Existing Transportation Conditions Report

ENVIRONMENTAL REVIEW OF THE PROPOSED RESTRIPING OF TELEGRAPH AVENUE TO ACCOMMODATE BIKE LANES

Draft

PREPARED FOR:

CITY OF OAKLAND

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I. Introduction

Telegraph Avenue is an important connection between the cities of Oakland and Berkeley serving regional, sub-regional and local traffic. Telegraph Avenue is also an important multi-modal street with significant transit, pedestrian and bicycle travel. Telegraph Avenue connects Oakland and Berkeley to the University of California – Berkeley campus, and connects downtown Berkeley to downtown Oakland. It provides access to many mixed-use and small commercial businesses and is a primary corridor accessing the MacArthur BART Station, as well as other BART stations. These connections to transit centers, citywide and neighborhood commercial centers, and institutional uses like schools centers underscore the importance of Telegraph Avenue's multi-modal function. The regional significance of Telegraph Avenue as a multi-modal corridor is underscored by the fact that it is included in both the Alameda County Bicycle Master Plan and the Metropolitan Transportation Commission's Bay Area Regional Bicycle Plan.

This Existing Conditions Report has been prepared by Kimley-Horn and Associates, Inc. (Kimley-Horn) for the purpose of analyzing current transportation conditions of Telegraph Avenue and identifying existing intersection capacity, as well as an assessment of bicycle and pedestrian issues.

A. Study Corridor

The study corridor covers a 2.47-mile segment of Telegraph Avenue within Oakland City limits. The limits of the study area are Aileen Street on north side and 16th Street on south side as shown in Figure 1. Most of the corridor is zoned as a Commercial Shopping District Zone. Denser development is allowed in the downtown area. 52nd Street and 54th Street are zoned as high-density residential areas. Surrounding the study corridor is a mix of low, medium, and high density housing as well as commercial uses.

Telegraph Avenue is classified as a major arterial street and has the following traffic characteristics:

- Posted Speed Limit: 25 miles per hour (mph) from 16th Street to 55th Street. North of 55th Street, speed limit increases to 30 mph. This speed limit continues into the City of Berkeley. Recent speed measurements show that the 85th percentile speed[1] ranges from 28.5 mph to 29.8 mph.

- On-Street Parking: Except for small portions, there is continuous on-street parallel parking along the both sides of Telegraph Avenue.

- Cross Section: Telegraph Avenue is primarily configured as a five-lane cross section road, which includes two through lanes southbound, two through lanes northbound

[1] The 85th percentile speed is the speed at which the majority (85%) of drivers travel at or below. This measurement is used to establish speed limits.

and a single center left turn lane which alternates between a Two Way Left Turn Lane and a single-direction left turn lane at intersections. Parking lanes are located on both sides of the corridor. The curb to curb width of Telegraph Avenue ranges from about 55-feet to over 80-feet.

- Grade: Telegraph Avenue is relatively flat and straight with no significant grade changes that would affect sight distance while traveling along the street.

- Off-set Intersections: Telegraph Avenue has numerous intersections in which the side streets are not aligned, creating closely spaced "T" intersections. Traffic crossing Telegraph Avenue on these side streets is required to "jog" across Telegraph Avenue to if traveling through on these side streets. While a series of "T" intersections reduces the number of conflicts at the intersection (from 24 conflict points to 12) though movements can be difficult to negotiate. There are approximately 12 off-set intersections on Telegraph Avenue with the study corridor.

- Bike Lanes: There are no bike lanes within the study corridor limits. Within the City of Oakland there are existing bike lanes on Telegraph Avenue from Aileen Street to Woolsey Street. These bike lanes continue into the City of Berkeley.

- Freeway Access: Telegraph Avenue provides direct and indirect access to Highway 24 at multiple locations along the corridor and direct access to Interstate 580 near 36th Avenue. Highway 24 is a primary regional connection to Interstate 580 (I-580) and Interstate 880 (I-880), the Caldecott Tunnel and Contra Costa County, and Interstate 80 and the San Francisco-Oakland Bay Bridge.

- Regional Transit Corridor: served by three major AC Transit bus lines and two BART stations. Telegraph Avenue has been proposed as a candidate corridor for implementation of Bus Rapid Transit (BRT).

B. Data Collection

Kimley-Horn conducted a field reconnaissance of the entire corridor to observe travel conditions and collect relevant geometric and operational data. The following criteria and characteristics were inventoried during the field reconnaissance for 53 intersections on Telegraph Avenue from Aileen Street to 16th Street. This information was used as part of the analysis of pedestrian and bicycling conditions.

<u>Data Used in Bicycle Analyses</u>

- Outside lane widths
- Posted speed limit
- General pavement conditions
- On-street parking and percent occupied

- General sight distance from intersections and driveways (driver's ability to see oncoming bicyclists and pedestrians)
- Signal phasing and left and right turning vehicle conflicts

<u>Data Used in Pedestrian Analyses</u>

- Spacing between intersections
- Pedestrian buffer from traffic (e.g. planting strips, street trees, on-street parking)
- Signal phasing
- Pedestrian signals and pushbuttons
- Right turn radius (as a indicator of right turn speed)
- Crosswalks on intersection approaches
- Crossing width
- General sight distance from intersections and driveways (driver's ability to see oncoming bicyclists and pedestrians)
- ADA conformance at intersections

Data from field Reconnaissance is illustrated in figures included in the Appendix. In addition to the data collected and observed in the field, Kimley-Horn has conducted the following quantitative surveys:

1) Manual turning movement counts at 53 intersections during three 2-hour AM, Midday, and PM periods.
2) Mid-block turning movement counts at two major generating driveways.
3) Round-trip auto travel time surveys along two routes during three 2-hour AM, Midday and PM periods.
4) Bi-directional transit travel times for each bus route traveling between 19th and Aileen during a 2-hour PM Peak period.
5) Pedestrian and bicycle directional counts at 17 intersections during three 2-hour AM, Midday, and PM periods.

II. Existing Traffic Conditions

A. Average Daily Traffic Volumes

Twenty-four hour bi-directional mechanical tube traffic count data was collected at eight locations within the study area over a one-week time period. Data used for this analysis was collected during the first week of December, 2002 and the third and fourth weeks of January, 2003 to avoid holiday variations. Data was collected at the following locations on Telegraph Avenue:

1) South of Alcatraz Avenue
2) South of 51st Street
3) North of 42nd Street
4) South of 40th Street
5) Between West MacArthur Boulevard and 27th Street
6) Between 27th Street and West Grand Avenue
7) Between 21st Street and 22nd Street
8) Between 18th Street and 19th Street

Table 1 summarizes ADTs along these eight segments.

