UPDATED
HSM Part C Spreadsheets

jointly funded by ALDOT and VDOT

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ACKNOWLEDGEMENTS - During 2009 and 2010, Dr. Karen Dixon, Principal Investigator of NCHRP 17-38, developed three spreadsheets in a volunteer effort to support training efforts on the first edition of the HSM. These Highway Safety Manual (HSM) predictive analysis spreadsheet tools represent updates to these three spreadsheets. The update was funded through a partnership between the Alabama Department of Transportation and Virginia Department of Transportation. These agencies are releasing these tools for use by other individuals and agencies to support the implementation of the HSM across the nation.

The user of this tool acknowledges that these spreadsheets were developed from information contained in AASHTO Highway Safety Manual, 2010, and should be familiar with the concepts and procedures outlined therein when using this spreadsheet analysis tool.

Overview of Tasks

Task 1. Create a Project File

Task 2. Enter project information

Task 3. Complete the element table

Task 4. Enter required information on each element tab (segments and intersections)

Task 5. Generate EB analysis results and analysisreport

Task 6. Review analysis report and discussion of results

<u>If applicable:</u>

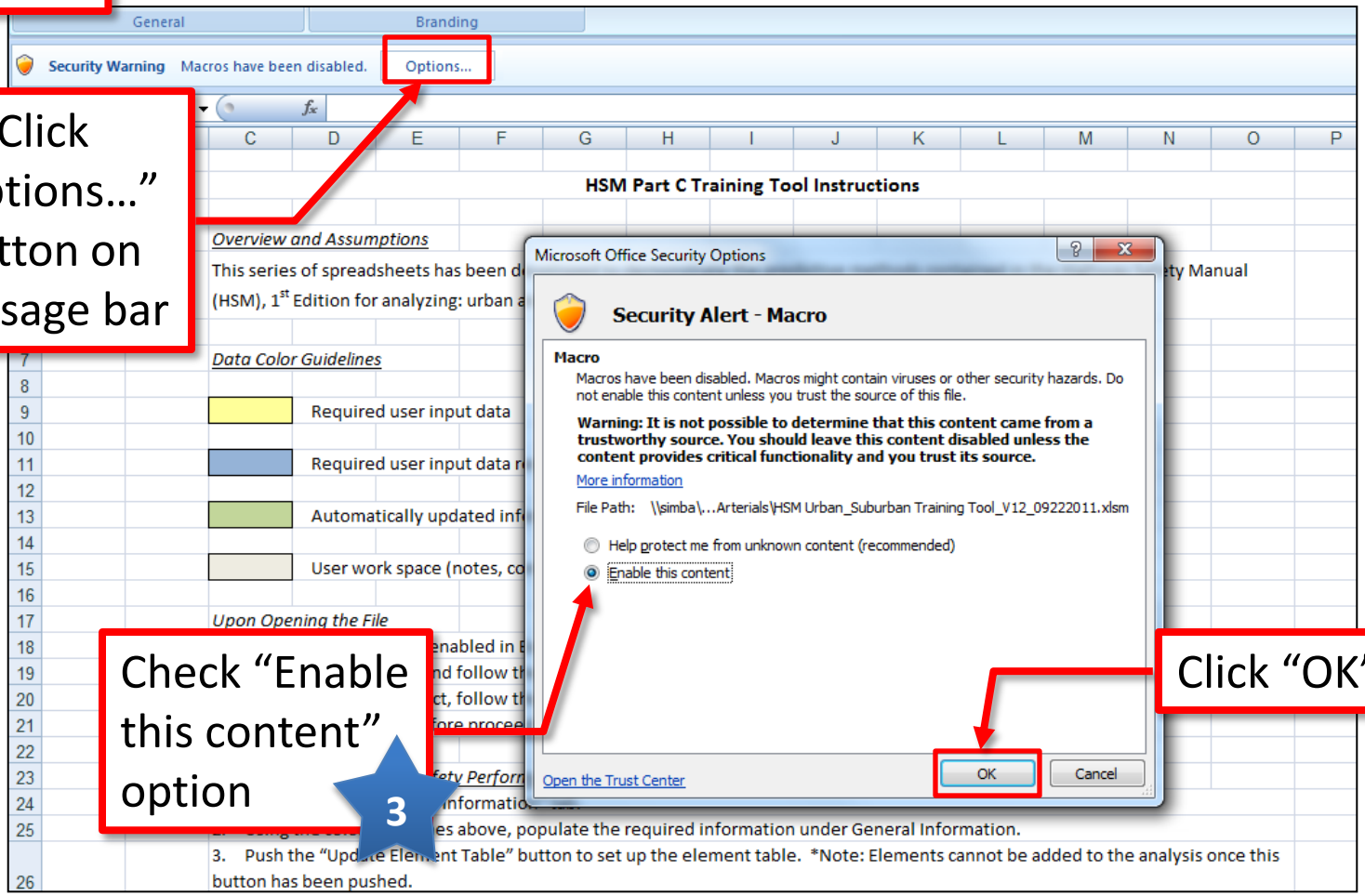
Task 7. Enter multi-year analysis information

