
Highway Safety Improvement Program

User's Manual
Benefit-Cost Tool

Prepared for
Illinois Department of Transportation

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Acronyms and Abbreviations

AA DT	Average Annual Daily Traffic
B/C	benefit/cost
BCA	benefit-cost analysis
CMF	crash modification factor
FHWA	Federal Highway Administration
HSIP	Highway Safety Improvement
HSM	Highway Safety Manual
IDOT	Illinois Department of Transportation
IRIS	Illinois Roadway Information System

1 Introduction

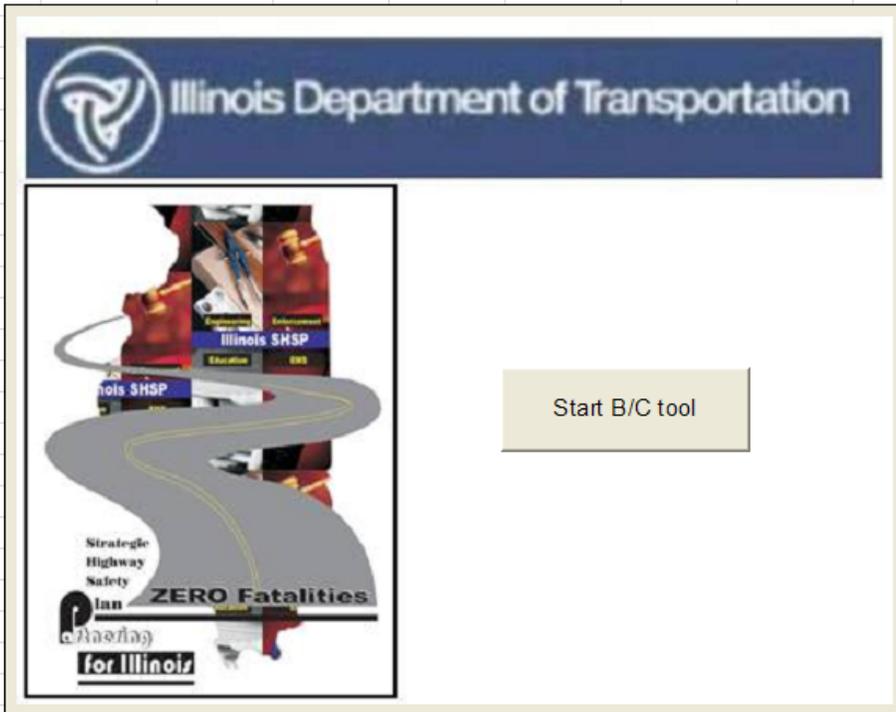
Benefit-cost analysis (BCA) is one of the tools used to determine if a project is appropriate for receipt of Highway Safety Improvement (HSIP) funding support. An approved project should have a safety focus and result in an improvement that will likely reduce the number of fatal and/or severe injury crashes. To facilitate the process, the Illinois Department of Transportation (IDOT) developed a BCA tool to aid in quick and accurate evaluation of highway improvement proposals.

This manual provides step-by-step instructions for using the BCA tool developed by IDOT. It also provides several example scenarios to assist the user in understanding use of the tool in project development. The final section of this document provides guidelines for appropriate benefit-cost (B/C) values.

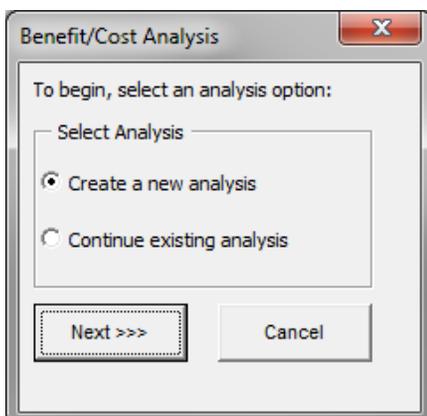
2 Step-by-Step Instructions

The image below shows the opening page of the B/C Tool.

STEP 1: Start by pressing **Start B/C Tool**.



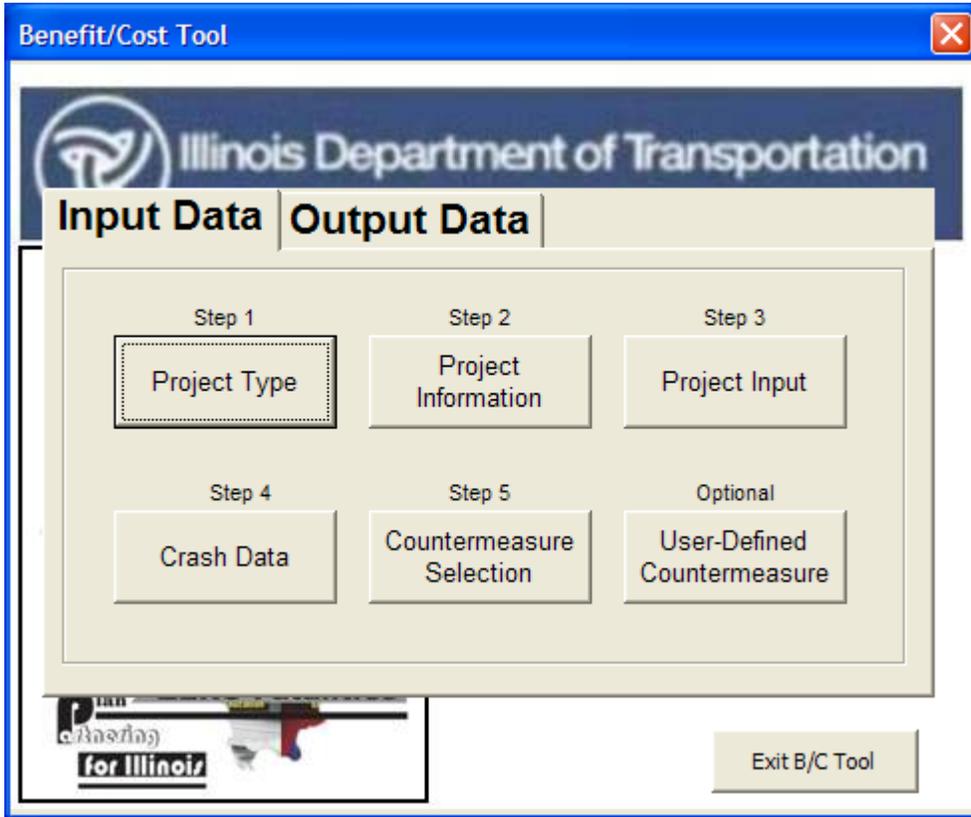
A new window will open asking the user to decide between creating a new analysis or continue an existing analysis. Since this is the first time opening the tool, the user should select **Create a new analysis**. If the tool has been used previously and the user would like to continue a previous analysis, select the second option, **Continue existing analysis**.



The main menu will open. The main menu has two tabs located at the top of the screen. One is for entering Input Data and the other for obtaining Output Data.

STEP 2: Select the **Input Data** tab if necessary. This is the default and should have been opened when starting the tool.

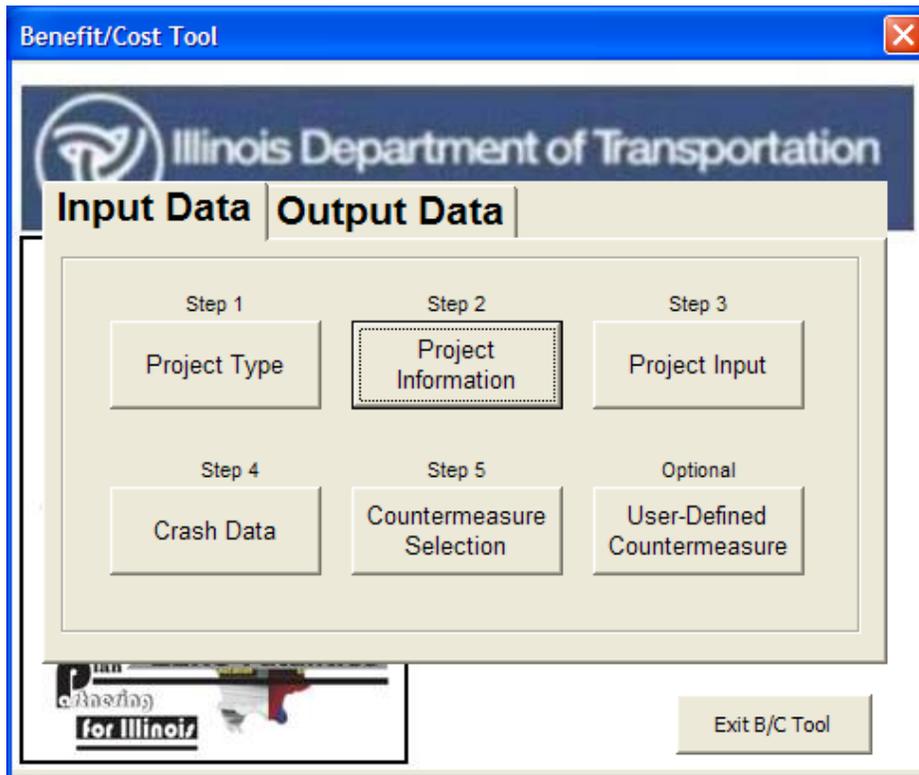
The input tab shows a series of steps. It is recommended that you follow the sequence of input steps as shown in the pop-up window; however, you can come back to buttons to revise the data as needed.



STEP 3: Select **Project Type**. The Project Type Selection window will appear.

STEP 4: Choose the project type by selecting either Intersection or Segment. After selecting the appropriate project type, the 8 IDOT intersection or 12 IDOT segment **Peer Groups** will be activated.

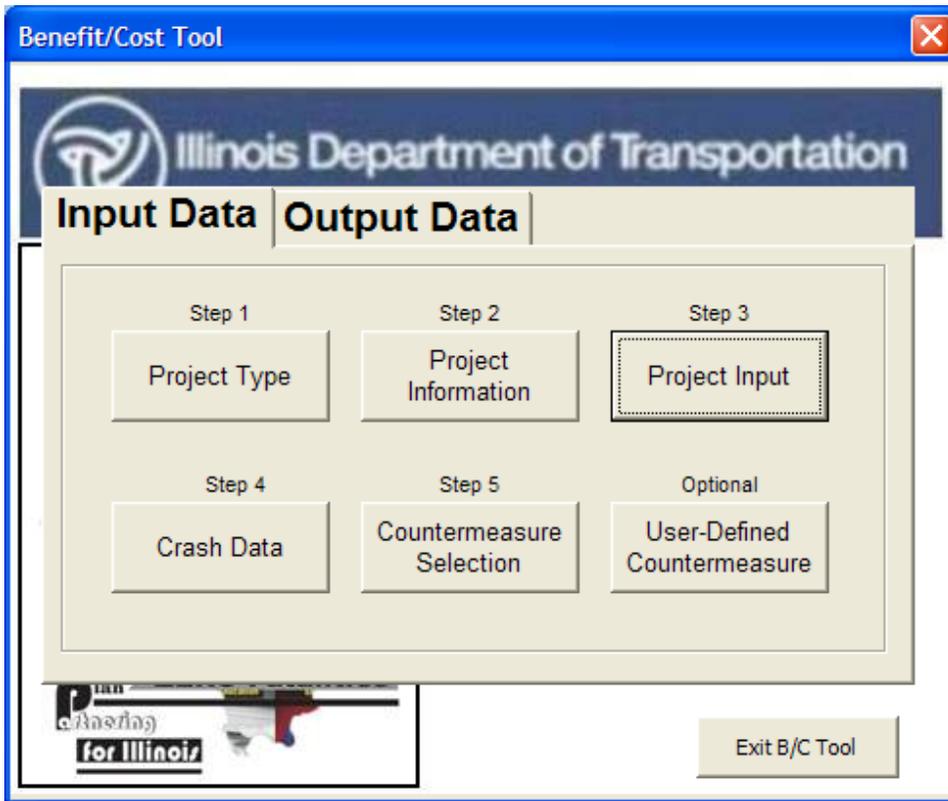
When complete, click on **Return to Main** to return to the main input window or **Next – Proceed Step 2**.



STEP 5: On the main menu, select **Project Information**. The Project Information window will open.

STEP 6: Complete the information in the boxes shown. For segments, enter either key route or marked route and the beginning milepost station. Key Route refers to the Illinois Roadway Information System (IRIS) terminology and it is a universal identifier for any segment. Marked Route refers to the Division of Traffic Safety route inventory. The key route information is not necessary for intersections, but all information provided will assist in

tracking projects. For the **Location** field, enter a description such as “Maple Road and Oak Street” for an intersection or “Maple Road between Oak Street and Walnut Street” for a segment. When all fields have been completed, click on **Return to Main** or click **Next – Proceed to Step 3**.



The main menu will re-open.

STEP 7: Select **Project Input**.

If **intersection** project type was selected, the project input window shown at the right will appear.

Intersection Input

Crash Data : From to

Current AADT : Major approach :

Minor approach :

Specify a value between 1 to 5%

Traffic Growth:

Discount rate:

If **segment** project type was selected, the project input window shown at the right will appear.

Segment Input

Crash Data : From to

Current AADT :

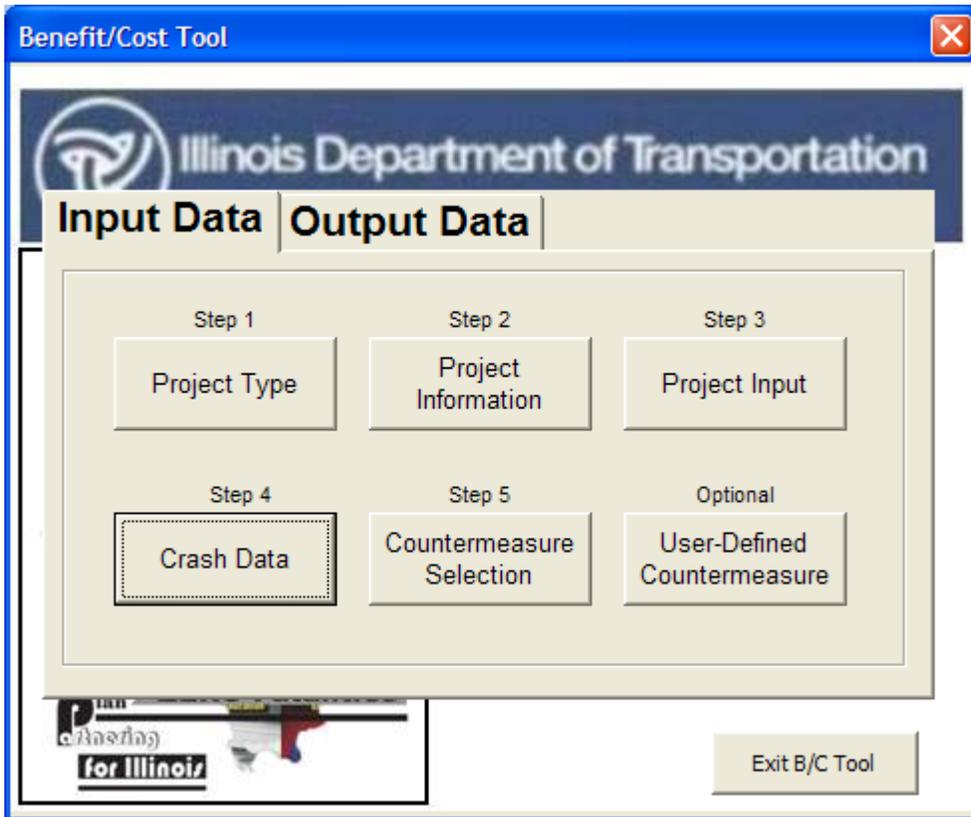
Length (Miles) :

Specify a value between 1 to 5%

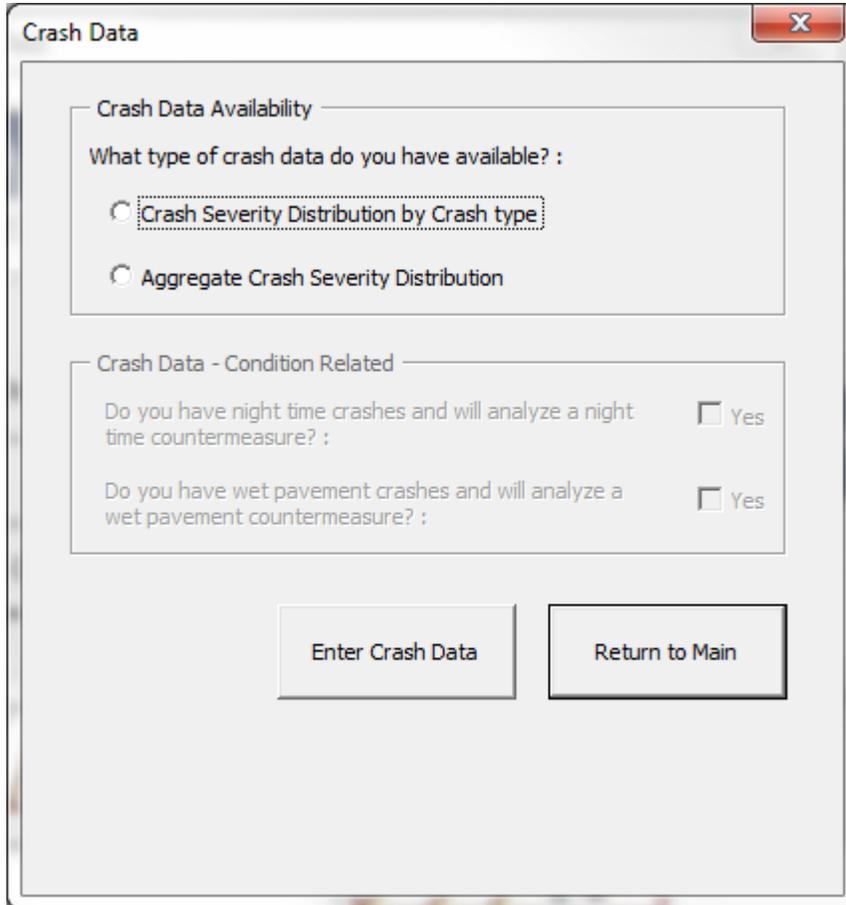
Traffic Growth:

Discount rate:

STEP 8: Input the information requested in the fields of either the **Intersection Input** or **Segment Input** window. For **Crash Data**, enter the period for which crash data are available (for example, 2004 to 2008). Enter the **Current AADT** (Average Annual Daily Traffic), length of project if applicable, and the annual traffic growth. The annual **traffic growth** should be a number between 1 and 5. If no selection is made, the default value of 1.25 will be shown. If the user enters a value less than 1, it is assumed that the traffic growth is declining. The **discount rate** cannot be modified from the default value of 3.00. When all fields are completed, click on **Return to Main** or click **Next – Proceed to Step 4**. The main menu will re-open.



STEP 9: Select **Crash Data** to open the window shown below.



The screenshot shows a window titled "Crash Data" with a close button (X) in the top right corner. The window contains two main sections:

- Crash Data Availability**: A section with the heading "What type of crash data do you have available? :". It contains two radio button options:
 - Crash Severity Distribution by Crash type
 - Aggregate Crash Severity Distribution
- Crash Data - Condition Related**: A section with two questions, each followed by a "Yes" checkbox:
 - Do you have night time crashes and will analyze a night time countermeasure? : Yes
 - Do you have wet pavement crashes and will analyze a wet pavement countermeasure? : Yes

At the bottom of the window, there are two buttons: "Enter Crash Data" and "Return to Main".

STEP 10: If crash type and crash severity data are available, select **Crash Severity Distribution by Crash Type**. If crash type data are not available, select the **Aggregate Crash Severity Distribution** category. In most cases, crash type data will be available. This is the preferred condition since countermeasures are applied to reduce particular crash types.

If Crash Severity Distribution by Crash Type is selected, follow STEPs 11A to 12A. If Aggregate Crash Severity Distribution is selected, skip to STEP 11B and follow to STEP 12B. When Crash Severity Distribution by Crash Type is selected, Crash Data – Condition Related will highlight.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes and will analyze a night time countermeasure? : Yes

Do you have wet pavement crashes and will analyze a wet pavement countermeasure? : Yes

Enter Crash Data

STEP 11A: If there are night-time crashes in your data set, click on the **Yes** box following the question **Do you have night time crashes and will analyze a night time countermeasure?** If there are wet pavement crashes in your data set, click on the **Yes** box following the question **Do you have wet pavement crashes and will analyze a wet pavement countermeasure?** If there are night-time and/or wet pavement crashes present in the study area, however, a night time or wet pavement countermeasure (such as de-slicking) is not proposed, the data input for these crash types is optional.

See page 4-1 to learn more about obtaining crash information from the crash reports.

After selecting **Enter Crash Data**, up to three input boxes will appear, depending on whether wet pavement and night time crash types were selected. In the top input box, **Intersection Crash Severity Distribution by Crash Type for Analysis Period- All Crashes**, enter all crashes during the analysis period, regardless of if they occurred at night or during wet pavement conditions. Under the All Crashes input box, a separate input box for night time and wet pavement crashes will be shown if either of these options was selected under the crash data window. Fill in only the applicable crashes (specific to night time or wet pavement conditions) under these two input boxes.

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtumed	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total	
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR		
Fatal Crashes	1											1	1						3
A-Injury Crashes									1	1						1			3
B-Injury Crashes				1															1
C-Injury Crashes																			0
PDO Crashes																			0

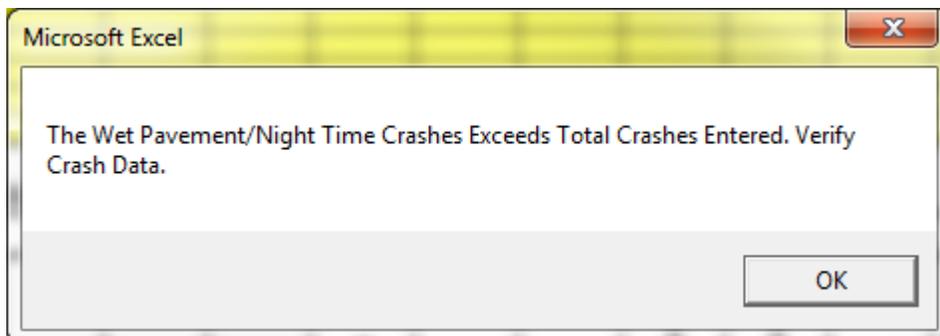
INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - NIGHTTIME

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtumed	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total	
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR		
Fatal Crashes												1							1
A-Injury Crashes																			0
B-Injury Crashes																			0
C-Injury Crashes																			0
PDO Crashes																			0

At the bottom of the worksheet, a grayed out matrix shows the difference between all crashes and the wet pavement/night time crashes. If a value is less than zero in this matrix, a warning box will pop up, and will not allow the user to continue until the input error has been corrected.

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL NON WP/NGT CRASHES

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtumed	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total	
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR		
Fatal Crashes	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
A-Injury Crashes	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0
B-Injury Crashes	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0
C-Injury Crashes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
PDO Crashes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



STEP 12A: Enter the crash data for the analysis period by crash type and severity. Individual crashes should only be entered once based on the first event of the crash. When complete, select the **Return to Main** button and continue with STEP 14. Be sure to “enter” the last data entered by using the **Enter** key or clicking another cell before attempting to select **Return to Main**.

STEP 11B: If crash type by severity is not available, select **Aggregate Crash Severity Distribution** in the Crash Data screen. Then click on **Enter Crash Data** to enter aggregate crashes by severity. It is important to notice that the user will not be able to input night time or wet pavement crashes with an aggregate crash severity distribution. Furthermore, the number of selectable countermeasures will be reduced. If **Aggregate Crash Severity Distribution** is selected, the **Crash Data – Condition Related** frame will not become available, as is shown in the figure above.

After selecting **Enter Crash Data**, the input screen shown below will appear. The screen shown is for intersections, but a similar table will appear for segments.

	A	B	C	D
1	INTERSECTION AGGREGATE CRASH SEVERITY DISTRIBUTION			
2				
3		All Crashes		
4	<i>Crash Severity</i>	<i>ALL</i>		
5	Fatal Crashes			
6	A-Injury Crashes			
7	B-Injury Crashes			
8	C-Injury Crashes			
9	PDO Crashes			
10				
11				
12	Return to Main			
13				
14				
15				

STEP 12B: Enter the number of crashes by severity that have occurred during the analysis period. When complete, select **Return to Main**. Be sure to “enter” the last data entered by using the Enter key or clicking another cell before attempting to select **Return to Main**. The main menu will re-open.

The screenshot shows the 'Benefit/Cost Tool' window with the Illinois Department of Transportation logo. The interface is divided into 'Input Data' and 'Output Data' tabs. A central panel displays a sequence of steps: Step 1 (Project Type), Step 2 (Project Information), Step 3 (Project Input), Step 4 (Crash Data), Step 5 (Countermeasure Selection), and an Optional step (User-Defined Countermeasure). The 'Countermeasure Selection' button is highlighted with a dashed border. At the bottom, there is an 'Exit B/C Tool' button and a small graphic of a road sign.

STEP 14: Select **Countermeasure Selection**. If intersection project type was selected, the countermeasure table shown below will appear. If segment project type was selected, a similar countermeasure table will appear.

INTERSECTION BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CRF *	Crash Type affected by this improvement			Unit Cost	Quantity	Units	Total Cost	Service Life
	0%	0					0	\$0	0
	0%	0					0	\$0	0
	0%	0					0	\$0	0
	0%	0					0	\$0	0
	0%	0					0	\$0	0

***NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).

* CRF = Crash Reduction Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

STEP 15: Review the list of countermeasures shown in the drop down boxes. Appendix A provides additional information regarding the countermeasures included in the tool and their applicability. A list of all countermeasures is also provided in Table A4. Select countermeasures that affect the predominant crash types in the data set for the intersection or segment to be analyzed. Many countermeasures are only applicable to certain IDOT Peer Groups. It is also recommended that you review additional resources such as the latest edition of the Highway Safety Manual (AASHTO) and the Federal highway Administration (FHWA) Crash Modification Factors Clearinghouse (<http://www.cmfclearinghouse.org/>) for additional countermeasures and current crash modification factors (CMF). Appendix A provides additional information regarding countermeasure selection.

A CMF is a multiplicative factor used to compute the reduction in number crashes after implementing a given countermeasure at a specific site. For example, adding a left turn lane at an existing signalized intersection has a CMF of 0.91 for all crash types. If 10 crashes were recorded, 0.9 crashes would be reduced if the left turn lane was implemented.

INTERSECTION BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CMF*	Crash Type affected by this improvement			Unit Cost	Quantity	Units	Total Cost	Service Life
1.2.11.17.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)	0.91	All			\$75,000	1	Unit Qty	\$75,000	15
		All						\$0	
		All						\$0	
		All						\$0	

***NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.

* CMF = Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

STEP - 1 Enter the list of potential countermeasures selected from the drop down menus***

STEP - 2 Enter "Unit Cost" for the countermeasure selected

STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations

STEP 16: Select the appropriate countermeasures using the pull-down menu under the countermeasure tab. The tool allows for selection and analysis of up to four countermeasures for one project. After selecting the countermeasure, the CMF, crash type affected, service life, and countermeasure units will automatically populate.

Note that if only aggregate crash data are provided, the tool will calculate only a benefit for countermeasures that affect All Crash Types.

STEP 17: Enter the **Unit Cost** and **Quantity** for each countermeasure. For example, enter \$10,000 and 1 if you are adding signing of this cost at one intersection. When complete, select **Return to Main**. Be sure to “enter” the last data entered by using the Enter key or clicking another cell before attempting to select **Return to Main**.

If you wish to add a countermeasure or use a countermeasure that is not listed, click on the Optional **User-Defined Countermeasure**. After selecting “User-Defined Countermeasure” the input box will appear. The box shown is for segments, but a similar screen will appear for intersections.

STEP 18: Enter the user-defined countermeasure description in the first box under countermeasures, shown in yellow. This box currently contains the text “User defined 01.” Enter the unit of measurement, service life, CMF, and crash type affected to the right of the countermeasure description. Refer to the various CMF resources discussed above to obtain CMF values. Crash Type Affected should be entered by using the abbreviations shown in the legend, separated by commas without spaces. Examples are shown in the window above the input data.

COUNTERMEASURES LIST: CRASH REDUCTION FACTORS, COS										
COUNTERMEASURES	Cost	Unit	Service Life	CRF	Crash Type Affected by Countermeasures	RE	RT	SSD	SDO	T
Non-Intersection (Segment) Locations										
<i>Flumble Strips (Shoulder)</i>		Miles	3	30%	FO,OVT					
<i>General Pavement Marking</i>		Miles	1	30%	All					
<i>Curb Parking Removal</i>		Unit Qty	20	50%	PKV,RE	50%				
<i>User defined 01</i>										
<i>User defined 02</i>										
<i>User defined 03</i>										
Note: If you have different CRFs for one countermeasure (See Example: cell F9), it is strongly suggested to input the CRFs under the proper crash type manually.										
Place new CRFs										
Return to Main										
Legend										
<i>All</i>	All Crashes									
<i>AG</i>	Angle									
<i>AN</i>	Animal									
<i>FO</i>	Fixed Object									
<i>HO</i>	Head On									
<i>LT</i>	Left Turn									
<i>OtherNC</i>	Other Noncollision									
<i>OtherO</i>	Other Object									
<i>OVT</i>	Overturned									
<i>PD</i>	Pedestrian									
<i>PDC</i>	Pedalcyclist									
<i>PKV</i>	Parked Vehicle									
<i>RE</i>	Rear End									
<i>RT</i>	Right Turn									
<i>SSD</i>	Sideswipe Same Direction									
<i>SDO</i>	Sideswipe Opposite Direction									
<i>T</i>	Turning									
<i>TR</i>	Train									
<i>NGT</i>	Night Time crash									
<i>WP</i>	Wet Pavement									

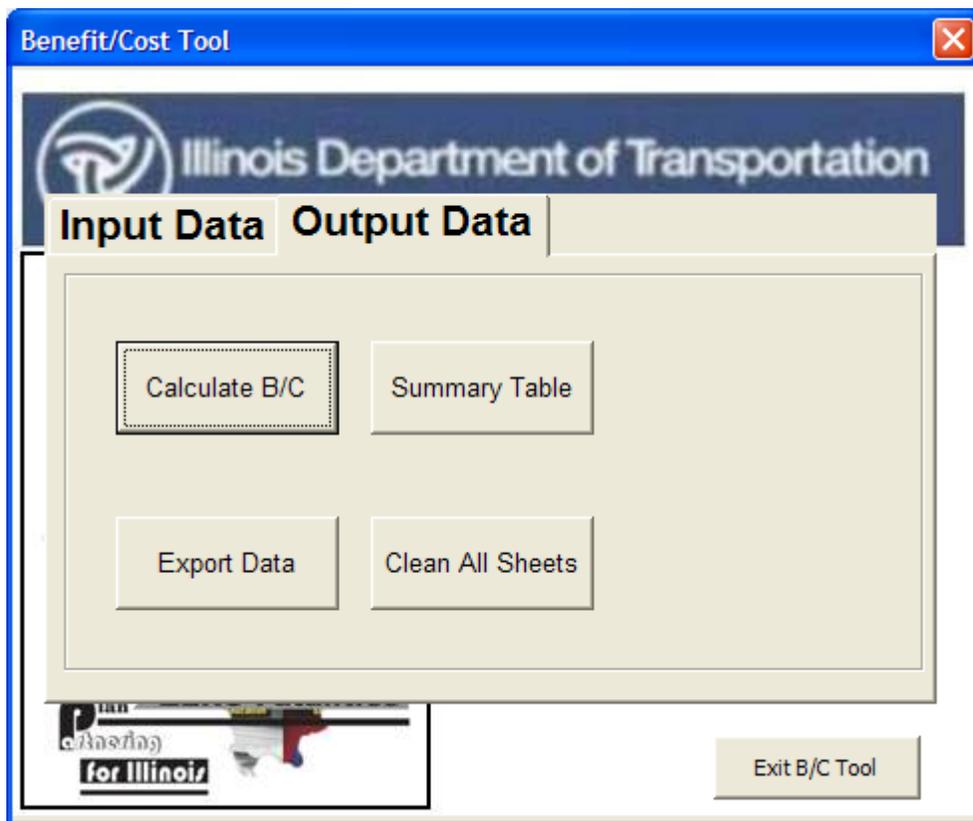
Legend	
<i>All</i>	All Crashes
<i>AG</i>	Angle
<i>AN</i>	Animal
<i>FO</i>	Fixed Object
<i>HO</i>	Head On
<i>LT</i>	Left Turn
<i>OtherNC</i>	Other Noncollision
<i>OtherO</i>	Other Object
<i>OVT</i>	Overturned
<i>PD</i>	Pedestrian
<i>PDC</i>	Pedalcyclist
<i>PKV</i>	Parked Vehicle
<i>RE</i>	Rear End
<i>RT</i>	Right Turn
<i>SSD</i>	Sideswipe Same Direction
<i>SDO</i>	Sideswipe Opposite Direction
<i>T</i>	Turning
<i>TR</i>	Train
<i>NGT</i>	Night Time crash
<i>WP</i>	Wet Pavement

STEP 19: After completing the user defined countermeasure information, select the **Place New CMFs** button. This will populate the CMFs to the appropriate crash types in the columns to the right of the input data. A total of four user defined countermeasures can be added.

