 1980 more than 20,000,000 vehicle-miles will be driven daily. This is an increase of nearly 70 percent and represents an additional 8,000,000 vehicle-miles. Inasmuch as most of the streets in the region are operating at capacity, this means that about 8,000,000 vehicle-miles of capacity must be added to the highway system by 1980.

Analysis of the Interstate Highway System programmed for the area showed that it would provide about half of this required highway capacity and that programmed arterial street improvements will provide a capacity of about 2,000,000 vehicle-miles. This means that more than 2,000,000 vehicle-miles of highway capacity will have to be added

to accommodate the traffic adequately in 1980. The latter figure might be thought of as representing 50 miles of 4-lane freeways. In other words, at least 50 miles of freeways other than the Interstate System will be required by 1980 in addition to those now programmed.

Screen Line Analysis

This quick appraisal gave the scale of the problem. However, it did not indicate where these freeways will be needed. Figure 1 depicts the desire lines of traffic

TABLE 1

AVERAGE DAILY VEHICLE MILEAGE IN THE BALTIMORE REGION, 1957-1980

Item	Volume (veh-mi)
Avg daily driving, 1957	12,100,000
Avg daily driving, 1980	20,300,000
Increase, 1957-1980	8,200,000
Capacity provided by 1980:	
Program freeways	4,000,000
Arterial streets	2,000,000
Total	6,000,000
Addl capacity needed	2,200,000

