

VARIATIONS OF TRIP GENERATION AND TRIP DISTANCE WITHIN THE URBAN AREA

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INTRODUCTION

Engineers and planners typically measure the amount of urban travel in terms of daily vehicle miles. The adequacy of the roadway network and even air quality analyses are based upon the number of daily vehicle miles of travel. Personal vehicle miles of travel (VMT) are generally thought to decrease with an increasing distance from the city center. This relationship is confirmed by household travel survey data and the transportation planning literature (1,2).

Vehicle miles are calculated as the product of the number of vehicle trips and the average trip length. Household travel surveys show that both the number of vehicle trips and the average trip lengths vary with the increasing distance from the city center. However, neither parameter shows the linear relationship demonstrated by vehicle miles of travel.

The present study uses travel survey data from two different cities to quantify and demonstrate the varying relationships between a household's distance from the city center and number of vehicle trips, the average trip distance, and daily vehicle miles traveled.

STUDY PROCEDURE

Household travel survey data were collected from two urban locations, Calgary, Alberta and Boise, Idaho. These two cities were selected strictly on the basis of data availability. These data anomalies were first apparent when both authors

were consultants in Canada when the Calgary data were developed. The Boise data were developed from a 1994 travel survey of over 1,500 households for a major modeling update.

Calgary, at the time of the modeling effort, was a city of nearly 600,000 residents. It had a strong employment and retail presence in the downtown core. There were no real satellite cities that formed a suburban ring of attractions.

Boise, Idaho is the major city of Ada County. The Boise metro area represents approximately two-thirds of the county-wide population of 200,000. Another 20,000 residents live in two suburban cities within ten miles of downtown Boise.

Exhibits 1 (Calgary) and 2 (Boise) show the generalized pattern of daily travel demand (expressed as vehicle miles per person) for the two study sites. Both exhibits depict the data as expected. The lowest travel demand areas are near the downtown cores. The Calgary example (Exhibit 1) has the clearer pattern due to the stronger downtown core and no appreciable suburban development. Boise (Exhibit 2) has a less distinct pattern, due in part to the decreased focus on the downtown and increased suburban commercial and employment opportunities.

The authors developed the average daily vehicle mile's parameter as the product of the number of vehicle trips and the average trip distance from the transportation planning model's output. The hypothesis was that the distance and number of trips parameters would exhibit the same pattern as the vehicle miles of travel. Future data needs could therefore be taken directly from either of the two available tables.

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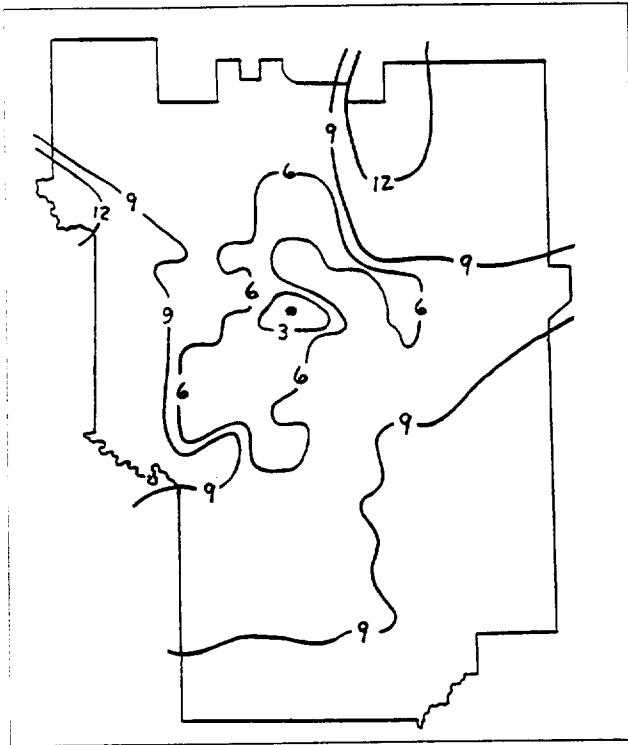


