STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
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January 12, 1995

MEMORANDUM

In Reply Refer to File No.
Safety 94-12-38

TO: Area Traffic Engineers and Unit Heads

FROM: J. F. Rosendahl
Traffic Safety Systems Engineer

SUBJECT: Cost per Crash in North Carolina

The Traffic Engineering Branch periodically updates cost figures associated with traffic crashes for use by branch personnel for cost analyses. Rapid increases in medical care and other inflationary costs quickly render cost estimates obsolete.

The 1993 crash costs include the cost associated with the average number of injuries in each crash type. For example, the average fatal crash in 1993 on North Carolina's roads contained 1.13 fatal injuries, 0.5 A injuries, 0.31 B injuries and 0.22 C injuries. The injury costs include medical, emergency service, loss of productivity, employer cost, property damage and change in quality of life. In order to bring our cost more in line with the cost figures used by others, we have worked closely with Dr. Ted Miller, a nationally recognized expert in the field, to calculate the cost per crash in 1993 dollars. Table 1 shows the comprehensive cost of crashes by severity.

Table 1: Comprehensive Cost Per Crash

Crash Type	Cost Per Crash 1993 Dollars
Fatal Crash	$3,100,000
A Injury Crash	$240,000
B Injury Crash	$61,000
C Injury Crash	$29,000
Property Damage only Crash	$2,400
Average Crash	$47,000
Non-Fatal Injury Crash	$61,000

Note: All figures are rounded to two significant figures

These cost figures will be used by the Traffic Engineering Branch effective January 1, 1995, we will modify all affected computer programs to reflect the new estimates. Please use these costs when preparing benefit to cost estimates on the Project Report Forms after January 1, 1995. At that time, we will modify the benefit to cost computations on any proposed projects that have not been added to the Highway Safety Improvement Program.

The coefficients used to calculate the equivalent property damage only index (EPDO) will be changed to reflect new cost estimates. The severity index is based on the EPDO and will also be modified. Equations 1 and 2 show the updated formulas. These equations are used to compare one location to another and only consider the monetary cost.

$$EPDO_{1993} = 76.8(K + A) + 8.4(B + C) + PDO \quad (1$$

$$SI_{1993} = \frac{76.8(K + A) + 8.4(B + C) + PDO}{N} \quad (2$$

Table 2 includes only the reportable crashes that occurred on public roads in 1993. A traffic crash is reportable if it involves an injury or a total property damage of $500 or more. However, for various reasons, many traffic crashes are not reported. Traffic crashes are rated by the most severe injury involved in the incident. If a crash had eight people involved and seven people sustained C type injuries and one person sustained an A type injury, the crash is recorded as an A Injury crash. However, there were eight injuries. A property damage only crash (PDO) is a crash in which no people were injured in the incident.

Table 2: Number of Crashes Compared to the Number of Injuries in North Carolina during 1993

	Number of Crashes	Number of Injuries
Fatal	1,226	1,384
A Injury	9,001	12,439
B Injury	20,019	28,855
C Injury	49,810	87,385
Non-Fatal Injury	78,830	128,679
Property Damage Only	104,521	0
Total	**184,577**	**130,063**

Source: The North Carolina Accident Database

Table 2 shows the average number of each type of injury that occurred in each crash severity category. These numbers were derived by totaling all the individual injuries that occurred in a severity category. The total is dividing by the total number of crashes in that category. For example, there were **1384 fatalities, 610 A injuries, 382 B injuries and 271 C injuries in 1226 fatal crashes**. If the number of injuries is divided by the number of crashes, then there was an average of 1.13 fatalities, 0.50 A injuries, 0.31 B injuries and 0.22 C injuries in each fatal crash.

The Non-Fatal Injury category includes the crashes that had at least one A, B or C injury and zero (0) fatal injuries. The All Crash category contains all reported crashes occurring on North Carolina's highways that met the minimum reporting requirements.

Table 3: Average Number of Injuries and Property Damage for Crashes

Crash Type	Average Number of Fatal Injuries	Average Number of A Injuries	Average Number of B Injuries	Average Number of C Injuries
C Injury Crash	0	0	0	1.47
B Injury Crash	0	0	1.32	0.40
A Injury Crash	0	1.31	0.22	0.33
Non-Fatal Injury Crash	0	0.15	0.36	1.11
Fatal Crash	1.13	0.50	0.31	0.22
All Crashes	0.01	0.07	0.16	0.47

The cost per injury data were obtained from Dr. Miller, who adjusted the costs to reflect inflationary factors specific to North Carolina. Table 4 shows a breakdown of the cost for each injury type. The monetary cost considers only the cost of medical, emergency service, loss of productivity, employer cost, traffic delay and property damage. This cost is often considered "out of pocket" expenses. The comprehensive cost considers the pain and suffering associated with the injuries.

When computing benefit to cost ratios, using the monetary cost is inappropriate because the true cost to society is not considered. **The comprehensive cost is substantially higher than the monetary cost because it includes the cost associated with the quality of life as well as the monetary cost. The comprehensive cost should be used when comparing benefit to cost analysis for projects.** If the monetary cost is used, the value for life is often dominated by minor cost such as travel delay. Dr. Miller used an example of a project that may have two options. One is to decrease the travel delay and the other is to improve the safety of the section. The travel delay is shown to save approximately $1.5 million dollars over the lifetime of the project. The safety improvement is shown to save one life. Using only the monetary cost, the savings

in travel time seems to be the best option. However, when comprehensive costs are considered, it is cost effective to improve the safety of the section. This example only considered the one life saved and does not include the cost associated with the reduction in less severe injuries that the safety improvement would prevent.