Task 8. Generate and review multi-year report

Open File and Enable Macros

1. Open file

2. Click "Options…" button on message bar



3. Check "Enable this content" option

4. Click "OK"

Review Terms and Save File

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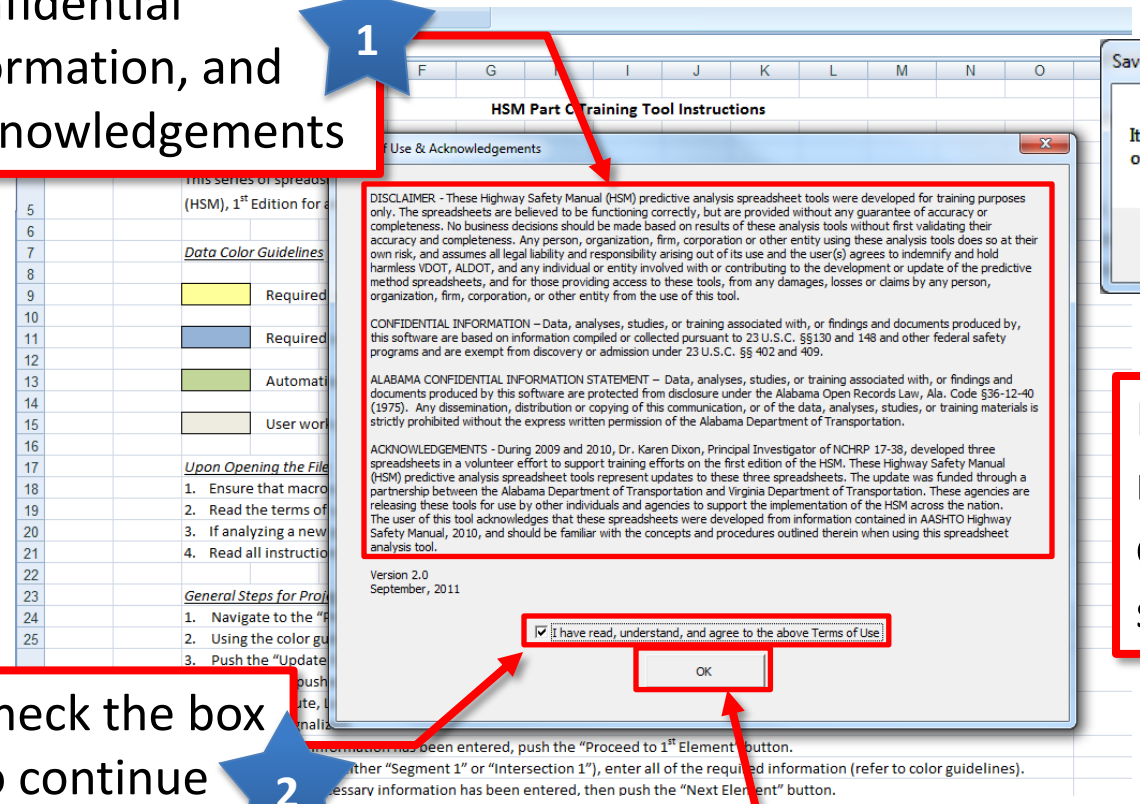
1



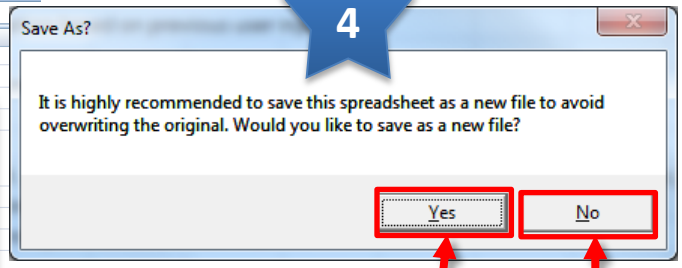
Check the box to continue

2

Click "OK"

