Relation Between Number of Accidents and Traffic Volume at Divided-Highway Intersections

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THIS report presents a graphic expression of the accident-volume relation at divided highway intersections. The expression was produced by averaging the past accident experience at 150 intersections. A total of 1,811 accidents was tabulated in developing the chart.

Uses of the chart include: (1) estimating the probable number of accidents which will occur in a future period and (2) correcting for the influence of volume differences when comparing one intersection accident rate with another.

Interpretation of the expression led to the following conclusions:

1. Accident rates at intersections are much more sensitive to changes in crossroad (minor road) volume than to changes in divided highway (major road) volume.
2. No direct relation exists between intersection accident rates and the sum of the two entering volumes. The existence of such a relation is implied when intersections are compared on the basis of "accidents per million vehicles."
3. Low-crossroad-volume intersections have higher accident rates per crossroad vehicle than do higher-crossroad-volume intersections. This is evidence that the concentration of cross traffic, through the closing of low-volume crossroads and the provision of frontage roads, is an effective means of reducing the number of intersection accidents.

● IN recent years, the California Division of Highways has built a considerable mileage of expressways and, concurrently, a lesser mileage of full freeways. The major difference between these two types of highway is that a freeway can have no intersections at grade while an expressway may have many such intersections. The initial costs of the two types can be estimated fairly accurately, the cost per mile for a freeway being greater because of the structures and additional right-of-way necessary to meet the freeway definition. With a fixed amount of money to spend, the choice, then, is between the construction of a certain number of miles of new expressways or, with the same money, fewer miles of freeways. In all but the most-congested urban areas, the greater mileage of expressways is generally favored.

But what is the cost of the expressway grade intersection after the facility is in use? This cost cannot be so readily estimated, because congestion, delay, and accidents are the items to be considered. It was this question which led to the initiation of the present study of accidents at intersections on divided highways. One study alone will not answer the question completely, but the more light that can be cast on the problem, the better equipped we will be to consider it.

The primary aim of this study is to find the average relation between traffic volume and number of accidents at expressway intersections. With such a guide, the probable number of intersection accidents in a given period can be estimated prior to the construction of a new facility and can be considered in deciding whether or not to construct grade-separation structures at the intersections.

An average relation between traffic volume and number of accidents is useful also in making comparative accident studies of intersections. The relation provides a means of correcting for the influence of volume differences when comparing one intersection accident rate with another. In the case of before-and-after studies, for instance, the after period is often at a higher volume than the before period, and the effect of the increased volume on accidents should be considered when comparing the rates for the two periods.

COLLECTION OF DATA

On 180 mi. of expressway sections of State Routes 4, 6, and 7 (US 99 and US 40) between Bakersfield and Sacramento and between Vallejo and Sacramento, 171 intersections were arbitrarily selected for study. The general location of these intersections is shown in Figure 1. This

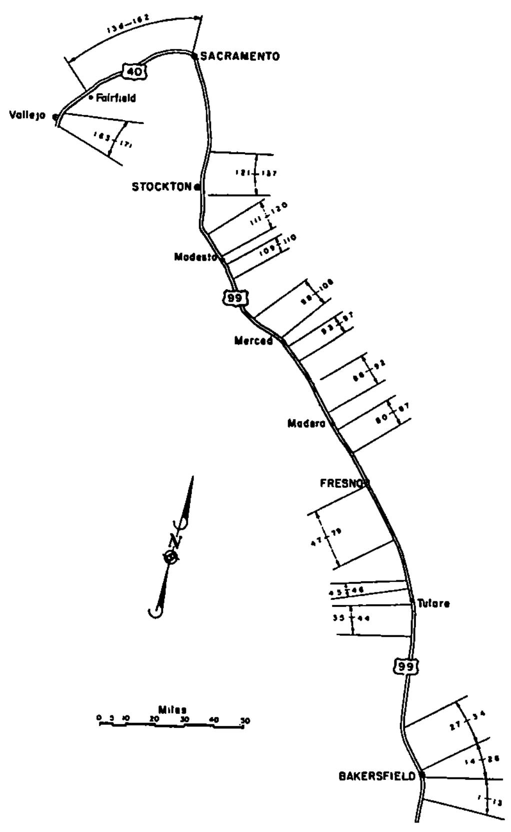

Figure 1. Location of intersections by numbers (see appendix for list).

sample included a wide variety of design types, a few of which were signalized, ranging from simple, uncurbed cross-overs to completely channelized intersections. At all of the unsignalized intersections, the divided highway was the preference road. All cross traffic was controlled by stop signs, except that which entered by way of separate turning lanes. Most of these intersections are located on level tangent sections of rural highway, and there are no extreme differences in weather conditions within the sample area.

