

IMPACT OF A NEW SITE DEVELOPMENT
ON THE LOCAL TRANSPORTATION NETWORK,
A CASE STUDY

By

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Abstract. Suburban mobility has become a major issue as extensive office and industrial developments are being located within the traditional suburban areas causing increased congestion on both the arterial and local road system. This study analyzes the impacts one development has on the surrounding street system and the adjacent residential areas. The analysis looks at how to limit neighborhood infiltration while providing adequate capacity to handle the traffic from the site development.

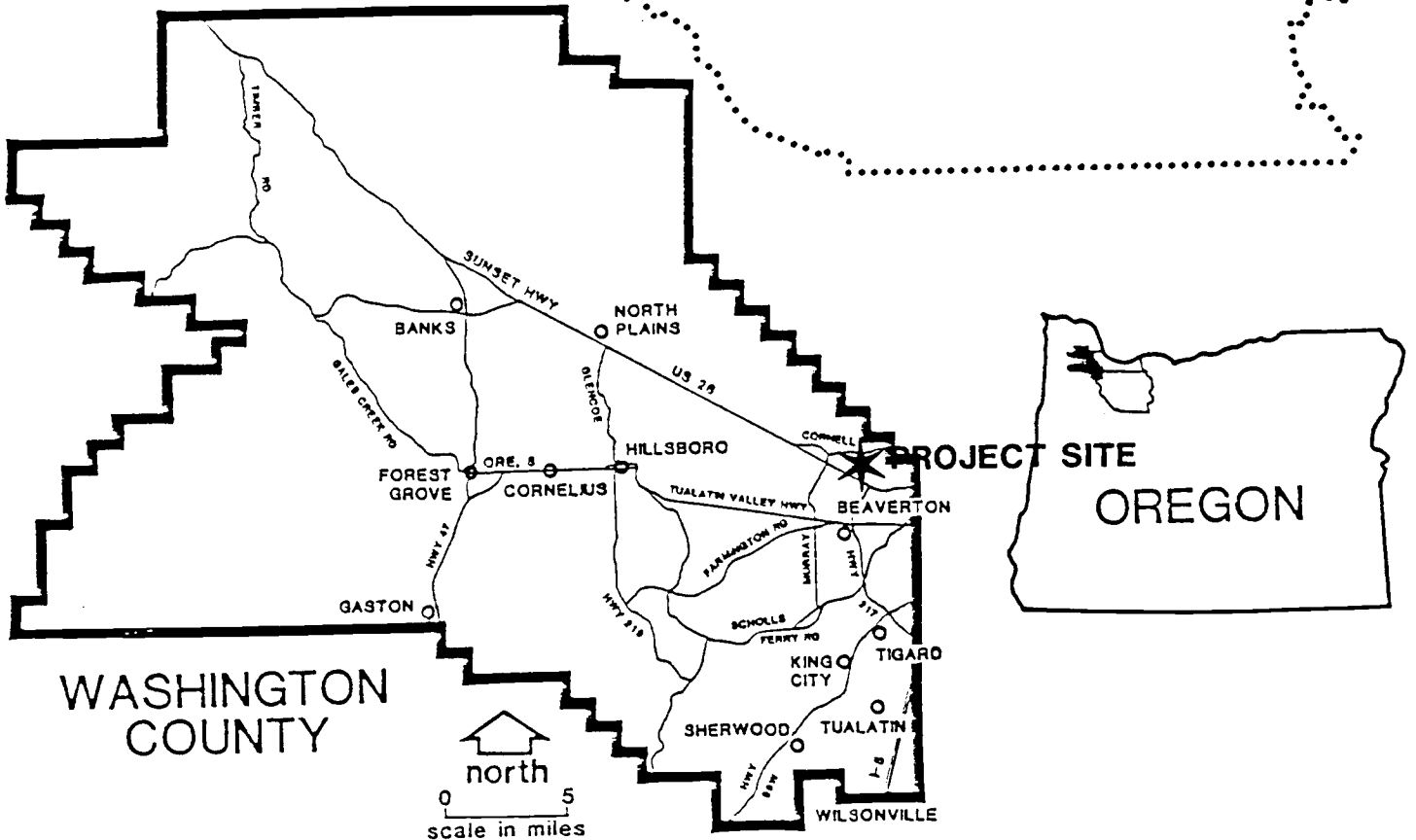
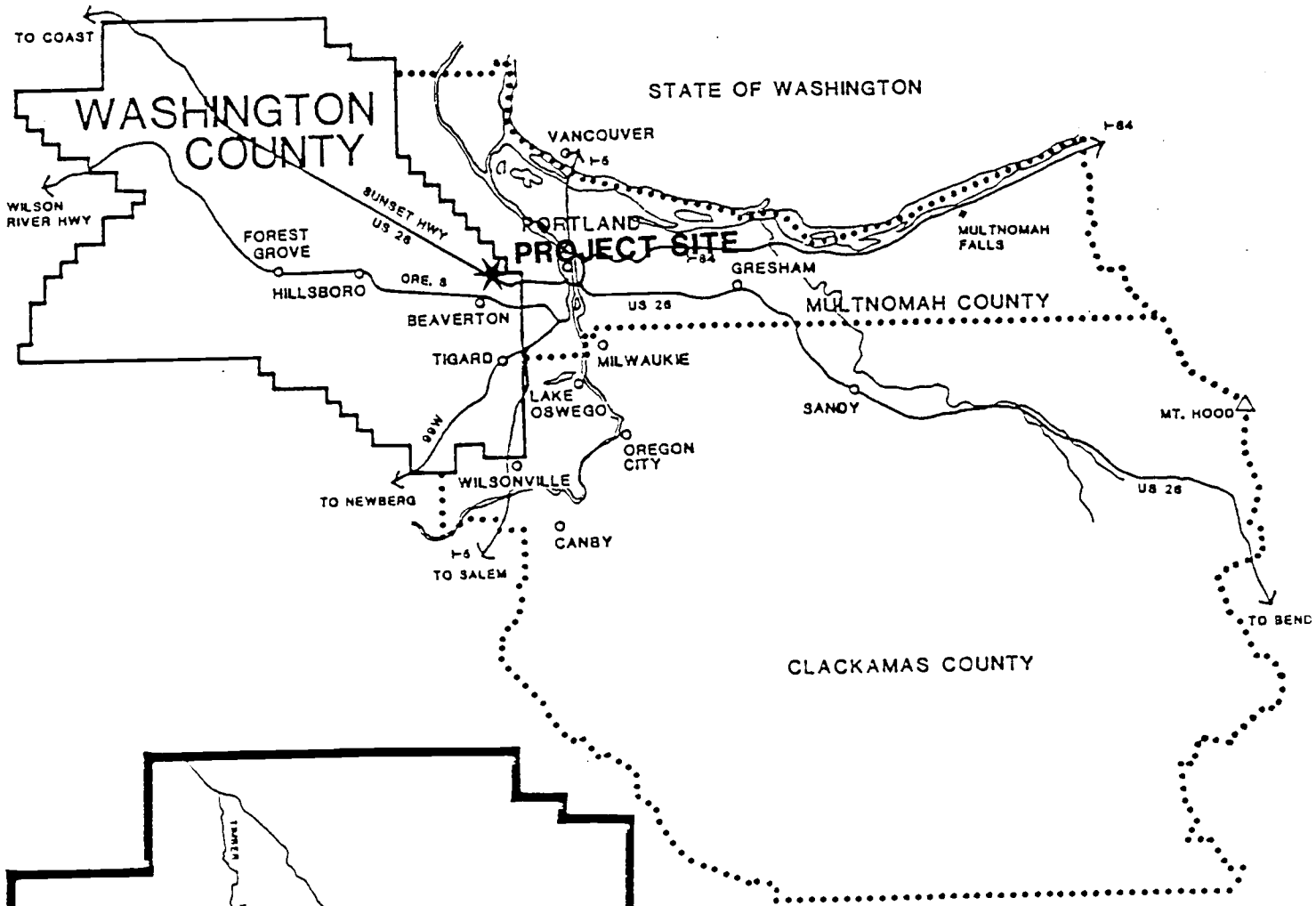
INTRODUCTION

Washington County, a suburban county west of Portland, has in the last three years shown a tremendous growth in new jobs, primarily within the electronics industries, and is expected to continue this growth throughout the rest of the century. Because of this expected growth two major transportation problems have been identified that need to be solved : 1) inadequate capacity to handle the expected traffic and 2) increased through traffic on existing residential streets. In many cases, these two problems are inter-related in that without adequate capacity on the arterial and collector systems

VICINITY MAP

SOURCE: WASHINGTON COUNTY
DEPARTMENT OF LAND USE AND TRANSPORTATION

MAP 1



traffic will use the local residential street system to enter/ leave a employment or commercial center. This will cause major problems for the residents on these streets.

This study analyzes the impacts of one development (Peterkort office/commercial development, map 1) and how it will impact an existing residential community with the purpose of solving the above mentioned transportation problems for both the site and the existing residents.

