Surrogate Safety Assessment Model (SSAM)—**SOFTWARE USER MANUAL**

PUBLICATION NO. FHWA-HRT-08-050

MAY 2008

U.S. Department of Transportation
Federal Highway Administration

Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

FOREWORD

This document is a software user's manual for the Surrogate Safety Assessment Model (SSAM). It provides guidance on the installation and use of the software, which is used to perform surrogate safety analysis of a traffic facility, such as a signalized intersection. It does so by processing vehicle trajectory data from a given microscopic traffic simulation to identify the frequency of conflicts—where two vehicles are on a collision course and one vehicle must make an evasive maneuver to avoid a collision. Such surrogate measures have been shown to correlate to some degree with the historical frequency of crashes at intersections. This technique may be of use to researchers, transportation engineers, construction and design companies, and safety engineers.

Michael Trentacoste
Director, Office of Safety
Research and Development

Notice

This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this report only because they are considered essential to the objective of the document.

Quality Assurance Statement

The Federal Highway Administration (FHWA) provides high-quality information to serve Government, industry, and the public in a manner that promotes public understanding. Standards and policies are used to ensure and maximize the quality, objectivity, utility, and integrity of its information. FHWA periodically reviews quality issues and adjusts its programs and processes to ensure continuous quality improvement.

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. FHWA-HRT-08-050	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle Surrogate Safety Assessment Model (SSAM): Software User Manual		5. Report Date May 2008 6. Performing Organization Code
7. Author(s) Lili Pu and Rahul Joshi		8. Performing Organization Report No.
9. Performing Organization Name and Address Siemens Energy and Automation, Inc. Business Unit Intelligent Transportation Systems 6375 E Tanque Verde, Suite 170 Tucson, AZ 85715		10. Work Unit No. 11. Contract or Grant No. DTFH61-03-C-00129
12. Sponsoring Agency Name and Address Federal Highway Administration 6300 Georgetown Pike McLean, VA 22101-2296		13. Type of Report and Period Software User Manual – May 2008 14. Sponsoring Agency Code HRDS-05
15. Supplementary Notes FHWA Contracting Officer's Technical Representative (COTR): Joe Bared		
16. Abstract This document presents guidelines for the installation and use of the Surrogate Safety Assessment Model (SSAM) software. For more information regarding the SSAM application, including discussion of theoretical background and the results of a series of evaluation tests, see the corresponding FHWA research report entitled *Surrogate Safety Assessment Model and Validation: Final Report*, FHWA-HRT-08-051.		
17. Key Words Safety, simulation, surrogate measures, conflict, software, user manual.	18. Distribution Statement No restrictions. This document is available through the National Technical Information Service, Springfield, VA 22161.	

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 96	22. Price N/A

Form DOT F 1700.7 (8-72) Reproduction of completed pages authorized

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
^oF	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	^oC
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
^oC	Celsius	1.8C+32	Fahrenheit	^oF
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

TABLE OF CONTENTS

INTRODUCTION **1**
ORGANIZATION OF THE USER MANUAL **1**
Chapter 1. Installation 1
Chapter 2. Graphical User 1
Appendix. Terms and Definitions 1

CHAPTER 1. INSTALLATION **3**
INSTALLING SSAM **3**
UNINSTALLING SSAM **8**
LAUNCHING THE SSAM SOFTWARE **11**

CHAPTER 2. GRAPHICAL USER INTERFACE **13**
1. INTRODUCTION **13**
2 .CONFIGURATION **13**
3. ANALYSIS **13**
4. USABILITY **13**
INTRODUCTION **14**
1. Case document viewer 14
2. Menus 15
3. The toolbar area 15
4. The internal frame 15
CONFIGURATION **18**
Creating a New Case Document 18
Adding Trajectory Files to a Case Document 20
Processing Trajectory Files 23
ANALYSIS **27**
Note on Units of Analysis 27
Using the Conflict Tab 27
Using the Summary Tab 29
Using the Filter Tab 32
Applying the Filter 34
Using the T-Test Tab 37
Adding Another Case Document 37
Exporting the T-Test Results 43
Viewing the T-Test Analysis on Filtered Data 45
Using the Map Tab 47
Showing Conflicts Without Loading Map Files 49
Showing Conflicts on Loaded Map Image 51
Showing Conflicts on Loaded VISSIM .inp File 56
Saving Image File 58
Filtering Conflicts by Area 60
Configuring Conflict Display 63
Displaying Conflict Line 65
Recoding Map Coordinates 65
Saving the Case Document 68
Editing an Existing Case Document 70

Checking Filter Robustness 72
USABILITY 75
Working with the Tiling Options 75
Toggling the Workspace Window 79
Exporting Data 80
APPENDIX. TERMS AND DEFINITIONS 83

LIST OF FIGURES

Figure 1. Screen Capture. Installation Program, SSAMinstall.exe....3
Figure 2. Screen Capture. InstallShield Wizard Screen....3
Figure 3. Screen Capture. Installer Screen—InstallShield Welcome Screen....4
Figure 4. Screen Capture. Installer Screen—Directory Name....4
Figure 5. Screen Capture. Installer Screen—Option Choices Typical or Custom....5
Figure 6. Screen Capture. Installer Screen—Typical Installation Option....6
Figure 7. Screen Capture. Installer Screen—Custom Installation Option....6
Figure 8. Screen Capture. Installer Screen—Installation Process....7
Figure 9. Screen Capture. Installer Screen—Installation Complete....7
Figure 10. Screen Capture. Location of Installed SSAM Launcher and SSAM Uninstaller....8
Figure 11. Screen Capture. Uninstaller Screen—InstallShield Welcome Screen....9
Figure 12. Screen Capture. Uninstaller Screen—Product Uninstallation Features....9
Figure 13. Screen Capture. Uninstaller Screen—Uninstalling from Local Machine....10
Figure 14. Screen Capture. Uninstaller Screen—Uninstall Process Complete....11
Figure 15. Screen Capture. SSAM—Beginning Screen....11
Figure 16. Screen Capture. SSAM Screen—Beginning Screen with Callouts....14
Figure 17. Screen Capture. SSAM Screen—Toolbar Section Buttons....16
Figure 18. Screen Capture. SSAM Screen—File Menu....17
Figure 19. Screen Capture. SSAM Screen—Window Menu....17
Figure 20. Screen Capture. SSAM Screen—Configuration Tab....18
Figure 21. Screen capture. SSAM Screen—Configuration Tab Displaying Case Information....19
Figure 22. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files....20
Figure 23. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: File Selection....21
Figure 24. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Files Added....22
Figure 25. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Selection Applied....23
Figure 26. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Analysis Progress....24
Figure 27. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Analysis Complete....25
Figure 28. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Summary Complete....26
Figure 29. Screen Capture. SSAM Screen—Conflict Tab....28
Figure 30. Screen capture. SSAM Screen—Summary Tab....29
Figure 31. Screen Capture. SSAM Screen—Filter Tab with Default Settings....32
Figure 32. Screen capture. SSAM Screen—Filter Tab with Filter Settings....33
Figure 33. Screen Capture. SSAM Screen—Filter Tab with Filters Applied: Confirmation Message....34
Figure 34. Screen Capture. SSAM Screen—Conflicts Tab: Filtered Conflicts Table....35
Figure 35. Screen Capture. SSAM Screen—Summary Tab: Filtered Summary Tables....35
Figure 36. Screen Capture. SSAM Screen—Ttest Tab....37

Figure 37. Screen Capture. SSAM Screen—Ttest Tab SSAM Files 38
Figure 38. Screen Capture. SSAM Screen—Ttest Tab File Selection Window 38
Figure 39. Screen Capture. SSAM Screen—Ttest Tab Default Settings 39
Figure 40. Screen Capture. SSAM Screen—Ttest Tab Modified Settings 40
Figure 41. Screen Capture. SSAM Screen—Ttest Tab Open Confirmation Message 41
Figure 42. Screen Capture. SSAM Screen—Ttest Tab Active Case Document 41
Figure 43. Screen Capture. SSAM Screen—Ttest Tab Results Table 42
Figure 44. Screen Capture. SSAM Screen—Ttest Tab with Enlarged Results Table 42
Figure 45. Screen Capture. SSAM Screen—Ttest Tab Export T-Test Results 43
Figure 46. Screen Capture. Excel Screen—T-Test Results in .csv File 44
Figure 47. Screen Capture. SSAM Screen—T-Test Tab Filtered Data Selected 45
Figure 48. Screen Capture. SSAM Screen—Ttest Tab Filtering Confirmation Message 45
Figure 49. Screen Capture. SSAM Screen—Ttest Tab Analyze Warning Message 46
Figure 50. Screen Capture. SSAM Screen—Map Tab 47
Figure 51. Screen Capture. SSAM Screen—Map Tab Map Info Section 48
Figure 52. Screen Capture. SSAM Screen—Map Tab Map View Section 49
Figure 53. Screen Capture. SSAM Screen—Map Tab Conflicts Without Background 50
Figure 54. Screen Capture. SSAM Screen—Map Tab Filtered Conflicts Without Background 50
Figure 55. Screen Capture. SSAM Screen—Map Tab Import Map Image 51
Figure 56. Screen Capture. SSAM Screen—Map Tab with Map File Loaded 52
Figure 57. Screen Capture. SSAM Screen—Map Tab Map Coordinates Input 53
Figure 58. Screen Capture. SSAM Screen—Map Tab Map Coordinates Input Entered 53
Figure 59. Screen Capture. SSAM Screen—Map Tab Conflicts with Background 54
Figure 60. Screen Capture. SSAM Screen—Map Tab with Zoomed Map View 55
Figure 61. Screen Capture. SSAM Screen—Map Tab with Filtered Conflicts 56
Figure 62. Screen Capture. SSAM Screen—Map Tab Load .inp File 57
Figure 63. Screen Capture. SSAM Screen—Map Tab Loaded .inp File and Generated Network 57
Figure 64. Screen Capture. SSAM Screen—Map Tab with Zoomed View of Generated Network 58
Figure 65. Screen Capture. SSAM Screen—Map Tab Saving Image 59
Figure 66. Screen Capture. Microsoft® Office Picture Manager—.png Format Image Open 60
Figure 67. Screen Capture. SSAM Screen—Map Tab Specify Rectangle 61
Figure 68. Screen Capture. SSAM Screen—Map Tab Filter Confirmation Message 61
Figure 69. Screen Capture. SSAM Screen—Map Tab Filtered Conflicts 62
Figure 70. Screen Capture. SSAM Screen—Filter Tab Location Filter 63
Figure 71. Screen Capture. SSAM Screen—Map Tab Conflicts Display Configuration 64
Figure 72. Screen Capture. SSAM Screen—Map Tab Additional Conflicts Display Configuration 64
Figure 73. Screen Capture. SSAM Screen—Map Tab Conflict Information Window 65
Figure 74. Screen Capture. VISSIM Screen—Network Example 66
Figure 75. Screen Capture. VISSIM Screen—Record Upper-Left Corner Coordinates 67

Figure 76. Screen Capture. VISSIM Screen— Record Lower-Right Corner Coordinates. 67
Figure 77. Screen Capture. SSAM Screen—Case Document Not Saved....68
Figure 78. Screen Capture. SSAM Screen—Case Document Saved....69
Figure 79. Screen Capture. SSAM Screen—Case Document Closed 69
Figure 80. Screen Capture. SSAM Screen—Open Case Document from Workspace....70
Figure 81. Screen Capture. SSAM Screen—Confirm Delete Message....70
Figure 82. Screen Capture. SSAM Screen—Edit a Case Document....71
Figure 83. Screen Capture. SSAM Screen—Delete a .trj File....71
Figure 84. Screen Capture. SSAM Screen—Error Message for Nonexisting Data....72
Figure 85. Screen Capture. SSAM Screen—Filter Tab Errors....73
Figure 86. Screen Capture. SSAM Screen—Wrong Filter Settings Error Message....74
Figure 87. Screen Capture. SSAM Screen—No Results Error Message....74
Figure 88. Screen Capture. SSAM Screen—Opening Case Documents....75
Figure 89. Screen Capture. SSAM Screen—Horizontal Tiling....76
Figure 90. Screen Capture. SSAM Screen—Vertical Tiling....77
Figure 91. Screen Capture. SSAM Screen—Grid Tiling....78
Figure 92. Screen Capture. SSAM Screen—Cascade Tiling....79
Figure 93. Screen Capture. SSAM Screen—Toggling the Workspace Window 80
Figure 94. Screen Capture. Export Conflict Table to .csv File....81
Figure 95. Screen Capture. Microsoft® Excel—Exported .csv File 81
Figure 96. Illustration. Conflict Angle....85
Figure 97. Illustration. Clock Angle 86

INTRODUCTION

The Surrogate Safety Assessment Model (SSAM) is a software application designed to perform statistical analysis of vehicle trajectory data output from microscopic traffic simulation models. The software computes a number of surrogate measures of safety for each conflict that is identified in the trajectory data and then computes summaries (mean, max, etc.) of each surrogate measure. This document explains the installation, configuration, and usage of the SSAM software, focusing primarily on the graphical user interface features. This chapter summarizes the organization of the document.

ORGANIZATION OF THE USER MANUAL

This document explains terms and definitions pertinent to the installation and operation of the SSAM software. The major chapters of the user manual are outlined as follows and are in chronological order.

Chapter 1. Installation

This section describes how to install the SSAM software using the automated SSAM installation program, *SSAMinstall.exe*. The section also describes how to uninstall the SSAM software.

Chapter 2. Graphical User Interface

This section describes how to use the graphical user interface of SSAM to perform conflict analysis on simulation trajectory data files. The **Analysis** section walks through an example to demonstrate the configuration and the usage of the available views and filters to analyze the simulation data. The **Usability** section reviews the Help menu, the different viewing options available in the SSAM software, and the functionality provided by the tool to export data from a SSAM case document to a .csv file, which can be viewed in Microsoft® Excel. The **Error Checking** section provides a description of some of the error checking performed on user input.

Appendix. Terms and Definitions

This section explains the terms and measures necessary to interpret the data viewed on the SSAM software screens.

CHAPTER 1. INSTALLATION

INSTALLING SSAM

The SSAM software may be installed using an available installation program, *SSAMinstall.exe*. This InstallShield™ icon is shown in figure 1.

Figure 1. Screen Capture. Installation Program, SSAMinstall.exe.

Double-click *SSAMinstall.exe* to bring up the InstallShield™ Wizard screen as seen in figure 2. At this point, the installer initializes itself and looks for a Java Virtual Machine (JVM) on the local machine. If a JVM is not found on the local machine, the installer will install the appropriate JVM. The SSAM software has been developed and tested for Windows XP; however, it was built with Java technology and other platforms may be supported in the future.

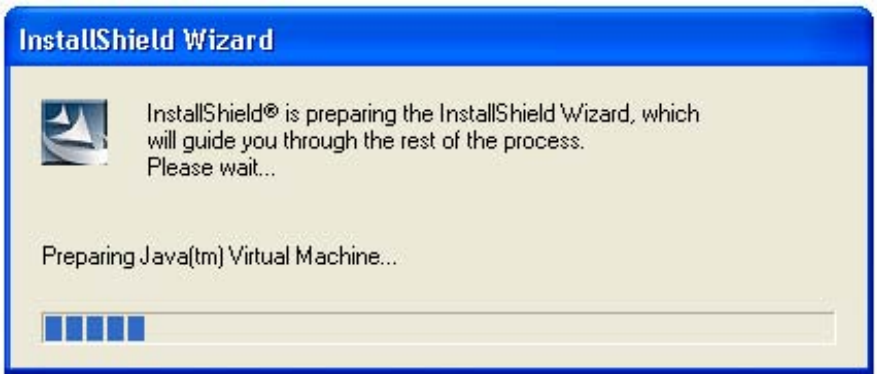


Figure 2. Screen Capture. InstallShield Wizard Screen.

Once the installer initializes and installs the JVM on the local machine, it brings up the Welcome screen as shown in figure 3. Click **Next** to continue installation of the SSAM software.

Figure 3. Screen Capture. Installer Screen—InstallShield Welcome Screen.

Click **Next** to bring up the screen shown in figure 4.

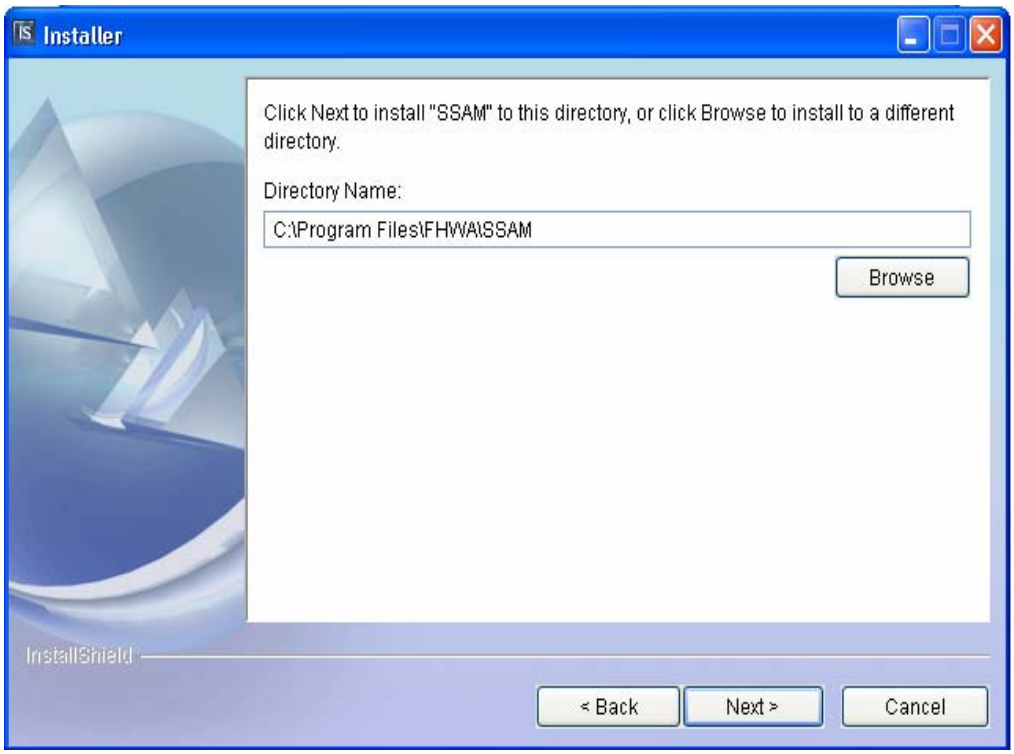


Figure 4. Screen Capture. Installer Screen—Directory Name.

As seen in figure 4, the installer will install the *SSAM.exe* file in the *C:\ProgramsFiles\FHWA\SSAM* directory by default. The user can choose to install the SSAM software in a different path by clicking **Browse**. Click **Next** to bring up the window seen in figure 5.

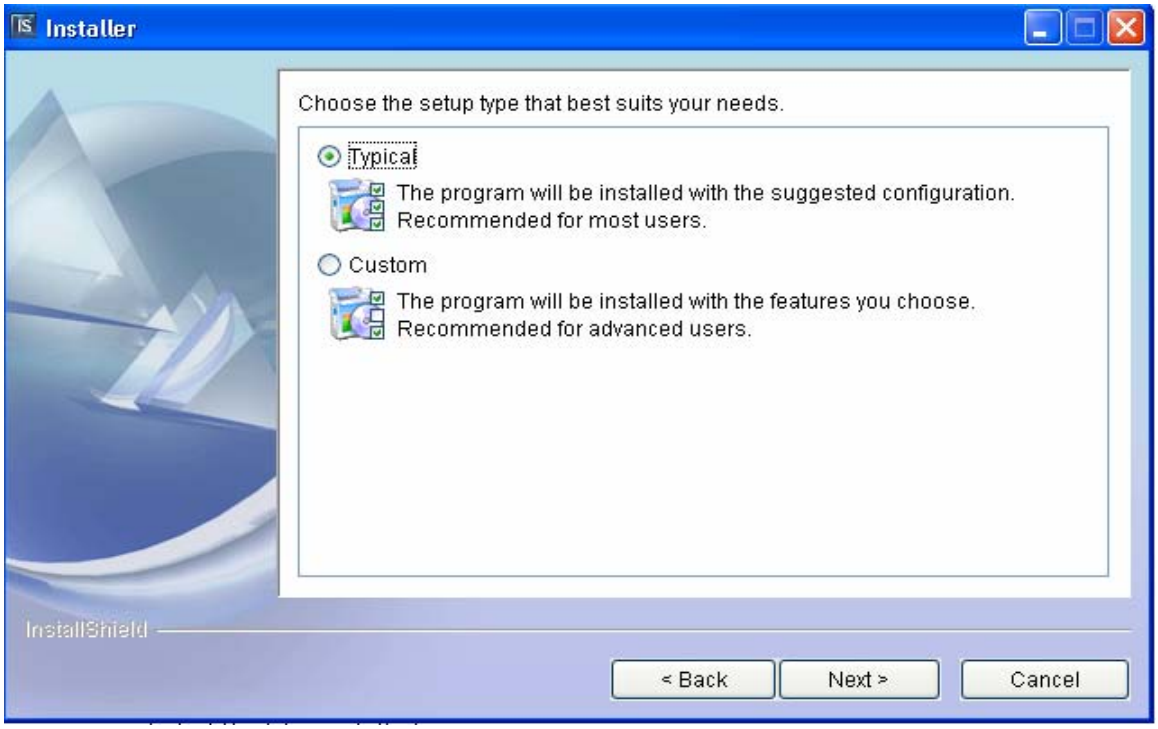


Figure 5. Screen Capture. Installer Screen—Option Choices Typical or Custom.

As seen in figure 5, the installer gives the user the option of either a typical or a custom install. In a typical install, the user does not have the option of selecting software features to be installed. In the case of SSAM, all the functionality is bundled into a single feature. As a result, choosing the custom installation is not necessary. Figure 6 shows the screen when the user selects the typical install option and figure 7 shows the screen when the user selects the custom install option.

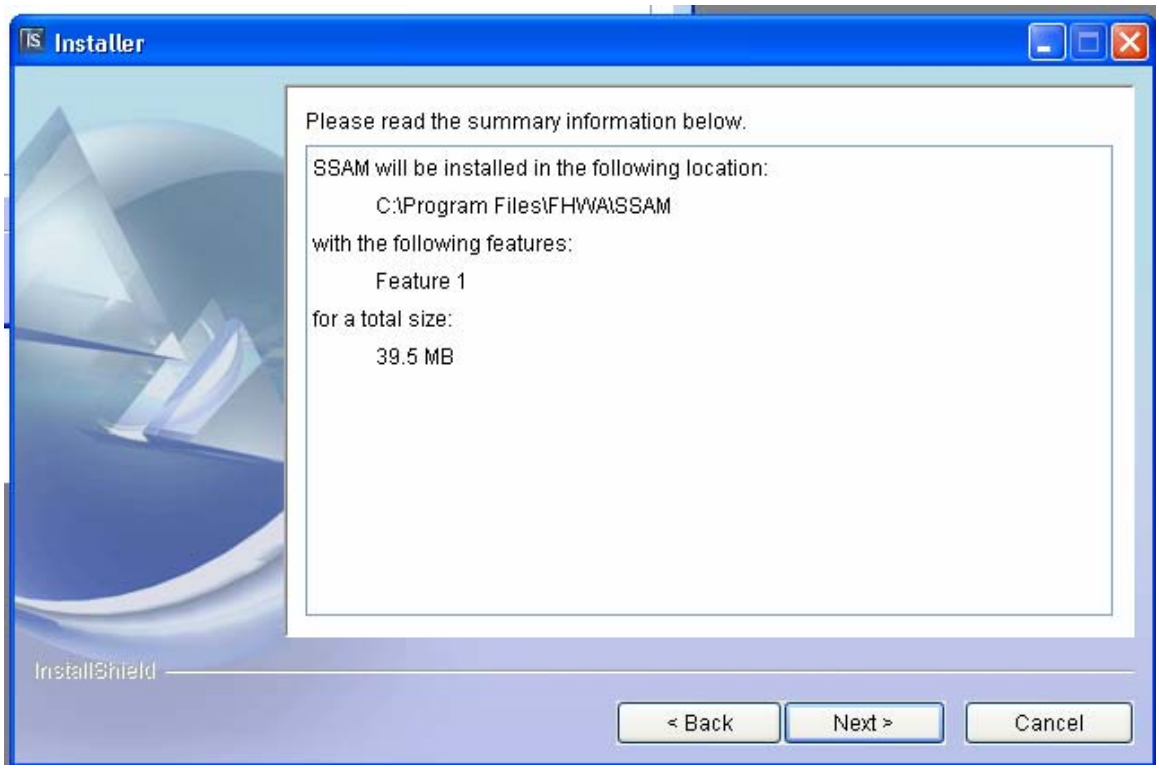


Figure 6. Screen Capture. Installer Screen—Typical Installation Option.

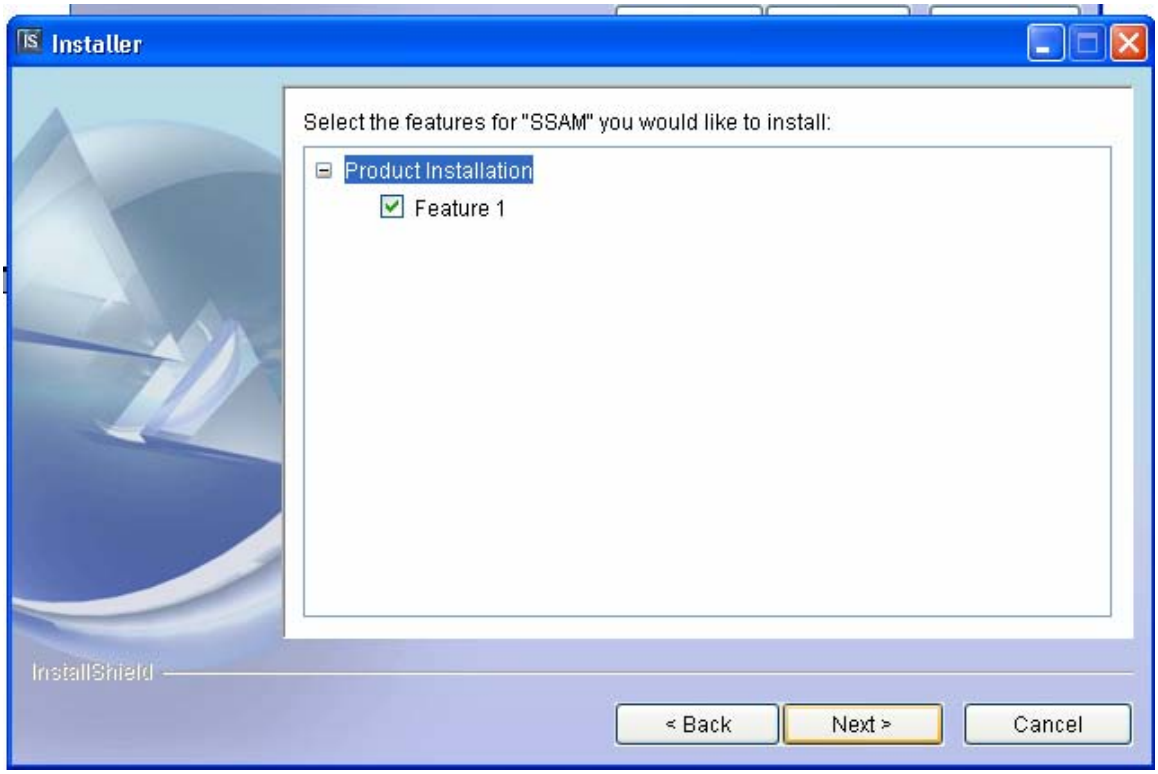


Figure 7. Screen Capture. Installer Screen—Custom Installation Option.

Click **Next** to proceed with the installation of the SSAM software. The installer will install the SSAM software on the local machine. Figure 8 shows the screen displayed as the installation process is being carried out.