A complete investigation was made of the physical characteristics of each intersection. First, through reference to plans available at the headquarters office, scale sketches were made which provided design information such as median width, type of intersection (T or cross), skew angle, and the existence of median speed-change lanes, channelizing islands, and curbs. The sketches were then taken into the field where the layouts were verified or corrected wherever any differences were found. Illumination, signalization, and speed zoning information was also verified. Additional data collected in the field included the existence of roadside business and sight restrictions, and notes regarding any unusual conditions observed. At least one and often several photographs were taken of each intersection.

Estimates of the average daily traffic volumes on the divided highway and the crossroad were obtained for each intersection. Annual traffic counts could be used to obtain these estimates at a few of the intersections, but in most cases it was necessary to make special counts to obtain the crossroad volumes. Counting was done mechanically for a period of 24 hr. on week days only. These 24-hr. counts were then converted to ADT by use of appropriate factors obtained from regular monthly count stations in the vicinity. At certain locations along the divided highway between the regular annual count stations, additional counts of the mainline traffic were made. This was done because frequently the distances between the regular stations were too great for the determination of a mainline traffic-volume profile sufficiently accurate for the purpose of this study.

The ADT volumes obtained for use here were not annual averages but were averages for the periods during which accident histories were obtained. The volumes at the several intersections varied on the divided highway from 4,300 to 27,200 and on the cross roads from less than 100 to 7,700.

All reported accidents occurring at the intersections between the date of opening (but not before January 1, 1946) and January 1, 1951, were cataloged by type (left turn, broadside, overtake, etc.), time of occurrence (night or day), and severity (injury, including fatal, or property damage only). The accidents were listed for each intersection by year of occurrence and then summarized for the total period. California Highway Patrol reports were the source of accident data on rural state-highway sections and these were supplemented by accident summaries obtained from city police files for those sections lying within corporate limits. Accident reports covering roughly a quarter of a mile on the state highways in both directions from each of the intersections were scanned to pick up and include in the listings those accidents which were obviously intersection types, even though the point of impact had been outside the immediate intersection area.

The total number of accidents listed was 1,811, while the number at any one intersection ranged from 0 to 79.

ANALYSIS

As mentioned in the introduction, the primary aim of this study is to find the average relation between traffic volume and the number of accidents at expressway intersections. As a first step toward this end, it was necessary to define the variables: intersection volume and intersection accidents. Volume at intersections was defined as the average daily entering traffic. Assuming that total ADT on a two-directional road is equally divided by direction, entering traffic on either road at an intersection will equal the ADT if the road carries the same volume on both sides of the intersection; entering traffic will equal the average of the volumes on the two sides wherever they are different; and, for T-type intersections, entering traffic from the terminated road will equal half of the ADT on that road. Only simple cross and T-type intersections were included in this study.

Intersection accidents were defined as all those reported accidents, regardless of severity, which occurred at the intersection, or which occurred near the intersection and were obviously intersection types. The decision to lump all levels of severity came as a result of investigating the relative merits of using all or just injury accidents as the dependent variable. Approximately 60 percent of the accidents listed were of the noninjury type. Upon temporary removal of this accident type, no improvement in the central tendency of the remaining data was noted, so total accidents, bringing the advantage of larger numbers, was selected as the measure for the dependent variable.

The next step was the choice of a means by which the relation might best be expressed. A direct approach to the problem was possible on the assumption that the effect of volume on the number of accidents is sufficiently significant to appear in a large sample, even though many other variables may not be controlled. Support for this assumption was found when the effect of each variable was investigated independently. This investigation also showed that attempting to find the effect of volume by segregating the intersections into more nearly homogeneous groups only reduced the stability of the result, without altering it appreciably. The three variables considered, then, were volume on the divided highway, volume on the crossroad, and number of accidents per year. Rather than initially combining the two volumes by some arbitrary means to produce a single independent variable, such as the per-million-vehicles base commonly used, a more fundamental relation was sought by providing three dimensions for expression of the three variables.