When complete, select **Return to Main**.

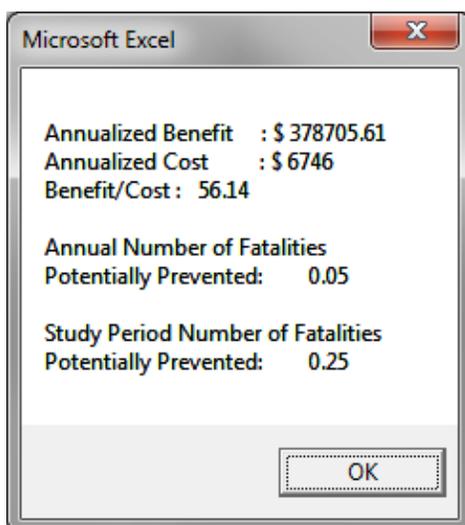
To add the User Defined CMF, go back to Step 5 – Countermeasure Selection in the main menu. Select any dropdown menu, and scroll down to the bottom of the CMF list. The User Defined CMFs should be the last five countermeasures.

When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.



STEP 20: Click on the **Calculate B/C** button to obtain the benefit-cost ratio. The image below will appear with the benefit /cost ratio, and the annual and study period number of fatalities potentially prevented for the given countermeasures.

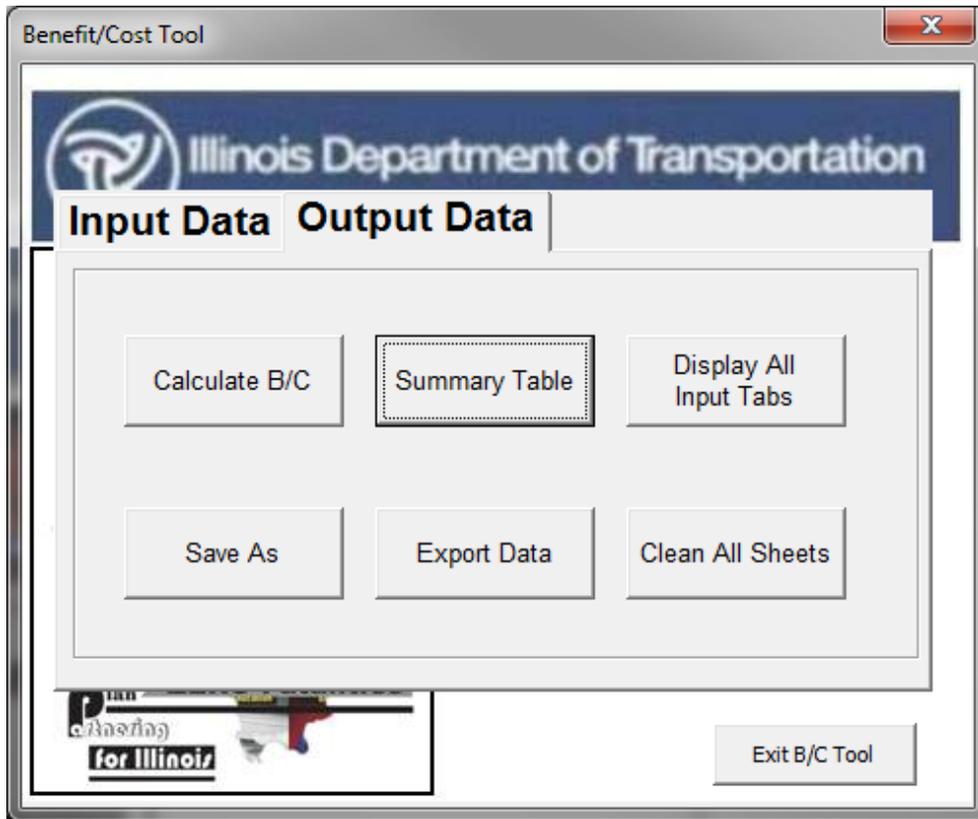
If you wish to test different countermeasure scenarios, you can go back to the **Input Data** tab, modify the input, and re-run calculation of the B/C. This can be run as many times as desired to obtain the most favorable B/C ratio. If you wish to erase and re-enter the crash data, select **Clean All Sheets**. The prompt will ask **“Are you sure?”** before deleting the information.



STEP 21: Select **Summary Table** to see a summary of the analysis or to verify inputs. The summary table will also provide the user with a list of warning message that occurred during the countermeasure selection process, as shown in the upper right corner of the summary sheet. These warning messages may include:

- Countermeasure does not fully match Highway Safety Manual (HSM) Setting/Facility Type Criteria
- Countermeasure AADT is not within HSM limits
- The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF.
- The analysis contains a User Defined Countermeasure

IDOT may require a review of these warning messages prior to acceptance of an HSIP application.



The window shown below will appear when "Summary Table" is selected.

PROJECT DESCRIPTION - PROJECT DATA INPUT (INTERSECTIONS)

Project:	County:	City:	Project No.:
Address:	Major Route:	Minor:	Date:
Location Description:	Current AADT:	Major Street:	12000
	Minor Street:	Minor Street:	10000
Crash data:	Years:	Traffic Growth Factor:	3.0%
From:	2007	to:	2011
		Interest Rate:	4.0%
Peer Group:	Peer Group: T - Urban, Signalized Intersections		

Messages / Cost / Measure / For Agency:
 1.2.11.17.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection) AADT is not within HCM limits
 The analysis contains a User Defined Countermeasure

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD

Crash Severity	All Crashes	Right	Area II	Fixed Object	Head On	Left Turn	Other Noncoll	Other Coll	Overturned	Pedestrian	Ped/Bicyclist	Parked Vehicle	Road End	Right Turn	Side-swipe Same Direction	Side-swipe Opposite Direction	Turning	Train	Right Turn	Wet Pavement	Total
Crash Severity	ALL	AD	AV	FO	HO	LT	OtherNC	OtherC	OVT	PD	PBC	PV	RE	RT	SD	SO	T	TR	RTT	WP	TOT
All Crashes	1									1	1		1	1			1				6
Field Crashes					1																1
Area II Crashes																					1
Fixed Object Crashes																					1
Head On Crashes																					1
Left Turn Crashes																					1
Other Noncoll Crashes																					1
Other Coll Crashes																					1
Overturned Crashes																					1
Pedestrian Crashes																					1
Ped/Bicyclist Crashes																					1
Parked Vehicle Crashes																					1
Road End Crashes																					1
Right Turn Crashes																					1
Side-swipe Same Direction Crashes																					1
Side-swipe Opposite Direction Crashes																					1
Turning Crashes																					1
Train Crashes																					1
Right Turn Crashes																					1
Wet Pavement Crashes																					1
Total Crashes																					6

INTERSECTION BENEFIT COST ANALYSIS

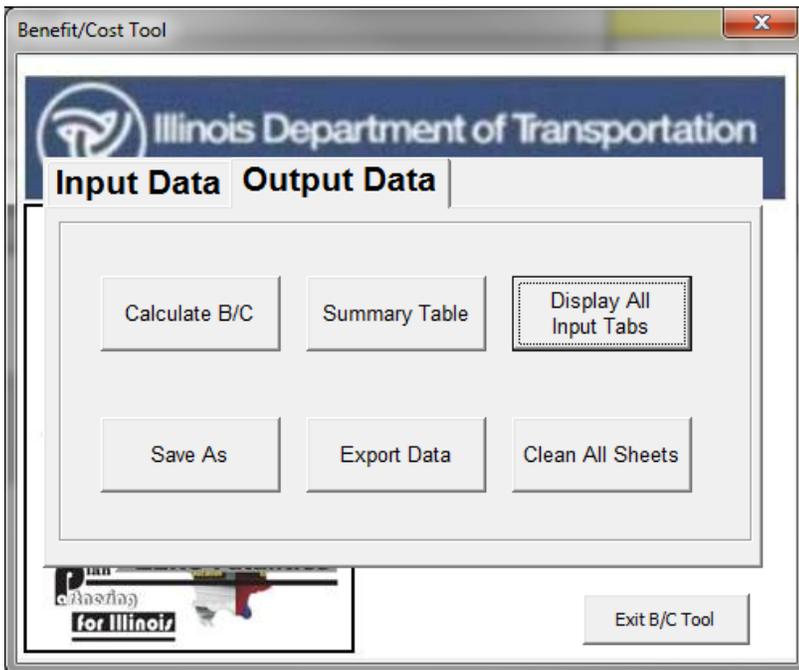
BENEFIT CALCULATIONS				COUNTERMEASURE COST CALCULATIONS						
Countermeasure	CMF*	Crash Type affected/Number of crashes	Unit Cost	Quantity	Units	Total Cost	Severities	Percent Avoided	AVAC**	
1.2.11.17.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)	0.91	All	\$75,000	1	Unit Only	\$75,000	15	\$75,000	\$6,748	
14.14.14.1 User defined 01	0.70	All	\$50,000	1	Wires	\$50,000	5	\$124,874	\$11,231	
		All								
		All								
		All								
TOTAL BENEFIT									\$17,977	
BENEFIT COST			84.97							
		ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED		0.24						
		TOTAL FATALITIES PREVENTED							1.20	

NOTE: IF THE NUMBER OF LESS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).
 * CMF = Crash Modification Factor
 ** AVAC = Estimated Uniform Annual Cost

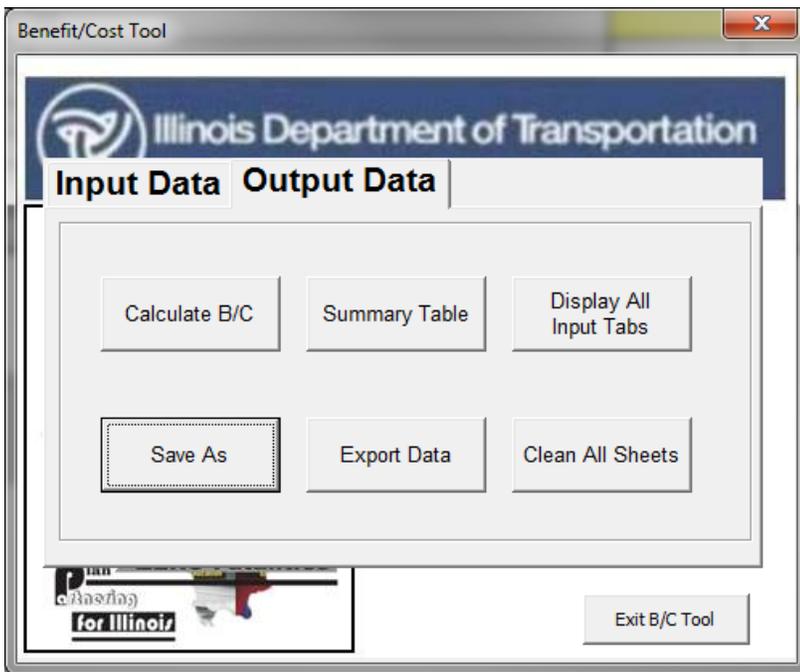
Return to Main

Additional Output Features

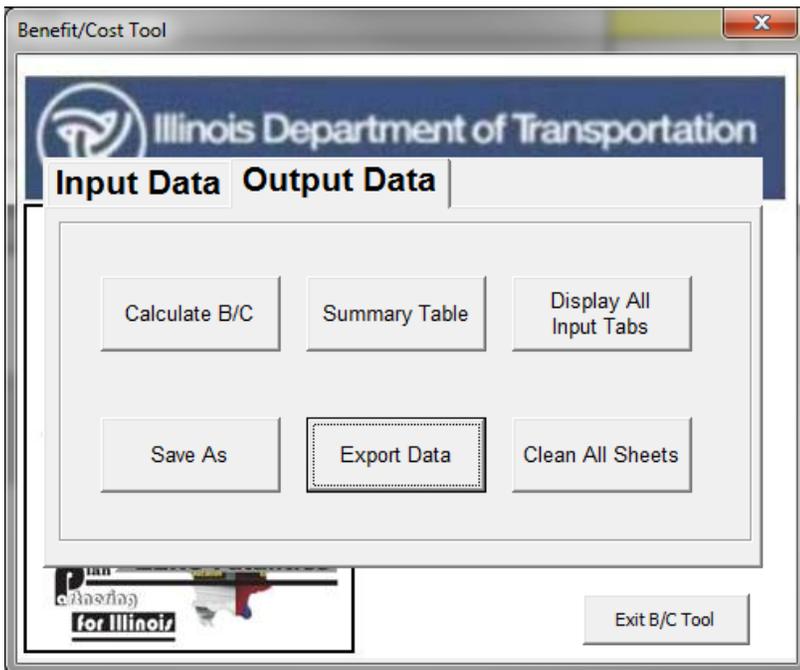
Display All Input Tabs: This feature will display all tabs used for the analysis, should the user choose to review the data.



Save As: This feature can be used when the user would like to stop the analysis and return to it some other time. This replicates the built-in Excel Save As feature. In addition, the user will be prompted with additional windows containing information about the last time the tool was saved.



Export Data: If you would like to create a copy of the analysis, select **Export Data**. This will allow you to create a copy of the file with a new name. The file can be opened at a later date and modified if necessary.



3 Special Cases - Partial Application of Countermeasures

The user may wish to consider applying a safety-based countermeasure to part but not all of a segment or intersection. For example, left turn lanes may be contemplated for one roadway but not the crossing facility at an intersection. Should this be the case, the analyst must take care to properly estimate expected benefits and calculate an appropriate B/C ratio.

Proper use of the tool for such cases requires that the analyst perform the benefit calculation taking into account the specific countermeasure application. This means calculating benefits separately for each approach or segment, applying only those countermeasures that apply to that approach, and applying them only to the crashes associated with that approach or segment. The following procedure is suggested:

STEP ONE: Determine which countermeasures apply to each intersection approach or segment.

STEP TWO: Identify or designate which crashes are associated with each segment (best practices would be to refer to a crash diagram), inputting only those crashes into the worksheet that apply to that segment.

STEP THREE: Perform the procedure as outlined in this manual, calculating total benefits and costs for each unique segment and approach. Take care to label the input as 'approach A' or 'segment B', etc.

STEP FOUR: Sum all benefits and all costs from each approach calculation, and calculate a single overall project B/C.

This procedure can apply where multiple countermeasures are being studied. For example, one countermeasure may apply to the entire segment but the second to only part or parts of the study area. Use the tool to compute benefits for each unique segment, identifying the proper countermeasures for each one.

Care should be taken in designating crashes to not 'double count' or apply any one crash or crash type to multiple segments. Similarly, costs by segment should be carefully assigned to avoid double counting.

Note that the tool output will provide a B/C ratio for each approach. This *should not be used* (i.e., it is not correct to 'average' the segment B/C ratios); rather the costs and benefits provided in the output should be summed together and used to compute *one overall B/C ratio*.

4 Reading a Crash Report for Benefit-Cost Input Tool

Key input factors for the countermeasure tool are crash type, crash severity, weather condition, and time of day. This example indicates the area of a crash report where this information can be obtained.

Crash type – This is coded as an Event in the lower left hand corner of the report. The event coded Unit 1 and Event 1 is usually the cause of the crash. In this example the crash type is “1.” Using template 1, this indicates a non-collision, run off the roadway event. The event in row 3 shows a “2.” Again using template 1, this indicates that after running off of the road, the vehicle is overturned.

Crash severity – Injury type is coded in the middle of the crash report to the right of the description of Unit 1. In this example, the injury was “K” or fatal. “A” is an incapacitating injury; “B” is a noncapacitating injury; “C” is reported, but not evident; and “0” is no indication of injury. If multiple vehicles are involved in the crash, use the most severe injury type to describe the crash severity.

Weather condition – To determine if the pavement was wet during this crash, refer to the column on the right of the report. The sixth entry from the top is labeled “RSUR” and reflects the roadway surface condition. In this example, a “1” refers to dry pavement.

Night time crashes – To determine if this crash occurred at night, refer to the top line, sixth box from the left labeled “LGHT.” This refers to the lighting condition. For this example, “4” indicates “darkness.” Therefore, night time crashes should be selected.

Examples of the IDOT traffic crash report are shown on the following pages.

CRASH REPORT Sheet of Sheets

DRAC: 7 X X 1 1 1 4 X 1 X 1 X 4 6 15 X X X

INVESTIGATED BY: Fulton Co Sheriff POLICE

AGENCY CRASH REPORT NO.: 91 7022

DATE OF CRASH: 09/27/01 TIME: 1:30 AM/PM

ADDRESS NO (OPTIONAL): _____ HIGHWAY or STREET NAME: NB Co Hwy 24

CITY/TOWNSHIP (CIRCLE): Farmington COUNTY: Fulton

INTERSECTION RELATED: Yes No

PRIVATE PROPERTY: Yes No

HIT & RUN: Yes No

ANY SINGLE VEHICLE/PROPERTY DAMAGED OVER \$500: Yes No

NO MOTOR VEHICLES INVLD: Yes No

NAME (LAST, FIRST, M.I.): _____ DATE OF BIRTH: 02/06/79

MAKE: Jeep MODEL: Grand Cherokee YEAR: 2000

SEX: M SAFT: 2 AIR: 2

INJURY: K EJECT: 2 CLASS: _____

CIRCLE NUMBER(S) FOR DAMAGED AREA(S):

00 - NONE
10 - UNDER CARRIAGE
11 - TOTAL (ALL AREAS)
12 - OTHER
99 - UNKNOWN

POINT OF IMPACT: FRONT

TOWED DUE TO DAMAGE: Y N

OTHER: FIRE: HAZ MAT: COM VEH:

INSURANCE CO: _____

TAKEN TO: Proctor EMS AGENCY: Fulton

ADDRESS: 209 E Chestnut Canton IL 61520 TELEPHONE: 41-330-4131-00

UNIT	DRIVER	EMERGENCY	EMERGENCY	EMERGENCY	EMERGENCY	EMERGENCY	EMERGENCY
1							
2							
3							
4							

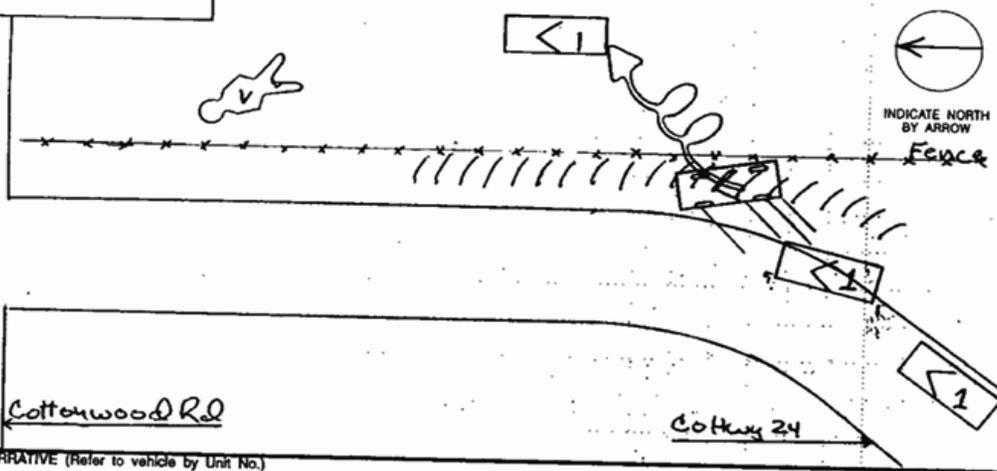
DAMAGED PROPERTY: _____

CITATION NO: 61531

P1099

5102776

DIAGRAM



NARRATIVE (Refer to vehicle by Unit No.)

Unit #1 was NB on Colony 24, 2 mi S. of Cottonwood Rd at this point Unit #1 left the roadway to the East. Unit #1 was skidding broadside and struck the embankment. Upon impact Unit #1 became airborne continuing E. into a soybean field. Unit #1 rolled over approx. 3 times. Unit #1 Driver was ejected from Unit #1 and was found approx 100' from Unit #1 to the North.

COMMERCIAL VEHICLE		UNIT NO.
CARRIER NAME	ADDRESS	SOURCE <input type="checkbox"/> Side of truck <input type="checkbox"/> Papers <input type="checkbox"/> Driver <input type="checkbox"/> Log book
CITY	STATE ZIP	
ID NUMBER	GVWR	
US DOT or State No.	ICCMC State Name	<input type="checkbox"/> None
HAZARDOUS MATERIALS: If Yes: 4-Digits	PLACARDED? or Name	<input type="checkbox"/> Yes <input type="checkbox"/> No
Hazardous cargo released from truck? (do not count fuel from vehicle fuel tank)	Y N Unk	
Violation of HAZMAT regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Violation of MCS regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Inspection form completed?	Y N Unk	Form No.
HAZMAT <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service?	Y N	
MCS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
IDOT PERMIT #	WIDE LOAD	<input type="checkbox"/>
TRAILER WIDTH(S) 0-96" 97-102" Over 102"	TRAILER LENGTH(S) - #	VEHICLE LENGTH (TOTAL) - #
Trailer 1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Trailer 1	NO. OF AXLES
Trailer 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Trailer 2	
<input type="checkbox"/> IN CITY OF / <input type="checkbox"/> NEAREST CITY: _____ Miles N E S W of: _____		
INSERT APPLICABLE NUMBERS FROM CHOICES ON BACK OF TEMPLATE TWO VEHICLE CONFIGURATION _____ CARGO BODY TYPE _____ LOAD TYPE _____		

COMMERCIAL VEHICLE		UNIT NO.
CARRIER NAME	ADDRESS	SOURCE <input type="checkbox"/> Side of truck <input type="checkbox"/> Papers <input type="checkbox"/> Driver <input type="checkbox"/> Log book
CITY	STATE ZIP	
ID NUMBER	GVWR	
US DOT or State No.	ICCMC State Name	<input type="checkbox"/> None
HAZARDOUS MATERIALS: If Yes: 4-Digits	PLACARDED? or Name	<input type="checkbox"/> Yes <input type="checkbox"/> No
Hazardous cargo released from truck? (do not count fuel from vehicle fuel tank)	Y N Unk	
Violation of HAZMAT regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Violation of MCS regs. contribute to crash?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Inspection form completed?	Y N Unk	Form No.
HAZMAT <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service?	Y N	
MCS <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Out of Service?	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
IDOT PERMIT #	WIDE LOAD	<input type="checkbox"/>
TRAILER WIDTH(S) 0-96" 97-102" Over 102"	TRAILER LENGTH(S) - #	VEHICLE LENGTH (TOTAL) - #
Trailer 1 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Trailer 1	NO. OF AXLES
Trailer 2 <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Trailer 2	
<input type="checkbox"/> IN CITY OF / <input type="checkbox"/> NEAREST CITY: _____ Miles N E S W of: _____		
INSERT APPLICABLE NUMBERS FROM CHOICES ON BACK OF TEMPLATE TWO VEHICLE CONFIGURATION _____ CARGO BODY TYPE _____ LOAD TYPE _____		

ILLINOIS TRAFFIC CRASH REPORT

TEMPLATE 1

Printed by authority of the State of Illinois

EVENT (EVNT) NONCOLLISION: 1 Ran off the roadway 2 Overturn 3 Fire/explosion 4 Immersion 5 Jackknife 6 Cargo shift/loss 7 Separation 8 Downhill runaway 9 Other noncollision 99 Unknown COLLISION WITH: NOT FIXED OBJECTS: 11 Motor vehicle in traffic 12 Pedestrian 13 Pedalcyclist 14 Railway train 15 Deer 16 Other animal 17 Falling load 18 Parked vehicle 19 Thrown/falling object 20 Other object 99 Unknown FIXED OBJECTS: 21 Crash cushion 22 Guardrail face 23 Guardrail end 24 Concrete med. barrier 25 Bridge support 26 Bridge end 27 Bridge rail 28 Bridge underside 29 Traffic signal 30 Light support 31 Utility pole 32 Delineator post 33 Railroad signal/gates 34 Other pole or post 35 Culvert 36 Curb 37 Ditch/embankment 38 Snowbank 39 Fence 40 Mailbox 41 Tree or shrub 42 Building/structure 43 Other fixed object 99 Unknown	WEATHER COND. (WEAT) 1 Clear 2 Rain 3 Snow 4 Fog/smoke/haze 5 Sleet/hail 6 Severe cross wind 7 Other 9 Unknown	TYPE OF FIRST CRASH (COLL)		PED/PEDAL LOCATION (PPL) 1 In roadway 2 In crosswalk 3 Not in available crosswalk 4 Crosswalk not available 5 Driveway access 6 Not in roadway 9 Unknown/NA	VEHICLE TYPE (VEHT) 1 Passenger 2 Pickup 3 Van/mini-van 4 Bus up to 15 pass. 5 Bus over 15 pass. 6 Truck - single unit 7 Tractor w/ semi-trailer 8 Tractor w/o semi-trailer 9 Farm equipment 10 Motorcycle (over 150cc) 11 Motor driven cycle 12 Snowmobile 13 All-terrain vehicle (ATV) 14 Other vehicle with trailer 15 Sport utility vehicle (SUV) 16 Other 99 Unknown/NA																													
	TRAFFIC CONTROL DEVICE (TRFD) 1 No controls 2 Stop sign/flasher 3 Traffic signal 4 Yield 5 Police/flagman 6 RR crossing gate 7 Other RR crossing 8 School zone 9 No passing 10 Other reg. sign 11 Other warning sign 12 Lane use marking 13 Other 99 Unknown	<table border="1"> <thead> <tr> <th>SINGLE VEHICLE CRASH</th> <th colspan="2">MULTI VEHICLE CRASH</th> </tr> </thead> <tbody> <tr> <td>Select a code for a Single Vehicle Crash based on the crash code that illustrates what caused the first damage/injury, not what caused the most severe damage/injury.</td> <td colspan="2">The intended direction of travel of each motor vehicle prior to the onset of the crash should determine the selection of the Multi Vehicle Crash code, not the direction of travel or position/angle of the vehicle at the point of contact. If the first damage/injury occurs when two vehicles strike, you must select a code 9-15.</td> </tr> <tr> <td>1 Pedestrian</td> <td colspan="2">9 Parked motor vehicle</td> </tr> <tr> <td>2 Pedalcyclist</td> <td>10 Turning (at least one vehicle turning)</td> <td>11 Rear end</td> </tr> <tr> <td>3 Train</td> <td></td> <td></td> </tr> <tr> <td>4 Animal</td> <td>12 Sideswipe same direction</td> <td>13 Sideswipe opposite direction</td> </tr> <tr> <td>5 Overturned</td> <td></td> <td></td> </tr> <tr> <td>6 Fixed object</td> <td>14 Head on</td> <td>15 Angle</td> </tr> <tr> <td>7 Other object</td> <td></td> <td></td> </tr> <tr> <td>8 Other noncollision</td> <td colspan="2"> Example: Unit 1 is NB and Unit 2 is SB on a four-lane divided roadway. Unit 1 skids on ice, loses control, crosses the grass median, re-enters the roadway into oncoming traffic, and collides with Unit 2. The COLL code should be 14 - Head on because no damage occurred until the two units collided. </td> </tr> </tbody> </table>		SINGLE VEHICLE CRASH	MULTI VEHICLE CRASH		Select a code for a Single Vehicle Crash based on the crash code that illustrates what caused the first damage/injury, not what caused the most severe damage/injury.	The intended direction of travel of each motor vehicle prior to the onset of the crash should determine the selection of the Multi Vehicle Crash code, not the direction of travel or position/angle of the vehicle at the point of contact. If the first damage/injury occurs when two vehicles strike, you must select a code 9-15.		1 Pedestrian	9 Parked motor vehicle		2 Pedalcyclist	10 Turning (at least one vehicle turning)	11 Rear end	3 Train			4 Animal	12 Sideswipe same direction	13 Sideswipe opposite direction	5 Overturned			6 Fixed object	14 Head on	15 Angle	7 Other object			8 Other noncollision	Example: Unit 1 is NB and Unit 2 is SB on a four-lane divided roadway. Unit 1 skids on ice, loses control, crosses the grass median, re-enters the roadway into oncoming traffic, and collides with Unit 2. The COLL code should be 14 - Head on because no damage occurred until the two units collided.		PED/PEDAL ACTION (PPA) 3 Turning left 4 Turning right 20 Enter from drive/alley 50 No action 51 Crossing - with signal 52 Crossing - against signal ENTERING / LEAVING / CROSSING 53 School bus (within 50 ft.) 54 Parked vehicle 55 Not at intersection WALKING / RIDING 56 With traffic 57 Against traffic 58 To/from disabled vehicle OTHER: 59 Waiting for school bus 60 Playing/working on vehicle 61 Playing in roadway 62 Standing in roadway 63 Working in roadway 64 Other action 99 Unknown/NA
SINGLE VEHICLE CRASH	MULTI VEHICLE CRASH																																	
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DEVICE COND. (TRFC) 1 No controls 2 Not functioning 3 Functioning improperly 4 Functioning properly 5 Worn reflect. material 6 Missing 7 Other 9 Unknown	LIGHTING COND. (LGHT) 1 Daylight 2 Dawn 3 Dusk 4 Darkness 5 Darkness, lighted road 9 Unknown	VEHICLE MANEUVER PRIOR (MANV)		CRASH DATA SAVES LIVES!	NUMBER OF OCCUPANTS (NO. OCCS)																													
EVENT LOCATION (LOC) 1 On pavement (roadway) 2 Off pavement - left 3 Off pavement - right 4 Intersection 5 Other 9 Unknown	CHECK MOST SEVERE NUMBER (MOST) Unit No.	1 Straight ahead 2 Passing/overtaking 3 Turning left 4 Turning right 5 Turning on red 6 U-turn 7 Starting in traffic 8 Slow/stop - left turn 9 Slow/stop - right turn 10 Slow/stop - load/unload 11 Slow/stop in traffic 12 Driving wrong way 13 Changing lanes 14 Avoiding vehicles/objects 15 Skidding/control loss 16 Entering traffic lane from parking 17 Leaving traffic lane to park 18 Merging 19 Diverging 20 Enter from drive/alley 21 Parked 22 Parked in traffic lane 23 Backing 24 Driverless 25 Other 26 Negotiating a curve 99 Unknown/NA	DIRECTION TRAVEL PRIOR (DIRP) 																															

SR 1000A.2M (REPRINT 10/06)

ILLINOIS TRAFFIC CRASH REPORT

TEMPLATE 2

Printed by authority of the State of Illinois

SR 1000B 2M (REPRINT 10/06)

APPARENT PHYSICAL CONDITION (DRAC)

- 1 Normal
- 2 Impaired - alcohol
- 3 Impaired - drugs
- 4 Illness
- 5 Asleep/fainted
- 6 Medicated
- 7 Had been drinking
- 8 Fatigued
- 9 Other/unknown

PED / BIKE VISIBILITY (PEDV)

- 1 No contrasting clothing
- 2 Contrasting clothing
- 3 Reflective material
- 4 Other light source used

SEATING POSITION (SEAT)

1	2	3
4	5	6
10	11	12
7 Enclosed passengers		
8 Exposed passengers		

SAFETY EQUIPMENT USED (SAFT)

- 1 None present
- 2 Safety belt used
- 3 Safety belt not used
- 4 Helmet used
- 5 Helmet not used
- 6 Child restraint used
- 7 Child restraint used improperly
- 8 Child restraint not used
- 9 Usage Unknown

DRIVER VISION (VIS)

- 1 Not obscured
- 2 Windshield (water/ice)
- 3 Trees, plants
- 4 Buildings
- 5 Embankment
- 6 Signboard
- 7 Hillcrest
- 8 Parked vehicles
- 9 Moving vehicles
- 10 Blinded - headlights
- 11 Blinded - sunlight
- 12 Blowing materials
- 13 Other
- 99 Unknown

VEHICLE DEFECTS (VEHD)

- 1 None
- 2 Brakes
- 3 Steering
- 4 Engine/motor
- 5 Suspension
- 6 Tires
- 7 Exhaust
- 8 Lights
- 9 Signals
- 10 Windows
- 11 Restraint system
- 12 Wheels
- 13 Trailer coupling
- 14 Cargo
- 15 Fuel system
- 16 Other
- 99 Unknown

DRIVER ACTION (DRVA)

- 1 None
- 2 Failed to yield
- 3 Disregarded control devices
- 4 Too fast for conditions
- 5 Improper turn
- 6 Wrong way/side
- 7 Followed too closely
- 8 Improper lane change
- 9 Improper backing
- 10 Improper passing
- 11 Improper parking
- 12 License restrictions
- 13 Stopped school bus
- 14 Emergency vehicle on call
- 15 Evading police vehicle
- 16 Other
- 99 Unknown

TRAFFICWAY DESCRIPTION (TRFW)

TWO-WAY		OTHER	
1 Not divided	5 One-way or ramp	6 Alley or driveway	7 Parking lot
2 Divided, no median barrier	6 Alley or driveway	8 Other	9 Unknown
3 Divided w/median barrier			
4 Center turn lane			

NUMBER OF LANES (NO. LANES)

Count through lanes, both directions. If at intersection, use '0' (zero).