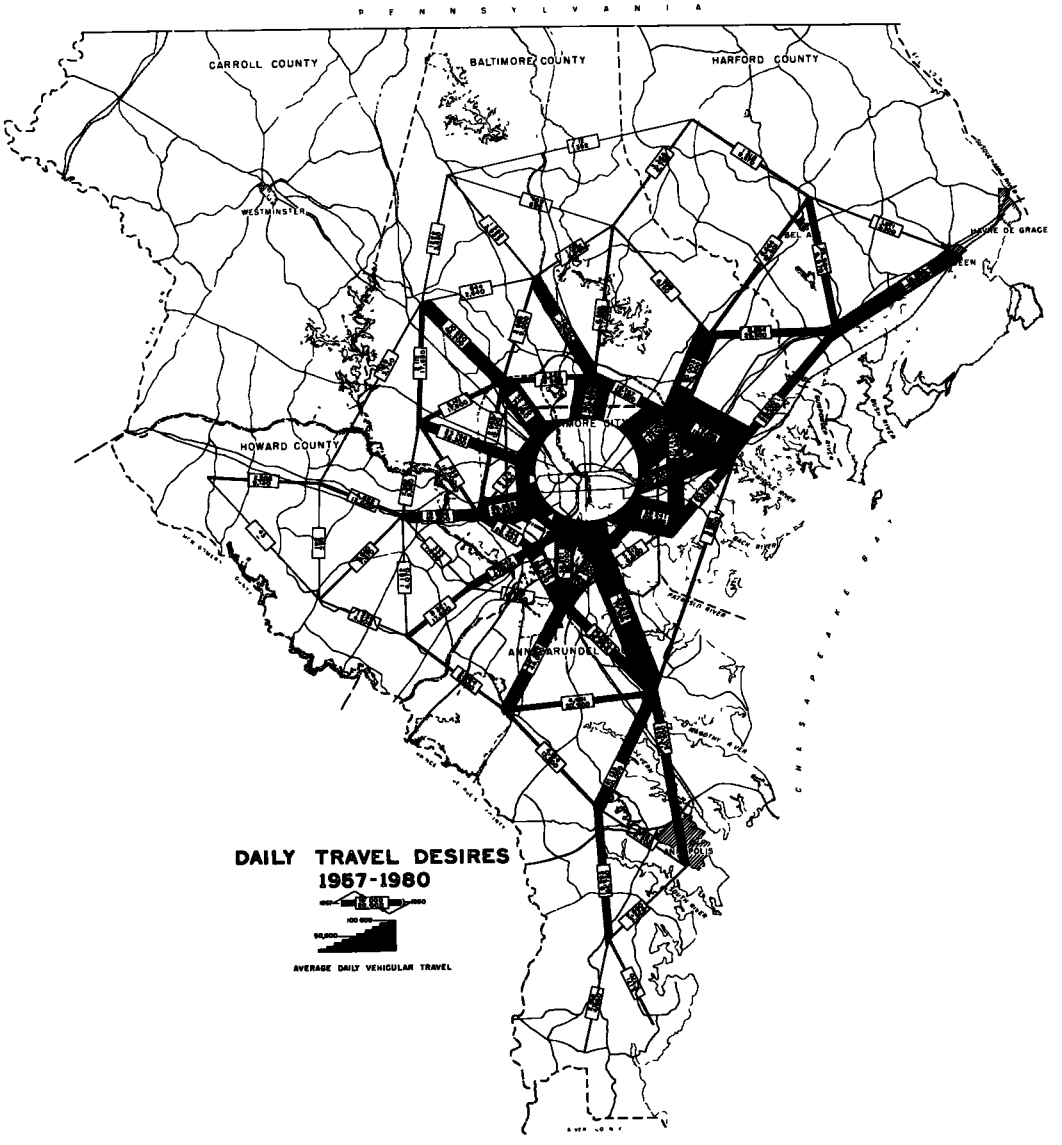


Figure 1. Desire line chart of 1957 and 1980 daily traffic.

throughout the counties of the region in 1957 as well as in 1980. Another one was prepared for the city of Baltimore.

These desire line charts indicate by the thickness of the band the estimated number of trips that desire to go through certain areas of the region. To make this presentation as simple as possible, all desire lines have been considered as passing through the centers of the transportation zones.

It was readily apparent from these charts that most of the increases in traffic would occur in the outlying areas, the largest portion occurring between the industrial areas in the northeast and the residential areas in the northwest. Another marked increase is in the traffic south of the city, primarily in the Baltimore-Washington area. These projections are reflected in the land use forecast prepared by the Baltimore Regional Planning Council.

Another factor of prime importance in designing highways is the directional aspect of the traffic flow. The gravity model technique used made it possible to forecast for

