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Analysis of Mid-Block Pedestrian Crashes for the Las Vegas Urbanized Area 1995-1997

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16. Abstract

The study examined 774 mid-block pedestrian crashes reported in the NDOT crash data base that occurred in Las Vegas during 1995, 1996, and 1997 for the purpose of identifying mid-block crash patterns, characteristics of the pedestrians involved in the crashes, roadway segments having high concentrations of crashes, characteristics of pedestrian behaviors at those segments, and the development of crash rates. The NDOT crash data were geo-referenced , and GIS and cluster analysis methods were utilized to identify the areas of high concentrations. The relationship of crashes to bus stops and marked mid-block crass walks was examined. Field observations, including pedestrian surveys, were made at th4e areas of highest concentration. The study revealed that GIS in combination with cluster analysis is a powerful tool for identifying areas of high concentration. Though the number of crashes at individual sites was too small, and the number of potential independent variables too great to develop statistically based models, results show that it is feasible to develop crash rates based on both AADT and the number of mid-block crossings.

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ANALYSIS OF MID-BLOCK PEDESTRIAN CRASHES FOR THE LAS VEGAS URBANIZED AREA, 1995-1997

INTRODUCTION

A growing concern of traffic safety engineers in the Las Vegas metropolitan area is the number of vehicular crashes involving pedestrians at mid-block locations. The following report is an analysis of 1995 through 1997 Nevada Department of Transportation (NDOT) crash reports for the Las Vegas urbanized area. The definition of Mid-Block Pedestrian Crashes (MBPC's) used in this study is based on specific NDOT Crash Database attributes and their codes. The basic selection criteria utilized codes from the Pedestrian Action attribute. Codes used for the query were:

5 – crossing – not an intersection
6 – coming from behind parked cars
19 – ran into roadway

Appendix A further explains the NDOT database and filtering process used to prepare the data for this report. Results of the analyses reveal several highly localized relationships as well as a number of overall associations.

The years 1995-1997 were chosen for analysis to study recent occurrences, and to ensure a sufficient sample size to test specific hypotheses and identify corridors or locations with a high number of incidences of crashes. The specific study objectives and tasks included several spatial analyses to explore relationships among the following characteristics of the crashes:

A. General crash characteristics

1. Distribution of distances from the geo-referenced location of a crash to the nearest intersection.
2. Age and sex of the pedestrian.
3. Time of day, day of week, month of year.
4. Light condition, specifically daylight vs. darkness.
5. Alcohol involvement.

B. Identification of specific corridors and/or locations with high incidences for further detailed analyses.

C. Relationships to bus stop locations, and transfer points.

D. Relationship to existing marked mid-block crosswalks.

E. Relationships to other site roadway characteristics, including land use, demographics, and vehicular volumes.

PROJECT STUDY AREA AND CRASH DATABASE

The crash database provided by the Nevada Department of Transportation was filtered by extracting those records that met a set of specific conditions to permit both meaningful statistical analysis and provide database integrity with the other datasets being used. The initial filtering was based on extracting all records for Clark County, Nevada in the three-year period 1995 through 1997. Because of the low total numbers of MBPC's in any one year at any one location, the identification of any patterns of concentration require sampling over time. A three-year time frame of recent crashes was used. The rapid growth and development in the Las Vegas area as well as changes occurring to the physical characteristics and features of the highway network and growth of travel volumes requires comparison of time series data under similar structural and operational conditions.

The crash reports were geocoded against the Clark County street centerline file using the ESRI ARC/INFO software. The result was a GIS database of geo-referenced pedestrian crashes. A number of records were rejected from further analysis during this filtering process. These were largely records that could not be geocoded for a variety of routine reasons, usually because of ambiguous, incomplete, or otherwise mis-coded data. A number of records were also re-coded where the distances were reported as less than one foot from an intersection.[1] The result was a set of 774 useable pedestrian crash report point locations, representing 794 pedestrians.[2] The general spatial distribution of these crashes is presented in the accompanying map titled Distribution of Mid-Block Pedestrian Crashes. This map depicts all crash point locations used in the study.

Demographic Analysis. Demographic analysis of the MBPC's is based on attribute information reported in the NDOT database. As with any large database of this type, there may not be useable data in every field for each individual incident. Thus, at first glance, some of the totals presented in the tables that follow may not "appear to add up." This is strictly a statistical anomaly common in demographic analysis. For example, in the sex field of the database, 10 individuals were coded as "unknown" or had missing data. Therefore, the tables and statistics presented below exclude these individuals from the sex totals and resultant percentages, but do utilize those 10 records when assessing the totals of another independent field. For example, the total number of MBPC's occurring in daylight hours is completely independent of individual sex, thus all viable records are used, including the 10 where sex was not reported as male or female. However, when examining the sex cohort groups, these 10 records are not used.

[1] NDOT codes distances from an intersection as either feet or tenths of a mile. The field uses an implied decimal and a second field to indicate which system is used. In cases where the coded distance was less than one foot and the record was not intended to be in tenths of a mile, it was assumed that the values should be shifted; i.e. multiplied by ten.

[2] The NDOT database records characteristics on age and sex for as many as two pedestrians involved in any one crash. The first pedestrian listed in each crash record is the primary pedestrian. In several of the analyses the total number of crash occurrences was used and in others the total number of pedestrians with useable characteristics was used. In a few rare instances the total number of pedestrians involved in any one crash may include more than two pedestrians, but there is no way to extract this information from the database codes.

Geometric Analysis. The Clark County street centerline database is developed and maintained by the Geographic Information Systems Management Office, a division of the Clark County Information Technology Department. It is designed as a general purpose dataset for use in locating addresses and general planning applications. Other agencies and departments, in particular the Regional Transportation Commission and local jurisdictional departments of public works rely on this dataset for numerous traffic and transportation planning efforts. In 1997, there were approximately 50,000 individual records in this database.

The spatial accuracy is very good in the central Las Vegas urbanized area. While specific parametric measurements do not exist, the planimetric accuracy is typically well within 10 feet of the center of the roadway. Actual completeness is unknown, but is generally thought to be very good. The County street centerline file represents the most accurate database available for purposes of this study.

There is an inherent underestimation of distance from the nearest intersection in the crash database that needs correction for display and certain analyses. The distances in the crash database are entered from law enforcement "accident reports." Officers in the field measure distance to an intersection as the distance from the closest curb. Intersections in the street centerline database are represented as nodes at the center of the crossing streets or as breaks in certain line segments (these latter "pseudo-nodes" are in the database for undocumented reasons, but do not generally affect the analysis). The specific geometry of each intersection (i.e. the width of the crossing streets and distances between curbs is not reported in the County's street centerline database). The points generated in the geocoding process utilize the reported attribute but measured from the node.

For example, if a pedestrian crash is documented in the database as occurring 200 feet from the intersection a natural underestimation of its location will occur in the automated geocoding process. If the intersection is 50 feet wide, the center is 25 feet from the curb. An uncorrected geocoding process would therefore place this point 175 feet from the curb. The distance underestimation does not present a problem for most analyses in this study because the analyses are based on comparisons of the reported attribute values, not coordinate locations determined by geocoding or other relative measures.

The underestimation of distance becomes an issue for this study only in large scale display and planimetric map measurement. Interim solutions for future applications may include adding a constant to each distance equal to one-half the average width of a typical intersection. For example, 25 feet would be added where two residential streets cross, and 50 to 75 feet where arterials intersect. If the roads are functionally classified and roadway widths known, this can be calibrated accordingly. Due to the unavailability of data this study did not utilize any surrogate measures for intersection width. Hence, the large scale maps display only relative locations and not absolute coordinates. This is not a serious problem since the symbol size for crashes on these maps is approximately 75 feet when converted to ground coordinates. Any error is thus less than the symbol size used on the map.

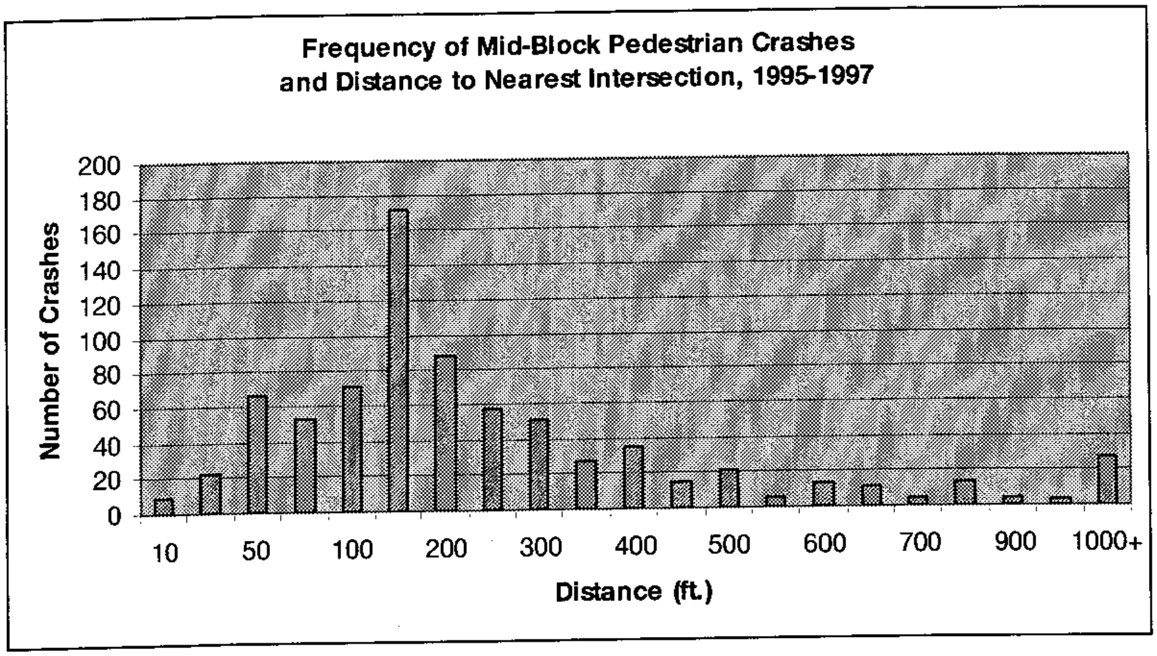
EXPLORATORY RELATIONSHIPS

General Crash Characteristics

Distance Relationships. The initial analysis of "crashes - not at an intersection" examines the distance of crashes from the nearest intersection as identified in the reported attributes. These are summarized in the frequency graph in Figure 1 and accompanying Table 1. The geocoded locations are based on distance from the cross streets or mileposts reported in the NDOT database. These are subsequently referred to as the primary intersections and the primary distance. The opposite end of the roadway link is referred to as the secondary intersection and secondary distance.

FIGURE 1. FREQUENCY DISTRIBUTION OF MID-BLOCK CRASHES AND DISTANCE

1.A. Frequency Graph



1.B. Cumulative Frequency Graph

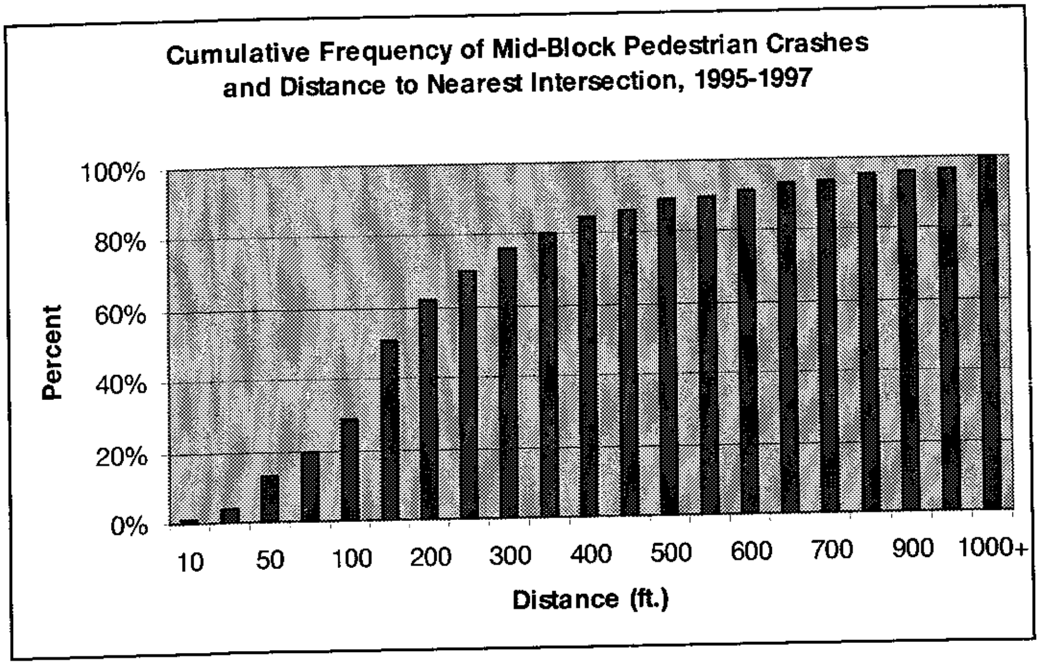


TABLE 1. CRASH DISTANCE TO NEAREST INTERSECTION

Distance to Nearest Intersection	
Mean	258.5
Standard Error	11.4
Median	150
Mode	150
Standard Deviation	316.6
Sample Variance	100210.7
Kurtosis	17.9
Skewness	3.7
Range	2638
Minimum	2
Maximum	2640
Sum	200087
Count	774

Analysis of the distance distribution for 774 mid-block pedestrian crash reports from 1995 through 1997 clearly shows one very prominent spike along a skewed distribution curve. The curve exhibits a high positive skewness, 3.7, typical of spatial phenomena. The distribution begins with a generally normal curve followed by a very long tail of increasingly large distances from the observation point. This is reinforced by the large standard deviation in the distance measures. The spike peaks at the 150-foot distance, and results in a very high kurtosis value of 17.9. Closer examination of this anomaly reveals that between 135 feet and 165 feet there were 136 crashes with 96 at exactly 150 feet. This represents approximately 18% of all mid-block pedestrian crashes. A discussion with the Las Vegas Metropolitan Police Department's Crime Analysis Division and Traffic Division officers indicated that this is a valid percentage.[3] The LVMPD attributes this to the high number of corner strip mall driveways occurring at this distance due to subdivision regulations regarding minimum distance from corners for entrances.

The spatial distribution of the "150-foot MBPC's" was examined using techniques available in the GIS software. The methodology involves buffering the arterials 200 feet and examining each individual crash inside the buffer zone, assigning it to the nearest arterial. Of the 136 crashes in the 150-foot interval, 98 (72%) lie within an arterial buffer. A plot of the individual locations of the 150-foot crashes shows a pattern along arterial corridors with a high number of commercial establishments, and the southeast part of the City of North Las Vegas. The number of crashes in the southeast portion of North Las Vegas is 38, approximately 28% of all 150-foot interval crashes. The patterned concentrations are listed in the table below.