Table 4: Cost per Injury in North Carolina

	Fatal Injury	A Injury	B Injury	C Injury
Medical[a]	$15,908	$19,204	$4,032	$1,997
Emergency Services[b]	$1,024	$298	$177	$129
Productivity[c]	$805,283	$22,659	$6,183	$3,243
Employer Costs[d]	$6,763	$1,033	$374	$218
Traffic Delay[e]	$393	$173	$169	$152
Property Damage[f]	$9,631	$4,108	$3,416	$2,873
MONETARY COST	$839,002	$47,475	$14,351	$8,612
Quality of Life[g]	$1,809,195	$123,786	$25,083	$10,647
COMPREHENSIVE COST	$2,648,197	$171,261	$39,434	$19,259

[a] **Medical** includes hospital, physician, rehabilitation, prescription and related cost.

[b] **Emergency Service** includes police, fire, ambulance and helicopter services.

[c] **Productivity** includes wages, fringe benefits and household work.

[d] **Employer Cost** values time, the extra work and distractions for supervisors and coworkers that injuries cause.

[e] **Traffic Delay** values the time lost in traffic jams caused by crashes.

[f] **Property Damage** is the cost to repair or replace damaged vehicles and property.

[g] **Quality of Life** values the pain, suffering and quality of life that the family loses because of a death or injury.

Source: Miller, T; Director, Children's Safety Network Third Party Payers Injury Prevention Resource Center, National Public Services Research Institute, Landover, Maryland; 1994

The cost per crash is calculated by multiplying the cost per injury from Table 4 and the average number of injuries per crash from Table 3. Table 5 shows the computations for fatal crashes in 1993. The cost associated with a crash includes all cost associated with each injury involved. The example of the fatal crash shows that the average fatal crash

Table 5: Computation of Monetary and Comprehensive Cost Per Fatal Crash

Injury	Number of Injuries (1)	Monetary Cost (2)	Comprehensive Cost (3)	Monetary Crash Cost (1) X (2)	Comprehensive Crash Cost (1) X (3)
Fatal Injury	1.13	$839,002	$2,648,197	$948,072	$2,992,463
A Injury	0.50	$47,475	$171,261	$23,738	$85,631
B Injury	0.31	$14,351	$39,434	$4,449	$12,225
C Injury	0.22	$8,612	$19,259	$1,895	$4,237
Total				$978,154	$3,094,556
TOTAL (rounded to 2 significant figures)				**$980,000**	**$3,100,000**

included 1.13 fatal injuries, 0.5 A injuries, 0.31 B injuries and 0.22 C injuries. The same type calculations were completed for A, B and C injury Crashes. Table 6 shows the results of these calculations.

Table 6: Monetary and Comprehensive Cost for Traffic Crashes In North Carolina

	Monetary	Comprehensive
Fatal Crash	$980,000	$3,100,000
A Injury Crash	$76,000	$240,000
B Injury Crash	$28,000	$61,000
C Injury Crash	$17,000	$29,000
Property Damage Only Crash	$2,400	$2,400
All Traffic Crashes	$20,000	$47,000
Average Non-Fatal Injury Crash	$26,000	$61,000

The cost figures computed for benefit to cost ratios use the comprehensive cost. The monetary cost is used to calculate the coefficients in the equivalent property damage only (EPDO) equation. To determine the coefficients for the EPDO equation with 1993 cost, the weighted average cost for fatal and A injury crashes (K & A) and B and C injury crashes (B & C) must be computed. The weighted average cost for fatal and A injury crashes is computed by

$$K\&A\ Cost = \frac{(Cost_{fatal\ crash})(\#\ fatal_{crashes}) + (Cost_{A\ crash})(\#\ A\ injury_{crash})}{\#\ fatal_{crashes} + \#\ A\ injury_{crash}}$$

For 1993 the monetary cost of a fatal crash is $980,000 and an A injury crash is $76,000. There were 1226 fatal crashes and 9001 A injury crashes in 1993.

$$K\&A\ Cost = \frac{(980000)(1226) + (76000)(9001)}{1226 + 9001} = \mathbf{\$184{,}370}$$

The coefficient for the K and A crashes is calculated by dividing the K and A crash cost by the cost of a PDO crash. The PDO crash cost in 1993 is $2400. The coefficient for the B and C injury crashes is calculated in the same manner. The coefficients and equation for 1993 are shown below.

K & A coefficient = 76.8
B & C coefficient = 8.4

$$EPDO_{1993} = 76.8(K + A) + 8.4(B + C) + PDO$$

The Severity Index (SI) is the EPDO divided by the total number of crashes. The Severity Index equation for 1993 is shown below where N is the number of crashes.

$$SI_{1993} = \frac{76.8(K + A) + 8.4(B + C) + PDO}{N}$$

If you have any questions concerning these crash costs, please contact Kevin Lacy at (919) 733-8012.

JFR/jkl

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