The objective of this study is to evaluate future traffic conditions in order to identify the best road network to: 1) minimize the impact of a large commercial/residential development (Peterkort development) on the existing adjacent residential community; and 2) provide for adequate capacity in order to handle the expected traffic from the proposed development.

In order to accomplish these objectives, this study uses a standard transportation network analysis procedure that determines the traffic on both the existing road system and the proposed alternatives. This procedure is discussed within the methodology section of this report..

AREA DESCRIPTION

The study area is bounded by Sunset Freeway to the south, Cornell Road to the north, Leahy Road to the east and Barnes Road to the west (figure 1). In addition to being the boundaries, these roads are the arterials and collectors surrounding and servicing the development site. Therefore, these roads are included within the this analysis.

Sunset Highway is the principal east/west arterial servicing the city center of Portland and the suburban west side. Sunset

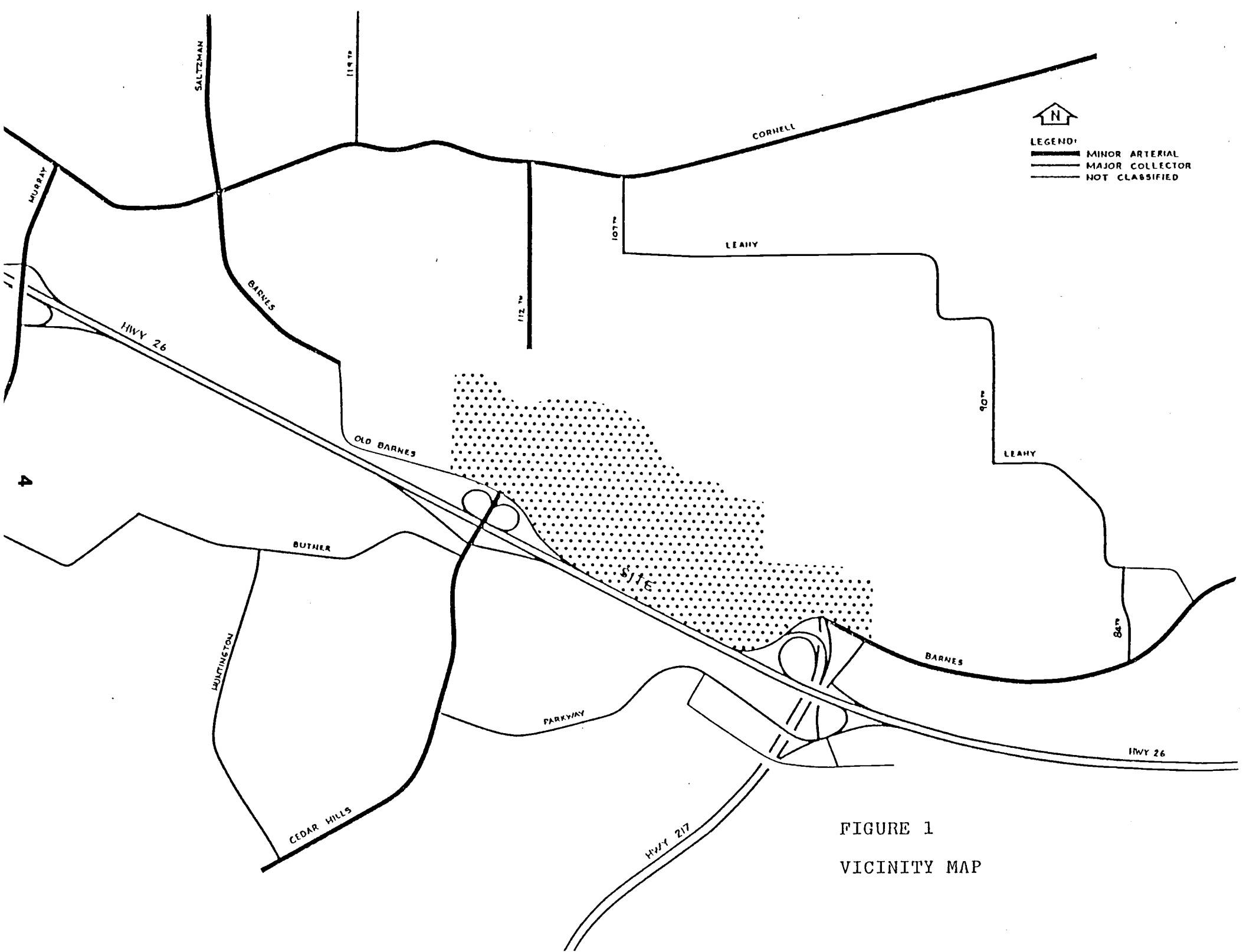


FIGURE 1
VICINITY MAP

Highway just south of the study area is intersected by Highway 217 which is the principal north/south arterial within Washington county. Barnes Road is a two lane arterial that is split into two segments; one forming the western boundary of the study area and the second part the southeast corner of the study area just north of the Sunset Hwy. Cornell Road is a two lane east/west arterial on the northside of the study area and is currently acting as an alternate route for Sunset Highway from and to Portland. Leahy Road is a two lane major collector that connects Cornell Road with Barnes Road. The existing local roads, in most cases, are dead end streets(Taylor Street, Morrison Street, 107th Avenue, 112th Avenue, and 114th Avenue).

Within the study area, Tri-Met currently operates seven bus lines. Five of these lines meet at the existing Cedar Hills Transit center located south of Sunset Highway. This transit center will be replaced by a transit center on the Peterkort property located near the Highway 217/Sunset interchange.

Land uses

The existing land uses are mostly residential with single family residences along Leahy and Cornell and a high concentration of apartments and condominiums along Barnes Road. In addition, two nurseries are located on Barnes Road. St.Vincent Hospital is located on the eastern portion of Barnes Road west of Leahy Road. The Peterkort site(Figure 1) itself is currently agricultural with a stream flowing east/west cutting the property into two parts.

The proposed Peterkort development consists of the following uses(Buttke,p. 5):

- 1) Office - 1,330,000 square feet

2) Hotel - 580 rooms

3) Retail/Commercial - 205,000 square feet

As mentioned, Tri-Met plans to construct a 600 space park and ride transit center that will serve existing bus routes and will ultimately serve the proposed light rail line.

The land uses surrounding this development are expected to remain residential except within the Peterkort development and near St. Vincent Hospital. The projected level of residential development is expected to increase from 29% in 1985 to about 82% in the year 2000. The projected level of commercial/industrial uses is expected to increase from 39% in 1985 to about 90% in the year 2000(Transportation Plan,p. 8).

METHOD OF PROCEDURES/ASSUMPTION

The following sections describe the alternatives, the decision criteria and modelling procedures used within this study.

Description of Alternatives

The alternatives developed for this study were developed to identify the impacts on the road system and to identify what the minimum road improvements are necessary for the road system to operate at an acceptable level of service(see Decision Criteria for actual criteria). These alternatives came from two sources:

1) staff analysis of the area and;

2) interested residents within the study area(5 -10 residents)

The following is the description of the alternatives that were tested:

1) No Build - year 2000 traffic on the existing road system(Figure 3). No build was used as the base case for comparison purposes.

2)Alternative #1/ Barnes Extension - proposed 4-5 lane road from Barnes Road near Highway 217 to Barnes Road west of Cedar Hills Blvd.(Figure 4).

3)Alternative #2 - Barnes Extension plus a connection from Barnes Road to Cornell Road near 119th Avenue(Figure 5).

4)Alternative #3 - Alternative #2 plus a connection from Cedar Hills Blvd. to 113th Avenue using either 112th Avenue,113th Avenue(new) or 114th Avenue(Figure 6).

5)Alternative #4 - Alternative #2 plus an link from Barnes Road to 112th and 114th, 112th and 114th as a one way couplet system and connections to both Morrison Street and Taylor Street(Figure 7).

6) Alternative #5 - Alternative#3 plus a link from Barnes to the Cedar Hill Blvd extension and connections to Morrison Street, Taylor Street and 107th Avenue(Figure 8).

7)Alternative #6 - Alternative #2 plus a loop road that would connect Barnes Road with Morrison Street,Taylor Street,107th Avenue,112th Avenue and 114th Avenue(Figure 9).

8)Alternative #7 - Alternative #2 plus connections to Cornell Road from Barnes using 112th Avenue and 114 th Avenue.Loop road from Barnes to 112th Avenue with connections to Taylor Street,Morrison Street and 107th Avenue(Figure 10).

9)Alternative #8 - Connection of Barnes Extension west of Cedar Hills Blvd. to the western portion of Barnes Road, indirect connection from Barnes Road to Cornell Road using 112th Avenue with connections to Taylor Street,Morrison Street and 107th Avenue(Figure 11).