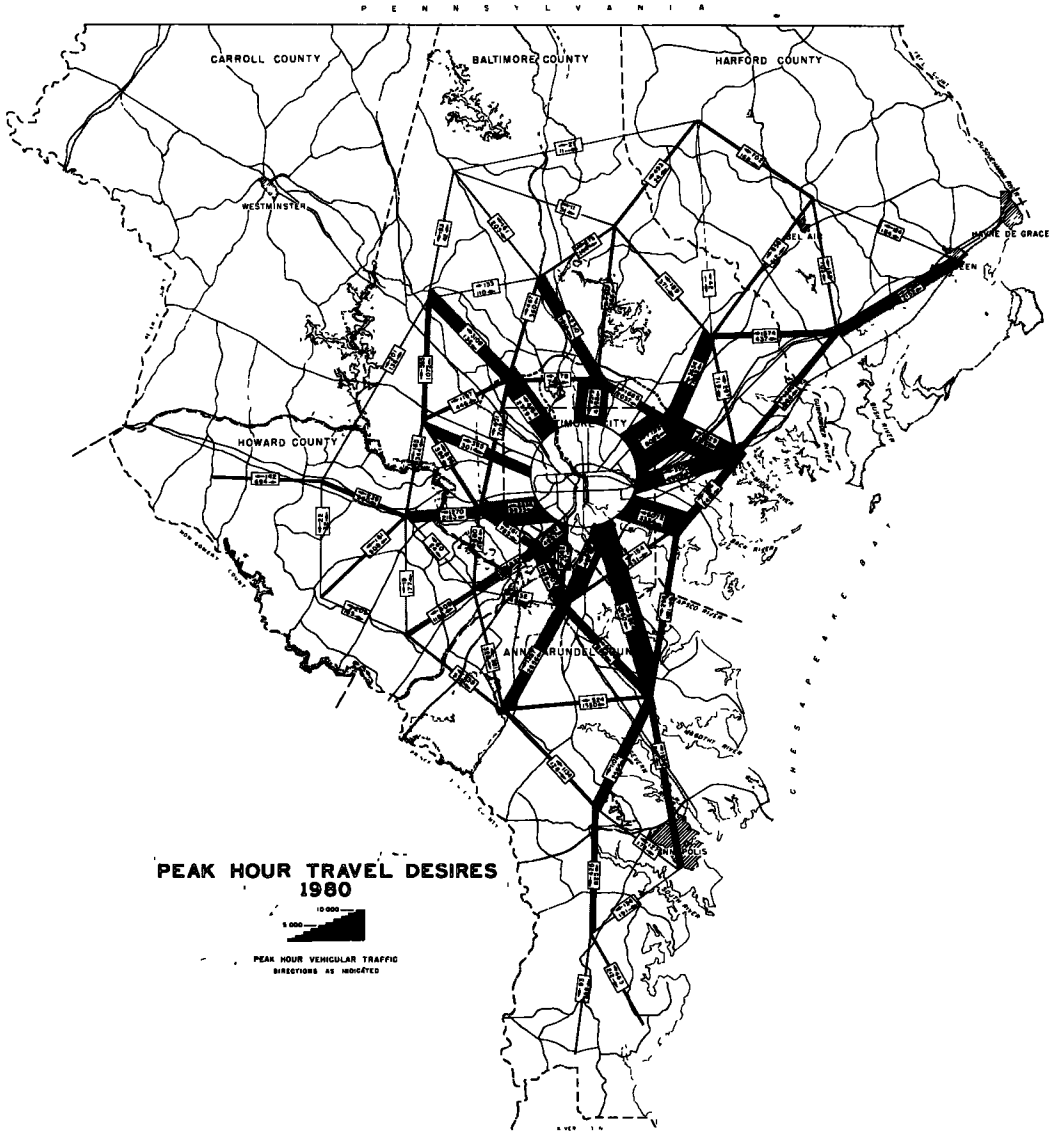


Figure 2. Desire line chart showing directional characteristics of 1980 peak hour traffic.

such movement in 1980 (Fig. 2). This forecast indicated that the traffic in and out of coastal industrial areas in the Baltimore County area show a marked imbalance and raised some question about the desirability of the projected land use pattern. It indicated the need for establishing ample employment opportunities in all suburban areas.

One of the principal advantages of using such origin and destination desire line charts is that it helps to delineate the highway network that will be required. By analyzing the 1980 desire lines crossing predetermined screen lines, the adequacy of the highway system, or any proposed system, can be readily determined by comparing desire lines with existing or proposed street capacity across these screen lines. For example, there is an anticipated volume of 61,000 vehicles per hour across the Jones Falls screen line in both directions by 1980 (see Table 2). The present street capacity across this line is about 41,000 vehicles, so that without improvements in the highway system, there would exist a capacity shortage of 20,000 vehicles per hour, about the capacity of 20 freeway lanes. (One thousand vehicles per hour were used in this analysis to reflect unbalanced flow conditions, as well as the fact that, if a freeway system is built, some of the arterial streets will not be used to their full capacity.)

Planned freeway construction, supplemented by possible improvements in mass transit and new arterial streets, could reduce the needs by 16 lanes, thus indicating a deficiency of four lanes across this particular screen line by 1980. A comparison of existing and proposed street capacity across this line with the desire line for 1980 gave a clue to the location of the principal deficiency (about half way between downtown and the Baltimore Beltway, in the vicinity of Cold Spring Lane Fig. 3).

