TRANSPORTATION PLANNING AND
TRAFFIC ENGINEERING CONSULTANTS

2690 Lake Forest Road, Suite C
Post Office Box 5875
Tahoe City, California 96145
(530) 583-4053 FAX: (530) 583-5966
info@lsctahoe.com
www.lsctahoe.com

Tahoe Region Bicycle and Pedestrian Use Models
User Instructions

September 30, 2009

As part of the Tahoe Basin Bicycle / Pedestrian Master Plan, LSC Transportation Consultants, Inc. with assistance from Alta Planning has developed linked bicycle and pedestrian use level estimation models for travel corridors in the Tahoe Region. This model is based upon observed facility use levels in the Tahoe Region, data regarding the characteristics of individual facility users, as well as demographic and travel data for the Tahoe region. Note that this model is for relatively urban or inter-community travel corridors, and is not applicable to mountain bike trails.

Use models for both bicycle and pedestrian modes have been developed (other users, such as rollerbladers, are included as pedestrians). Due to the lack of data, bicycle use levels is only estimated for Class I/shared use path and Class II/bike lane facilities, and pedestrian use levels for Class I facilities. Overall, this model identifies the maximum feasible use level along a specific travel corridor assuming a "perfect" condition, and then applies a series of reductions that reflect factors (grade, continuity, congestion, etc.) that would reduce the actual use level from the maximum feasible level.

This memo presents straightforward instructions regarding how to use the model. It is intended to be used with a spreadsheet ("TRPA Region Bike Ped Simplified Model.xls"). If the analyst desires additional understanding as to the model methodology, please refer to a separate memo entitled "Tahoe Region Bicycle and Pedestrian Use Models" (LSC Transportation Consultants, Inc. September 28, 2009) available from either LSC or the TRPA.

Using the Models

The single page to be used by the analyst summarizing the models is shown in Table A. The boxes indicate data that the analyst will need to enter. The analysis should be conducted in the following steps:

1. Using the attached Figure A, identify the corridor in which your facility is located. (If you want to consider either a longer facility comprising two or more of these corridors or a specific sub-section of a corridor, please refer to the "Tahoe Region Bicycle and Pedestrian Use Models" memo.)

2. From Table B, identify the values for visitor and resident bike-to-trail maximum feasible demand for the specific corridor, and enter them in Table A.

3. The potential demand for persons driving to the trail depends on whether you are evaluating an existing facility, or a potential new facility. If your corridor is already served by a Class I/shared use path facility, enter 480 in Cell F19 and 135 in Cell F29. If a potential new facility, enter 240 in Cell F19 and 41 in Cell F29.

4. From Table C, identify the values for visitor and resident walk-to-trail maximum feasible demand for the specific corridor, and enter them in Table A.

5. Starting from the trail usage generated by a "perfect" trail, identify the reduction in usage expected to occur based on the various factors, for each user type, as presented in Table D. (A "perfect" trail is Class I/shared use path, continual, no street crossings, flat, great maintenance, through an area with high recreation al value (woods, meadows, shoreline), and no trail congestion.) If a specific characteristic of a particular facility lies between (or beyond) the categories shown in Table D, the analyst is encouraged to use these values as a guide in estimating more appropriate values. Enter these volumes in the "Use Factor" boxes in Table A.[1]

6. After entering these values, the spreadsheet will calculate the daily use estimates for both bicyclists and pedestrians. (If a use estimate for only one mode is desired, zeros should be entered in the "Maximum Feasible Demand" column for the other mode).

7. Peak-hour use volumes can then be estimated by applying a peak-hour-to-daily factor. An evaluation of existing Tahoe facility peak hour and daily use levels indicates that this factor averages 0.153 for Class I/shared use path facilities (indicating that 15.3 percent of total daily use occurs during the peak hour) and 0.096 for Class II/bike lane facilities. The appropriate value should be entered into the "Peak Hour Factor" column of Table A.

8. Total annual use estimates can also be generated by applying an annual-to-daily factor. For existing Tahoe facilities, these factors were calculated to equal 172.8 for facilities maintained year-round (i.e., cleared of snow and ice) and 146.5 for facilities without snow/ice removal (which are the large majority of Tahoe facilities). The appropriate value should be entered into the "Annual / Daily Factor" column of Table A.

