

# Trip Generation from Suburban Office Buildings in Pennsylvania

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May 1990

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Delaware Valley Regional Planning Commission



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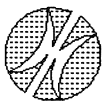
May 1990

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Created in 1965, the Delaware Valley Regional Planning Commission (DVRPC) is an interstate, intercounty and intercity agency which provides continuing, comprehensive and coordinated planning for the orderly growth and development of the Delaware Valley region. The region includes Bucks, Chester, Delaware, and Montgomery counties as well as the City of Philadelphia in Pennsylvania and Burlington, Camden, Gloucester, and Mercer counties in New Jersey. The Commission is an advisory agency which divides its planning and service functions among the Office of the Executive Director, the Office of Public Affairs, and four line Divisions: Transportation Planning, Regional Information Services Center, Strategic Planning, and Finance and Administration. DVRPC's mission for the 1990's is to emphasize technical assistance and services and to conduct high priority studies for member state and local governments, while determining and meeting the needs of the private sector.



The DVRPC logo is adapted from the official seal of the Commission and is designed as a stylized image of the Delaware Valley. The outer ring symbolizes the region as a whole while the diagonal bar signifies the Delaware River flowing through it. The two adjoining crescents represent the Commonwealth of Pennsylvania and the State of New Jersey. The logo combines these elements to depict the areas served by DVRPC.

# DELAWARE VALLEY REGIONAL PLANNING COMMISSION

## Publication Abstract

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TRIP GENERATION FROM SUBURBAN OFFICE BUILDINGS IN PENNSYLVANIA	May 1990
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### Geographic Area Covered:

Trip data is drawn from office sites in Chester, Delaware, and Montgomery Counties. Results are applicable throughout suburban southeastern Pennsylvania.

### Key Words:

Trip generation, suburbs, office buildings, land use, traffic counts.

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## ABSTRACT

This report presents the results of an examination of trip generation at ten suburban office buildings in southeastern Pennsylvania. Study efforts were focused on developing detailed profiles of each site including site, building, and tenant characteristics and collecting hourly traffic counts over a two day period at each site. Trip data is furnished for the sites for the average weekday and three peak hours. Trip rates in terms of gross floor area and number of employees are also specified. Observed local trip rates are compared with rates identified in the Institute of Transportation Engineers' Trip Generation--4th Edition.

This study was funded by the Pennsylvania Department of Transportation. A similar report has also been produced for office sites in the New Jersey portion of the Philadelphia region.

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## EXECUTIVE SUMMARY

Trip generation rates are frequently utilized transportation planning tools. The purpose of this study is to expand the knowledge of local trip generation rates by developing and examining trip rates at existing office developments in suburban southeastern Pennsylvania. The rates identified in the region are then compared to national rates derived from the Institute of Traffic Engineers' Trip Generation--4th Edition.

Selection of potential study sites was based on several factors. Only sites with buildings utilized solely as offices and with parking facilities isolated from other sites were considered. Also, all study sites possessed driveways which permitted accurate traffic counts to be conducted.

Ten office sites located in suburban Philadelphia were studied. Traffic counts were conducted at each driveway serving a site over a 48-hour weekday period. Additional information about the sites including building, site, and tenant characteristics was also obtained. Individual profiles of the sites are provided in the blue pages at the back of the report.

Based on the traffic counts, vehicle trips and trip rates were calculated for each site. These values are presented for the average weekday and for three peak periods (the A.M. peak hour, the P.M. peak hour, and the Other peak, or highest off-peak, hour). Rates are expressed in terms of trips per 1000 square feet of gross floor area and number of employees.

Predicted trip values based on ITE data and methodologies are also furnished for each site. The vehicle trips and trip rates were derived from regression equations which predict mean trip rates for office buildings of a particular size or with a certain number of employees.

The limited sample and data base acquired for this study did not clearly demonstrate that ITE office trip estimation methodologies and data are inappropriate to use in the Philadelphia suburban region. However, the study did show the discrepancies that can arise from using ITE-derived estimates. The estimates must be used with care and, whenever possible, supplemented with additional information about the site's characteristics to avoid gross under-estimation or over-estimation of vehicle trips.



## 1 INTRODUCTION

In recent years, the impact of new development on the road system in suburban areas of the Philadelphia region has become an important issue. Municipal officials and residents have grown concerned with managing growth and with increases in traffic volumes and congestion. Active developers are now often requested to fund highway improvements to mitigate the impact of traffic generated by new development. At the same time, transportation consultants have endeavored to accurately predict the increases in traffic caused by new development.

The number of vehicle trips generated by a proposed land use is traditionally estimated on the basis of observed trip generation rates of existing similar facilities. The most common source of this information is the Institute of Transportation Engineers' (ITE) Trip Generation--4th Edition, published in 1987. The ITE trip generation rates are accepted and applied in the DVRPC region even though few local trip generation studies are incorporated in ITE's data. The lack of trip generation data from the region has placed into question the appropriateness of utilizing ITE rates, particularly when they are used to calculate development fees and identify necessary off-site transportation improvements.

In response to this issue, the Delaware Valley Regional Planning Commission (DVRPC) has undertaken this research to determine office trip generation rates in the region. The study methodology has been based, in part, on suggestions made by a number of researchers and local consultants and developers. This report provides detailed information about each of the study sites, as well as summary trip generation statistics similar to those found in the ITE report.

### Preliminary Research

Prior to undertaking the examination of individual sites, a number of efforts were undertaken to refine the study methodology. This included several meetings or contacts with transportation professionals and persons concerned with trip generation data. The results of the preliminary research are summarized below.

### Institute of Transportation Engineers

DVRPC staff met with ITE's editor of Trip Generation. The editor stated that few trip generation studies used to estimate the ITE trip rates were conducted in the Philadelphia region. The editor suggested ways to present and utilize the trip data collected for this study. DVRPC agreed to provide all of the collected data to ITE for use in the next edition of Trip Generation.

### State Departments of Transportation

Representatives from the state departments of transportation in Pennsylvania and New Jersey indicated that they usually do not project traffic at development sites; rather, they review the work of local professional consultants who project traffic as part of driveway permit applications. ITE rates are the generally accepted source of trip rates, both for the consultants and the DOTs, although studies of similar developments are considered when available. None of the DOT representatives who were interviewed believed that the ITE rates are uniformly high, as suggested by some developers.

A number of independent variables were discussed which could influence trip generation. State DOT representatives pointed out that much of the recent development in the region is termed "flex-space" and includes varying amounts of office and non-office uses. It was observed that first tenants in a building sometimes can be expected to provide greater space per employee than subsequent tenants. Also, the level of service on the adjacent highway influences the peak hour rates. These and other factors were planned to be examined in the course of the study.

### Consultants

Fifteen consultants in the region who perform traffic studies in which trips by land uses are calculated were mailed an inquiry about trip generation. All respondents stated that there is a need for well-documented local trip generation rates for office developments and that they would be willing to cooperate with DVRPC in this study.

All of the consultants currently use ITE trip generation data as well as their own data in those cases where it is applicable. The consultants consider Trip Generation the best available source of trip generation data, even though it is national in nature. A specific concern was voiced about the effect of recent trends towards the use of flex time.

The consultants made the following suggestions regarding particular site characteristics to consider in the study:

- Employ three categories of size: less than 50,000 sq. ft., 50,000 to 200,000 sq. ft. and over 200,000 sq. ft.
- Examine single building sites and those with multiple buildings.
- Include very large sites in congested areas.

Few of the consultants acknowledged having significant data which might be incorporated into DVRPC's data base, although all agreed to share whatever they had.