Delineating the System

A closer look at the nature of the travel desiring to pass through this critical area revealed more specific information as to the origins and destinations involved (Fig. 4). Close inspection revealed that the bulk of traffic desire moved from the west and northwest to the east and southeast. Therefore, the apparent solution here would seem to be a cross-town freeway connecting the residential areas between the Baltimore Beltway and proposed east-west radial, and the industrial area east of the city. This need reflects the predictions of planners that a very substantial residential growth in the Baltimore Region will take place in the northwest section, whereas the industrial growth will be concentrated primarily along the coastal areas in both Baltimore and Anne Arundel Counties.

Similar analyses of other trouble spots on the screen lines helped to delineate the over-all plan for the area. In the case of the southwest screen line the analysis showed two critical areas, one on the eastern portion of the line and the other south of the CBD. The Gwynns Falls screen line showed no particular deficiency, whereas the Canton-White March screen line revealed two critical areas, one near the CBD and the other at the eastern end of the area. The Beltway screen line analysis indicated a major deficiency due south of the CBD, one northwest, and another northeast of the CBD.

On the basis of the deficiencies previously noted and a thorough investigation of the travel desires of traffic related to these critical areas, as was done for the Jones Falls screen line, it was possible to delineate the basic freeway needs for the area (Fig. 5). This figure indicates only the approximate location of the deficiency and how it is related to the existing freeway interstate system.

Once the freeway roots had been generally located, an attempt was made to determine

TABLE 2

CAPACITY DEFICIENCIES ACROSS SCREEN LINES BY 1980 IN TERMS OF FREEWAY LANES

Screen lines	Traffic		Capacity deficiency	Need Reduction			Additional need
	1957	1980	1980	Transit	Arterial	Freeway	
Jones Falls	40,000	61,000	20 lanes	2	2	12	4
South-West	30,000	53,000	24 lanes	4	2	10	8
Gwynns Falls	36,600	49,500	12 lanes	-	-	12	-
Canton-White Marsh	23,000	32,500	10 lanes	-	-	-	10
Beltway	51,500	83,500	32 lanes	-	-	24	8

their more specific location. In doing this, the following objectives were followed:

1. To reduce to the minimum the need for and the time required for vehicular travel.
2. To provide good access to all regional activities.
3. To enhance the accessibility of the CBD.
4. To encourage and foster industrial and commercial development in the Region.
5. To minimize the taking of productive property for right-of-way.
6. To provide maximum highway service with minimum disturbance to existing residential areas.