DEVELOPMENT OF A SURFACE TO EXPRESS THE AVERAGE VOLUME-ACCIDENT RELATION

The three coordinates involved in this study are divided-highway volume in the X direction, crossroad volume in the Y direction, and number of accidents per year in the Z direction. In Figure 2, the surface developed is described in chart form, just as a portion of the surface of the earth is described by a contour map. The two traffic volumes are the plane coordinates, and accident frequencies are shown as elevations by the use of contour lines.

Development of the surface followed an inspection of the original sample of 171 intersections to determine whether or not benefits, such as a reduction in the extreme variations and increased homogenity, might be realized through small reductions in the size and scope of the sample.

This inspection proved fruitful and resulted in the removal of all intersections with less than 6 mo. of accident history (three), or a divided highway volume of less than 5,500 (two), and all signalized intersections (sixteen). As might be expected, the short accident histories were conducive to extreme variations in the annual rates. The low divided-highway distort the surface and make less evident the effect of volume. The removal of these 21 intersections reduced the sample size by only about 8 percent, but the upper limit on crossroad volume dropped from 7,700 to 3,100. This considerable reduction in scope was inevitable, since the original sample included so few intersections with crossroad vol-

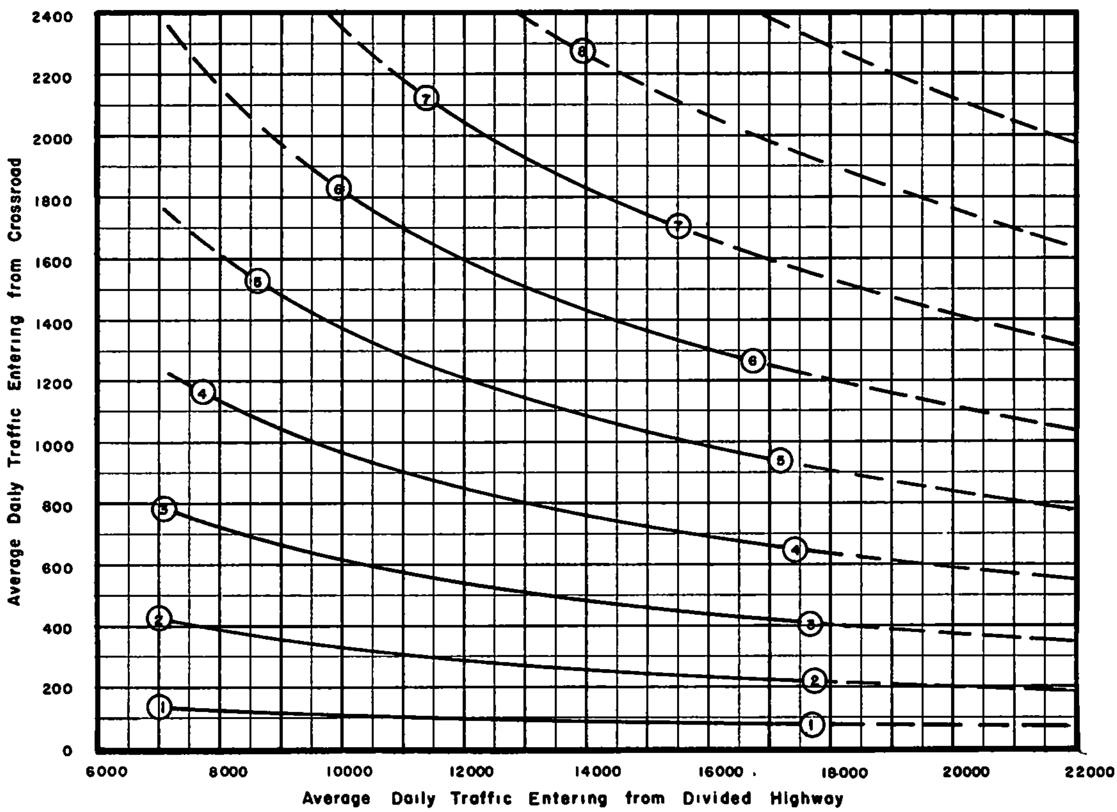

Figure 2. Average number of accidents per year related to volume at divided-highway intersections.

volumes represented a fringe condition which is unusual on expressways, and the small amount of experience obtained in this volume range was of little value. Almost all the signalized intersections were, of course, in the highest-crossroad-volume range, and thus they, too, in this case, represented a fringe condition in relation to the bulk of the sample, which is made up of lower-crossroad-volume intersections. The inclusion of intersections which would introduce an influential characteristic, such as signalization, into a limited part of the volume range covered by this surface could umes greater than 3,100. Further inspection revealed that the remaining physical characteristics, or secondary variables, were generally well distributed throughout both the divided-highway and the crossroad volume ranges.