Decision Criteria

The following decision criteria were developed to be quantify the benefits and impacts to both the site and the surrounding community(Figure 12):

- 1) Minimize the impact to the local residential street system by minimizing the direct connections through the project to the local street system.
- 2) Minimize the amount of new road construction within the study area. Construct only what is needed for the system to function.
- 3) Minimize the number of dwelling units that would be impacted.
- 4) Insure that the Barnes/Cornell and Barnes/Hwy 217 intersections operate at an acceptable level of service(Appendix b) by minimizing the traffic flowing through these intersections.
- 5) Maximize transit by increasing the accessibility to transit within the study area. Determine the number of bus stops within the study area.

Methodology

The basic forecasting model used in this study was the TMODEL package developed by Professional Solution Inc. (Shull). The model is a zone-network model in which the study area is divided into zones, each of which produces and attracts trips. These trips are then distributed from each zone to all possible destinations zones. Trips are assigned to the street network based upon the time it takes to travel from one zone to the other zones. Figure 2 is a flow chart of

TRANSPORTATION MODELING FLOW CHART

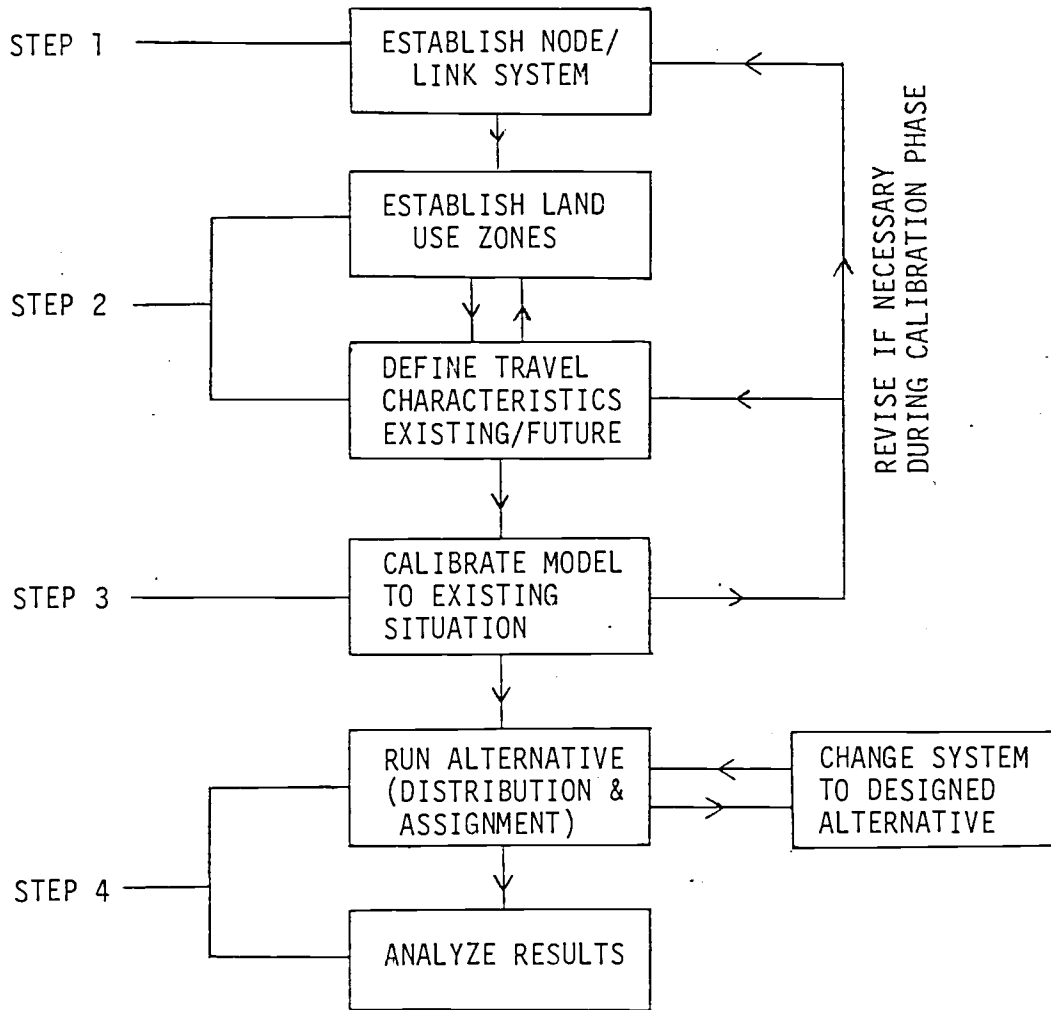


FIGURE 2

the steps in building a transportation model.

The first step defines the road system as a series of links and nodes. The links representing the road sections are assigned the following attributes in order to measure a driver's route decision:

- 1) capacity
- 2) length
- 3) speed

The nodes, representing the intersections within the system, measure the delay to a driver when he passes through an intersection by assigning a capacity to each node.

In setting up the network, the study area was divided into zones for the purpose of trip generation and distribution. The zones represent the land uses within specific spatial areas. A total of 42 internal zones were used within this study (Appendix a). The travel characteristics (production and attraction) are based upon the type of land use and the number of trips from each of these zones.

Once the network and zones were set up, the standard four-step transportation planning process of trip generation, trip distribution, modal split and trip assignment was used to determine the expected volumes for each alternative tested.

Trip Generation

Trip generation is the total number of trips which depart from or arrive at a zone and is based upon the character, location and intensity of land use within that zone. It has been shown that different types of land use have different trip generation rates. Therefore, given the type of land uses, we then can estimate the trips entering and leaving a zone by applying specific rates and factors. Within this study, the trip generation was based on nationally

measured rates contained in NCHRP Report # 187 Quick-Response Urban Travel Estimation Techniques and Transferable Parameters(p. 10-12).

The population and employment used within this study came from two sources. The first source was the year 2000 population and employment forecasts from the Metropolitan Service District(MSD) for Washington County. These forecasts were used for all zones except for the zones that represented the Peterkort Development. The population and employment data for the Peterkort zones came from the Peterkort Development land use application.

In addition to the above trips generated within the study area, external trips (trips with one or both ends outside the study area) were added to the system. External trips were added by calibrating the model to the traffic counts taken where major roads led into and out of the study area.

Trip Distribution

The objective of trip distribution is to distribute or allocate the total number of trips originating in each zone among all possible destinations zones. This step uses the output from step one(productions and attractions) as its data input. Within this study,the trips were distributed using the the most commonly used method,the gravity model.

The basic concepts behind the gravity model are that :

1) for any given trip purpose,the number of trips from one zone to two other equally attractive zones for satisfying that purpose should be greater to the zone which is the least costly to reach(for example less travel time between zones) and

2) for any given trip purpose, the number of trips to each of two zones equally costly to reach should be greater to the zone which is more attractive for satisfying that purpose. (Morlok p.433)

The Gravity model is recomputed for each trip type and for each zone.

The form of the gravity model used in the TMODEL software is as follows (TMODEL, p.a-5):

$$\text{Trips}(ij) = \frac{\text{prod}(i) * (\text{attractions}(j) / \text{tf}(ij))}{\text{sum}(\text{attractions}(j) / \text{tf}(ij))}$$

and

$$\text{TF}(ij) = (\text{Travel Time}(ij) ** \text{exp}) * (e ** (\text{beta}) * \text{Travel time}(ij))$$

where:

Attraction(j) = Attraction at zone j

beta = Secondary gravity model exponent

exp = Primary gravity model exponent

prod(i) = Production at zone i

tf(ij) = Travel Friction

Travel Time(ij) = Travel time from zone i to zone j

Trips(ij) = Trips from zone i to zone j

Travel time is the shortest path travel time plus the terminal times for zone i and zone j.

The output of the trip distribution phase is matrices of zone to zone trip interchanges which is used in both of the next two steps (modal choice and trip assignment).