ALIGNMENT (ALGN)

1 Straight and level	4 Curve, level
2 Straight on grade	5 Curve on grade
3 Straight on hillcrest	6 Curve on hillcrest

ROADWAY SURFACE CONDITION (RSUR)

1 Dry	4 Ice
2 Wet	5 Sand, mud, dirt
3 Snow or slush	6 Other
	9 Unknown

ROAD DEFECTS (RDEF)

1 No defects	6 Shoulders
2 Construction zone	7 Rut, holes
3 Maintenance zone	8 Worn surface
4 Utility work zone	9 Debris on roadway
5 Work zone - unk.	10 Other
	99 Unknown

Intersection Related: Was this an intersection related crash? A crash does not have to actually occur at an intersection to be considered intersection related. For example; if 5 vehicles are lined up at a traffic signal and a rear end collision occurs at the back of the line, 75 feet from the intersection, it is intersection related.

Private Property: This is not the area to indicate that there was private property damage. Check **Yes only if the crash began on, ended on and all damage occurred on private property.**

If the crash began on a public roadway, it is not a private property crash; check **No.**

EJECTION OR EXTRICATION (EJCT)

1 None	3 Partially ejected	9 Unknown
2 Totally ejected	4 Trapped/extricated	

AIR BAG DEPLOYED (AIR)

- 3 Not applicable
- 4 Did not deploy
- 5 Deployed, front
- 6 Deployed, side
- 7 Deployed other (knee, air belt, etc.)
- 8 Deployed, combination
- 9 Deployment unknown

INJURY CLASSIF. (INJ)

K Fatal
A Incapacitating injury
B Nonincapacitating injury
C Reported, not evident
0 No indication of injury

DRIVER BAC TEST RESULT (BAC)

Enter BAC result or one of the following:

95 Test refused
96 Test not offered
97 Test performed results unknown

If drug test was given put in the narrative

UNIT NO.

DATE OF BIRTH
m/d/y

PASSENGERS & WITNESSES
Full Name, Address, Telephone

TAKEN TO (hospital)

EMS RUN NUMBER or AGENCY NAME

5 Examples

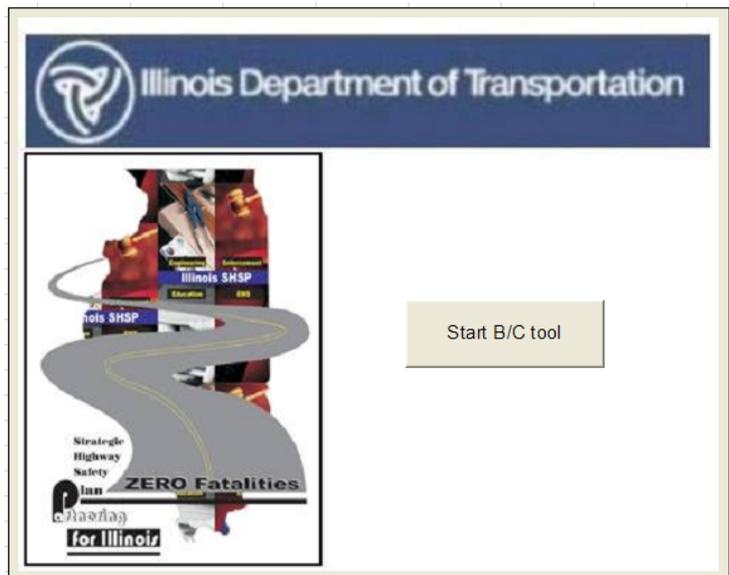
Case Study 1: Benefit Cost Analysis for a Segment

The rural 2-lane state highway segment along IL 0 between Maple Street and Oak Street was identified as a hazardous location. It is located in District 10, Wooded County, in the Village of Forest. From 2007 to 2011, two fatal crashes (animal and fixed object) occurred, two A-injury crashes (head-on and overturned) occurred, and one B-injury crashes (fixed object) occurred. C-injury crashes and property damage only crashes also occurred at this location, but the exact number is not needed for this analysis. Two of the crashes, one fatal and one A-injury, occurred at night time.

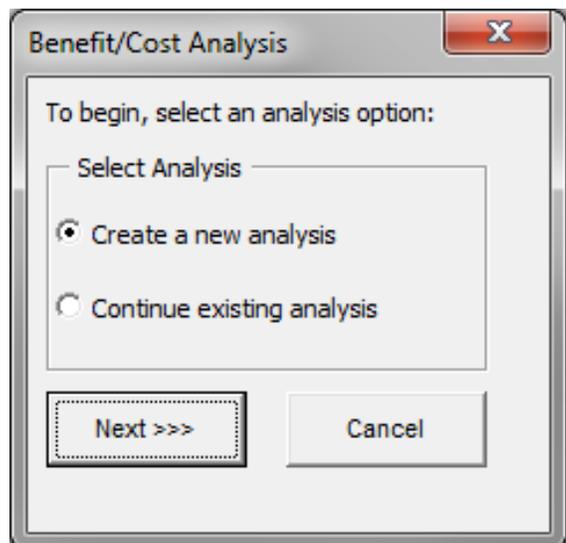
Countermeasures were reviewed and B/C calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the B/C ratio for adding rumble strips to the existing shoulder.

Step-by-Step Procedure

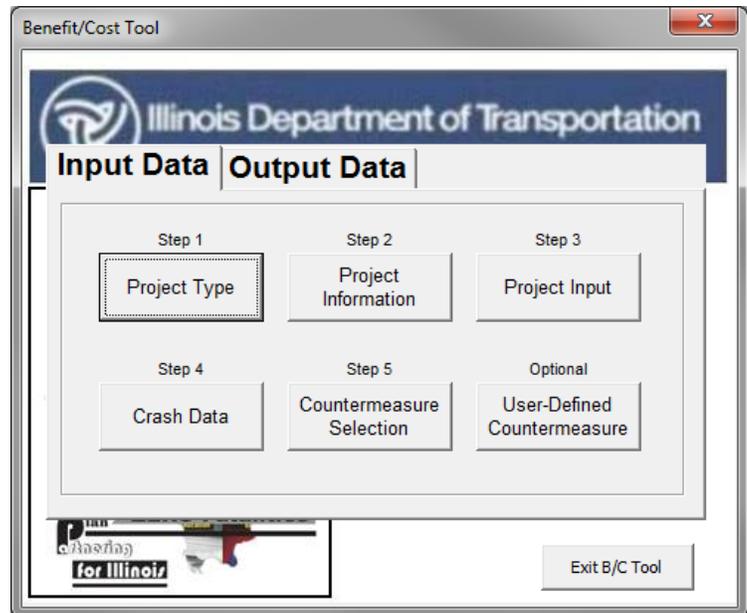
STEP 1: Press **Start B/C Tool**.



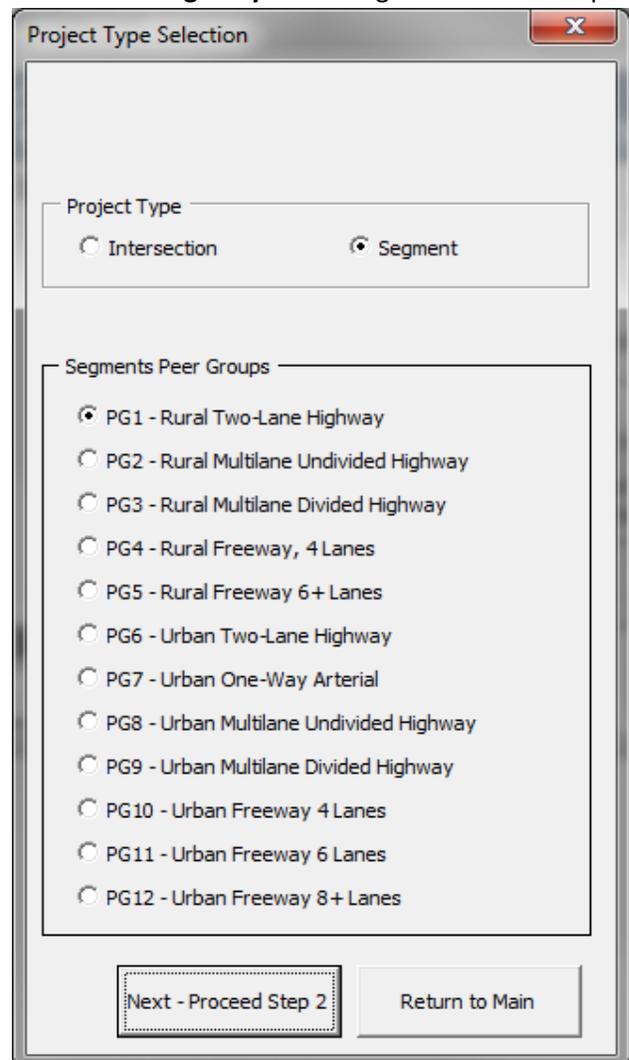
STEP 2: Select the **Create a new analysis** option and click **Next**.



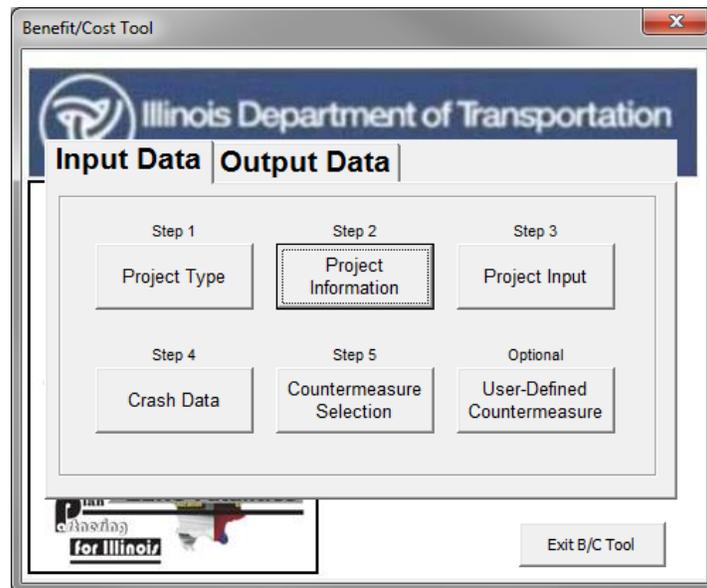
STEP 3: In the **Input Data** tab, select the button labeled **Project Type**.



STEP 4: Select **Segment** under Project Type. Select **PG1-Rural Two-Lane Highway** under Segments Peer Groups. When complete, click on **Return to Main** to return to the main input window.

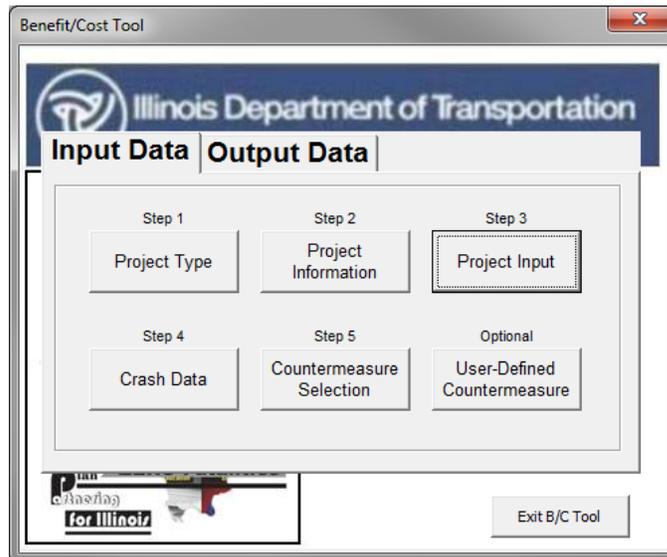


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When all fields are complete, click on **Return to Main**.

Segment Input

Crash Data : From 2007 to 2011

Current AADT : 9500

Length (Miles) : 2.3

Specify a value between 1 to 5%

Traffic Growth: 3.00

Discount rate: 4.00

Next - Proceed Step 4 Return to Main

STEP 9: Select **Crash Data**.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data Output Data

Step 1 Step 2 Step 3

Project Type Project Information Project Input

Step 4 Step 5 Optional

Crash Data Countermeasure Selection User-Defined Countermeasure

Exit B/C Tool

STEP 10: Select **Crash Severity Distribution by Crash Type**. Since there are two night time crashes, check the box for night time related crashes. When complete, select **Enter Crash Data**.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes and will analyze a night time countermeasure? : Yes

Do you have wet pavement crashes and will analyze a wet pavement countermeasure? : Yes

Enter Crash Data

STEP 11: Enter crash data for the analysis period by crash type and severity as shown. When complete, select **Return to Main**.

SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR	
Fatal Crashes		1	1															2
A-Injury Crashes				1				1										2
B-Injury Crashes			1															1
C-Injury Crashes																		0
PDO Crashes																		0

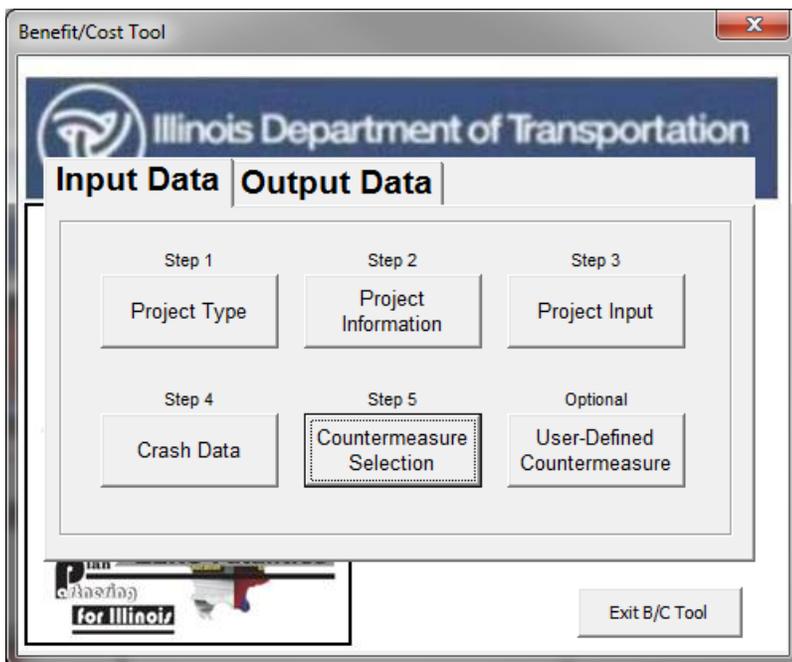
SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - NIGHTTIME

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR	
Fatal Crashes		1																1
A-Injury Crashes								1										1
B-Injury Crashes																		0
C-Injury Crashes																		0
PDO Crashes																		0

STEP - 1 Input crash data for the analysis period based on crash severity by crash type in the highlighted cells

Return to Main

STEP 12: Select **Countermeasure Selection**.



STEP 13: Select 2.1.8.1 Install Rumble Strips (Shoulder) from the countermeasures dropdown menu. To address the night time crashes, select 2.7.12.AL.1 Provide Lighting.

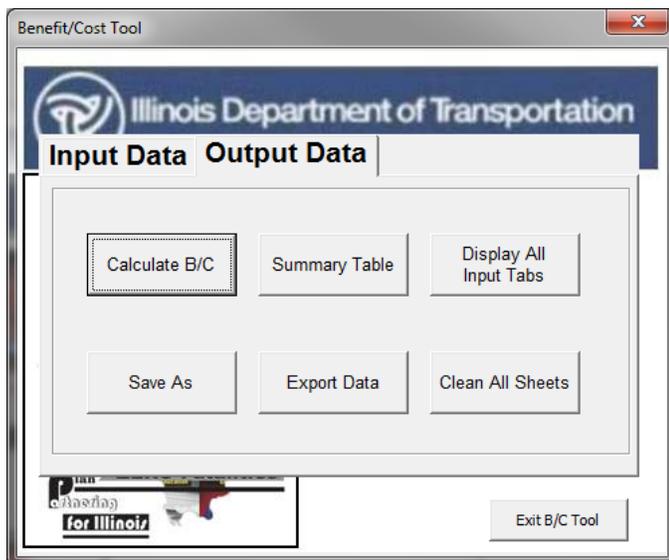
SEGMENTS BENEFIT COST ANALYSIS						
BENEFIT CALCULATIONS			COUNTERMEASURE COST CALCULATIONS			
COUNTERMEASURE	CMF*	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Service Life
2.1.8.S1.1 - Pavement Treatments - Install Rumble Strips (Shoulder)	0.78	FO, OVT	\$9,000	4.6	Miles	8
2.7.12.AL.1 - Roadside Safety - Provide Lighting	0.72	NGT	\$50,000	4.6	Miles	15
		All				\$0
		All				\$0

* CMF= Crash Modification Factor
** EUAC = Estimated Uniform Annual Cost

[Return to Main](#)

STEP - 1 Enter the list of potential countermeasures selected from the drop down menus
STEP - 2 Enter "Unit Cost" for the countermeasure selected
STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations
(Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen below will appear.

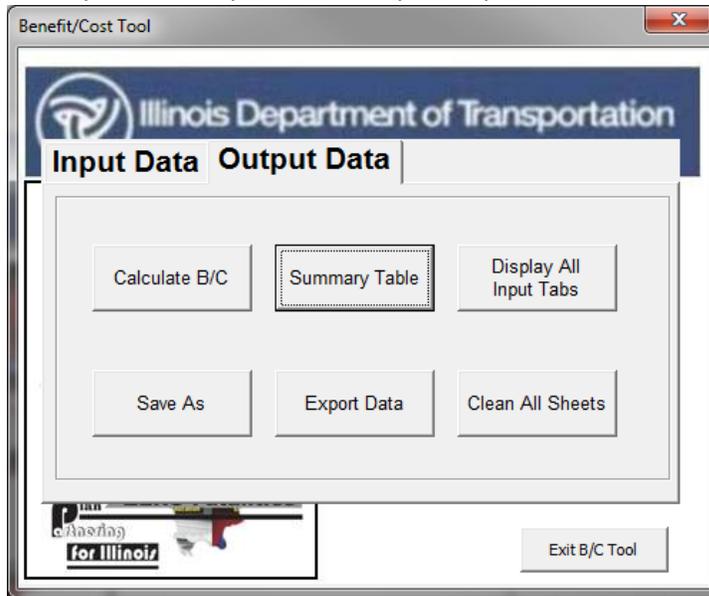


STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.

The image to the right will appear with the B/C ratio for this project. Click **OK** to return to the main menu.

Microsoft Excel	
Annualized Benefit	: \$ 725617.42
Annualized Cost	: \$ 27130
Benefit/Cost	: 26.75
Annual Number of Fatalities Potentially Prevented:	0.11
Study Period Number of Fatalities Potentially Prevented:	0.55
OK	

STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



Summary Table

The window below will appear when **Summary Table** is selected.

If you wish to create a backup copy and save the run, select **Export Data**. This will allow you to save the file with a new name. The file can be opened at later data and modified if necessary.

PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)														
Project	I-D Segment Improvement				Prepared by	DWB				Message				
Subsect	IS	County	Wooded		City	Forest				Date	4/15/2013			
Div/Route	003 81000 000000		Marked Route: I-D		Map/Scale					Current AADT	9500			
Location/Description	Rural two-lane road between Maple Street and Oak Street													
Segment Length	5	Years			Lights (miles)	2.3				Traffic Growth Factor	3.0%			
From	2007	to	2011		Interest rate	4.0%								
Peer Group	Peer Group 1 - Rural Two-Lane Highway													

SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																				
Crash Type	Crash Type										Crash Type									Total
	All Crashes	AD	AD	AD	AD	AD	AD	AD	AD	AD										
Crash Severity	ALL	AD	AD	AD	AD	AD	AD	AD	AD	AD										
Fatal Crashes																				
Major Crashes																				
Minor Crashes																				
Other Crashes																				

SEGMENTS BENEFIT COST ANALYSIS										COUNTERMEASURE COST CALCULATIONS									
COUNTY/SEGMENT	CMP**	Crash type affected by the improvement								Unit Cost	Quantity	Units	Total Cost	Service Life	Present worth	EUAC**			
218-011 - Pavement Treatment - Install Flexible Strip (Shoulder)	0.78	FD, CVT								\$9,000	4.6	Miles	\$41,400	8	\$71,651	\$8,444			
217-BAL-1 - Paved Shoulder Safety - Paved Shoulder Lighting	0.72	WGT								\$50,000	4.6	Miles	\$230,000	15	\$270,000	\$20,000			
		AD																	
		AD																	
TOTAL BENEFIT	\$725,617									TOTAL COST				\$27,190					
BENEFIT/COST	26.70	ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED				0.11				TOTAL FATALITIES PREVENTED				0.55					

* CMP = Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

Case Study 2: Benefit Cost Analysis for a Signalized Intersection

The signalized intersection of Maple Street and Oak Street was identified as a hazardous location. It is located in District 0, Wooded County, in the Village of Forest. From 2007 to 2011 there were 2 fatal crashes, 38 A-injury crashes, and 63 B-injury crashes. There were also C-injury and property damage only crashes at this location. The most representative crash types are angle, left turns, and rear ends.

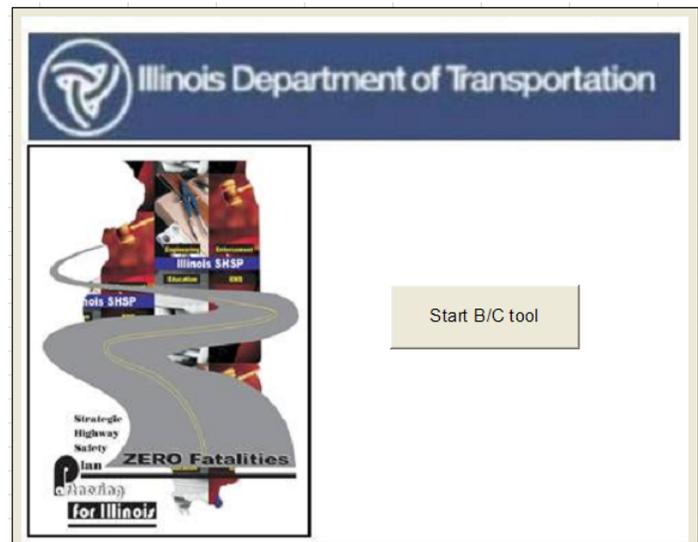
A road safety assessment was conducted and it was determined that there is a high left turn volume from a shared thru lane. The traffic signal heads were also difficult to see from a distance.

Countermeasures were reviewed and benefit-cost calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two countermeasures; an increase in the signal lens size to 12 inches for the intersection and a left turn lane and left turn phase addition for two legs of the intersection.

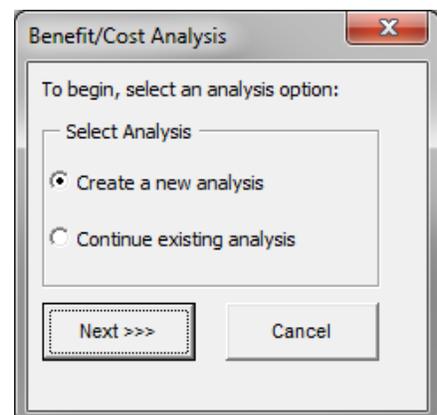
In this example, the first b/c calculation will be for treatment of two legs of the intersection with the increase in signal lens size. The second calculation will be for treatment of the other two legs of the intersection with an increase in signal lens size and the addition of left turn lane and left turn phases.

Step-by-Step Procedure

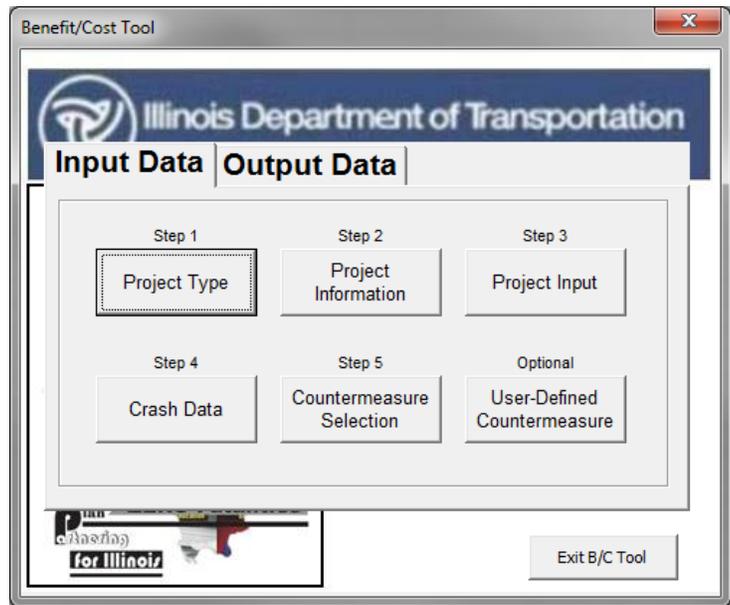
STEP 1: Press **Start B/C Tool**.



STEP 2: Select the **Create a new analysis** option, then click **Next**.

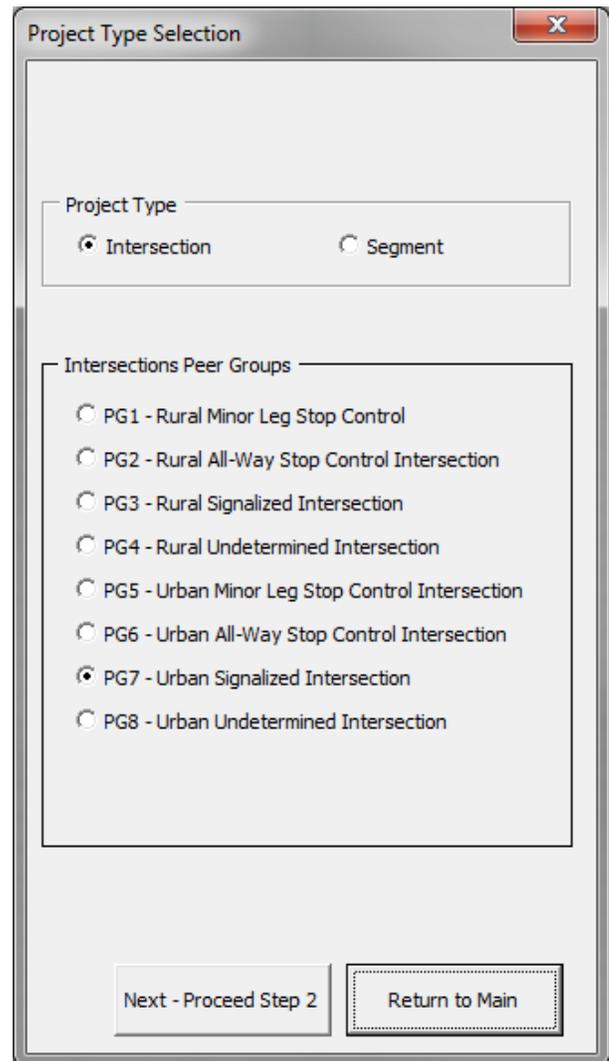


STEP 3: Select **Project Type**.

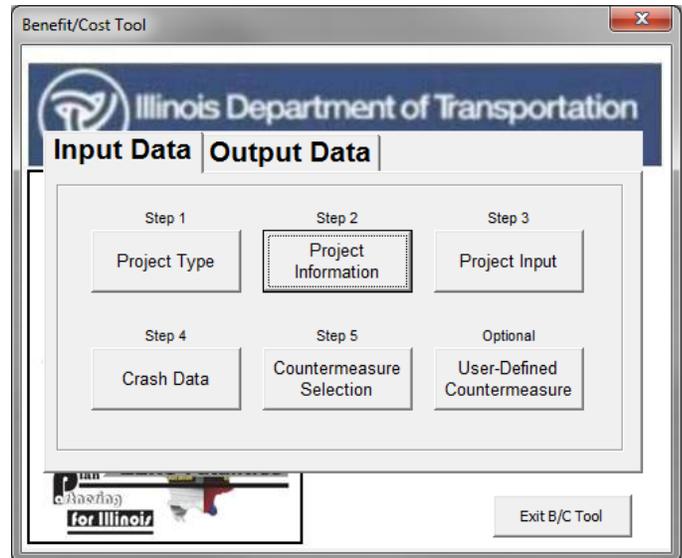


STEP 4: Select **Intersection** under Project Type. Select **PG7-Urban Signalized Intersection** under Intersection Peer Groups.

When complete, click on **Return to Main** to return to the main input window.

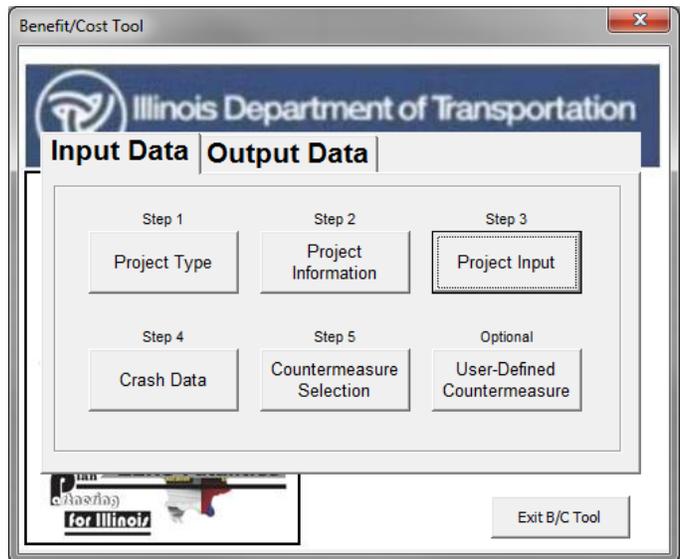


STEP 5: On the main menu, select **Project Information**.

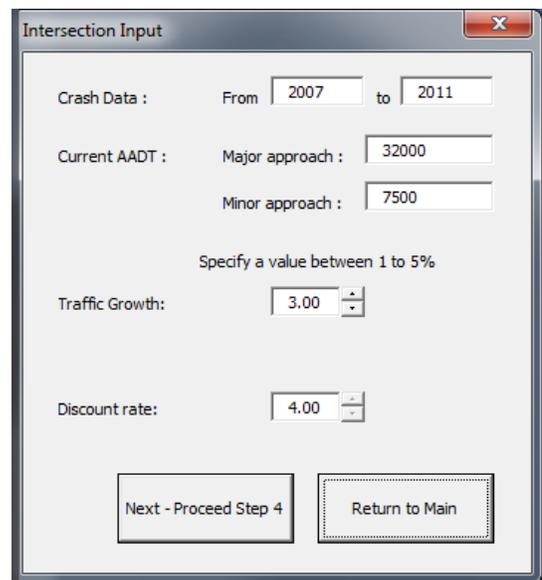


STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

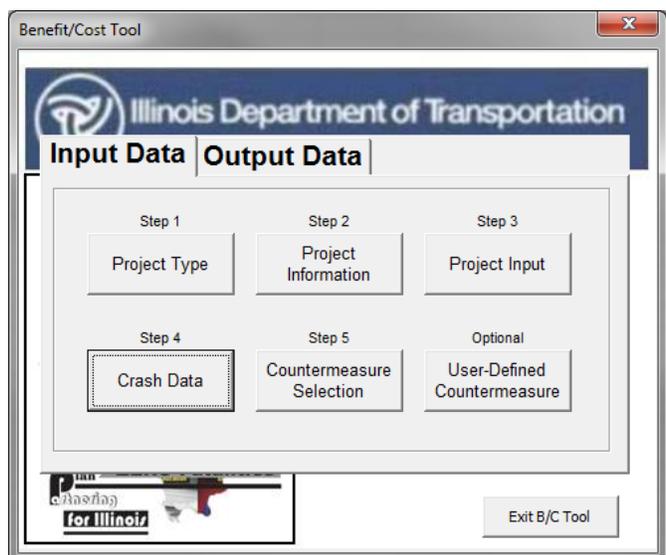
STEP 7: Select Project Input.