Table 1: Average Daily Traffic (ADT) Counts on Telegraph Avenue

Location	Direction	ADT Weekday	ADT Combined
South of Alcatraz Avenue	Southbound	22,852	38,689
	Northbound	15,837	
South of 51st Street	Southbound	12,156	25,577
	Northbound	13,421	
North of 42nd Street	Southbound	11,992	23,713
	Northbound	11,721	
South of 40th Street	Southbound	11,177	23,562
	Northbound	12,385	
Between West MacArthur Boulevard and 27th Street	Southbound	8,976	18,190
	Northbound	9,214	
Between 27th Street and West Grand Avenue	Southbound	7,673	15,509
	Northbound	7,836	
Between 21st Street and 22nd Street	Southbound	7,051	13,618
	Northbound	6,567	
Between 18th Street and 19th Street	Southbound	4,481	10,243
	Northbound	5,762	

Generally traffic volumes on Telegraph Avenue are concentrated in the Temescal Shopping District located between 40th and 55th Streets. Specifically, Telegraph /Claremont/ 51st and Telegraph/West MacArthur are considered busy traffic intersections. As described above, there is a major freeway interchange between 35th and 36th Streets with on ramps to Highway 24 and Interstate 580. Also there is a freeway interchange between 55th and Aileen Streets with Highway 24 on and off-ramps.

The ADT traffic count data are included in the Appendix. From inspection of the data, it is clear that traffic volumes increase towards the Highway 24 ramps on the north end of the study corridor.

B. Intersection Turning Movements and Peak Hour Volumes

Two-hour morning, midday and evening peak hour turning movement counts were collected at fifty-three intersections within the study corridor. Morning peak hour turning movement counts were collected from 7:00 AM to 9:00 AM. Midday peak hour turning movement counts were collected from 11:00 AM to 1:00 PM. Evening peak hour turning movement counts were collected from 4:00 PM to 6:00PM. Data was collected during the third and fourth weeks of January, 2003 at the following 53 intersections on Telegraph Avenue:

1- Aileen Street/Hwy 24 Off Ramp
2- 56th Street/Hwy 24 EB On Ramp
3- 55th Street
4- 52nd Street/Claremont Avenue
5- 51st Street
6- 50th Street
7- 49th Street - East Approach
8- 49th Street - West Approach
9- 48th Street - West Approach
10- 48th Street - East Approach
11- 47th Street
12- 46th Street
13- 45th Street/Shattuck Avenue
14- 44th Street
15- 43rd Street
16- 42nd Street
17- 41st Street
18- 40th Street
19- 39th Street
20- Apgar Street
21- 38th Street
22- MacArthur Boulevard
23- 37th Street - West Approach
24- 37th Street - East Approach
25- 36th Street
26- 34th Street
27- 33rd Street
28- Hawthorne Avenue
29- 32nd Street
30- 31st Street
31- 30th Street - East Approach
32- 30th Street - West Approach
33- 29th Street
34- 28th Street - West Approach
35- 28th Street - East Approach
36- Merrimac Street
37- 27th Street
38- 26th Street
39- Sycamore Street
40- 25th Street - East Approach
41- 25th Street - West Approach
42- 24th Street - East Approach
43- 24th Street - West Approach
44- 23rd Street
45- W Grand Street
46- 22nd Street
47- 21st Street
48- 20th Street
49- Williams Street
50- 19th Street

51- 18th Street
52- 17th Street
53-16th Street

Complete peak hour turning movement counts for morning and evening may be found in the Appendix. These counts have been used to analyze and model traffic conditions and operations of the study corridor using the analysis methods found in the Highway Capacity Manual[2] and provide a number of performance measures[3].

C. Existing Intersection Level of Service

Level of Service (LOS) is a qualitative term describing operating conditions a driver will experience while traveling on a particular street or at an intersection during a specific time interval. It ranges from LOS A (very little delay) to LOS F (long delays). For this analysis, intersection level of service is defined as the average control delay[4] measured in seconds per vehicle. The criteria relating delay to LOS is shown in **Table 2**. The LOS criteria for unsignalized intersections differs slightly from the criteria for signalized intersections because driver perception varies. According to research conducted for the Highway Capacity Manual, drivers expect higher volumes at signalized intersections and are less tolerant of delay at unsignalized intersections. Level of service for unsignalized intersections is given for the movement from the side street with the highest delay. As required by the City of Oakland for environmental assessment, LOS and delay are based on the *Highway Capacity Manual*, Transportation Research Board, National Research Council, 2000. To calculate intersection delay, Kimley-Horn uses SYNCHRO software which is based on the Highway Capacity Manual methods and uses actual City signal timing data.

Table 3 presents the existing LOS and delay for twenty-four signalized intersections. Other performance measures such as queue length may be found in the Appendix. As indicated in the table, presently, all signalized intersections within the study corridor operate at LOS D or better. About 92% of the signalized intersections on Telegraph Avenue presently operate at LOS A or LOS B. Only one intersection operates at LOS D.

Table 4 presents the existing LOS and delay for twenty-nine unsignalized intersections. As presented in the table, the worst side-street movement at all of the intersections operates at a LOS E or better, an average delay of 35 to 50 seconds. About 80% of the unsignalized intersections operate at LOS C or better. Four of the unsignalized intersections (14%) operate at LOS E. A comparison of Tables 3 and 4 illustrate the

[2] Highway Capacity Manual Special Report 209, Transportation Research Board, National Research Council, 2000.
[3] Performance measures are standardized ways of measuring transportation operations. For vehicular travel, performance measures include intersection level of service, average delay per vehicle, and travel time, to name a few.
[4] Control delay is the portion of the total delay experienced by drivers at intersections that is attributable to traffic signal operation. It includes the delay for decelerating to a stop at a signal, moving slowly in a queue of vehicles, stopped delay, and acceleration after the signal turns green.

difference in average delay drivers experience at various levels of service. Drivers at signalized intersections experience a slightly higher level of delay than at unsignalized intersection for the same level of service.