Testing the Plan

The soundness of any particular plan developed for a region depends largely on

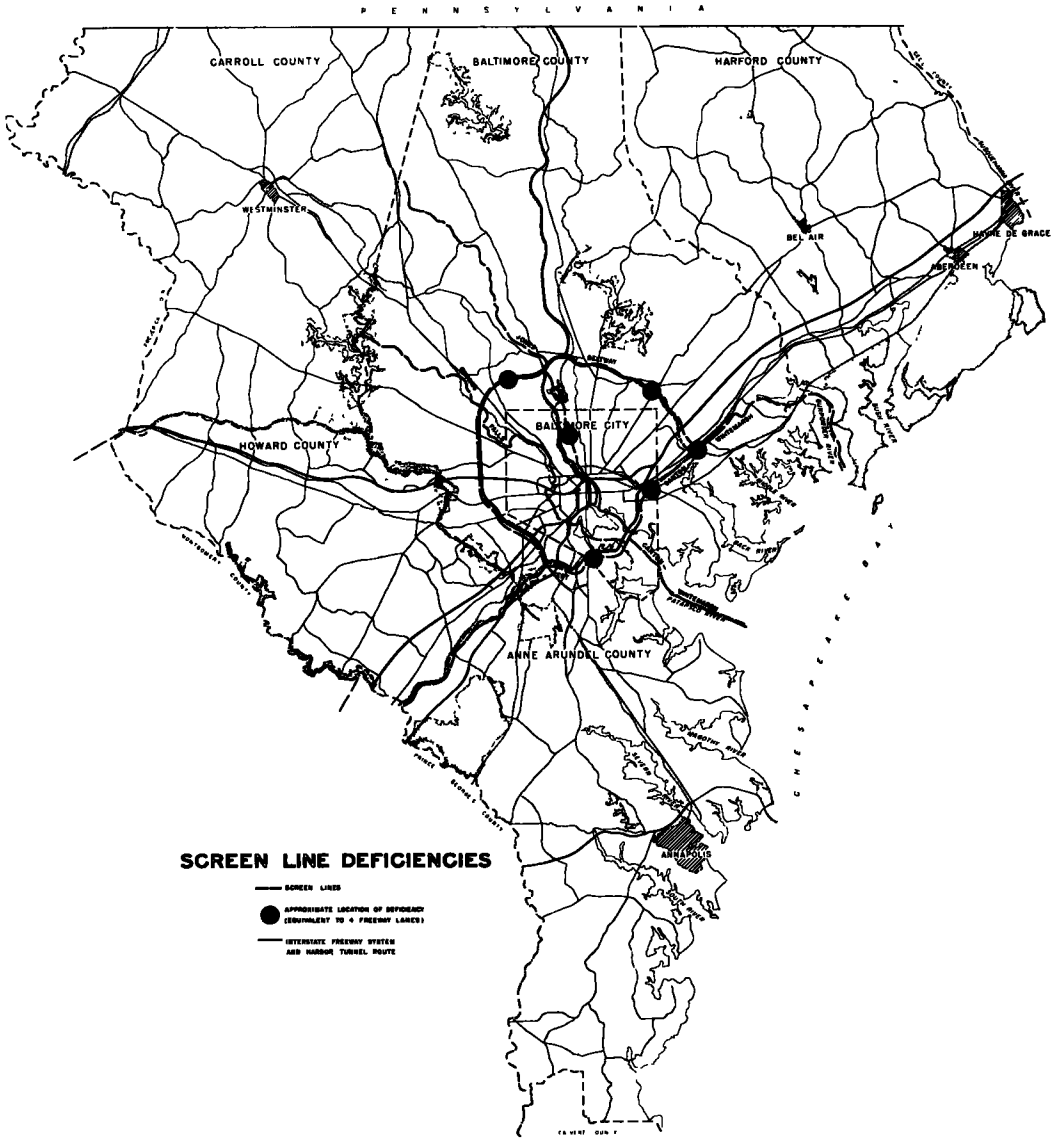


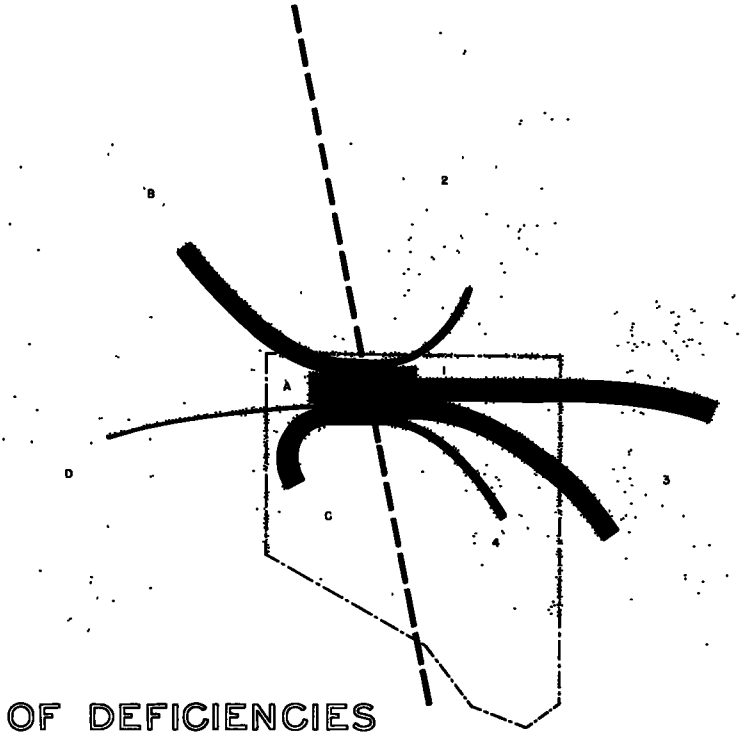
Figure 3. Map that depicts the location of screen line deficiencies.