Actual determination of the surface began with the plotting of the 150 remaining intersections, each at its respective volume combination. These were then grouped and an average volume combination and accident rate obtained for each group. Grouping was by similar volume combinations and followed the chance groupings existing within the sample wherever these were consistent with the effort to include at least four intersections in each group. A few groups in the volume ranges near the limits of the surface included less than four intersections, and the portions of the surface within these ranges are indicated by the dashed contour lines in Figure 2. The 150 intersections formed 24 groups with a range of from 2 to 19 intersections in each and an average number of about 7. The arithmetic mean number of accidents per year was computed for each group and the X and Y coordinates of the centroid of each, located graphically, determined the average volume combination for the group.

With the 150 single-intersection points replaced by 24 group-average points, the next step was the location and description of a regular surface which would best fit the average points. As mentioned earlier, contour lines were used as the means of description and the initial location of these lines was accomplished by interpolation between the mean accident rates at the various group-average points. Regular curves were then fitted, by freehand smoothing, to the initial irregular lines. The surface was also smoothed in a direction approximately normal to the contours by plotting cross sections at selected divided-highway volumes, smoothing these cross sections, and then adjusting the location of the contours accordingly. Twelve of the 24 groups lie within 0.2 contour of the computed surface, and the maximum deviation is 1.1, occurring once.

The shape of the contours developed in the preceding manner suggested that the accident rate might be a function of the product of the two volumes. It was decided to fit a curve to the 24 groups by the method of least squares, and in order to provide some freedom, the exponents of the two volumes were allowed to determine themselves. The result of this fitting was Figure 2, which can be written:

$$N = 0.000783\, V_d^{0.455}\, V_c^{0.633},$$

where N is number of accidents per year, V_d is ADT entering from divided highway, and V_c is ADT entering from the crossroad.

An idea of the fit can be obtained from the following:

	24 Groups	150 Intersections
Net deviation (algebraic)	7.6	-1.9
Sum of squares of deviations	6.38	319.7
Deviation within which ⅔ of the points lie	0.5	1.0

INTERPRETATIONS AND USES OF THE ACCIDENT-VOLUME EXPRESSION

The chart developed in this study is simply a graphic working expression of the accident-volume relation at divided-highway intersections, as revealed by a sample of past experience. As such, exact mathematical limits indicating reliability cannot be assigned to it. However, the approximate spread of the limits for a given degree of reliability was evident in the scatter of the points — the individual-intersection points being widely scattered, but the group-average points showing considerable stability.

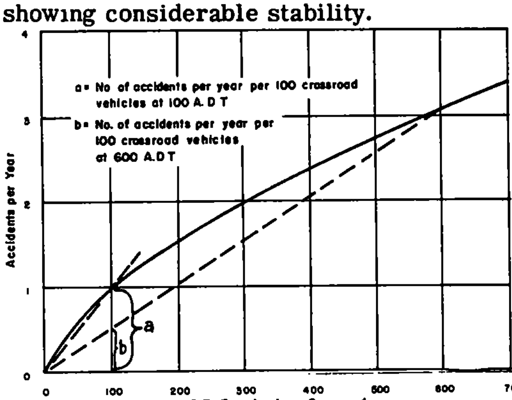

Figure 3. Partial cross section of accident-volume surface at 11,000 A.D.T. on divided highway

The wide scatter of individual points showed that an estimate of the number of accidents at any one intersection for 1 yr. can be made only within wide limits. Chance is largely responsible for the wide limits in such a case, much as it is responsible for our inability to predict heads correctly more than 50 percent of the time on a single toss of a coin, even though we can quite accurately predict the number of heads which will occur in many tosses. It follows, then, that when a relatively large number of intersections, or years, or both, are to be considered, the accident estimate can be made within much narrower limits. These narrower limits would apply, for instance, in estimating the aggregate number of intersection accidents per year which could be expected on a new facility of major project proportions where many intersections are involved. An even better estimate could be made, of course, if it were for a period of several years.