Table 2: Intersection Level of Service Definitions

Level of Service	Description	Signalized Avg. Control Delay (sec/veh)	Unsignalized Avg. Control Delay (sec/veh)
A	Free flow with no delays. Users are virtually unaffected by others in the traffic stream	≤ 10	≤10
B	Stable traffic. Traffic flows smoothly with few delays.	> 10 – 20	> 10 – 15
C	Stable flow but the operation of individual users becomes affected by other vehicles. Modest delays.	> 20 – 35	> 15 – 25
D	Approaching unstable flow. Operation of individual users becomes significantly affected by other vehicles. Delays may be more than one cycle during peak hours.	> 35 – 55	> 25 – 35
E	Unstable flow with operating conditions at or near the capacity level. Long delays and vehicle queuing.	> 55 – 80	> 35 – 50
F	Forced or breakdown flow that causes reduced capacity. Stop and go traffic conditions. Excessive long delays and vehicle queuing.	> 80	> 50
Source: Transportation Research Board, *Highway Capacity Manual 2000*, National Research Council, 2000.			

D. Corridor-Wide Traffic Conditions

Intersection level of service is the primary performance measure for a single intersection. For the entire corridor, the primary performance measure is how long it takes a driver to traverse the corridor from one end to the other – referred to as the corridor's "travel time." This performance measure reflects the aggregate delay experienced as the driver passes through all of the intersections. Automobile travel time surveys along Telegraph Avenue were obtained during three 2-hour AM (7:00-9:00), Midday (11:00-1:00) and PM (4:00 – 6:00) peak periods. **Table 5** shows the measured average travel time along Telegraph Avenue for each period. While the average speed appears to be less than the posted speed limit, it is important to note that the time it takes to travel the corridor includes the time waiting at red lights.

Presently, it takes between 10 and 11 minutes to traverse the 2.47 mile study corridor in the morning, midday, and evening peak periods. During the off-peak periods, it takes about 7.5 minutes to travel the length of the corridor. The peak hour travel times equate to an average corridor-wide speed ranging from 13 to 15 mph. Complete travel time data may be found in the Appendix. The measured travel times were used to calibrate the analytical models used in the traffic analysis to improve accuracy. **Table 6** shows the result of this calibration. Percent difference between field travel time and the model for all three scenarios is less than 10 percent. Although there is no established standard for calibrating travel time models, a 10 percent deviation between actual and modeling travel times is considered well-calibrated.

Calibrating analytical models is a method to ensure that the model predicts actual conditions as closely as possible. The model parameters used to calibrate the model's existing conditions are then used in the future analysis.

Table 3: Existing Level of Service (LOS) and Delay at Signalized Intersections on Telegraph Avenue

Cross Street	AM Peak		Midday Peak		PM Peak	
	LOS	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)
16th Street	A	7.4	A	8.8	A	8.9
17th Street	A	7.6	A	6.7	A	5.1
18th Street	A	5.2	A	4.2	A	5.5
19th Street	A	4.8	A	6.0	A	6.2
Williams Street	A	3.4	A	4.2	A	6.2
20th Street	A	5.5	A	5.4	B	12.1
W. Grand Street	B	13.2	B	13.8	B	19.9
24th Street (West)	A	6.4	A	5.7	A	5.9
26th Street	A	6.2	B	11.4	A	8.8
27th Street	B	13.4	B	12.1	B	13.6
29th Street	A	6.0	A	7.3	A	6.3
30th Street (East)	A	4.7	A	6.4	A	8.0
34th Street	A	8.6	A	9.3	B	10.0
MacArthur Boulevard	B	17.4	B	11.8	B	16.2
40th Street	B	12.9	A	9.4	B	15.9
42nd Street	A	5.9	A	6.3	B	12.4
45th Street	B	15.8	B	17.0	B	13.1
48th Street (East)	A	1.7	A	9.3	A	2.8
50th Street	A	6.3	B	10.7	A	5.8
51st Street	C	28.0	C	25.0	D	50.1
52nd Street	B	19.6	B	15.8	B	19.3
55th Street	A	9.9	B	12.2	B	15.3
56th Street	B	18.2	B	19.1	C	25.8
Aileen Street	D	54.7	A	9.7	A	9.8

Table 4: Existing Level of Service (LOS) and Delay at Unsignalized Intersections on Telegraph Avenue

Intersection	Level of Service			Delay (sec/veh)		
	AM	Midday	PM	AM	Midday	PM
49th Street (East)	B	C	D	14.0	16.2	28.5
49th Street (West)	B	C	C	12.8	21.6	20.6
48th Street	B	B	B	12.8	13.8	14.2
47th Street	B	B	B	12.3	14.6	10.6
46th Street	C	E	E	18.8	45.9	47.5
44th Street	C	D	E	22.1	30.5	47.7
43rd Street	C	D	E	21.4	25.1	44.4
41st Street	C	C	D	17.3	21.5	34.7
39th Street	C	B	C	16.6	13.1	18.0
Apgar Street	B	C	C	13.0	15.8	19.4
38th Street	B	C	C	13.0	18.8	22.0
37th Street (West)	C	C	C	16.4	17.4	17.2
37th Street (East)	B	C	C	13.6	18.3	20.7
36th Street	B	B	C	12.3	13.8	21.1
33rd Street	C	C	C	17.0	21.5	22.9
Hawthorne Avenue	B	C	E	14.5	21.1	35.4
32nd Street	B	C	C	13.9	16.6	15.4
31st Street	B	C	C	14.5	18.6	22.9
30th Street	C	C	C	15.8	17.4	22.2
28th Street (West)	B	B	C	13.4	14.6	19.5
28th Street (East)	C	C	D	19.2	22.8	27.6
Merrimac Street	B	C	B	14.3	15.2	11.1
Sycamore Street	B	B	C	11.3	11.6	15.3
25th Street (East)	B	B	B	11.1	14.1	12.3
25th Street (West)	B	B	B	10.1	10.2	13.5
24th Street	B	B	B	11.3	13.8	13.3
23rd Street	C	C	C	17.1	17.4	23.7
22nd Street	B	B	B	14.5	13.3	13.3
21st Street	C	C	C	22.2	16.8	18.6

Table 5: Existing Corridor-Wide Travel Time on Telegraph Avenue from Aileen Street to 16th Street

Time of Day	Average Travel Time (Min:Sec)		Equivalent Speed (MPH)
	Northbound	Southbound	
AM Peak	10:05	10:08	15
Midday Peak	10:23	10:10	14
PM Peak	11:03	11:17	13
Free Flow Speed	7.2	8.4	20

Table 6: Telegraph Avenue SYNCHRO Model Calibration Results

Time of Day	Travel Time (Min:Sec)				Percent Difference
	Northbound		Southbound		
	Field Measured	Model Prediction	Field Measured	Model Prediction	
AM Peak	10:05	9:06	10:08	10:10	~ 6%
Midday Peak	10:23	10:10	10:10	9:38	~ 4%
PM Peak	11:03	10:00	11:17	9:58	~ 9%

III. Pedestrian and Bicycle Conditions

Based on field observation, Kimley-Horn assessed pedestrian and bicycle travel in corridor. This assessment provides quantitative and qualitative assessment of how safe and efficient travelers are able to walk and bike along the corridor.