STEP 8: Input the information requested in the fields of the Intersection Input window. When all fields are complete, click on Return to Main.



STEP 9: Select Crash Data.



STEP 10: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.

Crash Data X

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes and will analyze a night time countermeasure? : Yes

Do you have wet pavement crashes and will analyze a wet pavement countermeasure? : Yes

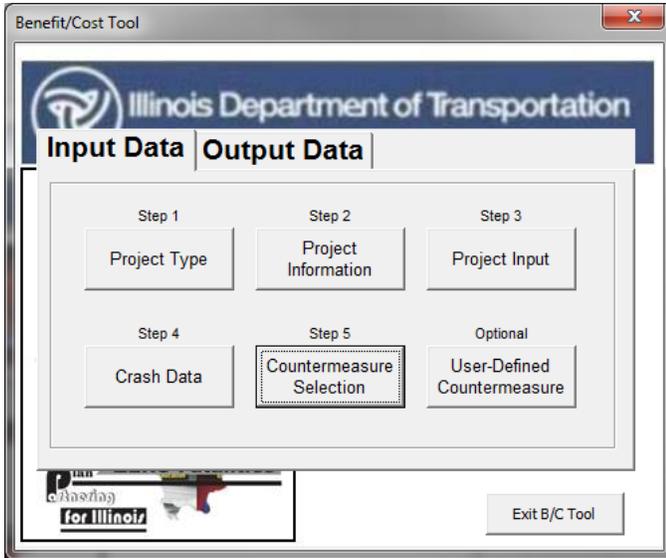
Enter Crash Data

STEP 11: Enter crash data for the analysis period by crash type and severity as shown. Crash data entered should be only for the two legs of the intersection that are to be treated with increasing lens size only. When complete, select **Return to Main**.

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtumed	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR	
Fatal Crashes												2						2
A-Injury Crashes	5				5													10
B-Injury Crashes	5				8													13
C-Injury Crashes																		0
PDO Crashes																		0

STEP 12: Select **Countermeasure Selection**.



STEP 13: Select 1.4.6.I7.1 Increase to 12 Inch Lens from the countermeasure dropdown menu.

INTERSECTION BENEFIT COST ANALYSIS							
BENEFIT CALCULATIONS				COUNTERMEASURE COST CALCULATIONS			
COUNTERMEASURE	CMF*	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life
1.4.6.I7.1 - Signalization - Increase to 12 Inch Lens	0.97	All	\$10,000	2	Unit Qty	\$20,000	10
		All				\$0	
		All				\$0	
		All				\$0	

***NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.

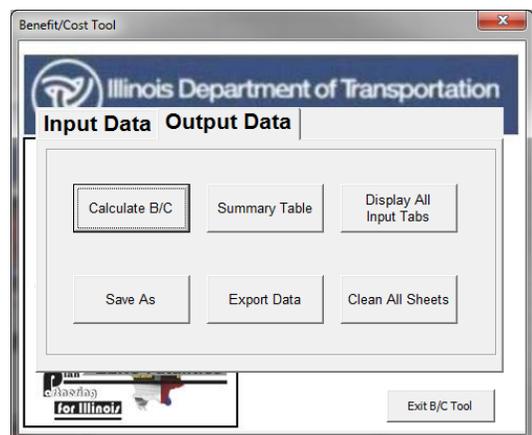
* CMF= Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

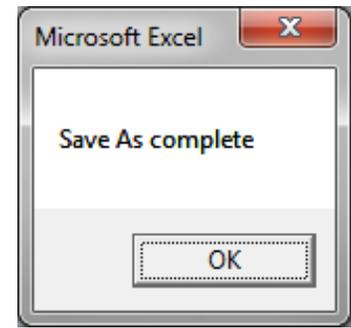
STEP - 1 Enter the list of potential countermeasures selected from the drop down menus***
 STEP - 2 Enter "Unit Cost" for the countermeasure selected
 STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. The unit cost should be the cost for increasing the lens size on one leg of the intersection. The quantity represents the number of legs for which the countermeasure will be applied. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

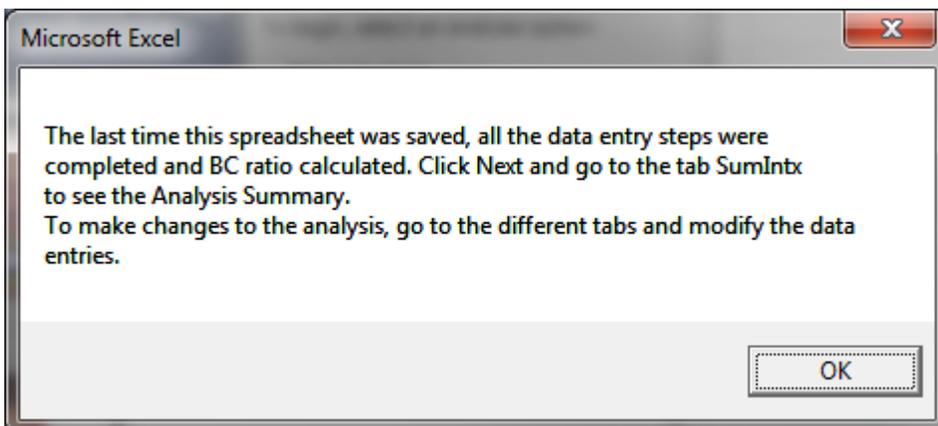
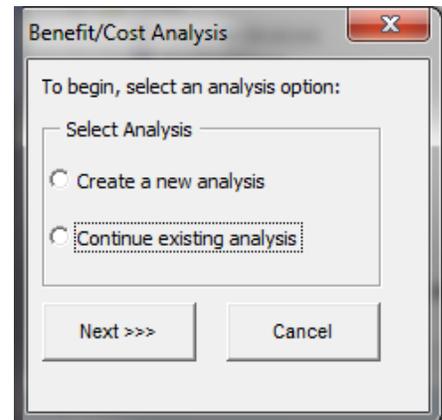
STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.



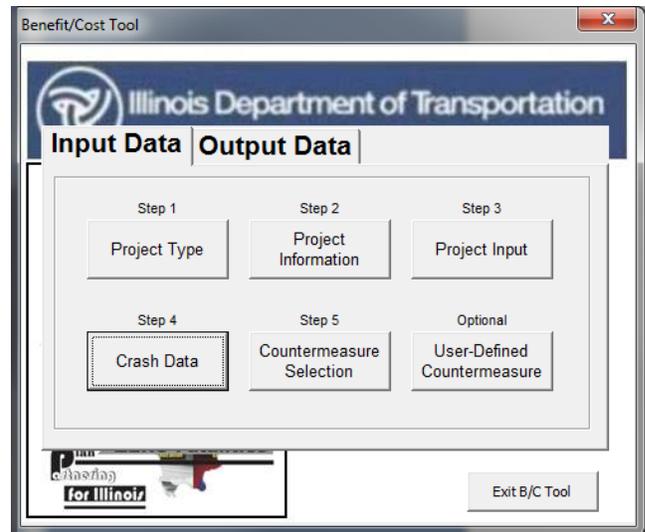
Once the **Save As** procedure is complete, the Save As complete window will open. Click **OK**.



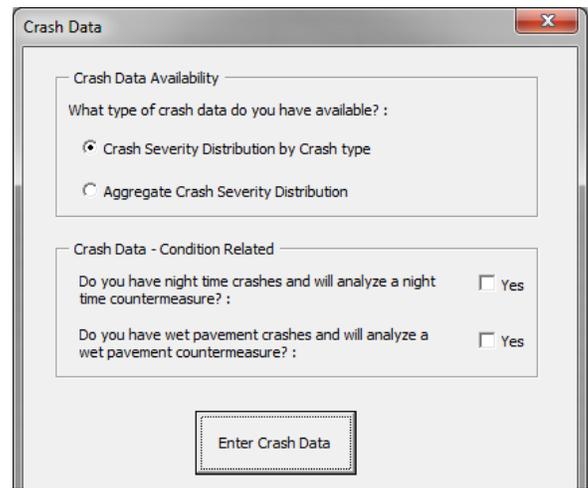
STEP 18: To treat the other two legs of the intersection with an increase in lens size and the addition of left turn phases, go back to the BC Tool Tab, click **Start B/C Tool**, and select **Continue existing analysis**. A window will open including details of the status of the file before it was saved. In this case, all the steps were previously completed, and the message will read as shown below.



STEP 19: Go back to the main menu – input tab and select **Crash Data**.



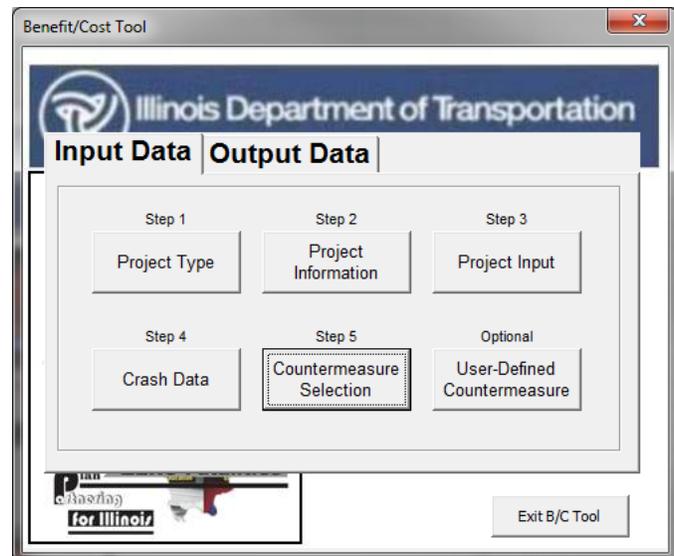
STEP 20: Select **Crash Severity Distribution by Crash Type**.
When complete, select **Enter Crash Data**.



STEP 21: Enter the crash data for the analysis period by crash type and severity for the crashes on the legs of the intersection that will be treated with increasing the lens size and the addition of the left turn lanes. Crashes should appear on only one of the two B/C analyses, not both, so that no crashes are counted more than once. When complete, select **Return to Main**.

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES																			
	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total	
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR		
Fatal Crashes																			0
A-Injury Crashes	10				10							8							28
B-Injury Crashes	20				10							10							40
C-Injury Crashes																			0
PDO Crashes																			0

STEP 22: Select **Countermeasure Selection**.



STEP 23: From the countermeasure dropdown menu, select 1.4.6.I7.1 Increase to 12 Inch Lens, 1.2.11.I7.1 Add left turn lane (existing signalized, four-leg intersection), and 1.4.4.I7.1 Add left turn phase on one approach.

INTERSECTION BENEFIT COST ANALYSIS			COUNTERMEASURE COST CALCULATIONS				
BENEFIT CALCULATIONS			COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CMF*	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life
1.4.6.I7.1 - Signalization - Increase to 12 Inch Lens	0.97	All	\$10,000	2	Unit Qty	\$20,000	10
1.2.11.I7.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)	0.91	All	\$100,000	2	Unit Qty	\$200,000	15
1.4.4.I7.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protect)	0.94	All	\$5,000	2	Unit Qty	\$10,000	10
		All				\$0	

***NOTE: If two or more countermeasures are selected; however, one is applicable to only one leg (i.e. installing traverse rumble strips on one approach), then calculate a benefit-cost ratio for each leg separately.

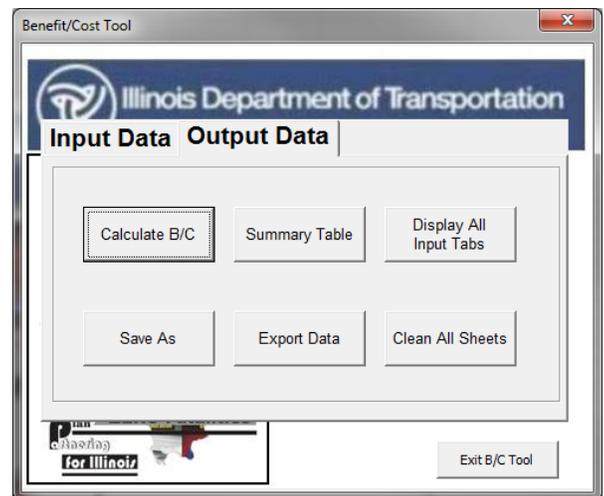
* CMF= Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

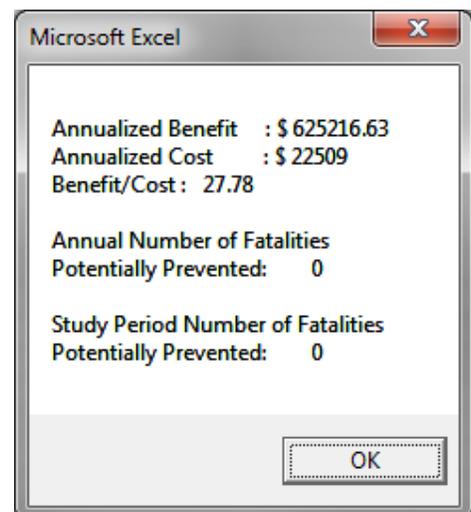
- STEP - 1 Enter the list of potential countermeasures selected from the drop down menus***
- STEP - 2 Enter "**Unit Cost**" for the countermeasure selected
- STEP - 3 Update the "**Quantity**" for each countermeasure selected for cost calculations

STEP 24: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**. When all input data has been completed, select the **Output Data** tab on the main menu.

STEP 25: Click on **Calculate B/C** to obtain the B/C ratio.



The image to the right will appear with the B/C ratio for this project. Click **OK** to return to the main menu.



STEP 26: Select **Summary Table** to see a summary of the analysis or to verify inputs. The window below will appear when **Summary Table** is selected.

PROJECT DESCRIPTION - PROJECT DATA INPUT (INTERSECTIONS)														
Project: Intersection Improvement - Village Street and Oak Street										Prepared by: CDB				
Address: 0		County: Invered		City: Forest		Date: 4/15/2015			Message: (See Manual for Details)					
City Name: Urban Signalized Intersection of Maple St & Oak St		Signal Cycle: 5176		Mile Post: 0.3		Current AADT: Main Street 20000 Maple Street 7500			1,2,11,17,1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection) AADT is not within HSM limits					
Construction Start: 5 Years		From: 2007		To: 2011		Traffic Growth Factor: 3.0%			Interest Rate: 4.0%					
Peer Group: Peer Group 7 - Urban Signalized Intersection														

INTERSECTION CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																						
Crash Type	All Crashes	Angle	Animal	Fixed Object	Head-On	Left Turn	Other Intersection	Other Object	Overturn	Pedestrian	Possible	Parked Vehicle	Four End	Right Turn	Intersection Signal Direction	Intersection Signal Direction	Turning	Truck	Right Time	WIP	Total	
Signalized	ALL	ANG	ANM	FOO	HCO	LT	Other/NC	Other/O	OV	PD	PSS	PV	FE	RT	SDD	SOD	T	TR	MGT	WIP	TOT	
2486 Crashes																						2486
Angle Crashes	16																					16
Animal Crashes	20																					20
Fixed Object Crashes																						0
Head-On Crashes																						0
Left Turn Crashes																						0
Possible Crashes																						0
Parked Vehicle Crashes																						0
Four End Crashes																						0
Right Turn Crashes																						0
Intersection Signal Direction Crashes																						0
Intersection Signal Direction Crashes																						0
Turning Crashes																						0
Truck Crashes																						0
Right Time Crashes																						0
WIP Crashes																						0

INTERSECTION BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CNF**	Crash Type affected by this improvement	Unit Cost	Quantity	Unit	Total Cost	Service Life	Present Worth	EWAC**
14.4.01 - Signalization - Increase to 12-Week Lens	0.97	AB	\$10,000	2	Unit Only	\$20,000	10	\$33,911	\$3,014
12.10.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)	0.91	AB	\$100,000	2	Unit Only	\$200,000	15	\$200,000	\$17,500
14.4.01 - Signalization - Add Left Turn Phase on One Approach (Premissive or Preemptive or PH)	0.94	AB	\$5,000	2	Unit Only	\$10,000	10	\$16,756	\$1,507
		AB							
TOTAL BENEFIT								\$625,217	
TOTAL COST									\$22,509
BENEFIT/COST								27.78	
ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED								0.00	
TOTAL FATALITIES PREVENTED									0.00

NOTE: IF THE NUMBER OF LEGS AFFECTED VARIES BY COUNTERMEASURES SELECTED, THEN CALCULATE THE BENEFIT-COST RATIO FOR EACH COUNTERMEASURE SEPARATELY (Use separate spreadsheets for each countermeasure applied).
 ** CNF = Crash Modification Factor
 ** EWAC = Estimated Uniform Annual Cost

If you wish to save the run, select **Save As**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.

After completing the two B/C analyses, a combined B/C ratio can be obtained by adding the benefits and dividing by the sum of the total costs. The sum of the total benefits for this example is \$746,898 and the sum of the total costs is \$24,975. The composite B/C is 29.91.

Part	Benefits	Costs	B/C ratio
Part 1	\$ 121,682.04	\$ 2,466.00	49.34
Part 2	\$ 625,216.63	\$ 22,509.00	27.78
Total	\$ 746,898.67	\$ 24,975.00	29.91

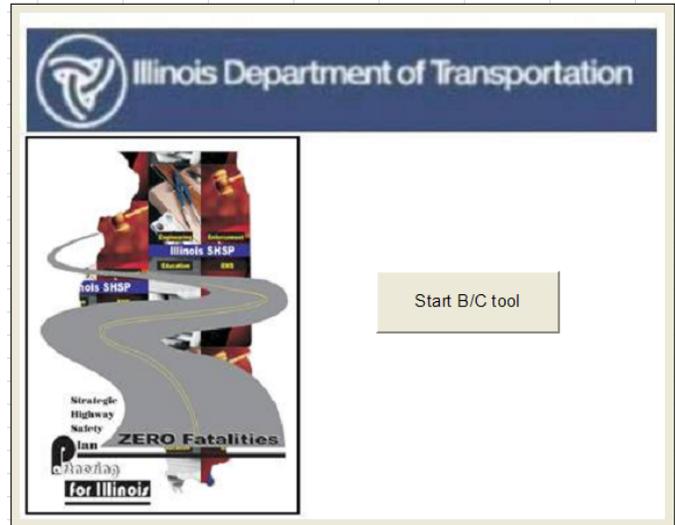
Case Study 3: Benefit Cost Analysis for a Systematic Improvement

This case study shows an analysis for systematic improvements at a series of locations that present similar types of risk or recurring number of crashes of certain types. The sites are located in District 10, and have 14 different county boundaries. A major crash pattern and risk at the different sites is associated with lack of warning signals and roadway markings.

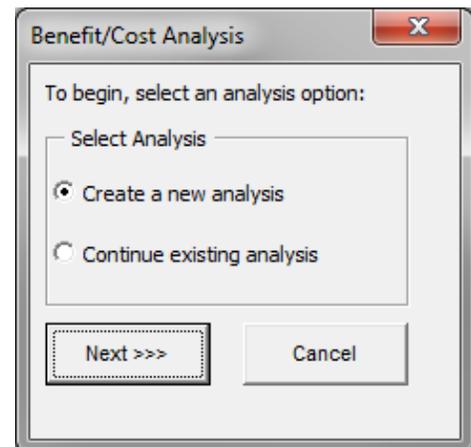
This example reflects the step-by-step procedure for calculating the benefit-cost ratio for adding two types of warning signs and roadway markings to the existing sites.

Step-by-Step Procedure

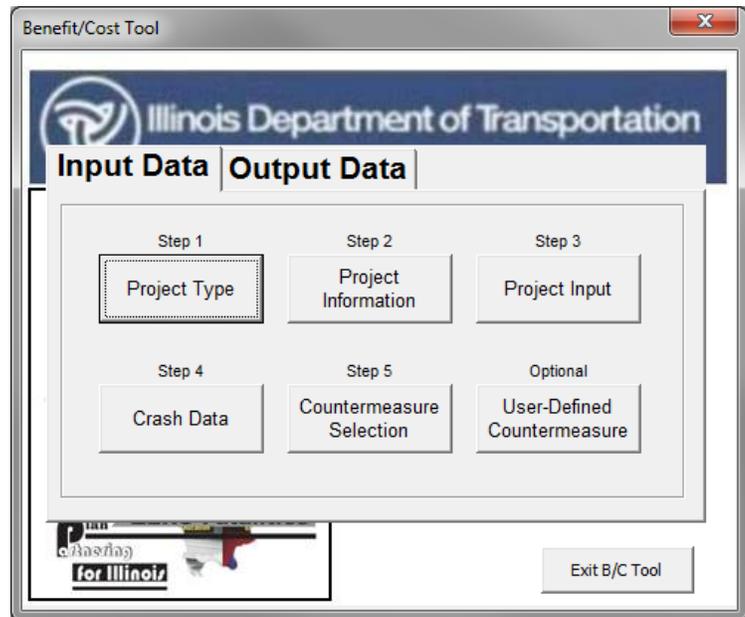
STEP 1: Press **Start B/C Tool**.



STEP 2: Select the **Create a new analysis** option, and then click **Next**.

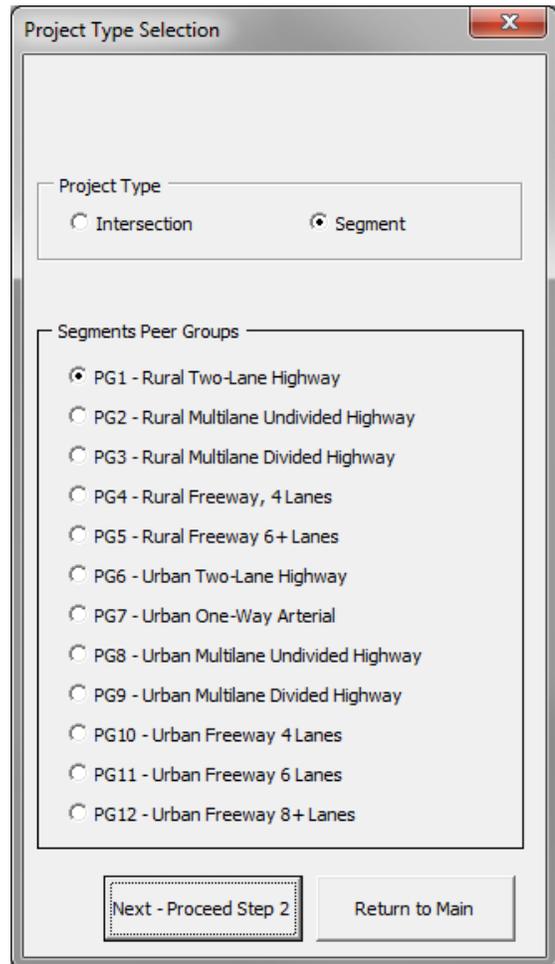


STEP 3: Select **Project Type**.

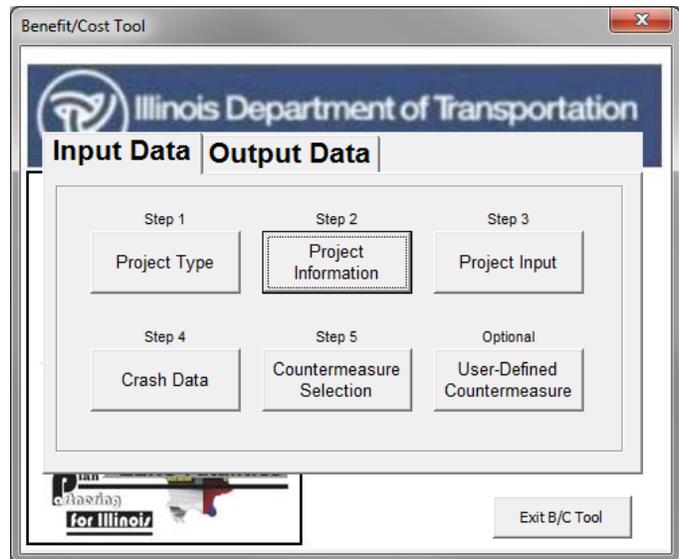


STEP 4: Select roadway system by clicking on **State**. Select **Segment** under Project Type. Select **PG1-Rural Two Lane Highway** under Segment Peer Groups.

When complete, select **Return to Main** to return to the main input window.

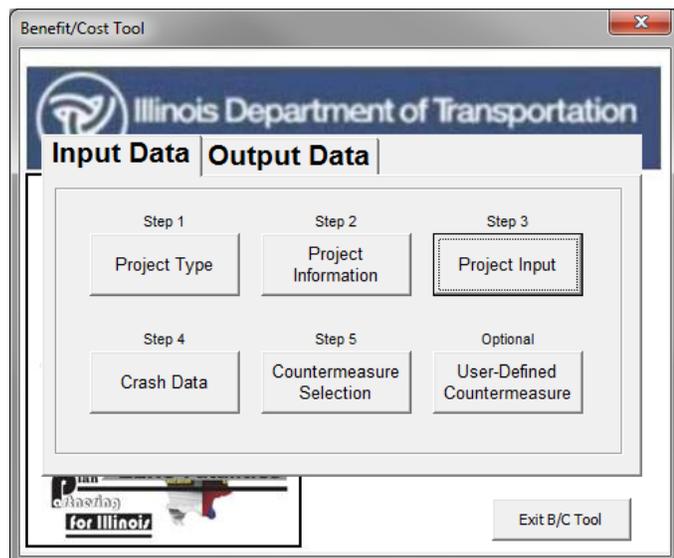


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When complete with all fields, click on **Return to Main**.

The screenshot shows a window titled "Segment Input" with a close button (X) in the top right corner. The window contains the following fields and controls:

- Crash Data :** From to
- Current AADT :**
- Length (Miles) :**
- Traffic Growth:** with up and down arrow buttons.
- Discount rate:** with up and down arrow buttons.
- A note below the Length field: "Specify a value between 1 to 5%"
- At the bottom, there are two buttons: "Next - Proceed Step 4" and "Return to Main".

STEP 9: Select **Crash Data**.

The screenshot shows the "Benefit/Cost Tool" main menu. At the top, it features the Illinois Department of Transportation logo and the text "Illinois Department of Transportation". Below this, there are two tabs: "Input Data" (selected) and "Output Data".

The main area displays a progress bar with six steps:

- Step 1: Project Type
- Step 2: Project Information
- Step 3: Project Input
- Step 4: **Crash Data** (highlighted with a dotted border)
- Step 5: Countermeasure Selection
- Optional: User-Defined Countermeasure

At the bottom left, there is a small graphic with the text "for Illinois". At the bottom right, there is an "Exit B/C Tool" button.

STEP 10: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.

STEP 11: Enter crash data for the analysis period by crash type and severity as shown. When complete, select **Return to Main**.

SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES

	Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtumed	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total
	AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR	
Fatal Crashes	1		1	2				2				1				1		8
A-Injury Crashes	15		7	1			1	12		1		8			1	9		55
B-Injury Crashes	9	1	15	6		4	3	12	1			20			4	13		88
C-Injury Crashes																		0
PDO Crashes																		0

STEP 12: Select **Countermeasure Selection**.

STEP 13: Select 2.3.6.S1.1 Install Edgelines, Centerlines, and Post Mounted Delineators, 2.6.7.S1.1 Install Chevron Signs on Horizontal Curves, and 2.6.5.AL.1 Install Advanced Curve/Speed Warning Sign.

SEGMENTS BENEFIT COST ANALYSIS							
BENEFIT CALCULATIONS			COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CMF*	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life
2.3.6.S1.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators	0.55	All	\$84,000	1	Miles	\$84,000	1
2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves	0.84	All	\$84,000	1	Unit Qnty	\$84,000	4
2.6.5.AL.1 - Curves - Install Advanced Curve Speed/Warning Sign	0.87	All	\$84,000	1	Unit Qnty	\$84,000	5
		All				\$0	

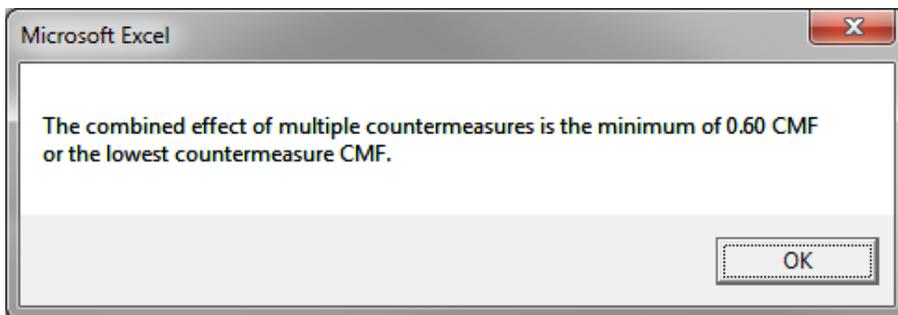
* CMF= Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

STEP - 1 Enter the list of potential countermeasures selected from the drop down menus
 STEP - 2 Enter "Unit Cost" for the countermeasure selected
 STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations
 (Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

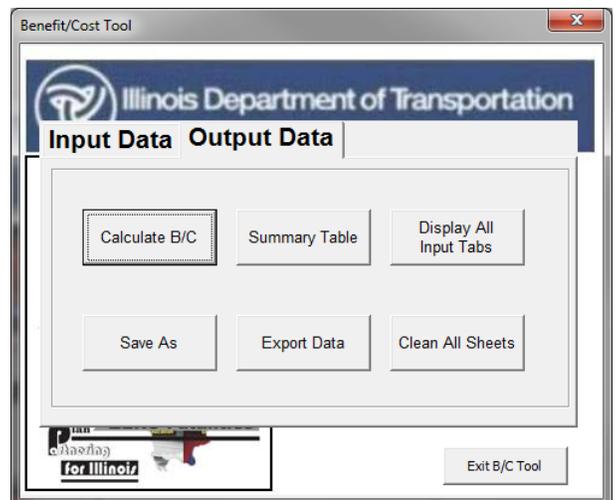
STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**.

On selection of **Return to Main**, the following message will appear to notify the user that the combined effect of multiple countermeasures will be limited to the minimum of 0.60 or the lowest selected CMF. In this example, Install Edgelines, Centerlines, and Post Mounted Delineators have a CMF of 0.55; therefore, the combined CMF for all selected countermeasures will equal 0.55. Select **OK**.

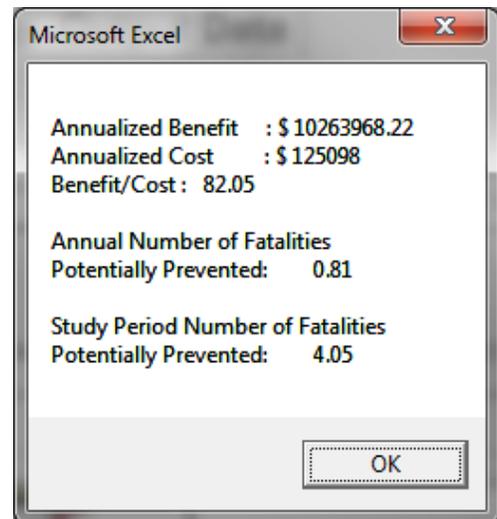


When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown below will appear.

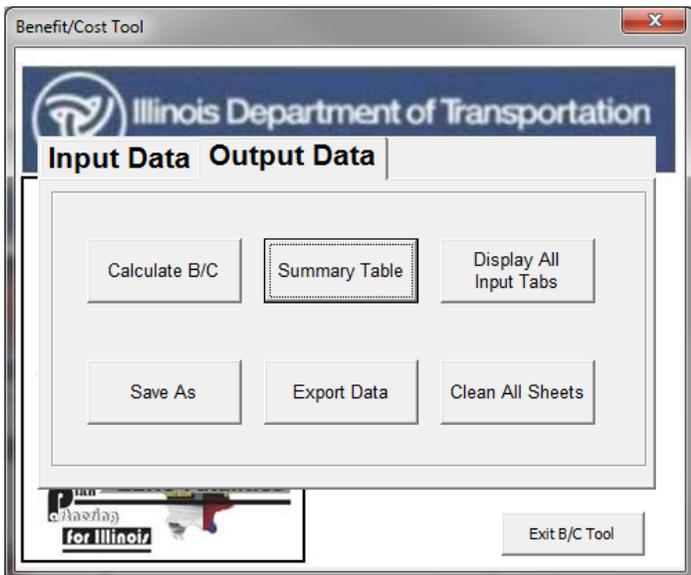
STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.



The image to the right will appear with the B/C ratio for this project.
Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.



The window below will appear when **Summary Table** is selected. If you would like to save the run, select **Export Data** or **Save As**. This will allow you to save the file with a new name. The file can be opened at a later date and modified if necessary.