Exhibit 1. Calgary Travel Demand

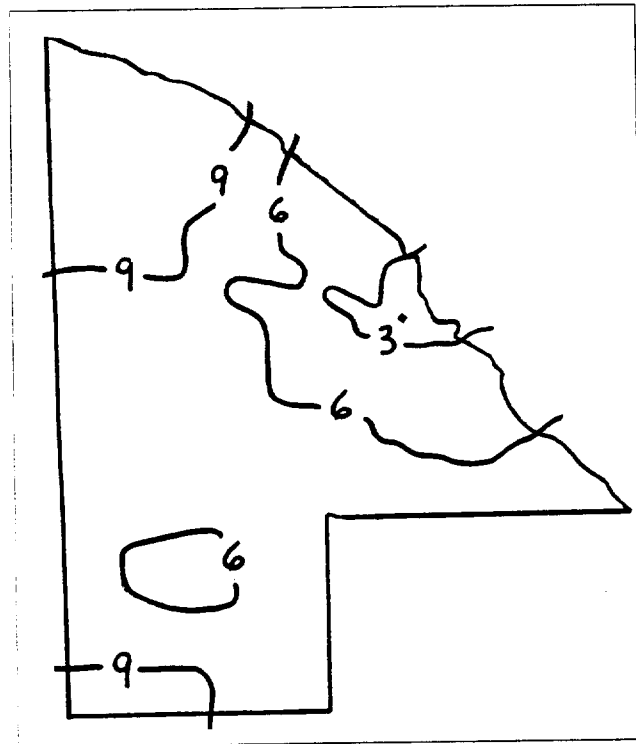


Exhibit 2. Boise Travel Demand

Generalized trip generation data are expressed as daily vehicle miles of travel per person and are shown in Exhibits 3 (Calgary) and 4 (Boise). The linear pattern of the two VMT exhibits (Exhibits 1 and 2) is not as apparent in the trip generation data. Here, trip generation is lowest in a near suburban ring and higher in the zones either near the city center or located in the far suburban ring. Both cities show a similar pattern of lower trip making in the near suburban ring.

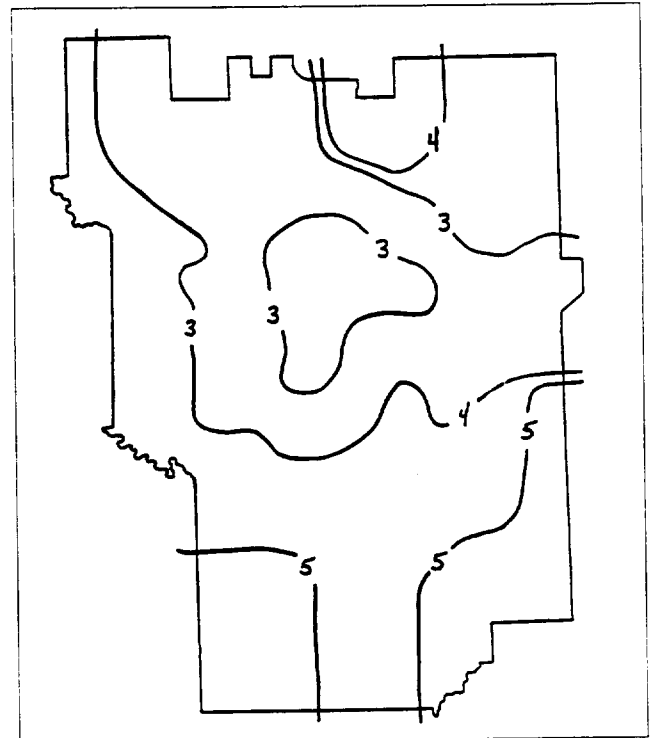


Exhibit 3. Calgary Trip Generation

The authors hypothesize that this pattern may be due to the fact that residents near the downtown core have shorter trips to make with many nearby destinations. They have little disincentives to make a vehicle trip because their travel time and distance are small. These residents show a higher trip making frequency.

The summarized trip distance data are expressed as the average vehicle trip distance and are shown in Figures 5 (Calgary) and 6 (Boise). The linear pattern of the two VMT

exhibits (Exhibits 1 and 2) is nearly as clear in the average trip distance data. Here, trip distance is lowest near the downtown core and highest in the far suburban ring.

The authors hypothesize that this pattern may be due to the fact that residents in the suburban ring have few nearby destinations and longer trips to make. There are travel disincentives because their travel time and distance are greater.