TABLE 1

Construction Project	No. of Inter-sections Involved	Accident History Available to Establish Actual Rate (Years)	Number of Accidents Per Year	
			Actual	From Chart
A	11	1 4	37.1	35 3
B	13	2.2	15 8	22 9
C	9	1.3	20 4	21.3
D	5	3 3	15.3	19.1
E	7	5.0	17.2	20.1
F	5	2 9	24 6	17 9
G	9	1.5	18 0	15.2
H	5	1.2	9.1	13.0
I	3	3.8	13.8	14 0
J	8	3.1	10.4	10 4
K	5	5 0	9 6	8 5
L	6	5 0	7 0	7 5
M	5	1.2	4.3	7 0
N	4	1.5	4.7	5.4
O	4	1.0	6.0	4.5
P	4	5 0	8.2	4.7

Table 1 is presented to suggest the limits within which such estimates might be made. The table lists the actual aggregate number of intersection accidents per year for groups of intersections from the study. These intersections have been grouped according to the construction project of which they were a part. Each actual number of accidents is compared with the corresponding number which would be obtained from the chart. The differences are actually deviations from the mean for project groups taken from the study sample, but it is probable that the number of accidents could be predicted for similar projects within comparable limits.

An actual case will serve as an example of the method of estimating the number of intersection accidents which will occur on a new facility. This case, presented as Table 2, involved 27 intersections along a proposed 18-mi. section of new expressway. The estimate was made for the 20-yr. period from 1954 to 1974. Traffic volumes for 1964, obtained by the application of appropriate expansion factors, were used as the average volumes for the period. The average accident rates for these volumes were read from the chart and then were multiplied by 20 to obtain the estimated number of accidents in 20 yr.

To be exact, the actual rates for each year, as the volume gradually increases, would need to be summed up. However, the error involved in using just one average volume is small and well within the probable error of other approxima-

TABLE 2

ESTIMATE OF NUMBER OF INTERSECTION ACCIDENTS ON PROPOSED EXPRESSWAY

Intersection Number	1964 ADT Entering Intersection: On Divided Highway	On Cross-road	Estimated Number of Accidents: Per Year	In 20 Years (1954-1974)
1	16,700	550	3.5	70
2	16,100	210	1 8	36
3	16,100	40	0.6	12
4	16,100	200	1.8	36
5	16,300	200	1.8	36
6	16,300	10	0 1	2
7	16,400	240	2.0	40
8	16,300	280	2.2	44
9	16,100	110	1 2	24
10	16,000	2,560	9 1	182
11	15,800	2,860	9.6	192
12	15,700	170	1.5	30
13	15,600	1,100	5.3	106
14	15,000	30	0.3	6
15	15,000	450	3 0	60
16	15,000	170	1.5	30
17	15,000	740	4 0	80
18	14,700	30	0.5	10
19	14,800	220	1.9	38
20	16,400	2,660	9.3	186
21	16,400	1,480	6 7	134
22	16,700	1,780	7.4	148
23	15,800	500	3.2	64
24	16,400	190	1 8	36
25	16,000	460	3 1	62
26	16,100	340	2.5	50
27	16,100	20	0.2	4
		TOTAL	85 9	1,718

tions made, such as the future growth of traffic.

Interpretations and uses of the chart which have to do with the relative effect of volume rather than the actual estimating of accident rates are less affected by the limitations of the sample. The orientation of the contours, for instance, shows that in these volume ranges the accident rate is much more sensitive to changes in crossroad volume than it is to changes in divided-highway volume. This observation indicates that no direct relation exists between intersection accident rates and the sum of the two entering volumes. As an example, Intersection A might have entering volumes of 13,000 and 1,300, while Intersection B has 14,000 and 300. The sum of the volumes is the same at both but, as read from the chart,

Figure 4. Typical intersection types: (A) Intersection 105, uncurbed crossover; (B) Intersection 146, curbed crossover; (C) Intersection 159, curbed and channelized; (D) Intersection 65, an older design; (E) Intersection 160, a recent design type; (F) Intersection 112, a very-low-volume T intersection; (G) Intersection 75, crossroad count is 2,500 vehicles per day; and (H) Intersection 116, old traveled way used as frontage road.

Intersection A would probably have 4.8 accidents per year, while Intersection B would have only 2.0 accidents per year.