Modal Choice

Once the trips have been allocated to and from each zone the next step is to estimate the modal split for the area. Within this study, transit was assumed to be 7% of the total trips. This was based upon the mode split developed by M.S.D. for the Regional Transportation Plan. The trip table from phase 2 was reduced to reflect this modal split. Furthermore, the zonal subsystem that

EXISTING NETWORK Y 2000

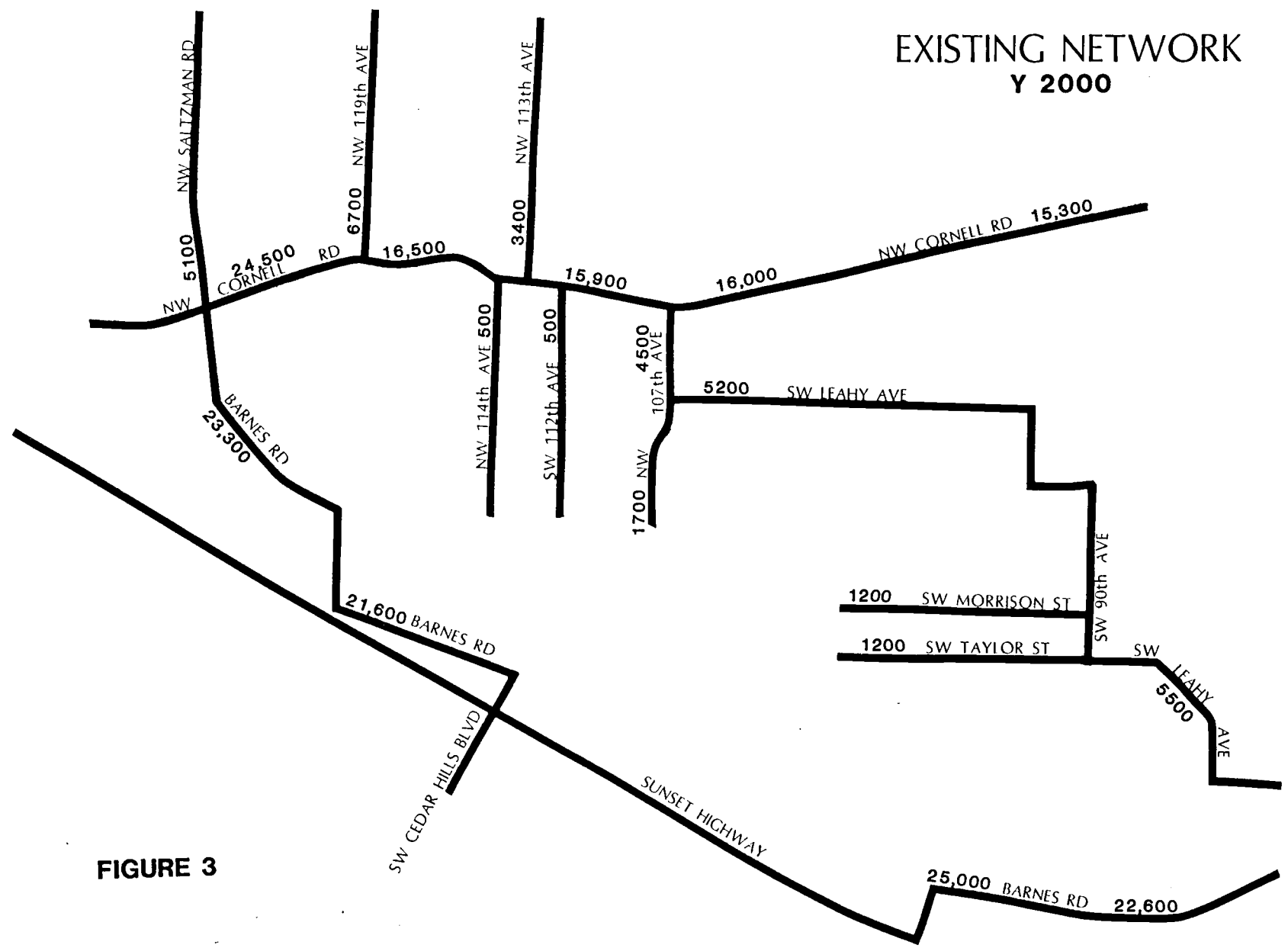




FIGURE 3

 EXISTING STREETS
 PROPOSED STREETS
 00000 AVERAGE DAILY TRAFFIC COUNT

represent Peterkort were further reduced because of the transit center being planned within the Peterkort Development (another 13%).

Trip Assignment

The final step is the assignment of the trips to particular routes throughout the network. The basic assumption is that travelers take the shortest path to their destination.

Shortest path trees are found for each zone using a variation of the standard minimum path algorithm. The trips are then assigned to the links using the shortest path from one zone to all other zones. This procedure is repeated for every zone within the system. The link travel times and delays are recalculated after all zones have been assigned to the network. This continues until a balanced assignment is obtained.

The Year 2000 traffic volumes for each alternative are shown in Figures 3 through 11.

The number of dwelling units impacted was identified by the use of tax maps, aerial photographs and field reconnaissance.

The number of transit access points was identified by using Tri-Met's transit schedules and route maps. Bus stops, transit centers and park and ride lots were used as transit access points.

Analysis

The following is a comparison of the alternatives. Figure 12 compares the decision criteria. Figures 3 through 11 shows the Year 2000 traffic volumes for each alternative.

BARNES EXTENSION ALTERNATIVE #1

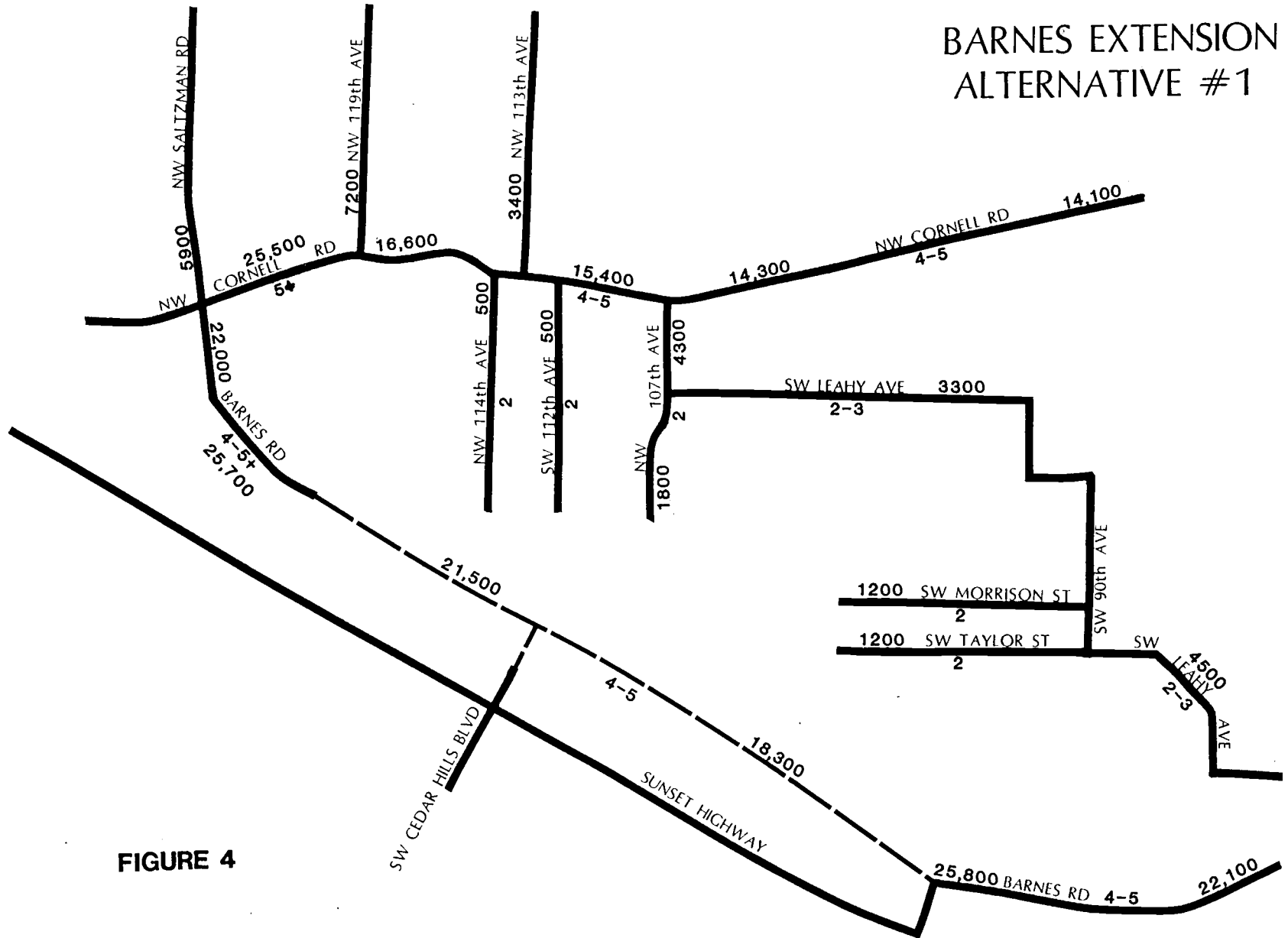


FIGURE 4

——— EXISTING STREETS
 - - - PROPOSED STREETS
 00000 AVERAGE DAILY TRAFFIC COUNT
 0-0 PROPOSED LANE REQUIREMENTS

NO BUILD

The No build alternative(Figure 3) shows that the existing road system cannot handle the Year 2000 traffic without major improvements throughout the study area. Traffic on Barnes Road is expected to be between 21,000 - 25,000 average weekday traffic(awdt). Traffic on Cornell Road is expected to be between 15,000 - 24,500 awdt. With these volumes, both would operate at or above the capacity of the road. Traffic volumes on Leahy Road are expected to be between 4,500 - 5,500 awdt. Major delays are expected on Barnes Road, Sunset Highway and Cornell Road. Through traffic is diverted to Leahy Road since the arterials cannot handle the expected traffic. This indicates that the proposed land use at the expected densities cannot be handled with the existing road system.