9. The resulting figures shown in the bottom line of Table A should be considered to be reasonable planning-level use estimates for total users at the location of highest use, barring special conditions. One such condition that may occur is reduction in use due to an effective restriction on parking availability. If an effective, enforced parking capacity is put in place at a specific location, the degree to which this caps the drive-to-facility use numbers can be calculated as follows:

Maximum Daily Drive-to-Facility Use =
Parking Capacity (# of vehicles) X
Average Vehicle Occupancy (persons per vehicle) X
Turnover Rate (# vehicles per space per day)

[1] You may need to make an initial estimate of the hourly number of trail users as a basis for the "congestion" factor, and then revise this estimate based upon the results of the analysis.

Average vehicle occupancy, per TCORP surveys, averages 2.1 persons per car for bicyclists and 2.5 for pedestrians. Turnover rates for more remote areas (such as the East Shore where visitors tend to stay for the day) have been observed to be roughly 1.33, while more "urban" recreational areas have a turnover rate of approximately 2.5. If the resulting value is less than the total daily bicyclist and pedestrian drive-to-trail use estimate, the daily use estimate should be reduced in the spreadsheet to reflect this cap (total of bicyclists plus pedestrians).

10. Finally, it is important to note that the model estimates total use at a single peak location along each segment. Particularly over the course of a long segment with multiple trip generators along its length, the total number of individual users over the entire corridor can be substantially higher. A simple equation to estimate total corridor use is as follows:

    Total Corridor Use =
    Use at Peak Location X
    (Total Corridor Length (miles) / Average Trip Length (miles)) X
    (1 + Ratio of Use at Lowest Location to Use at Peak Location) / 2

    Regionwide TCORP one-way trip length was found to average 2.4 miles for bicycling and 1.5 miles for walking, with detailed values for individual facilities presented in Table C of the Impacts Memo.

    As an example, consider a corridor 7.2 miles in length with an average trip length of 2.4 miles, a peak location use estimate of 1,000 bicyclists per day and an estimated use level at the location of lowest use that is 50 percent of that at the peak location. Total bicycle use throughout this facility would be calculated as follows:

    Total Corridor Daily Bicycle Use = 1,000 X (7.2 / 2.4) X (1 + 0.50) / 2
    = 1,000 X 3.0 X 1.5 / 2
    = 2,250 bicyclists per day

Discussion of Error

Considering both the variation in day-to-day observed trail use and the accuracy of the models when compared to counts, a reasonable error range for any one corridor is considered to be ±25 percent for the bicycle model and ±35 percent for the pedestrian model. These ranges are reflected in Table A.

Modifications to the Model

The model can be modified to consider longer segments (combining two or more corridors) or to consider shorter segments. The user is encouraged to refer to the "Tahoe Region Bicycle and Pedestrian Use Models" memo for discussion regarding these modifications (available on the TIIMS website: www.tiiims.org).