whether the proposed improvements will be able to handle the anticipated traffic in accordance with speed and safety standards. To ascertain this fact, an estimate was made of the number of vehicles that will use the freeway system when fully improved. In doing this, the projection of the origin and destination data must be used. On the basis of established relationships between travel time on alternate routes, trips estimated for 1980 were assigned to the proposed plan. This was achieved by following a procedure developed by the U. S. Bureau of Public Roads.

With the trips allocated to the freeway system, it is quite apparent that the freeway plan as proposed (Fig. 5) would be adequate in most respects for 1980 traffic.

The fact that the first plan tested by means of traffic assignments proved to be adequate indicated that the steps followed in delineating the plan were sound. Many other transportation studies have had to test numerous plans to find a system free of capacity problems. By the analysis made of the screen lines, it apparently was possible to develop an adequate system on the first try (Fig. 6).

It is recognized, of course, that the exact location of these freeways certainly will have to be determined by the local jurisdictions. To do this, transportation planning teams consisting of city planner, traffic engineer, and public works director, as well as the state highway representative, are being created in the various jurisdictions. In pinpointing the freeway locations, these teams not only will use the O-D data, but also



NATURE OF DEFICIENCIES ACROSS JONES FALLS

JONES FALLS SCREEN LINE

A STUDY AREAS

2,000 4,000 6,000 8,000 10,000

PEAK HOUR VEHICULAR TRIPS

PEAK HOUR VEHICULAR TRIPS BETWEEN AREAS

AREAS	A	B	C	D	TOTAL
1	1200	685	1455	262	3,602
2	1083	—	421	205	1,709
3	5000	3840	4749	288	13,877
4	2516	295	—	—	2,871
TOTAL	9859	4820	6625	755	22,059

Figure 4. Special analysis of O-D of traffic desiring to pass through critical area on the Jones Falls screen line.

will evaluate the advantages various alternate locations will have on community development. They plan to analyze the O-D of the traffic assigned to each segment of the freeway system to determine if there would be any advantage to moving the freeway one way or another.

DETERMINING LOCAL STREET NEEDS

Once the general freeway pattern was determined the various jurisdictions began to analyze their arterial street needs, ramp locations, and local street requirements. This was done by indicating the amount of traffic that would desire to enter or leave any freeway segment and the amount of traffic that would be left on the local street system. The latter was shown on desire line charts similar to Figure 1. In undertaking this analysis most of the work was done for areas bounded by freeways, such as the downtown area surrounded by the downtown loop. Such information was extremely valuable in