ALTERNATIVE # 1

Under Alternative #1 (figure 4) Barnes Road is connected through the Peterkort property. The traffic volumes on Barnes road are expected to be between 18,000 - 25,000 awdt which indicates that Barnes road will require at least 5 lanes in order to operate at an acceptable level of service. The traffic volumes on Cornell Road are expected to be between 14,000 - 25,000 awdt. With this traffic and the high peak directional split, Cornell Road would require at least 5 lanes throughout the study area. No major changes in traffic is expected as compared to the no build.

The advantages of this alternative are:

- 1) Provision of direct east/west access through the development;
- 2) No major impact to the local street system;and

ALTERNATIVE #2

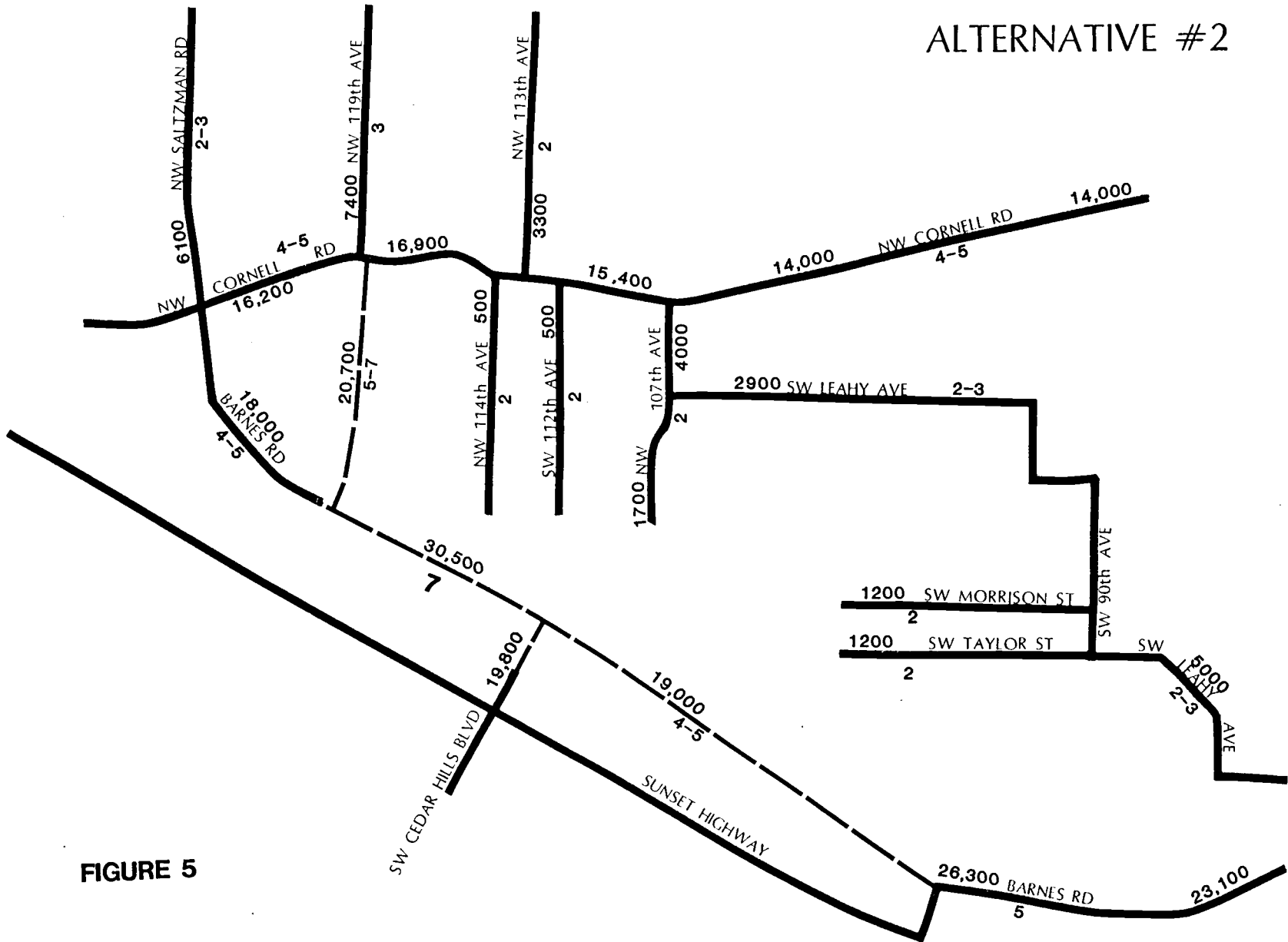




FIGURE 5

-  EXISTING STREETS
-  PROPOSED STREETS
- 00000 AVERAGE DAILY TRAFFIC COUNT
- 0-0 PROPOSED LANE REQUIREMENTS

3) No direct impact to the residential areas.

The disadvantages of this alternative are:

- 1) Major impact to the Barnes/Cornell Road intersection;
- 2) No direct access to Cornell Road from Sunset Highway;
- 3) No access to the high density residential areas just west of the Peterkort development;
- 4) Does not reduce the through traffic on Leahy Road and;
- 5) No direct access to transit.

ALTERNATIVE # 2

Under alternative #2 (Figure 5), the traffic volumes on Barnes Road are expected to increase by about 41% just west of Cedar Hills Blvd to the new north /south arterial and is expected to decrease by about 22% between Cornell road and the new arterial. The traffic volumes on Cornell Road is expected to be between 14,000 - 17,000 awdt. The new arterial is expected to have about 20,000 awdt which will handle the traffic from adjacent land uses and through traffic that would have used the Barnes/Cornell intersection. This road would require at least 4 lanes to function at an adequate level of service.

Traffic on the Leahy Road is expected to be about the same as in alternative #1. No connections were planned to the local street system.

The advantages of this alternative are:

- 1) Provision of direct east/west access through the development and north/south access through the high density residential areas;
- 2) No major impact to the local street system;
- 3) No direct impact to the residential areas;and

ALTERNATIVE #3

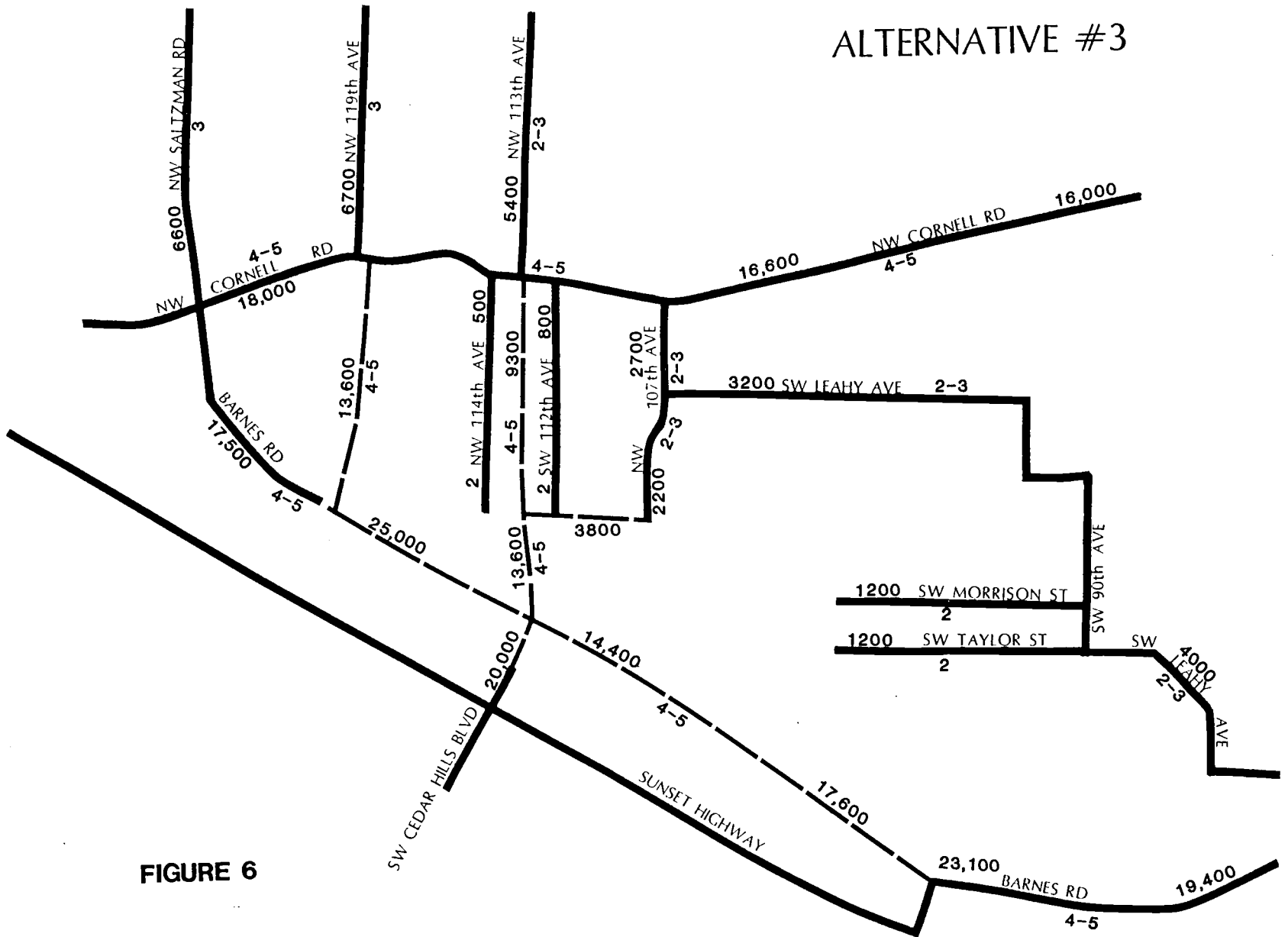


FIGURE 6

——— EXISTING STREETS
 - - - PROPOSED STREETS
 00000 AVERAGE DAILY TRAFFIC COUNT
 0-0 PROPOSED LANE REQUIREMENTS

4) Access to one transit stop.