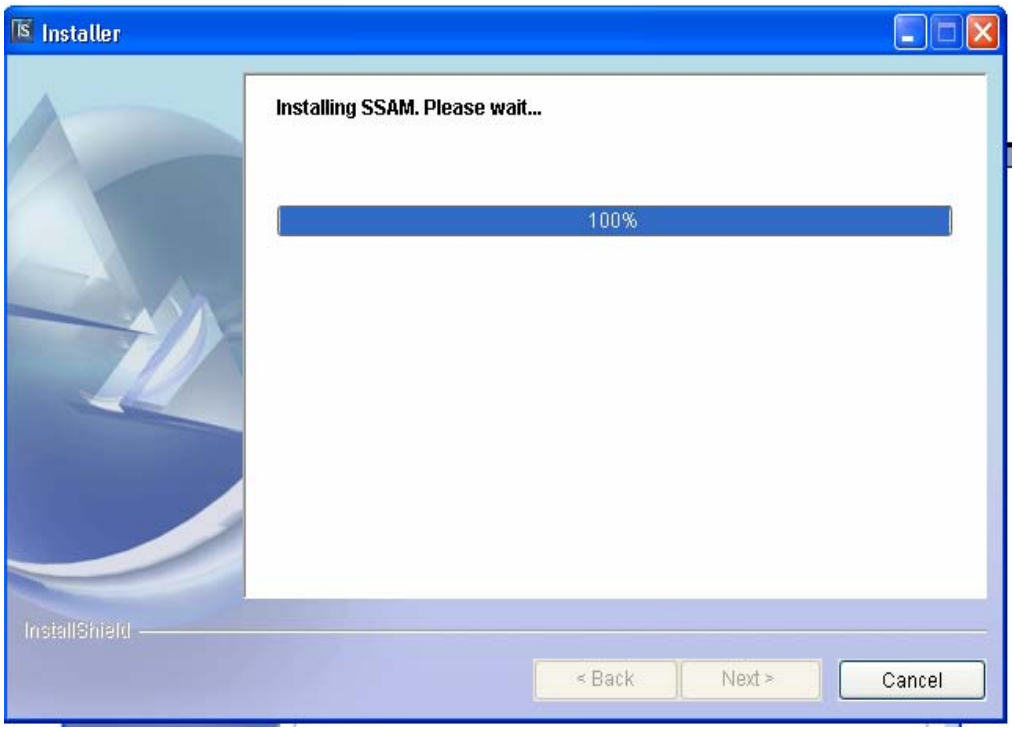


Figure 8. Screen Capture. Installer Screen—Installation Process.

Figure 9 shows the screen displayed when the installation is successful.

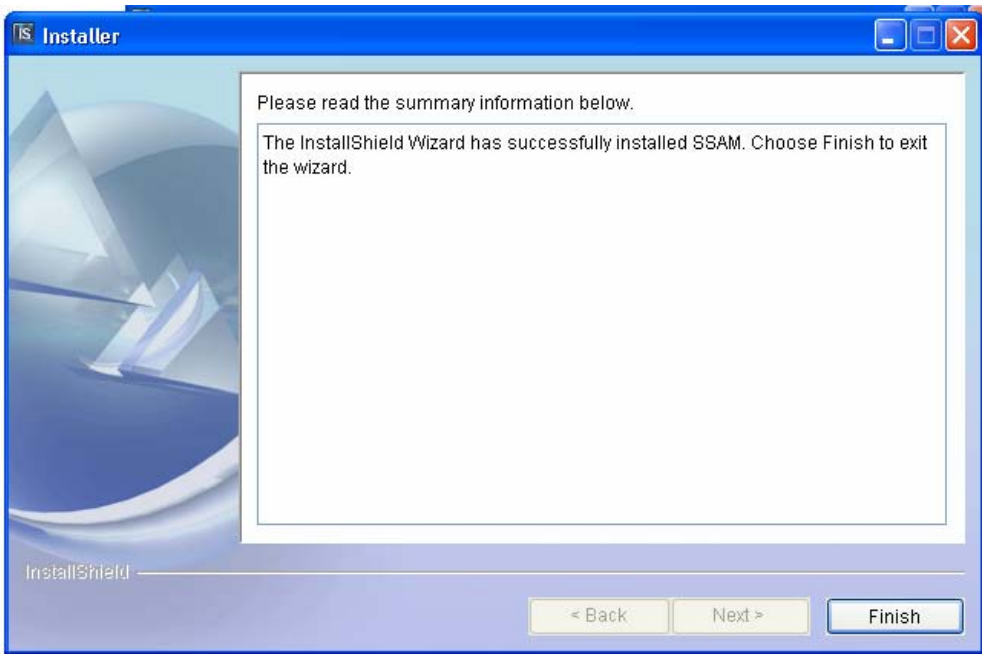


Figure 9. Screen Capture. Installer Screen—Installation Complete.

Click **Finish** to complete the installation of the SSAM software. A shortcut to the *SSAM.exe* file is created in the **Programs** menu. Figure 10 shows where the SSAM launcher and the SSAM uninstaller are installed. There is no need for the user to reboot the computer to begin using SSAM.

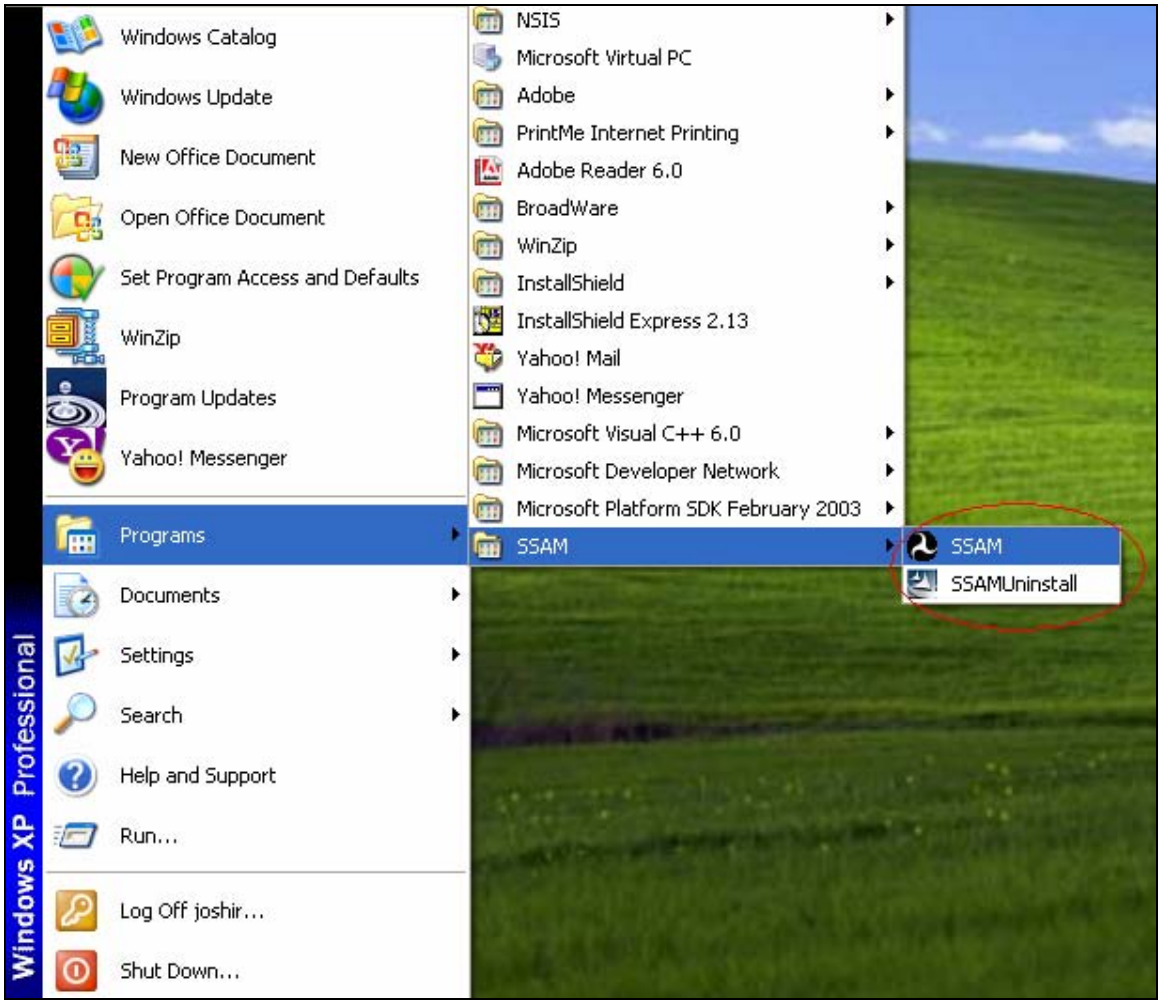


Figure 10. Screen Capture. Location of Installed SSAM Launcher and SSAM Uninstaller.

UNINSTALLING SSAM

To uninstall the SSAM software, click on **SSAM Uninstall** in the **Programs** menu as seen in figure 10. The uninstaller will begin to initialize and bring up the screen shown in figure 11.

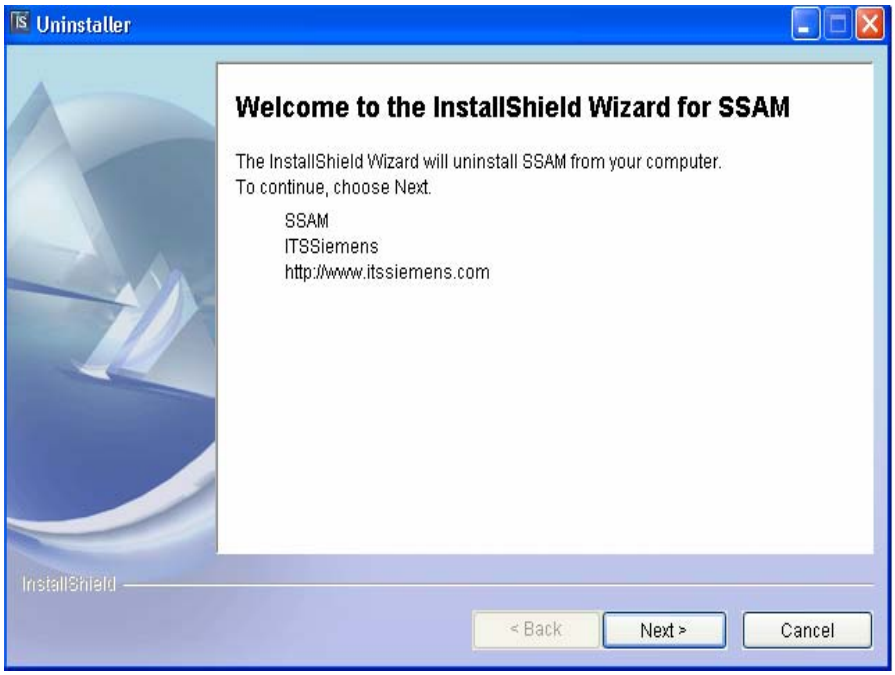


Figure 11. Screen Capture. Uninstaller Screen—InstallShield Welcome Screen.

As seen in figure 12, the installer informs the user that the SSAM software will be uninstalled from the local machine. Click **Next** to bring up the screen shown in figure 13.

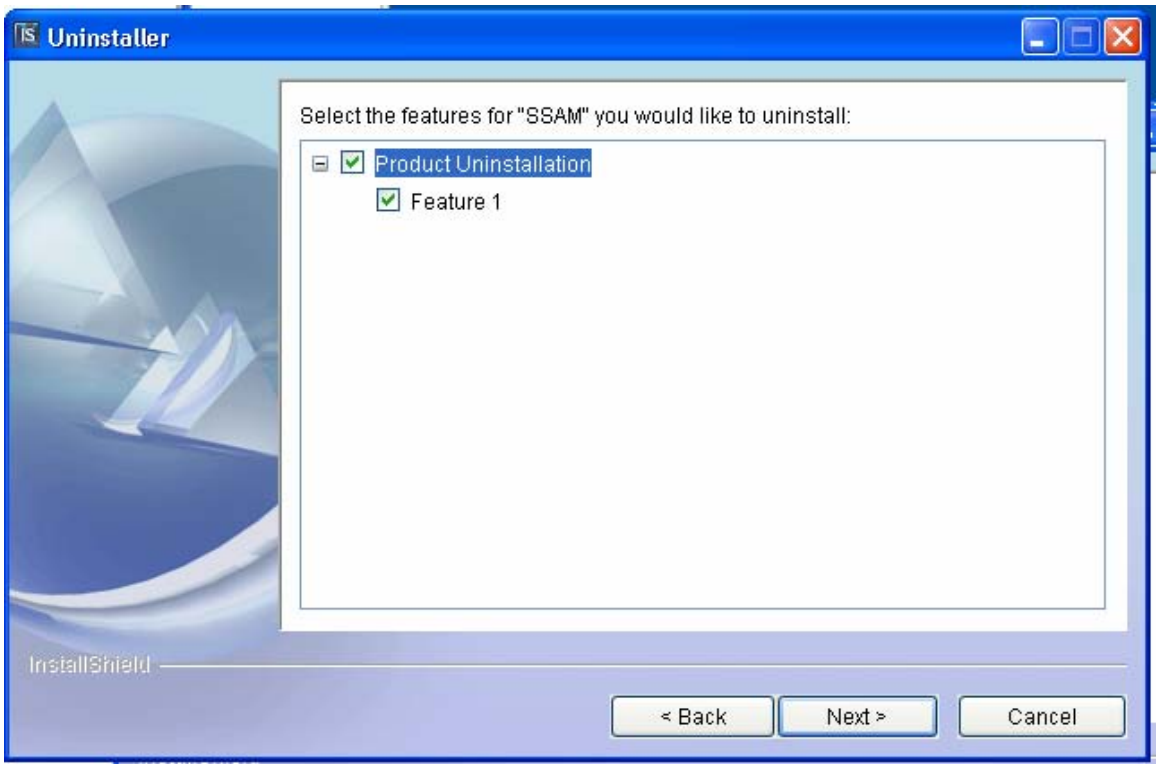


Figure 12. Screen Capture. Uninstaller Screen—Product Uninstallation Features.

As mentioned previously, all the functionality of the SSAM software is bundled in one feature. Uninstalling SSAM implies that the *Full SSAM application* must be uninstalled. Figure 12 shows that the uninstaller will remove this installed feature from the local machine. Click **Next** to bring up the screen shown in figure 13.

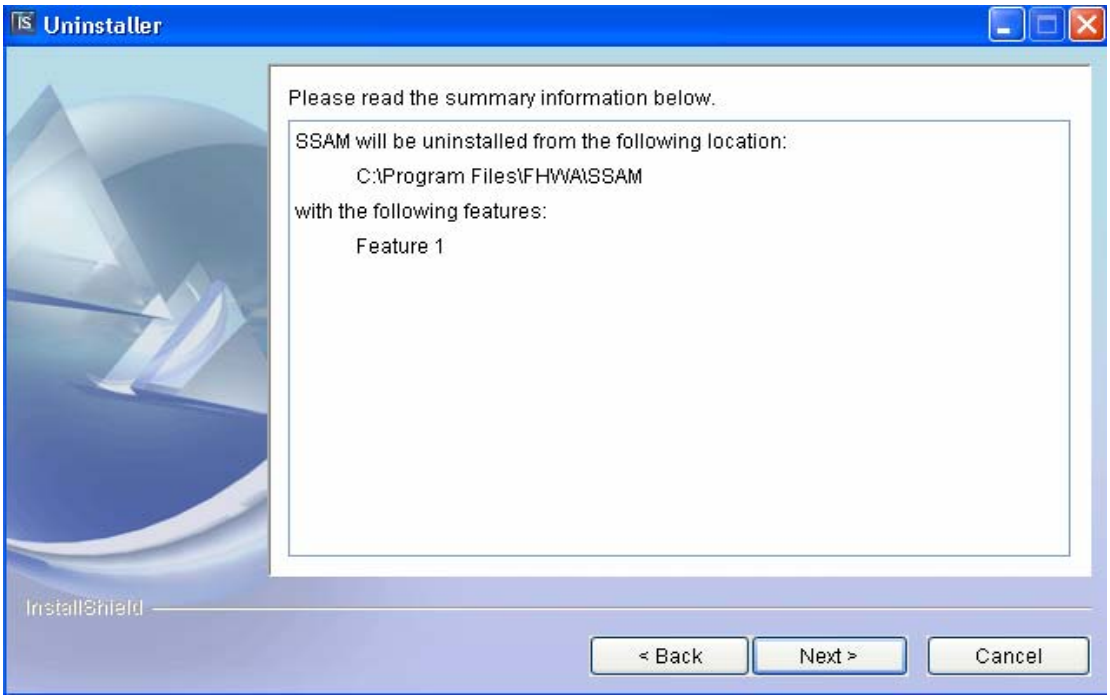


Figure 13. Screen Capture. Uninstaller Screen—Uninstalling from Local Machine.

This screen informs the user that the SSAM software is about to be uninstalled from the local machine. Click **Next** to instantaneously uninstall the SSAM software from the machine and bring up a screen that tells the user that the uninstall process is complete. This screen is shown in figure 14.

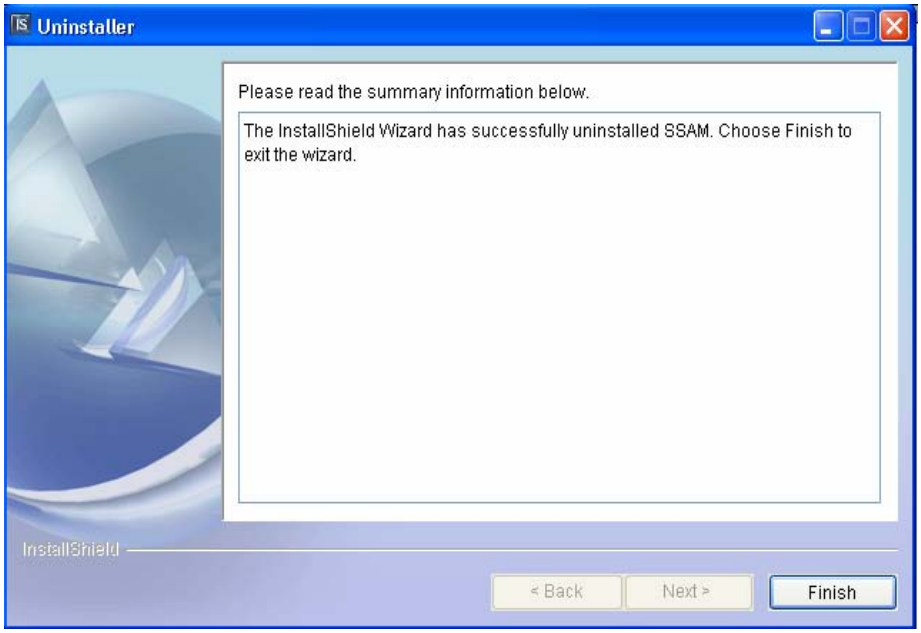


Figure 14. Screen Capture. Uninstaller Screen—Uninstall Process Complete.

Click **Finish** to complete the process. None of the SSAM options will appear in the **Programs** menu after the uninstall process is complete.

LAUNCHING THE SSAM SOFTWARE

Click the SSAM icon shown in figure 10 to start the SSAM software. Figure 15 shows the screen when SSAM is started for the first time after installation.

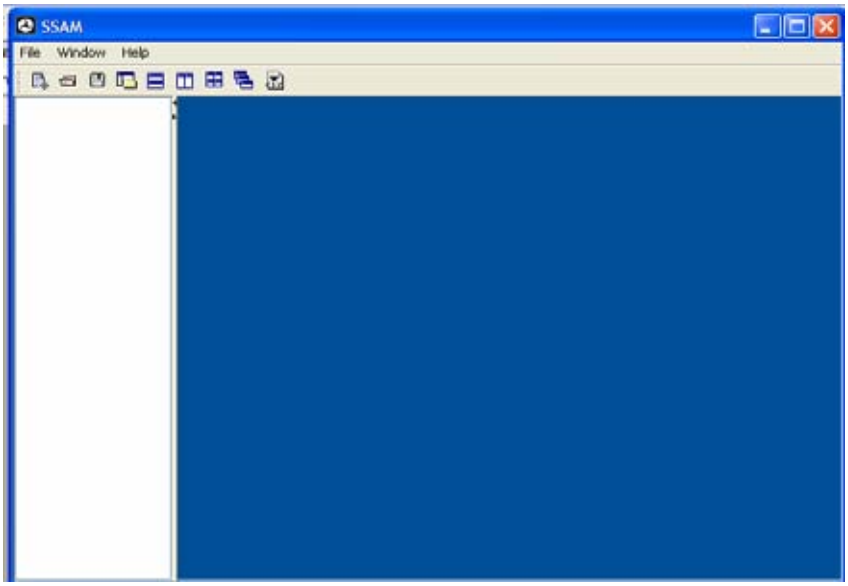


Figure 15. Screen Capture. SSAM—Beginning Screen.

CHAPTER 2. GRAPHICAL USER INTERFACE

This section of the user manual is divided into the following subsections:

1. INTRODUCTION

This subsection provides a general description of the menus, menu items, toolbars, and screens available in SSAM.

2 .CONFIGURATION

This subsection describes how to use the configuration screen so that SSAM can process the required data files to extract information based on user-defined parameters.

3. ANALYSIS

This subsection gives an overview of the conflict and summary screens. It also describes how the filter provided by SSAM can be used to view all or some of the processed data in the conflict and summary screens.

4. USABILITY

This subsection explains how multiple files can be saved and viewed using the menus and menu items provided by SSAM. This section also describes how the software can be used to export data from a case document to a .csv file viewable in Microsoft® Excel.

INTRODUCTION

Figure 16 is a screen shot of the SSAM software when it is started for the first time after installation.

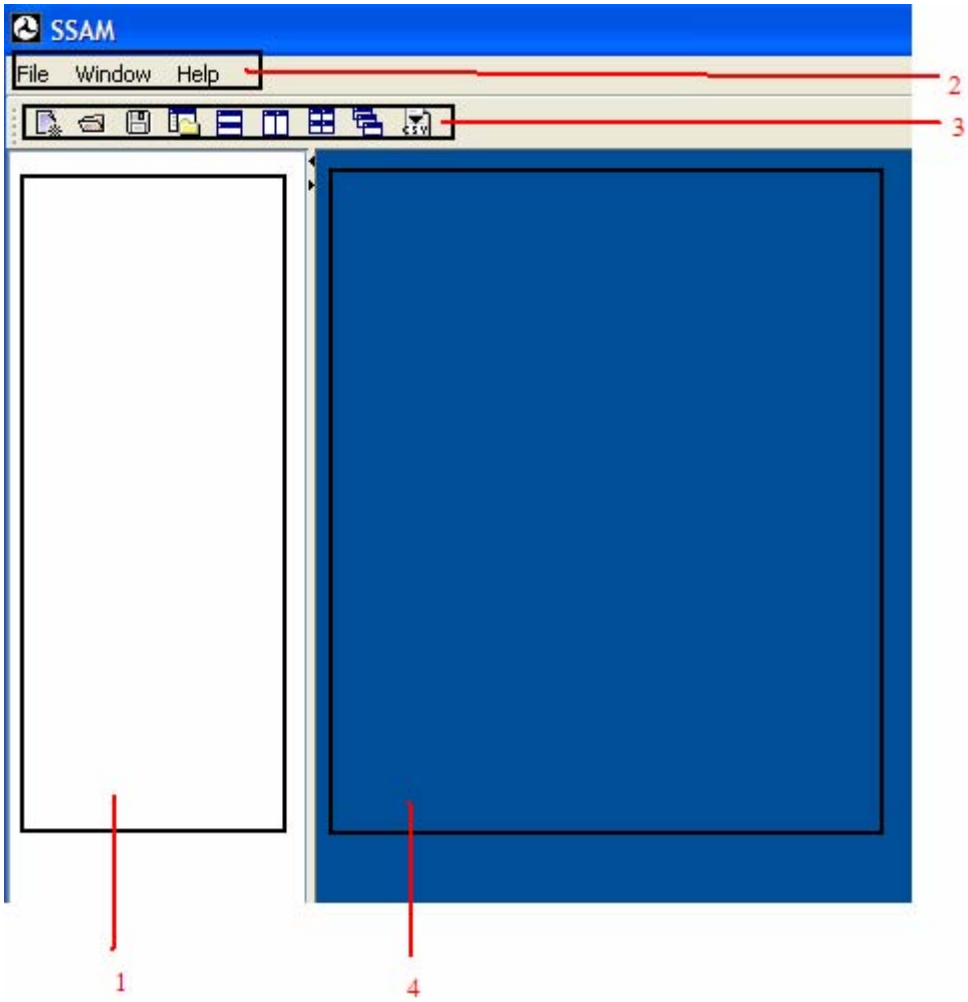


Figure 16. Screen Capture. SSAM Screen—Beginning Screen with Callouts.

As seen in figure 16, the graphical user interface can be divided into the following four main parts:

1. Case document viewer

This part of the screen is used to view the data related to the selected case document or trajectory file.

A case document is selected by double-clicking on the case document in the case document viewer.

2. Menus

This part of the tool is used to save, open, view, and export case documents. It also contains the **Help** menu.

3. The toolbar area

This part contains buttons to save, open, view, and export case documents.

4. The internal frame

This part contains six tabs. These tabs will be viewable in the internal frame when a case document is created. The available tabs are summarized as follows:

- Configuration screen: This screen is used to load data files to be analyzed. It provides the user with the ability to save information about the analysis, such as the name and description. The configuration screen also allows the user to set certain threshold values based on which tool will process the data in the selected .trj files. The **Configuration** tab is selected by default.

- Conflict screen: To view this screen, click the **Conflict** tab. The screen contains a view of the conflict data extracted from the .trj files in a table shown in a scrollable window. Details of what the data in each column and row represent are defined in the Terms and Definitions section of this document.

- Summary screen: Click the **Summary** tab to bring up the Summary table view which provides a statistical summary of the data viewed in the **Conflict** tab. The details of what each column and row represent are defined later in this manual.

- Filter screen: Click the **Filter** tab to bring up a screen which can be used to filter data viewed in the **Conflict** and **Summary** tabs. Parameters for viewing include threshold values, location, and types of conflicts. Details on use of the filter screen buttons are described later in this manual.

- T-test screen: Click the **T-test** tab to bring up a screen that enables the user to perform t-test analysis between the selected case file and a newly added case file. This screen allows the user to export the *t* statistics results about the analysis. Details on use of the t-test screen are described later in this manual.

- Map screen: The current version of the SSAM software does not include the map feature. The **Map** tab does not contain any functionality or data at this time.

Figure 17 labels the buttons available in the toolbar section.

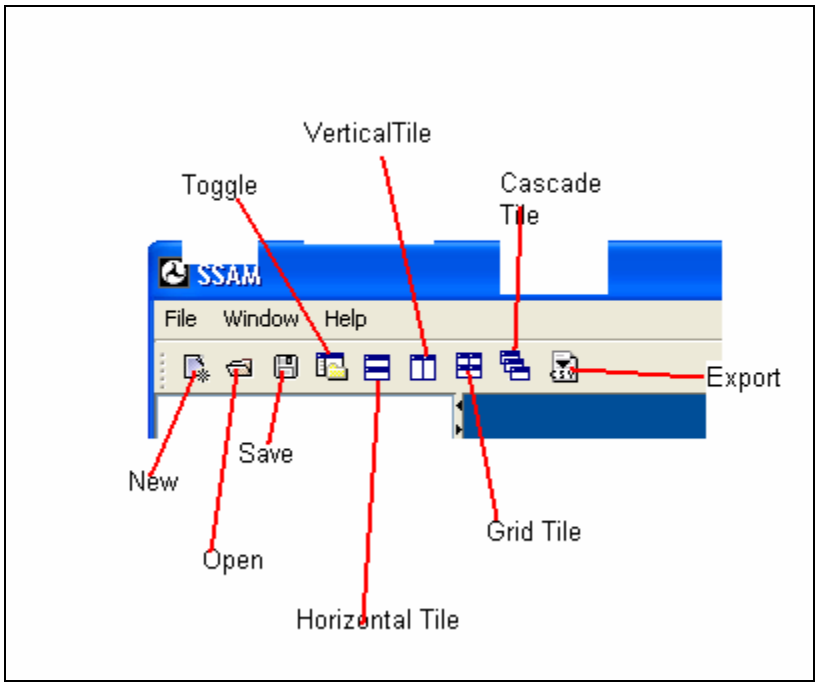


Figure 17. Screen Capture. SSAM Screen—Toolbar Section Buttons.