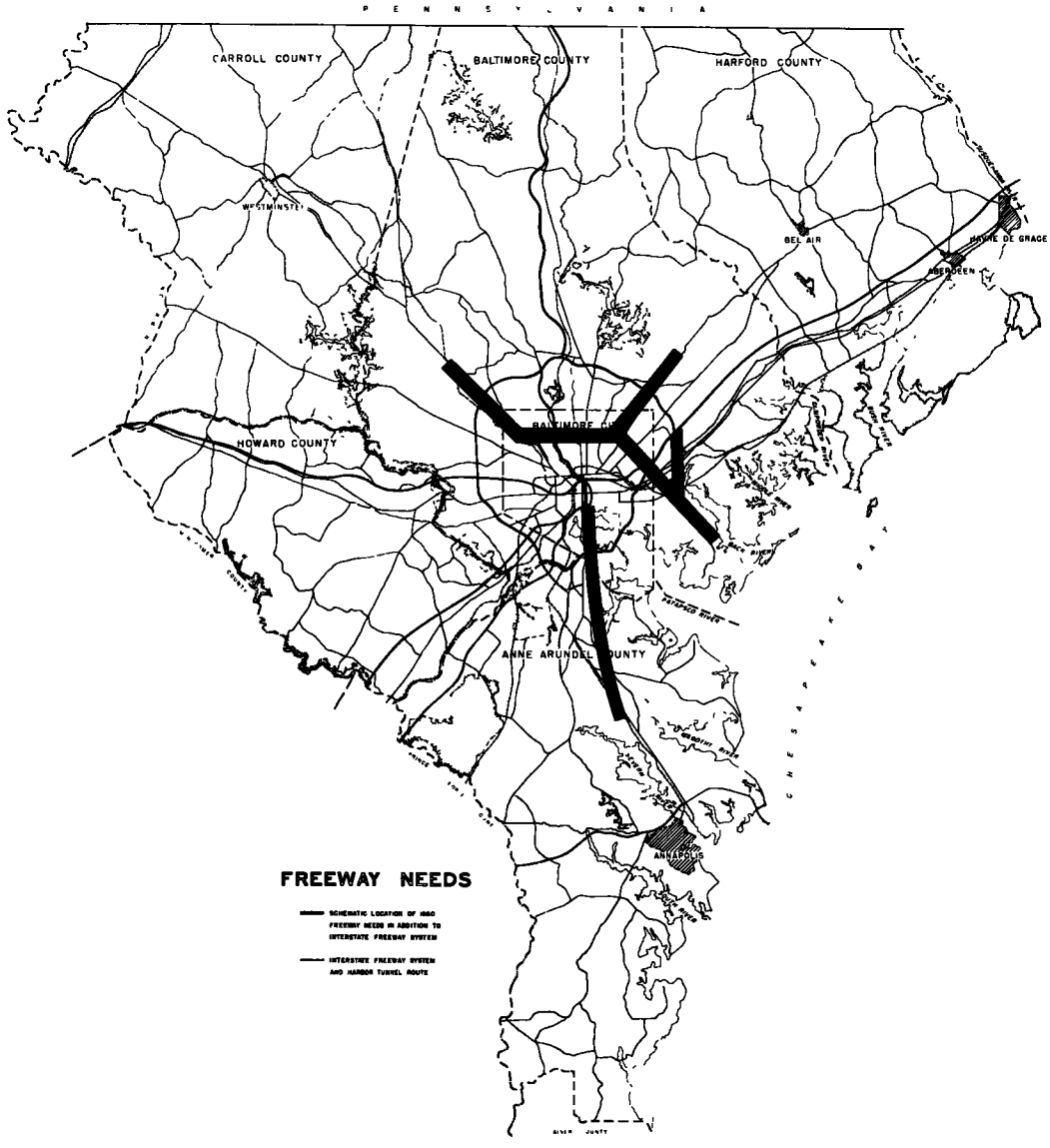


Figure 5. Appropriate location of the freeways needed in 1980 in addition to the Interstate System.

determining plans for the downtown area of Baltimore. It clearly indicated the capacity requirements that would have to be met by the local street system. It also showed the streets that would be most important for downtown circulation.

The analysis in the downtown area of Baltimore indicated that few streets could be closed in connection with the redevelopment of the downtown area unless new surface streets were provided. It is anticipated that similar studies will be made by all the jurisdictions in the area so that a complete arterial street and freeway plan can be developed for the metropolitan region.

