EXHIBIT 10-C SAFETY INDEX CALCULATION PROCEDURE AND INSTRUCTIONS

(*This Exhibit is for information only. Applicants do **NOT** need to fill in this form.)*

Local Agency: _____ Date: _____
Calculated By: _____
Checked By: _____

Project Location: _____

Description of Proposed Improvement(s):

_____
_____
_____

Total Project Cost (in $1000s): _____

ADT (existing, all directions, in 1000s): _____

STEP 1: SIGNIFICANCE TEST ON THE SEVERITY DISTRIBUTION OF EXISTING COLLISION DATA

Before estimating collisions that would occur on the existing facilities with no improvements and collisions that would occur after the proposed improvements, a statistical Significance Test needs to be performed on the severity distribution of the collisions occurring over the past several years on the existing road. If the distribution is normal or approximately so, the state average cost of collisions for that road type is used. If, however, the collisions are more severe than normal, a higher collision cost is used to reflect the higher costs of fatal and injury collisions. Conversely, if the collisions are less severe than usual, a lower cost is used. In this manner, considerably more weight is given to the fatal and injury collisions than to the "fender benders."

The Table below is used to perform the Severity Distribution of Existing Collision Data.

TABLE 1:SIGNIFICANCE TEST

Item	Description	Formula/Source	Total	F*	I*	F+I*	PDO*
A	No. of Collisions	(From Application Form)	(A1)				
B	% Severity	(From Exhibit 10-D)	100				
C	Average No. of Collisions	(A1) x B					
D	Difference	A – C					
E	Maximum Expected Deviations	$\sqrt{2.072xC}$ + 0.5					
F	Significant	If (absolute value of D) >E, Yes. Otherwise, No.		(Yes +/- /No)**	(Yes +/- /No)**	(Yes +/- /No)**	

* F: Fatal; I: Injury; F+I: Fatal + Injury; PDO: Property Damage Only.

** Yes (+) when D is positive; Yes (-) when D is negative.

STEP 2: COLLISION REDUCTION FACTOR (CRF)

In order to estimate the collisions that may still occur after the proposed improvements are completed, a Collision Reduction Factor (CRF) will be applied to the number of collisions. In Exhibit 10-E "Collision Reduction Factor and Improvement Life," a standard (or average) CRF can be found for each type of the improvements. However, this CRF may be too large, because it may result in a collision rate less than the Average Base Rate (ABR), which is available in Exhibit 10-D "Average Collision Rate and Collision Cost Table." In this case, a lesser CRF, or adjusted CRF, should be used.

The following table is used to calculate the CRF of collisions.

TABLE 2: DETERMINATION OF COLLISION REDUCTION FACTOR

Item	Description	Formula/Source	Value
1	No. Of Collisions (all severities)	(From Application Form)	
2	Time Period (years)	(From Application Form)	
3	ADT (in 1000s)	(From Application Form)	
4	N*	(From Application Form)	
5	Initial Collision Rate	(1) ÷ ((2) × (3) × (4) × 0.365)	
6	Standard RF (see the instruction)	(From Exhibit 10-E)	
7	Collisions Reduced	(5) × (6)	
8	Reduced Collision Rate	(5) – (7)	
9	Average Base Rate	(From Exhibit 10-D)	
10	Differential Rate	(5) – (the larger of (8) and (9))	
11	Adjusted RF	(10) ÷ (5)	

*N: 1 if the project is for an intersection; length in miles (rounded to an integer, minimum 1) if the project is for a road section.

If the project includes more than one type of improvement, adjust the CRF in accordance with the relative percentages of the work category (see example below).

Example: A project consists of constructing a left-turn pocket at an unsignalized intersection and installing new safety lighting. From Exhibit 10-E, "Collision Reduction Factor and Improvement Life," a 35 percent reduction can be applied to the left-turn pocket improvement, and a 15 percent reduction of nighttime collisions can be applied to the safety lighting. If there was an average of 20 collisions/year at this location with an average of 12 nighttime collisions/year, then the combined CRF is calculated as follows:

Lighting: (12 nighttime collisions) x 15% = 1.8 collisions reduced
Channelization: [(20 total collisions) - 1.8 collisions] x 35% = 18.2 x 35% = 6.4 collisions reduced
Combined: 1.8 + 6.4 = 8.2 total collisions reduced
Combined CRF: 8.2 ÷ 20 = 0.41 or 41%

STEP 3: PER COLLISION COST

If all three Significance Tests result in "No," which indicates that the actual collision experience is not statistically higher or lower than normal, skip this step. The collision costs used would be the state average collision cost for the identified existing and proposed rate groups.