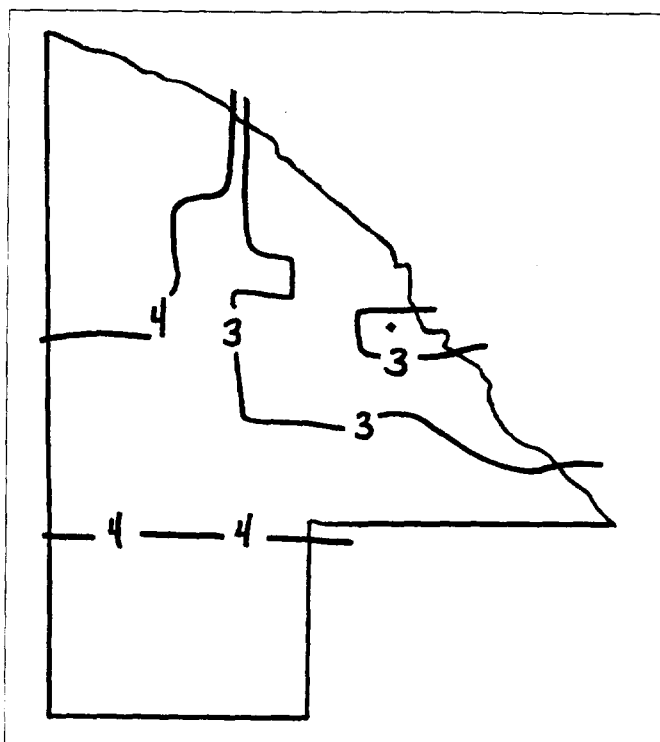


Exhibit 4. Boise Trip Generation

FINDINGS

The authors have developed the following conclusions on the basis of the available data.

- Residents in the downtown area generate more vehicle trips than households in the inner or far suburban areas. This is attributed to the availability of nearby trip destinations and the impact of travel disincentives.

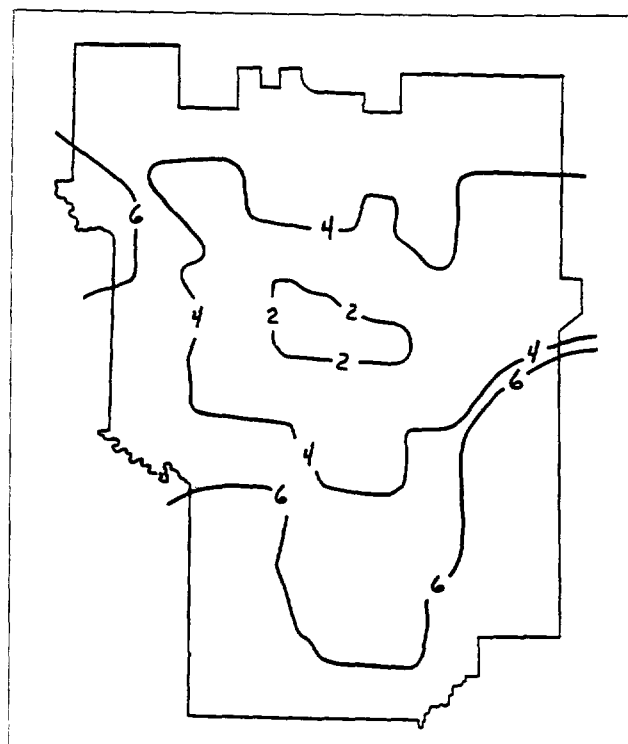


Exhibit 5. Calgary Trip Distance

- The average vehicle trip distance was found to increase in proportion to the increasing distance from the city center. This too is attributed to the availability of nearby trip destinations
- The number of daily vehicle miles of travel per person showed a nonlinear relationship with increasing distance from the city center.
- Residents in the downtown area have short trip distances but the lack of travel disincentives result in a higher trip frequency. Residents near the downtown core exhibit low levels of vehicle travel.
- Residents in the far suburban ring have longer trip distances but the significant travel disincentives result in a lower trip frequency. Residents near the far suburban ring exhibit the highest levels of vehicle miles of travel.