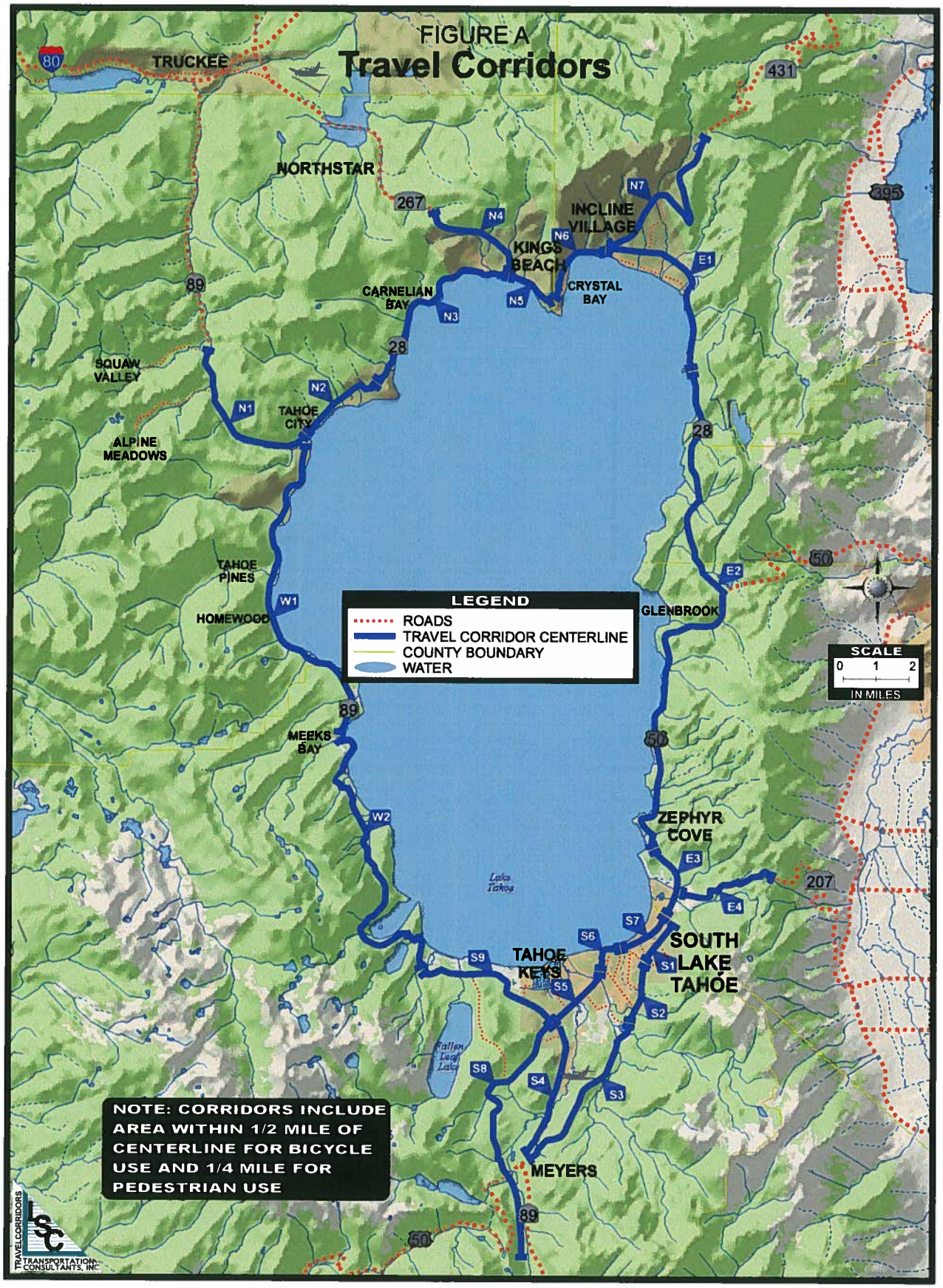
FIGURE A
Travel Corridors
TRUCKEE
80
NORTHSTAR
267
INCLINE VILLAGE
KINGS BEACH
CRYSTAL BAY
CARNELIAN BAY
89
28
SQUAW VALLEY
TAHOE CITY
ALPINE MEADOWS
TAHOE PINES
HOMEWOOD
MEEKS BAY
ZEPHYR COVE
GLENBROOK
TAHOE KEYS
SOUTH LAKE TAHOE
MEYERS
431
395
50
207
N1
N2
N3
N4
N5
N6
N7
E1
E2
E3
E4
W1
W2
S1
S2
S3
S4
S5
S6
S7
S8
S9
LEGEND
ROADS
TRAVEL CORRIDOR CENTERLINE
COUNTY BOUNDARY
WATER
SCALE
0 1 2
IN MILES
NOTE: CORRIDORS INCLUDE AREA WITHIN 1/2 MILE OF CENTERLINE FOR BICYCLE USE AND 1/4 MILE FOR PEDESTRIAN USE
TRAVEL CORRIDORS
LSC
TRANSPORTATION CONSULTANTS, INC.