3

4



If beginning a new project, click "Yes" to save as

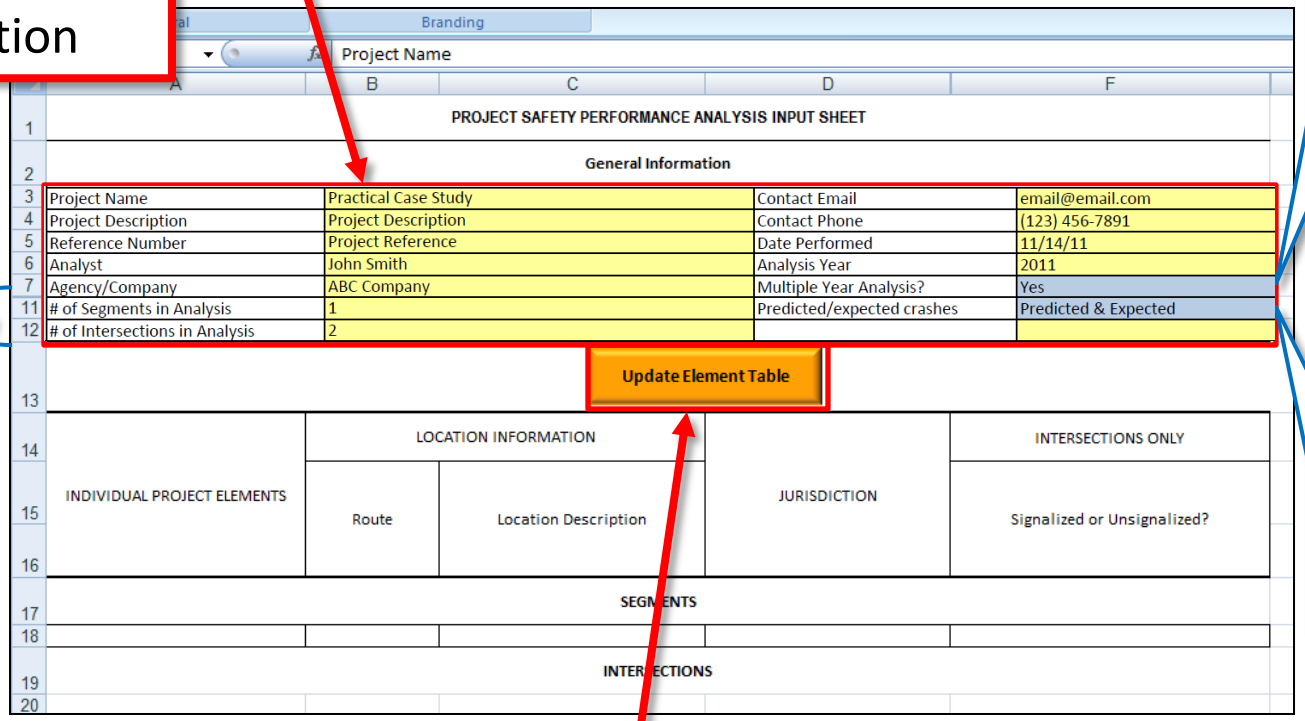
OR

If continuing from previously saved project, click "No"

Enter Project Information

1

Fill out all general project information



PROJECT SAFETY PERFORMANCE ANALYSIS INPUT SHEET

General Information

Project Name	Practical Case Study	Contact Email	email@email.com
Project Description	Project Description	Contact Phone	(123) 456-7891
Reference Number	Project Reference	Date Performed	11/14/11
Analyst	John Smith	Analysis Year	2011
Agency/Company	ABC Company	Multiple Year Analysis?	Yes
# of Segments in Analysis	1	Predicted/expected crashes	Predicted & Expected
# of Intersections in Analysis	2		

Update Element Table

INDIVIDUAL PROJECT ELEMENTS	LOCATION INFORMATION		JURISDICTION	INTERSECTIONS ONLY
	Route	Location Description		Signalized or Unsignalized?
SEGMENTS				
INTERSECTIONS				

Drop down: Perform multiple year analysis? (Yes or No)

Number of elements (segments & intersections)

Drop down: Include Predicted or Predicted & Expected crashes?