TABLE 2. DISTRIBUTION OF MBPC'S IN THE 150-FOOT INTERVAL FROM THE NEAREST INTERSECTION

(MBPC – Mid-Block Pedestrian Crash)

Arterial Corridor *	Number of 135-165 Foot MBPC's
Las Vegas Blvd (North Las Vegas)	9
Lake Mead Blvd	9
Tropicana Avenue	9
Sahara Avenue	7
Charleston Blvd	6
Bonanza Road	6
Cheyenne Avenue	5
Flamingo Road	5
Maryland Pkwy	6
Southeast Part of North Las Vegas (approx. bounded by I-15, Cheyenne, Pecos, and Owens)	38

*Arterial corridors are major arterials buffered 200 feet to identify crashes on crossing streets. Crashes with 150 feet of a crossing arterial are assigned to both arterials in this table. The 98 total MBPC's inside of arterial buffers are unique occurrences.

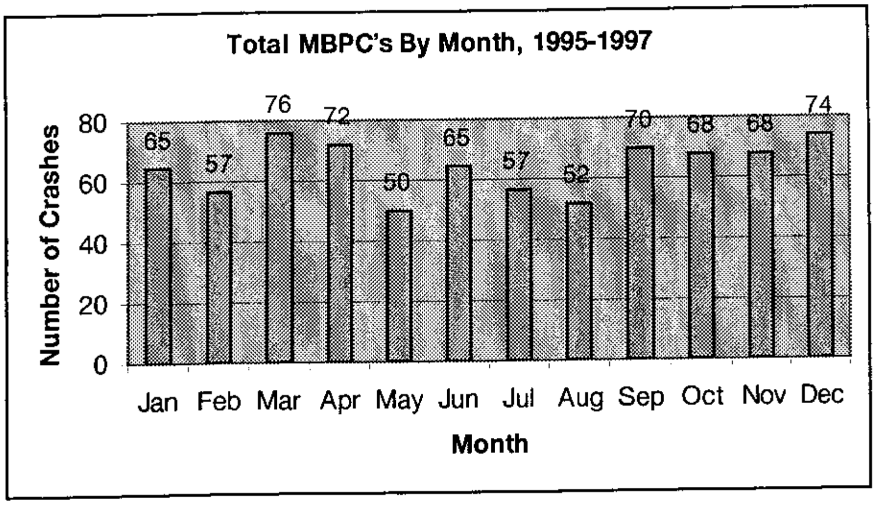
[3] Dan Helms, Crime Analysis Division, Las Vegas Metropolitan Police Department, meeting of February 3, 1999.

One can also observe a number of "mini-peaks" at each of the hundred-foot increments; i.e. 100, 200, 300, etc. These are ascribed to the natural tendency to round off or otherwise approximate distance measures. Except for the 150-foot peak, the distribution of distances is relatively steady for the first 400 feet, reaching 85% on the cumulative frequency. The number of crashes further than 400 feet from the intersection begins to taper off until 95% of all crashes are accounted for at the 800-foot distance.

Three structural limitations of the street centerline database preclude robust analysis of the distances to the far end of the block. First, the absence of data on intersection width hinders the development of reliable statistics. The underestimation of distances described earlier is a significant source of error. Perhaps future studies could examine surrogate measures and their statistical sensitivity. Second, the street centerline database uses a structural concept of what is generally referred to as a pseudo-node. By definition regular nodes are either 1) physical intersections where three or more road links intersect, or 2) the terminal end of an unconnected link. A pseudo-node is simply a split along a single link. Database designers can utilize these for a variety of purposes; for example, changes in road pavement condition presence of an alley, or simply data storage convenience. In the case of Clark County, there are no attributes indicating the reason for a particular pseudo-node. In the cases where the secondary distances are smaller (negative values), most were attributed to the pseudo-node geometry of the County's street centerline database. The third structural limitation is that the street centerline database is on a singular geometric plane. The database does not account for the non-planar nature of overpasses and underpasses; they appear as intersections that do not really exist for turning purposes. In the Las Vegas area, this is a very minor problem, particularly since most of these involved freeways and can be filtered using the roadway name. Other problems include locations of crashes on very long highway stretches at the edge of the urban area.

Time of Day, Day of Week, Month of Year. The exploration of time with respect to mid-block pedestrian crashes reveals some general trends. Chart 1, Temporal Distribution of Mid-Block Pedestrian Crashes, 1995-1997, clearly shows that the highest number of these crashes occurs in the early evening, particularly late in the week. The overall cumulative peak is on Fridays from 5:00 p.m. to 6:00 p.m.. The next largest concentrations are during the same hours throughout the week, starting as early as 3:00 p.m. on Thursdays. There is also another period of concentration, Friday and Saturday evenings from 8:00 p.m. to 9:00 p.m.

A slight statistical significance is seen in the number of crashes by month, with a range of 52 - 76. Most months have approximately 65 pedestrian crashes, with a standard deviation of 9 and a 95% confidence level of 5.5. The month of May had the fewest MBPC's, 50, while March had the most with 76. The summer months of July and August had three-year totals of 57 and 52 respectively. These are typically the hottest months, with a large number of local residents away on vacation and fewer people walking in the hot sun. December also had a high total with 74.



Light Condition. The data were analyzed for relationships to light condition. For each crash an attribute exists indicating whether the crash occurred during daylight hours or darkness. Approximately 57% of all MBPC's occur during daylight hours (Table 3). As previously noted, most of these happen in late afternoon and early evening.

Age and Sex Distributions. The table below summarizes several of the characteristics of the pedestrian victims. Approximately 68 percent of all pedestrians involved in mid-block crashes are male, a number far exceeding their proportion in the general population.[4] For all pedestrians, the mean age is 31 and the median age is 29 years. The standard deviation of the mean age is large, approximately 21 years. The mean age for both males and females is also in the early 30's, indicating there are no differences with respect to age versus sex. There may be a slight relationship between sex and light condition. For males, approximately 55% of all mid-block pedestrian crashes occur during daylight hours, whereas for females, this rises to 60%.

[4] The Nevada State Demographer's office estimated the 1997 population of Clark County at 1,192,200 with the proportion of males at 50.4% and females at 49.6%. The 1997 mean age in Clark County is estimated as 35.4 years. Source: Nevada State Data Center, Nevada State Library and Archives, online reports, Detailed Population Estimates by Age, Race, Sex, and Hispanic origin, plus projections for 1996-2002, http://www.clan.lib.nv.us/docs/NSLA/SDC/sdc.htm, February 1999.

TABLE 3. PEDESTRIAN AGE AND SEX CHARACTERISTICS

General Characteristics

	Primary Pedestrian			All Reported Pedestrians*	
Total Number	774			794	
Total with Valid Age	736			753	
Mean Age [Std Dev]	31	[21]		31	[21]
Median Age	29			29	
Count by Sex	M -	524	68%	531	68%
	F -	241	32%	253	32%
Mean Age by Sex	M -	31	[22]	31	[20]
[Std Dev]	F -	32	[20]	31	[22]

Detailed Characteristics All Reported Pedestrians

Lighting Condition	Total Number MBPC's		Total Persons		Male		Female	
Light	438	57%	448	56%	290	55%	153	60%
Dark	336	43%	346	44%	241	45%	100	40%

* All reported pedestrians include the 20 other pedestrians recorded in the NDOT database as Pedestrian Number Two. The database is not designed to contain information for more than two pedestrians per incident. Summary detailed statistics are presented for all pedestrians without classifying one as primary. Invalid records are not used in the summary statistics, so totals may not sum to the total record count. For example, when age is unknown it is reported as 99. While these individuals can be used in some analyses, it is inappropriate to use these records for computing age statistics. Similarly, total persons include the 5 individuals for which no sex was reported.

Alcohol Related. Crashes related to alcohol or drugs are a concern everywhere. The two tables below summarize these statistics for pedestrian crashes. The definition of alcohol related as used in this report includes any individual or driver that meets one of the following NDOT codes for a MBPC:

Pedestrian Sobriety

- (02) Had been drinking – under the influence
- (03) Had been drinking – not under the influence
- (04) Had been drinking – influence not known
- (06) Under influence of drugs

Driver Condition (vehicle 1 or 2)

- (01) Legally drunk – blood alcohol over 0.10
- (02) Under the influence of drugs
- (03) Ability impaired – blood alcohol 0.05 and over
- (06) Not known whether impaired – had been drinking impairment unknown
- (07) Blood alcohol test pending

Contributing Factor (vehicle 1 or 2)

- (01) D.U.I. Alcohol – citation issued
- (36) D.U.I. - drugs

Pedestrian sobriety is only reported for the primary pedestrian, whereas driver condition is reported for both drivers for whom detailed statistics are reported. Only eleven percent of the primary pedestrians had been drinking or under the influence. The average age of the males involved in alcohol related MBPC's is 41, somewhat higher than the average age of 32 for all MBPC's. The female average age for alcohol related MBPC's is also higher, at 35 years vs. 31 years for all MBPC's. The higher average ages are the result of eliminating children from the analysis.

TABLE 4. PEDESTRIAN AND DRIVER SOBRIETY

Pedestrian Sobriety*

Total Individuals	Pedestrians Drinking or Under the Influence Total		Male		Female	
794	156	20%	131	84%	25	16%

	Age and Drinking or Under the Influence Total	Male	Female
Mean Age [Std Dev]	40 [13]	41 [12]	35 [17]
Median Age	40	40	29

Driver Sobriety

Total Incidents	Driver Only Under the Influence or Impaired	
774	19	2.5%

Note: includes "had been drinking, impairment unknown," and "blood alcohol analysis pending," but sufficient for driving under the influence (see codes above)

Combined Pedestrian and Driver Sobriety

Total Incidents	Both Driver and Pedestrian Under the Influence or Impaired		Either Driver or Pedestrian Under the Influence or Impaired	
774	4	0.5%	171	22%

The relationship of lighting conditions and sobriety is in marked contrast to the statistics reported earlier in this report. For all crashes of any type, only 6% are alcohol related, whereas 22% of all MBPC's are alcohol related, a rate approximately three and one-half times greater. This is a very significant difference. Approximately 4 out of 10 (43%) of all MBPC's occur in dark hours. However, of those where either the pedestrian or driver are under the influence, this statistic doubles to almost 8 in 10 (78%). One can conclude that sobriety is a contributing factor in MBPC's both in daylight and particularly in the evening hours.

TABLE 5. LIGHTING CONDITIONS AND SOBRIETY

Sobriety and Lighting Condition*

	Mid-Block Pedestrian Crashes, 1995-1997				All Crashes, 1995-1997	
Lighting Condition	Total Number MBPC's		Total Under the Influence Incidents (Pedestrian or Driver)		Total Under the Influence Incidents	
Daylight	438	57%	38	22%	3709	36%
Dark	336	43%	133	78%	6459	63%
Total	774		171		10168	

* All crashes includes all pedestrian and vehicular crashes of any type. Not all records had complete data on age, sex, and lighting conditions. Thus, cohort subtotals may not add to the overall totals. Sobriety is reported only for one pedestrian. MBPC's are those used in the study.

Identification of Specific Corridors and/or Locations with High Incidences.

To identify spatial patterns and specific areas of high concentrations in the number of mid-block pedestrian crashes, a number of standard GIS spatial analysis operations were explored. These included various density and nearest neighborhood measures of spatial arrangement. Of these techniques, the standard nearest neighbor methodology provided the best characterization of the point pattern distribution. Calculating the statistic involves comparing the distance between each mid-block crash point and its nearest neighbor to an average between neighbor distance.

Nearest neighbor analysis is one of the most common and elementary measures of proximity used by analysts to compare the distances between categorical points.[5] A common variation of this procedure, and the one used in this study, is to calculate the statistic by establishing a grid over the study area, and then summing the total point events occurring within a specified distance from the center of each cell. For pedestrian crashes the analysis used grid cells with a dimension of 100

[5] Categorical point data refers to discrete spatial phenomena, for example, crash counts, as opposed to continuous phenomena sampled as points, such as pollution values.

feet per side and a circular radius of 500 feet.[6] The result is that nearby cells containing a crash event will increase the total score of the cell being evaluated. Based on the distribution of values the resultant scores are grouped and ranked. Clustering of points is thus easily identified.

The map titled Concentration of Mid-Block Pedestrian Crashes identifies areas where the frequency of mid-block pedestrian crashes can be considered high. These sites became candidates for further analysis. Although most of the very high concentration areas are along the Las Vegas Boulevard resort corridor (The Strip), the objectives of this study were to examine problems throughout the Las Vegas Valley. In consultation with NDOT, the areas in the table below were chosen for further detailed study. Only two areas in the vicinity of the resort corridor were used. These are 1) the contiguous Flamingo Road-Audrie and Flamingo Road-Koval Lane rows of the table, and 2) the Tropicana Avenue-Duke Ellington Way concentration. Several other areas are represented as combined units for statistical purposes. These include pockets of activity around Sahara Avenue and Valley View Drive, Sahara Avenue and Maryland Parkway, and Bonanza Road and Maryland Parkway. In addition, the downtown Las Vegas area is presented for comparison.

The ten large scale maps included at the end of this report illustrate these zones in greater detail and include a depiction of the generalized land use.

Table 6, Areas Of High Incidences Used For Further Investigation, enumerates several of the reported characteristics used throughout this report. Given the relatively small sample sizes at each area, parametric statistical analysis in the form of confidence levels is inappropriate. For example, one or two very young or very old persons can severely distort the mean age for a given area. However, there are some general observations that can be made.

For most of the areas, male pedestrians far outnumber the female pedestrians involved in MBPC's. This is similar to the overall pattern observed for the all MBPC's. Several areas have a near even male-female split but are too weak statistically for drawing any conclusions.

With respect to lighting conditions a number of the areas of concentration examined display a trend that is opposite from the overall statistics. Areas near the resort corridor, specifically the Flamingo Road-Audrie Street-Koval Lane area and the Tropicana-Duke Ellington Way segment, have a higher percentage of MBPC's in dark hours than the rest of the Las Vegas valley. Tourists crossing between Bally's and the Barbary Coast-Flamingo Hilton-Maxim Hotel area heavily use the area examined near the Las Vegas Strip, Flamingo Road-Koval Lane. This has a majority of MBPC's occurring after dark and a very high number of alcohol related crashes. Similarly a large number of MBPC's occur in the evening hours on the Tropicana-Duke Ellington Way segment near the MGM. Similarly, the Harmon Ave-Paradise Road area near the Hard Rock Café and Hotel has a large number of MBPC's in the evening and alcohol related.