#### Developers

Letters describing this study were sent to nineteen developers of office buildings in the suburban areas of the region. Ten developers conveyed their interest in the study and volunteered to assist in compiling data and in performing driveway traffic counts.

#### Literature

A review of professional literature regarding trip generation rates was conducted for further insight. Among the publications which were examined was the "Montgomery County Trip Generation Rate Study." The study was completed for the Maryland-National Capital Park and Planning Commission in August of 1989. One of the objectives of the study was to determine the suitability of the use of ITE methodologies for determining trip estimates in Montgomery County. The study was not limited to office sites, but also included residential sites, shopping centers, and fast food restaurants.

Although the study determined that the data in the 4th Edition of Trip Generation were superior to the 3rd Edition for predicting trips at office sites in Montgomery County, it still found some variation in predicted and observed average trip rates. For example, the study determined that Montgomery County office buildings with fewer than 300,000 square feet of gross floor area generated fewer trips than estimated by the 4th Edition estimation methods. As a result, the study recommended that future estimates of vehicle trips in Montgomery County be derived from data gathered in the study.

The Montgomery County study also recommended that a special analysis of certain sites be undertaken to avert the risk of severe underestimation of trips. The analysis was suggested for large or

isolated development projects expected to generate a significant number of trips (i.e., more than 200 P.M. peak hour vehicle trips). These sites pose the greatest potential for trip underestimation because inordinate trip generation patterns may not be effected by the stabilizing influence of adjacent facilities. The analysis is achieved by using a regression equation that is constructed by adding one standard error to the regression line which represents the equation for the mean trip rate. In this way, the estimated number of vehicle trips is greater than the mean and will be exceeded at actual sites in only a limited number of cases.

### **Design of the report**

Based on the discussions with transportation and development professionals, trip generation data collected for this study has been separated into two formats. First, trip data for all sites is presented in a way similar to the format employed by ITE. This includes tables and scatter diagrams containing observed and predicted values.

Secondly, because supplementary site information may illuminate trip generation characteristics at existing and proposed facilities, detailed profiles of each site are also provided in this report. The profiles contain characteristics of each site, its building(s), and tenant(s). The profile forms include an easily referenced summary of the most important information. Characteristics which cannot be described in numbers or short answers are described in a comments section.



## **2 METHODOLOGY**

### **Study Parameters**

To afford a significant yet manageable data base, it was concluded that a total of fifteen study sites would be a desirable sample size. All study sites were to be devoted to office use only with no retail services, or other non-office use, within the building(s) or in the parking areas. These sites can be classified under the ITE definition of general office building (land use type 710).

In choosing potential study sites, an effort was made to guarantee a variation in site characteristics. For example, an attempt was made to include sites small in size (under 100,000 square feet of gross floor area), intermediate in size (between 100,000 and 200,000 sq. ft.), and large in size (over 200,000 sq. ft.) in the sample. An effort was also made to incorporate sites which contained various combinations of characteristics such as number of tenants (i.e., single versus multiple tenants) and sites varied by type of suburb (i.e., mature versus developing suburb).

From the onset, the presentation and analysis of trip data (i.e., the time periods and trip rates) was to be consistent with ITE methods. It was felt that this would permit ready comparison of the observed trip data with the predicted values. This approach would also facilitate incorporation of the local data into the ITE data base.

### **Desired Site Attributes**

Prior to selecting candidate study sites, site attributes which were considered desirable were identified. One desired attribute was isolated parking facilities which were not shared with other sites. It was believed that sites which did not share parking facilities would not be affected by adjacent sites and that vehicle trips and trip rates would be the most accurate.

After beginning to collect trip data at the sites, it was observed that the configuration of the driveway(s) was also an important consideration. On short or narrow driveways, vehicles tended either to miss the tube counters or to hit both directional tubes at the same time and cause inaccuracies in the traffic counts. Accordingly, the criterion of either long or divided driveways was added to the list of desirable site attributes.

## Site Selection

The search for candidate study sites was begun by examining aerial photographs of suburban Philadelphia from 1985 and identifying corridors with high concentrations of office buildings. Each of the corridors was then examined for suitable study sites.

Field views of potential sites were conducted to examine the parking lot and driveway configurations and any other conditions which might render sites inappropriate for this study. In order to simplify the data collection process, sites with a minimal number of driveways (1-2) were preferred.

## Study Consent

Following the identification of potential study sites, the owner, manager, or tenant of the site was contacted by telephone to request permission to study the facility. A variety of techniques was employed to seek the name of the proper person to contact. When the building was not fully occupied, the name and telephone number of the leasing agent was usually prominently displayed outside. Phone numbers for single tenant buildings were obtained from the phone book. Real estate guides and township tax records were consulted to find the name of the owner or management company if a multi-tenant building was fully occupied. Obtaining permission to study a site often required a number of phone calls in order to reach the person with the authority to allow it.

Permission to begin data collection efforts and to be included in the study was obtained for fourteen sites. Most of the site representatives contacted were supportive of this research. Some agreed to participate only when given a guarantee of a reporting format that afforded anonymity to the site. Others declined participation based on their concern for financial obligations which might be incurred if the site was found to generate more trips than the traffic impact study prepared for the site had predicted.

## Data Collection

Following the establishment of consent, the contact person at each site was sent an informational letter about the project for their records, a questionnaire about the site, a postage-paid return envelope for the questionnaire, and a data collection authorization form. The questionnaire concerned characteristics of the facility including building size, amount of space occupied, number of employees, available parking spaces, and other information. The

data from the questionnaire served as the basis for preparation of the profiles of the sites. The authorization form was carried by data collection personnel while setting up traffic counting machines at that site.

Machine tube counters were installed at each driveway of each site to record traffic counts by direction for a 48-hour weekday period. Traffic counts were conducted when traffic was expected to be normal and unaffected by circumstances such as holidays and inclement weather. Installation of the machines occurred during a non-peak hour. Some sites were observed during a morning or evening peak hour to check traffic conditions on the adjacent roads and to insure proper machine operation.

### **Manipulation of Traffic Counts**

The machine traffic counts provided the hourly volumes by direction for each of the 48 hours at each site. The two volumes corresponding to each hour were then averaged, producing an average hourly volume. The average hourly entering volumes were then summed with the average hourly exiting volumes to estimate average hourly two-way trip volumes. The average hourly two-way volumes were then summed to derive the average daily vehicle trips for each site.

From the average hourly trip volumes, three peak hour trip volumes could be determined for each site: the A.M. peak, the P.M. peak, and the "Other peak," which was the period other than the A.M. or P.M. peak hour with the highest volume of traffic. The Other peak hour normally coincided with the lunch hour. These peak hour trip volumes were then used to derive trip rates expressed in terms of gross floor area and number of employees.

Traffic counts collected at four of the fourteen study sites proved unacceptable due to inaccuracies caused by driveway configurations. Consequently, these sites are not included in the discussion of study sites or trip generation.



### 3 STUDY SITES

Characteristics of office sites can be quite varied and are an important determinant of trip generation. Attributes of the office sites examined in this study are summarized below and demonstrate the many possible combinations of building, site, and tenant characteristics.

#### Building Characteristics

Study sites were located throughout suburban Philadelphia. Of the ten study sites, four were located in Chester County, one in Delaware County, and five in Montgomery County. Four sites were concentrated in the Valley Forge area and two sites were located in the King of Prussia area. The site names used in this report are fictitious, to provide a measure of anonymity, but they do reflect the general location of the site.

Of the sites studied, two exceeded 200,000 sq. ft. of gross floor area, two were between 100,000 and 200,000 sq. ft., and six were less than 100,000 sq. ft. (Table I). Two of the sites reported 100% of the gross floor area as leasable; other sites ranged from 88% to 97% leasable floor area. The amount of leasable floor area actually occupied varied considerably. At six sites, 94% or more was occupied, whereas at the remaining four sites 62% to 87% was reported as occupied.