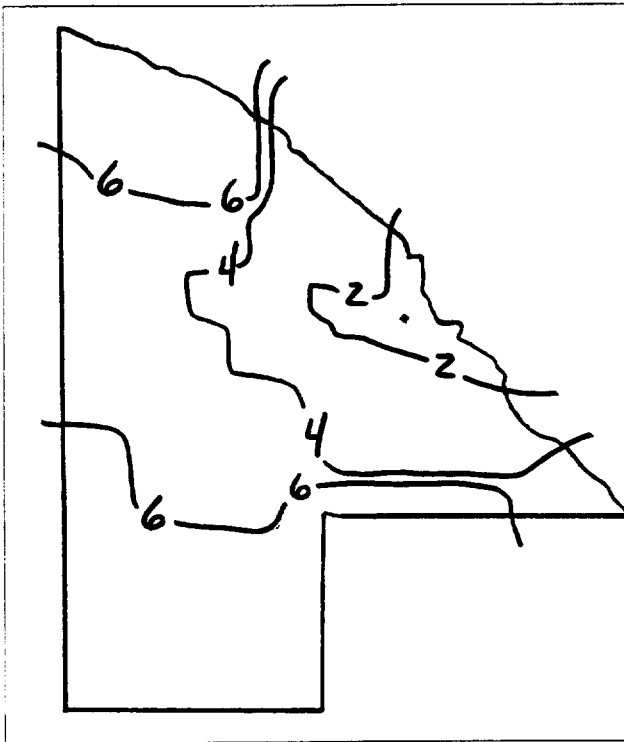


Exhibit 6. Boise Trip Distance

- Residents in the near suburban ring have moderate trip distances but there are some travel disincentives which result in a lower trip frequency. Residents in the near suburban ring exhibit the medium levels of vehicle miles of travel.

PLANNING IMPLICATIONS

There are several planning implications based upon the realization that there is spatial variation in travel demand, average trip distance, and personal vehicle miles of travel.

Impact Fees. Many urban areas now assess some form of development impact fees on new projects. The accepted philosophy is that new developments must help pay for the system-wide transportation improvements caused by the traffic generated by the new developments. This reduces the property tax burden for existing developments. Impact fees are often based on

the net increase in the amount vehicle miles of travel attributed to the new development. In the Boise example, the Ada County Highway District calculates the site impact fee on the basis of the total vehicle miles of travel attributed to the project site. Trip generation is calculated for the site, then an average trip distance factor is developed from the regional transportation planning model.

Vehicle miles of travel is used as the determining factor to more closely relate the impact of new developments to the wear and need for upgrading pavements. In practice however, it is found that the number of vehicles on the roadway (i.e., only the number of vehicle trips) appears to have a greater impact on traffic operations and the direct need to increase roadway capacity.

Because the average trip distance is lowest in the downtown core, the impact fee is lowest near the city center. Developments are therefore encouraged in the downtown area; the general location where additional vehicle trips are the most expensive to accommodate.

If the impact fee schedule were to be revised and based only upon the number of vehicle trips (i.e., trip generation) it would create a uniform impact fee throughout the urban area. This would eliminate the fee's impact on the developer's decision and lower fees in the near suburban ring. This would encourage developments away from the congested downtown core but near the available commercial and employment opportunities

Reductions in the Net Travel Demand. The acceptance that travel demand exhibits spatial variation allows decision makers to encourage development in those areas which exhibit lower level of vehicle miles or travel.

In the Calgary example, an analysis of different spatial allocation patterns was found to result in a potential of 10 percent variation in city wide

travel for a population increase of only 14 percent (3).

A land use planning ordinance (i.e., the local comprehensive plan) could be oriented toward the need to minimize city wide travel demand. While no more restrictive than any other comprehensive plan elements, this approach could benefit the overall urban form through reduced travel demand, improved air quality, and increased accessibility. This would also encourage developments away from the congested downtown core but near the available commercial and employment opportunities

VALUE TO OTHER RESEARCHERS

Many researchers are concerned with vehicle miles of travel. Architects and planners are concerned with urban form and function. Their goals are to develop an efficient and practical urban structure.

Engineers are similarly concerned with planning and designing the transportation infrastructure. This group's goals are to improve accessibility, maintain the operational efficiency of the roadway network and minimize travel demand

Household location determines the residents' travel needs. Because the total travel parameter is actually the product of two separate travel characteristics, a firm understanding of both the number of vehicle trips and the average trip distance allows both disciplines to create an efficient and effective urban structure.

2. Transportation Planning Handbook. Institute of Transportation Engineers. John Edwards Jr., editor. 1992.
3. Szplett, David. Automobile Fuel Conservation Through Planned Urban Residential Developments. Masters of Engineering Thesis, The University of Calgary. 1980.

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1. Quick Response Urban Travel Estimation Techniques and Transferable Parameters. National Cooperative Highway Research Program Report No. 187. Transportation Research Board. 1978.