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[6] The cell size and distance search values were chosen based on examination of the study area and general rules of thumb used in GIS. The average length of a link in the core study area is approximately 485 feet. Thus, the 500-foot search radius would approximate sampling along the entire length of the average link. The 100 foot cell size was chosen iteratively to provide enough "spatial fidelity" to reveal clusters of incidents along linear features.

TABLE 6. AREAS OF HIGH INCIDENCES USED FOR FURTHER INVESTIGATION

Cross Street*	# of Crashes*	Mean Age*	Males*	Females*	Light*	Dark*	Alcohol*
Bonanza Rd – Maryland Pkwy	4	29.8	3	1	4	0	0
Charleston Blvd – Eastern Av	7	31.0	5	2	4	3	1
Charleston Blvd – Lamb Blvd	7	23.4	7	0	3	4	0
Flamingo Rd – Audrie St	8	48.0	7	1	4	4	5
Flamingo Rd – Koval Ln	8	51.3	5	3	2	6	1
Flamingo Rd – Paradise Rd	12	40.4	9	3	5	7	3
Harmon Av – Paradise Rd	11	36.4	9	2	5	6	4
Las Vegas Blvd – Downtown	9	42.6	6	3	6	3	2
Maryland Pkwy – Flamingo Rd	6	23.0	4	2	2	4	2
Maryland Pkwy – Twain Av	7	42.3	4	3	5	2	2
Maryland Pkwy – Vegas Valley Dr	3	37.0	3	0	2	1	0
Sahara Av – Maryland Pkwy	10	46.8	6	2	5	5	0
Sahara Av - Valley View	7	47.6	4	3	6	1	0
Tropicana Av – Duke Ellington Wy	12	44.2	10	2	6	6	1
Tropicana Av – Maryland Pkwy	7	31.0	5	2	4	3	1
Tropicana Av – Jones Blvd	3	19.3	1	2	2	1	1

* Cross Street is the nearest major intersection of the cluster.
# of Crashes is the total count of reported pedestrians with valid detailed records.
Mean Age is the mean age of all pedestrians in the cluster.
Males and Females are the respective total counts by sex for each cluster.
Light and Dark refer to reported lighting conditions.
Alcohol refers to any crash where either the pedestrian or driver had been drinking or was under the influence.
Cohort detail may not be available for all records, for example, sex was not reported for all MBPC's.

Away from the resort corridor areas where at least half of all MBPC's occur mostly in dark hours include: the Charleston Blvd-Lamb Blvd, Sahara Ave-Maryland Pkwy, and Maryland Pkwy-Flamingo. These three areas are in the vicinity of major arterial cross streets and are very heavily traveled throughout the day and evening. Some of the most popular evening bus routes are along these arterials.

Relationships to Bus Stop Locations, and in Particular Transfer Points.

There are approximately 4800 bus stops in the Las Vegas Valley including approximately 420 transfer points. The large number of regular stops guarantees an association between just the location of a bus stop and a mid-block pedestrian crash. Transfer points are those stops designated by the Citizens Area Transit (CAT) where a bus will have a short scheduled wait and does not depart until a specific time. The times are coordinated with bus routes that have scheduled nearby stops to permit transfers with a minimal waiting period. Because historical schedule information is not available, nor is any information collected from the pedestrian involved as to whether the individual was either coming from or going to a bus, it is unsound to make any specific causal statements concerning the influence of bus stops on MBPC's. The transfer points are plotted in several of the accompanying maps and are used in the other phases of this project to explore the relationship of bus stops to mid-block crashes.

Relationship to Existing Marked Mid-Block Crosswalks.

A list of known mid-block marked crosswalks was obtained from the traffic division of Clark County Public Works. These are listed in the table below and illustrated in the accompanying map. There were no crashes reported as occurring in any of these crosswalks. A buffer analysis indicates there are only 14 mid-block pedestrian crashes "not in crosswalk" within 500 feet of these marked mid-block crosswalks and only 2 crashes within 250 feet. This may indicate the effectiveness of marked mid-block crosswalks. Further analysis is suggested before conclusions can be drawn.

TABLE 6. MID-BLOCK CROSSWALKS*

LOCATION OF MID-BLOCK CROSSWALKS	
Burnham and Flamingo	(at Desert Springs Hospital)
Cambridge and Desert Inn	
Desert Inn and Mountain Vista	
Dumont and Maryland Pkwy	
Edna and Rainbow	
Endora and Rainbow	
Flamingo and Shepard	

Lake Mead and Sloan
Maryland Pkwy and Reno
Morris and Tropicana
Palos Verde and Twain
Pecos and Villa Way
Russell and Mcleod
Sierra Vista and Maryland Pkwy
Vegas Valley and Mountain Vista
Viking and Jones
Warm Springs and Amigo (between Amigo and Pollock)
Windmill and Pollock

* Source: Traffic Division, Clark County Public Works. Crosswalk is located on the first street listed; second street is the nearest cross street.

Link Analysis To examine the relationship of MBPC's on a link by link basis a core study area is used to dampen the effects of the undeveloped urban fringe and rapidly changing characteristics. In the core study area there are 22,095 links representing approximately 38% of the County's 57,492 total links available in the database. Using the County's database of major roads, 6275 links can be used to represent the most heavily traveled non-freeway arterial roadways, representing approximately 389.5 linear miles. From the 774 MBPC's used in this study, 579 (75%) are identified as being on a non-freeway arterial using the NDOT functional classification code.

Of the arterial links, 540 (11%) different links have at least one MBPC for the period 1995-1997. There are 116 links with multiple MBPC's over this three-year period. Eleven links have 5 or more MBPC's during this period. They are all located along in resort corridor, either on the Strip or nearby Flamingo Road and Tropicana Avenue.

TABLE 7. LINK ANALYSIS TABLE

# MBPC's on One Link	Description or Count
19	Las Vegas Blvd. between Spring Mountain/Sands and Flamingo
14	Las Vegas Blvd. between Riviera and Convention Center Drive
6	Las Vegas Blvd. between Bellagio and Harmon
6	Las Vegas Blvd. between Hacienda and Diablo
6	Tropicana Avenue between the MGM Entrance and Duke Ellington
6	Harmon Avenue between La Mar and Paradise Road
5	Sahara Avenue east from the corner of Maryland Pkwy
5	Koval Lane south from the corner of Flamingo Road
5	Flamingo Road east from the corner of Paradise Road
5	Flamingo Road east from the corner of Las Vegas Blvd.
5	Las Vegas Blvd (in North Las Vegas) between Griswold and Van Der Meer (just southwest of Pecos and north of Carey)

4 10 different links
3 19 different links
2 75 different links

Direction of Travel The NDOT database does not capture specific information regarding the detailed movements of the pedestrians, for example, the origin and destination of the pedestrian, the nature of their crossing, or even from which side of the road they were crossing. The database does provide information on the direction of travel of the vehicles involved. Using directional data associated with the primary vehicle may be useful in assessing visibility other other geometric problems associted with a particular area of concentration. The table below indicates the general direction of travel of the primary vehicles.

General Direction	Straight Through	Turning Left	Turning Right	Other
North	196	3	4	3
South	181	4	4	3
East	201	2	4	1
West	159	3	4	2

FURTHER INVESTIGATION

Evaluation of mid-block pedestrian crash data from the NDOT database clearly supports the remaining steps of this study. The principal objective is to conduct field investigation at a number of the high incident areas in an effort to develop precise crash rates and costs associated with pedestrian crashes. The characterization of these data will be combined with available CODES data to develop these costs. The other objective is to further evaluate the association of bus stops and other physical characteristics that can be correlated with pedestrian behavior.

LIST OF ACCOMPANYING MAPS AND CHARTS

MAPS -

CHARTS –

APPENDIX A THE NDOT CRASH DATABASE

The Nevada Department of Transportation maintains a comprehensive database of crash data for the State of Nevada. The database contains records for all reported crashes. There are approximately 90 different attributes containing information on the location of the crash, when and under what conditions each crash occurred, certain roadway characteristics, driver and pedestrian characteristics, injury information, and data about the vehicles involved. These data records are sometimes incomplete or otherwise inconsistent with the specific requirements of individual analysis tools. For this report, the data were filtered to produce a set of useable records for analysis. Consequently, there may be a slight variation in totals used by other reports for other purposes.

The definition of Mid-Block Pedestrian Crashes (MBPC's) used in this study is based on specific NDOT Crash Database attributes and their codes. The basic selection criteria utilized codes from the Pedestrian Action attribute. Codes used for the query were:

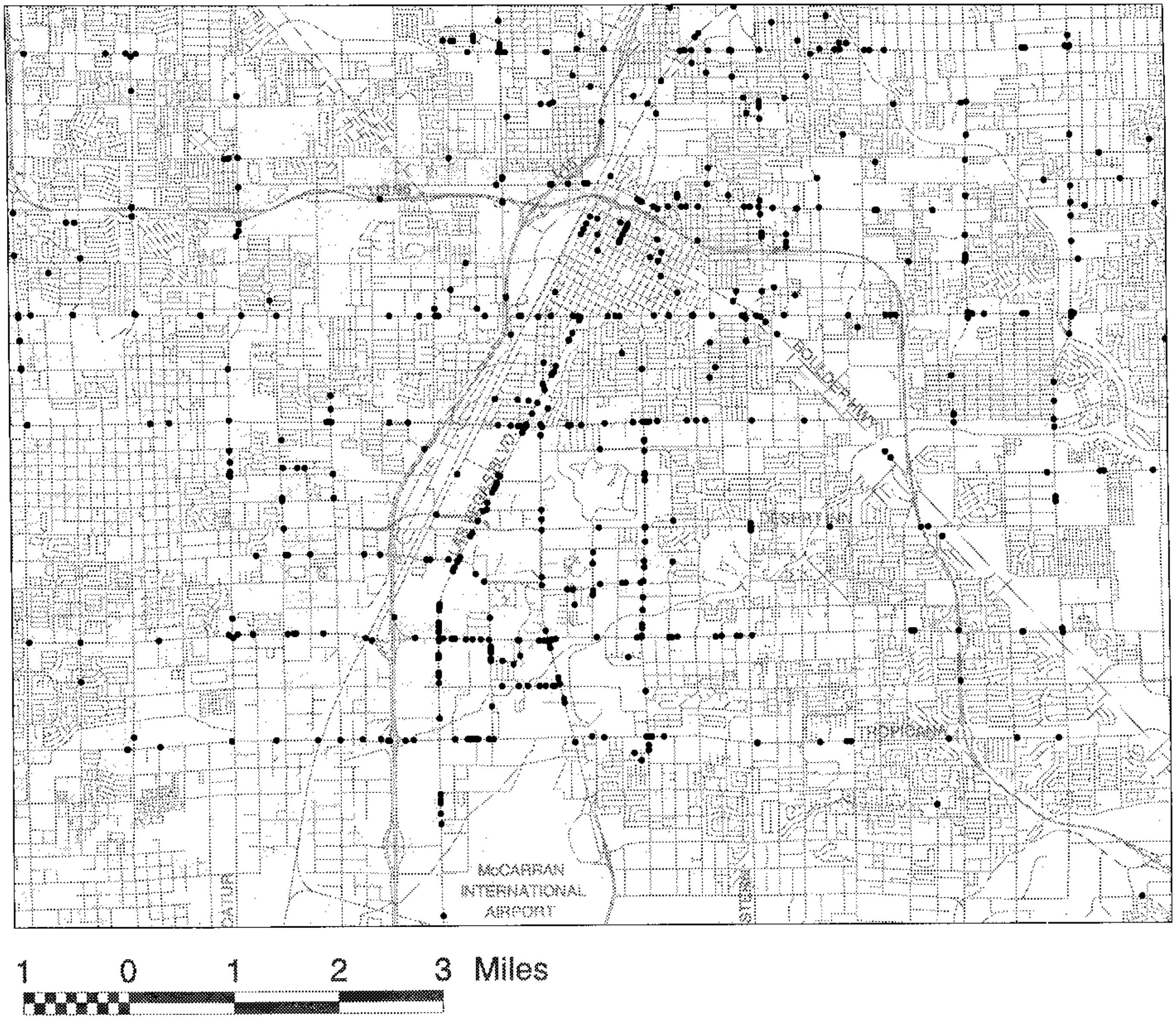
- 5 – crossing – not an intersection
- 6 – coming from behind parked cars
- 19 – ran into roadway

Locational information in the raw data is in the form of a distance reference to the nearest intersection or milepost. The spatial analysis required assigning X,Y coordinate pairs to each crash. This was accomplished using a combination of tools available with ESRI's ARC/INFO Geographic Information System software. The process involved several iterative steps. Data were first processed through an automatic geocoding routine and a point dataset created. Rejected records, including all those not at an intersection, were then processed through several custom routines that permitted the user to interactively verify a candidate link. The software precisely calculated the point location by tracing along the candidate link the reported distance from the intersection.

The total number of data records used in this study thus represents a filtered sample of all records. For example, in a previous study 358 mid-block pedestrian crashes were identified for 1996. After filtering these data for use in this study, 288 (80%) were useable. For the three-year period 1995-1997, a final set of 774 useable Mid-Block Pedestrian Crash records was produced.