As mentioned in the introduction, the average relation provides a means of correcting for the influence of volume differences when comparing one intersection accident rate with another. The comparison might be between different divided-highway intersection or it may be a comparison of rates at the same intersection for different periods. An example of the second case is the before-and-after intersection study in which the volume is higher during the after period. Such a study might produce the data below:

	Before	After
Divided-highway volume	12,000	13,000
Crossroad volume	900	1,400
Actual accident rate (Acc/Yr.)	8	9

The accident rate for the before period should be adjusted to the after volume, so a more equitable comparison can be made on the basis of constant traffic volume. The factor for making this adjustment is obtained from the chart as follows:

Factor =

$$\frac{\text{Ave. Acc. Rate for After Volume}}{\text{Ave. Acc. Rate for Before Volume}} = \frac{5.7}{4.1} = 1.4$$

This factor is then applied to the before rate:

1.4 x 8 = 11 Acc/Yr.

This amount, 11, is the probable number of accidents per year which would have occurred under the before condition at the after traffic volume. It is the number which should be compared with the nine accidents that actually did occur in order to measure the amount of improvement.

Looking at the chart once more, it can be seen that the one-accident-per-year contour lies much closer to the zero-accident-per-year contour than it does to the next higher contour. (By the definition of an intersection accident, the zero-accident-per-year contour must very nearly coincide with the zero-crossroad-traffic line.). Figure 3, part of a typical cross section of the surface taken at a divided-highway volume of 11,000 brings out the meaning of this observation. It shows that the average number of accidents per crossroad vehicle is reduced as the volume on the crossroad increases. It follows, then, that the concentration of cross traffic, through the closing of low-volume crossroads and the provision of frontage roads, is an effective means of reducing the number of accidents on divided highways.

For example, assume that a section of divided highway carrying 11,000 ADT intersects six county roads, each with an entering volume of 100 vehicles per day. Reference to the chart, or to Figure 3, shows that if a separate crossing is provided for each road, probably there will be an average of one accident per year at each intersection, or a total of six per year for the daily volume of 600 crossing vehicles. On the other hand, if frontage roads serving a single crossing are provided, the same volume probably will be involved in about three accidents per year.

While concentration is beneficial at low-volume crossroads, evidence was noted during the study that cross-road volumes above the limit of the chart again produce high accident rates per cross-road vehicle. This evidence, plus the fact that these volumes create congestion, gives added support to the belief that the only real solution to the traffic problem at high-volume crossroads is grade separation.

Appendix

List of the 150 intersections used to develop the accident-volume expression.

Intersection Number	Entering ADT Divided Highway	Entering ADT Crossroad	Accidents Per Year	Length of Accident Period (Years)
1	13,100	100	2.4	0.8
2	13,600	100	0.7	1.4
3	13,900	800	6.3	1.4
4	14,200	600	1.4	1.4
5	14,300	300	1.4	1.4
6	14,400	300	2.8	1.4
7	14,500	400	4.2	1.4
8	14,800	300	1.4	1.4
10	14,400	200	4.9	1.4
11	15,900	800	1.4	1.4
12	17,600	1,300	9.1	1.4
13	19,100	900	3.5	1.4
15	21,900	400	3.2	3.8
16	23,100	900	4.7	3.8
17	24,200	800	5.9	3.8
21	15,700	1,800	6.7	1.5
24	19,200	500	3.5	0.6
26	15,600	1,200	1.7	0.6
27	14,300	1,000	3.9	2.1
28	14,400	200	0	2.1
29	13,200	700	0.6	5.0
30	13,900	800	4.4	3.4
31	12,600	400	1.2	5.0
32	10,600	2,200	10.4	5.0
33	9,800	300	2.7	3.3
34	9,700	200	1.2	3.3
35	9,400	200	1.3	1.5
36	9,200	700	3.3	1.5
38	9,700	400	4.7	1.5
39	10,400	300	0.7	1.5
40	11,100	100	0	1.5
41	11,200	100	2.7	1.5
42	11,400	100	0	1.5
43	11,600	400	3.3	1.5
44	11,800	100	2.0	1.5
45	9,300	100	0.9	1.1
46	9,200	200	1.9	1.1
47	9,700	100	0.5	2.2
48	9,300	1,100	2.8	2.2
50	9,600	400	1.4	2.2
51	9,900	500	2.3	2.2
52	10,200	500	2.8	2.2
53	10,200	100	0.9	2.2
54	10,400	100	0.5	2.2
55	10,400	100	0.9	2.2
56	10,700	100	0	2.2
57	10,800	700	2.3	2.2
58	10,900	100	0.5	2.2

List of 150 intersections (continued)