**Table I: BUILDING CHARACTERISTICS**

Site	Site Name	Gross Floor Area	Leasable Floor Area	% of GFA	Occupied Floor Area	% of LFA
1	Willow Grove I	902,317	902,317	100	902,317	100
2	Bala Cynwyd I	420,697	372,110	88	349,039	94
3	King of Prussia I	176,000	171,000	97	112,860	66
4	Valley Forge I	120,470	120,470	100	74,691	62
5	King of Prussia II	97,500	95,000	97	82,650	87
6	Valley Forge II	87,714	81,890	93	57,323	70
7	Plymouth Meeting I	85,557	83,000	97	80,510	97
8	Valley Forge III	78,687	71,990	91	71,990	100
9	Radnor I	69,500	65,537	94	65,537	100
10	Valley Forge IV	66,606	64,270	96	63,627	99
	LOW	66,606	64,270	88	57,323	62
	HIGH	902,317	902,317	100	902,317	100
	AVERAGE	210,505	202,758	96	186,054	92

## Site Characteristics

The total acreage of the sites was varied: one site was very large at 107 acres, four were between 10 to 31 acres, and five sites ranged from three to nine acres (Table II). Seven of the sites had a single building; the other three had two buildings. Buildings at the sites were constructed between 1972 and 1986. The average age of the buildings was six years.

There was significant variation in the number of parking spaces per employee at the sites. The average number of spaces per employee was 0.96, but ranged from 0.67 to 2.47. For all of the sites, the average number of parking spaces per 1,000 square feet of gross floor area was 3.15, which is less than the corresponding value identified by ITE in Trip Generation (i.e., 3.68).

Only two of the sites reported the sponsoring or promotion of a ridesharing program. However, public transit services (bus and/or rail) were available at seven of the sites.

The functional classification of the roadways adjacent to the sites included the following: local, collector, minor arterial, and principal arterial. No one classification was prevalent.

The distribution of sites by number of driveways was similar to the distribution of sites by number of buildings; that is, seven sites had one driveway and three sites two driveways. However, there was no direct correlation between number of buildings and number of driveways.

**Table II: SITE CHARACTERISTICS**

Site	Site Name	Site Acreage	Year Built	Parking Spaces	Spaces/ Employee
1	Willow Grove I	107.0	1972	2189	0.83
2	Bala Cynwyd I	31.4	1981	1345	0.67
3	King of Prussia I	24.0	1983	700	1.47
4	Valley Forge I	20.6	1986	393	1.90
5	King of Prussia II	3.2	1980	527	1.36
6	Valley Forge II	10.0	1986	450	2.47
7	Plymouth Meeting I	4.4	1985	287	0.87
8	Valley Forge III	4.0	1985	317	1.27
9	Radnor I	6.6	1980	226	0.87
10	Valley Forge IV	9.2	1985	195	0.98
	LOW	3.2	1972	195	0.67
	HIGH	107.0	1986	2189	2.47
	AVERAGE	22.0	1982	663	0.96

The average peak hour vehicle occupancy at the study sites was not determined. However, in a similar study of office sites in southern New Jersey conducted by DVRPC, the average peak hour vehicle occupancy ranged from 1.0 to 1.2 persons. This approximates the value cited by ITE for average automobile occupancy (i.e., 1.2 persons per vehicle).

### Tenant Characteristics

Eight of the study sites were occupied by more than one tenant; only two sites had a single tenant (Table III). Two of the sites had a relatively large number of employees (2,000 or more). The remaining eight sites had between 182 and 475 employees.

The ranges of the rates of employees per 1,000 sq. ft. of gross floor area and per 1,000 sq. ft. of occupied floor area were considerable. The average number of employees for occupied floor area exceeded the average number of employees for gross floor area by almost 15%.

**Table III: TENANT CHARACTERISTICS**

Site	Site Name	No. of Tenants	No. of Employees	Emp/ GFA	Emp/ Occupied FA
1	Willow Grove I	1	2638	2.92	2.92
2	Bala Cynwyd I	24	2000	4.75	5.73
3	King of Prussia I	3	475	2.70	4.21
4	Valley Forge I	15	207	1.72	2.77
5	King of Prussia II	14	387	3.97	4.68
6	Valley Forge II	2	182	2.07	3.17
7	Plymouth Meeting I	14	330	3.86	4.10
8	Valley Forge III	6	250	3.18	3.47
9	Radnor I	1	260	3.74	3.97
10	Valley Forge IV	10	200	3.00	3.14
	LOW	1	182	1.72	2.77
	HIGH	24	2638	4.75	5.73
	AVERAGE	9	693	3.29	3.72

### Employee Density

Employee density of office sites may be affected by many factors including the nature of the occupant's business, the length of time the occupant has been at the site, and the size of the building(s). Employee densities at the study sites, expressed as the number of employees per 1,000 sq. ft. of gross floor area, were not entirely consistent with rates reported by ITE (Table IV). Rates for sites over 200,000 sq. ft. were roughly comparable. However, for office sites under 200,000 sq. ft., the average employee densities in the DVRPC region were lower and had a smaller range of rates.

**Table IV: OFFICE BUILDING EMPLOYEE DENSITY**

	Observed Avg	ITE Avg	Observed Range	ITE Range
Under 100,000 GFA	3.31	4.80	2.07-3.97	2.63-7.46
100,000-200,000 GFA	2.30	4.40	1.72-2.70	3.37-8.00
Over 200,000 GFA	3.51	3.50	2.92-4.75	2.16-5.60
Average	3.29	4.17	1.72-4.75	2.17-8.00

### Individual Profiles

Individual profiles of the ten study sites are found on the blue pages at the back of this report. The profiles are based on data collected in 1988. All site information was reported by building management or, in the case of single tenant sites, by a tenant representative. Once again, site names are not the true names of the sites.

The profiles provide trip data and a number of site characteristics including occupied floor area, availability of transit and ridesharing programs, and number of tenants. While detailed site characteristics such as these are not generally furnished in conjunction with trip generation studies, their provision affords greater insight into trip rates. The profiles also serve as a useful reference for matching characteristics of actual sites with proposed ones and for estimating trips.

The site profiles are catalogued by size, from the site largest in gross floor area to the smallest. Site characteristics are listed in the upper left portion of the form. For ease of use, the most pertinent information about the site is highlighted in the upper right hand margin. Trip generation and trip rates by direction and in total are reported in the lower left portion for each peak period and for the average weekday. A summary of the trip rates is provided in the right hand margin in the middle of the page. The bottom section of the form is reserved for comments and explanations of unusual conditions at the facility which might affect trip generation rates.



## 4 TRIP GENERATION

In this section, trip generation data is presented for each of the ten study sites. Included are vehicle trips, based on machine traffic counts performed at the sites, and trip rates expressed in terms of gross floor area and the number of employees. Scatter diagrams containing plots of observed trips, gross floor area, and employees and a graphic representation of the appropriate ITE regression equation are also presented. The data, and related text, are grouped into four sub-sections which reflect the time periods selected for analysis: the average weekday, the A.M. peak hour, the P.M. peak hour, and the Other peak hour.

### ITE Trip Estimation

ITE trip estimation is based on the use of exponential regression equations specified in Trip Generation. Regression equations are specified by ITE to estimate trip generation for office buildings because research indicates that the trip rates are non-linear. The equations estimate the average number of vehicle trips for office sites of a given gross floor area or with a certain number of employees. Observed values are expected to conform to a normal distribution about the predicted value. In the following tables and figures, predicted trip rates, based on ITE methodologies, are furnished adjacent to the observed values determined by this study.