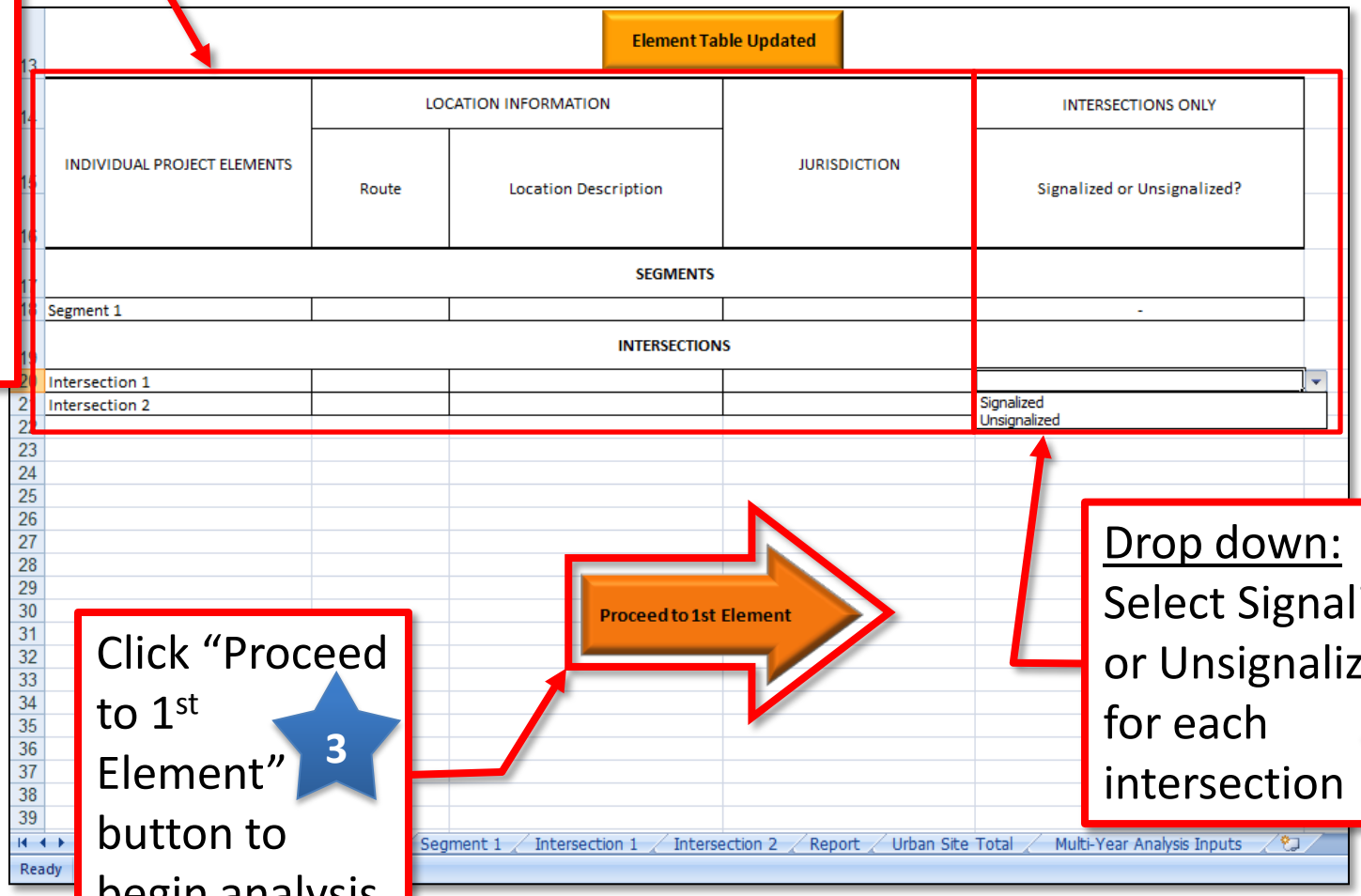
Click “Update Element Table” button

2

HSM Highway Safety Manual

Complete Element Table

1 Fill out Route, Location Description, and Jurisdiction for all elements



Drop down:
Select Signalized or Unsignalized for each intersection

2

Click "Proceed to 1st Element" button to begin analysis

3

HSM Highway Safety Manual

Enter Segment Data

1

Project and location information populates based on project information inputs

WORKSHEET 1A -- GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ROADWAY SEGMENTS

General Information		Location Information	
Analyst	John Smith	Roadway	ROUTE A
Agency or Company	ABC Company	Roadway Section	North Town
Date Performed	11/14/11	Jurisdiction	City, State
Segment for Analysis	Segment 1	Analysis Year	2011

Input Data					Site Conditions	Base Conditions
Roadway type (2U, 3T, 4U, 4D, 5T)					3T	--
Length of segment, L (mi)					3	--
AADT (veh/day)	is within range	$AADT_{MAX}$ =	32,900	(veh/day)	30,000	--
Type of on-street parking (none/parallel/angle)					None	None
Proportion of curb length with on-street parking					0	--
Median width (ft) - for divided only					Not Present	15
Lighting (present / not present)					Present	Not Present
Auto speed enforcement (present / not present)					Not Present	Not Present
Ma					2	--
Mir					3	--
Ma					2	--
Mir					3	--
Ma					1	--
Mir					4	--
Oth					3	--
Spe					Posted Speed Greater than 30 mph	--
Roa					3	0

Enter or select the appropriate site conditions for the segment

2

Enter Segment & Crash Data

3

Enter or select the appropriate site conditions for the segment

Click the "Next Element" button to advance to the next element

5

			Site Conditions		
10			3T		
11			3		
12			30,000		
13			None		
14			0		
15			Not Present		
16	Auto speed enforcement (present / not present)		Present		Not Present
17	Major commercial driveways (number)		Not Present		--
18	Minor commercial driveways (number)		2		--
19	Major industrial / institutional driveways (number)		3		--
20	Minor industrial / institutional driveways (number)		2		--
21	Major residential driveways (number)		3		--
22	Minor residential driveways (number)		1		--
23	Other driveways (number)		4		--
24	Speed Category		3		--
25	Roadside fixed object density (fixed objects / mi)		Posted Speed Greater than 30 mph		0
26	Offset to roadside fixed objects (ft) [If greater than 30 or Not Present, input 30]		3		30
27	Calibration Factor, Cr		30		1.00
28	**Average Annual Crash History (3 or 5-yr average)**		1.00		
29	Multiple vehicle driveway crashes	KABC	Fatal and Injury Only	8.0	
30		PDO	Property Damage Only	12.0	
31	Multiple vehicle nondriveway crashes	KABC	Fatal and Injury Only	6.0	
32		PDO	Property Damage Only	9.0	
33	Single-vehicle crashes	KABC	Fatal and Injury Only	1.0	
34		PDO	Property Damage Only	5.0	
35	NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p. 2-8 in Part C of the HSM)				