Intersection Number	Entering ADT Divided Highway	Entering ADT Crossroad	Accidents Per Year	Length of Accident Period (Years)
59	11,000	100	0	2.2
60	11,000	100	0.9	2.2
61	10,000	300	0.2	5.0
62	10,000	600	2.8	5.0
63	10,400	400	2.8	5.0
64	11,100	500	1.4	5.0
65	11,700	900	2.0	5.0
66	12,600	900	7.0	5.0
67	13,000	200	1.0	5.0
68	13,000	300	2.1	3.7
69	13,000	2,000	21.3	0.8*
70	14,400	1,000	6.8	2.9
71	14,800	500	2.1	2.9
72	14,900	100	0.7	2.9
73	16,100	400	4.1	2.9
74	16,200	1,400	11.0	2.9
75	15,100	2,500	19.8	4.0
76	15,100	500	2.8	4.0
77	15,200	1,600	6.0	4.0
78	15,200	1,100	5.0	2.4
79	15,200	2,600	7.9	2.4
80	11,600	300	0.7	1.5
81	11,300	100	2.0	1.5
82	11,100	100	1.3	1.5
83	10,700	200	0.7	1.5
84	9,800	100	0.8	5.0
85	9,700	200	2.6	5.0
86	9,400	100	0.6	5.0
87	9,400	200	4.2	5.0
88	11,300	100	0	1.0
89	11,100	100	1.0	1.0
90	10,900	100	0	1.0
91	10,800	200	4.0	1.0
92	6,900	200	2.2	5.0
93	7,500	100	1.8	5.0
94	7,800	300	1.4	5.0
95	7,900	600	1.8	5.0
96	8,500	400	2.4	5.0
97	9,700	2,100	3.8	4.0
98	12,200	200	2.0	3.1
99	11,900	300	3.3	3.1
100	11,700	100	1.6	3.1
101	11,500	300	2.0	3.1
102	10,400	900	5.5	3.1
103	9,400	200	1.7	1.2
104	9,400	200	1.7	1.2
105	9,400	100	0	1.2
106	9,300	100	0.9	1.2
107	9,100	400	0	1.2
109	14,400	400	1.8	5.0
110	16,200	2,700	9.4	5.0

*Period before signals were installed.

List of 150 intersections (continued)

Intersection Number	Entering ADT Divided Highway	Entering ADT Crossroad	Accidents Per Year	Length of Accident Period (Years)
111	11,400	500	3.6	5.0
112	10,500	100	0.6	5.0
113	10,200	100	1.2	5.0
114	9,500	100	0.2	5.0
115	8,800	300	1.4	5.0
116	9,900	1,300	3.0	3.3
117	9,700	400	2.4	3.3
118	9,300	1,100	4.2	3.3
119	8,400	1,300	3.6	3.3
120	8,200	800	2.1	3.3
125	10,300	200	1.0	3.1
126	10,100	100	1.3	3.1
127	10,200	300	0.6	3.1
128	10,000	300	0.7	3.1
129	9,500	700	7.4	3.1
130	9,300	100	1.0	3.1
131	9,400	200	3.9	3.1
132	9,400	100	1.3	3.1
133	9,400	300	1.9	3.1
134	9,500	200	2.6	3.1
135	9,500	400	4.9	3.1
136	9,600	100	2.6	3.1
137	9,500	1,200	9.6	3.3
138	14,500	1,200	8.8	5.0
139	13,600	900	2.6	5.0
140	8,500	200	0.8	5.0
141	8,400	300	1.0	5.0
142	8,400	200	0.4	5.0
143	8,900	100	0.6	4.7
144	9,300	3,100	6.0	4.7
145	6,300	400	0.9	4.7
146	6,800	200	0.4	4.7
147	7,800	1,300	3.5	4.3
148	9,400	1,100	3.0	3.1
149	9,000	100	0.9	3.5
150	9,000	100	0	3.5
151	9,000	100	0.6	3.5
152	9,000	600	3.7	3.5
153	9,000	300	2.3	3.5
154	9,500	100	1.6	3.8
155	10,300	500	3.3	3.3
156	10,600	700	0.3	3.5
157	11,300	1,500	4.0	1.3
158	11,900	100	1.6	1.3
159	11,700	600	0.9	1.2
160	10,900	200	0	1.2
161	10,700	300	2.6	1.2
163	10,500	300	4.2	1.4
169	13,900	400	2.8	1.4
170	13,700	300	2.1	1.4
171	13,000	1,600	6.3	1.4