A. Description of Pedestrian Facilities

Telegraph Avenue has continuous sidewalks on both sides of the street throughout the study corridor. All signalized intersections along Telegraph Avenue within the study area are equipped with pedestrian signal heads and crosswalks, but not on all approaches of intersections. All unsignalized intersections have crosswalks.

B. Description of Bicycle Facilities

Presently, Telegraph Avenue has striped bicycle lanes from Aileen Street to Woolsey Street, outside of the study corridor. These lanes are not considered legal Class II bicycle lanes because they do not have the associated signing required. Presently, the bicycle lanes from Aileen Street to Woolsey Street have faded paint. The bicycle lane system becomes discontinuous between downtown Oakland and the City limits; there are no bicycle lanes between 16^{th} and Aileen Streets.

C. Pedestrian and Bicycle Counts

Pedestrian and bicycle counts were conducted on Telegraph Avenue at 17 intersections during the morning (7:00 a.m. to 9:00 a.m.), midday (11:00 a.m. to 1:00 p.m.) and afternoon (4:00 p.m. to 6:00 p.m.) peak periods. These counts were conducted in good weather during the week of September 16 through 18, 2003 when schools were in session, including the University of California at Berkeley. Bicycle counts were conducted similar to vehicle traffic turning movement counts, recording each turning and through movement on all four approaches of Telegraph Avenue and side streets. In addition, bikes stored on bus bike racks were counted on buses traveling on Telegraph Avenue. Bicyclists riding on sidewalks were also counted. Pedestrians were counted as they crossed the street in all directions at the 17 intersections. Pedestrian and bicycle count data is located in the Appendix.

The 17 intersections were selected to reflect bicycle travel throughout the entire corridor from the northern endpoint at the City limit to the southern endpoint in downtown, and at mid-corridor intersections at major intersections. **Tables 7 and 8** present the a.m., midday, and p.m. peak hour pedestrian and bicycle counts respectively.

Table 7: Pedestrian Volume Counts on Telegraph Avenue

	AM Peak						Midday Peak						PM Peak					
	Telegraph Avenue			Side Street			Telegraph Avenue			Side Street			Telegraph Avenue			Side Street		
Intersection	**NB**	**SB**	**Total**	**EB**	**WB**	**Total**	**NB**	**SB**	**Total**	**EB**	**WB**	**Total**	**NB**	**SB**	**Total**	**EB**	**WB**	**Total**
16th Street	68	23	91	80	0	80	177	59	236	175	0	175	80	51	131	142	0	142
17th Street	51	46	97	92	40	132	98	59	157	115	53	168	66	69	135	98	38	136
20th Street	56	77	133	149	74	223	99	89	188	67	68	135	144	95	239	66	59	125
27th Street	17	18	35	18	20	38	15	23	38	23	34	57	15	25	40	45	29	74
29th Street	20	22	42	24	22	46	36	17	53	22	52	74	17	14	31	42	30	72
34th Street	24	48	72	27	23	50	17	72	89	40	17	57	37	79	116	35	29	64
38th Street	9	40	49	0	21	21	7	24	31	0	43	43	2	37	39	0	34	34
40th Street	50	57	107	51	42	93	6	20	26	6	15	21	3	30	33	14	49	63
41st Street	40	43	83	67	30	97	26	68	94	62	8	70	38	58	96	60	14	74
45th Street	58	59	117	52	85	137	44	12	56	46	60	106	30	35	65	75	58	133
51st Street	16	17	33	38	27	65	34	31	65	67	73	140	43	21	64	82	36	118
Aileen	2	0	2	1	0	1	3	1	4	6	0	6	1	6	7	15	0	15
Alcatraz	38	31	69	29	28	57	23	27	50	28	21	49	26	34	60	24	31	55
Claremont	0	17	17	34	13	47	1	30	31	28	22	50	0	30	30	50	8	58
MacArthur	9	40	49	21	18	39	7	24	31	38	50	88	2	37	39	25	29	54
W. Grand Street	22	33	55	42	27	69	23	41	64	22	45	67	22	42	64	45	47	92
Woolsey	39	20	59	41	46	87	42	54	96	60	61	121	37	40	77	108	41	149
Total Corridor	**519**	**591**	**1,110**	**766**	**516**	**1,282**	**658**	**651**	**1,309**	**805**	**622**	**1,427**	**563**	**703**	**1,266**	**926**	**532**	**1,458**

Source: Kimley-Horn and Associates, Inc. Counts conducted September 16-18, 2003. Corridor totals are approximate as some double counting occurs at adjacent intersections.

Table 8: Bicycle Volume Counts on Telegraph Avenue

Intersection	AM Peak						Midday Peak						PM Peak					
	Telegraph Avenue			Side Street			Telegraph Avenue			Side Street			Telegraph Avenue			Side Street		
	NB	SB	Total	EB	WB	Total	NB	SB	Total	EB	WB	Total	NB	SB	Total	EB	WB	Total
16th Street	9	12	21	1	0	1	17	14	31	4	0	4	20	10	30	15	0	15
17th Street	12	16	28	5	2	7	12	12	24	7	3	10	12	5	17	5	2	7
20th Street	7	24	31	5	8	13	13	19	32	7	6	13	19	15	34	9	11	20
27th Street	8	23	31	2	13	15	11	14	25	2	2	4	23	18	41	9	8	17
29th Street	19	20	39	2	1	3	12	15	27	2	1	3	32	22	54	5	3	8
34th Street	20	30	50	13	2	15	9	15	24	10	2	12	24	21	45	9	3	12
38th Street	22	33	55	0	0	0	17	19	36	0	2	2	41	28	69	0	3	3
40th Street	16	34	50	22	26	48	16	24	40	6	6	12	32	21	53	4	10	14
41st Street	80	101	181	20	36	56	18	19	37	6	0	6	34	22	56	19	4	23
45th Street	37	38	75	2	7	9	27	22	49	5	2	7	38	35	73	10	4	14
51st Street	31	22	53	4	7	11	25	26	51	9	9	18	35	32	67	14	10	24
Aileen	25	23	48	4	0	4	17	14	31	1	0	1	21	43	64	5	0	5
Alcatraz	46	33	79	22	16	38	22	24	46	13	17	30	20	44	64	22	20	42
Claremont	26	7	33	4	6	10	19	11	30	1	6	7	20	20	40	2	6	8
MacArthur	22	32	54	6	13	19	15	17	32	11	6	17	39	28	67	40	10	50
W. Grand Street	13	27	40	9	9	18	12	10	22	2	9	11	24	27	51	10	10	20
Woolsey	21	24	45	16	13	29	13	15	28	8	7	15	24	15	39	13	13	26
Total Corridor	**414**	**499**	**913**	**137**	**159**	**296**	**275**	**290**	**565**	**94**	**78**	**172**	**458**	**406**	**864**	**191**	**117**	**308**

Source: Kimley-Horn and Associates, Inc. Counts conducted September 16-18, 2003. Corridor totals are approximate as some double counting occurs at adjacent intersections.