The disadvantages of this alternative are:

- 1) Does not reduce the through traffic on Leahy Road;
- 2) No direct access to Cornell Road;and
- 3) Inadequate capacity on Barnes Road between Cedar Hills and the north/south arterial.

ALTERNATIVE # 3

Under alternative #3(Figure 6), the traffic on Barnes Road is expected to be about 14,000 - 25,000 awdt which is an 8% decrease in traffic volumes from the no build scenario. Cornell Road is expected to be about 16,000 - 18,000 which is a 27% decrease in traffic volumes. Traffic on the new north/south road is expected to decrease by about 32% within alternative #3. Traffic on the Cedar Hills extension is expected to be about 9,300 - 13,600 awdt. The traffic on Leahy Road is expected to decrease by about 27%.

The advantages of this alternative are;

- 1) Improvement in the operation of both Barnes and Cornell Roads;
- 2) Provision of direct access from Sunset Highway to Cornell Road;
- 3) Reduction of through traffic on Leahy Road; and
- 4) Direct Access to 3 transit points.

The disadvantages of this alternative are:

- 1) Some impact to the local street system; and
- 2) Impact to five homes.

ALTERNATIVE #4

Under alternative #4(Figure 8),the traffic volumes

ALTERNATIVE #4

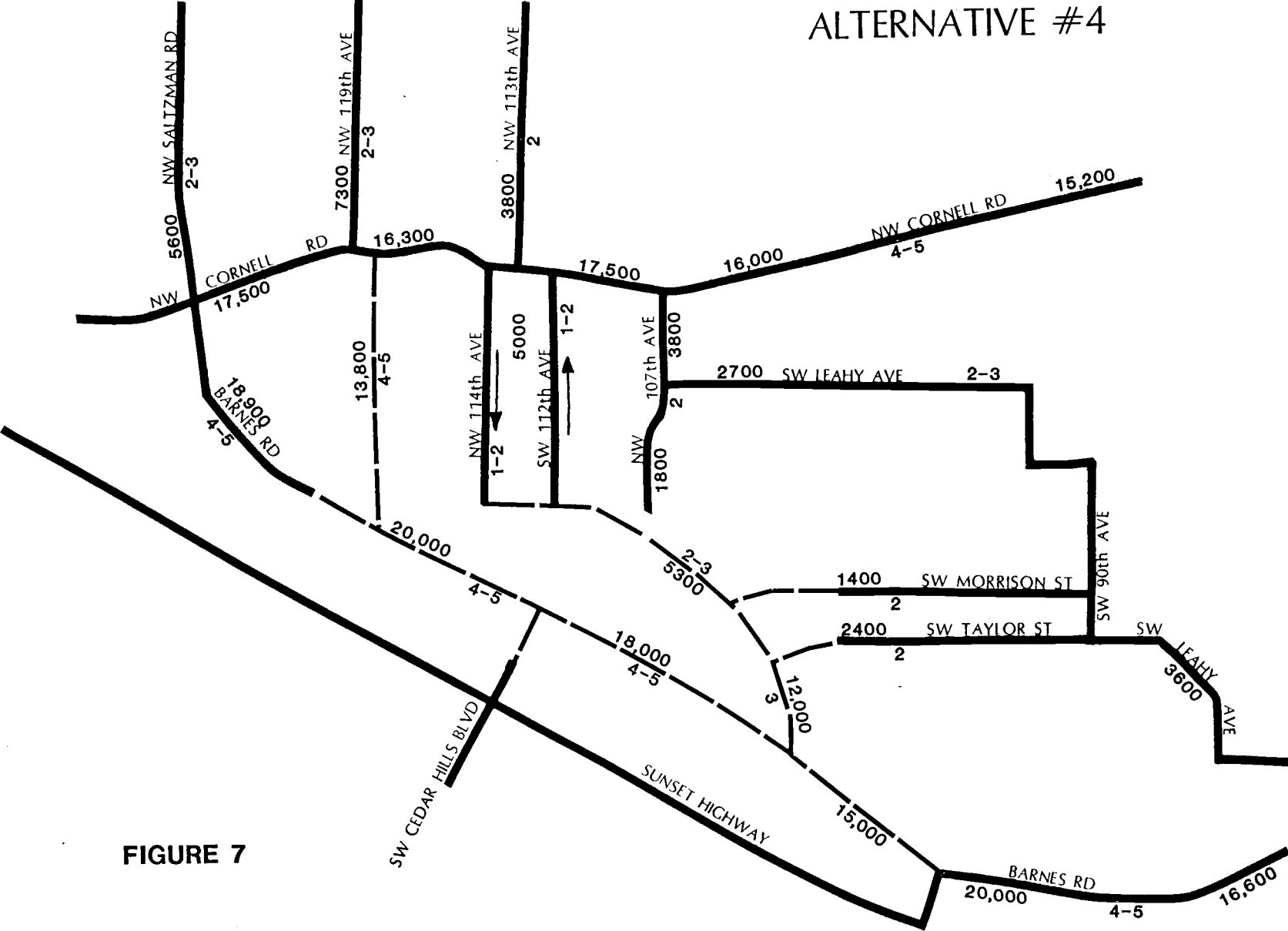




FIGURE 7

-  EXISTING STREETS
-  PROPOSED STREETS
- 00000 AVERAGE DAILY TRAFFIC COUNT
- 0-0 PROPOSED LANE REQUIREMENTS

ALTERNATIVE #5

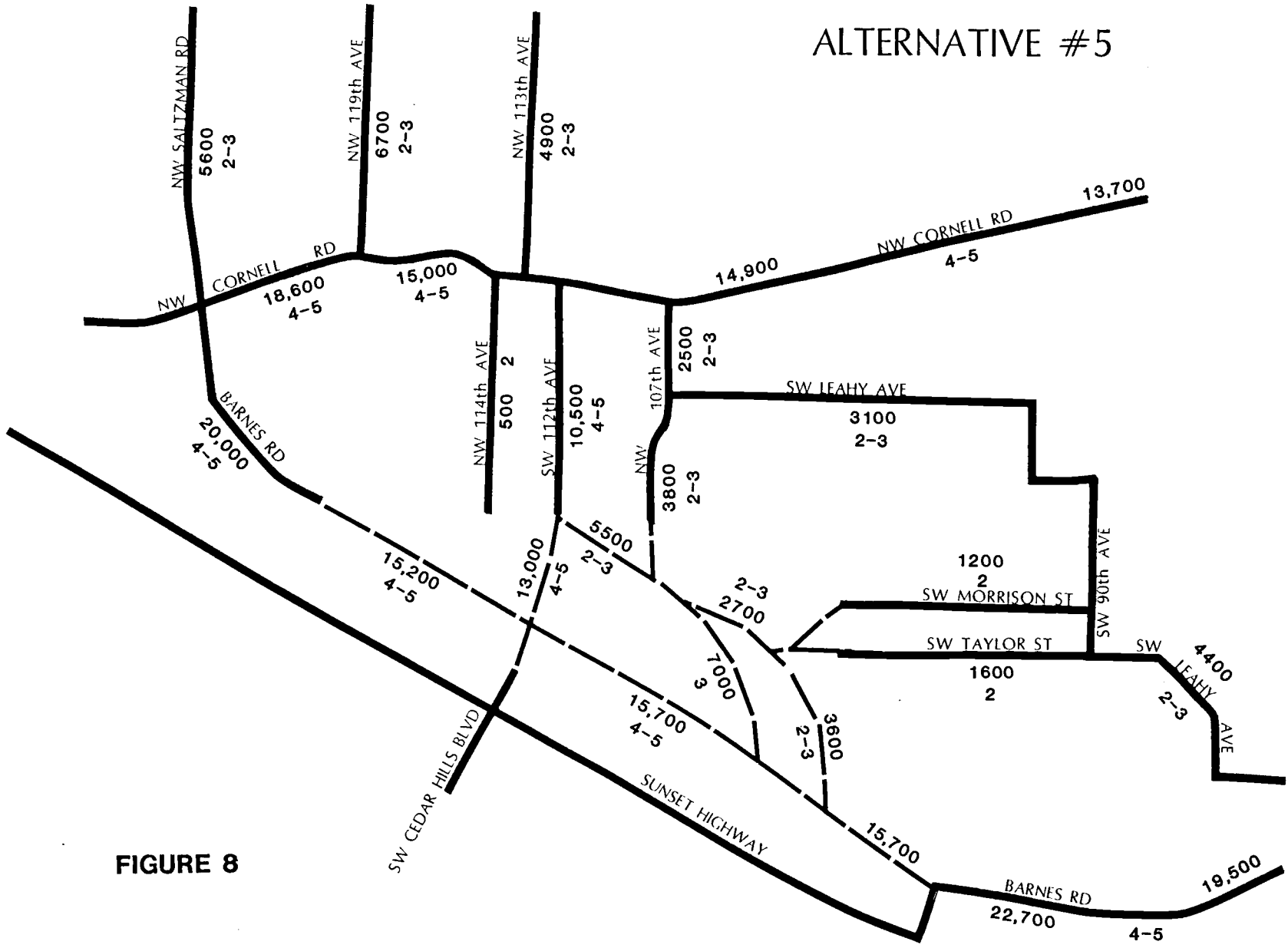


FIGURE 8

- EXISTING STREETS
- - - PROPOSED STREETS
- 00000 AVERAGE DAILY TRAFFIC COUNT
- 0-0 PROPOSED LANE REQUIREMENTS

expected on Barnes Road are between 15,000 - 20,000 which is a 10% increase in traffic. The traffic volumes expected on Cornell Road are between 15,000 - 17,500 awdt which is a 29% decrease in traffic.

The traffic on Leahy Road is expected to decrease to about 3600 awdt. However, traffic on the rest of the local street system will increase by about 108%.

The advantages of this alternative are:

- 1) Improvement to the operation of Barnes and Cornell Roads;
- 2) Reduction of through traffic on Leahy Road and;
- 3) Direct access to 4 transit points.

The disadvantages of this alternative are:

- 1) Major impact to the local street system;
- 2) Impact to 26 - 34 homes;
- 3) Increase in the number of new road connections; and
- 4) No direct access to Cornell Road from Sunset Highway.

ALTERNATIVE *5

Under alternative * 5(Figure 8), the traffic volumes expected on Barnes Road are between 15,000 - 20,000 awdt which is a 10% increase. The traffic volumes expected on Cornell Road are between 14,000 - 18,500 awdt which is a 25% decrease.

The traffic on Leahy Road is expected to decrease. However, traffic on the rest of the local street system will increase by about 245%.

The advantages of this alternative are:

- 1) Improvement of the operation of Barnes and Cornell Roads;