As seen in figure 17, the toolbar section of the tool includes the following buttons:

- *New:* Click to create a new case document.
- *Open:* Click to open an existing case document.
- *Save:* Click to save the case document.
- *Toggle:* Click to display or hide the left-hand side case document view.
- *Horizontal tile:* Click to tile the case documents in the internal frame horizontally.
- *Vertical tile:* Click to tile the case documents vertically in the internal frame.
- *Grid tile:* Click to organize the case documents in the internal frame in a gird.
- *Cascade tile:* Click to see a cascade view of the case documents.
- *Export*: Click to export the case document's conflict data to a .csv file.

Figure 18 and figure 19 show options available through the **File** menu and **Window** menu, respectively.

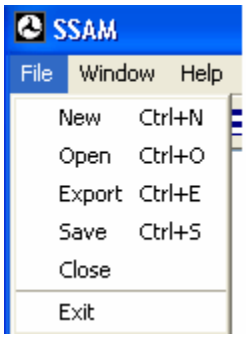


Figure 18. Screen Capture. SSAM Screen—File Menu.

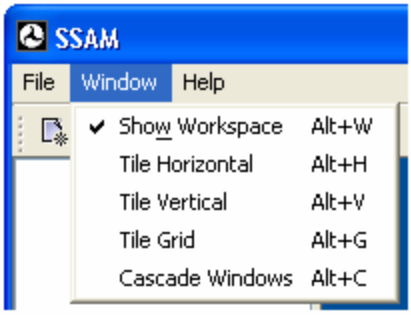


Figure 19. Screen Capture. SSAM Screen—Window Menu.

CONFIGURATION

If SSAM was used previously to perform analysis and the data was saved, a list of the saved case documents will display in the case document viewer.

Creating a New Case Document

This section walks through the steps of creating a new SSAM case document. This presentation assumes that SSAM has been started for the first time and does not contain a list of case documents in the case document viewer. To create a new SSAM case document, point to **New** in the **File** menu or click **New** in the toolbar. This will bring up the file selection window where the user can type in the desired file/case name. Figure 20 shows the user interface after creating a new case document.

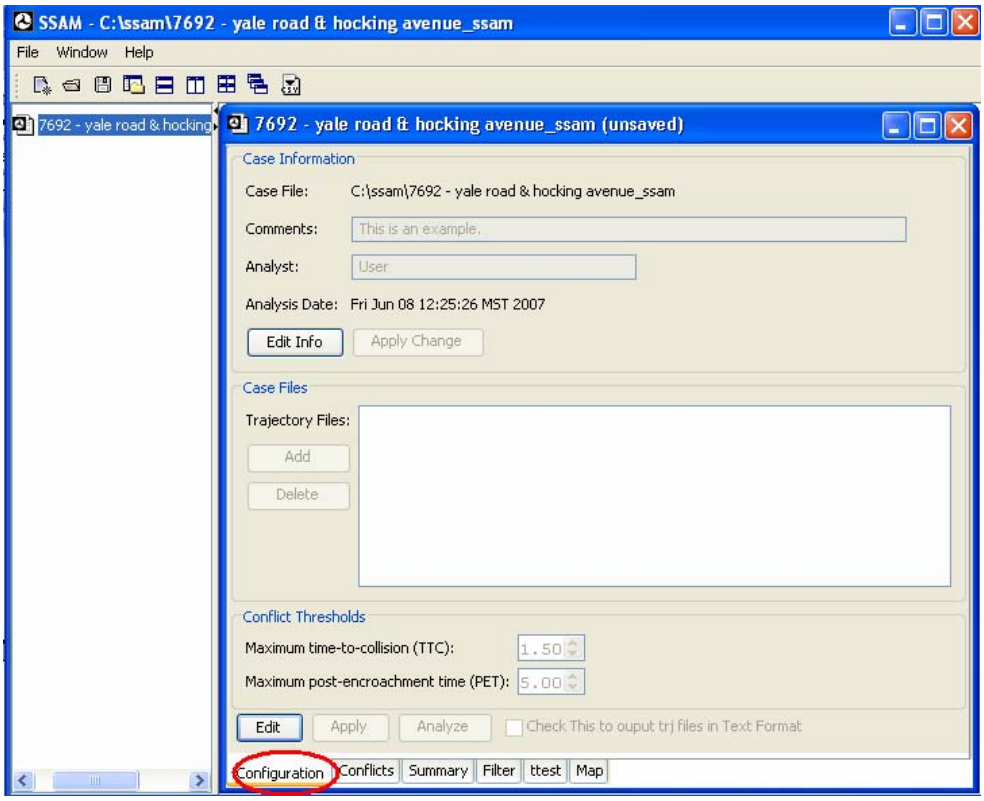


Figure 20. Screen Capture. SSAM Screen—Configuration Tab.

The case document *7692 yale road & hocking avenue_ssam* appears in the case document viewer. The **Configuration** tab is selected by default in the internal frame.

As seen in figure 20, the **Configuration** tab displays the following information:

- *Case Information*

  Case File: This is the name of the case file including the full path of the file.

Comments: This information can be edited by the user to save certain comments associated with the case document.

Analyst: The name of the user analyzing the data can be entered in this field.

Analysis Date: This field is updated automatically when the document is saved.

- *Case Files*

  This section is used to load .trj files, which serve as input to the analysis process.

- *Conflict Thresholds*

  This section allows the user to set the Times to Collision (TTC) and Post Encroachment Time (PET) threshold values for the analysis process. For example, if the user sets the Maximum TTC value to 1.5, then the analysis will only yield conflict data that contains TTC values less than 1.5.

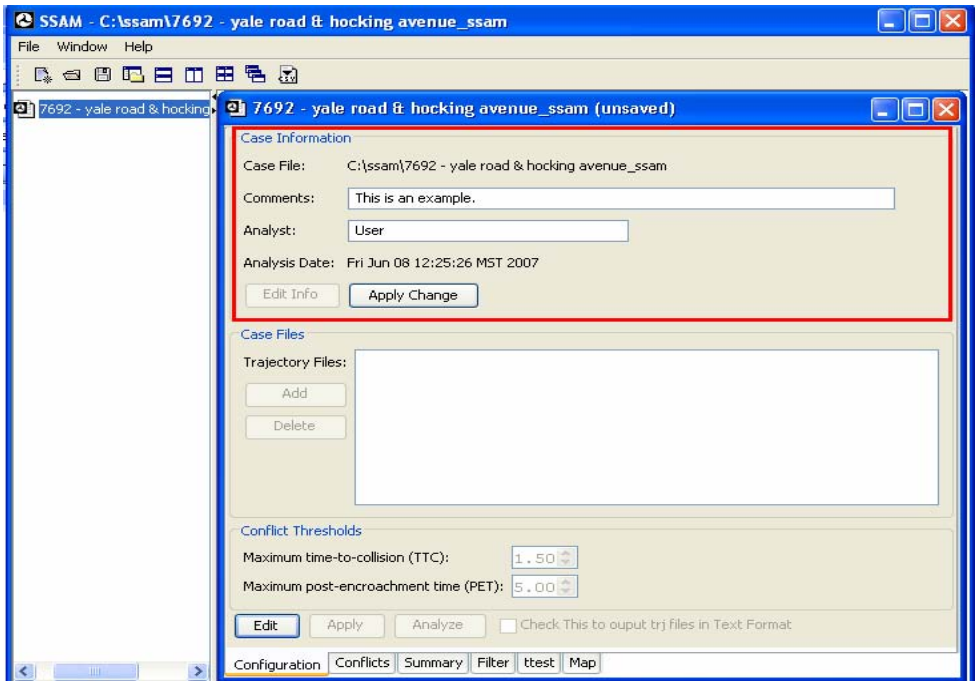


Figure 21. Screen capture. SSAM Screen—Configuration Tab Displaying Case Information.

Click **Edit Info** to change the case information. This will allow the text areas in the case file section to be edited and activate the apply change button. For example, figure 21 displays the following information:

- Comments: This is an example.
- Analyst: User.

To apply the change to the case information section, click **Apply Change**. This activates the **Edit** button and disables the text boxes as shown in figure 20. Note that this is not the same as saving the case document. The **Apply Change** button simply applies the changes to the **Configuration** tab of the internal frame so that case information exists on the screen even if the user switches tabs.

Adding Trajectory Files to a Case Document

Users can also select trajectory files that need to be analyzed. Click **Edit** to enable the case files in the threshold section of the **Configuration** tab. Figure 22 shows these fields activated.

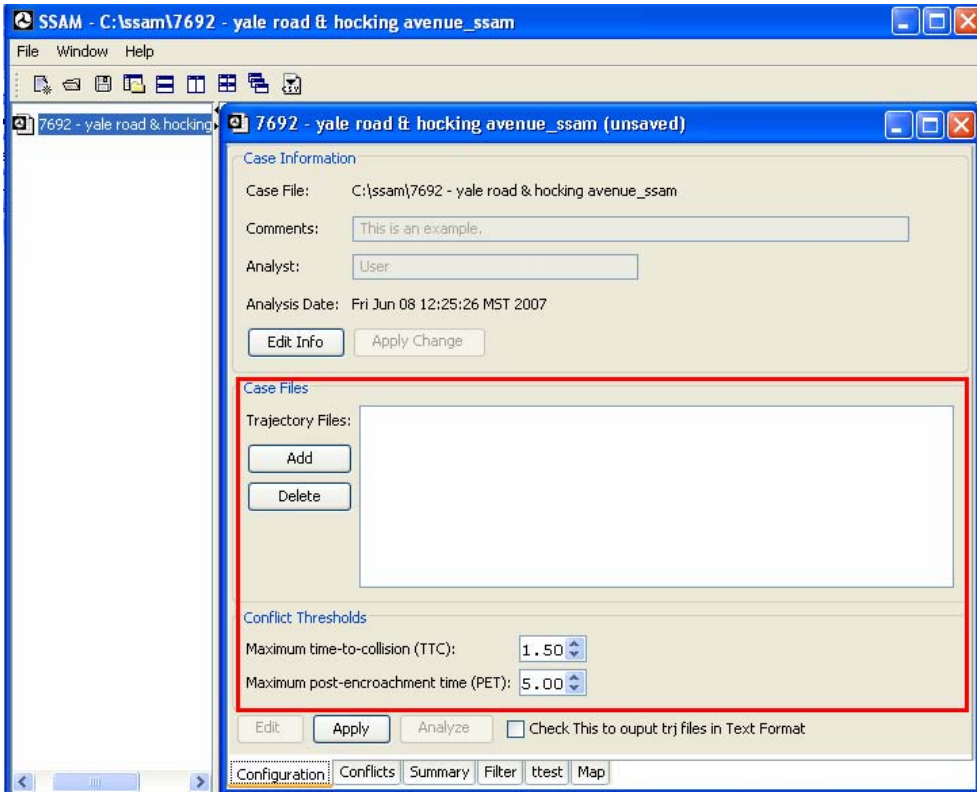


Figure 22. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files.

Clicking **Edit** enables the user to click **Apply** while the **Edit** and **Analyze** buttons are disabled. To add a trajectory file to the case document, click **Add**. This will bring up a file selection menu through which single or multiple files can be selected.

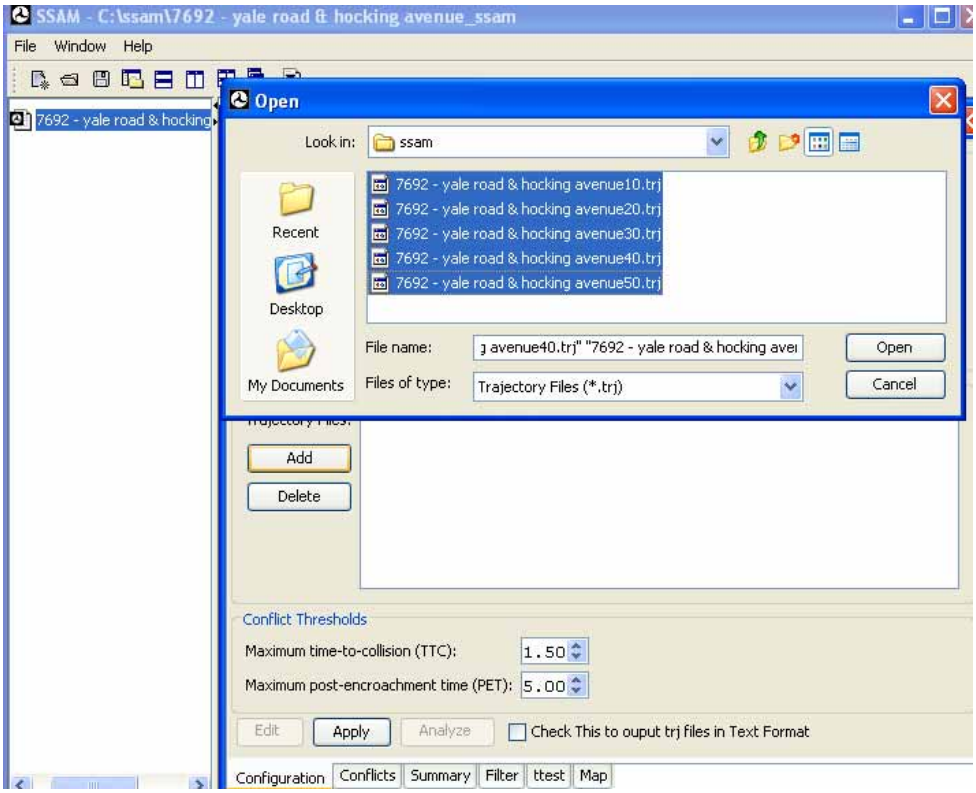


Figure 23. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: File Selection.

Figure 23 shows the file selection screen with multiple case files selected.

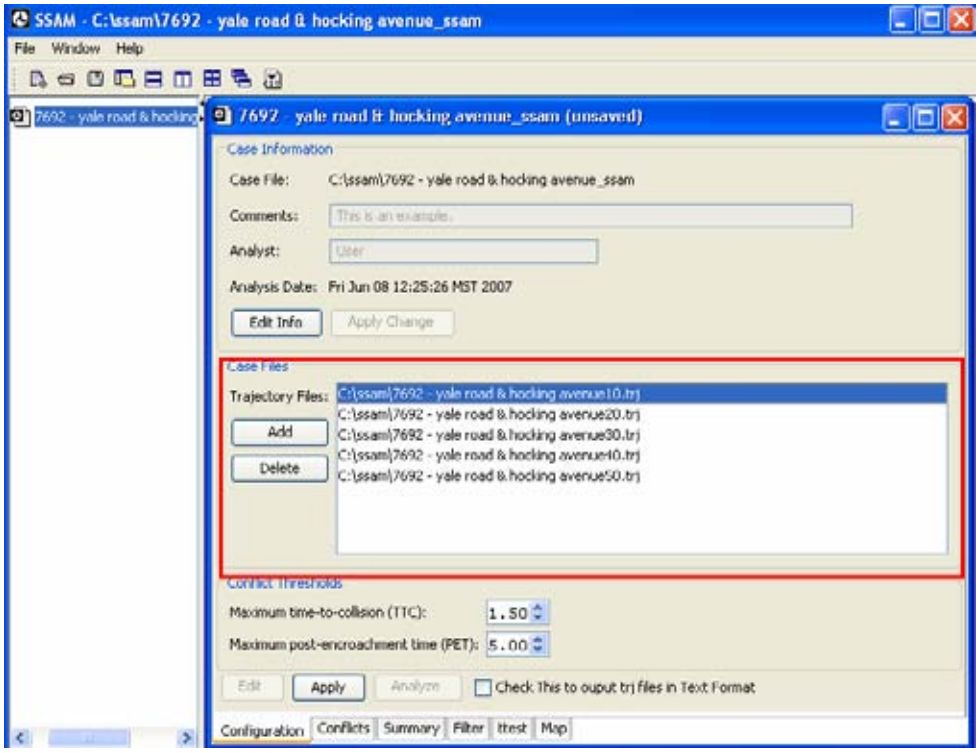


Figure 24. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Files Added.

Figure 24 shows five files added to the case files section. Note that the files selected have a .trj extension. In this example, default maximum TTC and maximum PET values in the Conflict Thresholds section are not changed.

Once the user has selected the case documents, changes can be applied to the case document. The user can click **Edit** again to add or delete any of the trajectory files in the case files section. Just as multiple files can be added, multiple files can be selected and deleted by clicking **Delete** in the case files section. Click **Apply** to activate the **Edit** and **Analyze** buttons as shown in figure 25.

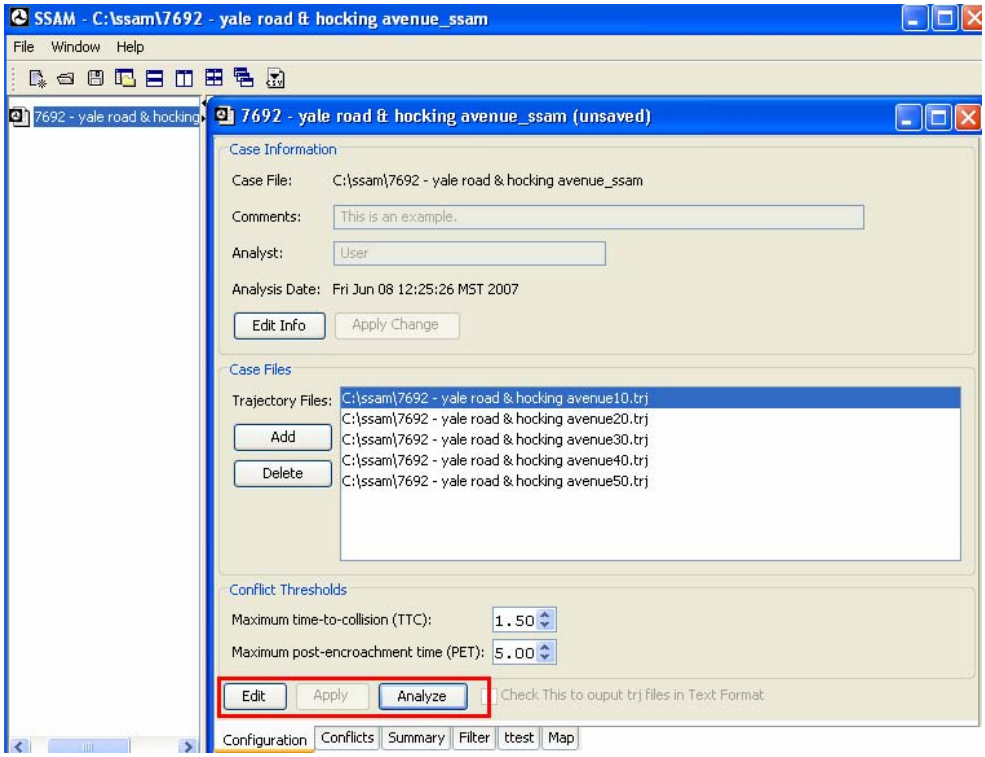


Figure 25. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Selection Applied.

Processing Trajectory Files

Click **Analyze** to start the analysis process. The SSAM software starts processing the data from each trajectory file to extract conflict data information from these files. The processing of trajectory files can take a long time depending on the size of each file and the number of trajectory files that need to be analyzed. The SSAM software presents the user with progress information about the processing of the trajectory files as shown in figure 26.

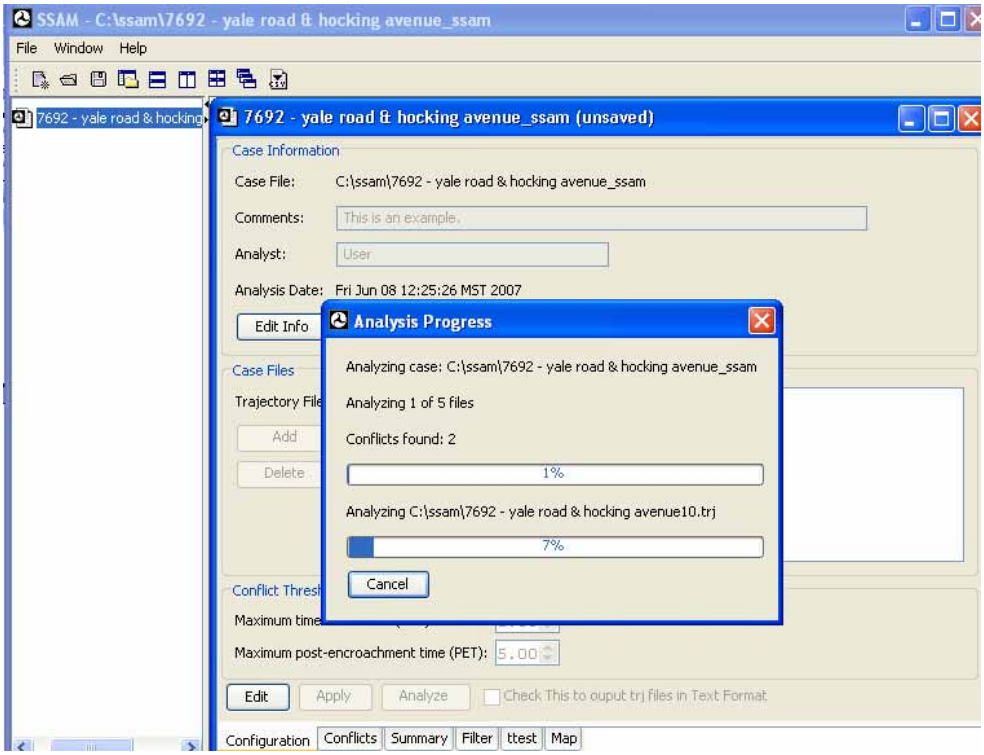


Figure 26. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Analysis Progress.

Clicking **Analyze** displays a window which shows progress information. In figure 26, 7 percent of the first file is complete and 1 percent of the total processing is done. This screen prevents the user from selecting any other options except **Cancel**. The screen provides the user with an option of canceling the entire analysis request. After the processing is complete, a message informs the user that the analysis process is finished without any errors. This can be seen in figure 27.

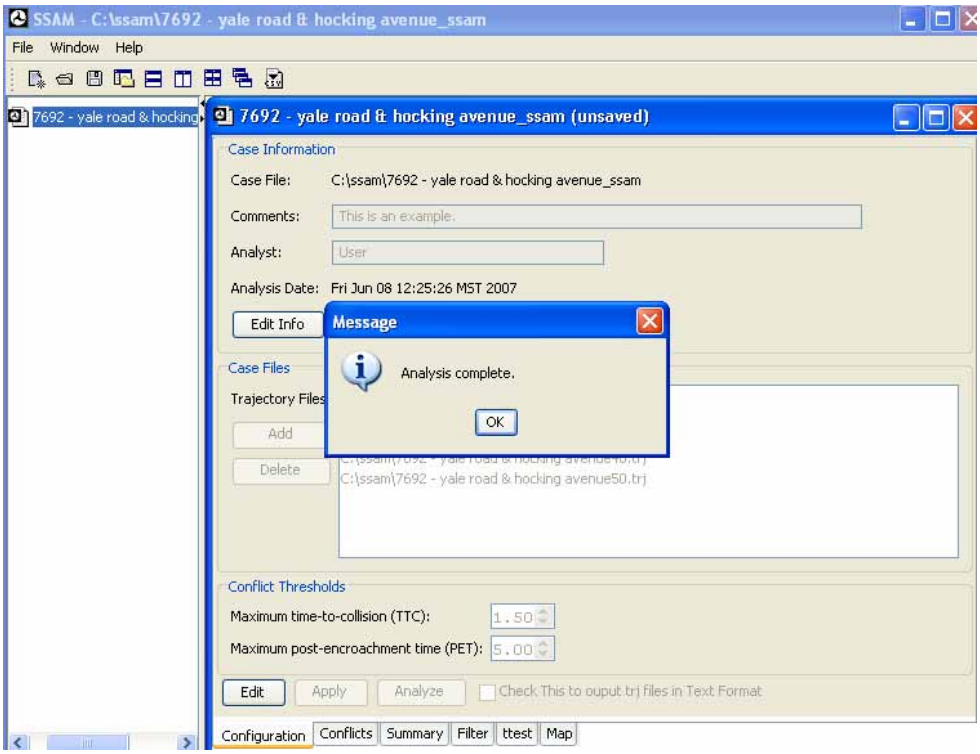


Figure 27. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Analysis Complete.

This message means that relevant conflict data can now be viewed in the **Conflict** tab of the internal frame. Internally, once the processing of the files is finished, the tool immediately starts calculating summaries, which can be viewed in the **Summary** tab of the internal frame. The software then informs the user that the summaries have been calculated, as seen in figure 28.

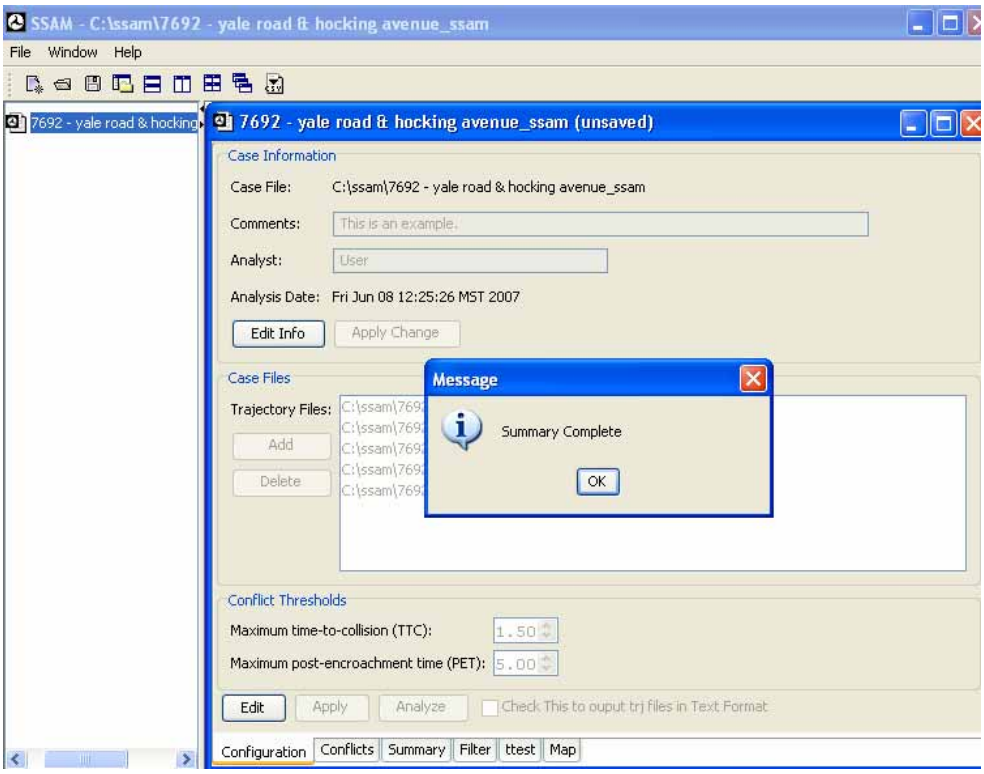


Figure 28. Screen Capture. SSAM Screen—Configuration Tab Displaying Case Files: Summary Complete.

The user is now ready to analyze the conflict and summary data obtained from the trajectory files. The next section of this manual covers the **Conflict**, **Summary**, and **Filter** tabs of the internal frame which help the user analyze the output conflict data populated by the SSAM software.

ANALYSIS

The analysis portion of the SSAM software allows users to filter conflicts, graphically visualize the conflicts within VISSIM .inp files, export maps, and perform t-tests between alternative case studies.