If Significance Test result is "Yes" for "Fatal," use Table 3.1 to calculate per collision cost, and then go to Step 4.

If Significance Test result is "No" for "Fatal," but "Yes" for "Injury" and/or "Fatal + Injury," use Table 3.2 to calculate per collision cost, and then go to Step 4.

TABLE 3.1 PER-COLLISION COST CALCULATION TABLE WHEN THE SIGNIFICANCE TEST IS "YES" FOR FATAL

	Collision Severity	F*	I*	PDO*	All Collisions
A	Collisions Per Year	(A1) (From Application Form)	(A2) (From Application Form)	(A3) (From Application Form)	(A4) = (A1)+(A2)+(A3)
B	Per Collision Cost – before ($1000s)	$3,900	$77.4	$4	(B4) (From Exhibit 10-D)
C	Total Collision Cost – before ($1000s)	(C1) =(A1) × $3,900	(C2) =(A2) × $77.4	(C3) =(A3) × $4	(C4) = (C1)+(C2)+(C3)
D	Per Collision Cost – before (all collisions) ($1000s)				(D4) = (C4)÷(A4)
E	Per Collision Cost – after (all collisions) ($1000s)**				(B4) or (D4) (See notes **)

* F: Fatal; I: Injury; F+I: Fatal + Injury; PDO: Property Damage Only.
** Per Collision Cost – After is:
a) (B4) if the Significance Test for "Fatal" is Yes (+);
b) (D4) (Per Collision Cost – Before) if the Significance Test for "Fatal" is Yes (-).

TABLE 3.2 PER-COLLISION COST CALCULATION TABLE WHEN SIGNIFICANCE TEST IS "YES" FOR "I" AND/OR "F+I"

	Collision Severity	F+I*	PDO*	All Collisions
A	Collisions Per Year	(A1) (From Application Form)	(A2) (From Application Form)	(A3) = (A1)+(A2)
B	Per Collision Cost – before ($1000s)	(B1) (From Exhibit 10-D)	$4	(B3) (From Exhibit 10-D)
C	Total Collision Cost – Before ($1000s)	(C1) =(A1) × (B1)	(C2) =(A2) × $4	(C3) = (C1)+(C2)
D	Per Collision Cost – before (all collisions) ($1000s)			(D3) = (C3)÷(A3)
E	Per Collision Cost – after (all collisions) ($1000s)**			(B3) or (D3) (See notes **)

* F+I: Fatal + Injury; PDO: Property Damage Only.
** Per Collision Cost – After is:
a) (B3) if the Significance Test for "Injury" and/or "Fatal + Injury" is Yes (+);
b) (D3) (Per Collision Cost – Before) if the Significance Test for "Injury" and/or "Fatal + Injury" is Yes (-).

STEP 4: SAFETY INDEX CALCULATION

Use the Table 4 below to calculate the estimated collision costs both before the improvement and after the proposed improvement.

TABLE 4: COLLISION COSTS BEFORE AND AFTER THE IMPROVEMENT

Item	Description	Formula/Source	Value
1	No. Of Collisions	(From Application Form)	
2	Time Period (Years)	(From Application Form)	
3	Initial Collisions per Year	(1) ÷ (2)	
4	Per Collision Cost – Before (All collisions)	(From Step 3, if any "yes" in Significance Test, else from Exhibit 10-D)	
5	Per Collision Cost – After (All collisions)	(From Step 3, if any "yes" in Significance Test, else from Exhibit 10-D)	
6	Improvement Life (Years)	(From Exhibit 10-E)	
7	Adjusted RF	(From Step 2)	
8	Expected Collisions per Year after Improvement	(3) × (1.0 - (7))	
9	Total Collision Cost – Before ($1000)	(3) × (4) × (6)	
10	Total Collision Cost – After ($1000)	(5) × (6) × (8)	

Then, Safety Index (SI) can be obtained by using the below formula:

Safety Index =100 × ((9) – (10)) ÷ Project Total Cost (in $1000s)