As shown in **Table 7** the intersection near BART stations (17th, 20th, 40th, and 41st) carry relatively high pedestrian volumes during the peak hours, particularly in the morning commute period. Intersections near commercial centers also carry relatively high pedestrian volumes. In total, at the intersections counted, Telegraph Avenue carries between 1,100 and 1,460 pedestrians in the peak hours.

Bicycle travel along Telegraph Avenue is concentrated around the MacArthur BART station, especially during the morning commute peak, as shown in **Table 8**. In total, Telegraph Avenue carries between 570 and 910 bicycles during the peak hours in both directions. These corridor-wide totals are approximate because some double counting occurs at adjacent intersections. Even accounting for the double counting, the Telegraph Avenue corridor carries a relatively high volume of bicycle traffic.

Few bikes were observed on buses traveling along Telegraph Avenue, generally less than 8 bikes during any given hour. Similarly, few bicyclists were observed riding on sidewalks, possibly because the high volume of pedestrian traffic makes riding on the sidewalk slow and unsafe.

D. Pedestrian and Bicycle Assessment Methodology

As of this writing there is no accepted standard methodology for evaluating the relative safety of streets and intersections for pedestrians and bicyclists. There are standards for the design and implementation of crosswalks, pedestrian signals, minimum signal clearance intervals, signing, and other devices and measures that have been developed by the California Department of Transportation (Caltrans), the Institute of Transportation Engineers (ITE), the American Society of Civil Engineers (ASCE), the Transportation Research Board (TRB), the American Association of State Highway Transportation Officials (AASHTO), and the Federal Highways Administration (FHWA).

A research paper in the *Journal of Transportation Planning* published by the American Planning Association (APA) addressed the issue of developing a level of service methodology for pedestrians and bicyclists. This approach was studied by the FHWA through the University of North Carolina.

The methodology used in this analysis incorporates many of the concepts in the APA research paper, but expanded the methods to make the criteria more measurable and more sensitive to actual observed field conditions. A scoring mechanism was developed for each of the criteria which reflects the relative importance of that criterion, but which obviously involves some professional judgment. Each intersection and corridor was tested and the criteria scoring was adjusted to reflect observed conditions in the study area. As a result, the general ranking reflects some obvious differences in the relative safety and performance of the locations studied. Most importantly, an evaluation of each intersection was completed relative to each other to determine a baseline set of conditions. This effort is required so that the analysis of proposed restriping changes can be assessed using a common set of data.

The following criteria were used to evaluate the pedestrian and bicycle performance measures at intersections and along the corridor:

✓ **Corridor (Bicycle Performance Measure)**

- No Bike Lane
- Bike Lane with or without Parking
- Bike Lanes in Relation to Traffic Volumes
- Pavement Maintenance
- On-Street Parking
- Driveways and Side Streets--Fewer Than 22 Per Mile
- Corridor Speed

✓ **Intersections (Pedestrian Performance Measure)**

- Signal Phasing
- Sight Distance
- Right Turn Speeds
- Crosswalks
- Right Turn Conflicts
- Pedestrian Signals

<u>Evaluation Criteria</u>

The following definitions explain the applicability of the characteristics used in evaluating the pedestrian and bicycle performance measures at intersections and along corridors. These criteria, and the maximum number of points assigned to them, are presented in the Performance Measure worksheets located in the Appendix.

No Bike Lane (Bicycle Corridors) - refers to on-street Class III (unstriped) bike routes.
Class III bike routes are generally acceptable on low traffic volume collector and residential streets, but less desirable when travel lanes are 14 feet wide or less. Wider curb lanes (14-19 feet) provide more clearance between vehicles and bicycles thus reducing potential conflicts.

Bike Lane With or Without Parking (Bicycle Corridors) - refers to on-street Class II (striped) bike lanes on streets with or without curbside parking. The presence of the lane provides a visible separation of vehicle and bicycle travel lanes for both motorists and bicyclists. The standard width of Class II bike lanes varies from 4 to 5 feet with 4 foot width generally acceptable only on low traffic volume streets. Narrower bike lanes on streets that permit curbside parking are less desirable. Five foot wide bike lanes are ideal to good on street regardless of the traffic volume and curbside parking.

Bike Lanes in Relation to Traffic Volumes (Bicycle Corridors) - the existence or lack of bike lanes is related to the daily traffic volumes of the street. Generally, streets with less than 5,000 vehicles per day and wide travel lanes do not require bike lanes. As traffic levels increase bike lanes become more important, particularly if curb lanes are narrow. At daily volumes exceeding 10,000 vehicles per day, narrow or no bike lanes are undesirable.

On-Street Parking (Bicycle Corridors) - refers to parking in the travel lanes adjacent to the curb. Parking in this area creates many conflicts for bicyclists such as vehicles performing parking maneuvers, motorists opening doors, and restricted line of sight. For pedestrians, however, curbside parking provides a buffer between the sidewalk and travel lanes and is considered a positive characteristic

Driveways and Side Streets Less Than 22 Per Mile (Bicycle Corridors) - the presence of a high concentration of driveways and side streets creates conflicts for pedestrians and bicycles who must cross. A density of 22 per mile translates into about one driveway or side street every 250 feet, which is average for most urban and suburban streets systems. High concentrations of residential driveways can be particularly hazardous as motorists usually back out, but fortunately driveway maneuvers are infrequent. A typical residential street has a driveway every 50 feet or so. A concentration of commercial driveways can be hazardous due to the volume of traffic, but motorists are generally more aware of oncoming pedestrians and bicyclists than at residential driveways.

Street and Crossing Width (Pedestrian Intersections) - refers to curb to curb street width. Along corridors a width of 40 feet or less (typical residential street width) is desirable, particularly for pedestrians crossing at uncontrolled intersections. Greater than 40 foot widths are tolerable when a median refuge is provided. At intersections a width of 60 feet or less enables pedestrians to cross the roadway without needing an inordinate amount of clearance or time to do so, and reduces the exposure to vehicular traffic. Widths greater than 60 feet with a median refuge 5 feet or wider is generally tolerable but still exposes pedestrians to traffic and may be uncomfortable for children. Intersection crossings greater than 60 feet without a median refuge are generally undesirable for children.