### Average Weekday Trip Generation

Data concerning average weekday trip generation at the ten study sites is presented in Table V and Figures I and II. In Table V, and the subsequent trip generation tables, the study sites are grouped according to a predetermined definition of large, intermediate, and small sites (i.e., sites larger than 200,000 GFA, sites between 100,000-200,000 GFA, and sites less than 100,000 GFA).

The ITE regression equation used to estimate daily vehicle trips from gross floor area is:

$$\ln(T)=0.75\ln(A)+3.77$$

where T=two-way volume of traffic or total trip ends and A=area in 1,000 gross square feet of building area.

For trip rates expressed in terms of employment, the ITE regression equation is:

$$\ln(T) = 0.87\ln(E) + 2.06$$

where T=two-way volume of traffic or total trip ends and E=number of employees.

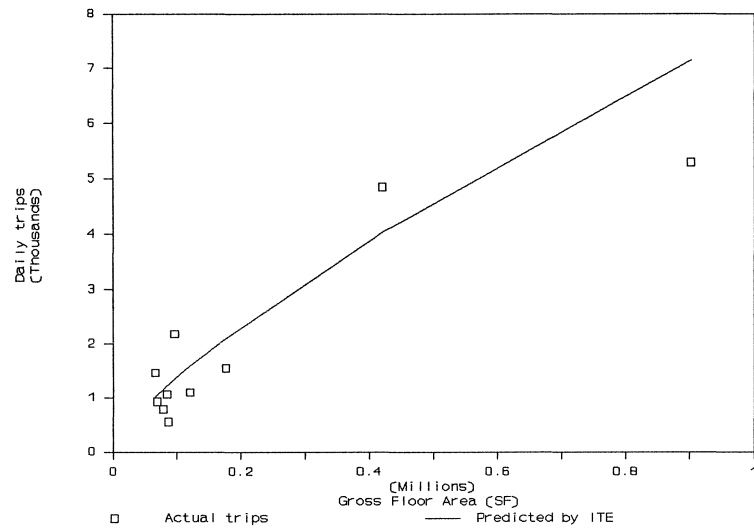
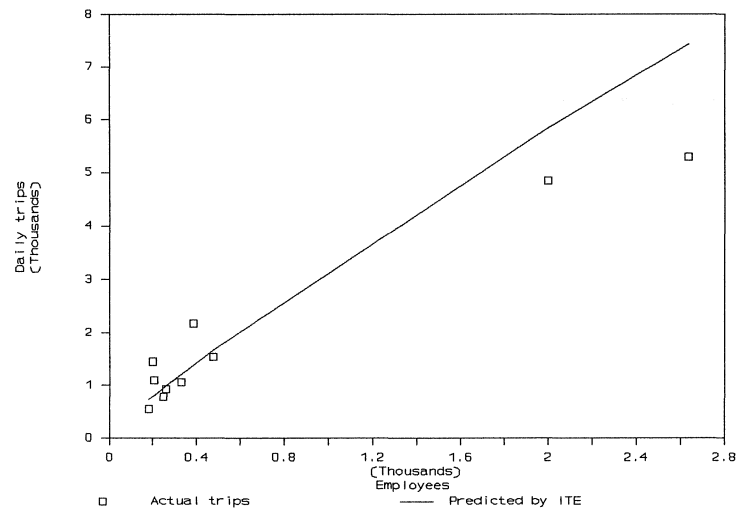
Table V and the figures reveal that the observed trip rates varied from the rates predicted by the ITE equation. For both types of trip rates (gross floor area and employees), three sites had observed rates in excess of the predicted values and seven sites had rates which were less than the predicted values.

As can be seen in the table, ITE trip rates for general office buildings are inversely related to gross floor area and the number of employees. It is interesting to note that the observed trip rates of the limited sample do not individually conform to this pattern, but that the averages of the observed rates within each category of sites based on size do yield results similar to ITE.

Variations in the trip rates underlie differences, sometimes extreme, in the number of observed trips and predicted trips. In the most pronounced case of over-prediction of daily trips, the number of trips for Site 6 predicted by the ITE gross floor area equation exceeded the observed trips by 123%. On the other hand, at Site 10 the daily trips predicted by the ITE employment equation was 46% less than the observed trips.

**Table V: AVERAGE WEEKDAY TRIP GENERATION**

Site	Site Name	Observed Trips	Trips/1000 GFA		Trips/Emp	
			Observed	ITE	Observed	ITE
Sites >200,000 GFA						
1	Willow Grove I	5293	5.87	7.91	2.01	2.82
2	Bala Cynwyd I	4856	11.54	9.58	2.43	2.92
Sites 100,000-200,000 GFA						
3	King of Prussia I	1546	8.78	11.91	3.25	3.52
4	Valley Forge I	1098	9.11	13.09	5.30	3.92
Sites <100,000 GFA						
5	King of Prussia II	2179	22.35	13.81	5.63	3.62
6	Valley Forge II	558	6.36	14.17	3.07	3.99
7	Plymouth Meeting I	1061	12.12	14.26	3.22	3.69
8	Valley Forge III	786	9.99	14.57	3.14	3.83
9	Radnor I	924	13.29	15.02	3.55	3.81
10	Valley Forge IV	1456	21.85	15.18	7.28	3.94
	LOW	558	5.87	7.91	2.01	2.82
	HIGH	5293	22.35	15.18	7.28	3.99

**Figure I: DAILY TRIPS vs GROSS FLOOR AREA****Figure II: DAILY TRIPS vs EMPLOYEES**

### A.M. Peak Hour Trip Generation

A.M. peak hour trip data at the study sites is presented in Table VI and Figures III and IV. At nine of the ten sites, the observed trip rates for any single hour period, in terms of both independent variables, were at their highest during the A.M. peak period.

The ITE trip rates and prediction lines in the scatter diagrams are derived from the following regression equations:

$$\begin{aligned}\ln(T) &= 0.86\ln(A) + 1.34; \text{ and} \\ \ln(T) &= 0.98\ln(E) - 0.55\end{aligned}$$

where T=two-way volume of traffic or total trip ends, A=area in 1,000 gross square feet of building area, and E=number of employees. The ITE methodology assumes that the peak hour traffic of the office building coincides with the peak hour of the adjacent street traffic; thus, only a single equation for each independent variable is specified.

As would be anticipated, observed trips and trip rates did not coincide with predicted values. ITE methods overestimated trip rates at seven sites in terms of gross floor area and at six sites in terms of employment. At the remaining sites, the predicted trip rates were less than the observed trip rates.

The observed A.M. peak hour trip rates at the sites were generally related to the predicted trip rates in a manner consistent with the average weekday trip rates. In other words, if the ITE methodologies overestimated, or underestimated, the trip rate for a site for the average weekday, it is likely that it did the same for the A.M. peak period.