PROJECT DESCRIPTION - PROJECT DATA INPUT (SEGMENTS)																																						
<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td>Project</td> <td colspan="4">Signage and Markings - Systematic Improvements</td> </tr> <tr> <td>Client</td> <td>TD</td> <td>County</td> <td>CO</td> <td>Prepared by</td> <td>CS</td> </tr> <tr> <td>City/Route</td> <td colspan="2">Marion Route</td> <td>Minority</td> <td>Date</td> <td>6/15/2013</td> </tr> <tr> <td>Location/Segment</td> <td colspan="2">Multiple locations, 14 counties</td> <td>Minority</td> <td>Current AADT</td> <td>3500-12000</td> </tr> </table>					Project	Signage and Markings - Systematic Improvements				Client	TD	County	CO	Prepared by	CS	City/Route	Marion Route		Minority	Date	6/15/2013	Location/Segment	Multiple locations, 14 counties		Minority	Current AADT	3500-12000	<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="2">Messages</td> </tr> <tr> <td colspan="2">2.6.7.5.1.1 - Curves - Install Chevron Signs on Horizontal Curves AADT is not within HCM limits</td> </tr> <tr> <td colspan="2">The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF.</td> </tr> </table>					Messages		2.6.7.5.1.1 - Curves - Install Chevron Signs on Horizontal Curves AADT is not within HCM limits		The combined effect of multiple countermeasures is limited to 0.60 or the smallest CMF.	
Project	Signage and Markings - Systematic Improvements																																					
Client	TD	County	CO	Prepared by	CS																																	
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<table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td colspan="2">Crash data:</td> <td colspan="2">5 Years</td> <td colspan="2">Lifespan (years):</td> </tr> <tr> <td>From</td> <td>2007</td> <td>to</td> <td>2011</td> <td>Traffic Growth Factor</td> <td>3.5%</td> </tr> <tr> <td colspan="4"></td> <td>Discount Rate</td> <td>4.0%</td> </tr> </table>					Crash data:		5 Years		Lifespan (years):		From	2007	to	2011	Traffic Growth Factor	3.5%					Discount Rate	4.0%																
Crash data:		5 Years		Lifespan (years):																																		
From	2007	to	2011	Traffic Growth Factor	3.5%																																	
				Discount Rate	4.0%																																	
Peer Group: Peer Group 1 - Rural Two-Lane Highway																																						
SEGMENTS CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD																																						
Crash Type	Crash Type																			Total																		
	All Crashes	Angle	Animal	Fixed Object	Head On	Left Turn	Other Intersection	Other Object	Overrun	Passing	Queue/Stop	Parked Vehicle	Other End	Right Turn	Clearance Same Direction	Clearance Opposite Direction	Turning	Truck	Right Time		Weir/Farmment																	
Crash Severity	All	AD	AM	FD	AD	LT	Other/IC	Other/O	OT	PO	OS	Other/V	AE	RT	SD	SO	T	TR	RTT	WF																		
FDA Crashes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Animal Crashes	15	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Other Crashes	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Crash Severity	All	AD	AM	FD	AD	LT	Other/IC	Other/O	OT	PO	OS	Other/V	AE	RT	SD	SO	T	TR	RTT	WF																		
FDA Crashes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Animal Crashes	15	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Other Crashes	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Crash Severity	All	AD	AM	FD	AD	LT	Other/IC	Other/O	OT	PO	OS	Other/V	AE	RT	SD	SO	T	TR	RTT	WF																		
FDA Crashes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Animal Crashes	15	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Other Crashes	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Crash Severity	All	AD	AM	FD	AD	LT	Other/IC	Other/O	OT	PO	OS	Other/V	AE	RT	SD	SO	T	TR	RTT	WF																		
FDA Crashes	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Animal Crashes	15	7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	
Other Crashes	9	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1																	

SEGMENTS BENEFIT COST ANALYSIS									
BENEFIT CALCULATIONS					COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CMF*	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Severity Ltr	Prevent Fatal	EUAC**
2.6.7.5.1.1 - Payment Markings - Install Edgelines, Centerlines and Post-Mounted Delineator	0.55	All	\$84,000	1	Miles	\$84,000	1	\$368,612	\$87,360
2.6.7.5.1.1 - Curves - Install Chevron Signs on Horizontal Curves	0.04	All	\$84,000	1	Unit Grty	\$84,000	4	\$84,000	\$18,000
2.6.8.1.1 - Curves - Install Advanced Curve Speed Warning Sign	0.87	All	\$84,000	1	Unit Grty	\$84,000	5	\$84,000	\$18,360
		All							
TOTAL BENEFIT									
TOTAL BENEFIT									
TOTAL COST									
BENEFIT COST	82.00								
ANNUAL NUMBER OF FATALITIES POTENTIALLY PREVENTED				0.81					
TOTAL FATALITIES PREVENTED								4.05	

* CMF = Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

Return to Main

Case Study 4: Benefit Cost Analysis for a Segment Median Improvement

A rural four-lane freeway segment along a 10 mile stretch of I-80 was identified as a hazardous location. It is located in District 10, Wooded County, in the Village of Forest. From 2007 to 2011, 3 fatal crashes occurred, 10 A-injury crashes occurred, and 11 B-injury crashes occurred. Six wet pavement crashes, one Fatal, three A-injury, and two B-injury, occurred. The majority of the crashes was head-on and overturns. 2011 traffic volumes show a segment AADT of 18,000.

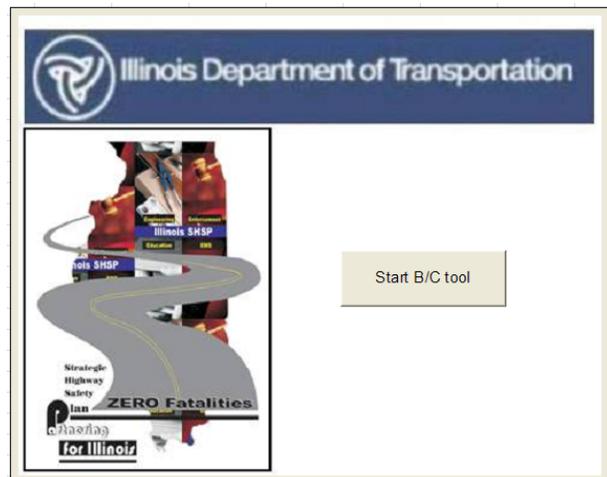
A road safety assessment was conducted and it was determined that the road has not been resurfaced, resulting in poor roadway friction. Furthermore, the median between eastbound and westbound of I-80 has steep side slopes and does not have any barrier treatments. Cross median crashes frequently resulted in overturned vehicles.

Countermeasures were reviewed and B/C calculations were conducted to select the recommended solution. This example reflects the step-by-step procedure for calculating the benefit-cost ratio by adding three countermeasures. A de-slicking treatment was selected to address the crashes associated with poor pavement friction. A combination of improving median side slopes and installing a cable median barrier was selected to address the head on and overturned crashes.

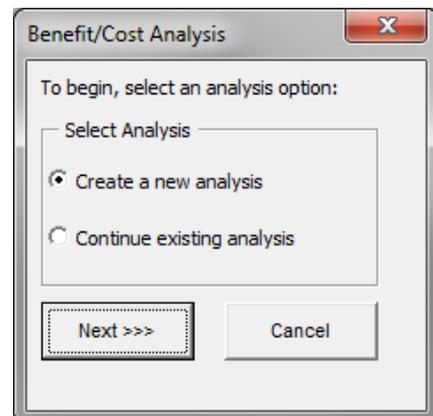
This example highlights how wet pavement crashes are handled in the BC Tool and also highlights some of the warning messages a user may encounter while completing an analysis.

Step-by-Step Procedure

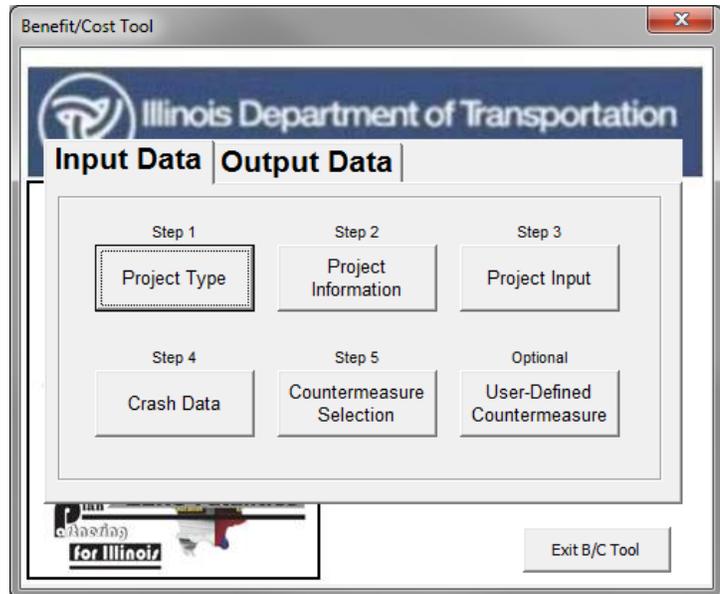
STEP 1: Press **Start B/C Tool**.



STEP 2: Select the **Create a new analysis** option, and then click **Next**.

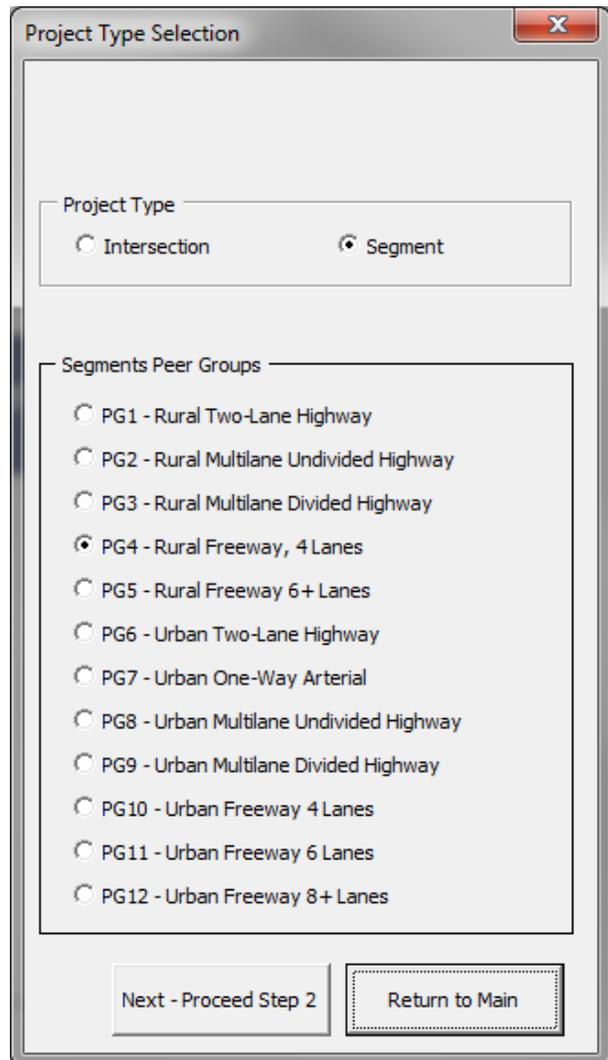


STEP 3: Select **Project Type**.

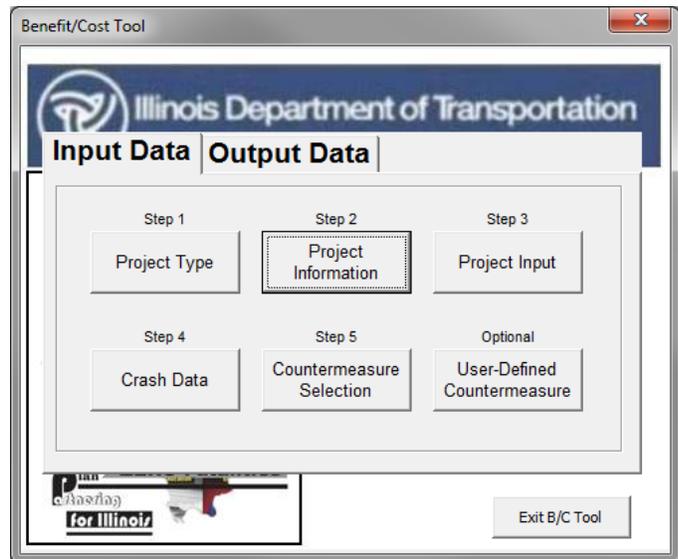


STEP 4: Select **Segment** under Project Type. Select **PG4-Rural Freeway, 4 Lanes** under Segment Peer Groups.

When complete, click on **Return to Main** to return to the main input window.

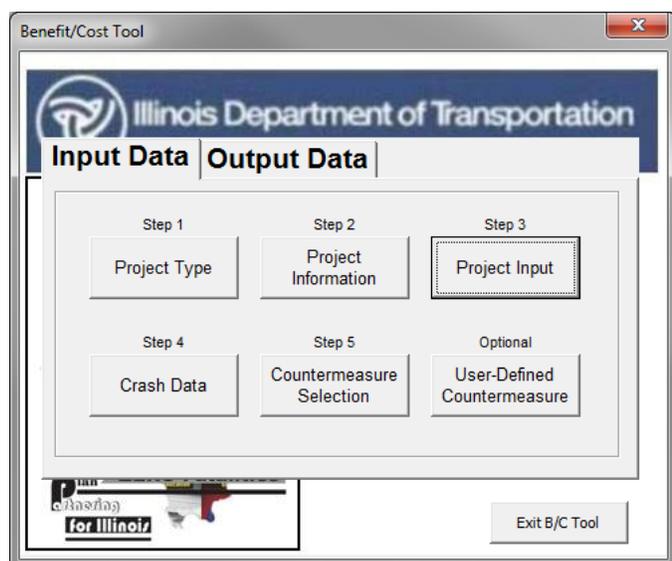


STEP 5: On the main menu, select **Project Information**.



STEP 6: Complete the information in the boxes as shown. When all fields have been completed, click on **Return to Main**.

STEP 7: Select **Project Input**.



STEP 8: Input the information requested in the fields of the **Segment Input** window. When all fields are complete, click on **Return to Main**.

Segment Input

Crash Data : From 2007 to 2011

Current AADT : 18000

Length (Miles) : 10

Specify a value between 1 to 5%

Traffic Growth: 3.00

Discount rate: 4.00

Next - Proceed Step 4 Return to Main

STEP 9: Select **Crash Data**.

Benefit/Cost Tool

Illinois Department of Transportation

Input Data Output Data

Step 1: Project Type

Step 2: Project Information

Step 3: Project Input

Step 4: **Crash Data**

Step 5: Countermeasure Selection

Optional: User-Defined Countermeasure

for Illinois

Exit B/C Tool

STEP10: Select **Crash Severity Distribution by Crash Type**. When complete, select **Enter Crash Data**.

Crash Data

Crash Data Availability

What type of crash data do you have available? :

Crash Severity Distribution by Crash type

Aggregate Crash Severity Distribution

Crash Data - Condition Related

Do you have night time crashes and will analyze a night time countermeasure? : Yes

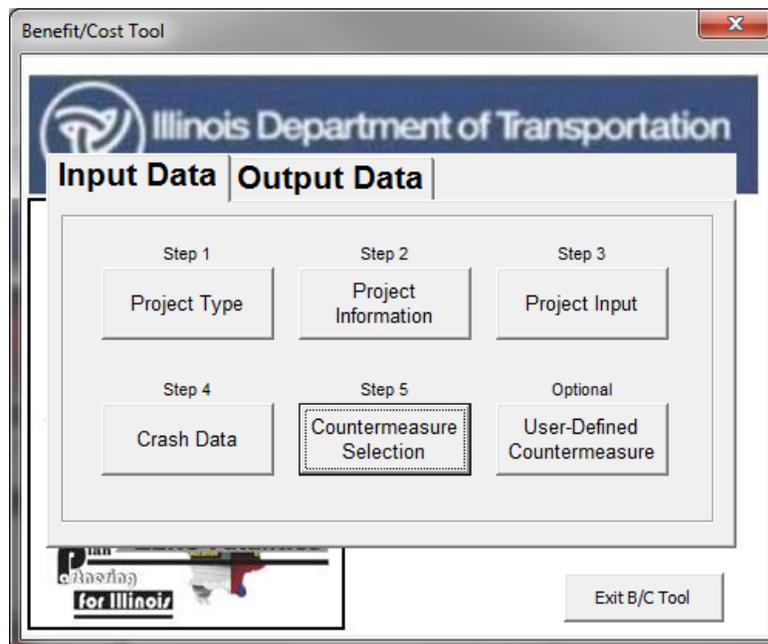
Do you have wet pavement crashes and will analyze a wet pavement countermeasure? : Yes

Enter Crash Data

STEP 11: Enter all crash data in the ALL CRASHES table and then enter wet pavement crash data in the WET PAVEMENT table. If a transcription error occurs during this process, a warning message will pop up notifying the user that wet pavement crashes exceed total crashes. When complete, select **Return to Main**.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - ALL CRASHES																		
2																			
3		Angle	Animal	Fixed Object	Head On	Left Turn	Other Noncollision	Other Object	Overtuned	Pedestrian	Pedalcyclist	Parked Vehicle	Rear End	Right Turn	Sideswipe Same Direction	Sideswipe Opposite Direction	Turning	Train	Total
4		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR	
5	Fatal Crashes			2					1										3
6	A-Injury Crashes		1	3					4						2				10
7	B-Injury Crashes			4					5				1		1				11
8	C-Injury Crashes																		0
9	PDO Crashes																		0
10																			
11																			
21																			
22																			
23																			
24	SEGMENT CRASH SEVERITY DISTRIBUTION BY CRASH TYPE FOR ANALYSIS PERIOD - WET PAVEMENT																		
25																			
26		AG	AN	FO	HO	LT	OtherNC	OtherO	OVT	PD	PDC	PKV	RE	RT	SSD	SOD	T	TR	
27	Fatal Crashes			1															1
28	A-Injury Crashes			1					2										3
29	B-Injury Crashes			1					1										2
30	C-Injury Crashes																		0
31	PDO Crashes																		0
32																			
33																			
43																			
44																			
45																			
46	STEP - 1	Input crash data for the analysis period based on crash severity by crash type in the highlighted cells																	Return to Main

STEP 12: Select **Countermeasure Selection**.



STEP 13: Select the following countermeasures: 2.2.2.S4.1 Install Steel Median Barrier, 2.7.3.S4.1 Flatten Sideslopes (Existing = 1V:4H, Future = 1V:6H), and 2.1.7.AL.1 De-Slick.

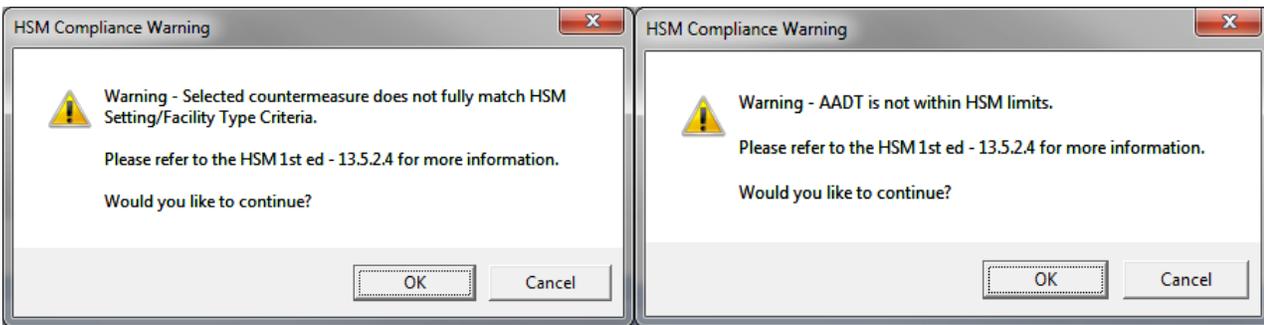
SEGMENTS BENEFIT COST ANALYSIS							
BENEFIT CALCULATIONS			COUNTERMEASURE COST CALCULATIONS				
COUNTERMEASURE	CMF*	Crash Type affected by this improvement	Unit Cost	Quantity	Units	Total Cost	Service Life
2.2.2.S4.1 - Median Treatments - Install Steel Median Barrier	0.65	All	\$125,000	10	Miles	\$1,250,000	15
2.7.3.S4.1 - Roadside Safety - Flatten Sideslopes	0.94	All	\$25,000	10	Miles	\$250,000	15
2.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing)	0.43	WP	\$1,250,000	10	Miles	\$12,500,000	5
		All				\$0	

* CMF= Crash Modification Factor
 ** EUAC = Estimated Uniform Annual Cost

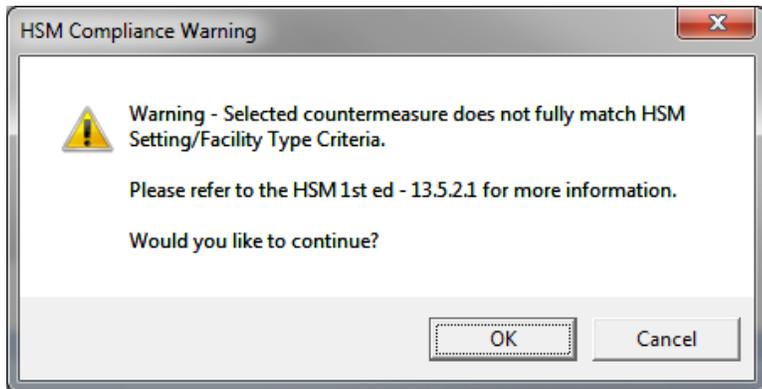
Return to Main

- STEP - 1 Enter the list of potential countermeasures selected from the drop down menus
- STEP - 2 Enter "Unit Cost" for the countermeasure selected
- STEP - 3 Update the "Quantity" for each countermeasure selected for cost calculations
 (Example: If Shoulder Rumble Strips are selected for a 3-mile segment in both directions, then the "Quantity = (3x2) = 6")

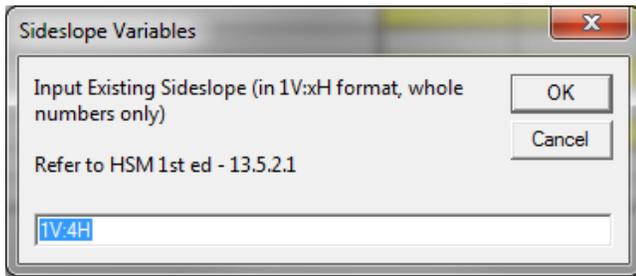
After selecting the first CMF, the following warning messages appear. These warning messages will inform the user that the selected countermeasures do not fully meet the setting/facility type and AADT requirements outlined in the HSM. The user has the ability to continue with the selected countermeasure or develop a user-defined countermeasure based on more current or applicable research. Otherwise, select **OK** for both warnings.



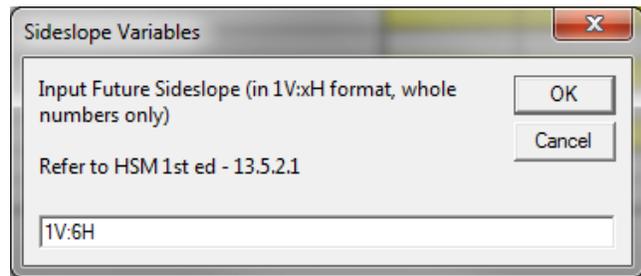
After selecting 2.7.3.S4.1 Flatten sideslopes, the following warning message will appear informing the user that the selected countermeasure does not fully meet the setting/facility type outlined in the HSM.



After selecting **OK**, the following windows appear. Enter the existing and proposed future sideslopes accordingly. Select **OK** to move on to the next window. After the existing and proposed future sideslopes are input, the tool will return the appropriate CMF based on HSM methodology. Select **OK** to continue.

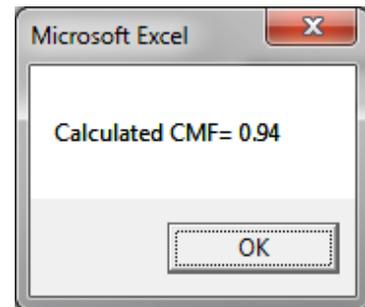


The dialog box is titled "Sideslope Variables" and contains the following text: "Input Existing Sideslope (in 1V:xH format, whole numbers only)", "Refer to HSM 1st ed - 13.5.2.1", and a text input field containing "1V:4H". There are "OK" and "Cancel" buttons.



The dialog box is titled "Sideslope Variables" and contains the following text: "Input Future Sideslope (in 1V:xH format, whole numbers only)", "Refer to HSM 1st ed - 13.5.2.1", and a text input field containing "1V:6H". There are "OK" and "Cancel" buttons.

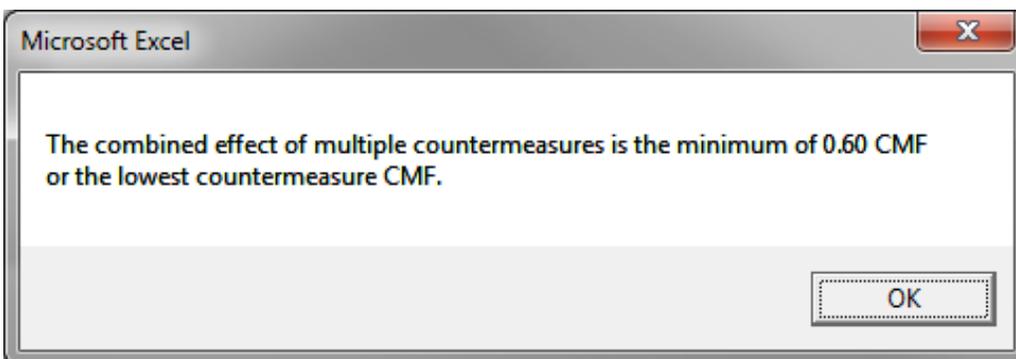
After selecting **OK**, a new window appears indicating the calculated CMF for the flatten sideslopes CMF.



The window is titled "Microsoft Excel" and displays the text "Calculated CMF= 0.94" and an "OK" button.

STEP 14: Enter the **Unit Cost** and **Quantity** for the selected countermeasures. When complete, select **Return to Main**.

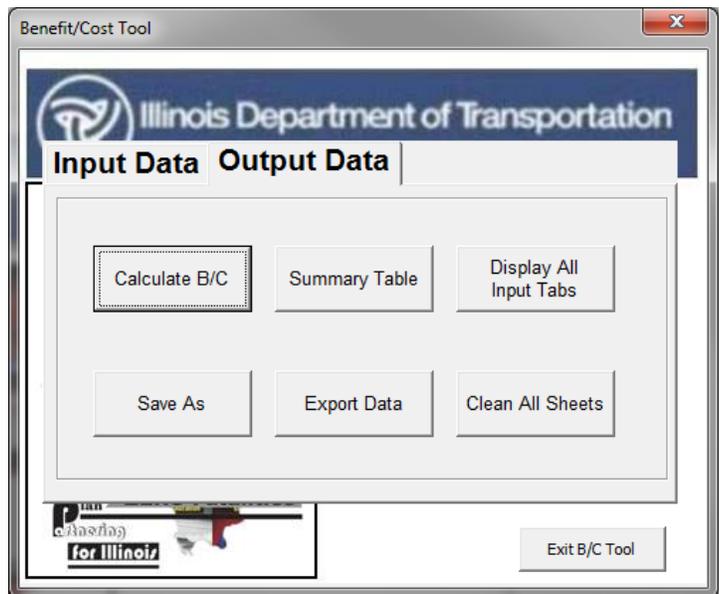
A final warning message will appear. For this example, the combined effect of multiple countermeasures only affects wet pavement crashes. Since the wet pavement CMF is equal to 0.43, the other two selected countermeasures will not modify wet pavement crashes. For non-wet pavement crashes, the tool will provide a blended CMF of 0.61 ($CMF = 0.65 * 0.94$) for the other two selected countermeasures. Select **OK**.



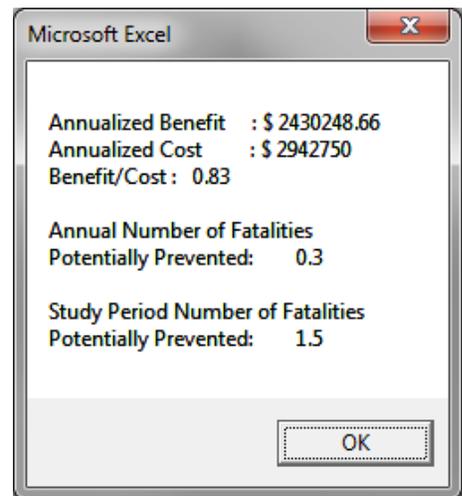
The window is titled "Microsoft Excel" and displays the text: "The combined effect of multiple countermeasures is the minimum of 0.60 CMF or the lowest countermeasure CMF." and an "OK" button.

When all input data has been completed, select the **Output Data** tab on the main menu and the screen shown will appear.

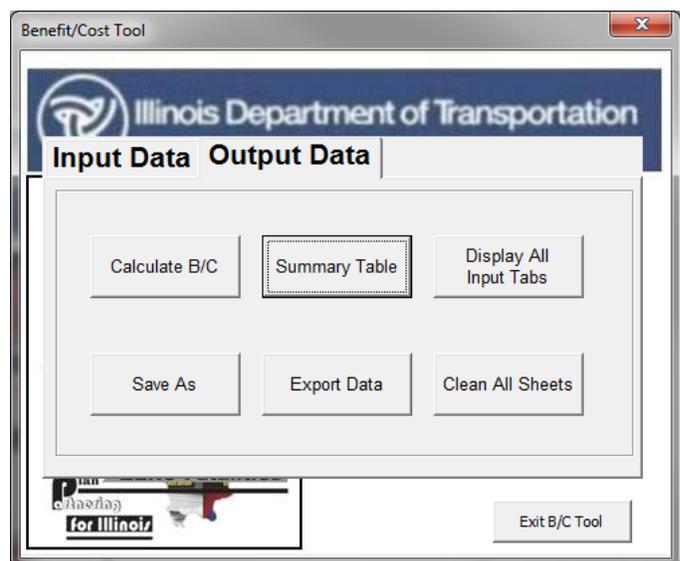
STEP 15: Click on **Calculate B/C** to obtain the B/C ratio.



The screen to the right will appear with the B/C ratio for this project. Click **OK** to return to the main menu.



STEP 16: Select **Summary Table** to see a summary of the analysis or to verify the inputs.