Pavement Maintenance (Bicycle Corridors) - refers to the condition of the corridor street or intersection in terms of pavement condition, transverse ridges, debris in bike lanes and shoulders (street sweeping), trimming of foliage, etc. A well maintained facility is more apt to be used and in general is safer.

Corridor Speeds (Bicycle Corridors) - refers to the prevalent travel speed of vehicles along a corridor (not the posted speed limit). Studies have shown that the severity of pedestrian and bicycle accidents with vehicles traveling 25 mph or less are generally minor, 25-35 mph moderate, and severe or fatal at speeds greater than 35 mph.

Sight Distance (Pedestrian Intersections) - refers to adequate sight distance not hindered by foliage, parked cars, utility poles, street geometry, etc. Along corridors, numerous sight distance restrictions such as road curvature and overgrown hedges increase the potential for conflicts. At unsignalized intersections, adequate sight distance from the stop bar enables motorists to look for gaps in traffic without creeping into the crosswalk and forcing pedestrians to go around into the travel lane.

Signal Phasing (Bicycles and Pedestrians at Signalized Intersections) - signal phases are divided into four classifications with increasing potential for conflicts between vehicles and pedestrians and bicyclists:

1) All-Pedestrian Phases offer the most protection for pedestrians and bicyclists because all traffic must wait through the phase (except right turns on red unless prohibited).

2) Protected Phases (e.g. leading left) offer less protection for pedestrians and bicyclists. While they are protected from left turning vehicles, they are subject to conflicts with right turning vehicles on the green.

3) Split Phases where all movements from one leg of an intersection are permitted, offer less protection for pedestrians and bicyclists because the right turns are given the green to proceed through the intersection and may be less attentive to pedestrian and bicycle activity.

4) Single Phases (e.g. permitted left turns) also offer the least protection to pedestrians and bicyclists because they are exposed to left turning vehicles who are watching for gaps in oncoming traffic, as well as right turning traffic. This type of phasing becomes less desirable to pedestrians and bicyclists as left turn volumes exceed 200 per hour. Often, at congested intersections, left turns experience long delays which cause motorists to become impatient and inattentive to pedestrians and bicycles.

Right Turn Speeds (Bicycle Corridors and Pedestrian Intersections) - refers to intersections design with “porkchop” channelizing islands which promote high turning speeds. Sometime referred to as "free right" turns, these movements can be at speeds up 40-45 mph on arterials. Generally these movements are associated with unprotected crosswalks between the sidewalk and the island creating the potential for conflicts. If properly designed, porkchop islands can slow traffic and increase pedestrian visibility to motorists. Standard small radii (20-40 feet) intersections generally force right turns to slow.

Crosswalks (Pedestrian Intersections) - the presence of crosswalks on each approach of an intersection alerts drivers to potential pedestrian activity. Approaches without crosswalks encourage pedestrians to cross at unmarked approaches because it is more convenient than crossing an intersection several times.

Right Turn Restrictions (Pedestrian Signalized Intersections) - refers to how right turn traffic is controlled at intersections. Generally vehicle right turns have a high potential for conflicts because the motorists are often looking to their left for gaps and fail to observe pedestrians and bicycles to their right. The safest type of control for pedestrians and bicyclists is prohibiting right turn (on green) during peak pedestrian and bicycle commute periods. This type of control, however, has severe ramifications on vehicular capacity and travel patterns. Prohibiting right turns on red provides pedestrians and bicyclists a second level of safety reducing the "looking left" situations. Permitting right turns on red provides the minimum level of safety for pedestrians and bicyclists.

Right Turn Conflicts (Bicycle Corridor and Pedestrian Intersections) - refers to the level of exposure pedestrians and bicyclists are subject to from right turning traffic. Generally, less than 200 vehicles per hour (vph) (about 5 per cycle at signalized intersections) turning right is safe. Between 200 and 500 (5-14 per cycle) vph turning right is less safe but tolerable. Right turns greater than 500 vph is considered undesirable for pedestrians and bicyclists.

E. Pedestrian and Bicycle Corridor Performance Measures

Corridor performance measures were calculated at a total of ten segments along Telegraph Avenue using the evaluation criteria described in the previous section. Segments could score a maximum of 100% of potential points. The weighing of each criterion was accomplished by an initial allotment of points based on relative importance and then multiplied by a weighing factor, which reflected (a) convenience, (b) exposure, or (c) protection. Characteristics primarily for convenience are given less weight (1) than those for protection (3).

The scores themselves are the most important output, showing the relative ranking of each segment. A high score does not mean that the segment is 100 percent safe, but the facility is relatively safe to use or has already many desirable features for pedestrians or bicyclists when compared to other locations. A summary of segments scores and performance measures are shown in **Table 9**.

Because bike lanes are the single highest weighted criteria for bicycle travel on arterial streets with average daily traffic volumes greater than 10,000, Telegraph Avenue generally scores low because it does not have bike lanes.

Table 9: Summary of Segment Performance Measures along Telegraph Avenue

Segment	Bicycles (Maximum Score = 94)	
	Score	Ratio of Segment Score to Maximum Possible Score
Aileen to Claremont	32	0.34
Claremont to 48th	29	0.31
48th to 42nd	21	0.22
42nd to 38th	21	0.22
38th to 34th	26	0.28
34th to 29th	26	0.28
29th to 25th	26	0.28
25th to West Grand	24	0.26
West Grand to 20th	24	0.26
20th to 16th	24	0.26
Average	**25.3**	**0.27**

F. Pedestrian Intersection Performance Measures

Intersection performance measures were calculated for 23 signalized intersections using the pre-described evaluation criteria. As with segments, intersections could score a maximum of 100 percent of potential points. A summary of intersection performance measures is shown in **Table 10**.

Some of the highest scoring intersections (i.e. 16th and Williams Street) have all-pedestrian phasing, which is the single highest weighted evaluation criteria for pedestrians at intersections. Additionally, because Telegraph Avenue has many signalized intersections with permitted phasing (i.e. allows turns against oncoming traffic – see criteria description above) the intersections tend to have lower scores. Permitted phasing creates more conflicts between pedestrians and turning vehicles than protected (green arrow) phasing.