DISTRIBUTION OF MID-BLOCK PEDESTRIAN CRASHES

LAS VEGAS, NEVADA STUDY AREA - 1995-1997



LEGEND

• Mid-Block Pedestrian Crash

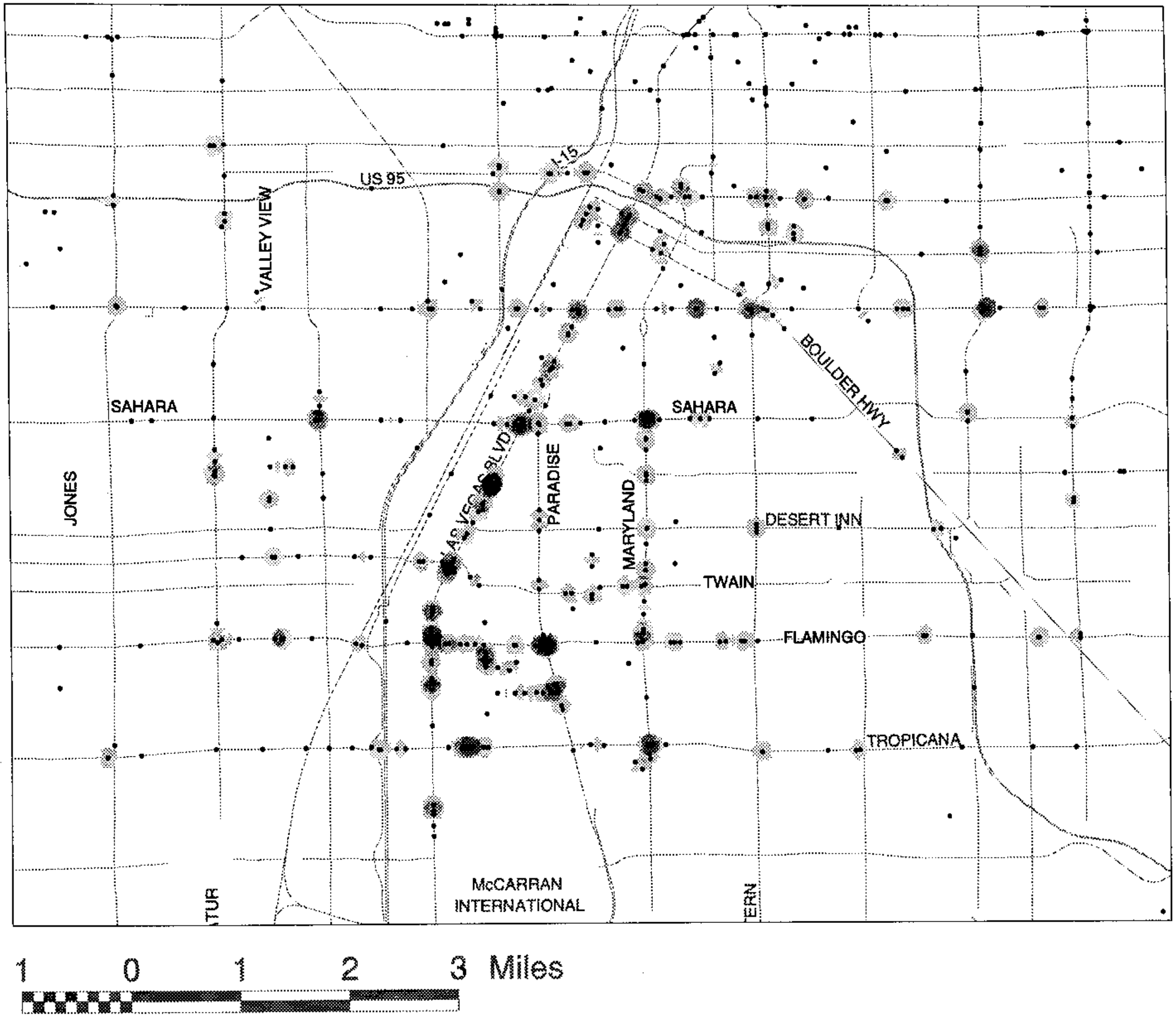
Source: Crash data provided by the Nevada Department of Transportation, 1995-1997. Analysis data compiled by the Transportation Research Center, UNLV.

January 1999

TRC N **NDOT**

CONCENTRATIONS OF MID-BLOCK PEDESTRIAN CRASHES

NEAREST NEIGHBOR ANALYSIS IN THE LAS VEGAS VALLEY 1995 - 1997



LEGEND

- Mid-Block Pedestrian Crash

Index of Incidents Within 500 Feet Mid-Block Only

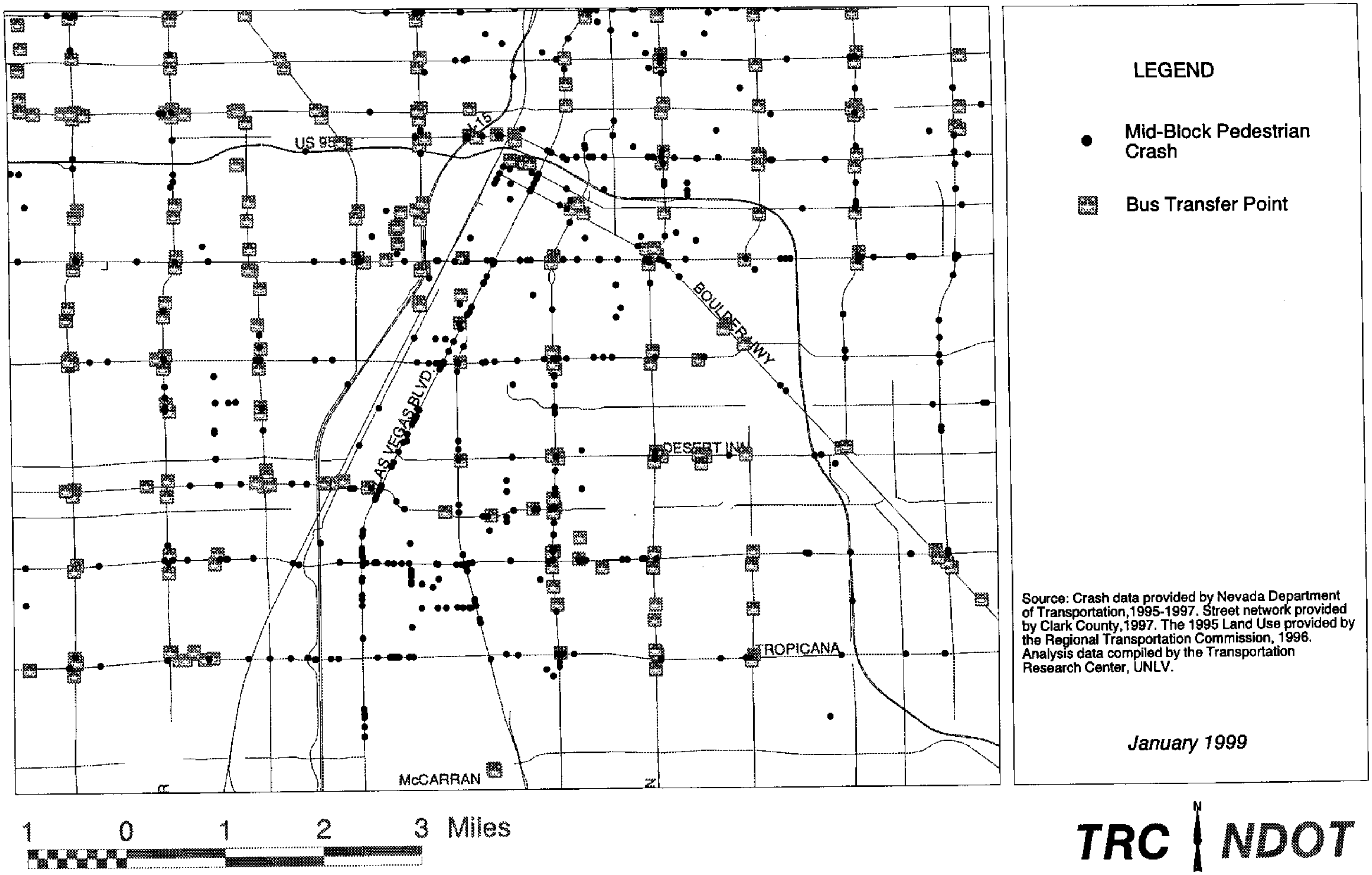
- Low
- Medium
- High
- Very High

Source: Crash data provided by Nevada Department of Transportation, 1995-1997. Street network provided by Clark County, 1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

January 1999

TRC N **NDOT**

RELATIONSHIP OF MID-BLOCK PEDESTRIAN CRASHES AND BUS TRANSFER STOPS

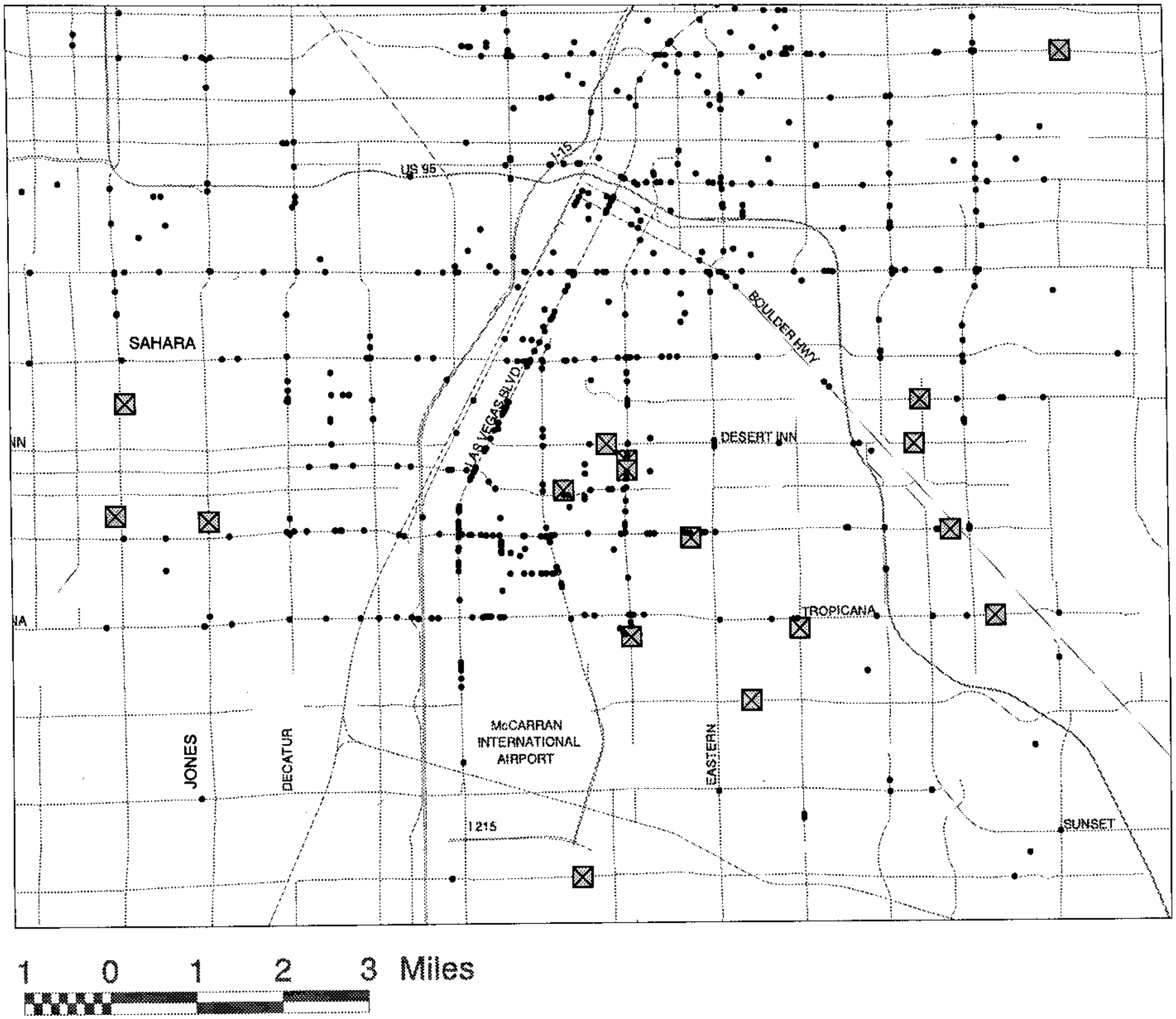


Source: Crash data provided by Nevada Department of Transportation,1995-1997. Street network provided by Clark County,1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

January 1999

TRC NDOT

RELATIONSHIP OF MID-BLOCK PEDESTRIAN CRASHES AND MAJOR MID-BLOCK CROSSWALKS



LEGEND

- Mid-Block Pedestrian Crash
- Mid-Block Crosswalk

Source: Crash data provided by Nevada Department of Transportation, 1995-1997. Street network provided by Clark County, 1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

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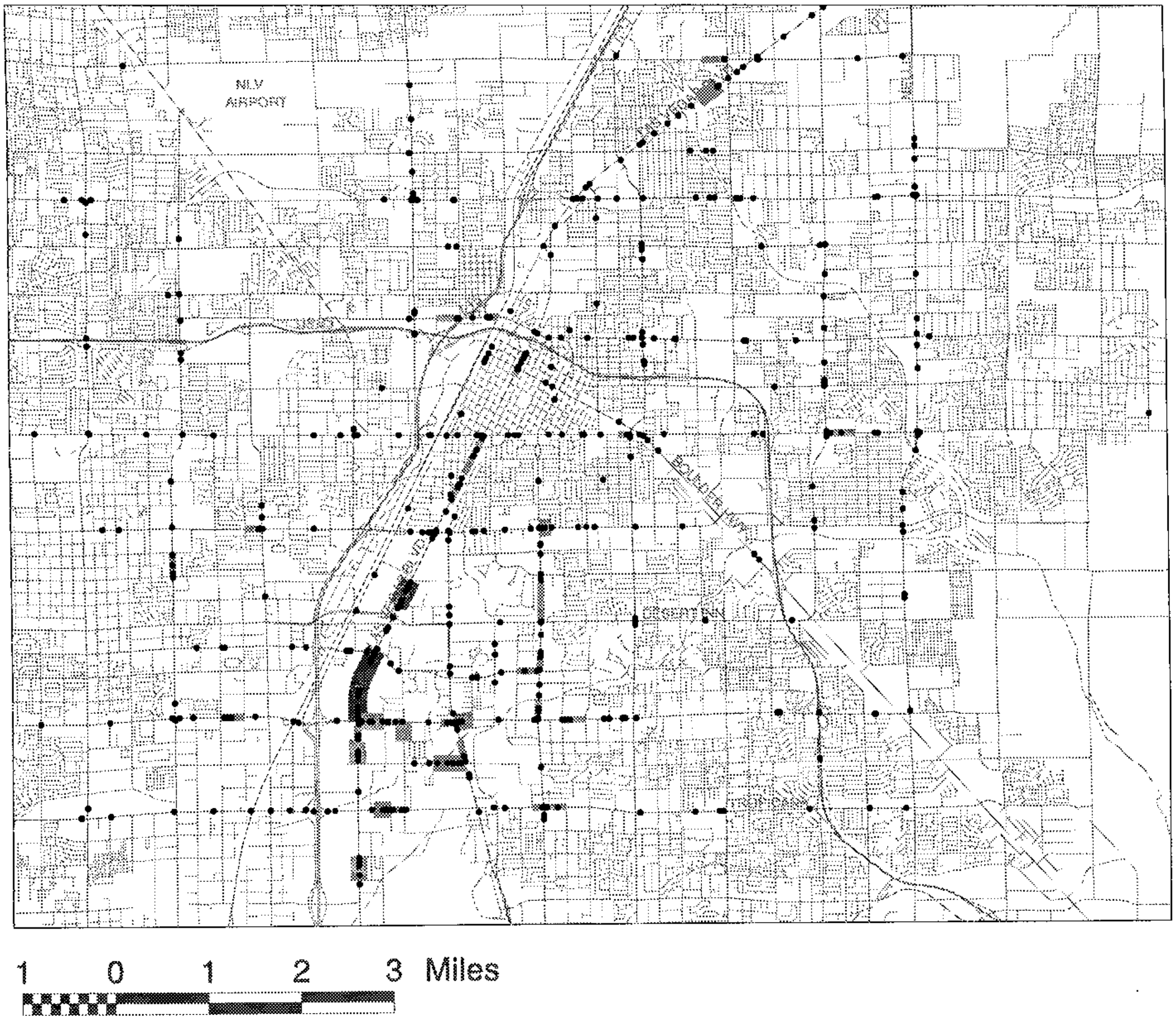
TRC NDOT