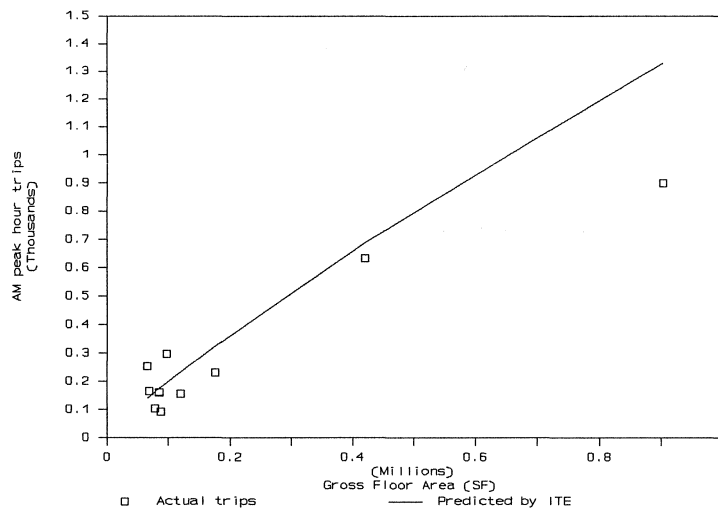
Two estimates of A.M. peak hour vehicle trips were derived for each of the ten sites by using the ITE regression equations. Of the twenty predicted values,

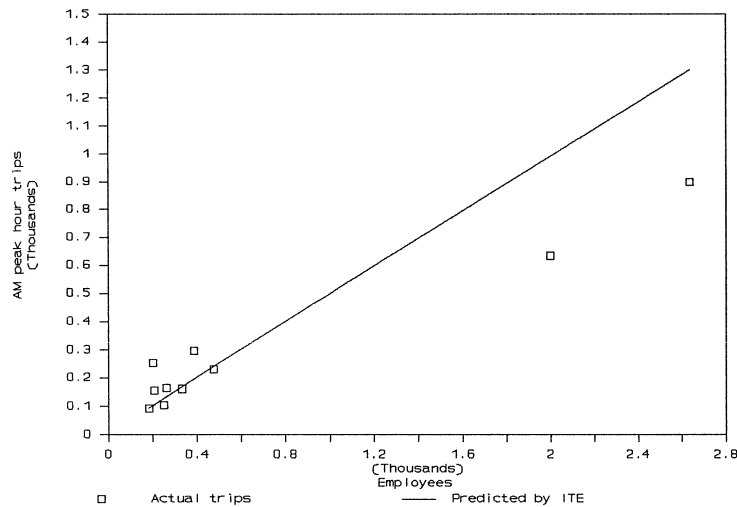
- six were within 15%, either above or below, the observed value;
- eleven were more than 15% above the observed values; and
- three were more than 15% below the observed values.

That is, the ITE equations predicted close to the observed value in fewer than one-third of the cases. In the more than two-thirds of the occasions where the ITE prediction was substantially different from the observed number, they were more likely to be high than low. It should be remembered, however, that these observations are based on a very small sample.

**Table VI: A.M. PEAK HOUR TRIP GENERATION**

Site	Site Name	Observed Trips	Trips/1000 GFA		Trips/Emp	
			Observed	ITE	Observed	ITE
<b>Sites &gt;200,000 GFA</b>						
1	Willow Grove I	898	1.00	1.47	0.34	0.49
2	Bala Cynwyd I	634	1.51	1.64	0.32	0.50
<b>Sites 100,000-200,000 GFA</b>						
3	King of Prussia I	231	1.31	1.85	0.49	0.51
4	Valley Forge I	156	1.29	1.95	0.75	0.52
<b>Sites &lt;100,000 GFA</b>						
5	King of Prussia II	297	3.05	2.01	0.77	0.51
6	Valley Forge II	93	1.06	2.04	0.51	0.52
7	Plymouth Meeting I	162	1.85	2.05	0.49	0.51
8	Valley Forge III	104	1.32	2.07	0.42	0.52
9	Radnor I	166	2.39	2.11	0.64	0.52
10	Valley Forge IV	254	3.81	2.12	1.27	0.52
	LOW	93	1.00	1.47	0.32	0.49
	HIGH	898	3.81	2.12	1.27	0.52

**Figure III: A.M. PEAK HOUR TRIPS vs GROSS FLOOR AREA**

**FIGURE IV: A.M. PEAK HOUR TRIPS vs EMPLOYEES**

### P.M. Peak Hour Trip Generation

Table VII summarizes the P.M. peak hour trip generation data for the study sites. The ITE trip rates contained in the table are derived from the following regression equations:

$$\begin{aligned} \ln(T) &= 0.83\ln(A) + 1.46; \text{ and} \\ \ln(T) &= 0.98\ln(E) - 0.60 \end{aligned}$$

where T=two-way volume of traffic or total trip ends, A=area in 1,000 gross square feet of building area, and E=number of employees.

Table VII indicates that the predicted P.M. peak hour trip rates are similarly related to the observed values as they were for the A.M. peak hour. For example, predicted trip rates based on gross floor area are overestimated at the same seven sites for the P.M. peak hour as they were for the A.M. peak hour.

This does not mean, however, that the A.M. and P.M. predicted values are equally related to the observed values. In some cases, the A.M. peak hour predicted value more closely approximates the observed value whereas in other cases the P.M. peak hour predicted value is closer to the observed value.

**Table VII: P.M. PEAK HOUR TRIP GENERATION**

Site	Site Name	Observed Trips	Trips/1000 GFA		Trips/Emp	
			Observed	ITE	Observed	ITE
<b>Sites &gt;200,000 GFA</b>						
1	Willow Grove I	895	0.99	1.35	0.34	0.47
2	Bala Cynwyd I	525	1.25	1.54	0.26	0.47
<b>Sites 100,000-200,000 GFA</b>						
3	King of Prussia I	194	1.10	1.79	0.41	0.49
4	Valley Forge I	134	1.11	1.91	0.65	0.49
<b>Sites &lt;100,000 GFA</b>						
5	King of Prussia II	271	2.78	1.98	0.70	0.49
6	Valley Forge II	76	0.87	2.01	0.42	0.49
7	Plymouth Meeting I	138	1.58	2.02	0.42	0.49
8	Valley Forge III	104	1.32	2.05	0.42	0.49
9	Radnor I	175	2.52	2.09	0.67	0.49
10	Valley Forge IV	140	2.10	2.11	0.70	0.49
	LOW	76	0.87	1.35	0.26	0.47
	HIGH	895	2.78	2.11	0.70	0.49

**Other Peak Hour Trip Generation**

Observed vehicle trips and trip rates during the off-peak, or Other, peak hour are contained in Table VIII. The Other peak hour occurred from either 12:00-1:00 P.M. or from 1:00-2:00 P.M. at each of the study sites.

The Other peak hour as presented in this study is not considered by ITE. As a result, no ITE trip rates or regression equations are presented for this time period.

Other peak hour trip rates are, generally speaking, 80% of A.M. peak hour rates and 90% of P.M. peak hour rates. However, there are some notable exceptions from these generalizations. At site 1, the trip rates during the Other peak hour are low (only 34-35% of the A.M. peak hour trip rates); this is the result of the facility having its own cafeteria, thereby reducing travel during the lunch hour. Another site which deviates from the normal pattern is site 10; at this site, the Other peak hour trip rates actually exceed the P.M. hour trip rates by 34%.

The traffic counts conducted at the sites indicate that several time periods adjacent to the Other peak hour had significant traffic volumes (i.e., 60% of the Other peak hour traffic). In fact, of 23 occasions when a one hour time period adjacent to one of the peak hours had at least 60% of the traffic of the peak hour, nearly half (eleven) occurred either before or after the Other peak hour. Since

the traffic counts were not broken down into 15 minute segments, a more precise definition of the Other peak hour is not possible. The adjacent time periods with significant traffic volumes are commented upon in the individual site profiles.