Note on Units of Analysis

SSAM does not allow user selection of the units of display and will perform no conversions (e.g., from metric to English or vice-versa). All values are interpreted and displayed in the units specified in the .trj files processed by SSAM. Some simulation vendors allow users to specify the units used in their simulation as metric or English; however, note that the units specified in the simulation may or may not affect the trajectory file output.[1]

Using the Conflict Tab

Figure 29 shows the **Conflict** tab after the tool is done analyzing the trajectory files. Notice that the first row of the conflict tab displays, "NO FILTER APPLIED." This means that the data shown is a complete result set obtained from processing trajectory files.

[1] Some issues with proper specification of units have been noted in certain versions of VISSIM (version 4 series), in which case use of metric units is suggested with version 4 to avoid potential issues.

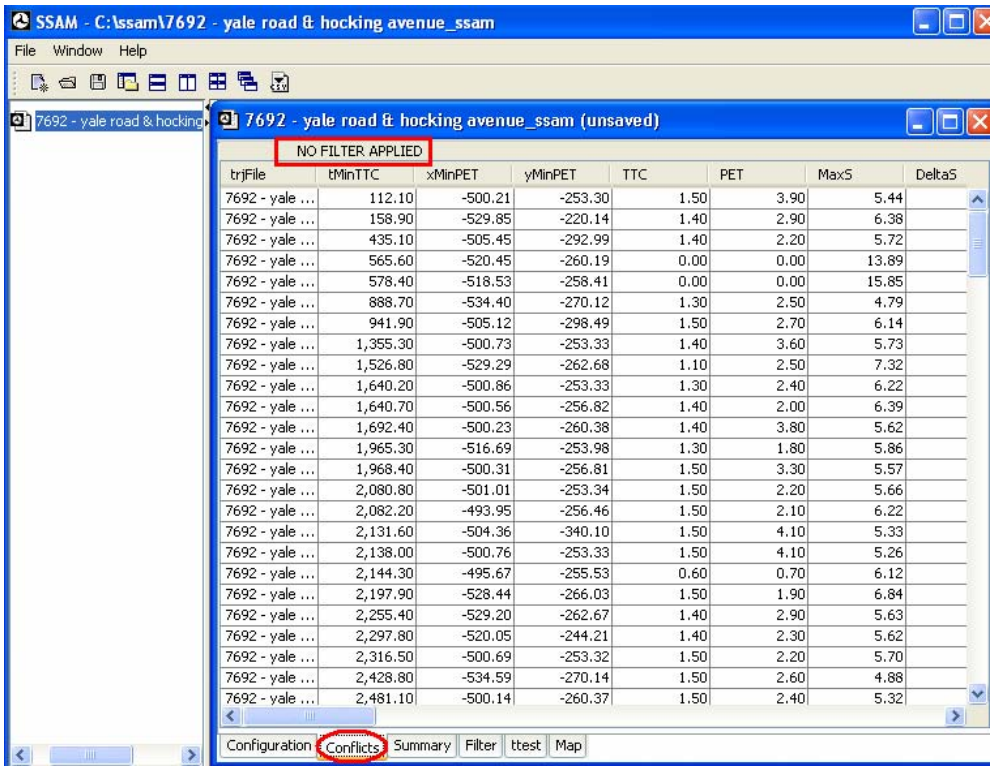


Figure 29. Screen Capture. SSAM Screen—Conflict Tab.

The **Conflict** tab displays a table in which each row represents a conflict and each column represents certain information about that conflict. There are a total of 40 columns. As seen in figure 29, the **Conflict** tab provides a scrollable view of the conflict data. The size of each column can be adjusted. View the Terms and Definitions section of this document for a description of each column in the conflict table. Users can sort data by column in the **Conflict** tab by clicking the column header.

Using the Summary Tab

Figure 30 shows the **Summary** tab after the tool has analyzed the trajectory files. Notice that the first row of the **Summary** tab displays, "NO FILTER APPLIED."

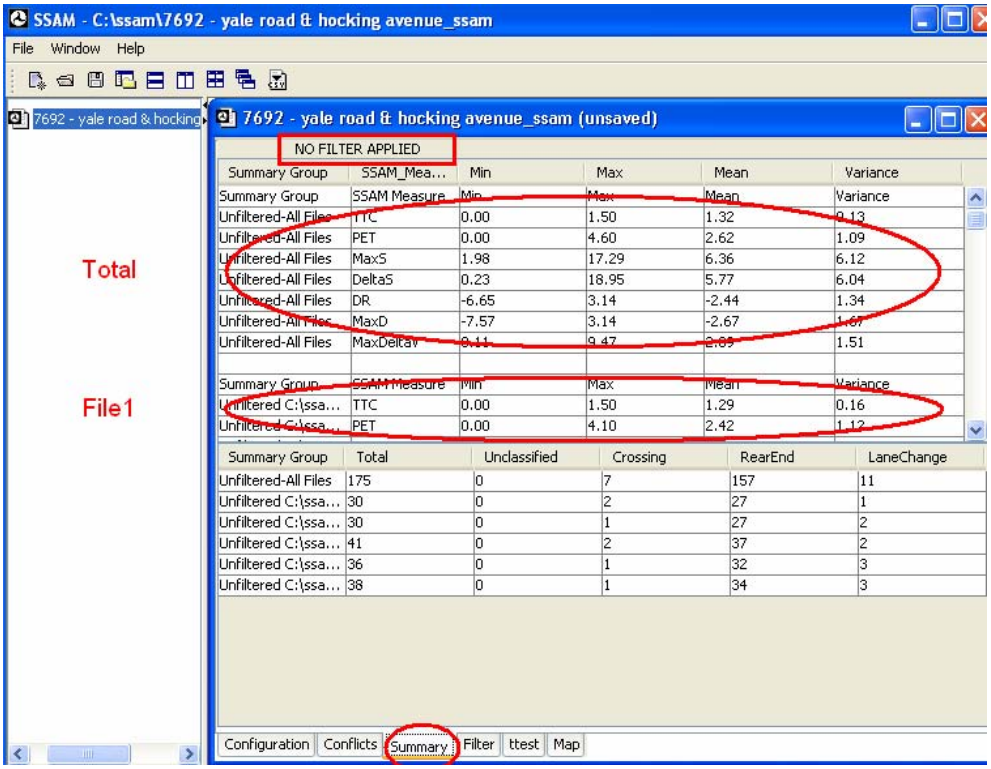


Figure 30. Screen capture. SSAM Screen—Summary Tab.

The data shown is a summary of the unfiltered conflict data in the **Conflict** tab. The **Summary** tab contains two tables. The first table provides a statistical summary of conflict data magnitudes, while the second table provides a summary of the total number of conflicts and the total number of conflict for each type seen in the **Conflict** tab. The first table provides statistical data on the following SSAM measures, which are defined in the appendix:

- TTC.
- PET.
- MaxS.
- MaxD (Maximum deceleration).
- DeltaS (Speed difference).
- DR.

- MaxDeltaV.

The statistical data is provided in terms of the minimum, maximum, mean, and variance of each of the above stated SSAM measures.

The second table provides a summary of the total number of conflicts broken down by type of conflicts. The four types of conflicts are

- Unclassified.
- Crossing.
- Rear-end.
- Lane-change.

The logic to classify conflicts into these types is summarized as follows:

A *conflict angle* is calculated for each pair of conflicting vehicles, based on the angle at which these vehicles converge to a hypothetical collision point. See the definition of *clock angle* in the appendix for more detailed definition. Very small (acute) angles indicate that the vehicles were on nearly the same trajectory (e.g., a rear-end event might have a conflict angle of 0 °), whereas large angles (plus or minus 180 ° being the largest) indicate that the two vehicle were on a head-on course. An angle of plus or minus 90 ° indicates two vehicles on perpendicular paths. The angle is expressed from the perspective of the first car to arrive at the collision point. Positive angles indicate the second vehicle is approaching from the right, and negative angles indicate the second vehicle is approaching from the left. Thus, the range of angles is from negative 180 ° to positive 180 °.

Conflicts classification is generally based on the conflict angle, although link and lane information may affect the classification. For example, if two vehicles have a conflict on the same link and lane, then the conflict is a rear-end event regardless of the conflict angle. If both vehicles are on the same link and one of the vehicles changes lanes, then it is a lane-change event regardless of the conflict angle. However, link and lane information is not used if (a) it is not provided in the trajectory file, (b) the vehicles are on differing links, or (c) either vehicle changed links over the course of the conflict event. In such cases, the conflict angle is used for classification as follows:

- Unclassified: Conflict angle unknown.
- Crossing: $|| \text{conflict angle} || > 85$ °.
- Rear-end: $|| \text{conflict angle} || < 30$ °.
- Lane-change: $30 \text{ °} \leq || \text{conflict angle} || \leq 85$ °.

The threshold angles (30 ° and 85 °) were determined by limited experimentation, though there are cases where classification is difficult. One such case involves a vehicle traveling in a traffic circle (within a roundabout) which crashes/conflicts with a vehicle entering the roundabout. Determining the appropriate type can be subjective if only one type can be selected. It is possible that these angle-thresholds will be exposed for user configuration in a future version of SSAM.

Notice that in figure 30 both tables provide a combined summary for all trajectory files as well as a break down of summaries by each trajectory file. These summaries are circled in figure 30. Unlike in the **Conflict** tab, data in the **Summary** tab cannot be sorted. The columns in the **Summary** tab can be resized and positioned differently.

Using the Filter Tab

Figure 30Figure 31 shows the **Filter** tab of the internal frame with default settings. Large amounts of data in the **Conflict** tab can make finding conflicts which have certain commonalities or follow a certain pattern difficult for the user. The **Filter** tab allows the user to filter the data in the **Conflict** tab using the five criteria shown in figure 31.

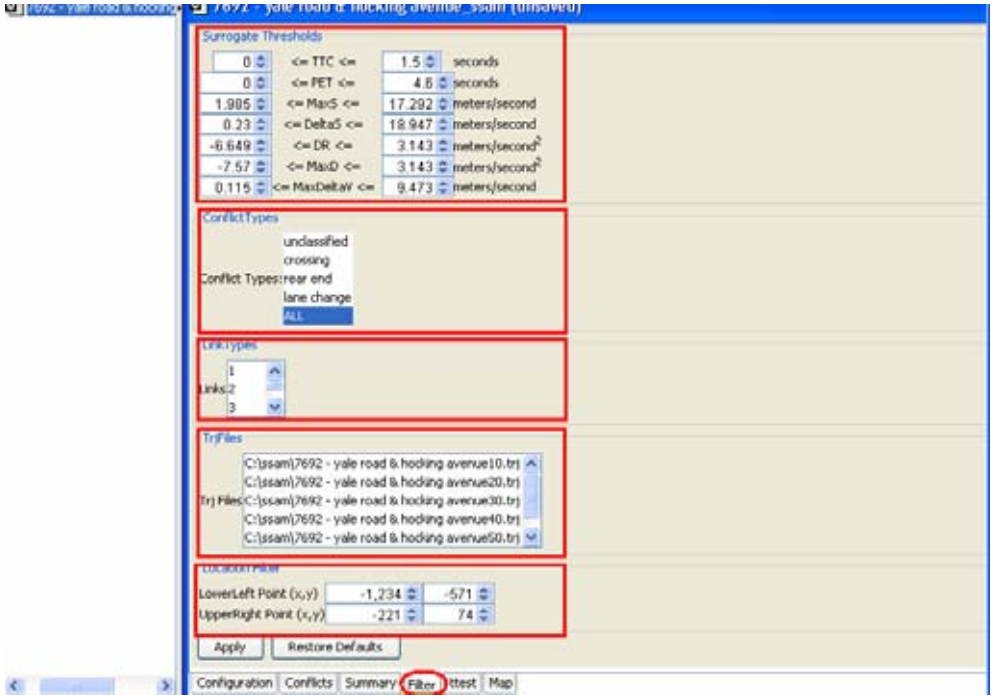


Figure 31. Screen Capture. SSAM Screen—Filter Tab with Default Settings.

- *Surrogate Thresholds*

  The user can specify a range of allowable values for each of several surrogate measures (e.g., TTC and PET) to filter out conflicts that do not fall in the specified ranges.

- *Conflict Types*

  The user can view conflicts by the type of conflict. The user can also select multiple conflicts in this list. The default filter is ALL, which means the user can view all types of conflicts.

- *Link Types*

  The user can filter conflicts by link number. The link list in the **Filter** tab is a scrollable list of all the links by which one can filter the conflict data. The default filter is ALL in this list. The user can select multiple links,

- *Trj Files*

  The user can filter conflicts by .trj files. All the .trj files that have been analyzed in the case documents are listed. The default filter is ALL, which means that the conflicts viewed by the user are extracted from all of the .trj files. The user can view conflicts extracted from any single or combination of .trj files by filtering in this area.

- *Location Filter*

  Each trajectory file is loaded along with coordinate information which defines the area within which the conflicts occur. The user can view conflicts in a given part of the map by defining this area by specifying the x and y coordinates of the lower-left and upper-right points of a rectangular region.

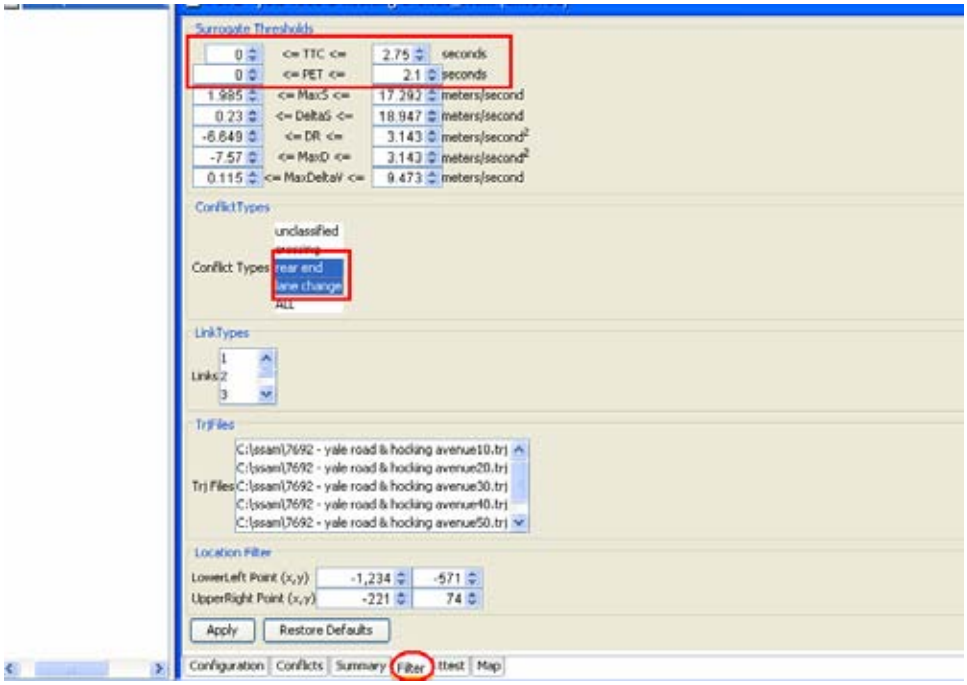


Figure 32. Screen capture. SSAM Screen—Filter Tab with Filter Settings.

Figure 32 displays the filter settings shown when the user chooses to view all the conflicts with

- A TTC value within the range of 0 and 2.75 seconds.
- A PET value within the range of 0 and 2.1 seconds.
- All the lane change and rear end conflicts.
- The rest of the filter settings are not changed.

Applying the Filter

Click the **Apply** button to calculate the filters and update the **Conflict** tab and the **Summary** tab. The tool informs the user that the filter was successfully applied, shown in figure 33.

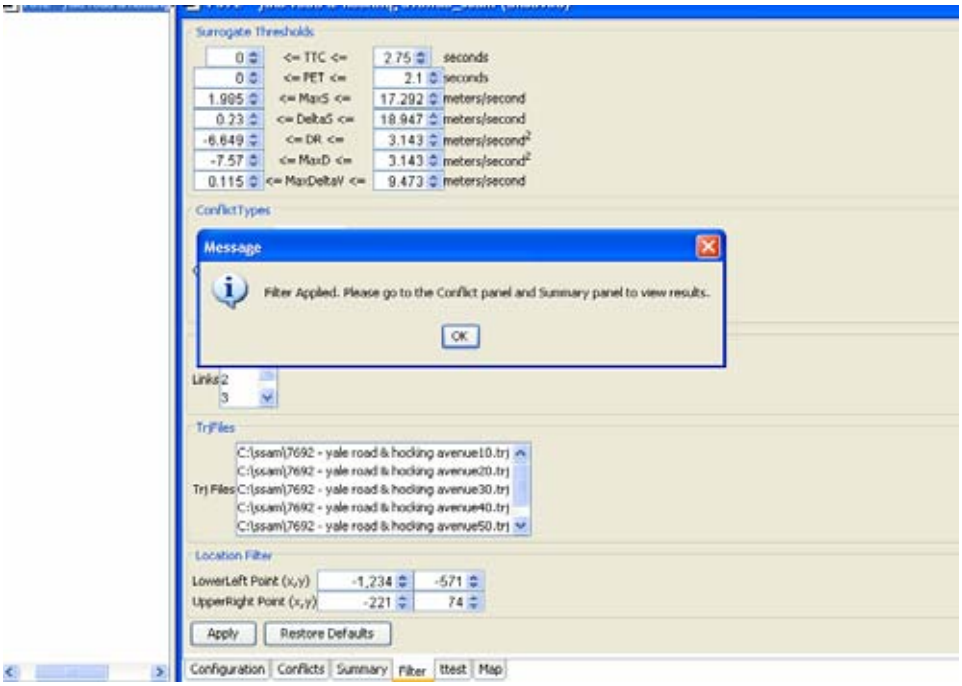


Figure 33. Screen Capture. SSAM Screen—Filter Tab with Filters Applied: Confirmation Message.

The **Restore Defaults** button restores the filter settings to all the default settings. It also restores the content in the **Conflict** tab and the **Summary** tab to show all conflicts and summaries for those conflicts. Figure 34 shows the **Conflict** tab after the filter is applied. Notice that the first line in the window now displays, "FILTER APPLIED."

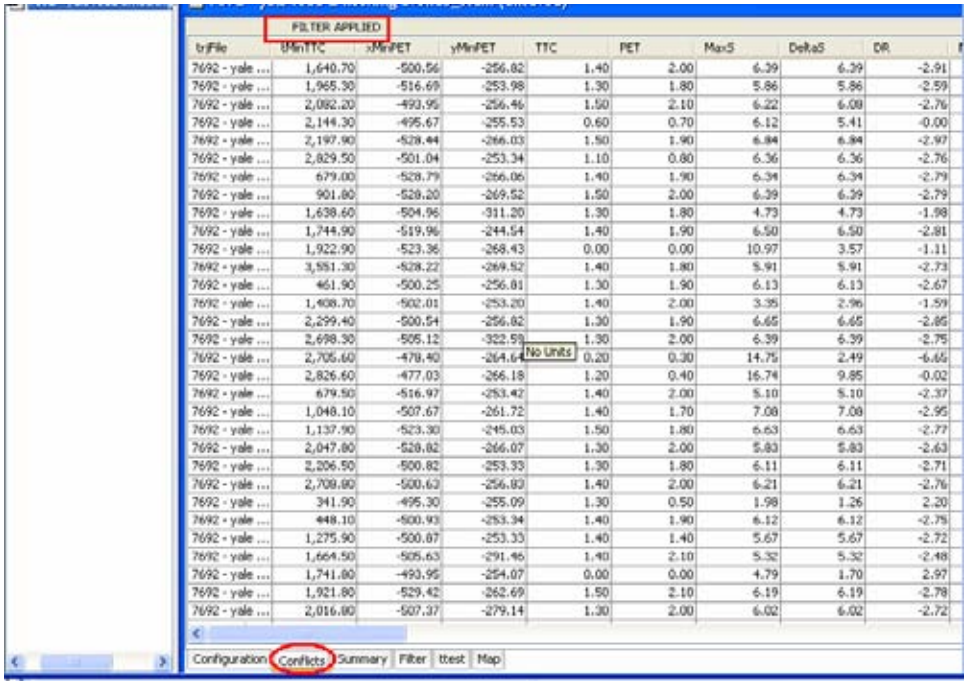


Figure 34. Screen Capture. SSAM Screen—Conflicts Tab: Filtered Conflicts Table.

Figure 35 shows the **Summary** tab after the filter is applied. Notice that the first line in the window now displays, "FILTER APLIED."

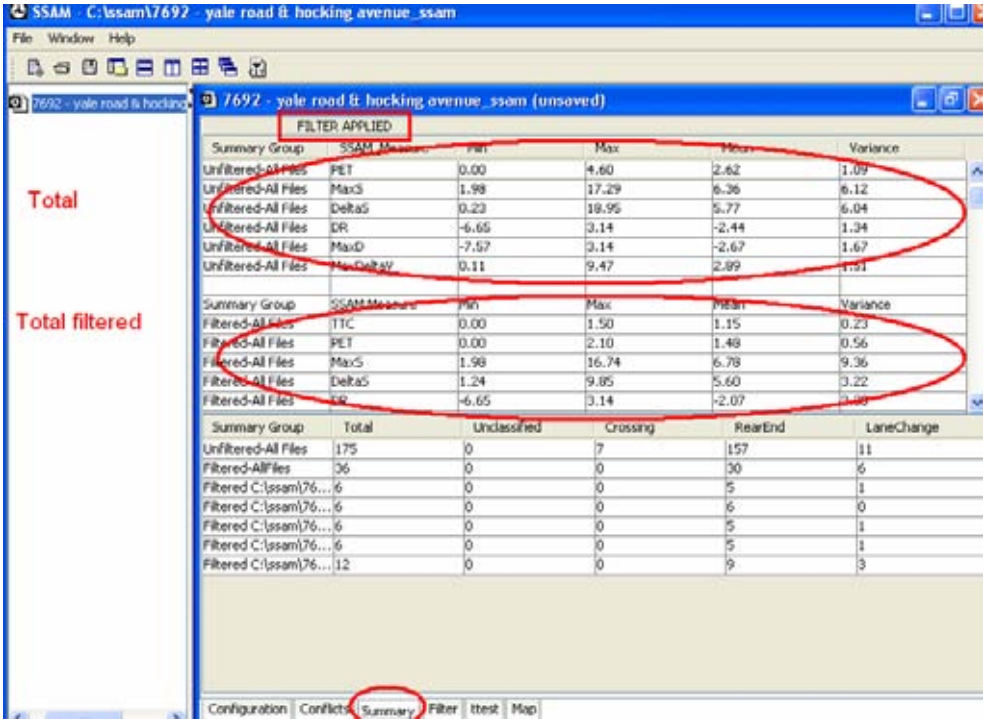


Figure 35. Screen Capture. SSAM Screen—Summary Tab: Filtered Summary Tables.

The summary tables now show the following kinds of summaries in chronological order:

- *Unfiltered All Files*

  This category is the summary for all the conflicts.

- *Filtered All Files*

  This category is the summary for all the conflicts which are now filtered into the **Conflict** tab.

- *Filtered File*

  This category is the summary for the filtered conflicts in the corresponding file.

Using the T-Test Tab

Figure 36 shows the **t-test** tab of the internal frame.

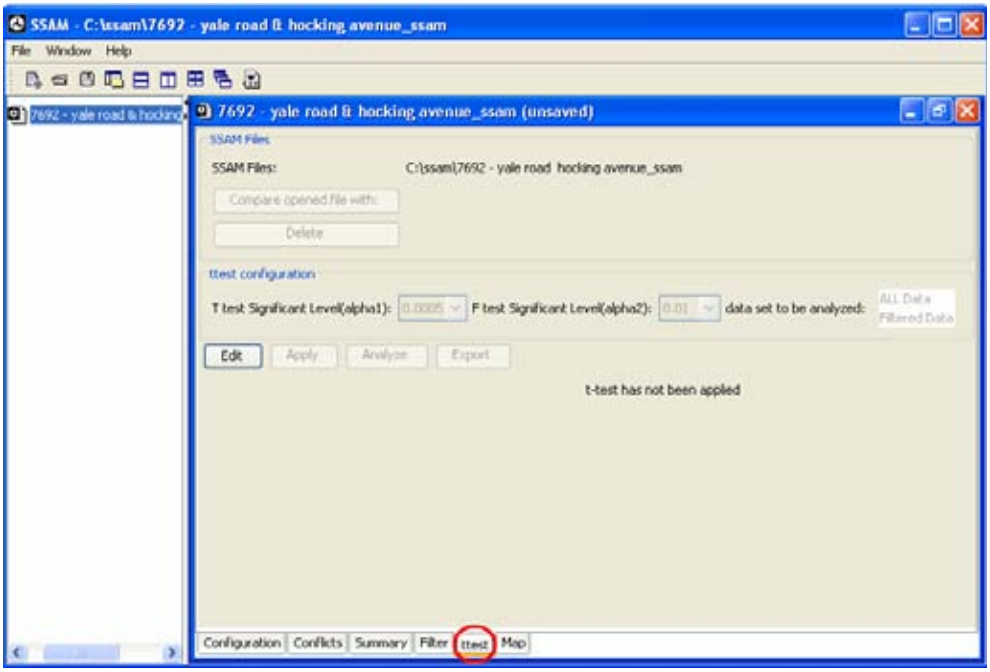


Figure 36. Screen Capture. SSAM Screen—Ttest Tab.

There are three sections in the **ttest** tab:

- *SSAM Files*

  This section is used to load additional case files for t-test analysis.

- *Ttest configuration*

  This section allows the user to set the significant levels for the t-test and f test. The user also selects the data set to be analyzed in this section.

- *T-test results section*

  Before an analysis has been performed, this section displays *t-test has not been applied*. The display will change to *t-test has been applied* when the user clicks **Analyze**. The tabular results of the analysis will also be displayed.

Adding Another Case Document

Users can select additional case documents to be compared with the current case document. Click the **Edit** to enable the SSAM files and t-test configuration sections of the **t-test** tab as shown in figure 37. Notice once **Edit** has been clicked, the **Apply** button is activated and the **Edit, Analyze,** and **Export** buttons are disabled.

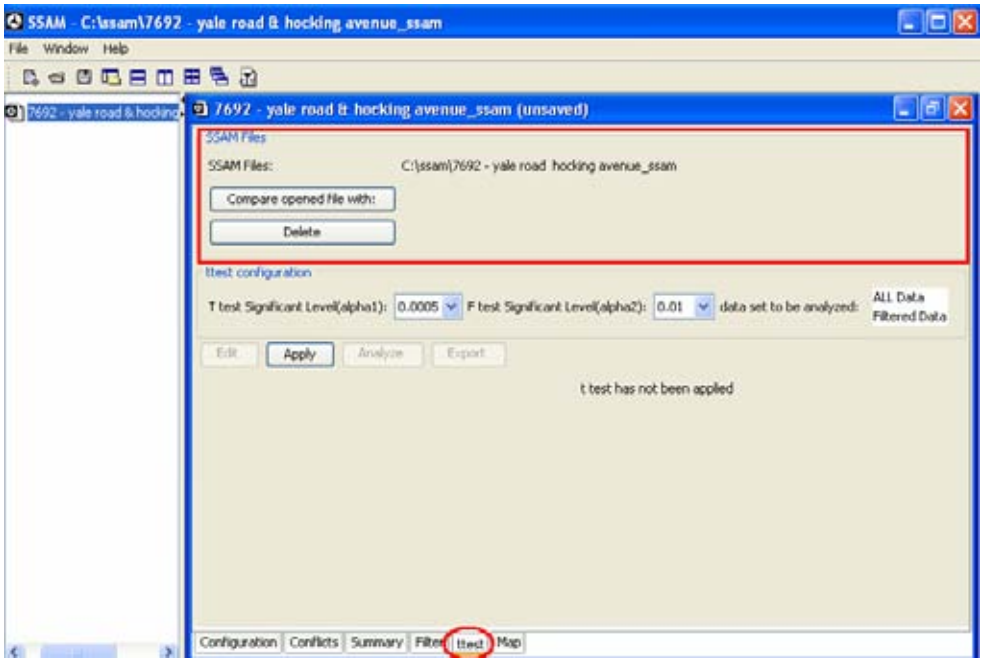


Figure 37. Screen Capture. SSAM Screen—Ttest Tab SSAM Files.