Next Element

4

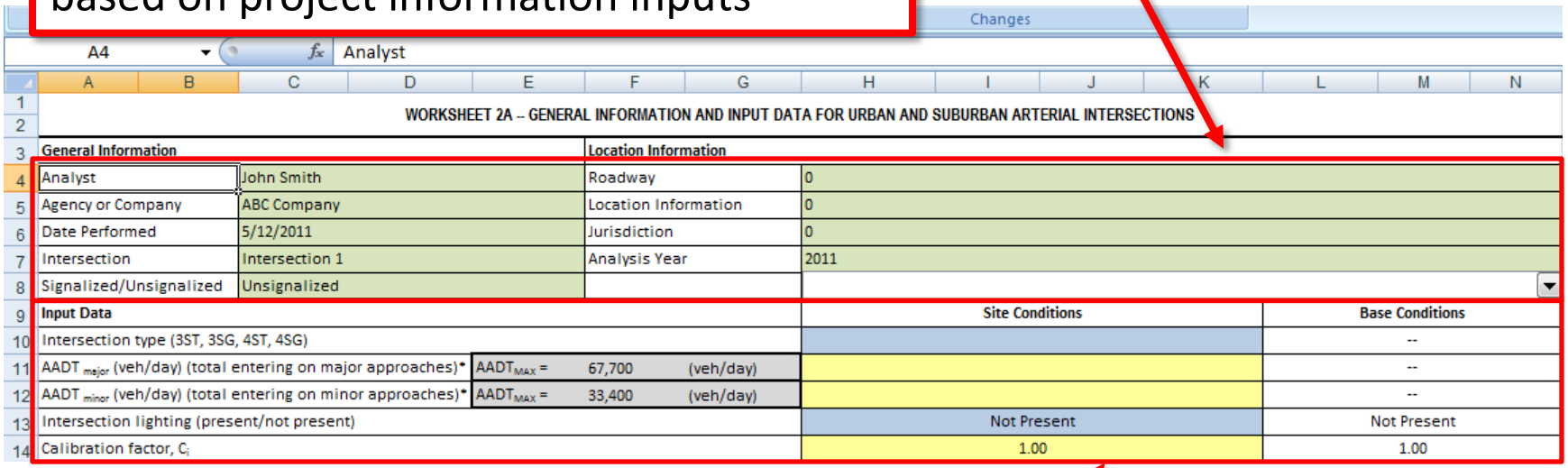
Enter the average annual crash history (3- or 5-year average)

6

Repeat steps 1-5 for each segment element included in the project

Enter Intersection Data

1. Project and location information populates based on project information inputs



Changes

A4 | Analyst

WORKSHEET 2A – GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		Location Information	
Analyst	John Smith	Roadway	0
Agency or Company	ABC Company	Location Information	0
Date Performed	5/12/2011	Jurisdiction	0
Intersection	Intersection 1	Analysis Year	2011
Signalized/Unsignalized	Unsignalized		

Input Data				Site Conditions	Base Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)					--
$AADT_{major}$ (veh/day) (total entering on major approaches)*	$AADT_{MAX}$ =	67,700	(veh/day)		--
$AADT_{minor}$ (veh/day) (total entering on minor approaches)*	$AADT_{MAX}$ =	33,400	(veh/day)		--
Intersection lighting (present/not present)				Not Present	Not Present
Calibration factor, C_i				1.00	1.00

2. Enter or select the appropriate site conditions for the intersection (for both signalized and unsignalized)

Enter Applicable Intersection Inputs

3

Proofing | Comments | Changes

A4 | Analyst

WORKSHEET 2A – GENERAL INFORMATION AND INPUT DATA FOR URBAN AND SUBURBAN ARTERIAL INTERSECTIONS

General Information		Location Information	
Analyst	John Smith	Roadway	0
Agency or Company	ABC Company	Location Information	0
Date Performed	5/12/2011	Jurisdiction	0
Intersection	Intersection 1	Analysis Year	2011
Signalized/Unsignalized	Unsignalized		

Input Data	Site Conditions	Base Conditions
		--
		--
		--
	Not Present	Not Present
Calibration factor, C_i	1.00	1.00
Data for unsignalized intersections only:		
Number of major-road approaches with left-turn lanes (0,1,2)	0	0
Number of major-road approaches with right-turn lanes (0,1,2)	0	0
Data for signalized intersections only:		
Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]	0	0
Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]	0	0
Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]	0	--
Type of left-turn signal phasing for Leg #1	Permissive	Permissive
Type of left-turn signal phasing for Leg #2		--
Type of left-turn signal phasing for Leg #3		--
Type of left-turn signal phasing for Leg #4 (if applicable)		--
Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]	0	0
Intersection red light cameras (present/not present)	Not Present	Not Present
Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only		--
Maximum number of lanes crossed by a pedestrian (n_{lanesx})		--
Number of bus stops within 300 m (1,000 ft) of the intersection	0	0
Schools within 300 m (1,000 ft) of the intersection (present/not present)	Not Present	Not Present
Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection	0	0
Average Annual Crash History (3 or 5-yr average)		
KABC	Fatal and Injury Only	0
		0
		0

NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)

Inputs for unsignalized intersections **ONLY**

Inputs for signalized intersections **ONLY**

Next Element

Enter Intersection & Crash Data

Sample shows signalized intersection
(Note: Unsignalized inputs are locked)