DISTRIBUTION OF MID-BLOCK PEDESTRIAN CRASHES ALONG NON-FREEWAY ARTERIALS



LEGEND

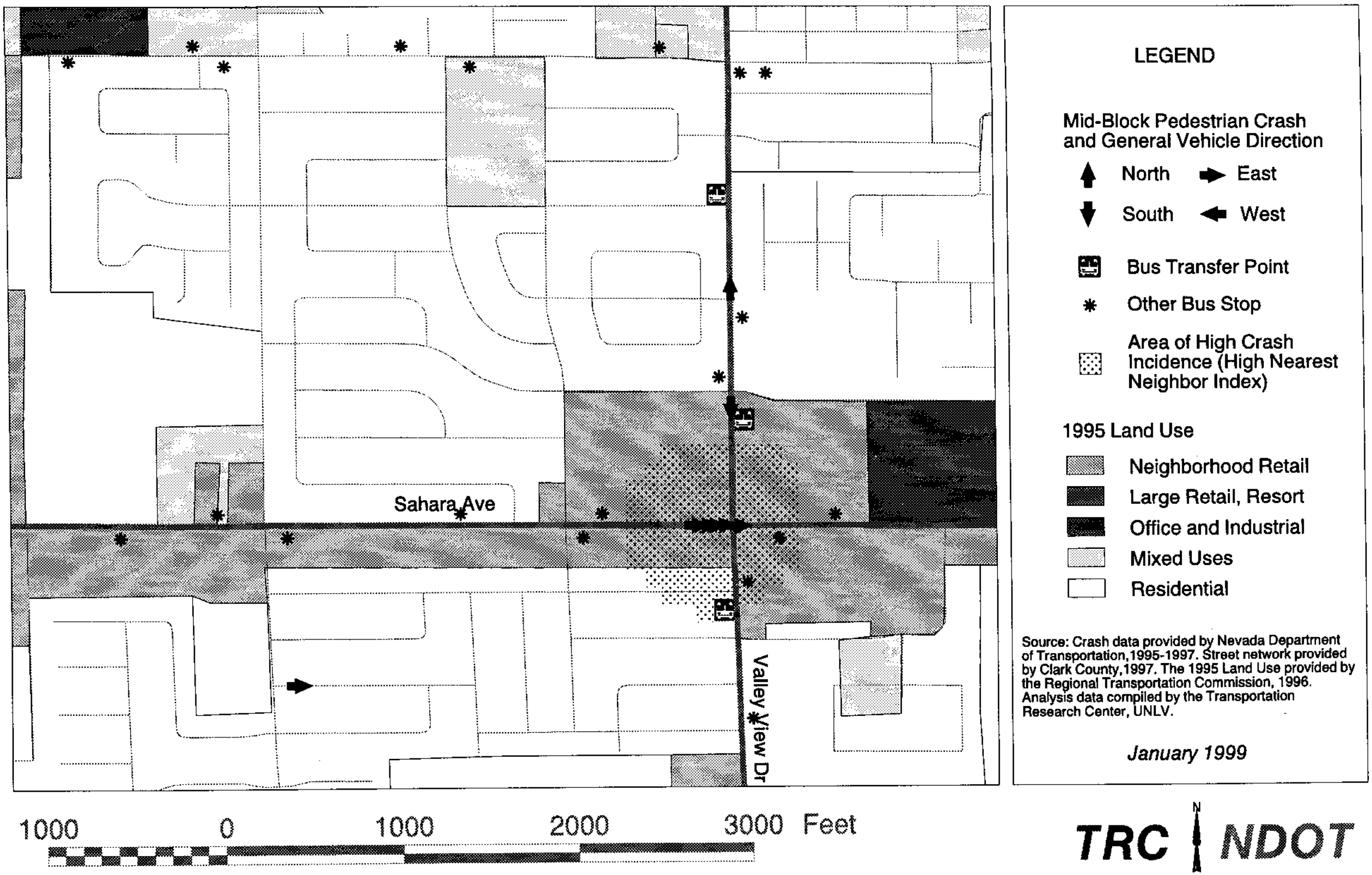
- Mid-Block Pedestrian Crash Along an Arterial
- Arterial Links with 3 - 4 Crashes
- Arterial Links with 5 - 8 Crashes
- Arterial Links with 9 or More Crashes

Source: Crash data provided by the Nevada Department of Transportation, 1995-1997. Analysis data compiled by the Transportation Research Center, UNLV.

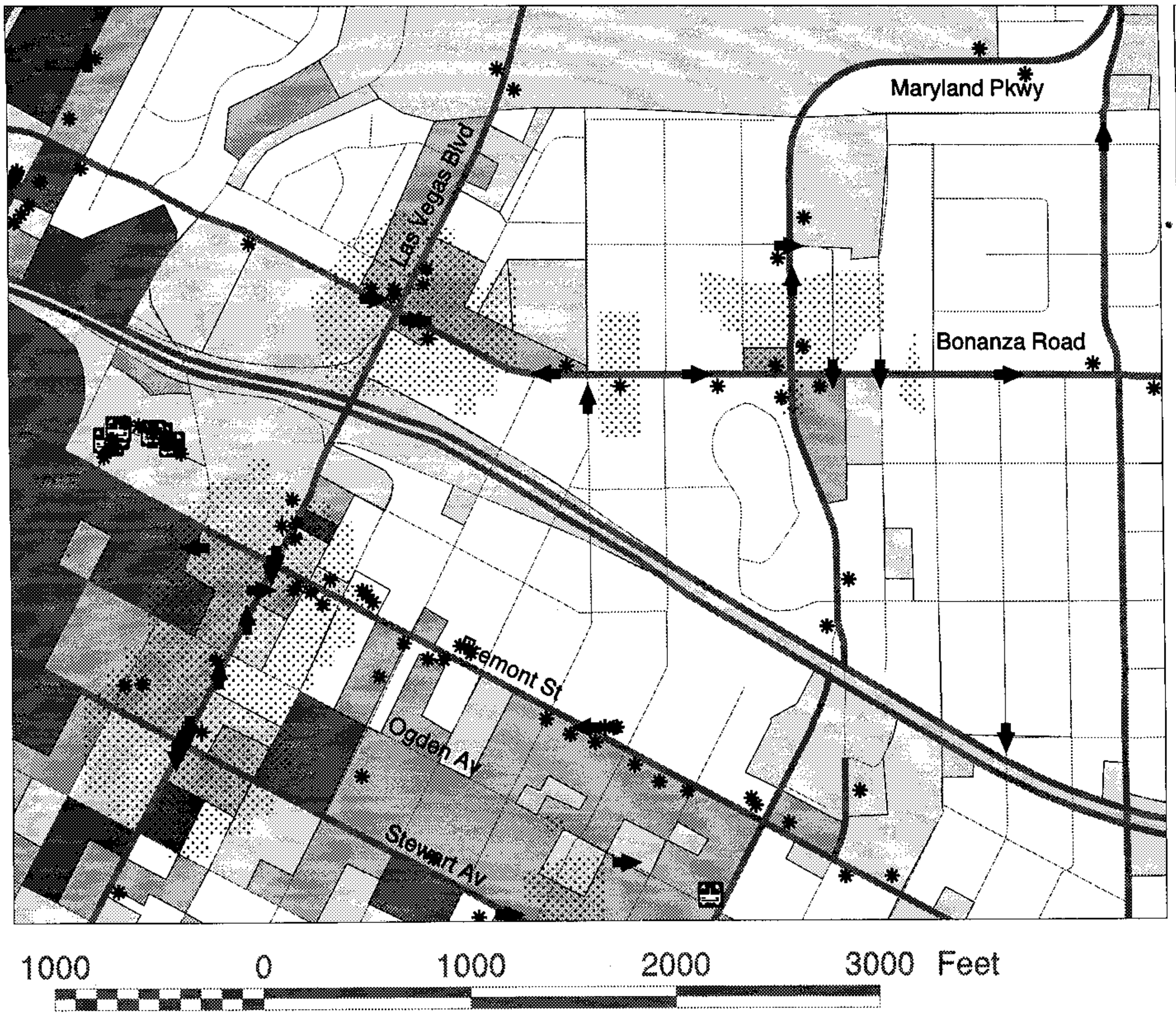
January 1999

TRC N **NDOT**

SAHARA - VALLEY VIEW



LAS VEGAS BLVD - DOWNTOWN AND BONANZA - MARYLAND PARKWAY



LEGEND

Mid-Block Pedestrian Crash and General Vehicle Direction

North East

South West

Bus Transfer Point

Other Bus Stop

Area of High Crash Incidence (High Nearest Neighbor Index)

1995 Land Use

Neighborhood Retail

Large Retail, Resort

Office and Industrial

Mixed Uses

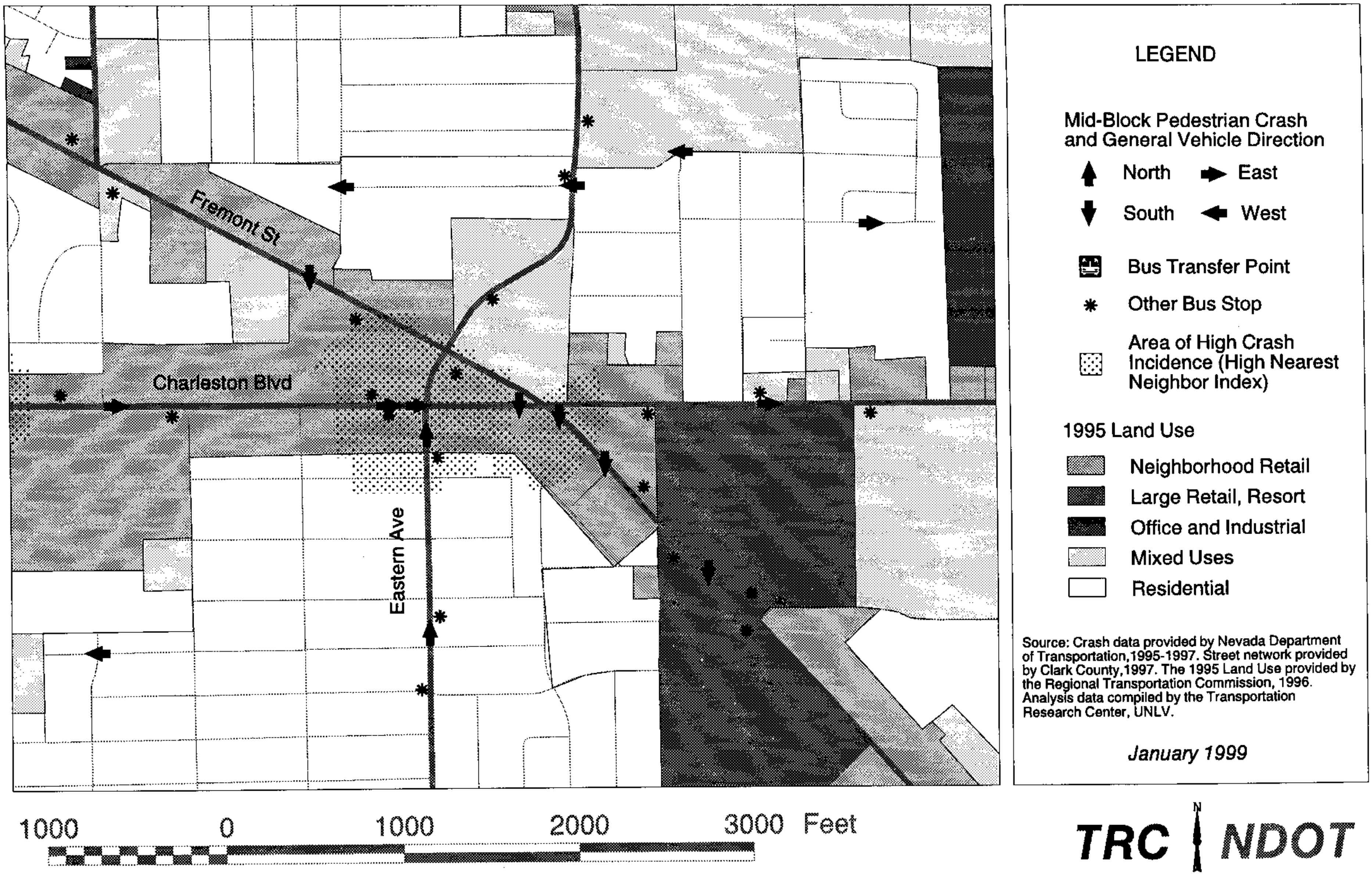
Residential

Source: Crash data provided by Nevada Department of Transportation, 1995-1997. Street network provided by Clark County, 1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