ADVANTAGE OF USING LOCAL JURISDICTIONS

In summary, the general procedure described herein works out very well where it is desired that the local jurisdictions carry out a great deal of the work. However, it does have limitations in that such an arrangement usually brings about many delays

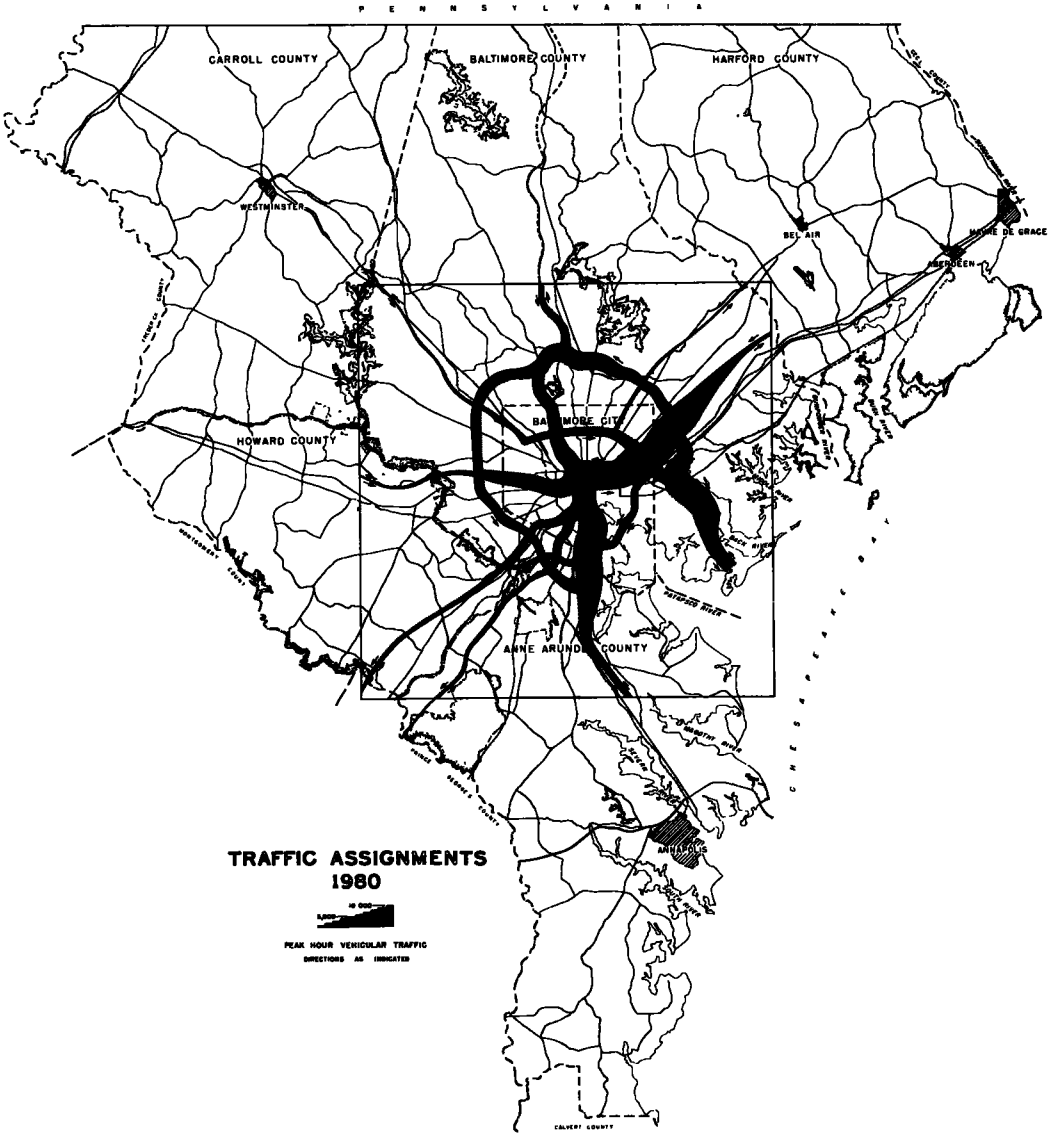


Figure 6. Traffic was assigned to the freeway system delineated by the screen line analysis.

because these local jurisdictions are burdened with so many other problems that consume their time. However, the end product of such an arrangement probably will have better local acceptance and, therefore, will have a greater chance of being completed.