Click the "Next Element" button to advance to the next element

5

15	Data for unsignalized intersections only:				
16	~~Number of major-road approaches with left-turn lanes (0,1,2)~~		~~0~~		~~0~~
17	~~Number of major-road approaches with right-turn lanes (0,1,2)~~		~~0~~		~~0~~
18	Data for signalized intersections only:				
19	Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0		0
20	Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]		0		0
21	Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]		0		--
22	Type of left-turn signal phasing for Leg #1		Permissive		Permissive
23	Type of left-turn signal phasing for Leg #2				--
24	Type of left-turn signal phasing for Leg #3				--
25	Type of left-turn signal phasing for Leg #4 (if applicable)				--
26	Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]		0		0
27	Intersection red light cameras (present/not present)		Not Present		Not Present
28	Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				--
29	Maximum number of lanes crossed by a pedestrian (n_{lanesx})				--
30	Number of bus stops within 300 m (1,000 ft) of the intersection		0		0
31	Schools within 300 m (1,000 ft) of the intersection (present/not present)		Not Present		Not Present
32	Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection		0		0
33	**Average Annual Crash History (3 or 5-yr average)**				
34	Multiple vehicle crashes	KABC	Fatal and Injury Only	0	
35		PDO	Property Damage Only	0	
36	Single-vehicle crashes	KABC	Fatal and Injury Only	0	
37		PDO	Property Damage Only	0	
38	NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)				

Next Element

4

Enter the average annual crash history (3- or 5-year average)

Repeat steps 1-5 for each intersection element included in the project

6

Generate Analysis Report

1

After all inputs have been entered for all elements, click the "Generate Report" button on final element page (Note: may be segment or intersection tab depending on the project)

15	Da				
16	~~Number of major-road approaches with left-turn lanes (0,1,2)~~			~~0~~	~~0~~
17	~~Number of major-road approaches with right-turn lanes (0,1,2)~~			~~0~~	~~0~~
18	Data for signalized intersections only:				
19	Number of approaches with left-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0
20	Number of approaches with right-turn lanes (0,1,2,3,4) [for 3SG, use maximum value of 3]			0	0
21	Number of approaches with left-turn signal phasing [for 3SG, use maximum value of 3]			0	--
22	Type of left-turn signal phasing for Leg #1			Permissive	Permissive
23	Type of left-turn signal phasing for Leg #2				--
24	Type of left-turn signal phasing for Leg #3				--
25	Type of left-turn signal phasing for Leg #4 (if applicable)				--
26	Number of approaches with right-turn-on-red prohibited [for 3SG, use maximum value of 3]			0	0
27	Intersection red light cameras (present/not present)			Not Present	Not Present
28	Sum of all pedestrian crossing volumes (PedVol) -- Signalized intersections only				--
29	Maximum number of lanes crossed by a pedestrian (n_{lanesx})				--
30	Number of bus stops within 300 m (1,000 ft) of the intersection			0	0
31	Schools within 300 m (1,000 ft) of the intersection (present/not present)			Not Present	Not Present
32	Number of alcohol sales establishments within 300 m (1,000 ft) of the intersection			0	0
33	**Average Annual Crash History (3 or 5-yr average)**				
34	Multiple vehicle crashes	KABC	Fatal and Injury Only	0	
35		PDO	Property Damage Only	0	
36	Single-vehicle crashes	KABC	Fatal and Injury Only	0	
37		PDO	Property Damage Only	0	
38	NOTES: * AADT: It is important to remember that the AADT(major) = AADT(major approach1) + AADT(minor approach2) (refer to p.12-8 in Part C of the HSM)				

Generate Report

Review Report Results

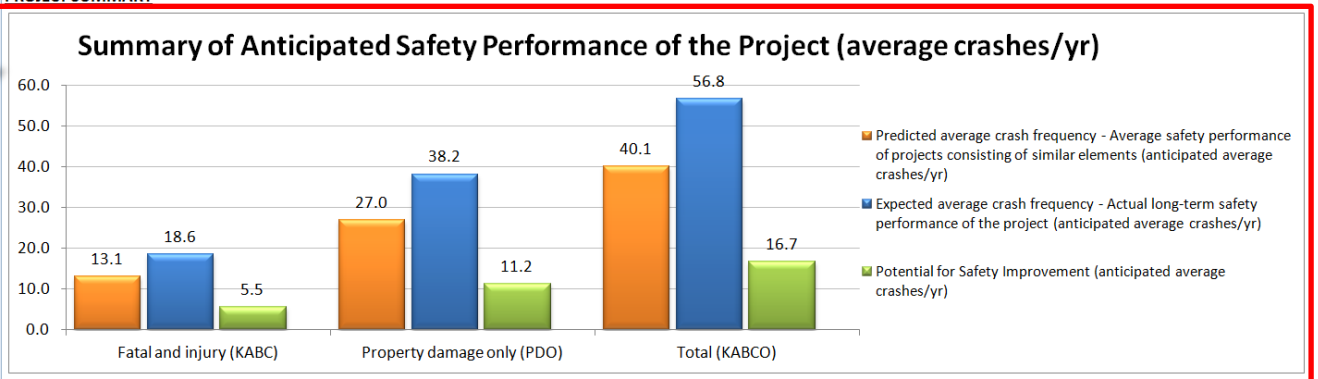
2 Graphical summary of anticipated safety performance of the project

Project information populates automatically using the Project Information worksheet inputs 1