To add a new case document file, click **Compare opened file with** in the SSAM files section. This will bring up a file selection menu through which single files can be selected. Figure 38 shows the file selection window. Once the file is selected, it can be seen in the SSAM files section of the **ttest** tab.

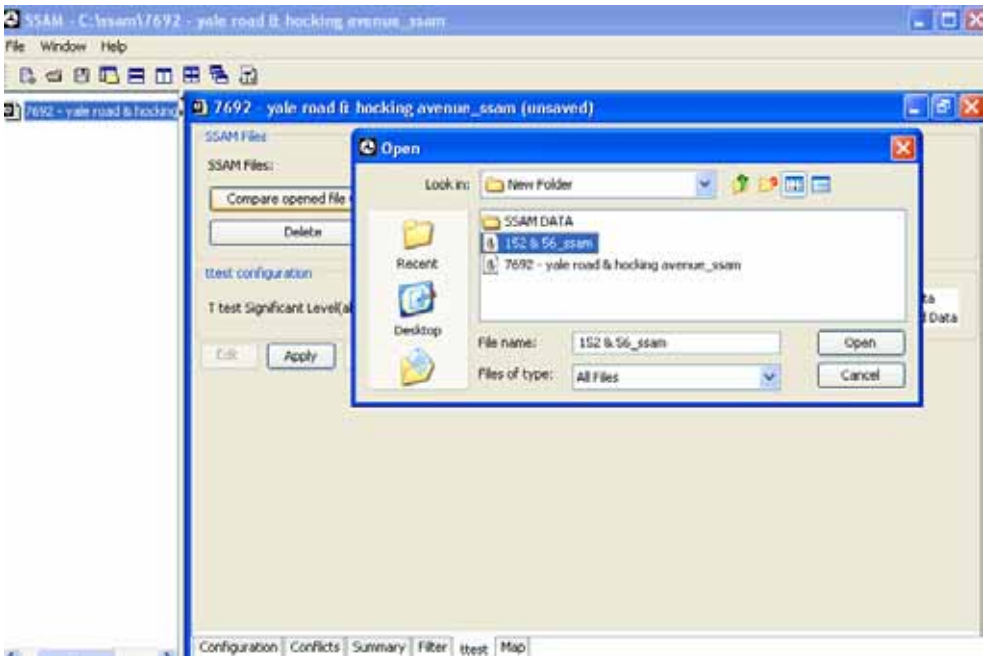


Figure 38. Screen Capture. SSAM Screen—Ttest Tab File Selection Window.

Figure 39 shows the case document file added to the SSAM file section, which is named *152& 56_ssam* in this example. The user can click **Delete** to delete the added case

document file or **Compare opened file with** to add another case document file. Since a t-test is used to compare the results of two case document files, only one other case document file can be added to the current case document for each analysis.

After another case document file is added, three sets of data must be configured in the t-test configuration section shown in figure 39 before the t-test analysis can begin.

The data to be configured include the following:

- *T-test Significant Level*

  This value is used in the t-test analysis to reflect the t statistic significant level.

- *F test Significant Level*

  This value is used in the t-test analysis to reflect the f statistic significant level, which is used to determine the sample variances significance.

- *Data set to be analyzed*

  There are two options available for the data set to be analyzed: All Data and Filtered Data. The user can perform the t-test on the unfiltered data of these two case documents by selecting **All Data**. Select **Filtered Data** for the t-test results on the filtered data of these two case documents.

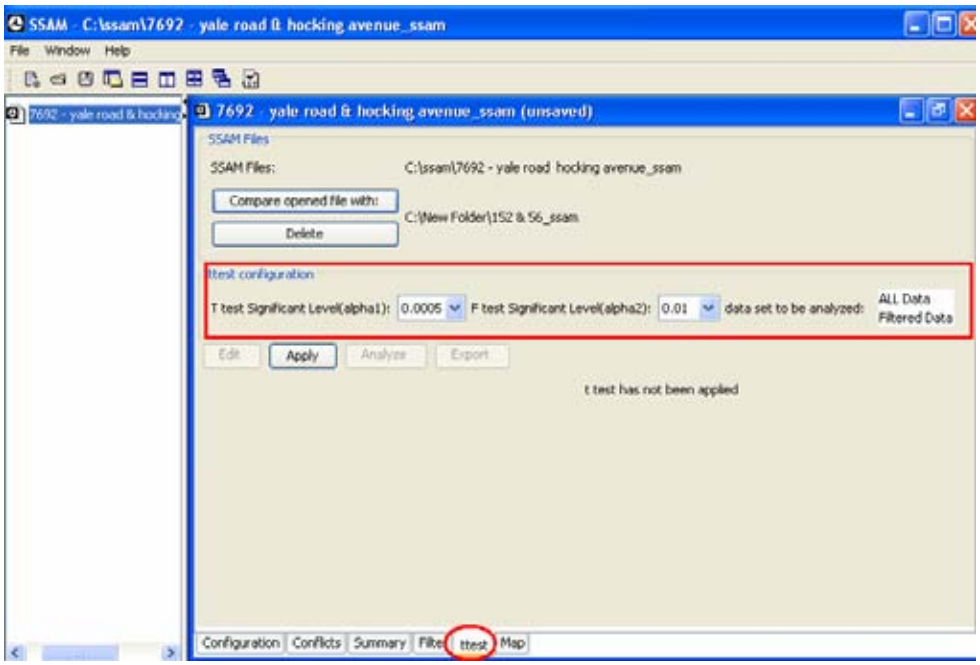


Figure 39. Screen Capture. SSAM Screen—Ttest Tab Default Settings.

As seen in figure 40, the t-test configuration section displays the following settings:

- 0.05 for t-test significance level.
- 0.1 for f test significance level.
- Unfiltered data for both case documents.

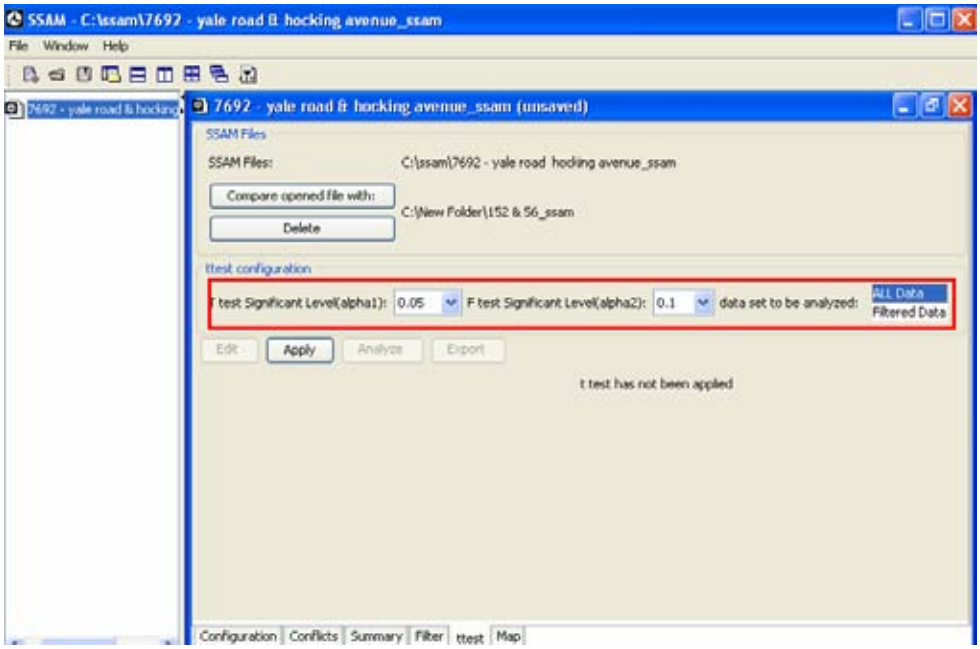


Figure 40. Screen Capture. SSAM Screen—Ttest Tab Modified Settings.

After both the SSAM file section and t-test configuration sections have been configured, click **Apply**. The added case document opens and becomes the active window.
At the same time, a message informs the user that the second case document is now open, as shown in figure 41.

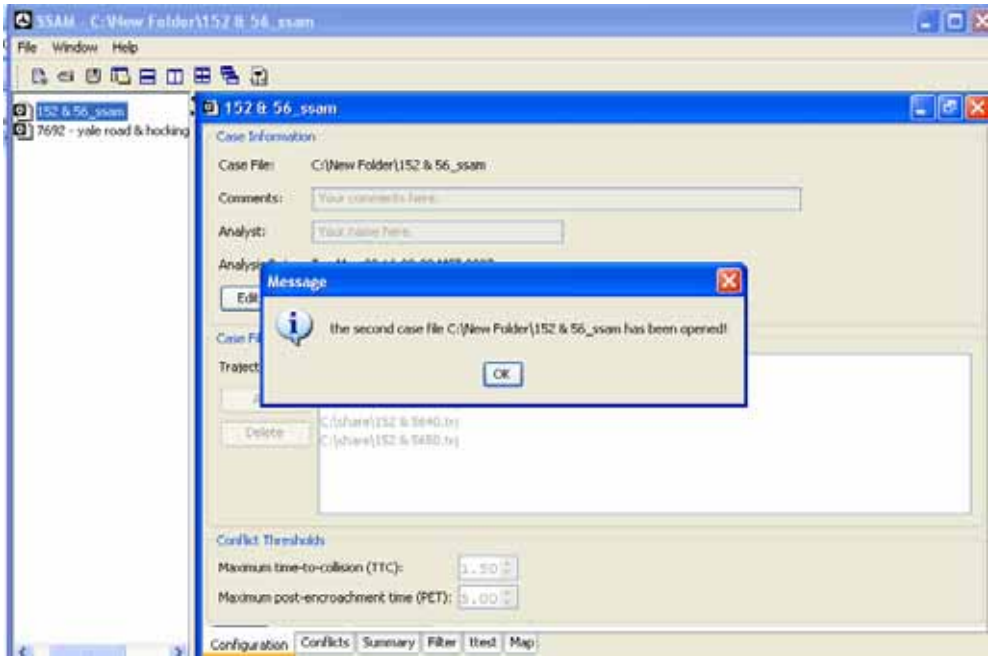


Figure 41. Screen Capture. SSAM Screen—Ttest Tab Open Confirmation Message.

With the second case document open, the user can perform all necessary changes. To confirm changes, click **OK**. This reactivates the previous case document window, as shown in figure 42.

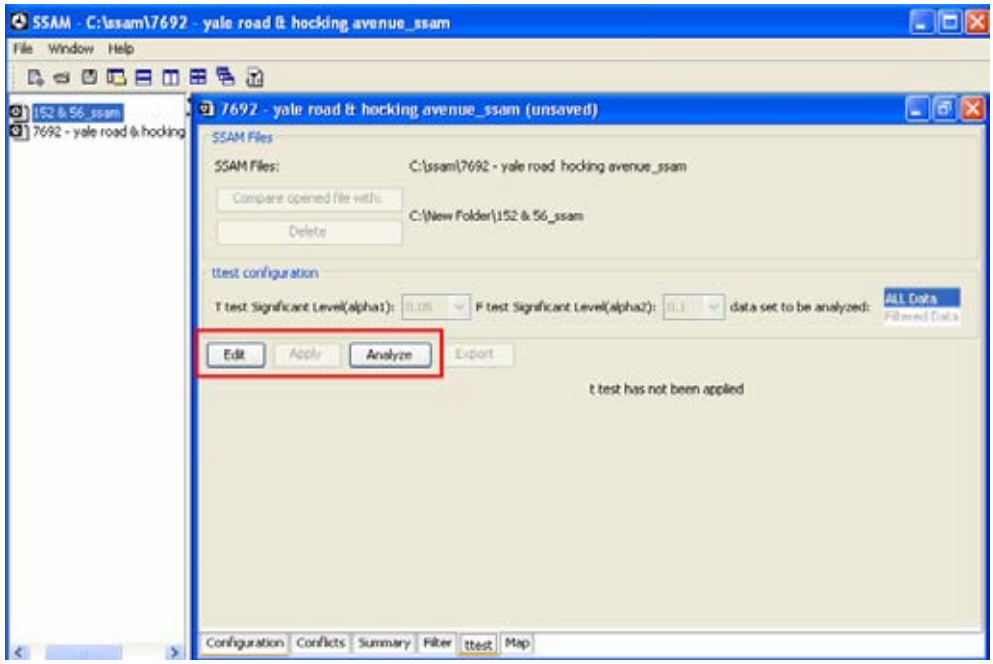


Figure 42. Screen Capture. SSAM Screen—Ttest Tab Active Case Document.

This is all the necessary data for the t-test analysis, which will compare the unfiltered conflicts data for these two case documents with t-test significant level 0.05 and f test significant level 0.1. By clicking **Analyze**, the tabular t-test results will be displayed in

the result section, as shown in figure 43. The label has been changed to *t-test for all data that have been applied*.

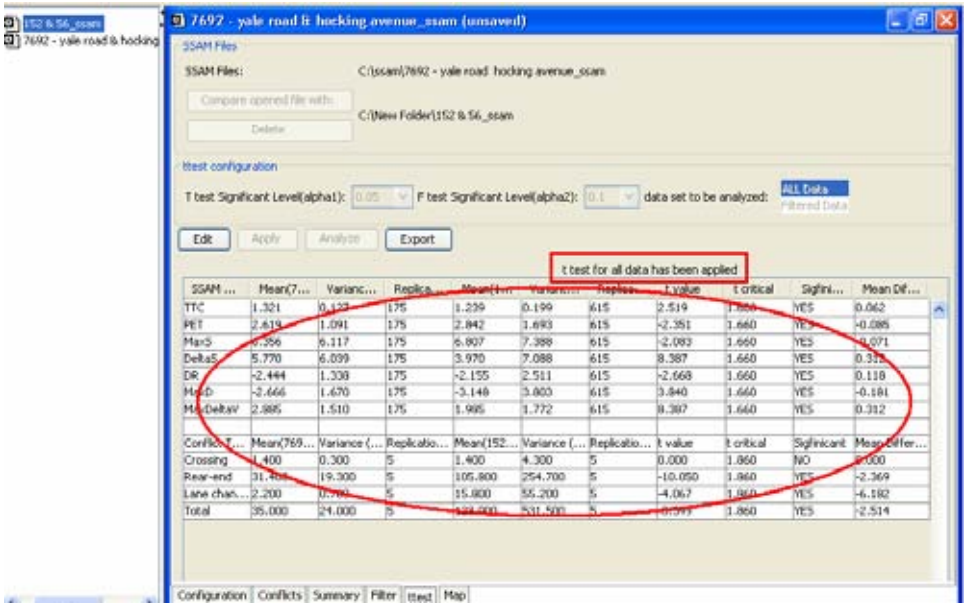


Figure 43. Screen Capture. SSAM Screen—Ttest Tab Results Table.

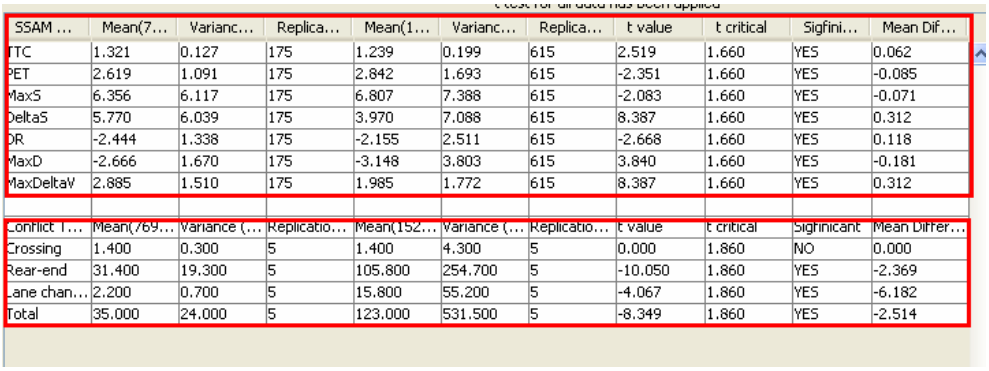
The t-test results table has two subtables. Figure 44 provides a clear view of the table, which includes the following sections:

- *Surrogate measure t-test results*

  This table displays the t-test results for all safety surrogate measures analyzed by SSAM, including TTC, PET, MaxS, DeltaS, DR, DeltaD, and MaxDeltaV.

- *Conflict numbers t-test results*

  This table displays the t-test results for conflict numbers analyzed by SSAM, including total conflicts, crossing conflicts, rear-end conflicts, and lane-changing conflicts.



SSAM ...	Mean(7...	Varianc...	Replica...	Mean(1...	Varianc...	Replica...	t value	t critical	Sigfini...	Mean Dif...
TTC	1.321	0.127	175	1.239	0.199	615	2.519	1.660	YES	0.062
PET	2.619	1.091	175	2.842	1.693	615	-2.351	1.660	YES	-0.085
MaxS	6.356	6.117	175	6.807	7.388	615	-2.083	1.660	YES	-0.071
DeltaS	5.770	6.039	175	3.970	7.088	615	8.387	1.660	YES	0.312
DR	-2.444	1.338	175	-2.155	2.511	615	-2.668	1.660	YES	0.118
MaxD	-2.666	1.670	175	-3.148	3.803	615	3.840	1.660	YES	-0.181
MaxDeltaV	2.885	1.510	175	1.985	1.772	615	8.387	1.660	YES	0.312
Conflict T...	Mean(769...	Variance (...	Replicatio...	Mean(152...	Variance (...	Replicatio...	t value	t critical	Sigfinicant	Mean Differ...
Crossing	1.400	0.300	5	1.400	4.300	5	0.000	1.860	NO	0.000
Rear-end	31.400	19.300	5	105.800	254.700	5	-10.050	1.860	YES	-2.369
Lane chan...	2.200	0.700	5	15.800	55.200	5	-4.067	1.860	YES	-6.182
Total	35.000	24.000	5	123.000	531.500	5	-8.349	1.860	YES	-2.514

Figure 44. Screen Capture. SSAM Screen—Ttest Tab with Enlarged Results Table.

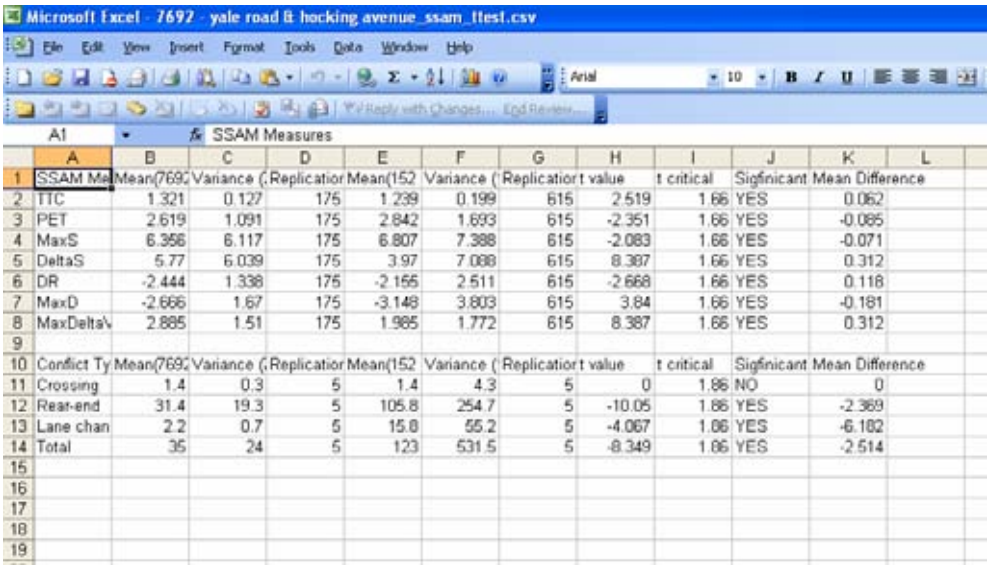
For each subtable, there are 11 columns. The first column lists the SSAM measures to be analyzed. For each measure, columns 2 through 4 list the corresponding mean, variance, and number of samples for the first case document. In this example, that document is *7692 yale road & hocking avenue_ssam*. Columns 5 through 7 list the mean, variance, and number of samples for the second case document. In this example, that document is *152& 56_ssam*. Column 8 shows the t value calculated for each measure. Column 9 displays the t critical value, obtained by looking at t tables. Column 10 shows whether or not each type of measure between these two case documents is significantly different. Column 11 shows the relative difference between the mean values of each measure.

Exporting the T-Test Results

The t-test results can be exported to a .csv file. Click **Export** to bring up the file menu shown in figure 45. By default, the exported file given the same name as the case document; in this example, the file is named *7692-yale road & hocking avenue_ssam_t-test.csv*. Click **Save** to save the file.

Figure 45. Screen Capture. SSAM Screen—Ttest Tab Export T-Test Results.

Figure 46 shows the *7692-yale road & hocking avenue_ssam_t-test.csv* file open in Microsoft® Excel. The first row of the .csv file displays the column names as seen in the results table of the case document.



	A	B	C	D	E	F	G	H	I	J	K	L
1	SSAM Me	Mean(7692	Variance (7	Replicatior	Mean(152	Variance (1	Replicatior	t value	t critical	Significant	Mean Difference	
2	TTC	1.321	0.127	175	1.239	0.199	615	2.519	1.66	YES	0.082	
3	PET	2.619	1.091	175	2.842	1.693	615	-2.351	1.66	YES	-0.085	
4	MaxS	6.356	6.117	175	6.807	7.388	615	-2.083	1.66	YES	-0.071	
5	DeltaS	5.77	6.039	175	3.97	7.088	615	8.387	1.66	YES	0.312	
6	DR	-2.444	1.338	175	-2.155	2.511	615	-2.668	1.66	YES	0.118	
7	MaxD	-2.666	1.67	175	-3.148	3.803	615	3.84	1.66	YES	-0.181	
8	MaxDelta\	2.885	1.51	175	1.985	1.772	615	8.387	1.66	YES	0.312	
9												
10	Conflict Ty	Mean(7692	Variance (7	Replicatior	Mean(152	Variance (1	Replicatior	t value	t critical	Significant	Mean Difference	
11	Crossing	1.4	0.3	5	1.4	4.3	5	0	1.86	NO	0	
12	Rear-end	31.4	19.3	5	105.8	254.7	5	-10.05	1.86	YES	-2.369	
13	Lane chan	2.2	0.7	5	15.8	55.2	5	-4.067	1.86	YES	-6.182	
14	Total	35	24	5	123	531.5	5	-8.349	1.86	YES	-2.514	
15												
16												
17												
18												
19												

Figure 46. Screen Capture. Excel Screen—T-Test Results in .csv File.

Viewing the T-Test Analysis on Filtered Data

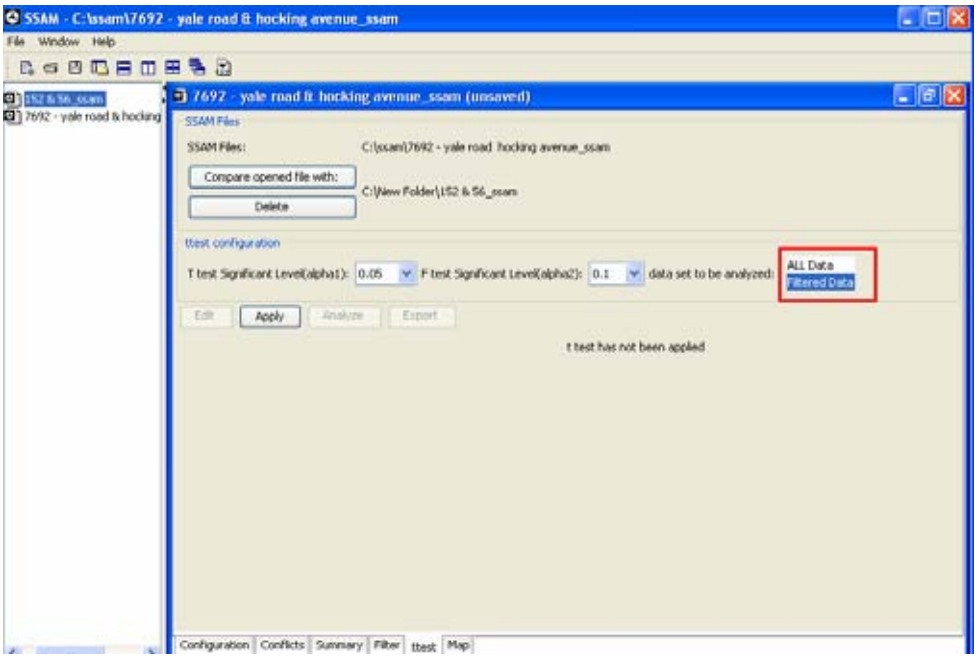


Figure 47. Screen Capture. SSAM Screen—Ttest Tab Filtered Data Selected.

Figure 47 displays the performance of the t-test on filtered data for those two case documents. When the user clicks **Apply,** a message appears to confirm the change as shown in figure 48.

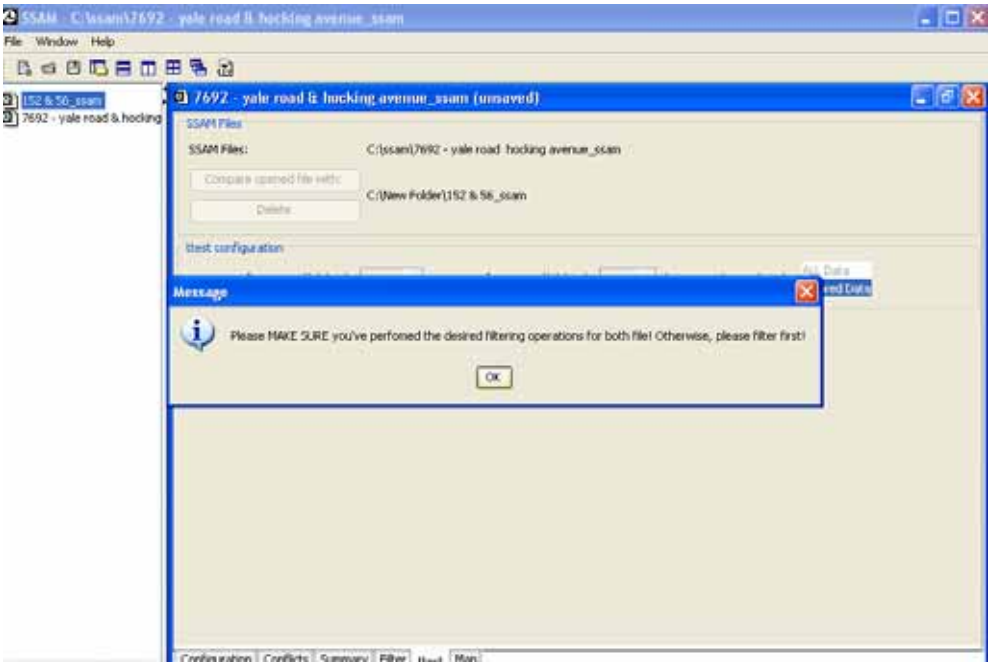


Figure 48. Screen Capture. SSAM Screen—Ttest Tab Filtering Confirmation Message.

After clicking **OK**, the user can click **Analyze** to continue the t-test process or return to the filtering screen for each case document to perform the desired filtering before continuing. If both case documents have filtered data, clicking **Analyze** will result in a t-test results table similar to figure 43. If one of the case documents does not have filtered data, a warning message will appear as shown in figure 49. This message displays, "There's no filtering data for one or two of the case files." The user must to go back to check on those two case files.