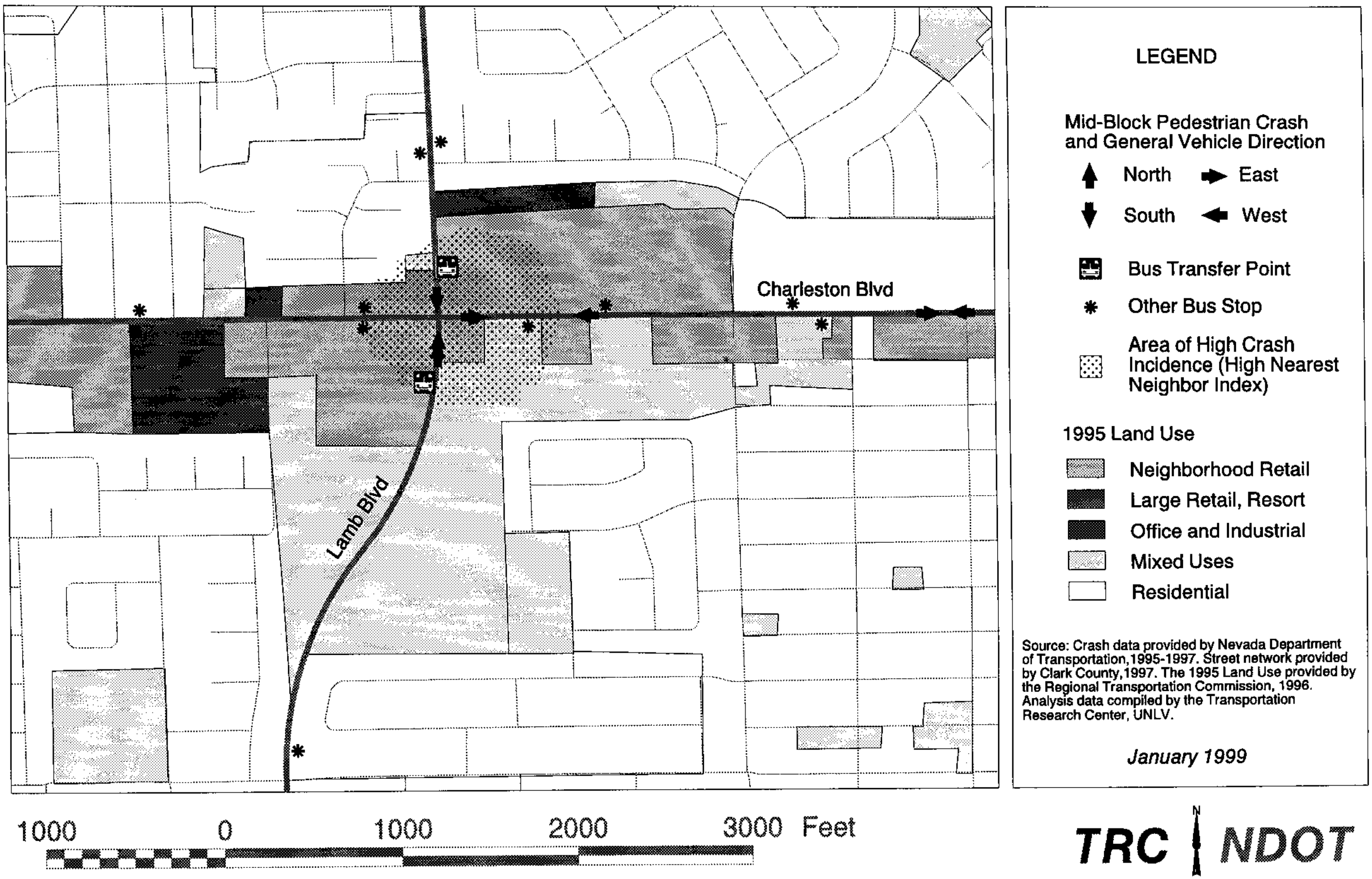
January 1999

TRC NDOT

CHARLESTON - EASTERN - FREMONT

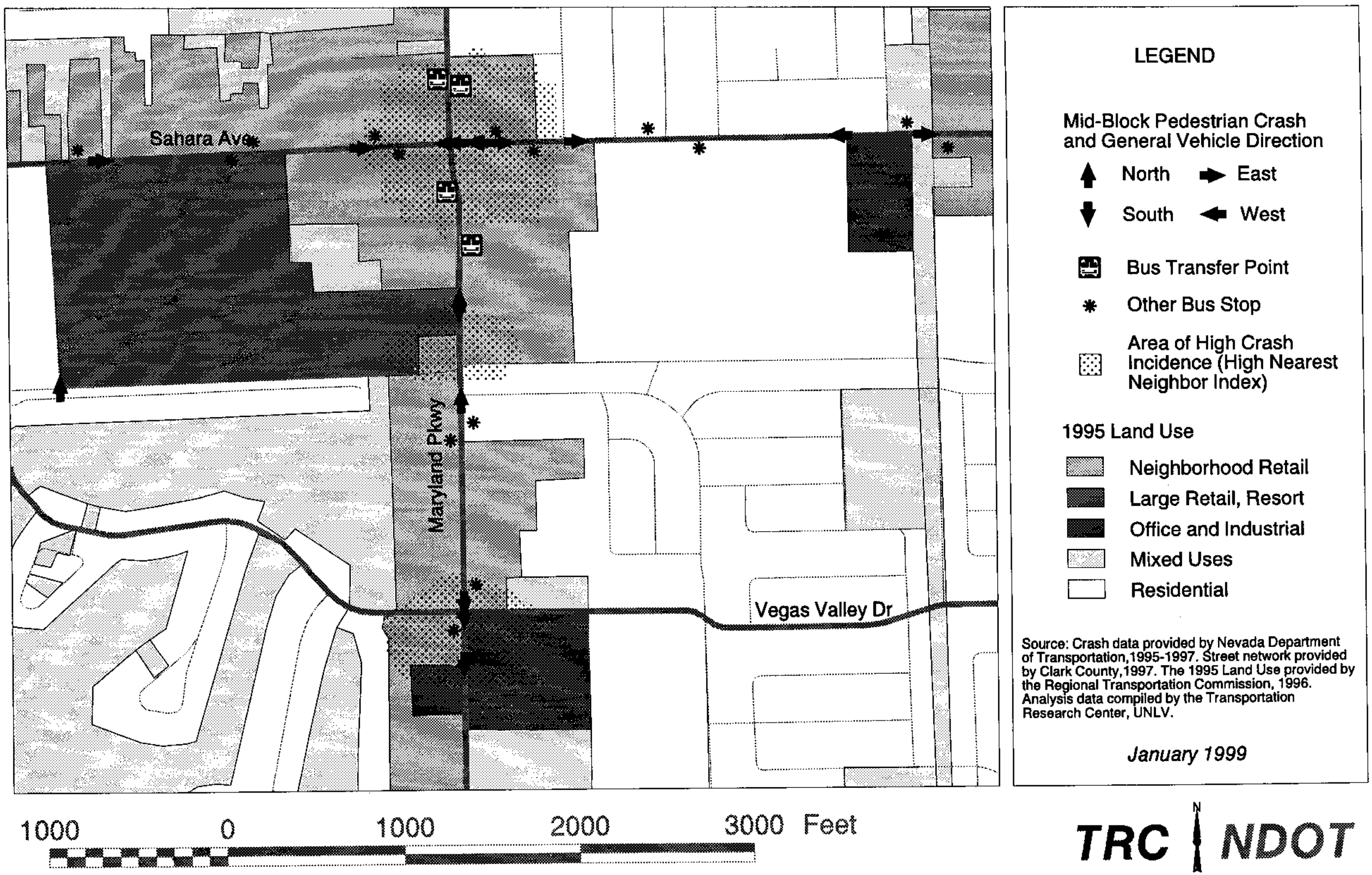


CHARLESTON - LAMB

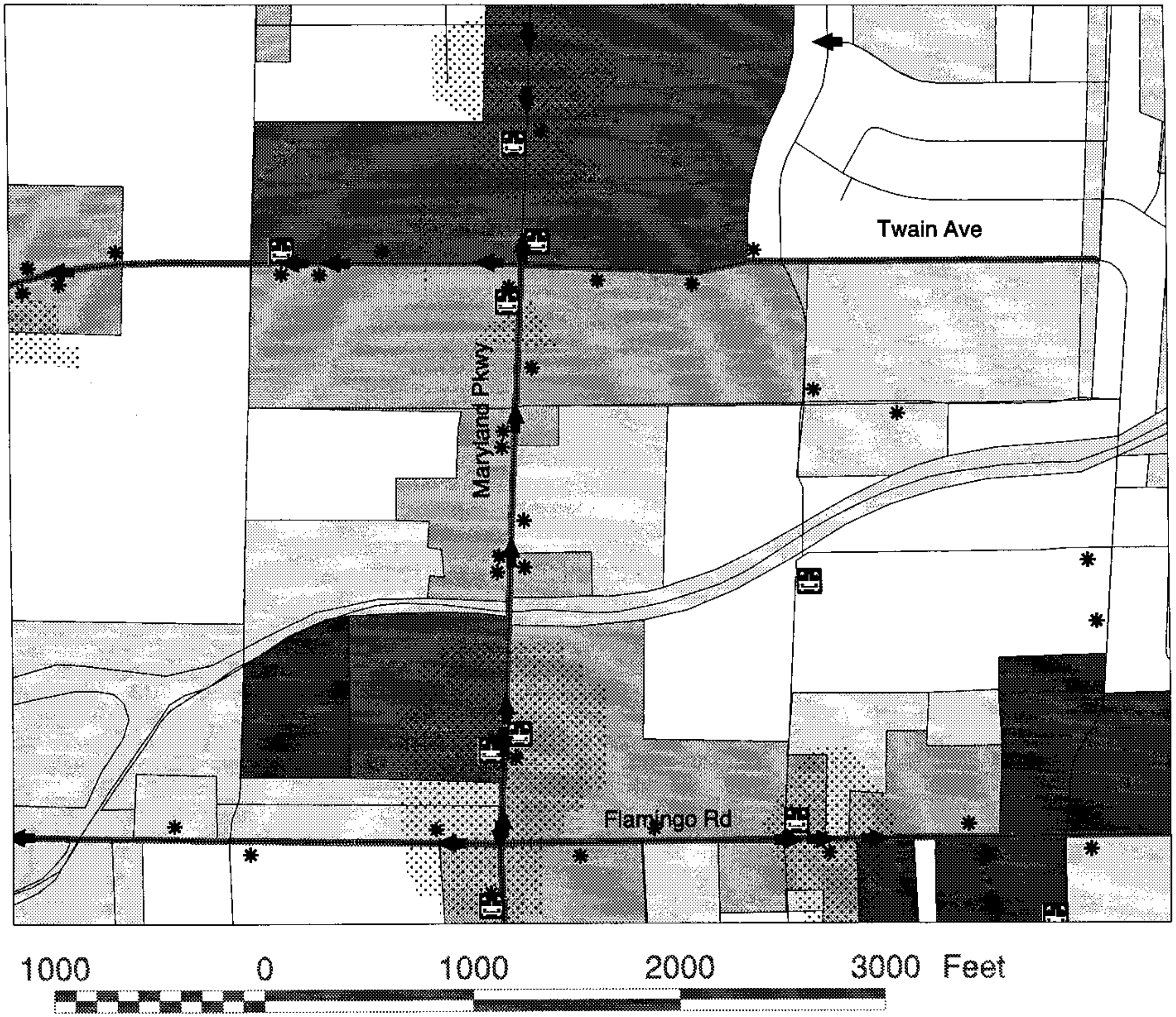


TRC NDOT

SAHARA - MARYLAND - VEGAS VALLEY



MARYLAND - TWAIN - FLAMINGO



LEGEND

Mid-Block Pedestrian Crash and General Vehicle Direction

- North
- East
- South
- West
- Bus Transfer Point
- Other Bus Stop
- Area of High Crash Incidence (High Nearest Neighbor Index)

1995 Land Use

- Neighborhood Retail
- Large Retail, Resort
- Office and Industrial
- Mixed Uses
- Residential

Source: Crash data provided by Nevada Department of Transportation,1995-1997. Street network provided by Clark County,1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

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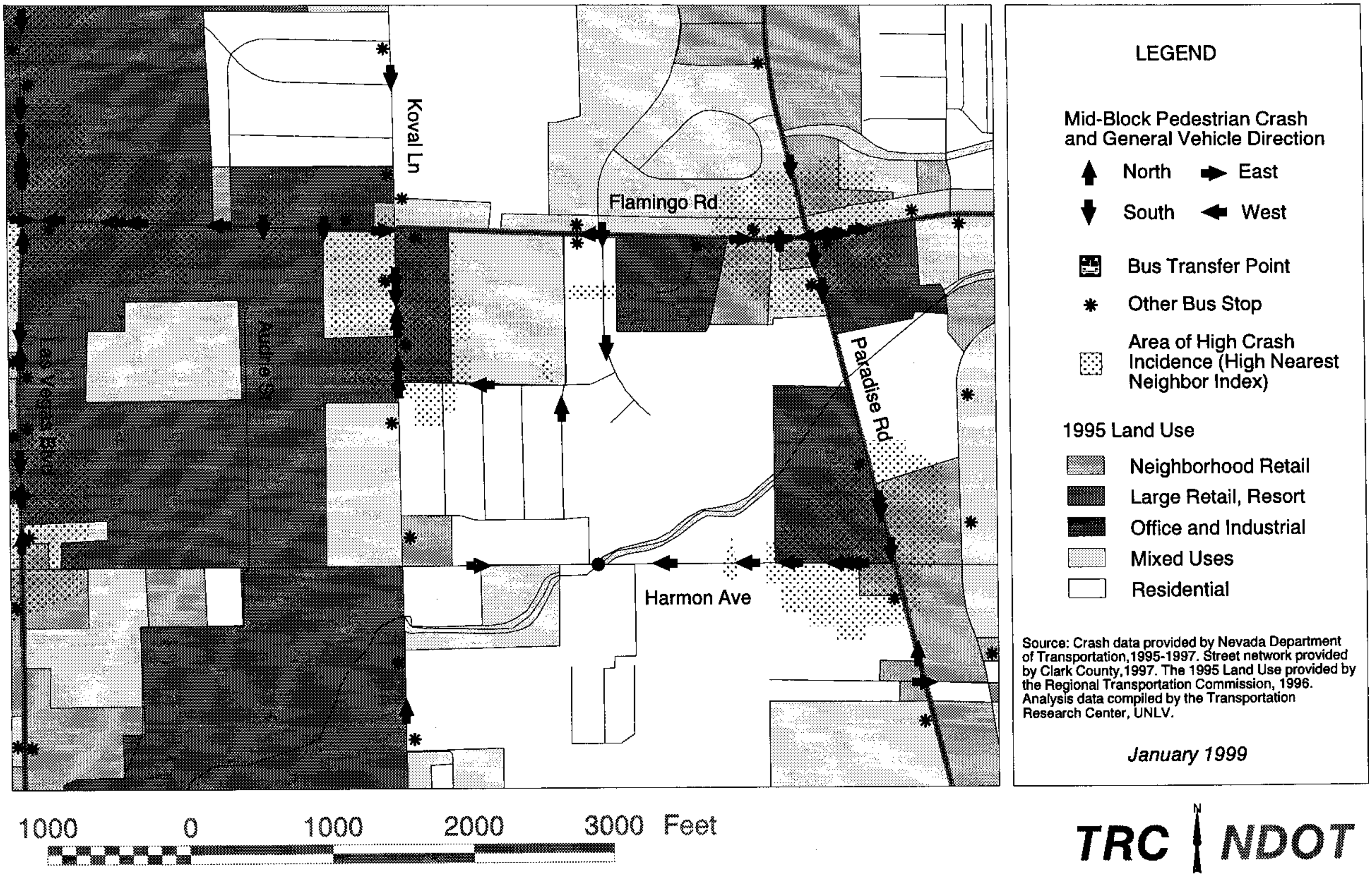
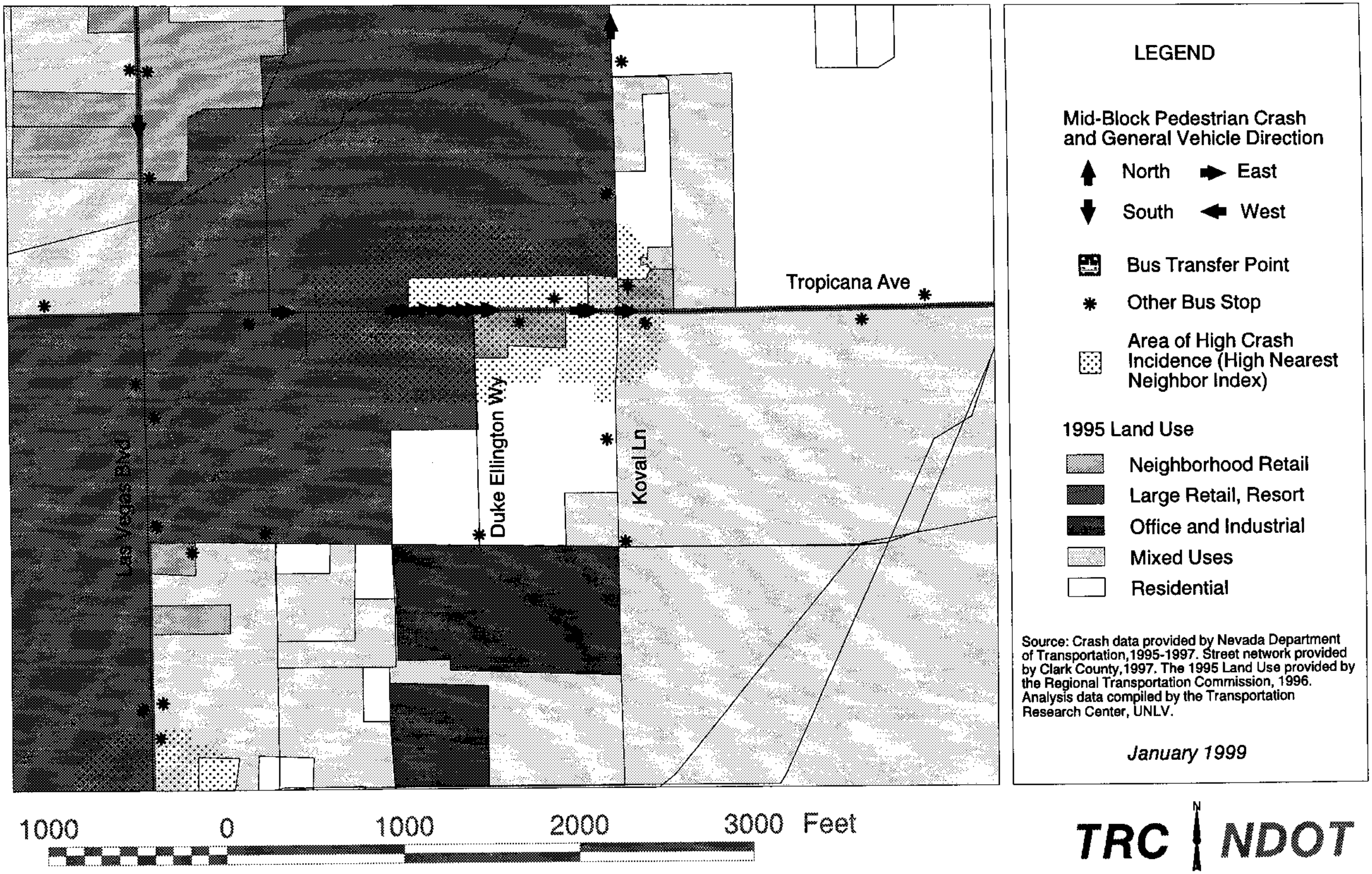
TRC **NDOT**