Table 10: Summary of Intersection Performance Measures Along Telegraph Avenue

Signalized Intersections	Pedestrian (Maximum Score = 53)	
	Score	Performance
16th Street	49	0.92
17th Street	33	0.62
18th Street	33	0.62
19th Street	33	0.62
Williams Street	49	0.92
20th Street	33	0.62
W. Grand Street	31	0.58
24th Street (West)	32	0.60
26th Street	33	0.62
27th Street	29	0.55
29th Street	33	0.62
30th Street (East)	33	0.62
34th Street	33	0.62
MacArthur Boulevard	23	0.43
40th Street	33	0.62
42nd Street	33	0.62
45th Street	33	0.62
48th Street (East)	32	0.60
51st Street	38	0.72
52nd Street	30	0.57
55th Street	31	0.58
56th Street	26	0.49
Aileen Street	28	0.53
Average	**33.09**	**0.62**

IV. Existing Transit Conditions

A. Existing Transit Service and Facilities

Bus service along Telegraph Avenue is provided by the Alameda-Contra Costa Transit District (AC Transit). The AC Transit system serves 230,000 riders daily in 13 cities in Alameda and western Contra Costa Counties, AC Transit is the largest bus-only system in California.

Description of Routes and Bus Stops in the Study Corridor

Bus lines traveling within the study area corridor are Routes 40, 40L and 43. Routes 40 and 40L are essentially the same except that 40L has limited service stops. Routes 40 and 40L run from the Berkeley BART station to the Bay Fair BART station in San Leandro while passing through Oakland. Other BART stations are directly and indirectly served by these routes, including MacArthur, 19th, and 12th Street Stations. Route 43 runs from the El Cerrito Plaza BART Station to the Eastmont Transit Center.

Bus stops are located within walking distance from each other on both sides of Telegraph Avenue. Most of the bus stops are near side bus stops, meaning that buses stop at intersections before crossing the intersection. Figures included in the Appendix clarify the location of all bus stops along the corridor. Bus stops will be reviewed for potential geometric and operational impacts with implementation of the bike lanes.

Access to BART

Telegraph Avenue provides access to several BART stations. Telegraph Avenue lies adjacent to the 12th Street, 19th Street and MacArthur BART stations in Oakland, as well as in close proximity to the Ashby Street and Rockridge BART stations in Berkeley. Telegraph also provides access to Berkeley BART, El Cerrito Plaza BART and Bay Fair BART in San Leandro. Access to these BART stations is either direct or through bus lines 40 and 43. Serving as a connection between all the BART stations and transit centers, Telegraph Avenue is considered a significant multi-modal corridor.

B. Existing Transit Ridership

Routes 40/40L/43, serve stops along Telegraph Avenue, and carry 21,300 weekday riders. As shown in **Table 11**, there are about 4,200 daily boardings in the Oakland portion of Telegraph Avenue at the 33 stops within the study corridor. **Table 11** shows the boardings and exits for each stop within the study corridor. The three routes serving Telegraph Avenue combined serve 7,800 boardings and exits per day.

Table 11: Telegraph Avenue Bus Ridership on Routes 40, 40L and 43

Stop	Boardings	Exits
Telegraph & Prince	31	25
Telegraph & 66th	45	53
Telegraph & Alcatraz	138	131
Telegraph & 62nd	47	57
Telegraph & 60th/McAuley	64	57
Telegraph & 58th	75	74
Telegraph & Aileen	35	46
Telegraph & 55th	58	60
Telegraph & 52nd/Claremont	147	106
Telegraph & 50th	82	30
Telegraph & 49th	44	66
Telegraph & 48th	67	19
Telegraph & 46th	38	59
Telegraph & 45th	54	27
Telegraph & 44th	78	13
Telegraph & 43rd	26	55
Telegraph & 42nd	232	142
Telegraph & 40th	481	432
Telegraph & 38th	29	50
Telegraph & MacArthur	307	212
Telegraph & 36th	85	62
Telegraph & 34th	224	207
Telegraph & 32nd	61	55
Telegraph & 31st	101	125
Telegraph & 30th	166	103
Telegraph & 29th	97	154
Telegraph & 27th	278	223
Telegraph & 24th	151	179
Telegraph & Grand	211	167
Telegraph & 20th	297	242
Telegraph & 19th	198	119
Telegraph & 18th	97	107
Telegraph & 16th	188	141
Total	**4232**	**3598**

Source: AC Transit from year 1999 surveys.

C. Existing Transit Travel Times

Both routes 40 and 43 travel Monday through Sunday along Telegraph Avenue with a headway of 30-minutes during AM and PM peak hours. **Table 12** presents the average travel times during the PM peak hour (4:00 – 6:00 PM) for each routes along Telegraph Avenue within the study corridor. Route 40 covers the entire length of the study corridor while route 43 covers only a portion of the study corridor from 45th to 16th Street.

Table 12: AC Transit Route Travel Times on Telegraph Avenue

Bus Line #	Travel Time (Min:Sec)	
	Northbound	Southbound
40 (40L)	17:33	16:34
43	14:19	12:13

Detailed transit travel time spreadsheets may be found in the Appendix. Transit travel times include dwell time (the time buses remain at a bus stop while passengers board and exit), the time it takes for a bus to get back into the traffic flow, and the time it takes for the bus to travel the corridor. With 33 bus stops, the average transit time along the corridor is 20% to 55% longer than the average travel time for an automobile.

V. Existing On-Street Parking

A. Parking Supply

Except for a few short segments, on-street parking exists on both sides of Telegraph Avenue providing parking spaces for commercial uses along the corridor. Parking is generally metered with 30 minute to 2-hour meters. There are short segments of unmetered parking in the northern end of the corridor which are subject to a 2-hour time restriction which is enforced. Segments of Telegraph Avenue that have no on-street parking include:

East Side of Telegraph Avenue:

- Between West Grand Avenue and 22nd Street
- Between MacArthur Boulevard and 38th Street
- Between 51st Street and 52nd Street

West Side of Telegraph Avenue:

- Between 19th and 20th

B. Parking Occupancy

Depending on the density of commercial businesses, proximity to BART and proximity to parking garages, parking occupancy varies along Telegraph Avenue. The rate of parking occupancy was observed in the field between 1:00 PM to 2:00PM, which is typically the time of day with the highest parking occupancy. **Table 13** shows the estimated parking occupancy for the entire length of Telegraph Avenue.

Table 13: Estimated Parking Occupancy on Telegraph Avenue

Location	Average Occupancy Rate
East Side of Telegraph	71%
West Side of Telegraph	74%

Although there are parking garages in the downtown area, on-street parking occupancy increases closer to the downtown area. The occupancy of parking spaces on Telegraph Avenue south of West Grand Avenue is nearly always 100%.