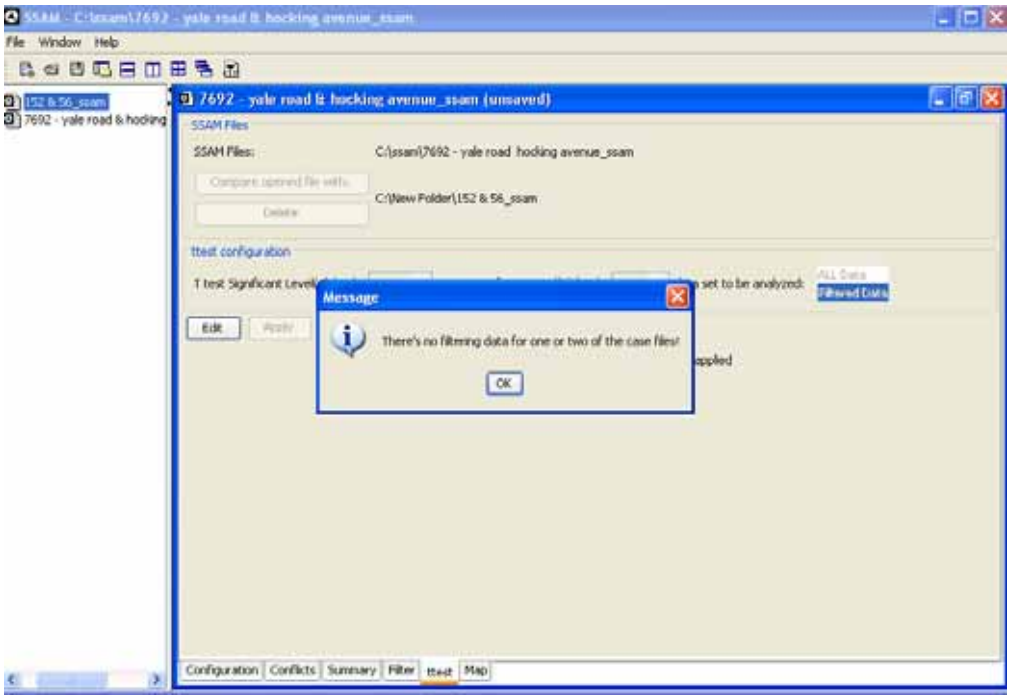


Figure 49. Screen Capture. SSAM Screen—Ttest Tab Analyze Warning Message.

Using the Map Tab

SSAM contains a built-in feature to visualize conflicts with respect to type (crossing, rear-end, or lane changing) and a time-to-collision preset threshold. The conflicts can be visualized within a map or imported to SSAM as a graphical image (20+ formats supported) or VISSIM .inp file. Visualization through an .inp file is more user-friendly because, unlike in the graphical image, map coordinates are specified.

Figure 50 shows the **Map** tab for a case document.

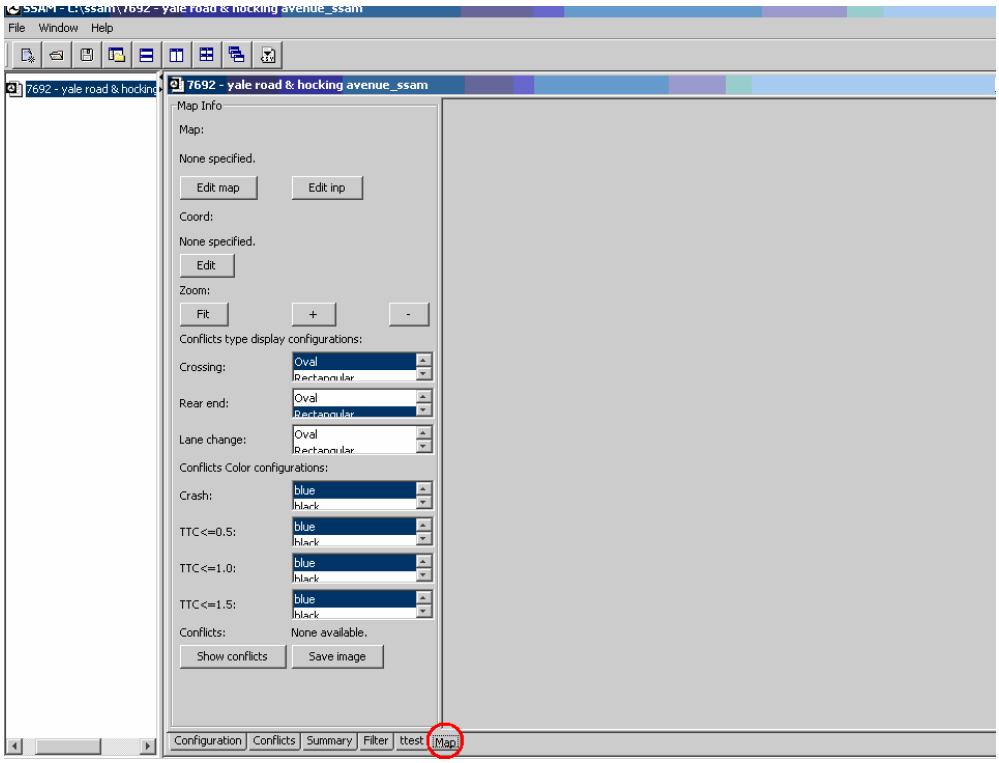


Figure 50. Screen Capture. SSAM Screen—Map Tab.

There are two sections in the **Map** tab—the Map Info and the Map View—which are described in the following subsections:

Map Info

This section allows the user to load the map file or VISSIM .inp file and to configure the conflicts that will be displayed within the map. It has four subsections, shown in figure 51.

- Map: This section allows the user to load the map file or VISSIM .inp file for the case document. Typically, the map file is the graphic file of the simulated network for the case document. The user must provide the location of the file and the coordinates for the upper-left and lower-right corners of the map image. For more information on retrieving coordinates from a simulated network is in the Recoding Map Coordinates section of this

manual. The VISSIM .inp file is the VISSIM network file that has been simulated and has generated the vehicle trajectory file that was used for SSAM analysis.

- Conflicts type display configurations: This section allows the user to configure the icon shape for displaying different type of conflicts.
- Conflicts color configurations: This section allows the user to configure the color for displaying conflicts with different severity levels.
- Conflicts: This section allows the user to enable the conflicts display in the map and export whole images.

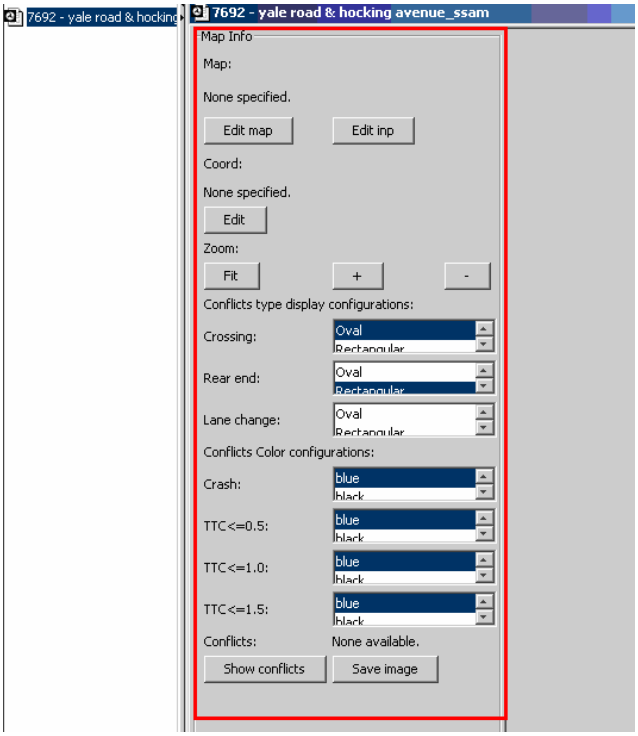


Figure 51. Screen Capture. SSAM Screen—Map Tab Map Info Section.

Map View

This section of the user interface, outlined in red in figure 52, is used to display the loaded map and to show the conflicts configured and filtered by the user within the map. Before the map is loaded, this section is empty.

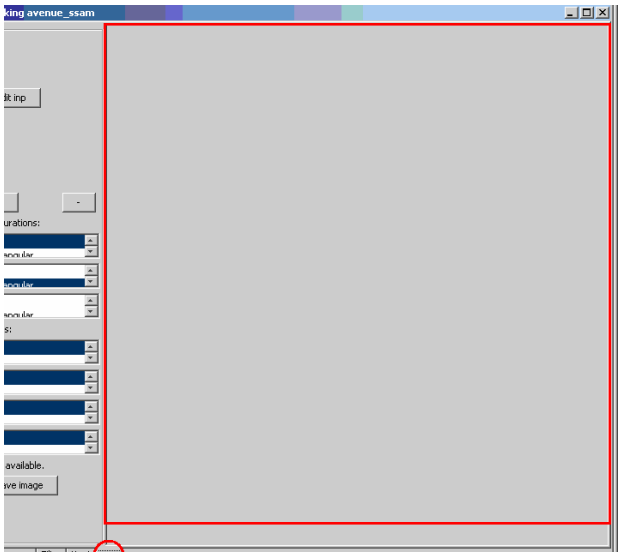


Figure 52. Screen Capture. SSAM Screen—Map Tab Map View Section.

Showing Conflicts Without Loading Map Files

SSAM can show conflicts in the map view section without loading a map file as a background. This is done by clicking **Show** at the bottom of the Map Info section. Figure 53 shows the display of 318 conflicts in the map view section. No map file or map coordinates have been specified. Conflicts shown without loading a map file are only a view of conflict layout. To receive detailed conflict information (e.g., absolute location), the user must load the corresponding map file and specify the correct map coordinates, which is covered in the next section of the manual.

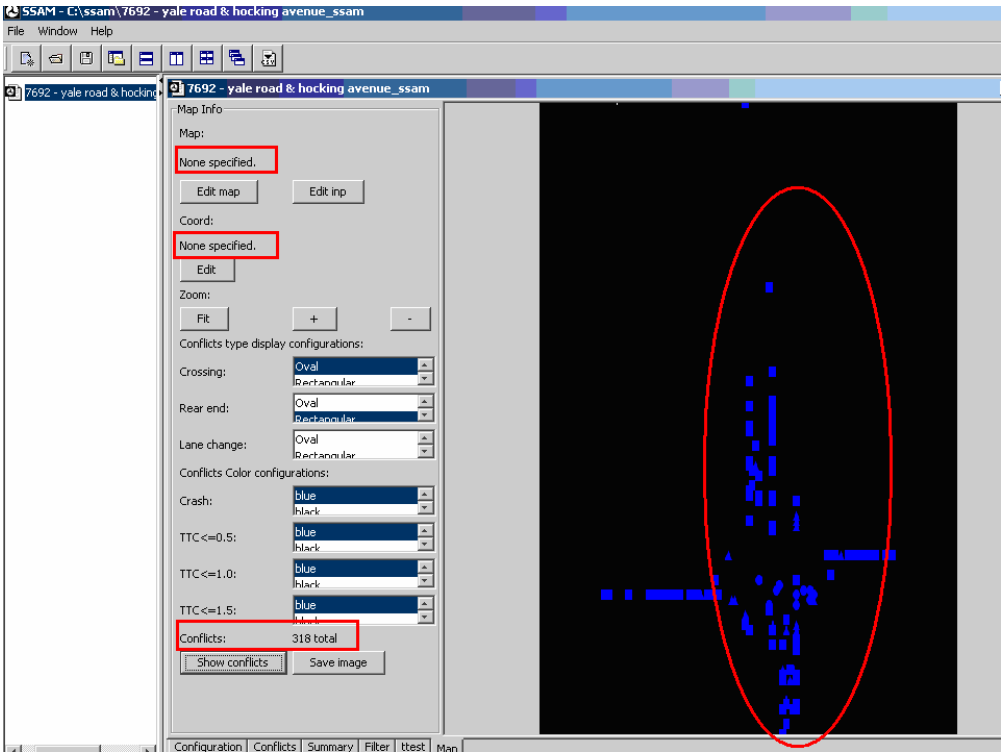


Figure 53. Screen Capture. SSAM Screen—Map Tab Conflicts Without Background.

The conflicts shown in the map view section are in sync with the conflicts specified by the filter panel. Figure 54 shows the filtered conflicts.

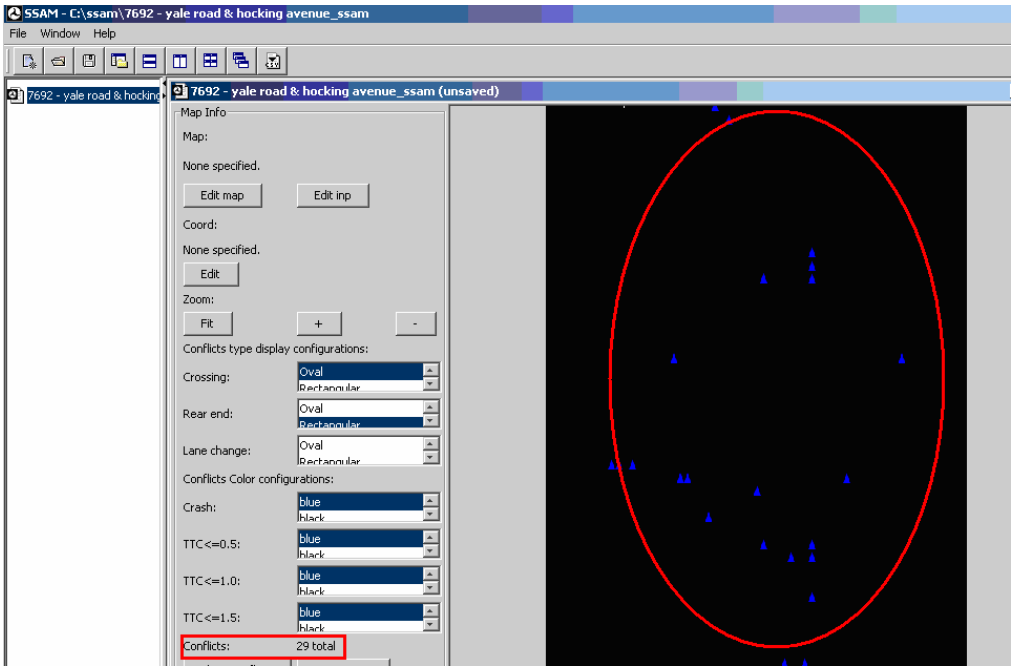


Figure 54. Screen Capture. SSAM Screen—Map Tab Filtered Conflicts Without Background.

Showing Conflicts on Loaded Map Image

Users can load a map file to be used as a background displaying the conflicts within the current case document. Click the **Edit map** button which corresponds to the map label in the Map Info section to bring up a file selection menu. A single file can be selected from this menu. Figure 55 shows the file selection window with the label *Import map image*.

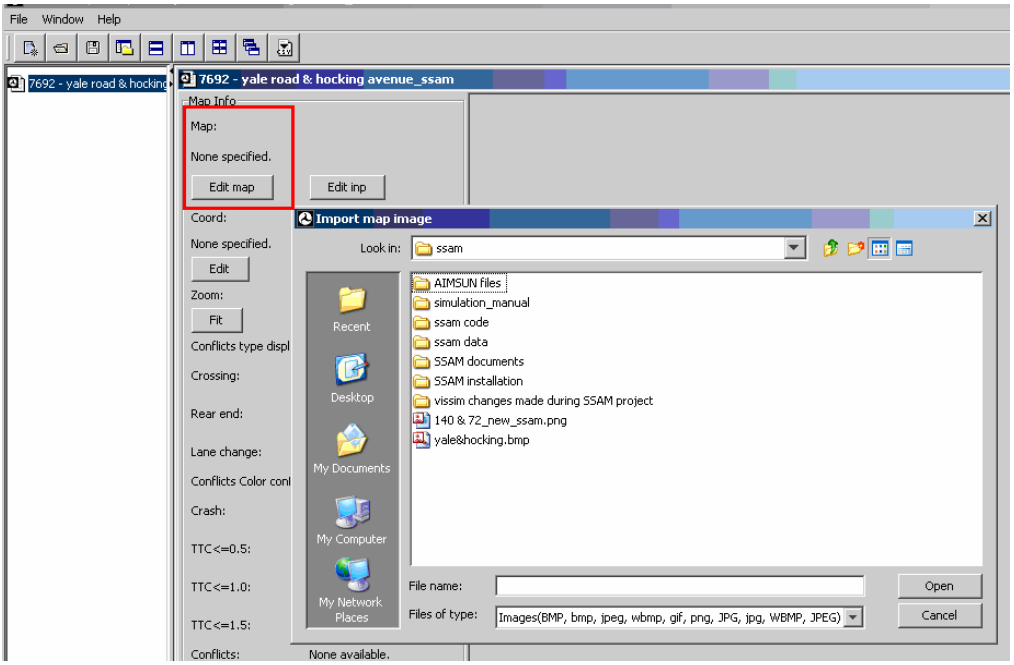


Figure 55. Screen Capture. SSAM Screen—Map Tab Import Map Image.

Once the map image file is selected, it can be seen in the map view section of the **Map** tab, as shown in figure 56. In this example, the selected map image file is named *yale&hocking.bmp*. The description label in the first row of the Map Info section has changed to *yale&hocking.bmp*, denoting that a map image file named has been loaded into the case document successfully.

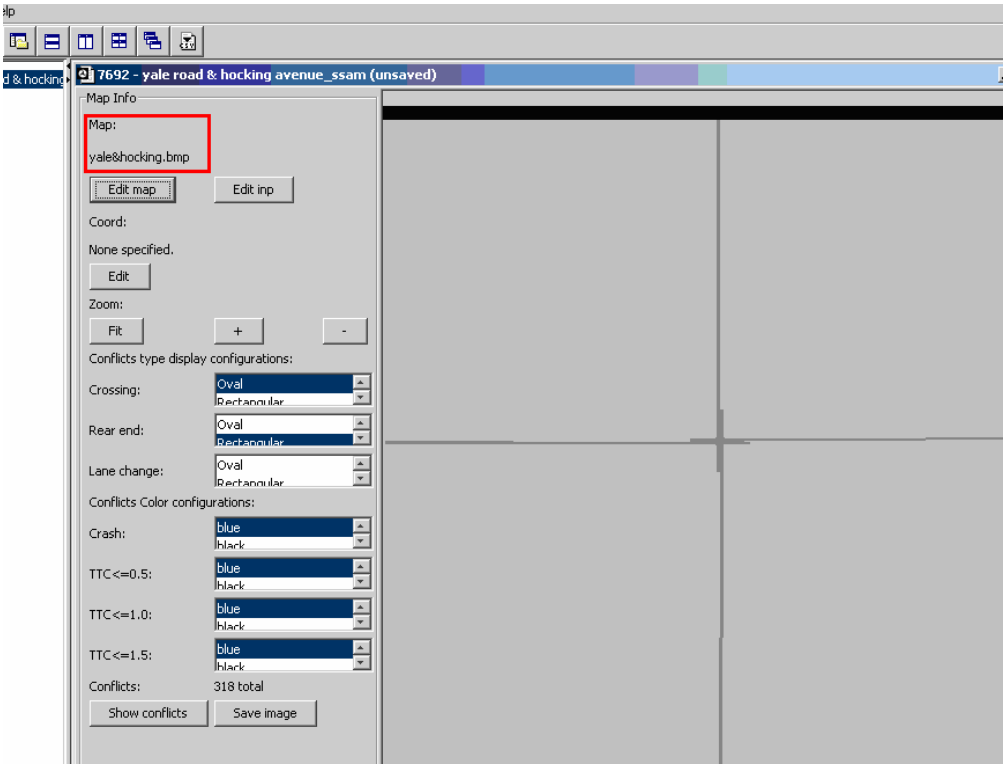


Figure 56. Screen Capture. SSAM Screen—Map Tab with Map File Loaded.

The software will use the loaded map image as a background to show the analyzed conflicts. To locate those conflicts, the user must specify the (x, y) coordinates of the reference points within the map image. The user can specify (x, y) coordinates for two reference points: the upper-left and lower-right corners of the map image. To specify the coordinates, click **Edit** in the **Coord** section. This will result in the message shown in figure 57, which states, "Please provide the coordinates (x_1, y_1) and (x_2, y_2) for the upper-left and lower-right corners of the map image." Type all (integer or decimal) values on one line, separated by a single space.

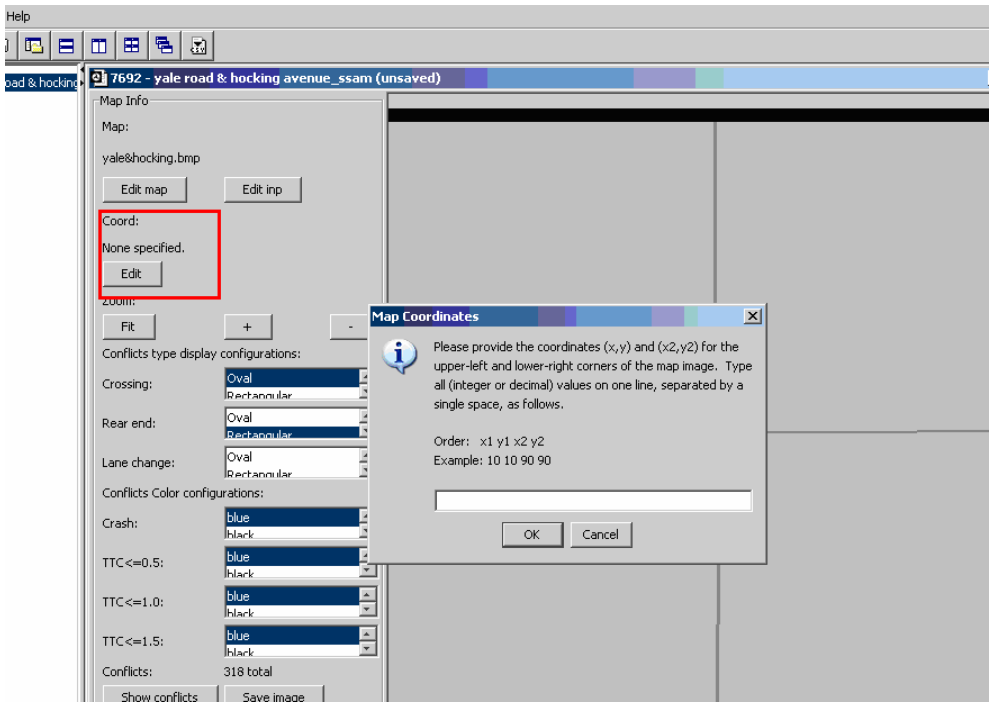


Figure 57. Screen Capture. SSAM Screen—Map Tab Map Coordinates Input.

Figure 58 shows four entered data points (separated by space). Click **OK** to continue.

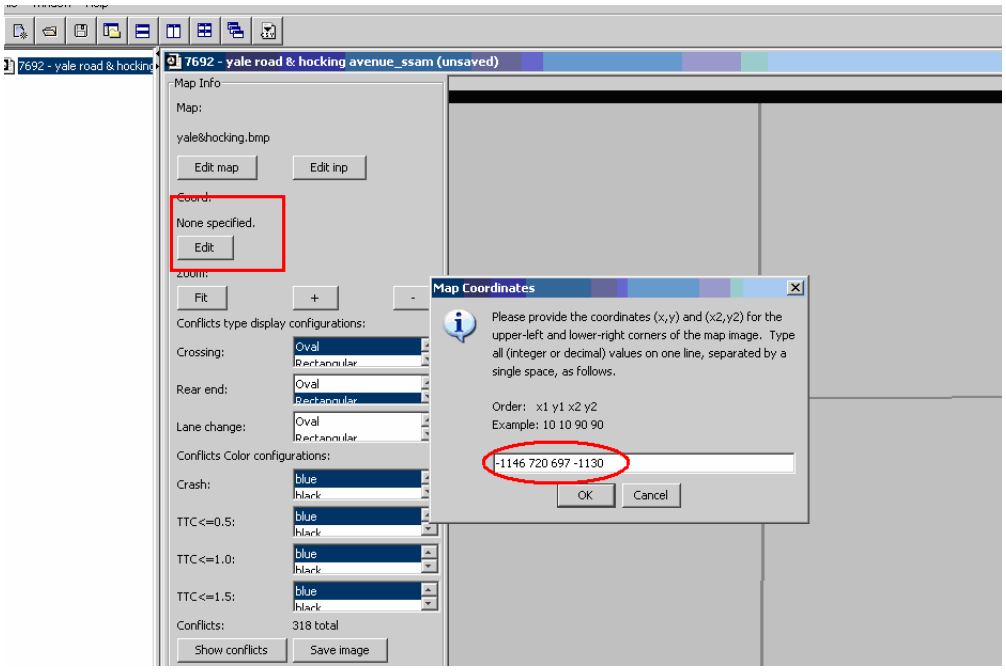


Figure 58. Screen Capture. SSAM Screen—Map Tab Map Coordinates Input Entered.

Figure 59 shows the input values recorded as two (x, y) coordinates. These coordinates replace the description label *None Specified* in the second row of the Map Info section. As shown in figure 59, conflicts are located within the intersection shown on the map image and the conflicts layout matches the intersection geometry. Each conflict dot

represents a single conflict or multiple conflicts happening in the same place. Click each conflict dot to retrieve a display of the detailed information for the conflicts. The green rectangle surrounding all of the conflicts represents the conflicts location range specified by the *Location Filter* in the **Filter** tab.

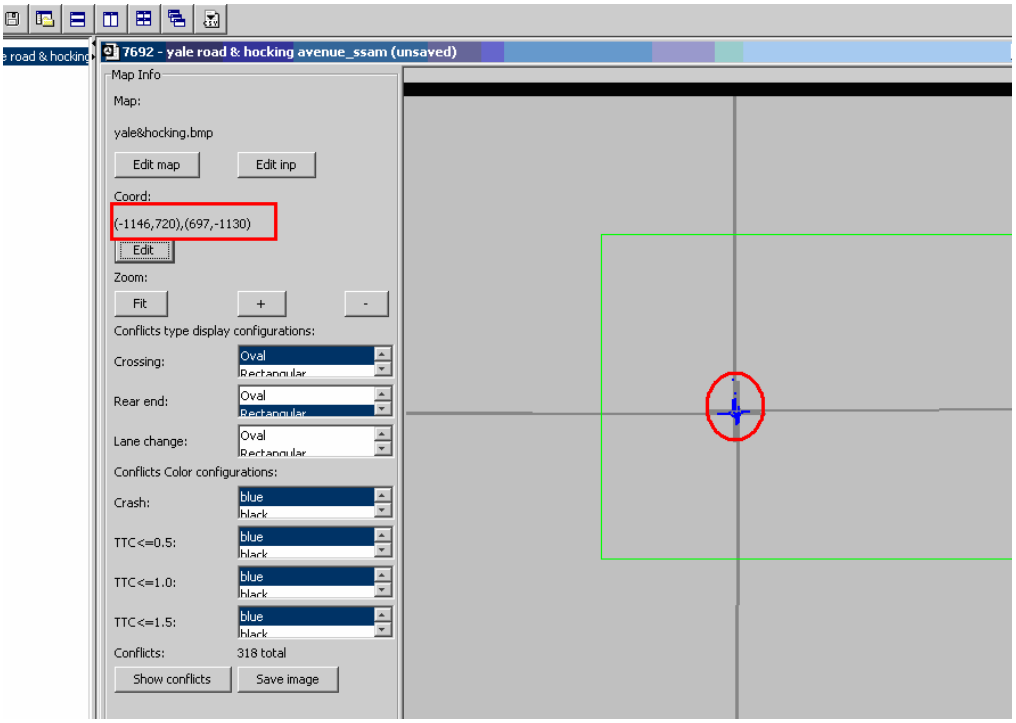


Figure 59. Screen Capture. SSAM Screen—Map Tab Conflicts with Background.

Users can zoom in or out of the map view by clicking + or - in the Coord section. Figure 60 shows a zoomed in view of the conflicts and the map image. Click **Fit** to restore the default map view.