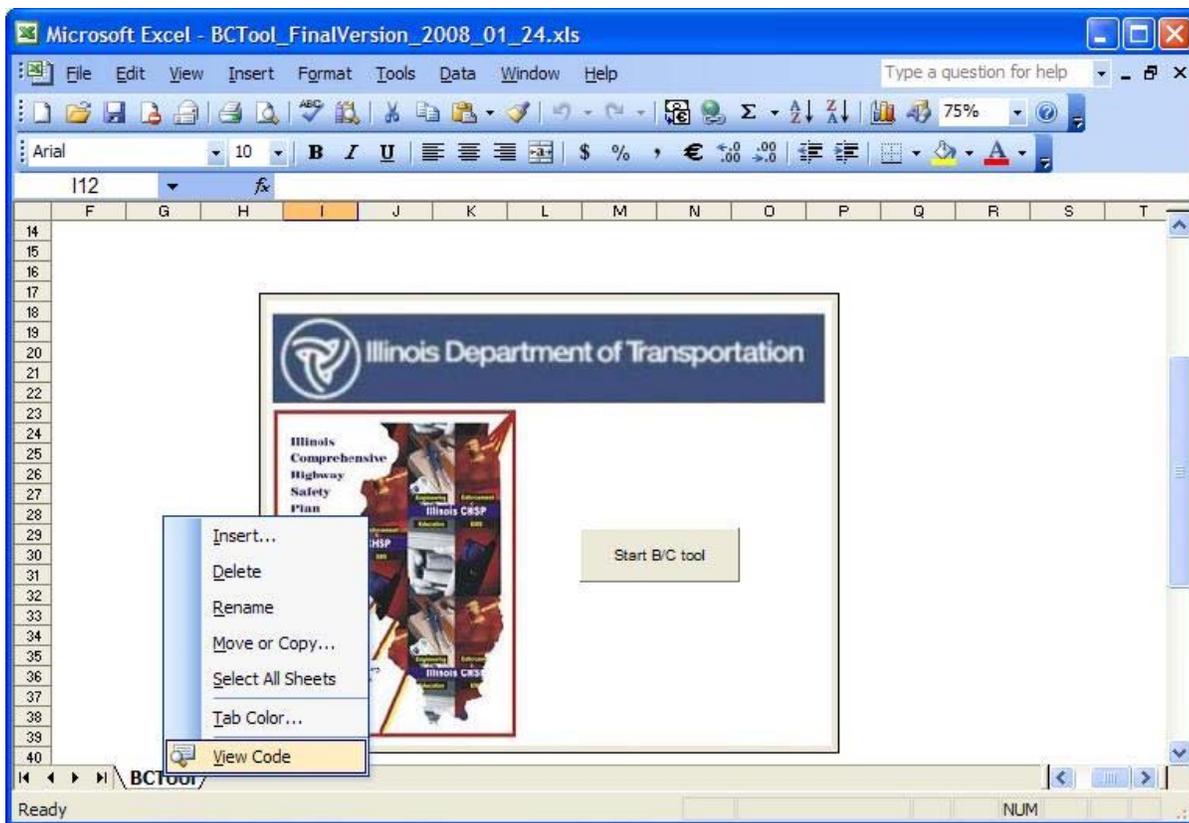


6 Troubleshooting Office 2003

1. I am getting the error message shown below. How can I fix it?



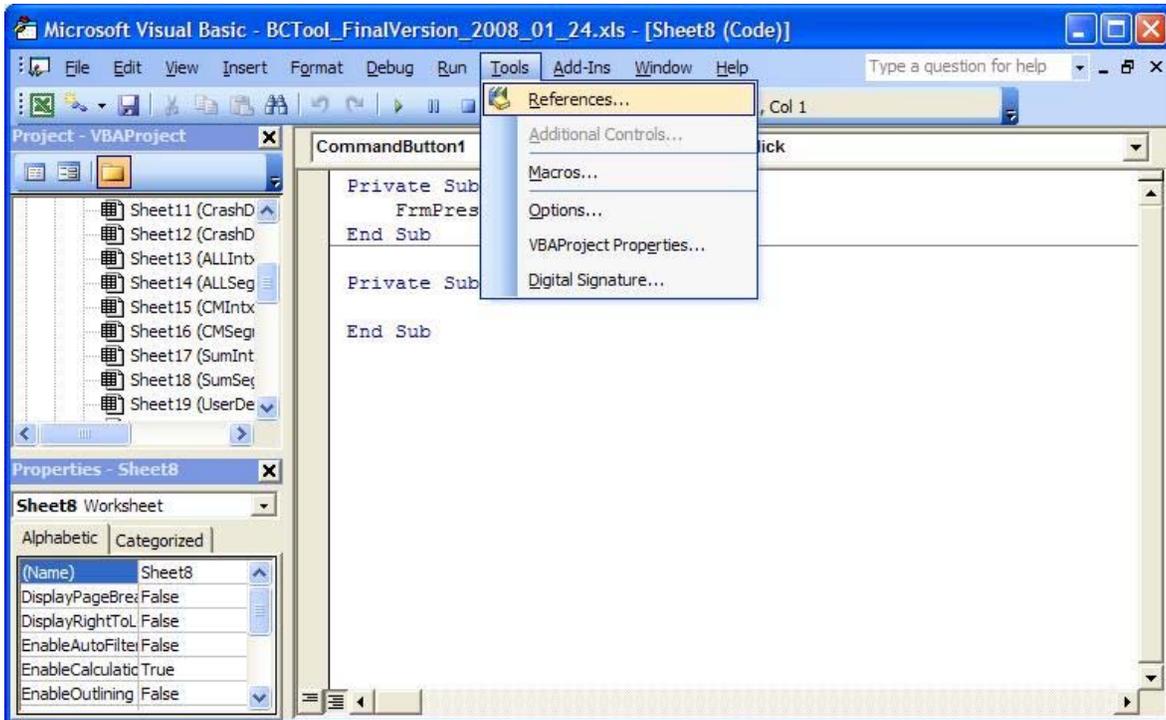
First, open the Visual Basic code. Right click on the BCTOOL tab located on the bottom left of the window. Select View Code from the pop-up menu.



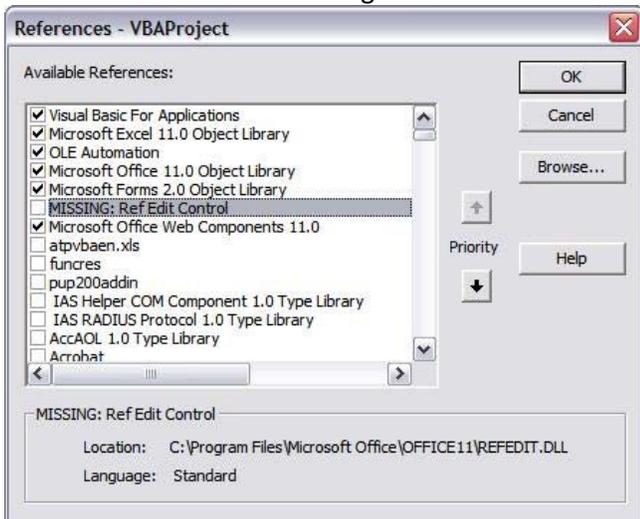
Since the tool is password protected, it is required to input the password (IDOTsafety) in the box shown below. Select **OK** to continue.



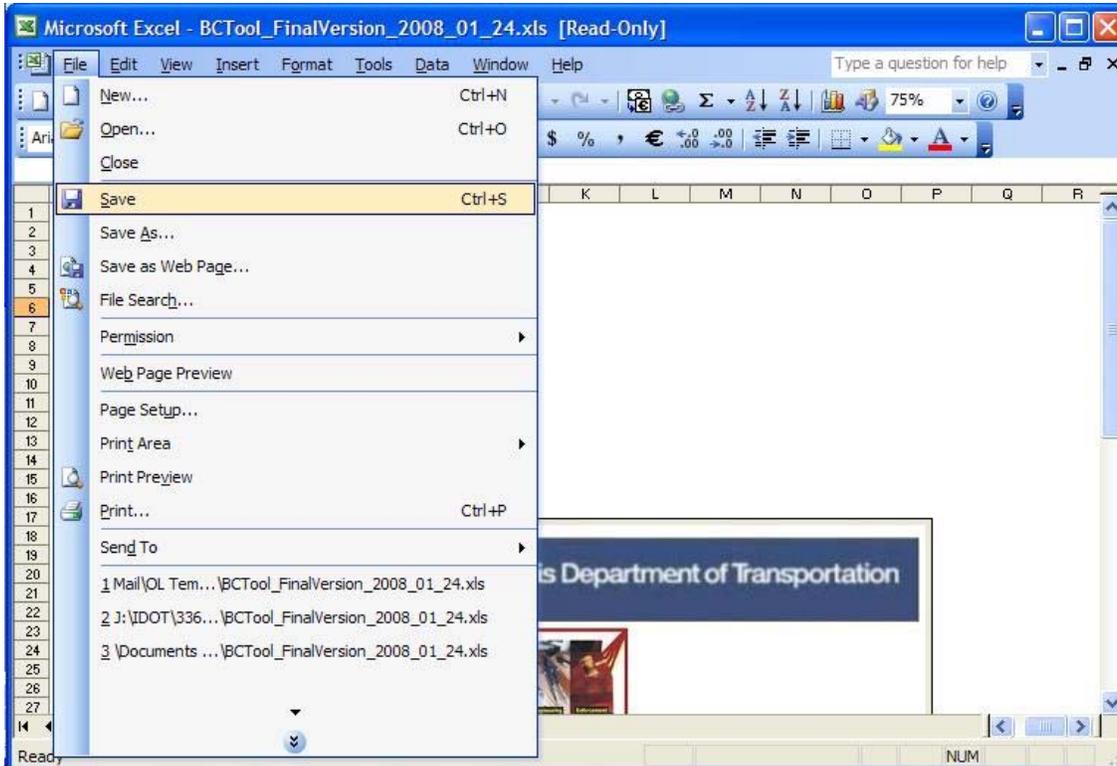
Select **Tools – References** from the top Microsoft Visual Basic toolbar.



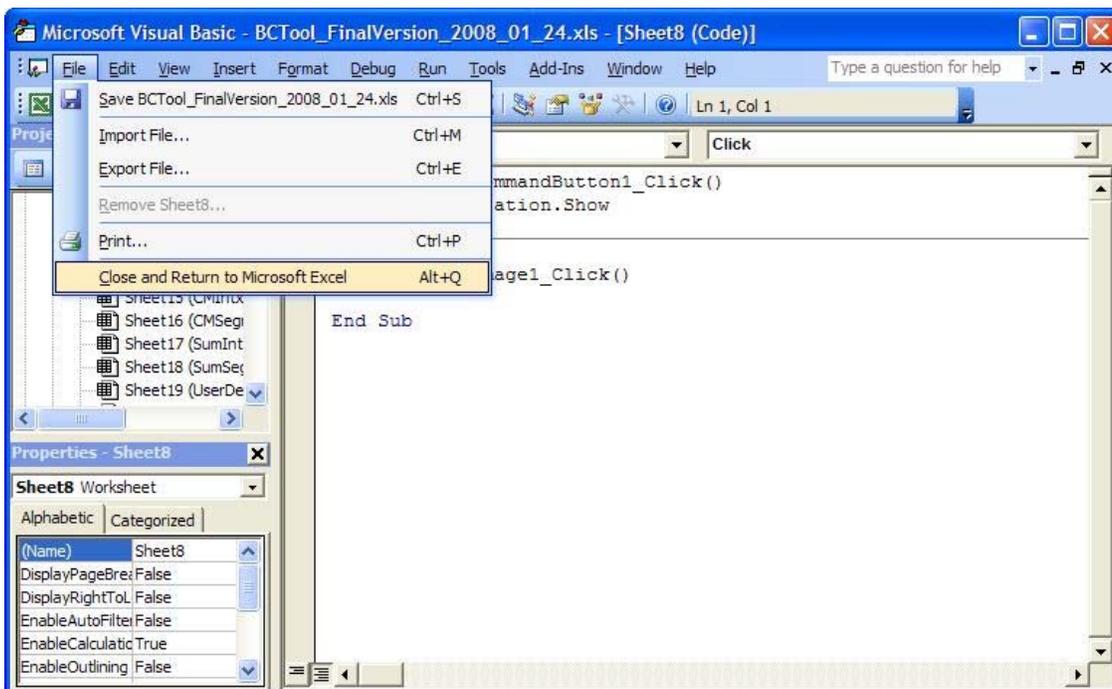
Look for the reference “Missing Ref Edit Control” and unchecked the box. Select **OK** to continue.



Go back to the Microsoft Excel window, and select File-Save from the top toolbar



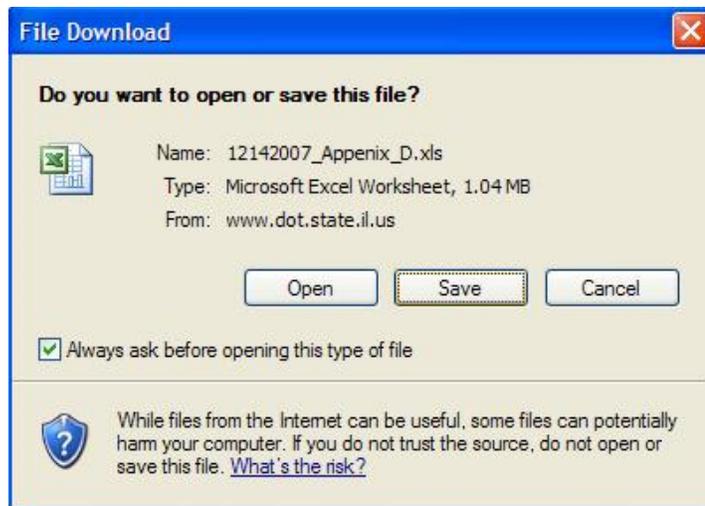
Once the file is saved, go back to the Visual Basic window, and select File - Close and Return to Microsoft Excel. Now you can start using the Benefit Cost Tool.



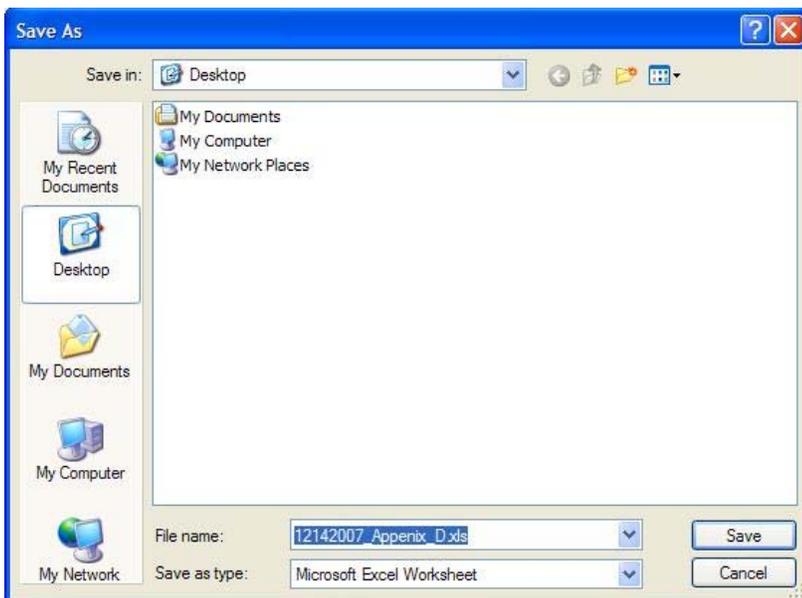
2. I open the file from IDOT website, and tried to run the tool, but I am getting the error shown below. How can I fix it?



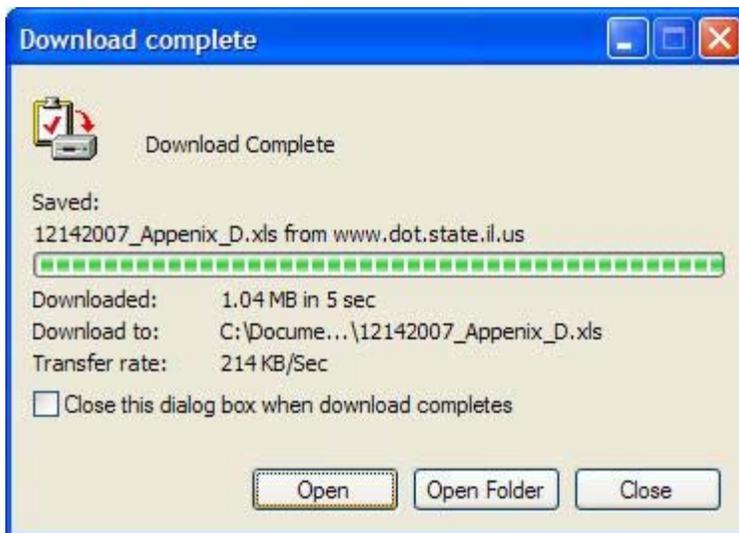
The tool will not work without downloading it and saving it into the computer prior its use. Try downloading the tool and click **Save**.



Select the desire location and an appropriate name to save the tool and click **Save**.



After the download is completed, click **Open**, and the tool is ready to use.



3. When I open the tool I clicked on Disable Macros, and I cannot have the tool to work. Is there a way of changing this setting?

Yes. Close the tool without saving changes and try to reopen it again. Be sure to click **Enable Macros**. This will solve the problem.

4. I accidentally saved the tool with the input data for my project inside. Is there a way to obtain the original tool without all the changes I made?

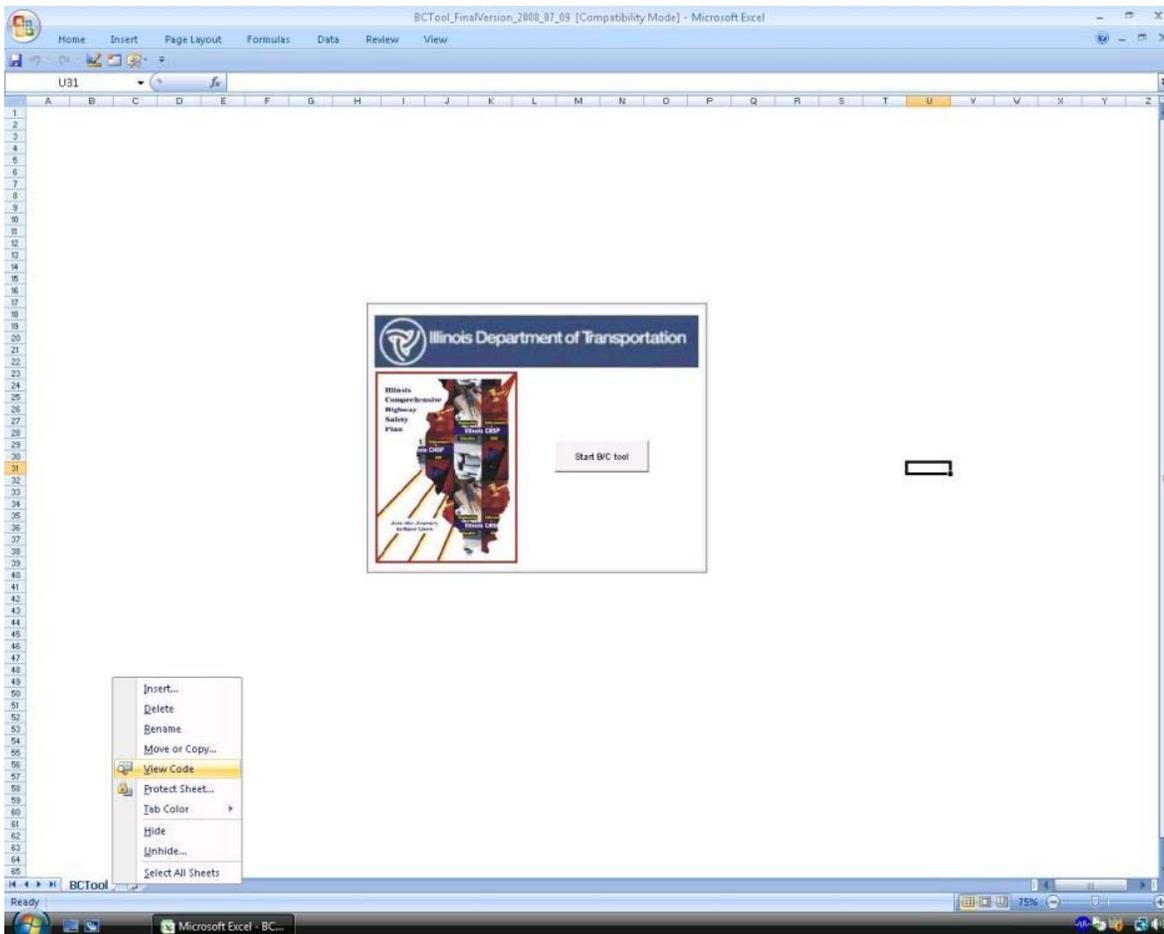
Yes. Go back to IDOT website (<http://www.dot.state.il.us/illinoisCHSP/hsip.html>) and download and save the tool again. If you want to save the information you input for a specific project, try using the option **export data** included in the tool under the Output data tab.

7 Troubleshooting Office 2007

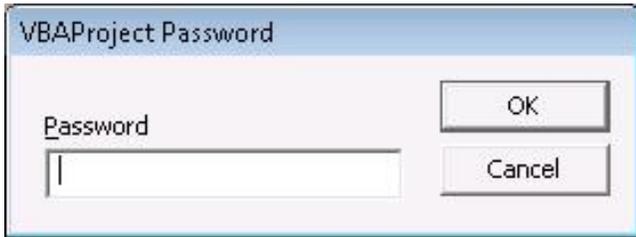
1. I am getting the error message shown below. How can I fix it?



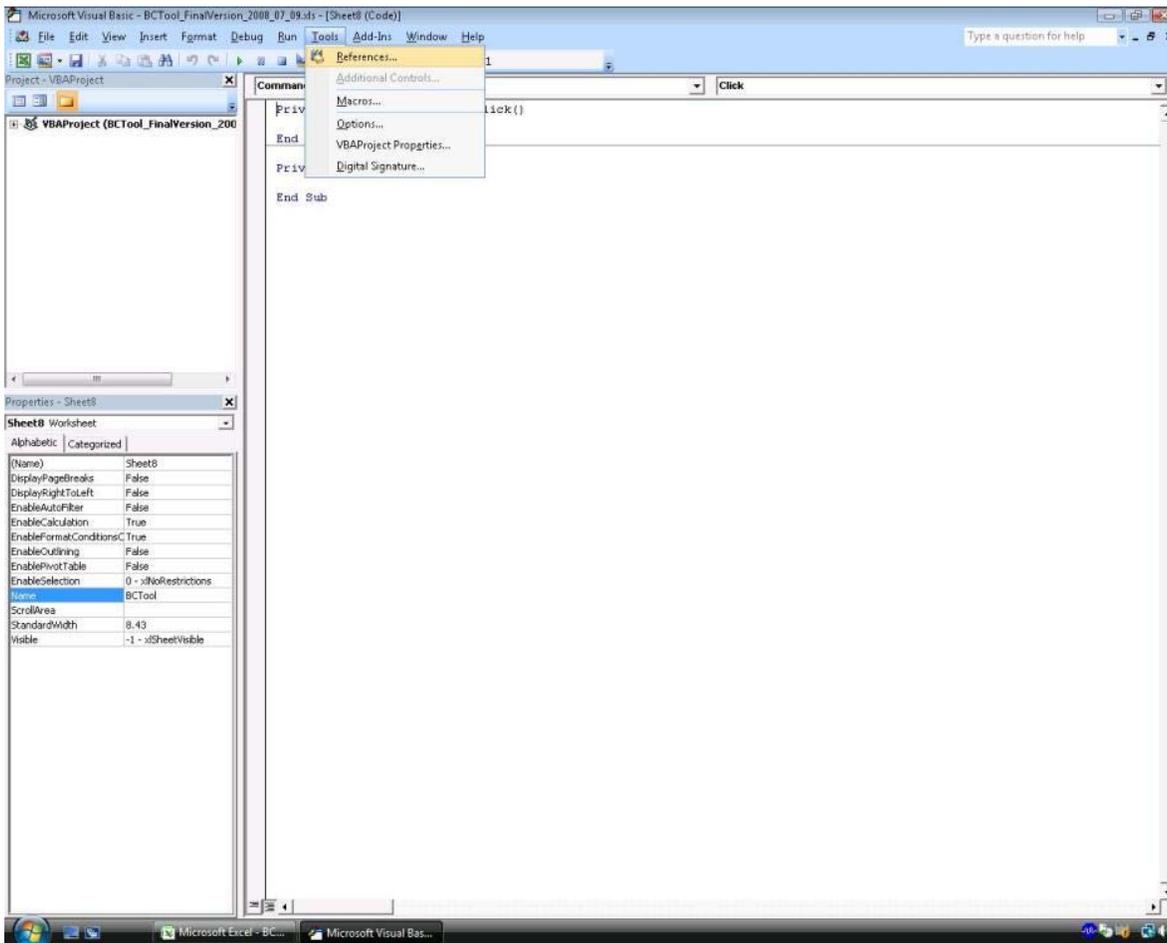
Open the Visual Basic code. Close everything, and reopen the Benefit-Cost Tool. Right click on the BCTOOL tab located on the bottom left of the window. Select **View Code** from the pop-up menu.



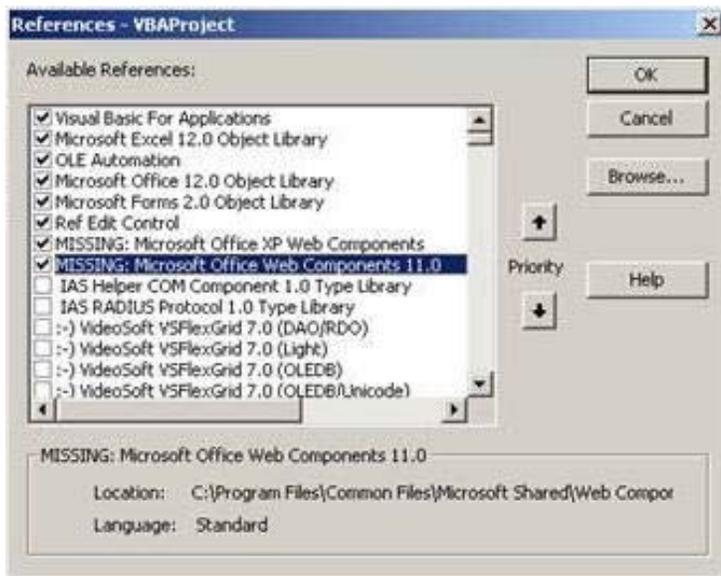
Since the tool is password protected, input the required password (IDOTsafety) in the box shown below. Select **OK** to continue. There are some files that are not protected, if you do not see the pop-up window shown below, ignore this step.



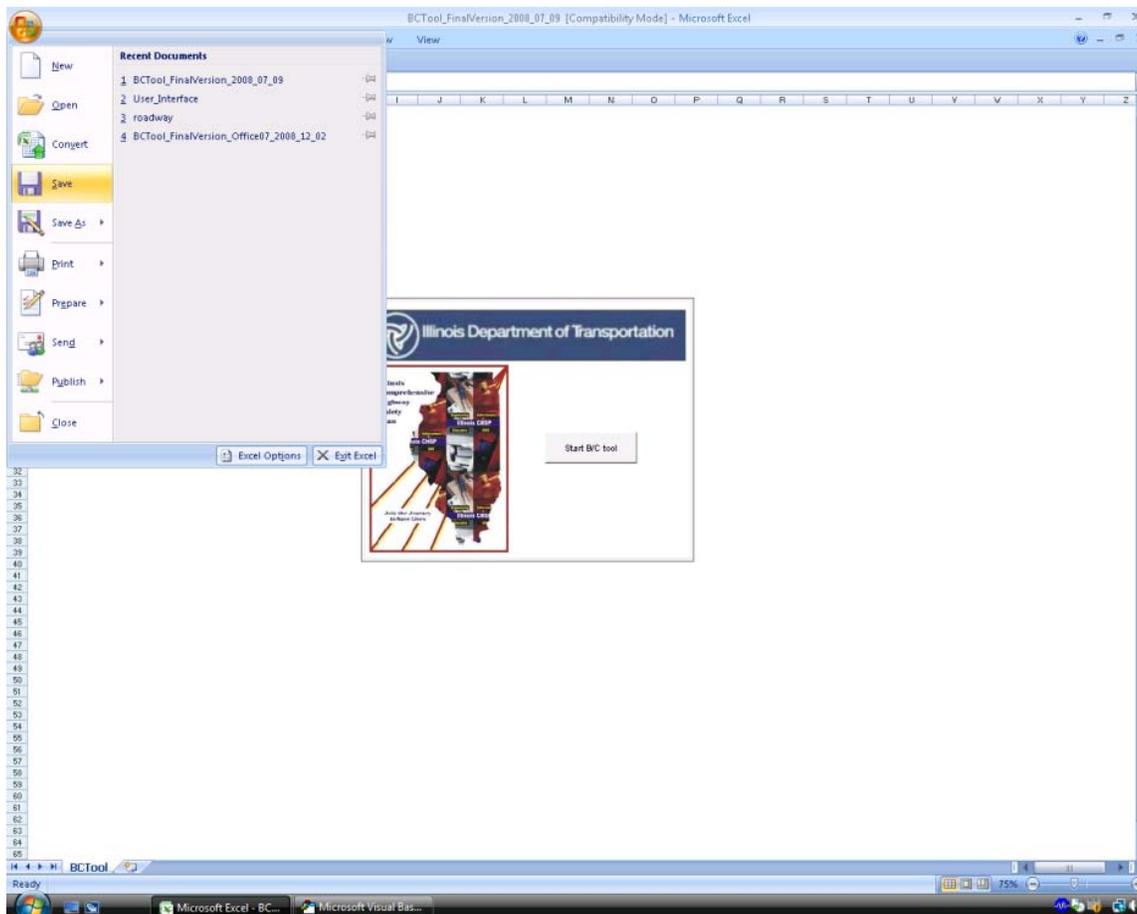
Select **Tools – References** from the top Microsoft Visual Basic toolbar.



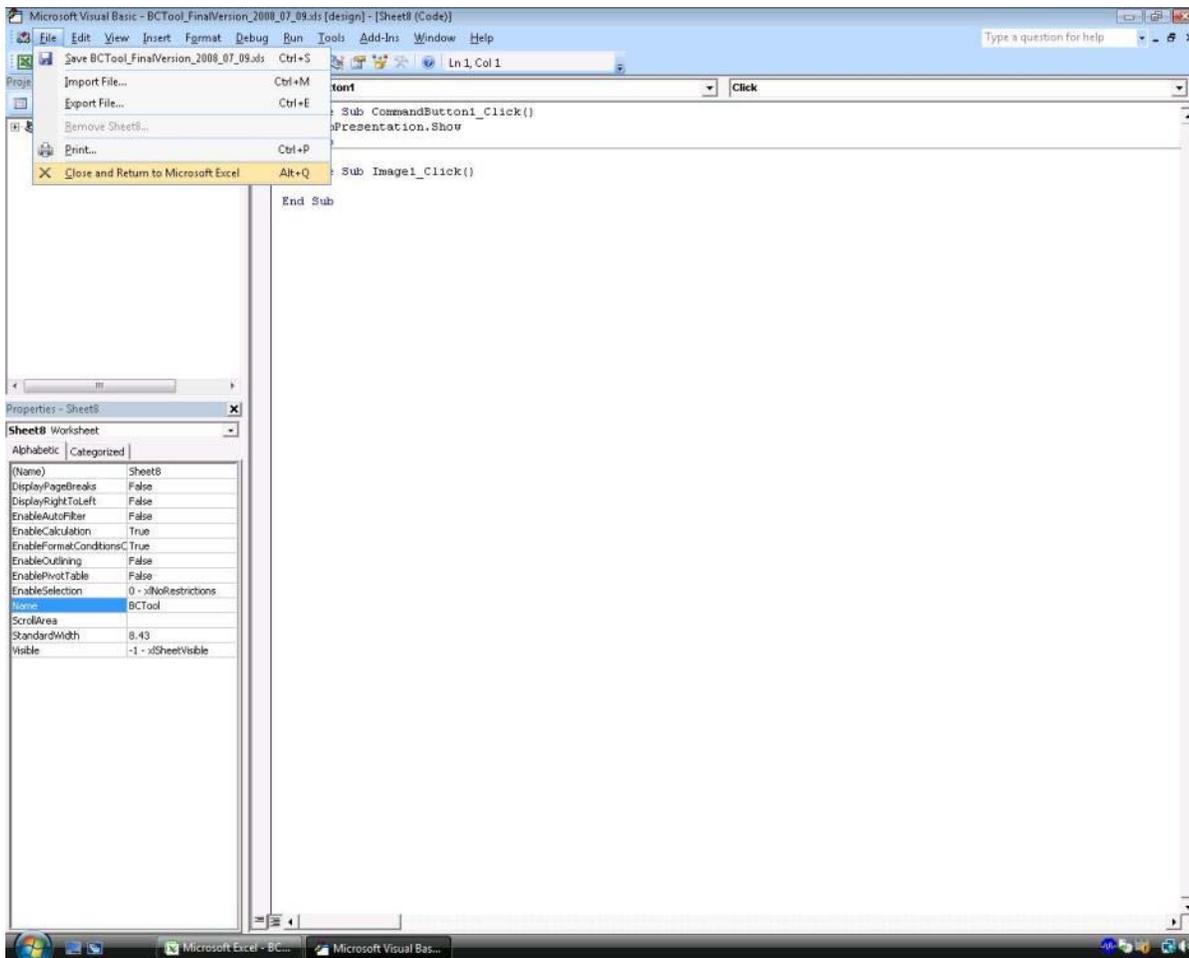
Look for the references “MISSING: Microsoft Office XP Web Components” and “MISSING: Microsoft Office Web components 11.0” and uncheck these boxes. Select **OK** to continue.



Go back to the Microsoft Excel window, and select the Office button **Save** from the top left corner.



Once the file is saved, go back to the Visual Basic window, and select **Close and Return to Microsoft Excel** under the File tab. You can now start using the Benefit Cost Tool.



Appendix A – Countermeasure References and Methodology

A crash modification factor (CMF) is used to estimate the change in crashes as a result of implementing a specific safety improvement countermeasure(s). With the release of the Highway Safety Manual (HSM) and the rollout of the Federal Highway Administration (FHWA) CMF Clearinghouse website, CMFs are better defined in terms of application and applicability. The BC Tool includes CMFs from a variety of sources. Most CMFs were obtained from the *Highway Safety Manual 1st Edition*.¹ CMFs not included in the HSM were obtained from the FHWA CMF Clearinghouse website (<http://www.cmfclearinghouse.org>) or in a few cases, historical IDOT CMF values were used.

The BC Tool currently includes 67 treatments for intersections and 96 treatments for segments. Many treatments have multiple CMFs because of varying characteristics of different facility types. The following sections describe how CMFs were used from each of the sources listed above.