ALTERNATIVE #6

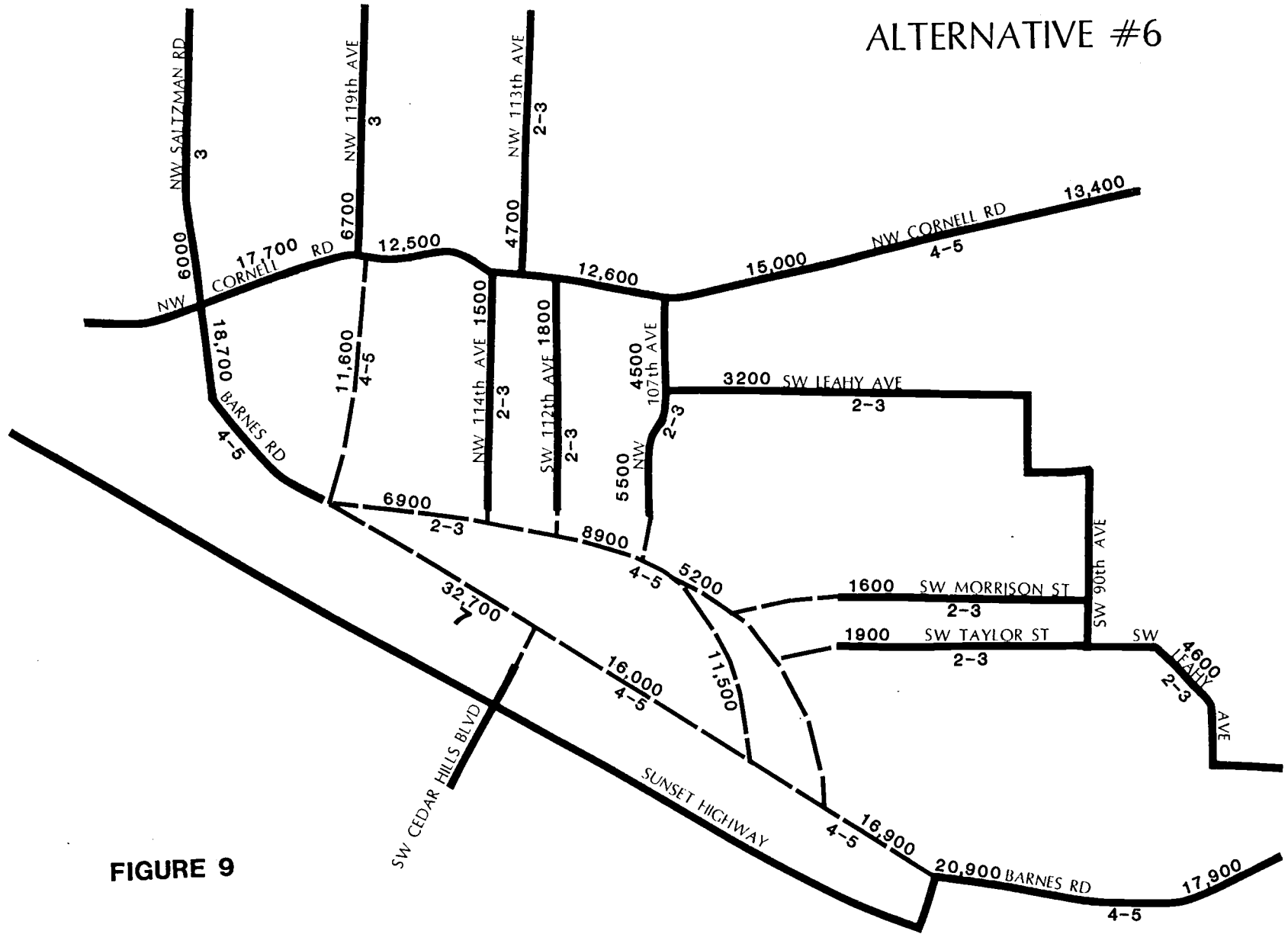




FIGURE 9

-  EXISTING STREETS
-  PROPOSED STREETS
- 00000 AVERAGE DAILY TRAFFIC COUNT
- 0-0 PROPOSED LANE REQUIREMENTS

ALTERNATIVE #7

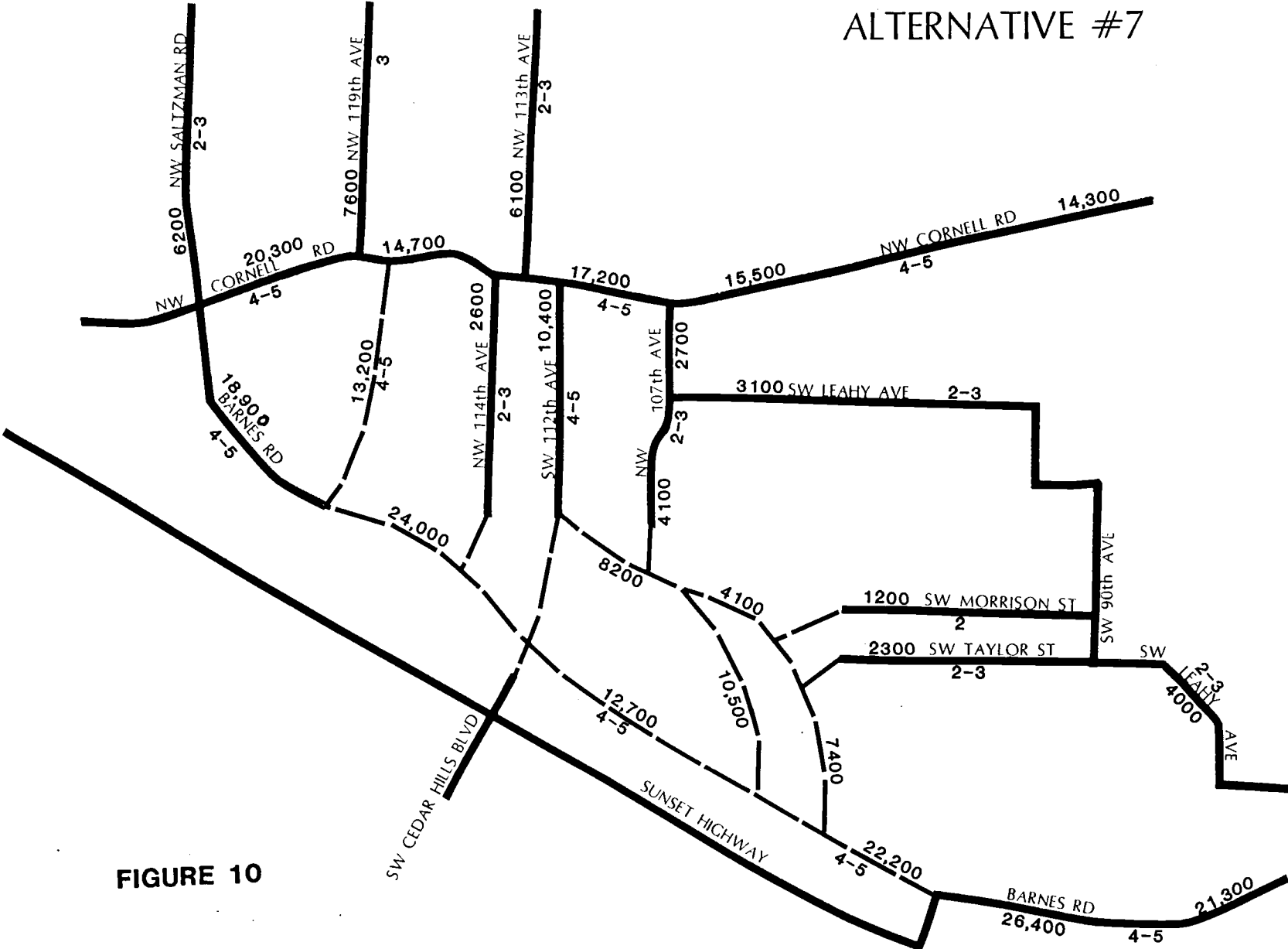


FIGURE 10

- EXISTING STREETS
- - - PROPOSED STREETS
- 00000 AVERAGE DAILY TRAFFIC COUNT
- 0-0 PROPOSED LANE REQUIREMENTS

- 2) Direct access to Cornell Road from Sunset Highway;and
- 3) Direct access to three transit points.

The disadvantages of this alternative are:

- 1) Major impact to the local street system;
- 2) Direct impact to 11 homes; and
- 3) An increase in the need for new road connections.

ALTERNATIVE #6

Under alternative #6(Figure 9),the traffic volumes expected on Barnes Road are between 18,000 - 32,700 awdt which is a 51% increase. Barnes Road would require more than five lanes in order for it to function at an acceptable level of service. The traffic volumes expected on Cornell Road are between 13,000 - 18,000 awdt which is a 28% decrease.

Traffic is expected to decrease on Leahy Road. However,traffic on the rest of the local street system is expected to increase by 141%.

The advantages of this alternative are:

- 1) Some improvement in the operation of Barnes and Cornell Roads;and
- 2) Direct access to 6 transit points.

The disadvantages of this alternative are:

- 1) Major impact to the local street system;
- 2) Direct impact to 26 to 34 homes;
- 3) Increase in the need for new road connections; and
- 4) No direct access to Cornell Road from Sunset Highway.

ALTERNATIVE #7

Under alternative # 7(Figure 10), the traffic volumes expected on Barnes Road are between 19,000 - 26,000 which is a

ALT NO.	LOCAL STREET TRAFFIC	BARNES-CORNELL TRAFFIC	BARNES-217 TRAFFIC	MILES OF NEW ROAD	TRANSIT ACCESS POINTS	DWELLING UNITS IMPACTED
1	5100	83,100	18,300	1.17	0	0
2	5100	67,600	19,000	1.61	1	0
3	5900	70,300	17,600	2.42	3	5
4	10,600	68,700	15,000	2.70	4	26-34
5	17,600	71,300	15,700	1.57	3	11
6	12,300	69,000	16,900	3.18	6	26-34
7	20,600	78,000	23,200	3.15	6	26-34
8	6,900	68,800	14,100	2.63	5	11

DECISION CRITERIA COMPARISON

FIGURE 12

11% decrease. The traffic volumes expected on Cornell Road are between 14,000 - 20,000 awdt which is a 17% increase.

Traffic on the local street system is expected to increase by about 304%

The advantages of this alternative are:

- 1) Improvement in the operation of Barnes and Cornell Roads;
- 2) Provides for a direct north/south connection from Sunset Highway to Cornell Road;and
- 3) Direct access to 6 transit points.

The disadvantages of this alternative are:

- 1) Major impact to the local street system;
- 2) Direct impact to 26 - 34 homes;and
- 3) Increased need for new road connections.

ALTERNATIVE * 8

Under alternative * 8(Figure 11), the traffic volumes expected on Barnes Road are between 14,000 - 26,000 awdt which is a 20% increase. Within this alternative, Barnes Road is a indirect connection through the development which is expected to hinder the operation of this road. The traffic volumes expected on Cornell Road are between 15,000 - 18,000 awdt which is a 28% decrease.

Traffic on the local street system is expected to increase by 35%.

The advantages of this alternative are:

- 1) Some improvement to the operation of Cornell Road is expected;
- 2) Some reduction in through traffic on Leahy Road; and

3) Direct access to 5 transit points.

The disadvantages of this alternative are:

- 1) no direct access to Cornell Road from Sunset Highway;
- 2) major impact to the local street system;
- 3) Direct impact to 11 homes;
- 4) Increased need for new road connection;and