On five segments along Telegraph Avenue on-street parking removal is proposed to accommodate bike lanes. **Table 14** shows the location of the proposed parking removal and the actual occupancy of these parking spaces.

Table 14: Proposed Parking Removal and Actual Occupancy

Location	Total Spaces	Proposed Removal	Percent Removed	Actual Occupancy
26th Street and 27th Street (East Side)		4		75%
26th Street and 27th Street (West Side)		5		50%
27th Street and 28th Street (East Side)		3		25%
W. Grand Avenue and 23rd Street (West Side)		4		75%
44th Street and 45th Street (East Side)		1		90%
Total/Average:		**17**		**63%**

Source: Occupancy surveys from 1:00 to 2:00 p.m. conducted by Kimley-Horn and Associates in February, 2003.

C. Commercial Loading Areas

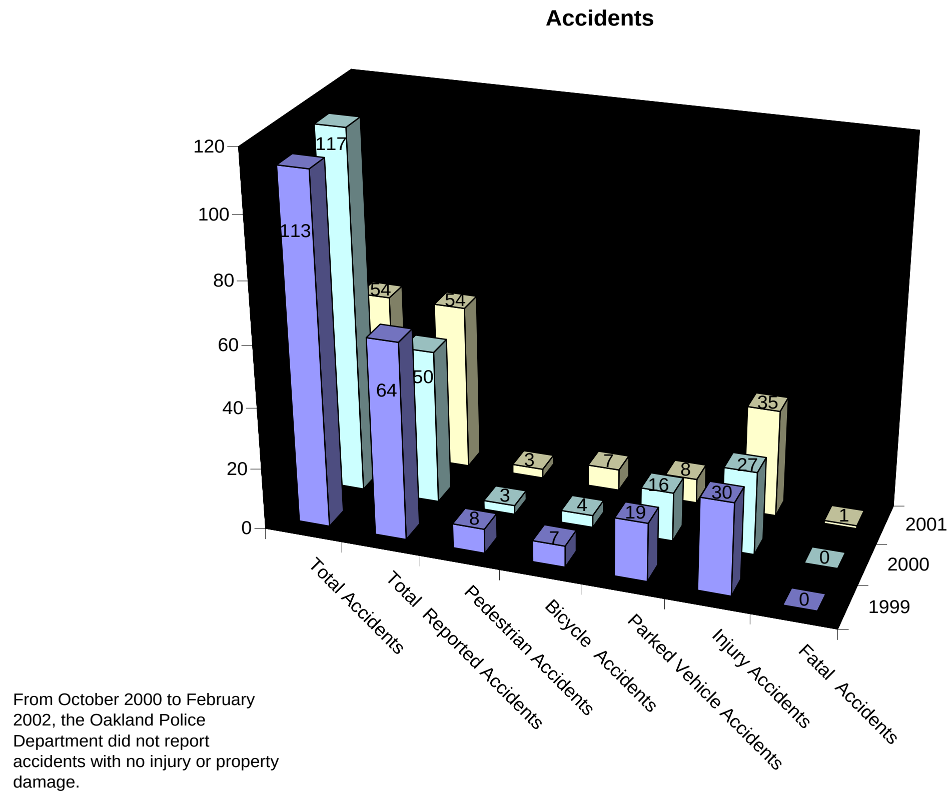
Except for commercial businesses located within a plaza or having off-street parking lots, most of the commercial loading/unloading is currently taking place on Telegraph Avenue adjacent to the curb or double-parking adjacent to the on-street parking lane. Frequently, commercial delivery vehicles are observed blocking a through lane while loading or unloading. This effects traffic flow along Telegraph Avenue.

VI. Accident History

A. Accident Data by Mode

Accident data along Telegraph Avenue were analyzed for three consecutive years. The following chart illustrates the number of accidents for 1999, 2000 and 2001 within the study corridor. Accidents are categorized by total accidents and sub-categorized in four groups: pedestrian, bicycle, accidents with parked vehicle and injury accidents.

Accidents within the Study Area:



It is important to note that for the years of 2001 and 2002 the Oakland Police Department stopped compiling accident data unless the accident involved property damage, injuries, or fatalities. This explains why the total accidents shown in the above chart decreases dramatically in year 2001. The Police Department has since changed this policy and has begun to compile all reported accidents.

B. Accident Rates and Comparison with Statewide Data

The California Department of Transportation compiles statistics on accidents throughout the state and computes accident rates by street type. Accident data included in Caltrans' database includes reported accidents with property damage, injuries and fatalities. According to 2001 Collision Data on California State Highways[5] the accident rate for an urban undivided 5-lane arterial street (the Telegraph Avenue cross-section) with a speed limit less than 45 miles per hour is 4.45 accidents per million vehicle miles (mvm). This rate is calculated using the following formula:

Accident Rate = (Number of Accidents) / Annual Vehicle Miles of Travel on Street x 1,000,000

Based on this formula, **Table 15** presents accident rates for 1999, 2000 and 2001 for the study corridor.

Table 15: Total Accident Rates Within Study Corridor

Year	Accident Rate Within Study Corridor
1999	3.61
2000	2.82
2001	3.05
Average	3.16
Average for Alameda County (urban)	5.82
Statewide Average for Similar Streets	4.45

1) Rates based on property damage, injury, and fatal accidents.
2) Countywide and statewide accident data: Basic average accident rate table for highways for undivided 4+ lane undivided arterial streets in urban areas, 2001 Collision Data on California State Highways, Caltrans, 2001

The average 3-year accident rate in the study corridor (3.16 acc/mvm) is 29% lower than the statewide average rate for similar arterial streets (4.45 acc/mvm). In 1999 the accident rate was 19% lower than the statewide average. In 2000, fewer accidents resulted in a rate that was lower than the statewide average by 37%, and in 2001 the accident rate climbed again, about 31% lower than the statewide average. Telegraph Avenue has a substantially lower accident rate than the Alameda countywide average of 5.82 accidents/mvm on similar 5-lane undivided arterial streets.

Caltrans does not report accident rates for pedestrians and bicycles, but does compile statewide data on the percent of injury and fatal accidents (whether pedestrian, bicycle or auto-related). For the 5-lane undivided type of street, injury accidents are 26% of the total

[5] California Department of Transportation (Caltrans)

accidents, and fatalities are 1% of total accidents. On average over a three year period, about 55% of Telegraph Avenue accidents involved an injury, while only 0.5% of the accidents involved fatalities. Accidents involving pedestrians on Telegraph Avenue are about 8% of the total accidents reported between 1999 and 2001, while accidents involving bicyclists are about 11% of the total.