**Table VIII: OTHER PEAK HOUR TRIP GENERATION**

Site	Site Name	<u>Observed</u>	<u>Trips/1000 GFA</u>		<u>Trips/Emp</u>	
		Trips	DVRPC	ITE	DVRPC	ITE
<b>Sites &gt;200,000 GFA</b>						
1	Willow Grove I	308	0.34	N/A	0.12	N/A
2	Bala Cynwyd I	496	1.18	N/A	0.25	N/A
<b>Sites 100,000-200,000 GFA</b>						
3	King of Prussia I	191	1.09	N/A	0.40	N/A
4	Valley Forge I	125	1.04	N/A	0.60	N/A
<b>Sites &lt;100,000 GFA</b>						
5	King of Prussia II	269	2.76	N/A	0.70	N/A
6	Valley Forge II	56	0.64	N/A	0.31	N/A
7	Plymouth Meeting I	125	1.43	N/A	0.38	N/A
8	Valley Forge III	94	1.19	N/A	0.38	N/A
9	Radnor I	131	1.88	N/A	0.50	N/A
10	Valley Forge IV	187	2.81	N/A	0.94	N/A
	LOW	56	0.34	N/A	0.12	N/A
	HIGH	496	2.81	N/A	0.94	N/A



## 5 CONCLUSIONS

The estimation of office trip generation is a complex undertaking, but it is also a useful one. This planning tool can be used to estimate the impact of development, guide the staging of development, and maintain the quality of life.

The sites examined in this study accentuate the unique nature of individual office developments. Each site uniquely combines a series of building, site, and tenant characteristics. These characteristics, which are not limited to gross floor area and number of employees, can affect a site's trip generation patterns.

Due to the unique nature of each office site, observed trip generation can deviate significantly from estimates based solely on ITE regression equations. In this study, it was found that A. M. peak hour vehicle trips estimated on the basis of ITE regression equations for gross floor area varied an average of 40%, either plus or minus, from the observed number of trips. Although equations based on the number of employees would be expected to be better predictors of trips than gross floor area, they were not found to be dramatically more accurate. The average difference in the A.M. peak hour between the estimated and the observed number of trips based on the number of employees was just under 30%.

Comparisons of the predicted and observed number of trips yielded no pattern which would indicate which sites ITE predictions most closely approximate the observed value. Significantly, differences can be as great at small sites as at large sites.

The limited sample and data base acquired for this study do not clearly demonstrate that ITE office trip estimation methodologies and data are inappropriate to use in the Philadelphia suburban region. However, the study does show that discrepancies can occur from relying solely on ITE methodologies. ITE-derived estimates represent mean values based on nationally collected trip data. The estimates must, therefore, be used with care and, whenever possible, supplemented with additional information about the site's characteristics to avoid gross under-estimation or over-estimation of vehicle trips.

The data contained in this study constitute a useful foundation for considering trip generation from proposed office sites in the region. The detailed site profiles form a catalogue of actual sites which can be consulted for estimating vehicle trips at proposed facilities.

Upon examination of additional sites, it is conceivable that the data could also be used to devise a trip estimation methodology, such as a regression equation, specially adapted to the region.

## GLOSSARY

The following is a glossary of terms used in the profile forms and elsewhere in this report:

**Adjacent Roadway Type** The functional classification of the roadway(s) adjacent to the site. The following classifications are used: local, collector, minor arterial, and principal arterial.

**Average Peak Hour Vehicle Occupancy** The average number of persons per vehicle during peak arrival or departure hour.

**County** The county where the site is located.

**Date of Count** The date of the machine traffic counts at the site.

**Facility** The site name used in this report. A fictitious name has been devised to provide anonymity to the site.

**Employees per 1000 sq. ft. Occupied FA** The number of employees divided by occupied floor area in thousands of square feet.

**Gross Floor Area (square feet)** The total floor area.

**Leasable Floor Area (square feet)** The gross floor area which is actually leasable. In multi-tenant buildings, this excludes corridors, mechanical areas, and common spaces.

**Number of Buildings** The number of office buildings at the site.

**Number of Driveways** The number of driveways which serve the site. This also indicates the number of driveways on which traffic counts were conducted.

**Number of Employees** The number of persons who work at the site.

**Number of Parking Spaces** The number of parking spaces at the site.

**Number of Tenants** The number of tenants who occupy the site.

**Occupied Floor Area (square feet)** The actual amount of leasable area which is occupied.

**Percent LFA Occupied** The percent of leasable floor area which is occupied.

**Ridesharing** The availability of a carpool or vanpool program sponsored or promoted by the site tenant(s).

**Site Acreage** The number of acres the site occupies.

**Transit** The availability of nearby public transportation service.

**Year Built** The year in which construction of the building(s) at the site was completed.

# General Office Building

1

## Site characteristics

Facility: **Willow Grove I**  
Gross Floor Area (square feet): **902,317**  
Leasable Floor Area (square feet): **902,317**  
Occupied Floor Area (square feet): **902,317**  
Percent LFA Occupied: **100%**  
Site acreage: **107**  
Number of tenants: **1**  
Number of employees: **2,638**  
Year built: **1972**  
Number of buildings: **1**  
Number of driveways: **2**  
Number of parking spaces: **2,189**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Principal Arterial**  
County: **Montgomery**  
Date of count: **11/88**  
Ridesharing: **Yes**  
Transit: **No**  
Employees per 1000 sq. ft. Occupied FA: **2.92**

## Site summary

Gross Floor Area: **> 200**  
**100-200**  
**50-100**  
**< 50**

Buildings **Single**  
**Multiple**

Tenants **Single**  
**Multiple**

Age of buildings: **< 2**  
**2 to 5**  
**> 5**

Transit available? **Yes**  
**No**

Ridesharing promoted? **Yes**  
**No**

State **PA**  
**NJ**

## Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	834	.32	.92
	Out	64	.02	.07
	Total	898	.34	1.00
PM peak	In	109	.04	.12
	Out	786	.30	.87
	Total	895	.34	.99
Other peak*	In	167	.06	.19
	Out	141	.05	.16
	Total	308	.12	.34

### \*12-1 PM

Total weekday two-way trips	5,293	2.01	5.87
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## Trip rate summary

Per employee:

Weekday: **2.01**  
Peak hour: **.34**

Per 1000 sf GFA:

Weekday: **5.87**  
Peak hour: **1.00**

## Comments:

Trip generation in the one hour periods before the AM and Other peak periods, and after the Other and PM peak periods, is equivalent to 60% or more of the adjacent peak hour traffic.

## General Office Building

2

### Site characteristics

Facility: **Bala Cynwyd I**  
Gross Floor Area (square feet): **420,697**  
Leasable Floor Area (square feet): **372,110**  
Occupied Floor Area (square feet): **349,039**  
Percent LFA Occupied: **94%**  
Site acreage: **31.36**  
Number of tenants: **24**  
Number of employees: **2,000**  
Year built: **1981**  
Number of buildings: **2**  
Number of driveways: **2**  
Number of parking spaces: **1,345**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Local and Collector**  
County: **Montgomery**  
Date of count: **11-12/88**  
Ridesharing: **No**  
Transit: **Yes**  
Employees per 1000 sq. ft. Occupied FA: **5.73**

### Site summary

Gross Floor Area: **> 200**  
**100-200**  
**50-100**  
**< 50**

Buildings **Single**  
**Multiple**

Tenants **Single**  
**Multiple**

Age of buildings: **< 2**  
**2 to 5**  
**> 5**

Transit available? **Yes**  
**No**

Ridesharing promoted? **Yes**  
**No**

State **PA**  
**NJ**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	585	.29	1.39
	Out	49	.02	.12
	Total	634	.32	1.51
PM peak	In	75	.04	.18
	Out	450	.23	1.07
	Total	525	.26	1.25
Other peak*	In	199	.10	.47
	Out	297	.15	.71
	Total	496	.25	1.18

**\*12-1 PM**

Total weekday two-way trips	4,856	2.43	11.54
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### Trip rate summary

Per employee:

Weekday: **2.43**  
Peak hour: **.32**

Per 1000 sf GFA:

Weekday: **11.54**  
Peak hour: **1.51**

### Comments:

Trip generation in the one hour periods before the AM peak hour and after the Other peak hour and the PM peak hour periods, is equivalent to 60% or more of the adjacent peak hour traffic.