PROJECT SAFETY PERFORMANCE SUMMARY REPORT

General Information	
Project Name	Practical Case Study
Project Description	Project Description
Reference Number	Project Reference
Analyst	John Smith
Agency/Company	ABC Company
Contact Email	email@email.com
Contact Phone	(123) 456-7891
Date Completed	11/14/11

PROJECT SUMMARY



Breakdown of results by element and severity with totals 3

Project Element	Total Crashes/yr (KABCO)			Fatal and Injury Crashes/yr (KABC)			Property Damage Only Crashes/yr (PDO)		
	Predicted average crash frequency $N_{predicted\ (KABCO)}$	Expected average crash frequency $N_{expected\ (KABCO)}$	Potential for Improvement	Predicted average crash frequency $N_{predicted\ (KABC)}$	Expected average crash frequency $N_{expected\ (KABC)}$	Potential for Improvement	Predicted average crash frequency $N_{predicted\ (O)}$	Expected average crash frequency $N_{expected\ (O)}$	Potential for Improvement
INDIVIDUAL SEGMENTS									
Segment 1	27.9	33.6	5.7	8.9	10.7	1.8	19.0	22.9	3.9
INDIVIDUAL INTERSECTIONS									
Intersection 1	5.7	13.2	7.5	1.8	4.2	2.4	3.9	9.0	5.1
Intersection 2	6.5	10.0	3.5	2.4	3.7	1.3	4.1	6.3	2.2
COMBINED (sum of column)	40.1	56.8	16.7	13.1	18.6	5.5	27.0	38.2	11.2

Review Results and Discussion

4 Tabular summary of results by severity

PROJECT SUMMARY -- Site-Specific EB Method Summary Results for Urban and Suburban Arterial Project			
Crash severity level	$N_{predicted(PROJECT)}$ Predicted average crash frequency - Average safety performance of projects consisting of similar elements (anticipated average	$N_{expected\ (PROJECT)}$ Expected average crash frequency - Actual long-term safety performance of the project (anticipated average crashes/yr)	$N_{potential\ for\ improvement\ (PROJECT)}$ Potential for Safety Improvement (anticipated average crashes/yr)
Fatal and injury (KABC)	13.1	18.6	5.5
Property damage only (PDO)	27.0	38.2	11.2
Total (KABCO)	40.1	56.8	16.7

Discussion of Results

Given the potential effects of project characteristics on safety performance, results indicate that:

1. It is anticipated that the project will, on average, experience 56.8 crashes per year (18.6 fatal and injury crashes per year; and 38.2 property damage only crashes per year).
2. A similar project is anticipated, on average, to experience 40.1 crashes per year (13.1 fatal and injury crashes per year; and 27 property damage only crashes per year).
3. It is anticipated the project has, on average, a potential for safety improvement of 16.7 crashes per year (5.5 fatal and injury crashes per year; and 11.2 property damage only crashes per year).

5 Discussion of results of safety performance analysis

FAQ for Site-Specific Analysis

- *Can I change the information I input on the element tabs?*
  - Yes. All of the report information will update automatically if element inputs are changed. Therefore the report does **not** need to be generated again.
- *Can I add elements (segments or intersections) later?*
  - No. The functionality does not exist to automatically add additional segments or intersections after initially updating the element table. However, with the knowledge of adding rows and extending formulas appropriately, more elements can be added manually by the user.

Enter Multi-Year Analysis Inputs

1

Project and location information populates based on project information inputs

	A	B	C	D	E	F	G	H	I	J
1										
2				MULTIPLE-YEAR ANALYSIS FOR URBAN AND SUBURBAN ARTERIALS - INPUTS						
3				General Information						
4	Project Name		Practical Case Study			Analyst		KEB		
5	Project Description		SR 99			Contact Email		KEB123@msn.com		
6	Reference Number		STARS Report A-1			Contact Phone		(123) 456-7891		
7	Agency/Company		CH2M HILL			Date Performed		10/18/2011		
8										
9										
10			Input Data							
11	Base Year		2011							
12	Analysis Period (Years)		10							
13	Linear Traffic Growth (annual %)		3.0%							
14										
15										
16										
17										
18										
19										
20										
21										
22										
23										