HSM CMF Methodology

The HSM provides detailed information for each safety countermeasure listed in Part D. The HSM has screened all published CMFs based on statistically methods to determine whether they are sufficiently reliable and stable to be presented in the HSM. As a result of this process, only select countermeasures were included in the manual. The application of the published CMFs associated with each countermeasure may have restrictive setting and facility types (e.g., rural two-lane highway), limiting average annual daily traffic (AADT) acceptability ranges, and varying crash type/severity applicability. Unfortunately, the HSM is not consistent between countermeasures. To account for this inconsistency, CMFs included in the BC Tool were selected based on the following logic.

Crash Type/Severity Type

The HSM provides CMFs based on the following crash type and severity type distributions:

- Crash Types
 - Specific (Single Vehicle Run off Road, Nighttime, Rear End, etc.)
 - All Types
 - Unspecified
- Severity Types
 - Fatal
 - Injury (Includes Fatal)
 - Non-Injury
 - All Severities
 - Unspecified

For the purpose of the BC Tool, injury severity crash types were always chosen over all severity types since the tool is developed to assess countermeasure benefits that target fatal, Injury Type A, and Injury Type B crashes. Furthermore, specific crash type information is more useful compared to all crash types since it applies the CMF to only to applicable crash types. Adhering to this logic, the following combination of crash type/injury severity was chosen for inclusion into the BC Tool (in order of preference):

- Specific Crash Type/Injury Severity

¹ American Association of State Highway and Transportation Officials (AASHTO). 2010. *Highway Safety Manual 1st Edition*. <http://www.highwaysafetymanual.org>.

- All Crash Types/Injury Severity
- Specific Crash Type/All Severities
- All Crash Types/All Severities

It was assumed if crash type/severity type was listed as unspecified, it would fall under the “all crash type” or “all severity” category.

For example, the HSM Section 13.9.2.1 provides CMF for Continuous Shoulder Rumble Strips for rural, multilane highways (IDOT Peer Group 3). Table A1 shows the provided information from the HSM Table 13-44.

TABLE A1
Shoulder Milled Rumble Strips Crash Modification Factors from HSM 13.9.2.1

Treatment	Setting (Road Type)	Traffic Volume (AADT)	Crash Type (Severity)	CMF	Std. Error
Install continuous milled-in shoulder rumble strips	Rural (Multi-lane divided)	2,000 to 50,000	All types (All severities)	0.84	0.1
			All types (injury)	0.83	0.2
			SVROR (All severities)	0.90	0.3
			SVROR (Injury)	0.78	0.3

Base Condition: Absence of shoulder rumble strips.

Based on the logic provided above, the SVROR (Injury) CMF of 0.78 is included in the BC Tool, although four different CMFs are provided in the HSM. The SVROR type CMF would only be applied to fixed object and overturned type crashes. If, for instance, the end user would want to use a more generic CMF, such as the one for “All Types (Injury),” they have the ability to create user-defined CMFs. This approach is appropriate when the end user does not have specific crash type data, but would still like to apply this type treatment. It is highly recommended that the user always reference the latest version of the HSM prior to using other CMF resources.

Setting/Facility Type

The HSM provides information regarding the applicability of each CMF to different setting (urban, rural) or facility (two-lane, undivided, divided, etc.) types. The combination of the setting and facility type can directly be correlated with Illinois Department of Transportation (IDOT) Peer Group designations. In many situations, the published countermeasure Setting/Facility Type in the HSM is specific and limiting. The BC Tool countermeasures typically adhered to the Setting/Facility type provided in the HSM; however, in several circumstances, a CMF was applied to a different Setting/Facility Type. When a specific Setting/Facility Type was not listed in the HSM for a given countermeasure, the values provided in the HSM were carried over to other Setting/Facility Types. Table A2 shows the 12 different countermeasures where the CMF was applied to a different Setting/Facility Type that was published in the HSM. Table A2 shows the countermeasure, the applicable HSM section, the published Setting/Facility Type, and the proposed Setting/Facility Type(s) for inclusion in the tool.

TABLE A2
HSM Countermeasures Applied to Unlisted Setting/Facility Types

Countermeasure	HSM Section	HSM Setting/Facility Type(s)	Also applied to Setting/Facility Type(s)
Add Left Turn Lane (Three-Leg Intersection)	14.6.2.2	Rural Minor Stop, Rural Signal, Urban Minor Stop, Urban Signal	Rural All Stop, Urban All Stop
Add Left Turn Lane (Four-Leg Intersection)	14.6.2.3	Rural Minor Stop, Rural Signal, Urban Minor Stop, Urban Signal	Rural All Stop, Urban All Stop
Install Traffic Signals	14.4.2.6	Rural Minor Stop, Urban Minor Stop	Rural All Stop, Urban All Stop

TABLE A2
HSM Countermeasures Applied to Unlisted Setting/Facility Types

Countermeasure	HSM Section	HSM Setting/Facility Type(s)	Also applied to Setting/Facility Type(s)
Shoulder Rumble Strips	13.9.2.1 (Clearinghouse #2423) ¹	Rural Two-Lane, Rural Multi-Divided, Urban/Rural Freeways	Rural Multi-Undivided ²
Install TWLTL	16.5.2.1	Rural Two-Lane	Rural Multi-Undivided, Urban Two-Lane, Urban Multi-Undivided
Median Barrier	13.5.2.4	Rural Multi-Divided	All Urban/Rural Divided Facilities
Steel Median Barrier	13.5.2.4	Rural Multi-Divided	All Urban/Rural Divided Facilities
Cable Median Barrier	13.5.2.4	Rural Multi-Divided	All Urban/Rural Divided Facilities
Flatten Sideslopes	13.5.2.1	Rural Two-Lane, Rural Multi-Undivided	All Other Urban/Rural Settings.
Raised Reflective Markers (Undivided Facility CMF)	13.8.2.7	Rural Two-Lane	Rural Multi-Undivided, Urban Two-Lane, Urban Multi-Undivided
Raised Reflective Markers (Divided Facility CMF)	13.8.2.7	Rural 4 Lane Freeway	All Urban/Rural Freeways
Convert Angle to Parallel Parking	13.11.2.4	Urban Two-Lane, Urban Multi-Divided, Urban Multi-Undivided	Urban One-Way

¹Used FHWA CMF Clearinghouse for Rural Two-Lane Shoulder Rumble Strips.

²Did not apply to urban two-way, urban multi-undivided, or urban multi-divided facilities.

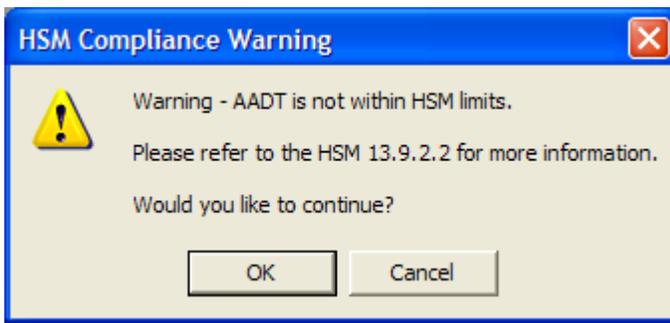
Within the tool, if a user does select one of the countermeasures listed in Table A2, a warning message would notify the user that the countermeasure does not fully meet the applicability requirements outlined in the HSM. The user then has the ability to continue using the selected countermeasure, or cancel and either create a user defined countermeasure or select a different countermeasure. The screen below shows a typical warning message.



If the user selects a countermeasure that does not fully match HSM Setting/Facility type criteria, this warning message will also be saved to the project summary report.

AADT Ranges

Several countermeasures listed in the HSM and FHWA CMF clearinghouse have traffic volume AADT thresholds. The BC Tool includes checks to determine if a study segment/intersection AADT is within the AADT limits defined for each countermeasure. Similar to the Setting/Facility type, a warning message would be presented if the AADT is outside the allowable limits and will be shown on the analysis summary sheet. It would not preclude the user from using the selected countermeasure, although the user can choose another countermeasure if desired. The screen below shows an AADT warning message and direction to the countermeasure reference for more information.



FHWA CMF Clearinghouse Methodology

For countermeasures not included in the HSM but identified to be included in the BC Tool, the FHWA CMF Clearinghouse was the primary CMF source for those countermeasures. It was used to update and supplement CMF values not included in the HSM. The FHWA CMF Clearinghouse is a regularly updated, online repository of CMFs. Each CMF listed in the clearinghouse is given a star quality rating, assessing the quality or confidence in the results of the study producing the CMF. The star rating is based on a scale (1 to 5), with five indicating the best rating. For the purpose of the BC Tool a three star or better rating was generally regarded as acceptable.

A total of 17 CMFs used values from the FHWA CMF clearinghouse in the BC tool. All countermeasures used CMFs that had a three star or greater rating with the following two exceptions:

- Separation between Pedestrians/Traffic
- Install Advance Signal Warning Signs

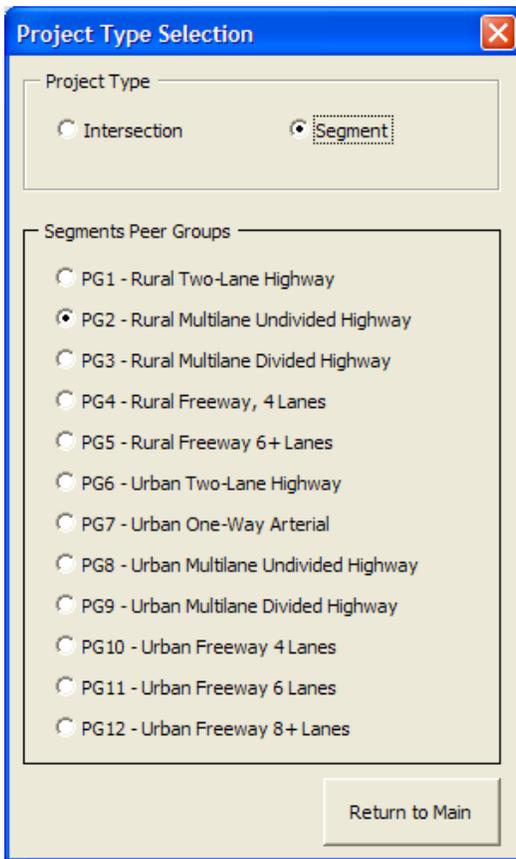
Historical IDOT CMFs

The remaining CMFs were determined based on historic IDOT CRM values. These CMFs were used only when better information was not provided in either the HSM or the FHWA CMF Clearinghouse.

Integration of CMFs into the BC Tool

The latest version of the BC Tool provides internal sorting functionality that only allows the user to select a countermeasure that is appropriate for the selected IDOT peer group. The following paragraphs describe how users will select countermeasures and also provide information regarding countermeasures that may require additional information.

The user will select an IDOT Peer Group as part of the project type section in the BC Tool. Upon selecting a specific project peer group, the tool will automatically filter the countermeasure list so only the appropriate countermeasures are available for selection. The screen below shows the Project Type Selection dialog box.



The screenshot shows a dialog box titled "Project Type Selection" with a close button (X) in the top right corner. The dialog is divided into two main sections. The first section, "Project Type", contains two radio buttons: "Intersection" (unselected) and "Segment" (selected). The second section, "Segments Peer Groups", contains a list of twelve radio buttons, each representing a different highway type. The "Segment" radio button is selected, and the "PG2 - Rural Multilane Undivided Highway" radio button is selected within this group. At the bottom of the dialog, there is a "Return to Main" button.

Project Type Selection

Project Type

Intersection Segment

Segments Peer Groups

PG1 - Rural Two-Lane Highway

PG2 - Rural Multilane Undivided Highway

PG3 - Rural Multilane Divided Highway

PG4 - Rural Freeway, 4 Lanes

PG5 - Rural Freeway 6+ Lanes

PG6 - Urban Two-Lane Highway

PG7 - Urban One-Way Arterial

PG8 - Urban Multilane Undivided Highway

PG9 - Urban Multilane Divided Highway

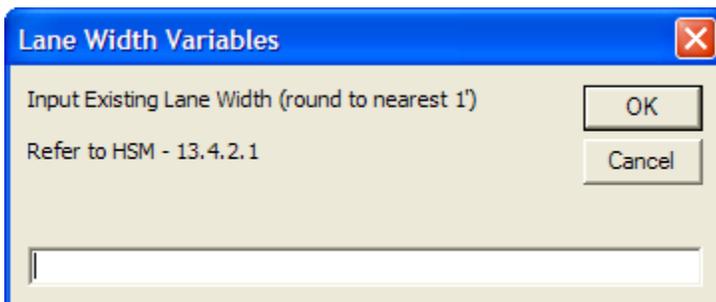
PG10 - Urban Freeway 4 Lanes

PG11 - Urban Freeway 6 Lanes

PG12 - Urban Freeway 8+ Lanes

Return to Main

The user will have the ability to select up to four different countermeasures. Based on HSM methodology, several countermeasures now are functions of other variables (e.g., lane width) or require a value to be read from a table. Upon selection of a countermeasure that requires additional information, the user will be prompted for the pertinent information through a series of input boxes. These input boxes will also provide the user with a source to obtain additional information regarding the selected countermeasure. After the user provides any additional required information, a message box will tell the user the calculated CMF for the given countermeasure. An example of this sequence for modifying lane width is shown below.



The screenshot shows a dialog box titled "Lane Width Variables" with a close button (X) in the top right corner. The dialog contains a text input field for "Input Existing Lane Width (round to nearest 1')". Below the input field, there is a reference text "Refer to HSM - 13.4.2.1". To the right of the input field, there are two buttons: "OK" and "Cancel". At the bottom of the dialog, there is a long, empty text input field.

Lane Width Variables

Input Existing Lane Width (round to nearest 1')

Refer to HSM - 13.4.2.1

OK

Cancel

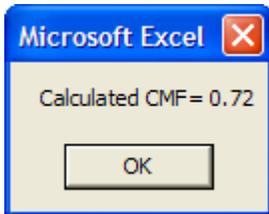
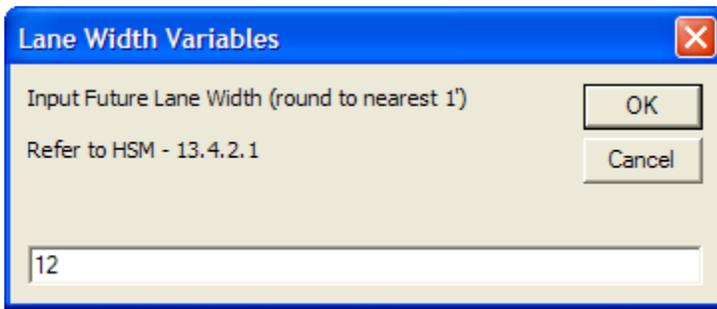


Table A3 lists the countermeasures that require additional user-defined inputs, the HSM reference section, specific additional data required, and comments that provide more clarification regarding each countermeasure. Table A4 shows the comprehensive countermeasures included in the BC Tool. Additional information for each countermeasure is also provided including service life, CMF, Crash Type Affected, Setting/Facility Type, and CMF source.

TABLE A3
HSM Countermeasures Requiring Additional User Inputs

Countermeasure	HSM Section	Additional Data Needed	Notes
Reduce Intersection Skew Angle	14.6.2.1	Existing Skew Angle, Future Skew Angle	Reference HSM Figure 14-5.
Modify Lane Width	13.4.2.1	Existing Lane Width, Future Lane Width	Round to nearest foot across all lanes.
Add or Widen Paved Shoulder	13.4.2.4	Existing Shoulder Width, Future Shoulder Width	
Modify Shoulder Type	13.4.2.5	Existing Shoulder Width, Existing Shoulder Type, Future Shoulder Type	Applicable Shoulder Types Include Paved, Gravel, Composite, and Turf. For Shoulder Widths >10 feet, use 10 feet.
Provide TWLTL	16.5.2.1	Driveway Density (dwy/mile), Proportion of Driveway Related Crashes (in decimal)	
Change Width of Existing Median	13.4.2.7	Existing Median Width, Future Median Width	
Improve Superelevation Variance	13.6.2.2	Existing Variance, Future Variance	Superelevation variance is the difference between recommended design value and existing superelevation.
Modify Horizontal Curve Radius	13.6.2.1	Length of Curve (miles), Radius of Curvature (feet)	
Flatten Sideslopes	13.5.2.1	Existing Sideslope (in 1V:xxH), Future Sideslope (in 1V:xxH)	Sideslopes can only be the following values: Existing (2H, 3H, 4H, 5H or 6H) Future (4H, 5H, 6H, or 7H)
Increase Distance to Roadside Features	13.5.2.2	Existing Distance to Roadside Features (feet), Future Distance to Roadside Features (feet)	
Reduce Roadside Hazard Rating	13.5.2.6	Existing Rating, Future Rating	Ratings can be found in Table 13-25 in the HSM.
Modify Access Point Density	13.14.2.1	Existing Density (dwy/mile), Future Density (dwy/mile)	
Modify Work Zone Duration	16.4.2.1	Existing Duration (days), Proposed Duration (days)	
Modify Work Zone Length	16.4.2.1	Existing Length (miles) Proposed Length (miles)	

TABLE A4

IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
1.0 Intersection Locations							
1.1 General							
1.1.1.I5.1 - General - Convert Four-leg Intersection to Two Three-Leg Intersections	Unit Qty	15	²	All	Urban	Minor Stop	HSM 14.4.2.1
1.1.2.AL.1 - General - Convert Intersection to Grade-separated Interchange (Four Leg Intersection)	Unit Qty	20	0.43	All	All	All	HSM 15.4.2.1
1.1.2.AL.2 - General - Convert Intersection to Grade-separated Interchange (Three-Leg Intersection)	Unit Qty	20	0.84	All	All	All	HSM 15.4.2.1
1.1.3.AL.1 - General - Design Interchange with Crossroad Above Freeway	Unit Qty	20	0.96	All	All	All	HSM 15.4.2.2
1.1.4.AL.1 - General - Modify Speed Change Lane Design (Deceleration Lanes)	Unit Qty	15	0.93	All	All	All	HSM 15.4.2.3
1.1.5.AL.1 - General - Modify Two-lane-change Merge/Diverge Area to One-Lane Change	Unit Qty	15	0.68	SSD, RE	All	All	HSM 15.4.2.4
1.2 Pavement							
1.2.1.AL.1 - Pavement - Widening and Resurfacing or Widening alone	Miles	15	0.75	All	All	All	Historic IDOT CMF
1.2.2.AL.1 - Pavement - Resurfacing alone	Miles	10	1.00	No CRF identified	All	All	No Good Data Available
1.2.3.AL.1 - Pavement - De-Slick (formerly known as skidproofing)	Miles	5	0.43	WP	All	All	Clearinghouse #2266
1.2.4.I1.1 - Pavement - Rumble Strips (Transverse)	Unit Qty	8	0.91	All	Rural	Minor Stop	Clearinghouse #2704
1.2.4.I2.1 - Pavement - Rumble Strips (Transverse)	Unit Qty	8	0.91	All	Rural	All Stop	Clearinghouse #2704
1.2.5.AL.1 - Pavement - Raised Reflective Marker Median	Miles	15	0.50	HO,SOD,LT,T,RT	All	All	Historic IDOT CMF
1.2.6.AL.1 - Pavement - Thermoplastic or Preformed Tape Median	Miles	3	0.50	RE,HO,SSD,SOD,LT,RT,T	All	All	Historic IDOT CMF
1.2.7.AL.1 - Pavement - Painted Median	Miles	2	0.50	RE,HO,SSD,SOD,LT,RT,T	All	All	Historic IDOT CMF
1.2.8.AL.1 - Pavement - Lane Addition	Unit Qty	15	0.50	RE,SSD, LT,RT,T	All	All	Historic IDOT CMF
1.2.9.I1.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)	Unit Qty	15	0.45	All	Rural	Minor Stop	HSM - 14.6.2.2
1.2.10.I2.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)	Unit Qty	15	0.45	All	Rural	All Stop	HSM - 14.6.2.2
1.2.10.I3.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)	Unit Qty	15	0.85	All	Rural	Signal	HSM - 14.6.2.2
1.2.10.I5.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)	Unit Qty	15	0.65	All	Urban	Minor Stop	HSM - 14.6.2.2
1.2.10.I6.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)	Unit Qty	15	0.65	All	Urban	All Stop	HSM - 14.6.2.2
1.2.10.I7.1 - Pavement - Add Left Turn Lane (Three-Leg Intersection)	Unit Qty	15	0.94	All	Urban	Signal	HSM - 14.6.2.2
1.2.11.I1.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)	Unit Qty	15	0.65	All	Rural	Minor Stop	HSM - 14.6.2.3
1.2.11.I2.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)	Unit Qty	15	0.65	All	Rural	All Stop	HSM - 14.6.2.3
1.2.11.I3.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)	Unit Qty	15	0.82	All	Rural	Signal	HSM - 14.6.2.3
1.2.11.I5.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)	Unit Qty	15	0.71	All	Urban	Minor Stop	HSM - 14.6.2.3
1.2.11.I6.1 - Pavement - Add Left Turn Lane (Four-Leg Intersection)	Unit Qty	15	0.71	All	Urban	All Stop	HSM - 14.6.2.3
1.2.11.I7.1 - Pavement - Add Left Turn Lane (Existing Signalized, Four-Leg Intersection)	Unit Qty	15	0.91	All	Urban	Signal	HSM - 14.6.2.3
1.2.11.I7.2 - Pavement - Add Left Turn Lane (Newly Signalized, Four-Leg Intersection)	Unit Qty	15	0.72	All	Urban	Signal	HSM - 14.6.2.3
1.2.12.I1.1 - Pavement - Add Right Turn Lane on One Approach	Unit Qty	15	0.77	All	Rural	Minor Stop	HSM - 14.6.2.6
1.2.12.I3.1 - Pavement - Add Right Turn Lane on One Approach	Unit Qty	15	0.91	All	Rural	Signal	HSM - 14.6.2.6
1.2.12.I5.1 - Pavement - Add Right Turn Lane on One Approach	Unit Qty	15	0.77	All	Urban	Minor Stop	HSM - 14.6.2.6
1.2.12.I7.1 - Pavement - Add Right Turn Lane on One Approach	Unit Qty	15	0.91	All	Urban	Signal	HSM - 14.6.2.6
1.2.13.AL.1 - Pavement - Left Turn Acceleration Lane	Unit Qty	15	0.50	RE,SOD,SSD,AG,LT	All	All	Historic IDOT CMF

TABLE A4
IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
1.2.14.AL.1 - Pavement - Right Turn Acceleration Lane	Unit Qty	15	0.50	RE,SSD,RT	All	All	Historic IDOT CMF
1.2.15.AL.1 - Pavement - One-Way Couple	Unit Qty	15	0.50	All	All	All	Historic IDOT CMF
1.2.16.I1.1 - Pavement - Convert Stop-Controlled Intersection to Roundabout	Unit Qty	15	0.18	All	Rural	Minor Stop	HSM - 14.4.2.3
1.2.16.I2.1 - Pavement - Convert All-Way Stop Controlled Intersection to Roundabout	Unit Qty	15	1.03	All	Rural	All Stop	HSM - 14.4.2.3
1.2.16.I5.1 - Pavement - Convert Stop-Controlled Intersection to Roundabout	Unit Qty	15	0.19	All	Urban	Minor Stop	HSM - 14.4.2.3
1.2.16.I6.1 - Pavement - Convert All-Way Stop Controlled Intersection to Roundabout	Unit Qty	15	1.03	All	Urban	All Stop	HSM - 14.4.2.3
1.2.17.I3.1 - Pavement - Convert Signal to Roundabout	Unit Qty	15	0.22	All	Rural	Signal	HSM - 14.4.2.2
1.2.17.I7.1 - Pavement - Convert Signal to Roundabout	Unit Qty	15	0.22	All	Urban	Signal	HSM - 14.4.2.2
1.2.18.I1.1 - Pavement - Reduce Intersection Skew Angle (3 Leg - Two Lane Facility)	Unit Qty	15	²	All	Rural	Minor Stop	HSM - 14.6.2.1
1.2.18.I1.2 - Pavement - Reduce Intersection Skew Angle (4 Leg - Two Lane Facility)	Unit Qty	15	²	All	Rural	Minor Stop	HSM - 14.6.2.1
1.2.18.I1.3 - Pavement - Reduce Intersection Skew Angle (3 Leg - Multilane Facility)	Unit Qty	15	²	All	Rural	Minor Stop	HSM - 14.6.2.1
1.2.18.I1.4 - Pavement - Reduce Intersection Skew Angle (4 Leg - Multilane Facility)	Unit Qty	15	²	All	Rural	Minor Stop	HSM - 14.6.2.1
1.2.19.I7.1 - Pavement - Remove Unwarranted Signal on One-way Street	Unit Qty	15	0.76	RT, AG, LT, T, SOD=0.76, RE=0.71, PD=0.82	Urban	Signal	HSM - 14.4.2.5
1.2.20.I1.1 - Pavement - Convert Minor-Road Stop Control to All-Way Stop Control	Unit Qty	5	0.52	All	Rural	Minor Stop	HSM - 14.4.2.4
1.2.20.I5.1 - Pavement - Convert Minor-Road Stop Control to All-Way Stop Control	Unit Qty	5	0.30	All	Urban	Minor Stop	HSM - 14.4.2.4
1.2.21.AL.1 - Pavement - Increase Width of Paved Shoulder	Miles	12	0.90	All	All	All	Historic IDOT CMF
1.2.22.AL.1 - Pavement - Increase Lane Width	Miles	12	0.90	All	All	All	Historic IDOT CMF
1.2.23.I1.1 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)	Miles	12	0.96	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Rural	Minor Stop	HSM - 14.6.2.7
1.2.23.I2.1 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)	Miles	12	0.96	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Rural	All Stop	HSM - 14.6.2.7
1.2.23.I5.1 - Pavement - Increase Intersection Median Width by 3 feet (3 Leg)	Miles	12	1.03	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Urban	Minor Stop	HSM - 14.6.2.7
1.2.23.I5.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)	Miles	12	1.05	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Urban	Minor Stop	HSM - 14.6.2.7
1.2.23.I6.1 - Pavement - Increase Intersection Median Width by 3 feet (3 Leg)	Miles	12	1.03	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Urban	All Stop	HSM - 14.6.2.7
1.2.23.I6.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)	Miles	12	1.05	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Urban	All Stop	HSM - 14.6.2.7
1.2.23.I7.2 - Pavement - Increase Intersection Median Width by 3 feet (4 Leg)	Miles	12	1.03	AG, HO, LT, PKV,RE, RT, SSD, SSO, T	Urban	Signal	HSM - 14.6.2.7
1.3 Signing							
1.3.1.IU.1 - Signing - Upgrade Signs to conform with MUTCD	Unit Qty	6	0.85	All	Urban	All	Clearinghouse #62
1.3.2.AL.1 - Signing - Speed Signing	Unit Qty	6	0.60	All	All	All	Historic IDOT CMF
1.3.3.I7.1 - Signing - Install Advance Signal Warning Signs	Unit Qty	6	0.65	AG (AG, RT, LT, T, SOD)	Urban	Signal	Clearinghouse #1684
1.4.4.I7.1 - Signing - Install Advance Signal Warning with Flashers	Unit Qty	6	0.64, 0.38	RE= 0.64, AG (AG, RT, LT, T, SOD)= 0.38	Urban	Signal	Clearinghouse #1672, 1673
1.3.5.I3.1 - Signing - Install Advance Street Name Signs	Unit Qty	6	0.99	All	Rural	Signal	Clearinghouse #2450
1.3.5.I7.1 - Signing - Install Advance Street Name Signs	Unit Qty	6	0.99	All	Urban	Signal	Clearinghouse #2450
1.3.6.I9.1 - Signing - Minor Leg Stop	Unit Qty	5	0.60	AG,LT,RT,T	All	Local Unsignalized	Historic IDOT CMF
1.3.6.I5.1 - Signing - Minor Leg Stop	Unit Qty	5	0.60	AG,LT,RT,T	Urban	Minor Stop	Historic IDOT CMF
1.3.7.I1.1 - Signing - Yield Sign	Unit Qty	5	0.60	AG,LT,RT,T	All	Local Unsignalized	Historic IDOT CMF
1.3.7.I5.1 - Signing - Yield Sign	Unit Qty	5	0.60	AG,LT,RT,T	Urban	Minor Stop	Historic IDOT CMF

TABLE A4
IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
1.3.8.AL.1 - Signing - Changeable Message Signs	Unit Qty	6	0.90	All	All	All	Historic IDOT CMF
1.3.9.AL.1 - Signing - Delineators	Unit Qty	4	0.60	All	All	All	Historic IDOT CMF
1.3.10.AL.1 - Signing - Overhead Sign Truss	Unit Qty	15	0.60	RE,SOD	All	All	Historic IDOT CMF
1.3.11.I3.1 - Signing - Permit Right-turn on Red	Unit Qty	15	1.60	RT, AG, SSD, T	Rural	Signal	HSM - 14.7.2.6
1.3.11.I7.1 - Signing - Permit Right-turn on Red	Unit Qty	15	1.60	RT, AG, SSD, T	Urban	Signal	HSM - 14.7.2.6
1.3.11.I3.1 - Signing - Prohibit Right-turn on Red	Unit Qty	15	0.63	RT, AG, SSD, T	Rural	Signal	HSM - 14.7.2.6
1.3.11.I7.1 - Signing - Prohibit Right-turn on Red	Unit Qty	15	0.63	RT, AG, SSD, T	Urban	Signal	HSM - 14.7.2.6
1.3.12.I5.1 - Signing - Prohibit Left-Turns	Unit Qty	15	0.36	LT, AG, T, SSD	Urban	Minor Stop	HSM - 14.7.2.1
1.3.12.I5.2 - Signing - Prohibit Left-Turns and U-turns	Unit Qty	15	0.23	LT, AG, T, SSD	Urban	Minor Stop	HSM - 14.7.2.1
1.3.12.I7.1 - Signing - Prohibit Left-Turns	Unit Qty	15	0.36	LT, AG, T, SSD	Urban	Signal	HSM - 14.7.2.1
1.3.12.I7.2 - Signing - Prohibit Left-Turns and U-turns	Unit Qty	15	0.23	LT, AG, T, SSD	Urban	Signal	HSM - 14.7.2.1
1.3.13.I1.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination	Unit Qty	15	0.64	All	Rural	Minor Stop	HSM - 14.7.2.5
1.3.13.I2.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination	Unit Qty	15	0.64	All	Rural	All Stop	HSM - 14.7.2.5
1.3.13.I5.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination	Unit Qty	15	0.64	All	Urban	Minor Stop	HSM - 14.7.2.5
1.3.13.I6.1 - Signing - Replace Left-turns with Right-Turn/U-Turn Combination	Unit Qty	15	0.64	All	Urban	All Stop	HSM - 14.7.2.5
1.3.14.I1.1 - Signing - Provide "Stop Ahead" Pavement Markings	Unit Qty	3	0.92	All	Rural	Minor Stop	HSM - 14.7.2.2
1.3.14.I2.1 - Signing - Provide "Stop Ahead" Pavement Markings	Unit Qty	3	0.58	All	Rural	All Stop	HSM - 14.7.2.2
1.4 Signalization							
1.4.1.I1.1 - Signalization - Install Traffic Signals	Unit Qty	15	Varies	RT (RT)= 0.23. LT (AG, T, LT,SOD) = 0.4, RE=1.58	Rural	Minor Stop	HSM - 14.4.2.6
1.4.1.I2.1 - Signalization - Install Traffic Signals	Unit Qty	15	Varies	RT (RT)= 0.23. LT (AG, T, LT,SOD) = 0.4, RE=1.58	Rural	All Stop	HSM - 14.4.2.6
1.4.1.I5.1 - Signalization - Install Traffic Signals	Unit Qty	15	Varies	RT (RT, AG,T,LT,SOD) = 0.33, RE = 2.43	Urban	Minor Stop	HSM - 14.4.2.6
1.4.1.I6.1 - Signalization - Install Traffic Signals	Unit Qty	15	Varies	RT (RT, AG,T,LT,SOD) = 0.33, RE = 2.43	Urban	All Stop	HSM - 14.4.2.6
1.4.2.I3.1 - Signalization - Relocation of Signal Supports	Unit Qty	15	0.75	FO	Rural	Signal	Historic IDOT CMF
1.4.2.I7.1 - Signalization - Relocation of Signal Supports	Unit Qty	15	0.75	FO	Urban	Signal	Historic IDOT CMF
1.4.3.I1.1 - Signalization - Flashing Beacon	Unit Qty	10	Varies	RE =0.92, AG (AG, LT, RT, T, SOD) = 0.87	Rural	Minor Stop	HSM - 14.7.2.3
1.4.3.I2.1 - Signalization - Flashing Beacon	Unit Qty	10	0.72	AG, LT, RT, T, SOD	Rural	All Stop	HSM - 14.7.2.3
1.4.3.I5.1 - Signalization - Flashing Beacon	Unit Qty	10	Varies	RE =0.92, AG (AG, LT, RT, T, SOD) = 0.87	Urban	Minor Stop	HSM - 14.7.2.3
1.4.3.I6.1 - Signalization - Flashing Beacon	Unit Qty	10	0.72	AG, LT, RT, T, SOD	Urban	All Stop	HSM - 14.7.2.3
1.4.4.I3.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protected)	Unit Qty	10	0.94	All	Rural	Signal	HSM - 14.7.2.4
1.4.4.I3.2 - Signalization - Add Left Turn Phase on One Approach (Permissive --> Perm/Prot)	Unit Qty	10	0.99	All	Rural	Signal	HSM - 14.7.2.4
1.4.4.I7.1 - Signalization - Add Left Turn Phase on One Approach (Permissive or Perm/Prot --> Protected)	Unit Qty	10	0.94	All	Urban	Signal	HSM - 14.7.2.4
1.4.4.I7.2 - Signalization - Add Left Turn Phase on One Approach (Permissive --> Perm/Prot)	Unit Qty	10	0.99	All	Urban	Signal	HSM - 14.7.2.4
1.4.5.I3.1 - Signalization - Modify Change and Clearance Interval (ITE Recommended Practice)	Unit Qty	10	0.88	All	Rural	Signal	HSM - 14.7.2.7
1.4.5.I7.1 - Signalization - Modify Change and Clearance Interval (ITE Recommended Practice)	Unit Qty	10	0.88	All	Urban	Signal	HSM - 14.7.2.7