## General Office Building

3

### Site characteristics

Facility: **King of Prussia I**  
Gross Floor Area (square feet): **176,000**  
Leasable Floor Area (square feet): **171,000**  
Occupied Floor Area (square feet): **112,860**  
Percent LFA Occupied: **66%**  
Site acreage: **24**  
Number of tenants: **3**  
Number of employees: **475**  
Year built: **1983**  
Number of buildings: **2**  
Number of driveways: **1**  
Number of parking spaces: **700**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Minor Arterial**  
County: **Montgomery**  
Date of count: **4/89**  
Ridesharing: **Yes**  
Transit: **No**  
Employees per 1000 sq. ft. Occupied FA: **4.21**

### Site summary

Gross Floor Area: >200  
**100-200**  
50-100  
<50  
Buildings Single  
**Multiple**  
Tenants Single  
**Multiple**  
Age of buildings: <2  
**2 to 5**  
>5  
Transit available? Yes  
**No**  
Ridesharing promoted? **Yes**  
No  
State **PA**  
**NJ**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	195	.41	1.11
	Out	36	.08	.20
	Total	231	.49	1.31
PM peak	In	27	.06	.15
	Out	167	.35	.95
	Total	194	.41	1.10
Other peak*	In	74	.16	.42
	Out	117	.25	.66
	Total	191	.40	1.09

#### \*12-1 PM

Total weekday two-way trips	1,546	3.25	8.78
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### Trip rate summary

Per employee:  
Weekday: **3.25**  
Peak hour: **.49**  
Per 1000 sf GFA:  
Weekday: **8.78**  
Peak hour: **1.31**

### Comments:

Trip generation in the one hour periods after the AM, PM, and Other peak hours and before the PM peak hour is equivalent to 60% or more of the adjacent peak hour traffic.

## General Office Building

4

### Site characteristics

Facility: **Valley Forge I**  
Gross Floor Area (square feet): **120,470**  
Leasable Floor Area (square feet): **120,470**  
Occupied Floor Area (square feet): **74,691**  
Percent LFA Occupied: **62%**  
Site acreage: **20.6**  
Number of tenants: **15**  
Number of employees: **207**  
Year built: **1986**  
Number of buildings: **2**  
Number of driveways: **1**  
Number of parking spaces: **393**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Principal Arterial**  
County: **Chester**  
Date of count: **5/89**  
Ridesharing: **No**  
Transit: **Yes**  
Employees per 1000 sq. ft. Occupied FA: **2.77**

### Site summary

Gross Floor Area: >200  
**100-200**  
50-100  
<50  
Buildings Single  
**Multiple**  
Tenants Single  
**Multiple**  
Age of buildings: <2  
**2 to 5**  
>5  
Transit available? **Yes**  
No  
Ridesharing promoted? Yes  
**No**  
State **PA**  
**NJ**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	146	.71	1.21
	Out	10	.05	.08
	Total	156	.75	1.29
PM peak	In	14	.07	.12
	Out	120	.58	1.00
	Total	134	.65	1.11
Other peak*	In	42	.20	.35
	Out	83	.40	.69
	Total	125	.60	1.04

\*12-1 PM

Total weekday two-way trips	1,098	5.30	9.11
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### Trip rate summary

Per employee:  
Weekday: **5.30**  
Peak hour: **.75**  
Per 1000 sf GFA:  
Weekday: **9.11**  
Peak hour: **1.29**

### Comments:

Driveway is signalized at the adjacent roadway. In the one hour periods after the Other peak hour and before the PM peak hour, trip generation is equivalent to 60% or more of the adjacent peak hour traffic. Trip generation in time periods adjacent to the AM peak hour is less than 60% of trip generation during the AM peak hour.



## General Office Building

5

### Site characteristics

Facility: **King of Prussia II**  
Gross Floor Area (square feet): **97,500**  
Leasable Floor Area (square feet): **95,000**  
Occupied Floor Area (square feet): **82,650**  
Percent LFA Occupied: **87%**  
Site acreage: **3.21**  
Number of tenants: **14**  
Number of employees: **387**  
Year built: **1980**  
Number of buildings: **1**  
Number of driveways: **2**  
Number of parking spaces: **527**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Minor Arterial**  
County: **Montgomery**  
Date of count: **11/88**  
Ridesharing: **No**  
Transit: **Yes**  
Employees per 1000 sq. ft. Occupied FA: **4.68**

### Site summary

Gross Floor Area: > 200  
100-200  
50-100  
< 50

Buildings **Single**  
**Multiple**

Tenants **Single**  
**Multiple**

Age of buildings: < 2  
2 to 5  
> 5

Transit available? **Yes**  
**No**

Ridesharing promoted? **Yes**  
**No**

State **PA**  
**NJ**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	261	.67	2.68
	Out	36	.09	.37
	Total	297	.77	3.05
PM peak	In	32	.08	.33
	Out	239	.62	2.45
	Total	271	.70	2.78
Other peak*	In	167	.43	1.71
	Out	102	.26	1.05
	Total	269	.70	2.76

\*1-2 PM

Total weekday two-way trips	2,179	5.63	22.35
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### Trip rate summary

Per employee:

Weekday: **5.63**  
Peak hour: **.77**

Per 1000 sf GFA:

Weekday: **22.35**  
Peak hour: **3.05**

### Comments:

Trip generation in the one hour periods before the AM peak hour and the Other peak hour is equivalent to 60% or more of the adjacent peak hour traffic. Trip generation in the time periods adjacent to the PM peak hour does not represent 60% or more of PM peak hour traffic. One driveway is signalized.

## General Office Building

6

### Site characteristics

Facility: **Valley Forge II**  
 Gross Floor Area (square feet): **87,714**  
 Leasable Floor Area (square feet): **81,890**  
 Occupied Floor Area (square feet): **57,323**  
 Percent LFA Occupied: **70%**  
 Site acreage: **10**  
 Number of tenants: **2**  
 Number of employees: **182**  
 Year built: **1986**  
 Number of buildings: **1**  
 Number of driveways: **1**  
 Number of parking spaces: **450**  
 Average peak hour vehicle occupancy: **N/A**  
 Adjacent roadway type: **Collector**  
 County: **Chester**  
 Date of count: **5/89**  
 Ridesharing: **No**  
 Transit: **Yes**  
 Employees per 1000 sq. ft. Occupied FA: **3.17**

### Site summary

Gross Floor Area: **>200**  
**100-200**  
**50-100**  
**<50**

Buildings **Single**  
**Multiple**

Tenants **Single**  
**Multiple**

Age of buildings: **<2**  
**2 to 5**  
**>5**

Transit available? **Yes**  
**No**

Ridesharing promoted? **Yes**  
**No**

State **PA**  
**NJ**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	83	.46	.95
	Out	10	.05	.11
	Total	93	.51	1.06
PM peak	In	7	.04	.08
	Out	69	.38	.79
	Total	76	.42	.87
Other peak*	In	36	.20	.41
	Out	20	.11	.23
	Total	56	.31	.64

### Trip rate summary

Per employee:

Weekday: **3.07**  
 Peak hour: **.51**

Per 1000 sf GFA:

Weekday: **6.36**  
 Peak hour: **1.06**

### \*1-2 PM

Total weekday two-way trips	<b>558</b>	<b>3.07</b>	<b>6.36</b>
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### Comments:

Trip generation is equivalent to 60% or more of the adjacent peak hour traffic only in the one hour period prior to the Other peak hour. Trip generation in the periods adjacent to the AM and PM peak hour periods is less than 60% of trip generation in the corresponding peak hours.