TABLE A: Tahoe Region Bicycle and Pedestrian Corridor Use Model

At Location of Peak Demand in Corridor

Location	Dollar Hill to Kings Beach
Scenario	
Analyst	

Corridor	Maximum Feasible Demand		Use Factor -- Reduction from Maximum (5) Class	Grade	Continuity	Maint-enance	Recre-ational Value	Conges-tion	Multi-plicative Total	Daily Use Estimate	Peak Hour Factor (6)	Peak Hour Use Estimate	Annual / Daily Factor (7)	Annual Use Estimate
BICYCLISTS														
Resident Bike to Facility	0	Note 1	0%	10%	0%	0%	0%	0%	10%	0				
Visitor Bike to Facility	0	Note 1	0%	30%	0%	0%	0%	0%	30%	0				
Bicyclists Drive to Facility	0	Note 2	0%	30%	0%	0%	0%	0%	30%	0				
Total -- Best Estimate										0	0.000	0	0.0	0
High End of Estimate Range										*0*		*0*		*0*
Low End of Estimate Range										*0*		*0*		*0*
PEDESTRIANS														
Resident Walk to Facility	0	Note 3	--	0%	0%	0%	0%	0%	0%	0				
Visitor Walk to Facility	0	Note 3	--	0%	0%	0%	0%	0%	0%	0				
Pedestrians Drive to Facility	0	Note 4	--	0%	0%	0%	0%	0%	0%	0				
Total -- Best Estimate										0	0.000	0	0.0	0
High End of Estimate Range										*0*		*0*		*0*
Low End of Estimate Range										*0*		*0*		*0*
TOTAL -- Best Estimate										0		0		0
High End of Estimate Range										*0*		*0*		*0*
Low End of Estimate Range										*0*		*0*		*0*

Notes

1. From Table B
2. 480 for corridors with an existing Class I facility, 240 for corridors without an existing Class I facility.
3. From Table C
4. 135 for corridors with an existing Class I facility, 41 for corridors without an existing Class I facility.
5. From Table D
6. 0.153 for Class I facility, 0.096 for Class II facility
7. 172.8 for facilities maintained year-round, 146.5 for facilities without snow removal.

LSC Transportation Consultants, Inc.

TABLE B: Potential Bicycling Demand

At Location of Peak Demand in Corridor, Excluding Bicyclists Driving to Trail

Corridor		1-Way Cyclist Trips -- Peak Summer Day	
		Resident Bike to Facility	Visitor Bike to Facility
E1	Incline to Sand Harbor	1,370	1,260
E2	Sand Harbor to Round Hill	250	300
E3	Round Hill to Stateline	390	2,130
E4	Kingsbury Grade	840	2,650
N1	Truckee River Corridor	172	258
N2	Tahoe City to Dollar Hill	570	390
N3	Dollar Hill to Kings Beach	650	330
N4	Kings Beach to Brockway Summit	280	150
N5	Kings Beach to Crystal Bay	410	210
N6	Crystal Bay to Incline	1,140	620
N7	Incline to Mt. Rose	1,220	960
S1	Pioneer Trail Corridor - Stateline to Ski Run	950	4,510
S2	Pioneer Trail Corridor - Ski Run to Trout Creek	360	140
S3	Pioneer Trail Corridor - Trout Creek to Meyers	380	40
S4	Meyers to South Y	600	180
S5	South Y to Al Tahoe	1,390	470
S6	Al Tahoe to Ski Run	480	420
S7	US 50 Corridor - Ski Run to Stateline	1,370	3,550
S8	South Y to Meyers via Tahoe Paradise	730	150
S9	South Y to Spring Creek	710	470
W1	Tahoe City to Meeks Bay	600	420
W2	Meeks Bay to Spring Creek	0	60
TOTAL REGIONWIDE		14,862	19,668