Enter input data for multi-year analysis

2

Click “Run Multi-Year Analysis” button to generate results

3

Multi-Year Analysis Processed

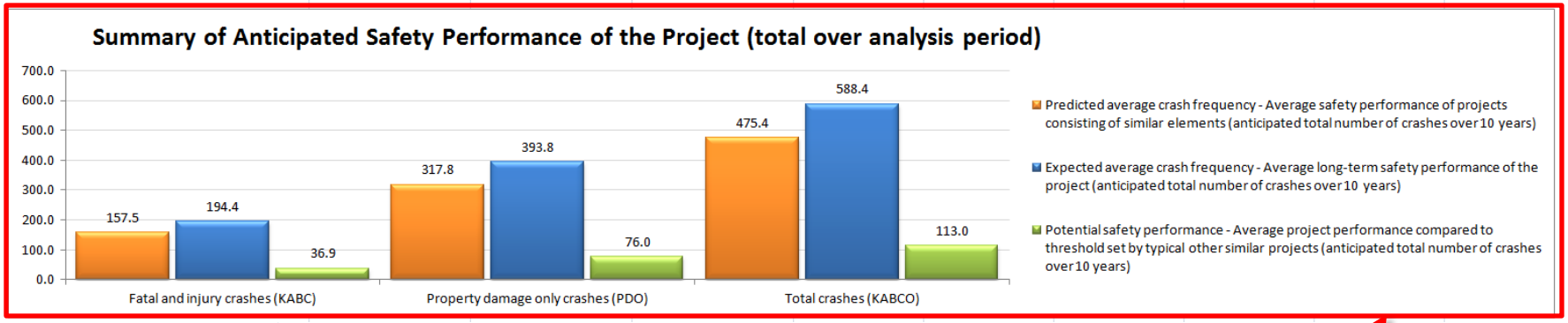
Review Multi-Year Report

MULTIPLE YEAR PROJECT SAFETY PERFORMANCE SUMMARY REPORT FOR URBAN AND SUBURBAN ARTERIAL

General Information	
Project Name	Practical Case Study
Project Description	Project Description
Reference Number	Project Reference
Analyst	John Smith
Agency/Company	ABC Company
Contact Email	email@email.com
Contact Phone	(123) 456-7891
Date Completed	11/14/11
Base Year	2011
Analysis Period (Years)	10
Linear Traffic Growth Rate (annual %)	3%
PROJECT SUMMARY	

1

Project information and analysis parameters populate based on project information and multi-year inputs



2

Graphical summary of total anticipated safety performance of the project over the analysis period specified

HSM Highway Safety Manual

Review Multi-Year Results & Discussion

3 Breakdown of results by year and severity with totals

10-Year Analysis Summary Report

Analysis Year	Predicted Average Crash Frequency (*Npredicted*)			Expected Average Crash Frequency (*Nexpected*)			Potential for Safety Improvement (crashes/yr)		
	KABC	*PDO*	*Total (KABCO)*	*KABC*	*PDO*	*Total (KABCO)*	*KABC*	*PDO*	*Total (KABCO)*
2011	13.1	27.0	40.1	18.6	38.2	56.8	5.5	11.2	16.7
2012	13.6	28.1	41.6	18.8	38.7	57.3	5.2	10.6	15.7
2013	14.2	29.1	43.4	19.0	38.7	57.8	4.8	9.6	14.4
2014	14.8	30.1	45.0	19.1	38.9	58.2	4.3	8.8	13.2
2015	15.4	31.2	46.6	19.4	39.3	58.7	4.0	8.1	12.1
2016	16.0	32.3	48.4	19.5	39.5	59.2	3.5	7.2	10.8
2017	16.7	33.4	50.0	19.8	39.9	59.5	3.1	6.5	9.5
2018	17.2	34.4	51.7	19.8	39.9	59.9	2.6	5.5	8.2
2019	17.9	35.5	53.4	20.1	40.2	60.3	2.2	4.7	6.9
2020	18.6	36.7	55.2	20.3	40.5	60.7	1.7	3.8	5.5
				194.4	393.8	588.4	36.9	76.0	113.0

4 Tabular summary of results by severity

PROJECT SUMMARY -- Site-Specific EB Method Summary Results for Urban and Suburban Arterial Project

Crash severity level	$N_{predicted(PROJECT)}$ Predicted average crash frequency - Average safety performance of projects consisting of similar elements (anticipated total number of crashes over 10 years)	$N_{expected(PROJECT)}$ Expected average crash frequency - Average long-term safety performance of the project (anticipated total number of crashes over 10 years)	$N_{potential\ for\ improvement(PROJECT)}$ Potential safety performance - Average project performance compared to threshold set by typical other similar projects (anticipated total number of crashes over 10 years)
Fatal and injury crashes (KABC)	157.5	194.4	36.9
Property damage only crashes (PDO)	317.8	393.8	76.0
Total crashes (KABCO)	475.4	588.4	113.0

Discussion of Results

Given the potential effects of project characteristics on safety performance and assuming a 3 % growth in AADT over a 10 year analysis period with 2011 as the base year, results indicate that:

1. The project is anticipated, on average, to experience 588.4 crashes over a 10 year analysis period (194.4 fatal and injury crashes; and 393.8 property damage only crashes).

2. A similar project is anticipated, on average, to experience 475.4 crashes over a 10 year analysis period (157.5 fatal and injury crashes over 10 years; and 317.8 property damage only crashes over 10 years).

3. It is anticipated the project will have an average potential for safety improvement of 113 crashes over a 10 year analysis period (36.9 fatal and injury crashes over 10 years; and 76 property damage only crashes over 10 years).

5 Discussion of results of multi-year safety performance analysis

HSM Highway Safety Manual

FAQs for Multi-Year Analysis

- *Can I change the information I input on the element tabs?*
  - No. The multi-year analysis will not update if information on the element tabs are changed after generating the report. Ensure that all desired changes to the element inputs are made before performing the multi-year analysis (Task 7, Step 3).
- *Can I change the number of years included in the analysis?*
  - No. More years cannot be added to the analysis, but the results for fewer years can be calculated manually from the generated results.