- 5) No direct east/west route through the development.

SUMMARY OF ANALYSIS

The traffic projections show that a five lane east/west facility would be required no matter which alternative is selected. In order to reduce the traffic flowing through the Barnes/Cornell intersection a direct north/south arterial from Sunset Highway to Cornell Road would be required. However, this new road would have a major impact to the residential area selected for this route(for example, 112th ave.).

Cornell Road would function at an acceptable level of service with three lanes except during the peak hours for traffic movement. During the peak hour, Cornell Road would require five lanes in order to function adequately. Furthermore, the traffic movement would be improved to an acceptable level of service if additional lanes were added to Sunset Highway.

Leahy Road and the other local roads would seem to function better if there were no through connection from the Peterkort development. However, traffic from the new residential areas within the development adjacent to the existing residential areas would increase the congestion on the streets that they would be forced to use. In addition,a north/south arterial to

Cornell Road seems to help reduce the through traffic on Leahy Road.

FINDING/CONCLUSIONS

This analysis shows the Barnes extension (five lanes) and a north/south route through the Peterkort property are necessary to handle the expected traffic. The north/south route is necessary to provide access from Sunset Highway to the area north of Cornell Road. The best location for this road is a connection from Cedar Hills Blvd. to 112th Avenue. Also, another north/south route is necessary for the property adjacent to the Peterkort development when it develops.

Furthermore, this Alternative #3 minimizes the impact to the local road system by concentrating its impact on 112th Avenue. However, 112th Avenue will have to be upgraded to a minor arterial. In addition, the road system will operate within its capacity without additional connections to the local street system thus minimizing the amount of new construction within the project area.

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APPENDIX A
YEAR 2000 POPULATION AND EMPLOYMENT FORECASTS

ZONE	SINGLE FAMILY	MULTI FAMILY	RETAIL	OFFICE
1	155	0	250	800
2	46	0	0	900
3	1173	0	413	0
4	0	1900	0	0
5	11	500	200	0
6	147	38	0	0
7	131	84	0	0
8	0	828	0	0
9	0	1058	0	0
10	0	0	0	1020
11	581	295	0	0
12	201	0	0	0
13	0	230	0	0
14	0	0	90	745
15	16	247	0	0
16	71	0	0	0
17	168	18	0	0
18	45	22	0	0
19	88	0	0	0
20	119	0	0	0
21	57	0	0	0
22	48	0	0	0
23	87	260	0	0
24	190	0	0	0
25	20	30	0	2800
26	218	83	0	0
27	169	0	0	0
28	0	0	300	840
29	0	0	400	1395
30	0	600	0	0
31	135	0	0	0
32	307	300	0	0
33	331	0	0	0
34	153	0	0	0
35	454	282	25	0
36	170	166	0	0
37	250	0	0	0
38	315	0	0	0
39	453	30	0	0
40	134	276	0	0
41	162	276	0	0
42	258	0	0	0

APPENDIX B

Level of Service Definition

(Highway Capacity Manual. p. 1-3 - 1-4)

The concept of level of service is defined as qualitative measure describing operation conditions within a traffic stream and their perception by motorists and/or passengers. A level of service definition describes these condition in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety.

Six levels of service are defined. They are given letter designations from A to F with level of service A representing the best operating condition and level of service F the worst.

Within this study, an unacceptable level was any level of service less than level of service D (level of service E and F).

Appendix C

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