# General Office Building

7

## Site characteristics

Facility: **Plymouth Meeting I**  
 Gross Floor Area (square feet): **87,557**  
 Leasable Floor Area (square feet): **83,000**  
 Occupied Floor Area (square feet): **80,510**  
 Percent LFA Occupied: **97%**  
 Site acreage: **4.4**  
 Number of tenants: **14**  
 Number of employees: **330**  
 Year built: **1985**  
 Number of buildings: **1**  
 Number of driveways: **1**  
 Number of parking spaces: **287**  
 Average peak hour vehicle occupancy: **N/A**  
 Adjacent roadway type: **Local**  
 County: **Montgomery**  
 Date of count: **6/89**  
 Ridesharing: **No**  
 Transit: **Yes**  
 Employees per 1000 sq. ft. Occupied FA: **4.10**

## Site summary

Gross Floor Area: >200  
 100-200  
 50-100  
 <50

Buildings **Single**  
**Multiple**

Tenants **Single**  
**Multiple**

Age of buildings: <2  
 2 to 5  
 >5

Transit available? **Yes**  
**No**

Ridesharing promoted? **Yes**  
**No**

State **PA**  
**NJ**

## Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	147	.45	1.68
	Out	15	.05	.17
	Total	162	.49	1.85
PM peak	In	14	.04	.16
	Out	124	.38	1.42
	Total	138	.42	1.58
Other peak*	In	48	.15	.55
	Out	77	.23	.88
	Total	125	.38	1.43

## Trip rate summary

Per employee:

Weekday: **3.22**  
 Peak hour: **.49**

Per 1000 sf GFA:

Weekday: **12.12**  
 Peak hour: **1.85**

## \*12-1 PM

Total weekday two-way trips	1,061	3.22	12.12
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## Comments:

Trip generation in the one hour periods after the Other peak hour and before the PM peak hour is equivalent to 60% or more of the adjacent peak hour traffic. Trip generation in the time periods before and after the AM peak hour is less than 60% of trip generation during the AM peak hour.

## General Office Building

8

### Site characteristics

Facility: **Valley Forge III**  
Gross Floor Area (square feet): **78,687**  
Leasable Floor Area (square feet): **71,990**  
Occupied Floor Area (square feet): **71,990**  
Percent LFA Occupied: **100%**  
Site acreage: **4.0**  
Number of tenants: **6**  
Number of employees: **250**  
Year built: **1985**  
Number of buildings: **1**  
Number of driveways: **1**  
Number of parking spaces: **317**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Local**  
County: **Chester**  
Date of count: **6/89**  
Ridesharing: **No**  
Transit: **No**  
Employees per 1000 sq. ft. Occupied FA: **3.47**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	91	.36	1.16
	Out	13	.05	.17
	Total	104	.42	1.32
PM peak	In	17	.07	.22
	Out	87	.35	1.11
	Total	104	.42	1.32
Other peak*	In	44	.18	.56
	Out	50	.20	.64
	Total	94	.38	1.19

#### \*12-1 PM

Total weekday two-way trips	786	3.14	9.99
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### Site summary

Gross Floor Area:	>200 100-200 50-100 <50
Buildings	Single Multiple
Tenants	Single Multiple
Age of buildings:	<2 2 to 5 >5
Transit available?	Yes No
Ridesharing promoted?	Yes No
State	PA NJ

### Trip rate summary

Per employee:	
Weekday:	3.14
Peak hour:	.42
Per 1000 sf GFA:	
Weekday:	9.99
Peak hour:	1.32

### Comments:

Trip generation in the one hour periods before the AM and Other peak hours and after the Other peak hour are equivalent to 60% or more of trip generation in the adjacent peak hour. In the time periods adjacent to the PM peak hour, trip generation is less than 60% of the PM peak hour traffic.

## Site summary

Facility: **Radnor I**  
 Gross Floor Area (square feet): **69,500**  
 Leasable Floor Area (square feet): **65,537**  
 Occupied Floor Area (square feet): **65,537**  
 Percent LFA Occupied: **100%**  
 Site acreage: **6.6**  
 Number of tenants: **1**  
 Number of employees: **260**  
 Year built: **1980**  
 Number of buildings: **1**  
 Number of driveways: **1**  
 Number of parking spaces: **226**  
 Average peak hour vehicle occupancy: **N/A**  
 Adjacent roadway type: **Collector**  
 County: **Delaware**  
 Date of count: **10/88**  
 Ridesharing: **No**  
 Transit: **Yes**  
 Employees per 1000 sq. ft. Occupied FA: **3.97**

Gross Floor Area:           >200  
                                      100-200  
                                      **50-100**  
                                      <50

Buildings **Single**  
Multiple

Tenants	Single Multiple
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
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42	42
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68	68
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79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Age of buildings:                   <2  
  2 to 5  
  >5

Transit available? **Yes**  
**No**

Ridesharing promoted?      Yes  
    No

State	PA NJ
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### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	151	.58	2.17
	Out	15	.06	.22
	Total	166	.64	2.39
PM peak	In	18	.07	.26
	Out	157	.60	2.26
	Total	175	.67	2.52
Other peak*	In	68	.26	.98
	Out	63	.24	.91
	Total	131	.50	1.88

### Trip rate summary

Per employee:

Weekday: 3.55  
Peak hour: .67

Per 1000 sf GFA:

Weekday: 13.29  
Peak hour: 2.52

**\*12-1 PM**

Total weekday two-way trips	924	3.55	13.29
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**Comments:**

No time periods adjacent to the peak hours are equivalent to 60% or more of the adjacent peak hour traffic. Site is closely situated to a regional rail station which affords frequent and convenient service.

## General Office Building

10

### Site characteristics

Facility: **Valley Forge IV**  
Gross Floor Area (square feet): **66,606**  
Leasable Floor Area (square feet): **64,270**  
Occupied Floor Area (square feet): **63,627**  
Percent LFA Occupied: **99%**  
Site acreage: **9.182**  
Number of tenants: **10**  
Number of employees: **200**  
Year built: **1985**  
Number of buildings: **1**  
Number of driveways: **1**  
Number of parking spaces: **195**  
Average peak hour vehicle occupancy: **N/A**  
Adjacent roadway type: **Collector**  
County: **Chester**  
Date of count: **4/89**  
Ridesharing: **No**  
Transit: **Yes**  
Employees per 1000 sq. ft. Occupied FA: **3.14**

### Site summary

Gross Floor Area: >200  
100-200  
50-100  
<50  
Buildings **Single**  
**Multiple**  
Tenants **Single**  
**Multiple**  
Age of buildings: <2  
**2 to 5**  
>5  
Transit available? **Yes**  
**No**  
Ridesharing promoted? **Yes**  
**No**  
State **PA**  
**NJ**

### Trip generation and rates

Period		Trips	/employee	/1000 sf GFA
AM peak	In	239	1.20	3.59
	Out	15	.08	.23
	Total	254	1.27	3.81
PM peak	In	18	.09	.27
	Out	122	.61	1.83
	Total	140	.70	2.10
Other peak*	In	90	.45	1.35
	Out	97	.49	1.46
	Total	187	.94	2.81

### Trip rate summary

Per employee:  
Weekday: **7.28**  
Peak hour: **1.27**  
Per 1000 sf GFA:  
Weekday: **21.85**  
Peak hour: **3.81**

### \*12-1 PM

Total weekday two-way trips	1,456	7.28	21.85
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### Comments:

Trip generation in the one hour periods after the Other peak hour and before the PM peak hour is equivalent to 60% or more of the adjacent peak hour traffic. In the time periods adjacent to the AM peak hour, trip generation does not equal or exceed 60% of the AM peak hour traffic.