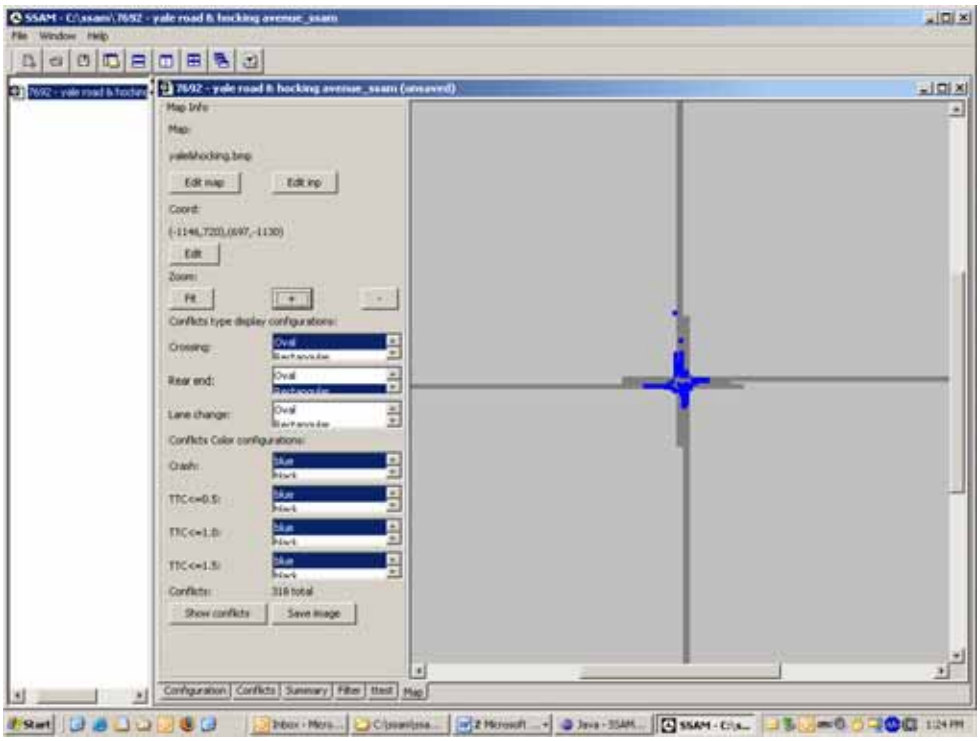


Figure 60. Screen Capture. SSAM Screen—Map Tab with Zoomed Map View.

Conflicts shown here are in sync with the conflicts specified by the conflicts table and summary table in the **Filter** tab. To only view conflicts with specified filtering criteria, users can perform the preferred filter operations in the **Filter** tab and then return to the Map panel. Filtered conflicts are shown in the map panel. Figure 61 shows only lane change conflicts with 1.0 = < TTC < = 1.5.

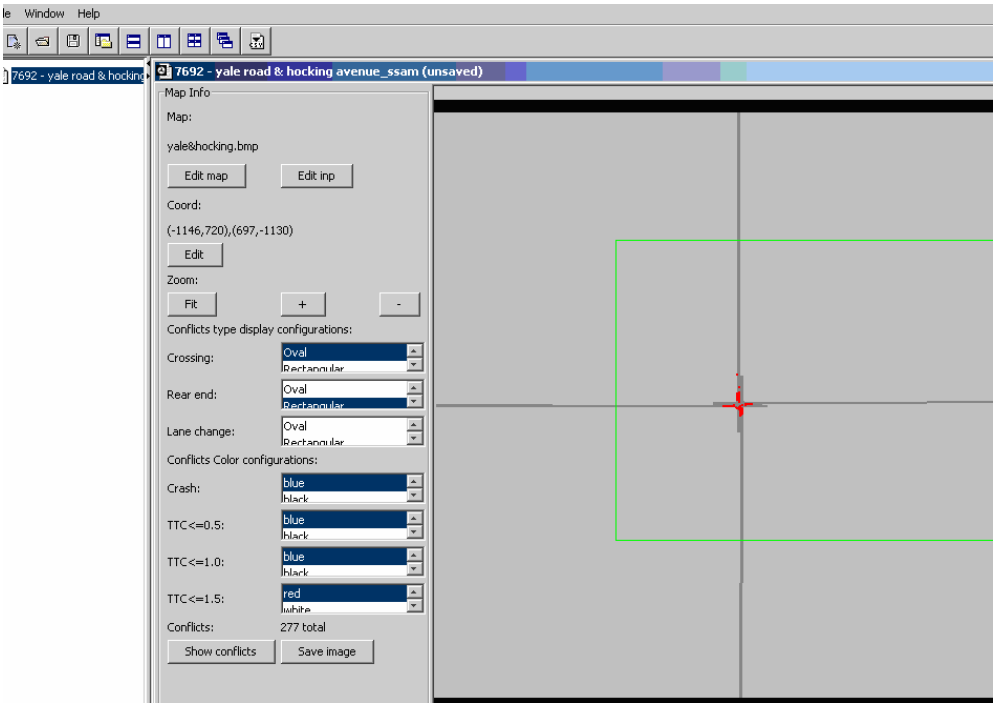


Figure 61. Screen Capture. SSAM Screen—Map Tab with Filtered Conflicts.

Showing Conflicts on Loaded VISSIM .inp File

Users can load a VISSIM .inp file to generate the corresponding .trj file processed by SSAM. Click **Edit inp** in the Map Info section to retrieve a file selection menu through which a single file can be selected. Figure 62 shows the file selection window. In this example, the file selected is *yale&hocking.inp*. Click **Open** to import the file.

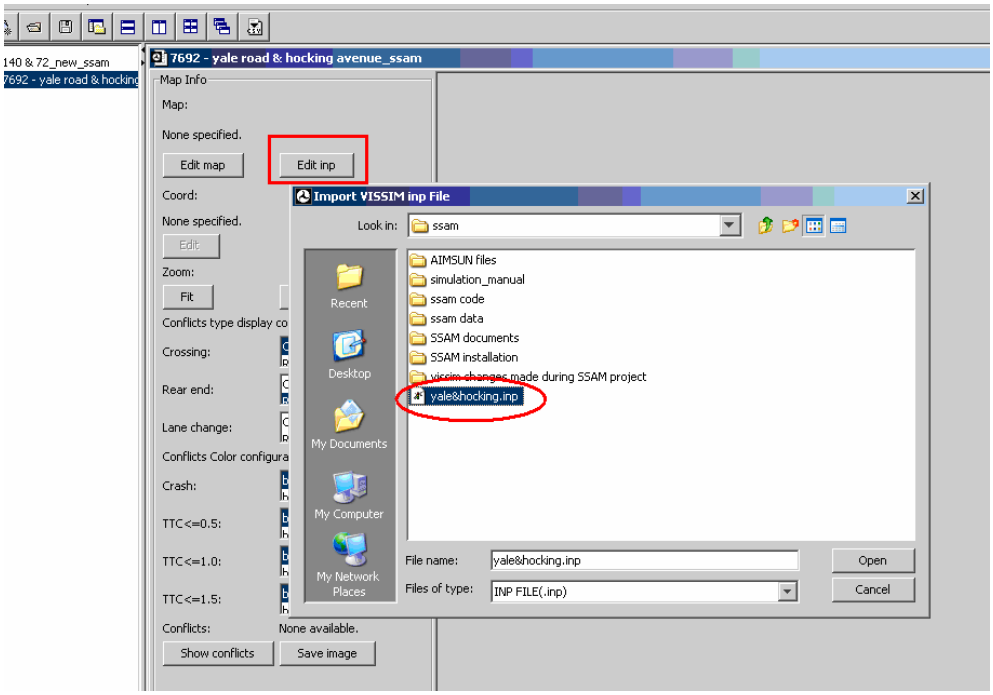


Figure 62. Screen Capture. SSAM Screen—Map Tab Load .inp File.

The Coord **Edit** button is inactive as the user will not provide the coordinates for the loaded .inp file. After loading the .inp file, the network displays in the map view section, as shown in figure 63.

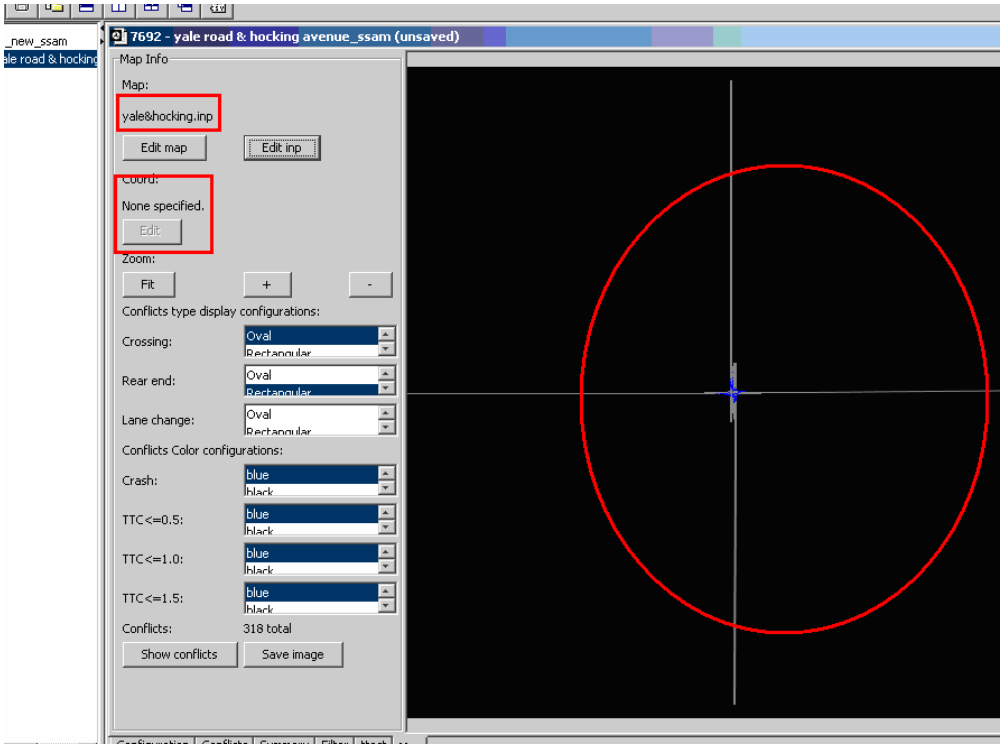


Figure 63. Screen Capture. SSAM Screen—Map Tab Loaded .inp File and Generated Network.

The loaded .inp file contains all the needed information for the network. Conflicts generated from this network are shown once the .inp file is loaded. A zoomed in view of the network is shown in figure 64.

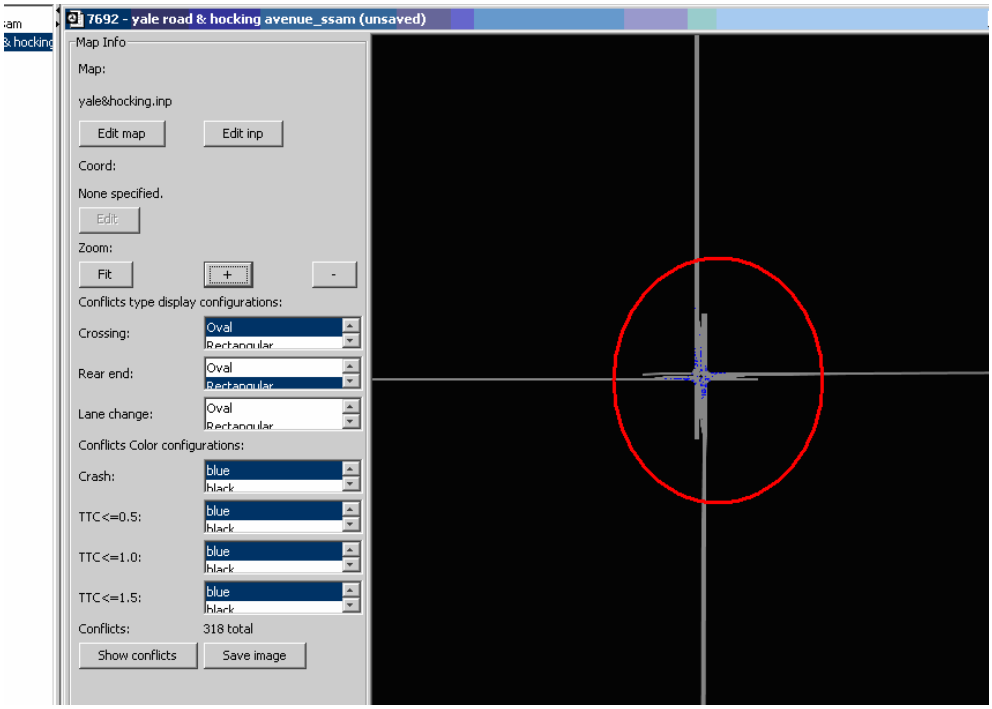


Figure 64. Screen Capture. SSAM Screen—Map Tab with Zoomed View of Generated Network.

Saving Image File

Users can export the image shown in the map view section by clicking **Save image** at the bottom of the Map Info section. As shown in figure 65, clicking **Save image** will retrieve a file selection window labeled *Save Image.* SSAM allows the image to be save in .png format only. In this example, the image is saved as *7692-yale & hocking avenuw_ssam.png.* Figure 66 shows the resulting .png file displayed using Microsoft® Office Picture Manager.

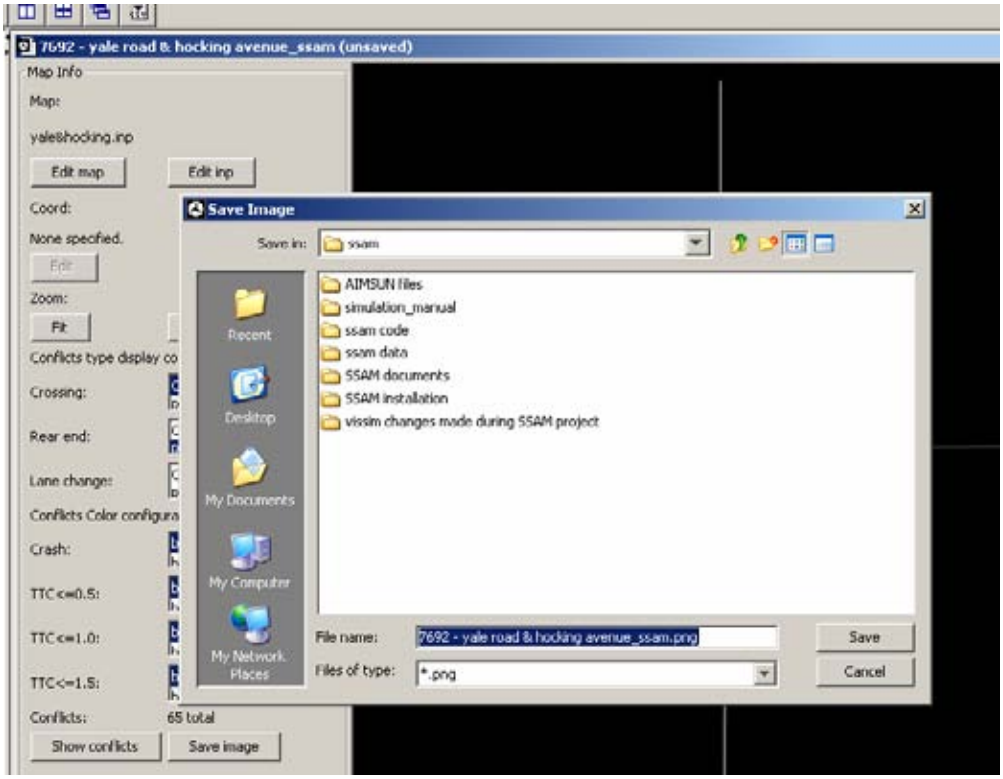


Figure 65. Screen Capture. SSAM Screen—Map Tab Saving Image.

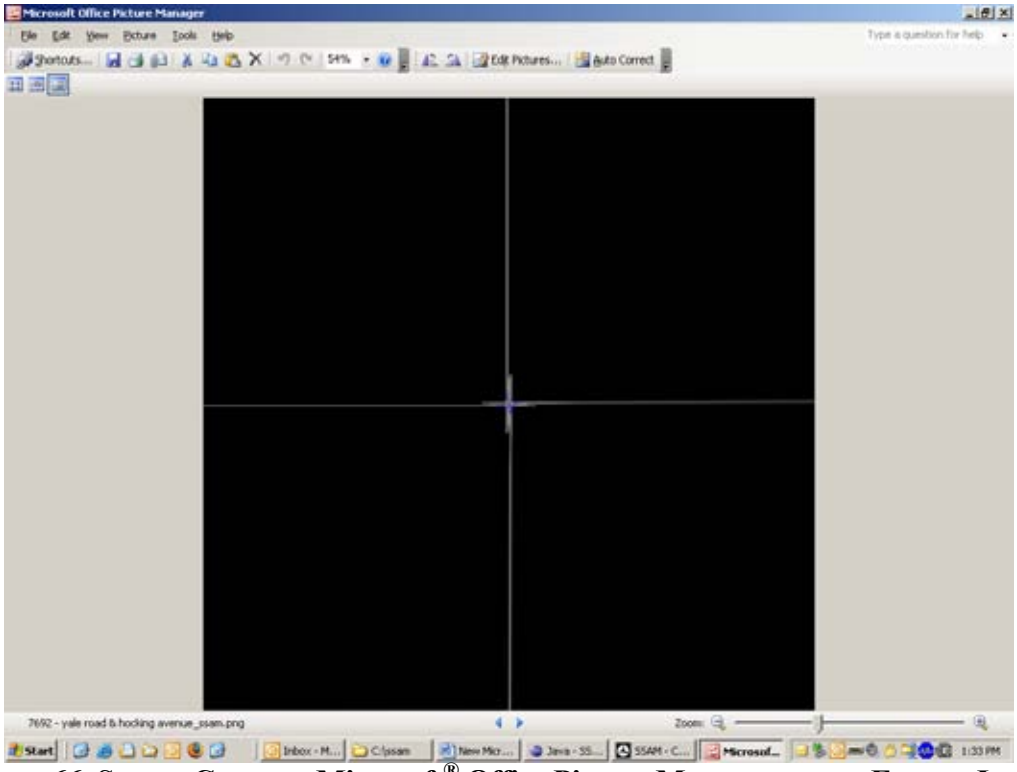


Figure 66. Screen Capture. Microsoft® Office Picture Manager—.png Format Image Open.

Filtering Conflicts by Area

In SSAM, the user can filter conflicts in the **Filter** tab and also filter conflicts by area in the **Map** tab. To filter in the **Map** tab, the user will drag a rectangle to specify the area of interest as shown in figure 67.

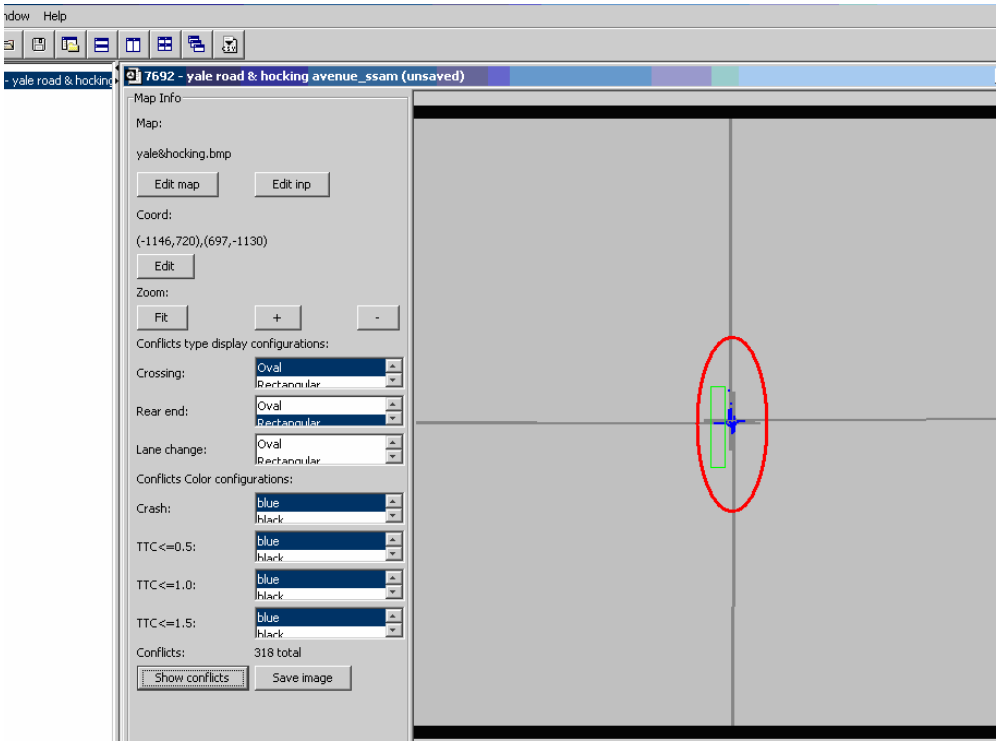


Figure 67. Screen Capture. SSAM Screen—Map Tab Specify Rectangle.

A message will appear and ask the user to confirm, as shown in see figure 68. Click **Yes** to confirm the action.

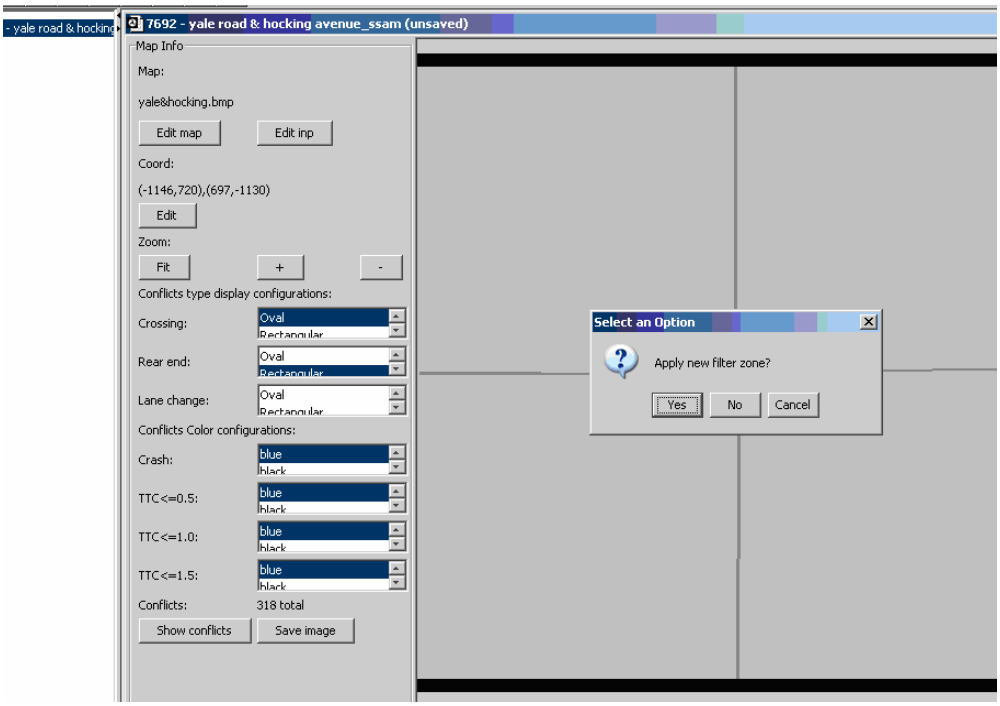


Figure 68. Screen Capture. SSAM Screen—Map Tab Filter Confirmation Message.

Only conflicts confined by the rectangle just specified will display. Figure 69 shows the resulting conflicts.

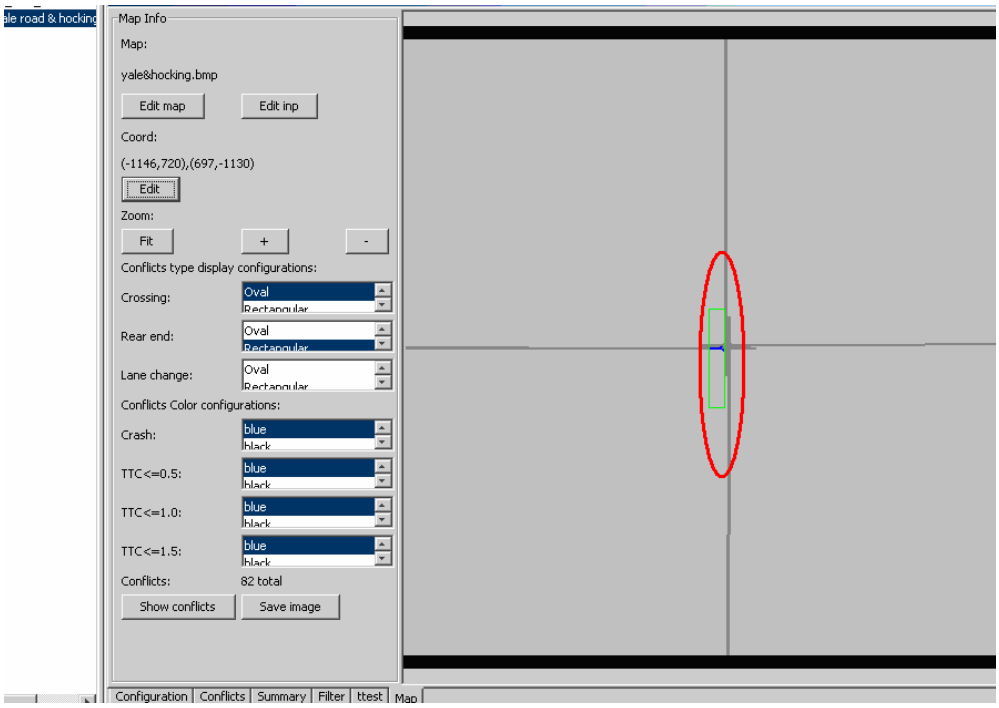


Figure 69. Screen Capture. SSAM Screen—Map Tab Filtered Conflicts.

Figure 70 shows that the values in the Location Filter in the **Filter** tab have changed to the values according to the dragged rectangle.

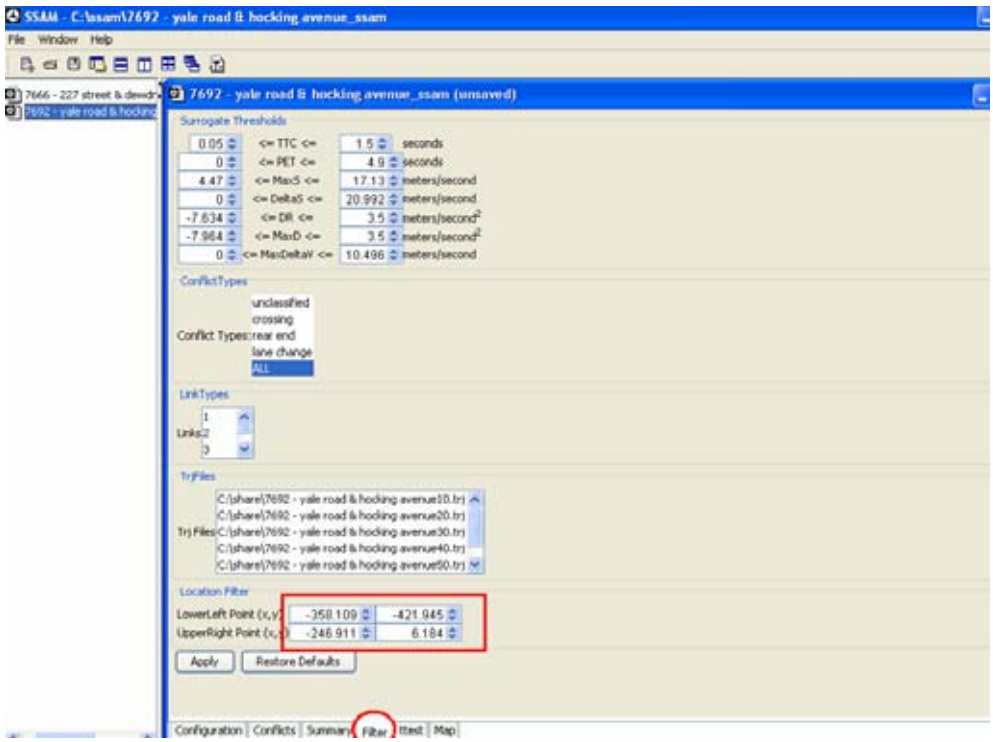


Figure 70. Screen Capture. SSAM Screen—Filter Tab Location Filter.