FLAMINGO - AUDRIE - KOVAL AND HARMON - PARADISE



TRC NDOT

TROPICANA - DUKE ELLINGTON

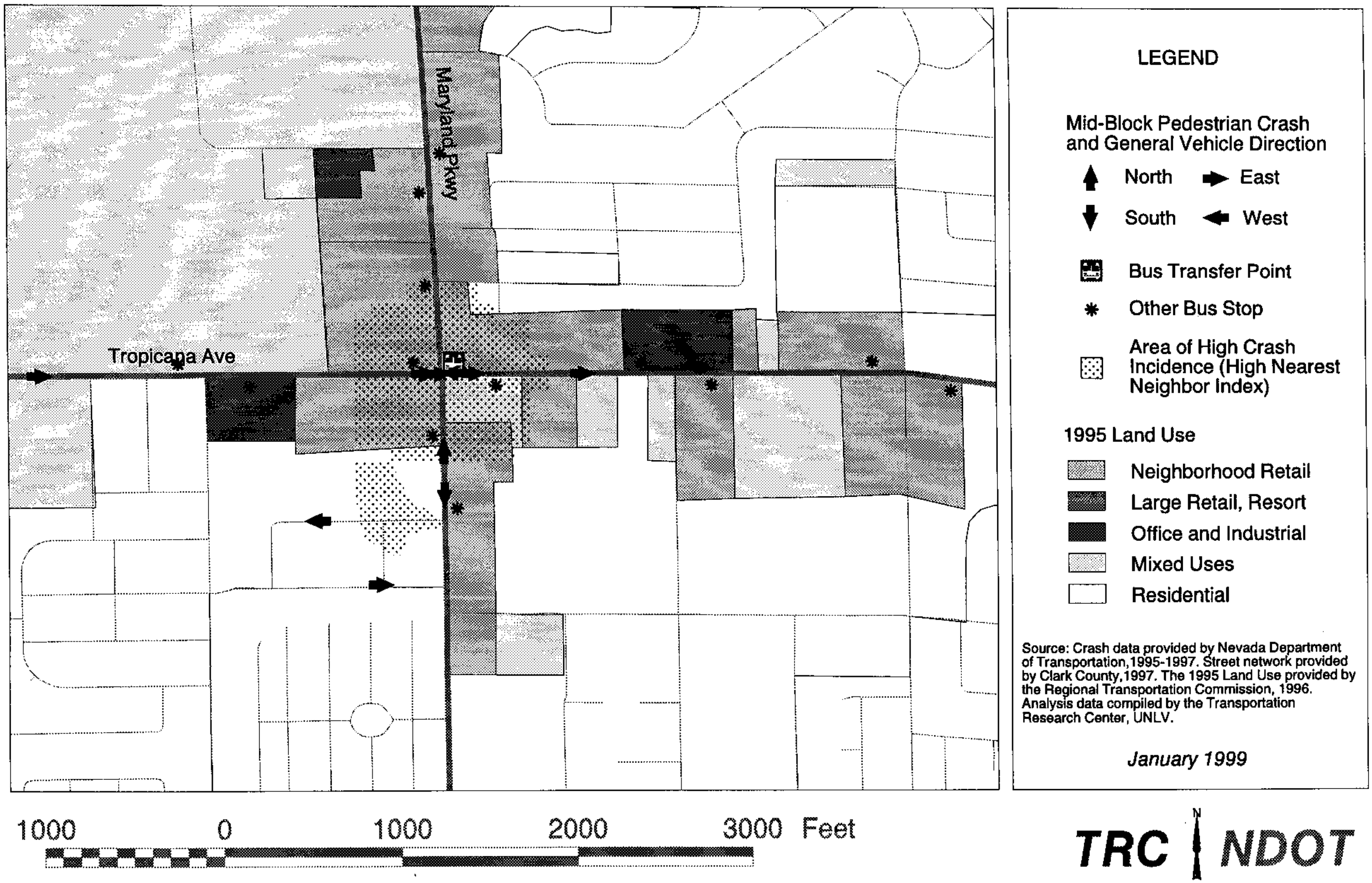


Source: Crash data provided by Nevada Department of Transportation, 1995-1997. Street network provided by Clark County, 1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

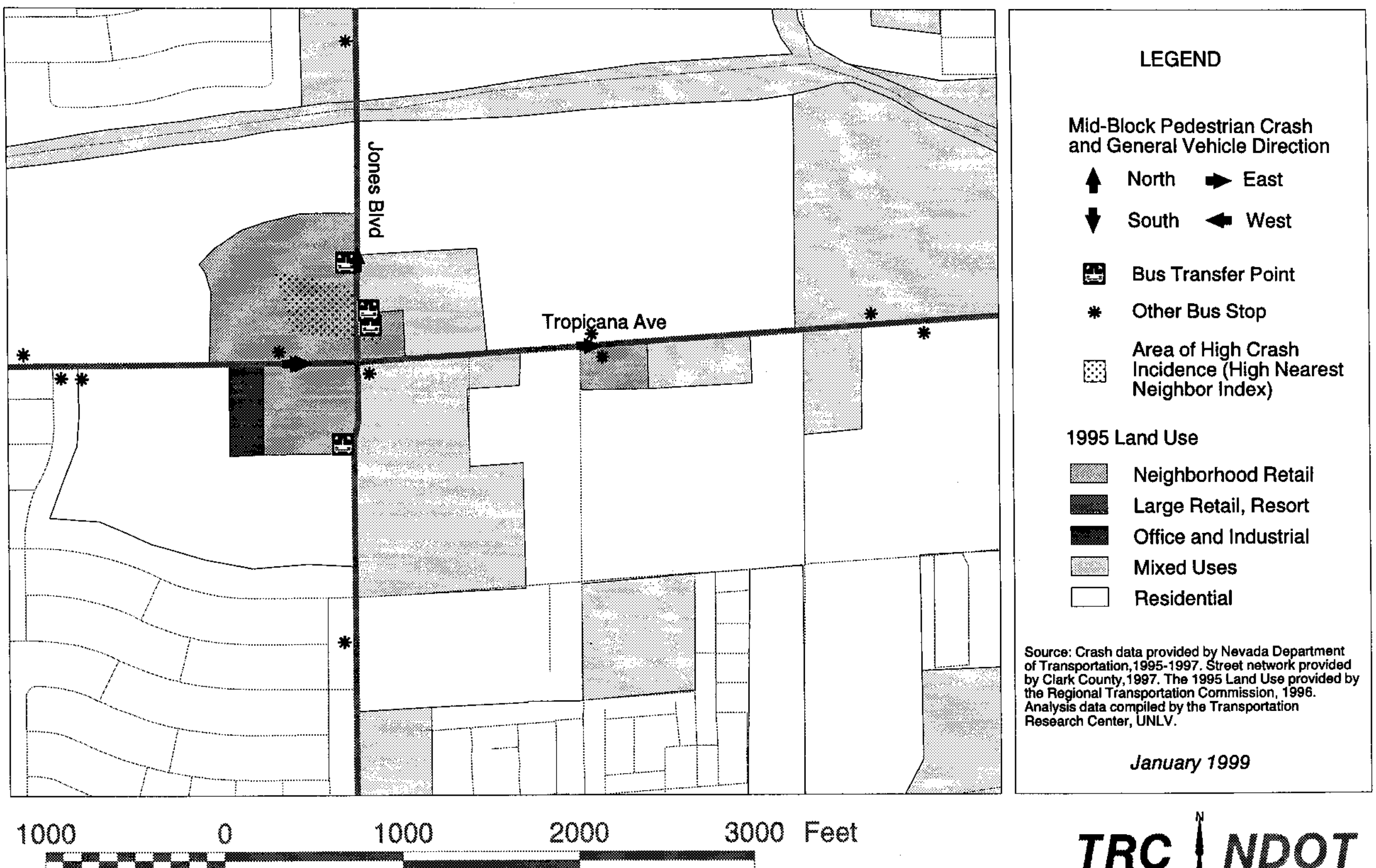
January 1999

TRC NDOT

TROPICANA - MARYLAND



TROPICANA - JONES



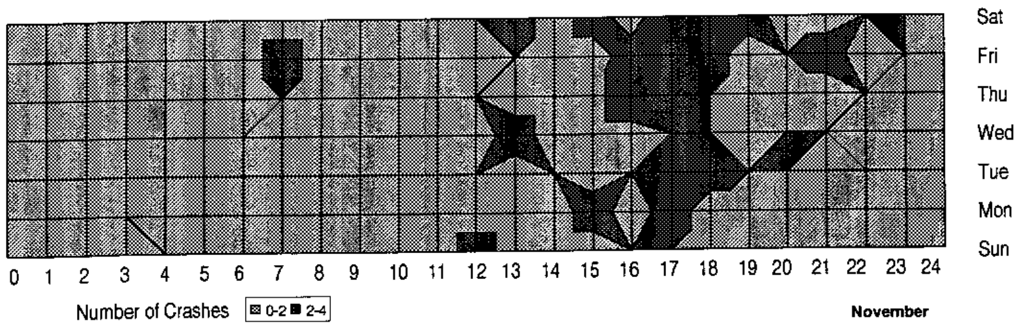
Source: Crash data provided by Nevada Department of Transportation, 1995-1997. Street network provided by Clark County, 1997. The 1995 Land Use provided by the Regional Transportation Commission, 1996. Analysis data compiled by the Transportation Research Center, UNLV.

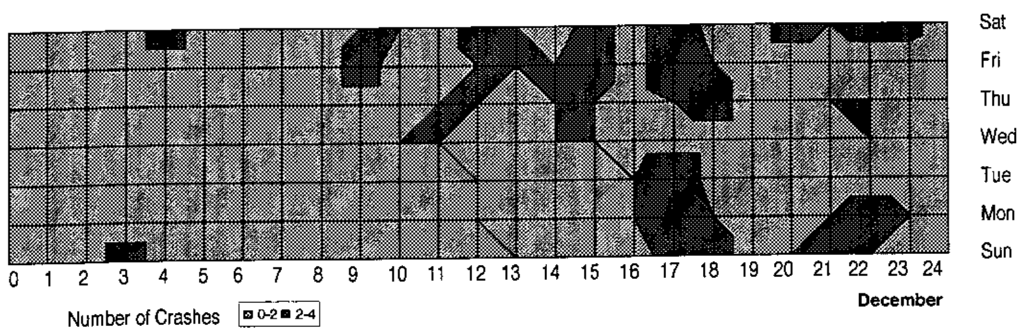
January 1999

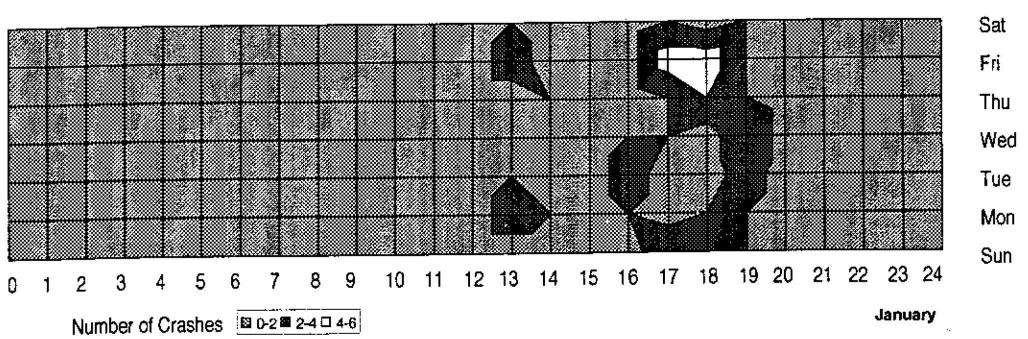
TRC NDOT

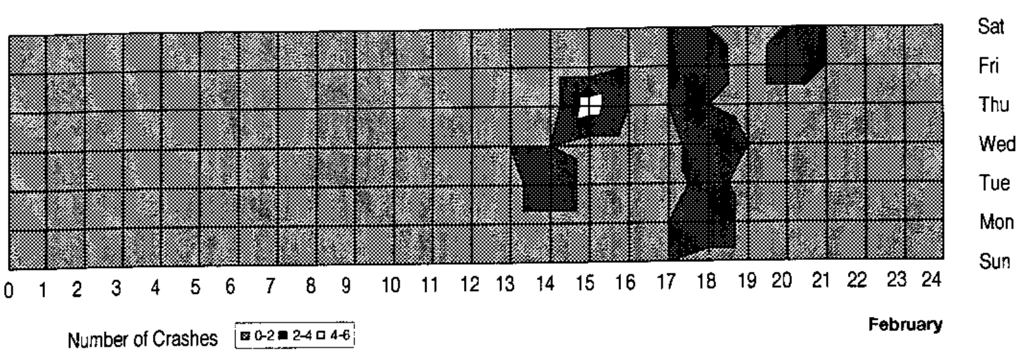
MONTHLY VARIATION IN THE TEMPORAL DISTRIBUTION OF MID-BLOCK PEDESTRIAN CRASHES, 1995-1997

Hourly distribution is represented in the x-axis and day of week in the y-axis.
Hour zero is 12:00 Midnight to 1:00 a.m. and so forth.