TABLE C: Potential Walking Demand

At Location of Peak Demand in Corridor, Excluding Pedestrians Driving to Trail

Corridor		1-Way Pedestrian Trips - Peak Summer Day	
		Non-Driver Resident	Non Driver Visitor
E1	Incline to Sand Harbor	750	160
E2	Sand Harbor to Round Hill	110	90
E3	Round Hill to Stateline	140	370
E4	Kingsbury Grade	120	240
N1	Truckee River Corridor	20	30
N2	Tahoe City to Dollar Hill	80	100
N3	Dollar Hill to Kings Beach	170	130
N4	Kings Beach to Brockway Summit	100	50
N5	Kings Beach to Crystal Bay	110	80
N6	Crystal Bay to Incline	180	180
N7	Incline to Mt. Rose	210	170
S1	Pioneer Trail Corridor - Stateline to Ski Run	130	580
S2	Pioneer Trail Corridor - Ski Run to Trout Creek	220	100
S3	Pioneer Trail Corridor - Trout Creek to Meyers	270	90
S4	Meyers to South Y	260	100
S5	South Y to Al Tahoe	350	140
S6	Al Tahoe to Ski Run	220	240
S7	US 50 Corridor - Ski Run to Stateline	190	710
S8	South Y to Meyers via Tahoe Paradise	290	100
S9	South Y to Spring Creek	260	140
W1	Tahoe City to Meeks Bay	120	180
W2	Meeks Bay to Spring Creek	0	50
TOTAL REGIONWIDE		4,300	4,030

TABLE D: Bicycle/Pedestrian Facility Use Factors

For use in Tahoe Basin Bicycle Pedestrian Master Plan

Starting from the trail usage that would occur from a "perfect" non-motorized facility (Class I, continual, no street crossings, flat, great maintenance, through an area with high recreational value (woods, shoreline), no trail congestion), the following reductions in usage would be eliminated based upon the following factors, for each user type.

		Bicyclists			Pedestrians		
		Residents Biking from Home	Visitors Biking from Lodging	Bicyclists Driving to Facility	Residents Walking from Home	Visitors Walking from Lodging	Walkers Driving to Facility
Facility Class	Class 1, attaining AASHTO standards	0%	0%	0%	0%	0%	0%
	Class 2, attaining standards for lane width	35%	55%	85%	Note 1	Note 1	Note 1
	Class 3, on street with acceptable width and traffic volumes	Note 2	Note 2	Note 2	Note 1	Note 1	Note 1
Grade	Flat or only short sections of gentle grade <4%	0%	0%	0%	0%	0%	0%
	Grades of 4%-8%, extending for no more than a few hundred yards	10%	30%	30%	10%	30%	30%
	Long sections of sustained maximum AASHTO grade, with total elevation change exceeding 300 feet	40%	60%	65%	20%	36%	37%
Facility Continuity	No breaks in trail or cross streets	0%	0%	0%	0%	0%	0%
	Infrequent crossings of low volume residential streets and driveways (<4 per mile)	0%	0%	0%	0%	0%	0%
	Frequent crossing of low volume residential streets and driveways (>4 per mile)	10%	15%	15%	4%	7%	16%
	Unprotected crossing of busy (ADT > 10,000) street (including crossings with striped crosswalk only)	22%	29%	40%	17%	35%	35%
	Protected crossing of busy (ADT >10,000) street (signal or roundabout)	14%	16%	18%	5%	10%	10%
	Breaks in facility continuity requiring travel along state highway or other busy street.	35%	44%	49%	36%	48%	54%
Maintenance	High -- No sand on trail or pavement deformities	0%	0%	0%	0%	0%	0%
	Medium -- Condition is an inconvenience, but not a safety hazard	11%	10%	10%	5%	5%	5%
	Poor -- Trail condition reduces safe travel speed	43%	41%	52%	8%	7%	7%
Recreational Value	High -- Shoreline, river corridor, dense woods	0%	0%	0%	0%	0%	0%
	Medium -- Scenery mixed with urban uses	9%	18%	30%	9%	24%	28%
	Low -- Urban corridor	21%	33%	75%	15%	36%	51%
Trail Congestion (Note 2)	None -- LOS A (< 40 passing events per hour)	0%	0%	0%	0%	0%	0%
	Low -- LOS B or C (40 to 100 passing events per hour)	13%	6%	4%	10%	5%	5%
	Moderate -- LOS D or E (100 to 195 passing events per hour)	26%	10%	8%	23%	8%	13%
	High -- LOS F (>195 passing events per hour)	40%	19%	15%	30%	8%	8%

Note 1: Pedestrian demand only evaluated for Class I facilities.
Note 2: Bicyclist demand only evaluated for Class I and II facilities.
Note 3: See Highway Capacity Manual 2000 Chapter 19: Bicycle Methodology. For example, 40 passenger events per hour reflects that an individual user would overtake, be overtaken, or be passed in the opposing direction by 40 other individuals over the course of an hour (or 1 every 1.5 minutes).