TABLE A4
IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
1.4.6.I7.1 - Signalization - Increase to 12 Inch Lens	Unit Qty	10	0.97	All	Urban	Signal	Clearinghouse #2334
1.4.7.I3.1 - Signalization - Add Traffic Actuation	Unit Qty	10	0.75	RE,AG,LT,RT,T	Rural	Signal	Historic IDOT CMF
1.4.7.I7.1 - Signalization - Add Traffic Actuation	Unit Qty	10	0.75	RE,AG,LT,RT,T	Urban	Signal	Historic IDOT CMF
1.4.8.I3.1 - Signalization - Time Lane Control	Unit Qty	10	0.75	HO,SOD	Rural	Signal	Historic IDOT CMF
1.4.8.I7.1 - Signalization - Time Lane Control	Unit Qty	10	0.75	HO,SOD	Urban	Signal	Historic IDOT CMF
1.4.9.I3.1 - Signalization - Optical Programmed	Unit Qty	10	0.75	RE,AG,LT,RT,T	Rural	Signal	Historic IDOT CMF
1.4.9.I7.1 - Signalization - Optical Programmed	Unit Qty	10	0.75	RE,AG,LT,RT,T	Urban	Signal	Historic IDOT CMF
1.4.10.I3.1 - Signalization - Add Pedestrian Controls	Unit Qty	10	0.75	PD,PDC	Rural	Signal	Historic IDOT CMF
1.4.10.I7.1 - Signalization - Add Pedestrian Controls	Unit Qty	10	0.75	PD,PDC	Urban	Signal	Historic IDOT CMF
1.4.11.I3.1 - Signalization - Add Mast Arms and Signal Head per Lane	Unit Qty	15	0.75	RE,AG,LT,RT,T	Rural	Signal	Historic IDOT CMF
1.4.11.I7.3 - Signalization - Add Mast Arms and Signal Head per Lane	Unit Qty	15	0.75	RE,AG,LT,RT,T	Urban	Signal	Historic IDOT CMF
1.4.12.AL.1 - Signalization - Safety Lighting	Unit Qty	15	0.62	NGT	All	All	HSM - 14.6.2.8
1.4.13.IU.1 - Signalization - Install Automated Enforcement of Red Light Violations	Unit Qty	10	0.84, 1.24	RT, LT, AG,SOD,T - 0.84, RE - 1.24	Urban	Signal	HSM - 14.7.2.8

2.0 Non-Intersection (Segment) Locations

2.1 Pavement Treatments

2.1.2.S1.1 - Pavement Treatments - Modify Lane Width	Miles	12	²	ROR, FO, HO, OVT, SOD, SSD	Rural	Two-Lane	HSM - 13.4.2.1
2.1.2.S2.1 - Pavement Treatments - Modify Lane Width	Miles	12	²	ROR, FO, HO, OVT, SOD, SSD	Rural	Multi-Undivided	HSM - 13.4.2.1
2.1.2.S3.1 - Pavement Treatments - Modify Lane Width	Miles	12	²	ROR, FO, HO, OVT, SOD, SSD	Rural	Multi-Divided	HSM - 13.4.2.1
2.1.3.S1.1 - Pavement Treatments - Add or Widen Paved Shoulder	Miles	12	²	ROR, FO, HO, OVT, SOD, SSD	Rural	Two-Lane	HSM - 13.4.2.4
2.1.3.S2.1 - Pavement Treatments - Add or Widen Paved Shoulder	Miles	12	²	ROR, FO, HO, OVT, SOD, SSD	Rural	Multi-Undivided	HSM - 13.4.2.4
2.1.3.S3.1 - Pavement Treatments - Add or Widen Paved Shoulder	Miles	12	²	All	Rural	Multi-Divided	HSM - 13.4.2.4
2.1.4.S8.1 - Pavement Treatments - Remove Through Lane (Road Diet - Small Urban Area)	Miles	12	0.53	All	Urban	Multi-Undivided	FHWA-HRT-10-053
2.1.4.S8.2 - Pavement Treatments - Remove Through Lane (Road Diet - Large Urban Area)	Miles	12	0.81	All	Urban	Multi-Undivided	FHWA-HRT-10-053
2.1.5.S10.1 - Pavement Treatments - Add Lanes by Narrowing Existing Lanes	Miles	12	1.11	All	Urban	4 Lane Freeway	HSM - 13.4.2.2
2.1.5.S11.1 - Pavement Treatments - Add Lanes by Narrowing Existing Lanes	Miles	12	1.07	All	Urban	6 Lane Freeway	HSM - 13.4.2.2
2.1.6.AL.1 - Pavement Treatments - Resurfacing alone	Miles	10	1.00	No CRF identified	All	All	No Good Data Available
2.1.7.AL.1 - Pavement Treatments - De-Slick (formerly known as skidproofing)	Miles	5	0.43	WP	All	All	Clearinghouse #2266
2.1.8.S1.1 - Pavement Treatments - Install Rumble Strips (Shoulder)	Miles	8	0.78	FO, OVT	Rural	Two-Lane	Clearinghouse #2423
2.1.8.S2.1 - Pavement Treatments - Install Rumble Strips (Shoulder)	Miles	8	0.78	FO, OVT	Rural	Multi-Undivided	Clearinghouse #2423
2.1.8.S3.1 - Pavement Treatments - Install Rumble Strips (Shoulder)	Miles	8	0.78	FO, OVT	Rural	Multi-Divided	HSM 13.9.2.1
2.1.8.S4.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)	Miles	8	0.21	FO, OVT	Rural	4 Lane Freeway	HSM 13.9.2.1
2.1.8.S4.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)	Miles	8	0.87	FO, OVT	Rural	4 Lane Freeway	HSM 13.9.2.1
2.1.8.S5.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)	Miles	8	0.21	FO, OVT	Rural	6+ Lane Freeway	HSM 13.9.2.1
2.1.8.S5.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)	Miles	8	0.87	FO, OVT	Rural	6+ Lane Freeway	HSM 13.9.2.1
2.1.8.S10.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)	Miles	8	0.21	FO, OVT	Urban	4 Lane Freeway	HSM 13.9.2.1
2.1.8.S10.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)	Miles	8	0.87	FO, OVT	Urban	4 Lane Freeway	HSM 13.9.2.1

TABLE A4

IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
2.1.8.S11.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)	Miles	8	0.21	FO, OVT	Urban	6 Lane Freeway	HSM 13.9.2.1
2.1.8.S11.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)	Miles	8	0.87	FO, OVT	Urban	6 Lane Freeway	HSM 13.9.2.1
2.1.8.S12.1 - Pavement Treatments - Install Rumble Strips (Shoulder - Milled)	Miles	8	0.21	FO, OVT	Urban	8+ Lane Freeway	HSM 13.9.2.1
2.1.8.S12.2 - Pavement Treatments - Install Rumble Strips (Shoulder-Rolled)	Miles	8	0.87	FO, OVT	Urban	8+ Lane Freeway	HSM 13.9.2.1
2.1.9.S1.1 - Pavement Treatments - Rumble Strips (Centerline)	Miles	8	0.79	HO, SOD	Rural	Two-Lane	HSM 13.9.2.2
2.1.10.S1.1 - Pavement Treatments - Change Vertical Grade by +1%	Miles	15	1.04	FO, OVT	Rural	Two-Lane	HSM - 13.6.2.3
2.1.10.S1.2 - Pavement Treatments - Change Vertical Grade by -1%	Miles	15	0.96	FO, OVT	Rural	Two-Lane	HSM - 13.6.2.3
2.1.11.S1.1 - Pavement Treatments - Modify Shoulder Type	Miles	15	²	FO, OVT, HO, SOD, SSD	Rural	Two-Lane	HSM - 13.4.2.5
2.1.12.S1.1 - Pavement Treatments - Provide TWLTL	Miles	15	²	LT, AG, T	Rural	Two-Lane	HSM - 16.5.2.1
2.1.12.S2.1 - Pavement Treatments - Provide TWLTL	Miles	15	²	LT, AG, T	Rural	Multi-Undivided	HSM - 16.5.2.1
2.1.12.S6.1 - Pavement Treatments - Provide TWLTL	Miles	15	²	LT, AG, T	Urban	Two-Lane	HSM - 16.5.2.1
2.1.12.S8.1 - Pavement Treatments - Provide TWLTL	Miles	15	²	LT, AG, T	Urban	Multi-Undivided	HSM - 16.5.2.1
2.1.13.S1.1 - Pavement Treatments - Provide Passing Lane	Miles	15	0.75	All	Rural	Two-Lane	HSM - 16.6.2.1
2.1.14.S1.1 - Pavement Treatments - Provide Short Four-Lane Section	Miles	15	0.65	All	Rural	Two-Lane	HSM - 16.6.2.1
<i>2.2 Median Treatments</i>							
2.2.1.S3.1 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Rural	Multi-Divided	HSM - 13.5.2.4
2.2.1.S4.1 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Rural	4 Lane Freeway	HSM - 13.5.2.4
2.2.1.S5.1 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Rural	6+ Lane Freeway	HSM - 13.5.2.4
2.2.1.S9.1 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Urban	Multi-Divided	HSM - 13.5.2.4
2.2.1.S10.1 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Urban	4 Lane Freeway	HSM - 13.5.2.4
2.2.1.S11.1 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Urban	6 Lane Freeway	HSM - 13.5.2.4
2.2.1.S12.2 - Median Treatments - Install Median Barrier (General)	Miles	15	0.70	All	Urban	8+ Lane Freeway	HSM - 13.5.2.4
2.2.2.S3.1 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Rural	Multi-Divided	HSM - 13.5.2.4
2.2.2.S4.1 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Rural	4 Lane Freeway	HSM - 13.5.2.4
2.2.2.S5.1 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Rural	6+ Lane Freeway	HSM - 13.5.2.4
2.2.2.S9.1 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Urban	Multi-Divided	HSM - 13.5.2.4
2.2.2.S10.1 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Urban	4 Lane Freeway	HSM - 13.5.2.4
2.2.2.S11.1 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Urban	6 Lane Freeway	HSM - 13.5.2.4
2.2.2.S12.2 - Median Treatments - Install Steel Median Barrier	Miles	15	0.65	All	Urban	8+ Lane Freeway	HSM - 13.5.2.4
2.2.3.S3.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Rural	Multi-Divided	HSM - 13.5.2.4
2.2.3.S3.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Rural	Multi-Divided	Clearinghouse #1965, #1961, #1966
2.2.3.S4.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Rural	4 Lane Freeway	HSM - 13.5.2.4
2.2.3.S4.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Rural	4 Lane Freeway	Clearinghouse #1965, #1961, #1966
2.2.3.S5.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Rural	6+ Lane Freeway	HSM - 13.5.2.4

TABLE A4
IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
2.2.3.S5.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Rural	6+ Lane Freeway	Clearinghouse #1965, #1961, #1966
2.2.3.S9.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Urban	Multi-Divided	HSM - 13.5.2.4
2.2.3.S9.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Urban	Multi-Divided	Clearinghouse #1965, #1961, #1966
2.2.3.S10.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Urban	4 Lane Freeway	HSM - 13.5.2.4
2.2.3.S10.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Urban	4 Lane Freeway	Clearinghouse #1965, #1961, #1966
2.2.3.S11.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Urban	6 Lane Freeway	HSM - 13.5.2.4
2.2.3.S11.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Urban	6 Lane Freeway	Clearinghouse #1965, #1961, #1966
2.2.3.S12.1 - Median Treatments - Install Cable Median Barrier (All Crashes)	Miles	15	0.71	All	Urban	8+ Lane Freeway	HSM - 13.5.2.4
2.2.3.S12.2 - Median Treatments - Install Cable Median Barrier (Crash Specific)	Miles	15	Varies	RE, SSD = 0.86, FO = 1.83, HO,SOD, OVT=0.09	Urban	8+ Lane Freeway	Clearinghouse #1965, #1961, #1966
2.2.4.S6.1 - Median Treatments - Provide a Raised Median	Miles	15	0.61	All	Urban	Two-Lane	HSM - 13.4.2.6
2.2.4.S2.1 - Median Treatments - Provide a Raised Median	Miles	15	0.88	All	Rural	Multi-Undivided	HSM - 13.4.2.6
2.2.4.S8.1 - Median Treatments - Provide a Raised Median	Miles	15	0.78	All	Urban	Multi-Undivided	HSM - 13.4.2.6
2.2.5.S3.1 - Median Treatments - Change Width of Existing Median (with Full Access Control)	Miles	15	²	HO, SOD	Rural	Multi-Divided	HSM - 13.4.2.7
2.2.5.S3.2 - Median Treatments - Change Width of Existing Median (with Partial/No Access Control)	Miles	15	²	HO, SOD	Rural	Multi-Divided	HSM - 13.4.2.7
2.2.5.S9.1 - Median Treatments - Change Width of Existing Median (with Full Access Control)	Miles	15	²	HO, SOD	Urban	Multi-Divided	HSM - 13.4.2.7
2.2.5.S9.2 - Median Treatments - Change Width of Existing Median (with Partial/No Access Control)	Miles	15	²	HO, SOD	Urban	Multi-Divided	HSM - 13.4.2.7
2.3 Pavement Marking							
2.3.1.S1.1 - Pavement Markings - Place Standard Edgeline Markings	Miles	1	0.97	All	Rural	Two-Lane	HSM - 13.8.2.2
2.3.2.S1.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Rural	Two-Lane	HSM - 13.8.2.7
2.3.2.S6.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Urban	Two-Lane	HSM - 13.8.2.7
2.3.2.S2.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Rural	Multi-Undivided	HSM - 13.8.2.7
2.3.2.S8.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Urban	Multi-Undivided	HSM - 13.8.2.7
2.3.2.S4.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Rural	4 Lane Freeway	HSM - 13.8.2.7
2.3.2.S3.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Rural	Multi-Divided	HSM - 13.8.2.7
2.3.2.S5.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Rural	6+ Lane Freeway	HSM - 13.8.2.7
2.3.2.S9.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Urban	Multi-Divided	HSM - 13.8.2.7
2.3.2.S10.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Urban	4 Lane Freeway	HSM - 13.8.2.7
2.3.2.S11.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Urban	6 Lane Freeway	HSM - 13.8.2.7
2.3.2.S12.1 - Pavement Markings - Raised Reflective Markers	Miles	4	²	NGT	Urban	8+ Lane Freeway	HSM - 13.8.2.7
2.3.3.S1.1 - Pavement Markings - Place Wide Edgeline Markings	Miles	1	1.05	All	Rural	Two-Lane	HSM - 13.8.2.3
2.3.4.S1.1 - Pavement Markings - Place Centerline Markings	Miles	1	0.99	All	Rural	Two-Lane	HSM - 13.8.2.4
2.3.5.S1.1 - Pavement Markings - Place Edgeline and Centerline Markings	Miles	1	0.76	All	Rural	Two-Lane	HSM - 13.8.2.5
2.3.5.S2.1 - Pavement Markings - Place Edgeline and Centerline Markings	Miles	1	0.76	All	Rural	Multi-Undivided	HSM - 13.8.2.5

TABLE A4

IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
2.3.6.S1.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators	Miles	1	0.55	All	Rural	Two-Lane	HSM - 13.8.2.6
2.3.6.S2.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators	Miles	1	0.55	All	Rural	Multi-Undivided	HSM - 13.8.2.6
2.3.6.S6.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators	Miles	1	0.55	All	Urban	Two-Lane	HSM - 13.8.2.6
2.3.6.S8.1 - Pavement Markings - Install Edgelines, Centerlines and Post Mounted Delineators	Miles	1	0.55	All	Urban	Multi-Undivided	HSM - 13.8.2.6
<i>2.4 Railroad Crossing</i>							
2.4.1.AL.1 - Railroad Crossings - Automatic Railroad Gates (Crossings w/o Lights and Sounds)	Miles	15	0.33	TR, FO, RE, OVT	All	All	HSM - 16.3.2.2
2.4.1.AL.2 - Railroad Crossings - Automatic Railroad Gates (Crossings w/ Lights and Sounds)	Miles	15	0.55	TR, FO, RE, OVT	All	All	HSM - 16.3.2.2
2.4.2.AL.1 - Railroad Crossings - Install Signs and Crossbucks	Miles	15	0.75	TR, FO, RE, OVT	All	All	Clearinghouse #481
2.4.3.AL.1 - Railroad Crossings - Flashing Lights	Unit Qty	15	0.40	TR,FO,RE,OVT	All	All	Historic IDOT CMF
2.4.4.AL.1 - Railroad Crossings - Flashing Beacons	Unit Qty	15	0.40	TR,FO,RE,OVT	All	All	Historic IDOT CMF
2.4.5.AL.1 - Railroad Crossings - Warning Bells	Unit Qty	15	0.50	TR	All	All	Historic IDOT CMF
2.4.6.AL.1 - Railroad Crossings - Install Flashing Lights and Sound Signals	Unit Qty	15	0.50	TR, FO, RE, OVT	All	All	HSM - 16.3.2.1
2.4.7.AL.1 - Railroad Crossings - Pavement Markings	Miles	2	0.70	TR,RE,FO,OVT	All	All	Historic IDOT CMF
2.4.8.AL.1 - Railroad Crossings - Warning Signs - Standard	Unit Qty	2	0.60	TR,FO,RE,OVT	All	All	Historic IDOT CMF
2.4.9.AL.1 - Railroad Crossings - Warning Signs - Special	Unit Qty	5	0.60	TR,FO,RE,OVT	All	All	Historic IDOT CMF
2.4.10.AL.1 - Railroad Crossings - Delineators	Miles	4	0.60	TR,FO,OVT	All	All	Historic IDOT CMF
2.4.11.AL.1 - Railroad Crossings - Safety Lighting	Unit Qty	15	0.50	TR,FO,RE,OVT	All	All	Historic IDOT CMF
2.4.12.AL.1 - Railroad Crossings - Resurfacing	Miles	10	0.75	TR,FO,RE,OVT	All	All	Historic IDOT CMF
2.4.13.AL.1 - Railroad Crossings - Grade Separation	Unit Qty	20	0.00	All	All	All	Historic IDOT CMF
<i>2.5 Bridge</i>							
2.5.1.AL.1 - Bridge - General Repair	Miles	10	0.85	PKV, HO,SOD,SSD,FO,OVT	All	All	Historic IDOT CMF
2.5.2.AL.1 - Bridge - Resurface	Miles	15	0.85	FO,HO,SOD,SSD,OVT	All	All	Historic IDOT CMF
2.5.3.AL.1 - Bridge - De-Slick	Miles	5	0.43	WP	All	All	Clearinghouse #2266
2.5.4.AL.1 - Bridge - Grooving	Miles	7	0.50	WP	All	All	Clearinghouse #2468
2.5.5.AL.1 - Bridge - Frost/Ice Detectors - Sign	Unit Qty	10	0.75	FO,HO,SOD,SSD,OVT	All	All	Historic IDOT CMF
2.5.6.AL.1 - Bridge - Frost/Ice Detectors - Radio	Unit Qty	10	0.75	PKV, HO,SOD,SSD,FO,OVT	All	All	Historic IDOT CMF
2.5.7.AL.1 - Bridge - Guardrail	Miles	10	0.85	FO,OVT	All	All	Historic IDOT CMF
2.5.8.AL.1 - Bridge - Separation between Pedestrians/Traffic	Miles	15	0.10	PD,PDC	All	All	Clearinghouse #1803
2.5.9.AL.1 - Bridge - Safety Lighting	Unit Qty	15	0.50	NGT	All	All	Historic IDOT CMF
2.5.10.S1.1 - Bridge - Delineators	Miles	4	1.04	All	Rural	Two-Lane	HSM - 13.8.2.1
2.5.11.AL.1 - Bridge - Impact Attenuators	Unit Qty	3	0.31	FO	All	All	HSM - 13.5.2.5
2.5.12.AL.1 - Bridge - Reconstruction	Miles	20	0.50	FO,HO,SOD,SSD,OVT	All	All	Historic IDOT CMF
<i>2.6 Curves</i>							
2.6.1.S1.1 - Curves - Improve Superelevation on Curve	Miles	15	²	All	Rural	Two-Lane	HSM - 13.6.2.2
2.6.2.AL.1 - Curves - Daylighting	Miles	15	0.70	OVT,FO,HO,SSD,SOD	All	All	Historic IDOT CMF
2.6.3.AL.1 - Curves - De-Slick (formerly known as skidproofing)	Miles	5	0.43	WP	All	All	Clearinghouse #2266

TABLE A4
IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
2.6.4.AL.1 - Curves - Guardrail	Miles	10	0.53	FO,OVT	All	All	Clearinghouse #38
2.6.5.AL.1 - Curves - Install Advanced Curve Speed/Warning Sign	Unit Qty	5	0.87	All	All	All	HSM - 13.7.2.1
2.6.6.S1.1 - Curves - Install Post Mounted Delineators	Unit Qty	4	1.04	All	Rural	Two-Lane	HSM - 13.8.2.1
2.6.7.S1.1 - Curves - Install Chevron Signs on Horizontal Curves	Unit Qty	4	0.84	All	Rural	Two-Lane	Clearing House #2438
2.6.8.S1.1 - Curves - Place Edgeline and Directional Pavement Markings on Horizontal Curves	Miles	2	0.81	FO, OVT	Rural	Two-Lane	Clearing House #91
2.6.9.S1.1 - Curves - Modify Horizontal Curve Radius and Length w/ Spiral Transitions	Miles	15	²	All	Rural	Two-Lane	HSM - 13.6.2.1
2.6.9.S1.2 - Curves - Modify Horizontal Curve Radius and Length w/o Spiral Transitions	Miles	15	²	All	Rural	Two-Lane	HSM - 13.6.2.1
2.6.10.S8.1 - Curves - Increase Horizontal Curvature by One Degree	Miles	15	1.06	FO, OVT	Urban	Multi-Undivided	Clearinghouse #59
2.6.10.S8.2 - Curves - Decrease Horizontal Curvature by One Degree	Miles	15	0.94	FO, OVT	Urban	Multi-Undivided	Clearinghouse #59
2.7 Roadside Safety							
2.7.1.AL.1 - Roadside Safety - General/Fixed Obstacle Removal	Unit Qty	20	0.62	All	All	All	Clearinghouse #1044
2.7.2.AL.1 - Roadside Safety - Guardrail	Miles	10	0.53	FO,OVT	All	All	Clearinghouse #38
2.7.3.S1.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Rural	Two-Lane	HSM - 13.5.2.1
2.7.3.S2.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Rural	Multi-Undivided	HSM - 13.5.2.1
2.7.3.S3.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Rural	Multi-Divided	HSM - 13.5.2.1
2.7.3.S4.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Rural	4 Lane Freeway	HSM - 13.5.2.1
2.7.3.S5.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Rural	6+ Lane Freeway	HSM - 13.5.2.1
2.7.3.S6.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Urban	Two-Lane	HSM - 13.5.2.1
2.7.3.S8.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Urban	Multi-Undivided	HSM - 13.5.2.1
2.7.3.S9.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Urban	Multi-Divided	HSM - 13.5.2.1
2.7.3.S10.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Urban	4 Lane Freeway	HSM - 13.5.2.1
2.7.3.S11.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Urban	6 Lane Freeway	HSM - 13.5.2.1
2.7.3.S12.1 - Roadside Safety - Flatten Sideslopes	Miles	15	²	All	Urban	8+ Lane Freeway	HSM - 13.5.2.1
2.7.4.SR.1 - Roadside Safety - Increase Distance to Roadside Features	Miles	15	²	All	Rural	All	HSM - 13.5.2.2
2.7.5.AL.1 - Roadside Safety - Change Road Barrier Along Embankment to Less Rigid Type	Miles	15	0.68	FO, OVT	All	All	HSM - 13.5.2.3
2.7.6.AL.1 - Roadside Safety - Impact Attenuators	Unit Qty	3	0.31	FO	All	All	HSM - 13.5.2.5
2.7.7.S1.1 - Roadside Safety - Reduce Roadside Hazard Rating	Miles	15	²	All	Rural	Two-Lane	HSM - 13.5.2.6
2.7.8.S6.1 - Roadside Safety - Prohibit On-Street Parking	Miles	15	0.78	All	Urban	Two-Lane	HSM - 13.11.2.1
2.7.8.S7.1 - Roadside Safety - Prohibit On-Street Parking	Miles	15	0.78	All	Urban	One-way	HSM - 13.11.2.1
2.7.9.S6.1 - Roadside Safety - Convert Free to Regulated On-Street Parking	Miles	15	0.94	All	Urban	Two-Lane	HSM - 13.11.2.2
2.7.9.S7.1 - Roadside Safety - Convert Free to Regulated On-Street Parking	Miles	15	0.94	All	Urban	One-way	HSM - 13.11.2.2
2.7.10.S6.1 - Roadside Safety - Implement Time-Limited On-Street Parking Restrictions	Miles	15	0.89	All	Urban	Two-Lane	HSM - 13.11.2.3
2.7.10.S7.1 - Roadside Safety - Implement Time-Limited On-Street Parking Restrictions	Miles	15	0.89	All	Urban	One-way	HSM - 13.11.2.3
2.7.11.S6.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)	Miles	15	²	All	Urban	Two-Lane	HSM - 13.11.2.4
2.7.11.S7.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)	Miles	15	²	All	Urban	One-way	HSM - 13.11.2.4
2.7.11.S8.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)	Miles	15	²	All	Urban	Multi-Undivided	HSM - 13.11.2.4

TABLE A4
IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
2.7.11.S9.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Residential)	Miles	15	²	All	Urban	Multi-Divided	HSM - 13.11.2.4
2.7.11.S6.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial)	Miles	15	²	All	Urban	Two-Lane	HSM - 13.11.2.4
2.7.11.S7.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial)	Miles	15	²	All	Urban	One-way	HSM - 13.11.2.4
2.7.11.S8.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial)	Miles	15	²	All	Urban	Multi-Undivided	HSM - 13.11.2.4
2.7.11.S9.1 - Roadside Safety - Convert Angle Parking to Parallel Parking (Commercial/Industrial)	Miles	15	²	All	Urban	Multi-Divided	HSM - 13.11.2.4
2.7.12.AL.1 - Roadside Safety - Provide Lighting	Miles	15	0.72	NGT	All	All	HSM - 13.13.2.1
2.7.13.AL.1 - Roadside Safety - Glare Shields	Miles	10	0.85	SSD,AG,FO,OVT	All	All	Historic IDOT CMF
2.7.14.AL.1 - Roadside Safety - Install Snow Fencing	Miles	10	0.92	All	All	All	Clearinghouse #190
2.8 Other							
2.8.1.AL.1 - Other - Turnouts (Mailbox or other)	Miles	15	0.50	Entering or exiting vehicles from shoulder area	All	All	Historic IDOT CMF
2.8.2.S10.1 - Other - Install Changeable Crash Ahead Warning Signs	Unit Qty	15	0.56	All	Urban	4 Lane Freeway	HSM - 13.7.2.2
2.8.2.S11.1 - Other - Install Changeable Crash Ahead Warning Signs	Unit Qty	15	0.56	All	Urban	6 Lane Freeway	HSM - 13.7.2.2
2.8.2.S12.1 - Other - Install Changeable Crash Ahead Warning Signs	Unit Qty	15	0.56	All	Urban	8+ Lane Freeway	HSM - 13.7.2.2
2.8.2.S10.1 - Other - Install Changeable "Queue Ahead" Warning Signs	Unit Qty	15	0.84	RE	Urban	4 Lane Freeway	HSM - 13.7.2.3
2.8.2.S11.1 - Other - Install Changeable "Queue Ahead" Warning Signs	Unit Qty	15	0.84	RE	Urban	6 Lane Freeway	HSM - 13.7.2.3
2.8.2.S12.1 - Other - Install Changeable "Queue Ahead" Warning Signs	Unit Qty	15	0.84	RE	Urban	8+ Lane Freeway	HSM - 13.7.2.3
2.8.3.xx.1 - Other - Install Speed Humps	Unit Qty	10	0.60	All	Urban	Local Segment	HSM - 13.10.2.1
2.8.3.S1.1 - Other - Modify Access Point Density	Miles	15	²	All	Rural	Two-Lane	HSM - 13.14.2.1
2.8.3.S6.1 - Other - Modify Access Point Density	Miles	15	²	All	Urban	Two-Lane	HSM - 13.14.2.1
2.8.3.S7.1 - Other - Modify Access Point Density	Miles	15	²	All	Urban	One-Way	HSM - 13.14.2.1
2.8.3.S8.1 - Other - Modify Access Point Density	Miles	15	²	All	Urban	Multi-Undivided	HSM - 13.14.2.1
2.8.4.AL.1 - Other - Implement Faster Response Times for Winter Maintenance	Unit Qty	15	0.89	All	All	All	HSM - 13.15.2.1
2.8.5.AL.1 - Other - Install Automated Speed Enforcement	Unit Qty	15	0.83	All	All	All	HSM - 17.5.2.1
2.8.6.AL.1 - Other - Install Changeable Speed Warning Signs	Unit Qty	15	0.54	All	All	All	HSM - 13.7.2.1
2.8.7.S14.1 - Other - Implement Area-wide Traffic Calming	Unit Qty	15	0.89	All	Urban	Local Segment	Clearingshouse #586
2.8.8.S4.1 - Other - Modify Work Zone Duration	Unit Qty	1	²	All	Rural	4 Lane Freeway	HSM - 16.4.2.1
2.8.8.S5.1 - Other - Modify Work Zone Duration	Unit Qty	1	²	All	Rural	6+ Lane Freeway	HSM - 16.4.2.1
2.8.8.S10.1 - Other - Modify Work Zone Duration	Unit Qty	1	²	All	Urban	4 Lane Freeway	HSM - 16.4.2.1
2.8.8.S11.1 - Other - Modify Work Zone Duration	Unit Qty	1	²	All	Urban	6 Lane Freeway	HSM - 16.4.2.1
2.8.8.S12.1 - Other - Modify Work Zone Duration	Unit Qty	1	²	All	Urban	8+ Lane Freeway	HSM - 16.4.2.1
2.8.9.S4.1 - Other - Modify Work Zone Length	Unit Qty	1	²	All	Rural	4 Lane Freeway	HSM - 16.4.2.1
2.8.9.S5.1 - Other - Modify Work Zone Length	Unit Qty	1	²	All	Rural	6+ Lane Freeway	HSM - 16.4.2.1
2.8.9.S10.1 - Other - Modify Work Zone Length	Unit Qty	1	²	All	Urban	4 Lane Freeway	HSM - 16.4.2.1
2.8.9.S11.1 - Other - Modify Work Zone Length	Unit Qty	1	²	All	Urban	6 Lane Freeway	HSM - 16.4.2.1
2.8.9.S12.1 - Other - Modify Work Zone Length	Unit Qty	1	²	All	Urban	8+ Lane Freeway	HSM - 16.4.2.1

Notes:

TABLE A4
 IDOT Benefit-Cost Analysis Tool Countermeasures List

Countermeasures	Unit	Service Life	CMF	Crash Type Affected by Countermeasures	Setting Type	Facility Type	Source ¹
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HSM = Highway Safety Manual 1st Edition

¹Clearinghouse #xxxx refers to the unique CMF ID referenced on the FHWA Clearinghouse Website, <http://www.cmfclearinghouse.org/>

²CMF value is represented by a function or a table and is dependent on additional data.