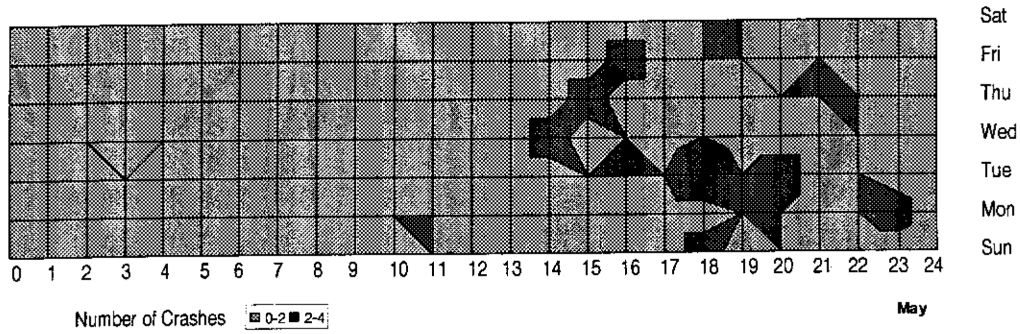


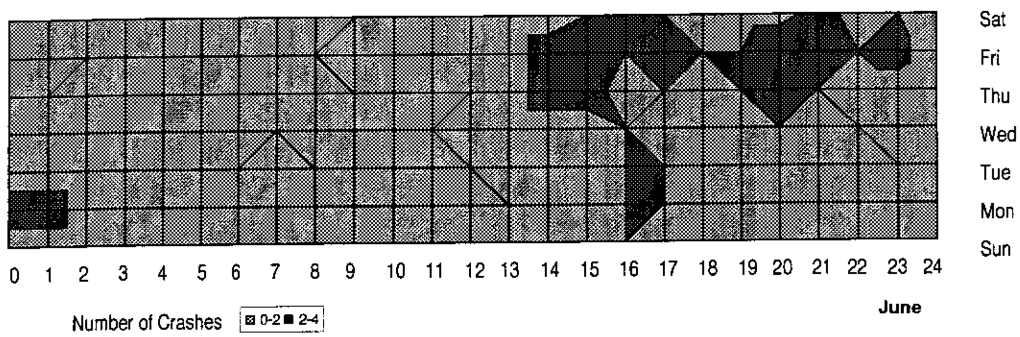


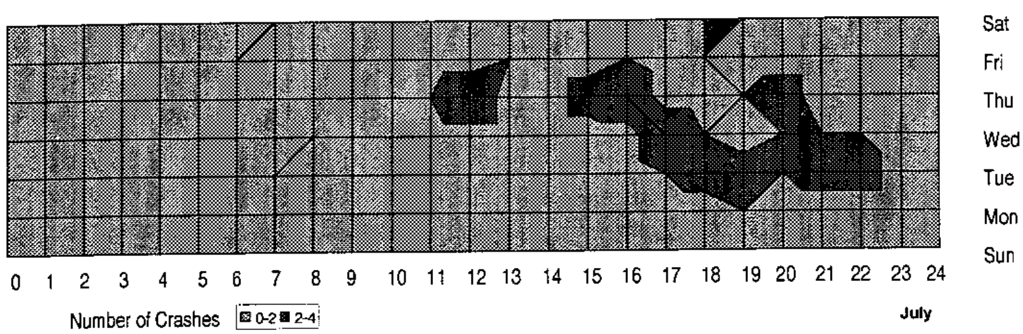


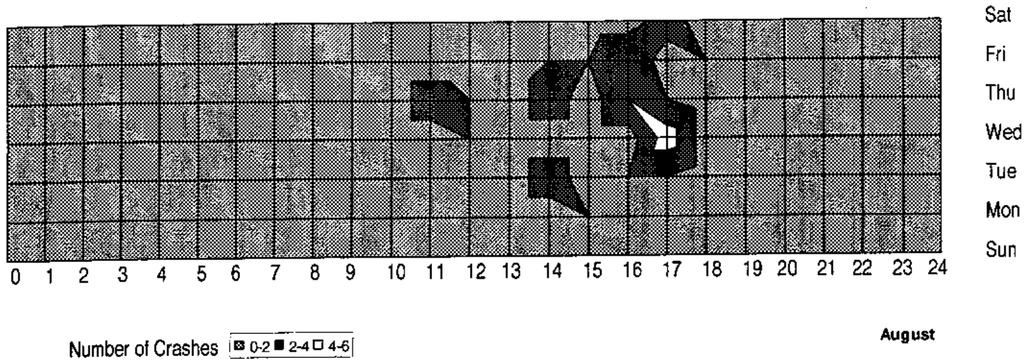
MONTHLY VARIATION IN THE TEMPORAL DISTRIBUTION OF MID-BLOCK PEDESTRIAN CRASHES, 1995-1997

Hourly distribution is represented in the x-axis and day of week in the y-axis. Hour zero is 12:00 Midnight to 1:00 a.m. and so forth.



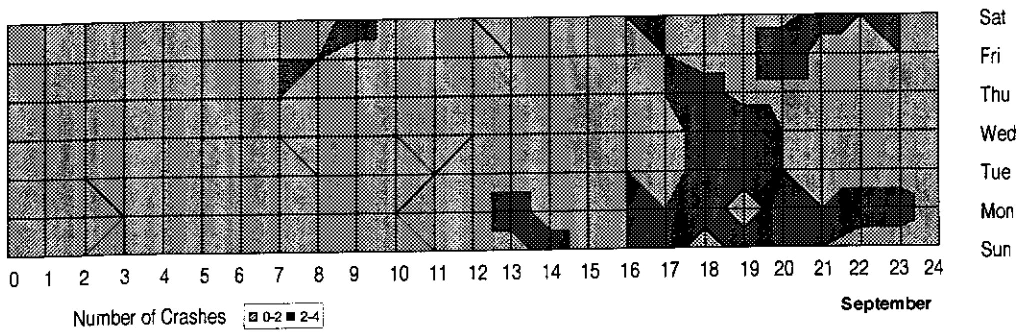


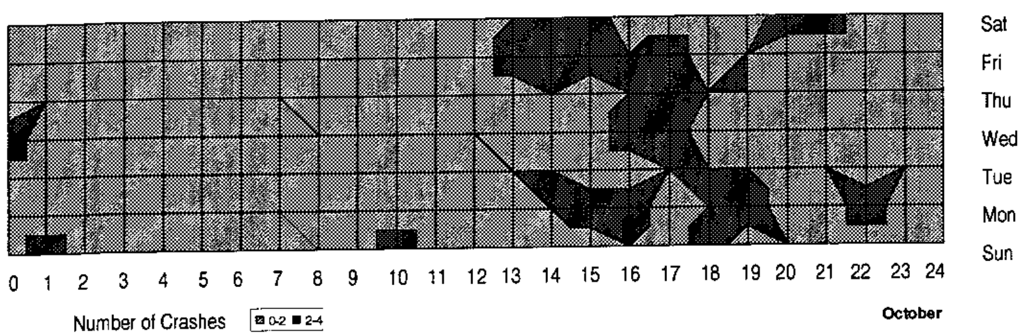


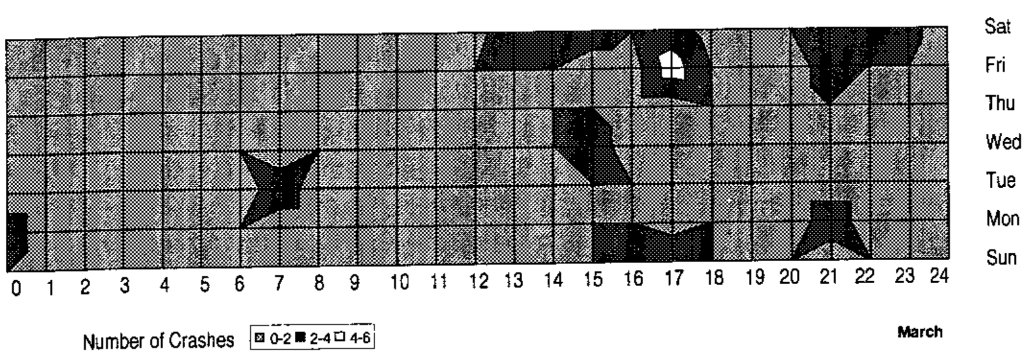


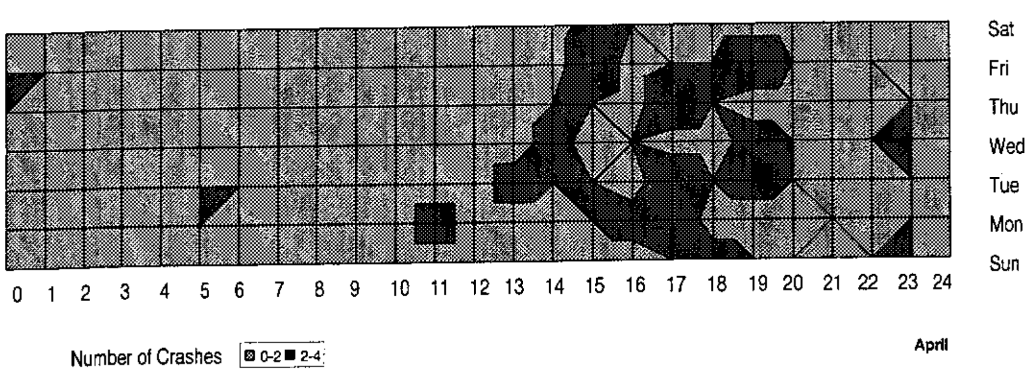
MONTHLY VARIATION IN THE TEMPORAL DISTRIBUTION OF MID-BLOCK PEDESTRIAN CRASHES, 1995-1997

Hourly distribution is represented in the x-axis and day of week in the y-axis. Hour zero is 12:00 Midnight to 1:00 a.m. and so forth.





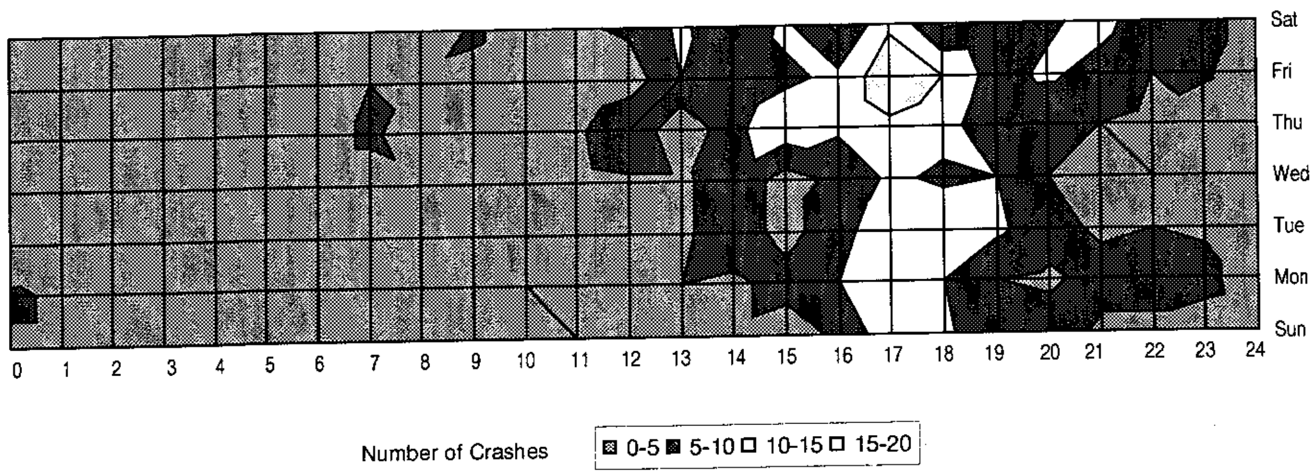




TEMPORAL DISTRIBUTION OF MID-BLOCK PEDESTRIAN CRASHES, 1995-1997

Sum of Crashes	Day of Week							
Hour	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Grand Total
0	4	6		4	1	5	4	24
1	4	4	1	1	3	2		15
2	1		1	3	1	2	1	9
3	4	2	1			1	1	9
4	2	1		1		1	4	9
5	1	1	1		1			4
6	1	1	3	2	2	2		11
7	1	3	5	2	6	5	1	23
8	1		4	4	2	4		15
9	2	2	1	2	3	3	6	19
10	2	5	1	3		2	2	15
11	5	4	2	3	4		4	22
12	3	3	3	4	10	2	6	31
13	3	5	4	4		10	11	37
14	4	4	8	8	9	7	6	46
15	2	7	3	3	13	9	11	48
16	6	10	9	6	11	11	4	57
17	14	10	12	11	14	19	14	94
18	11	10	14	9	12	15	4	75
19	6	5	11	10	6	8	5	51
20	8	4	7	5	5	11	9	49
21	4	7	4	2	5	8	12	42
22	4	7	5	5	4	5	7	37
23	2	7	4	2	2	6	9	32
Grand Total	95	108	104	94	114	138	121	774

Day of Week represents the total number of crashes for each day of the week.
Hour represents the hour of the day, with hour 0 equivalent to Midnight to 1:00 a.m. and so forth
The Sum of Crashes is the cumulative number of mid-block pedestrian crashes.



Hourly distribution is represented in the x-axis and day of week in the y-axis.

Kenny C. Guinn, Governor

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