Configuring Conflict Display

After a map file is loaded into the case document, users can specify how different conflicts within the map file are displayed. As shown in figure 71, there are two types of settings to configure. The first part of configuration allows the user to choose the icon shape for different types of conflicts—crossing, rear-end, and lane-change. There are three icon shapes for each type of conflicts—oval, rectangular, and triangle. The second part of the configuration allows the user to select display colors for conflicts with different severity levels. Severity levels are classified according to different group of TTC values. They are crash conflicts with TTC less and equal to 0.5 second, conflicts with TTC less and equal to 1.0 second, and conflict with TTC less and equal to 1.5 seconds.

Figure 71 shows crossing conflicts with the oval icon, rear-end conflicts with the rectangular icon, and lane-change conflicts with the triangle icon. It also shows crashes in blue, conflicts with TTC < = 0.5 in red, conflict with TTC < = 1.0 in orange, and conflicts with TTC < = 1.5 in green. The user can enable the conflict display by clicking **Show.** Conflicts with the user-defined configurations will be shown in the map view window.

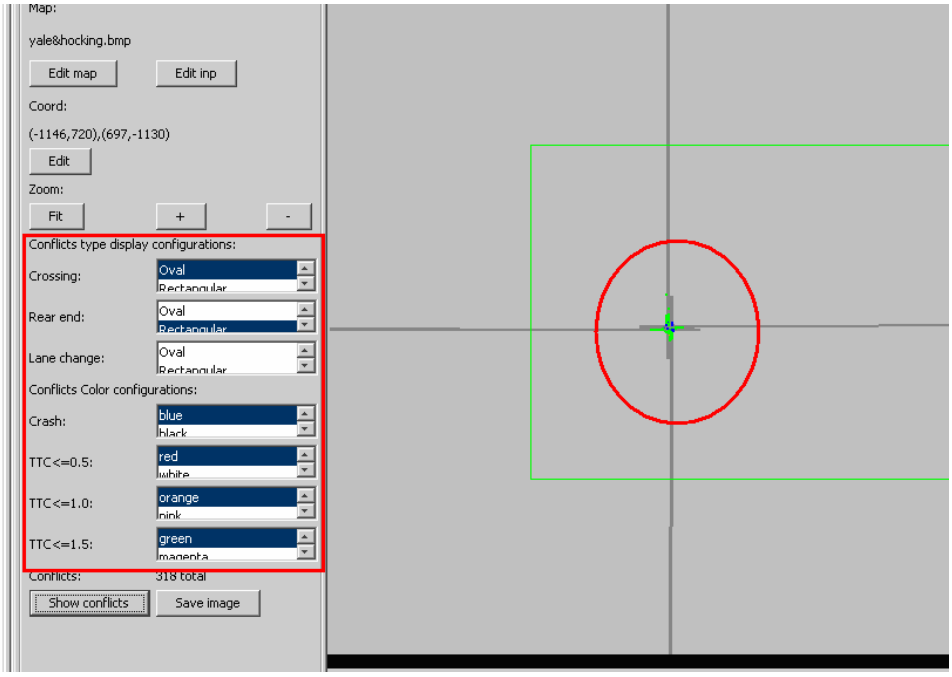


Figure 71. Screen Capture. SSAM Screen—Map Tab Conflicts Display Configuration.

Figure 72 shows another conflict display with different color configurations.

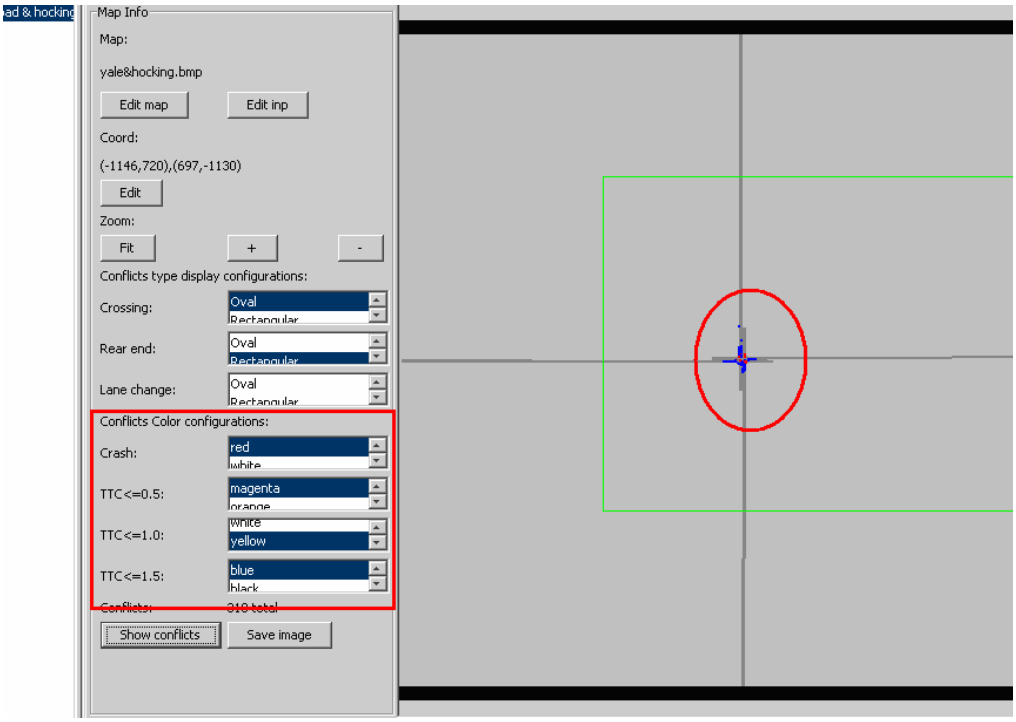


Figure 72. Screen Capture. SSAM Screen—Map Tab Additional Conflicts Display Configuration.

Displaying Conflict Line

Users can receive detailed conflict information for each conflict point shown in the conflict map view, as shown in figure 73. There are two sections within the resulting window. The right section provides the detailed surrogate safety measures corresponding to this conflict, including TTC, PET, as well as vehicle IDs and lane/link IDs. The left section shows the conflict lines for the two vehicles involved in this conflict. A blue line represents the first vehicle and a red line represents the second vehicle. Both conflict lines have arrows to indicate movement direction.

Sometimes clicking the conflict point will generate a set of windows because of multiple conflicts at this point. Up to 20 maximum windows can be generated by one click.

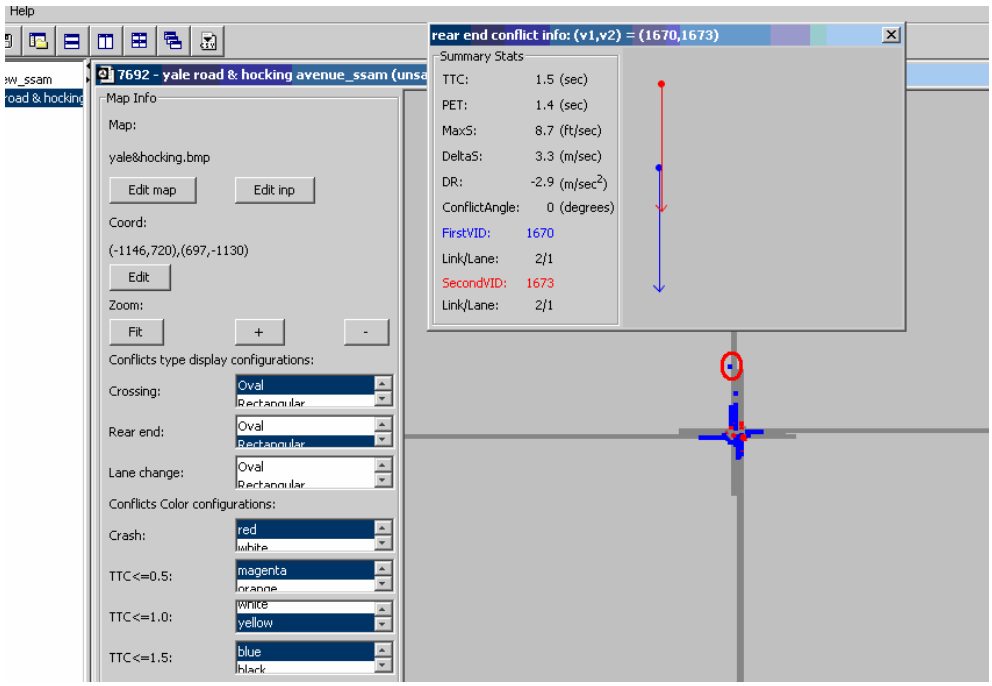


Figure 73. Screen Capture. SSAM Screen—Map Tab Conflict Information Window.

Recoding Map Coordinates

Users can get the corner point coordinates of a .bmp file from a VISSIM (or others network. Figure 74 shows a VISSIM network file (.inp file) named *7692-yale road & hocking avenue.inp*, which is the network that generates the .trj files used for the example in this manual.

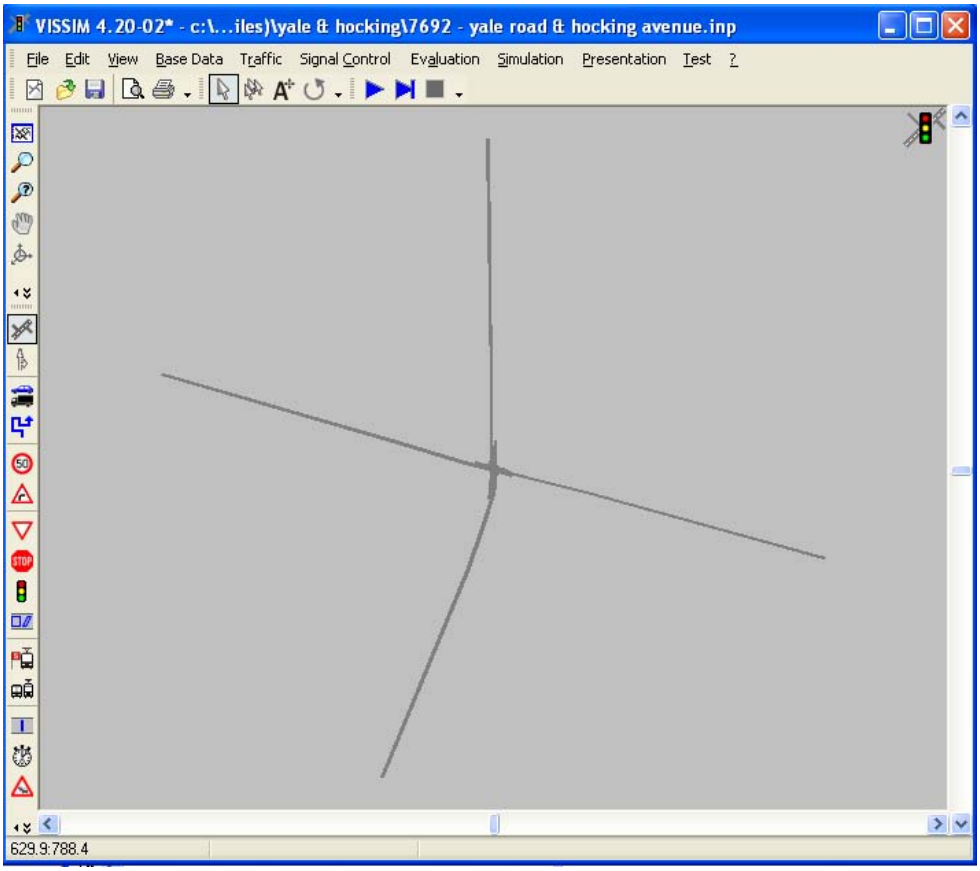


Figure 74. Screen Capture. VISSIM Screen—Network Example.

Map files can be generated by the print screen operation on this VISSIM network (or other programs). Users can paste in **Print** and save the image as .bmp file. The map corner coordinates can then be recorded within the VISSIM network, as shown in figure 75 and figure 76. The user can move the mouse cursor to the upper-left corner and lower-right corner of the network and record the coordinates data located at the bottom of the network in (x, y) format.

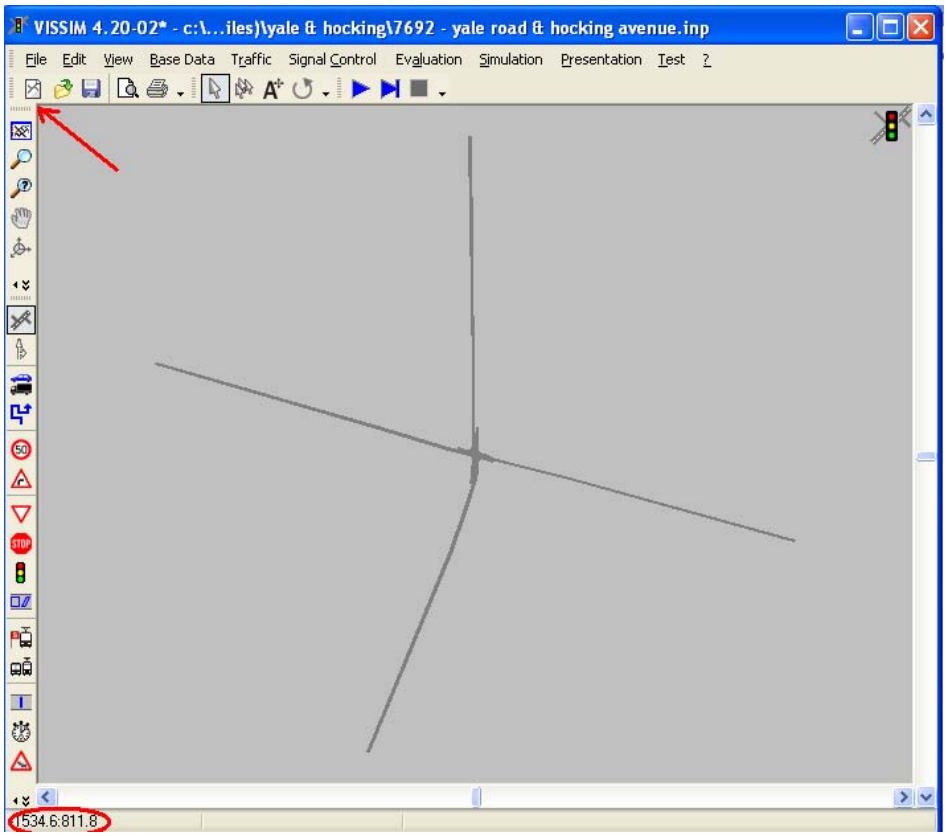


Figure 75. Screen Capture. VISSIM Screen—Record Upper-Left Corner Coordinates.

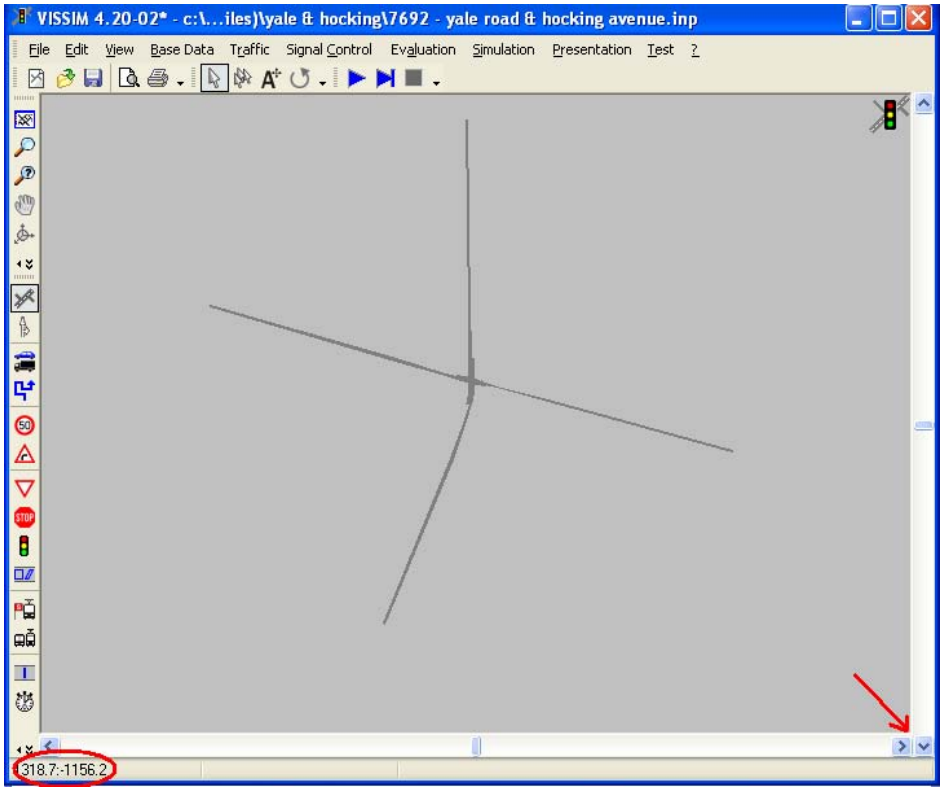


Figure 76. Screen Capture. VISSIM Screen— Record Lower-Right Corner Coordinates.

Saving the Case Document

To save the case document, click **Save**. Users can also choose **Save** in the **File** menu. In figure 77, the case document has not yet been saved, as indicated by the *(unsaved)* text appended to the case name in the title bar. In figure 78, the case document has been saved.

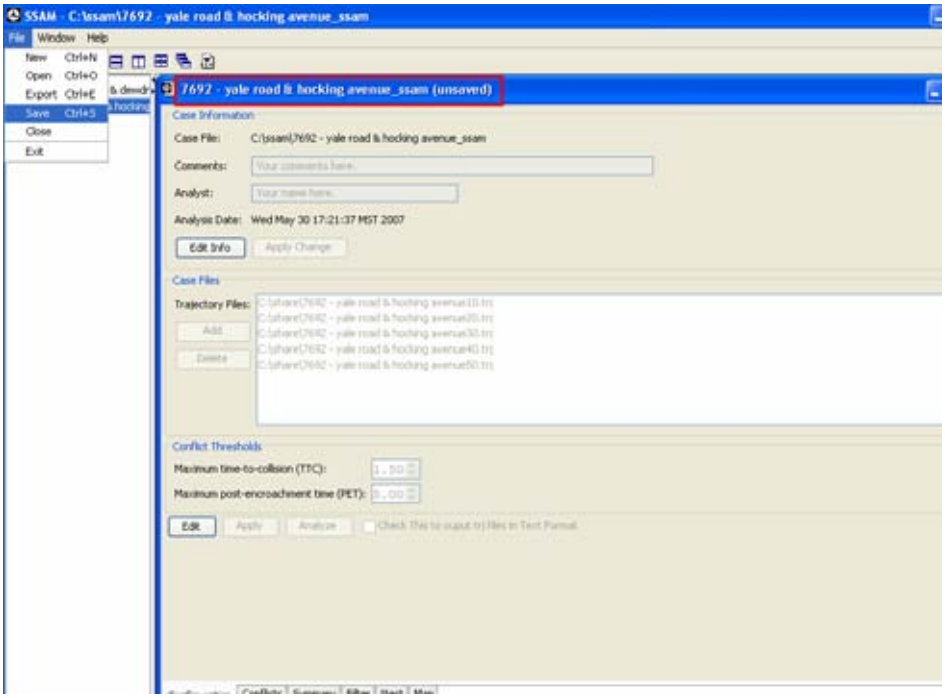


Figure 77. Screen Capture. SSAM Screen—Case Document Not Saved.

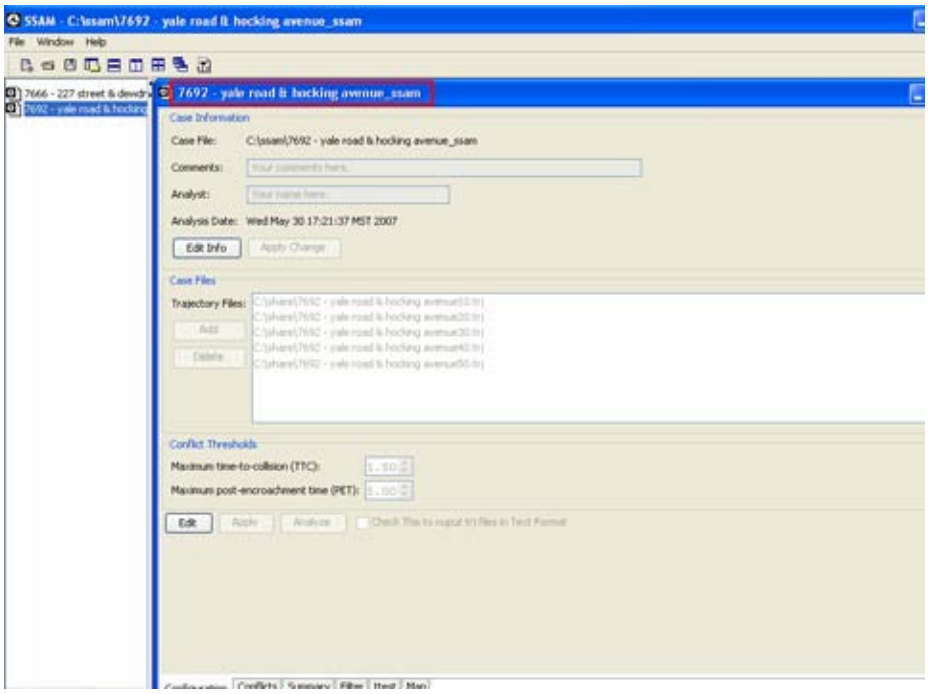


Figure 78. Screen Capture. SSAM Screen—Case Document Saved.

The case document can now be closed in the internal window. The case document remains in the workspace window after closing the case document as shown in figure 79.

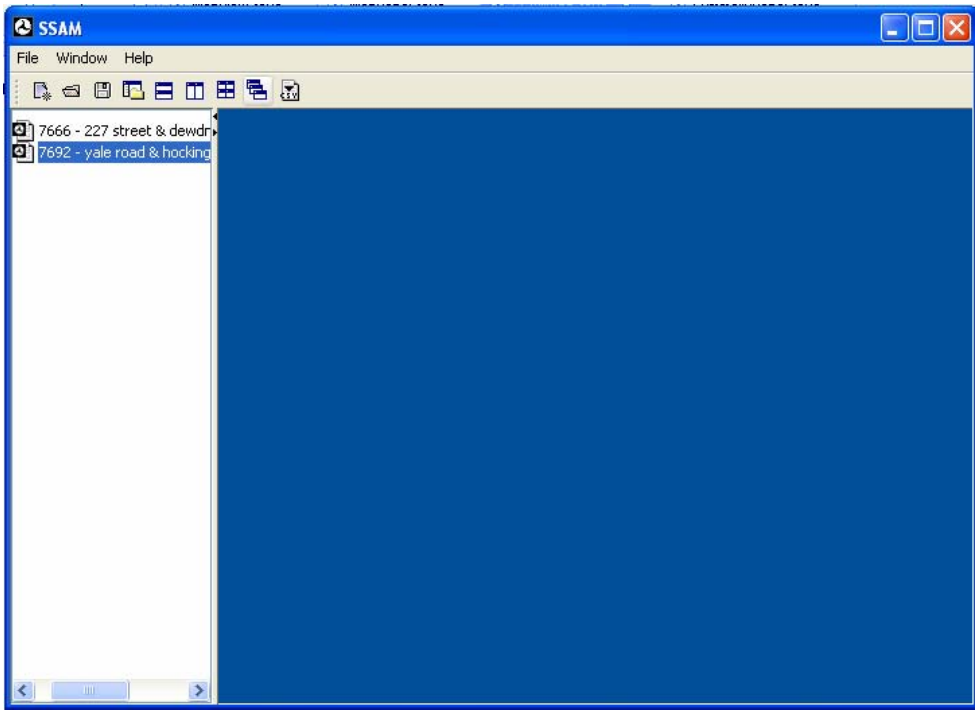


Figure 79. Screen Capture. SSAM Screen—Case Document Closed.

The case document can be opened again either by double-clicking on the case document name in the workspace window or by right-clicking on the case document name and choosing **Open** from the resulting menu. Choosing **Delete** from this menu will remove the document from the workspace and delete the case document from the disk.

Editing an Existing Case Document

To reopen a case document, double-click on the case file name in the case document workspace. The case document then appears in the internal frame as shown in figure 80.

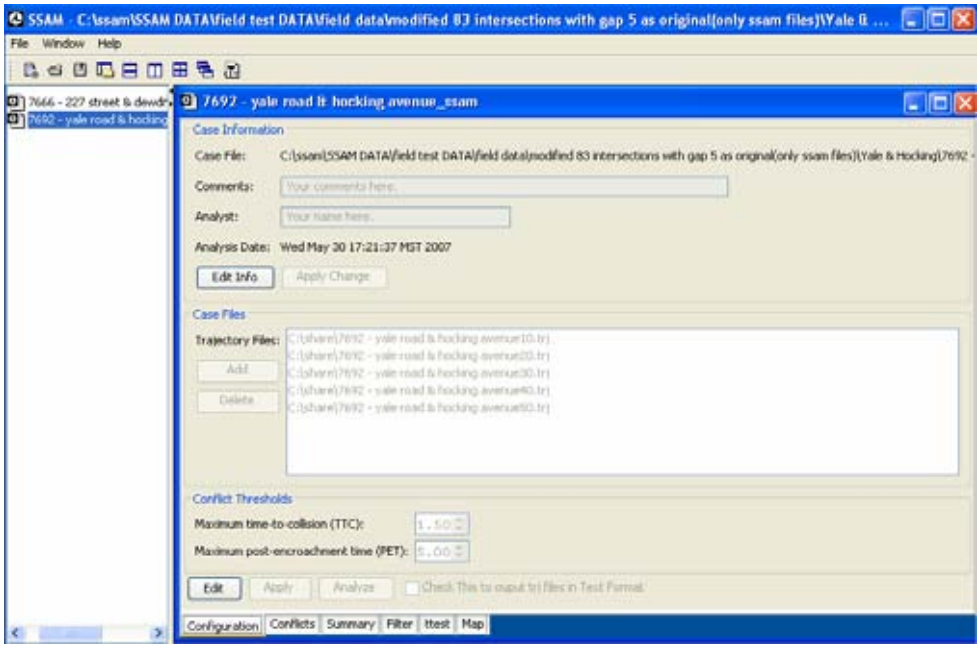


Figure 80. Screen Capture. SSAM Screen—Open Case Document from Workspace.

Users can edit the case document information. To delete a .trj file from the case files section, click **Edit**. A confirmation message appears as shown in figure 81.

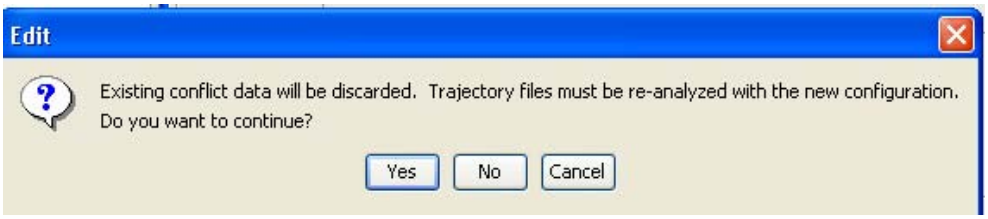


Figure 81. Screen Capture. SSAM Screen—Confirm Delete Message.

The message informs the user that all the data in the **Conflict** tab and **Summary** tab will be deleted. This means the Case Files section of a case document cannot be edited without discarding the conflict and summary information stored in the old document.

Click **Yes** to activate the case files and the threshold sections for editing as shown in figure 82.

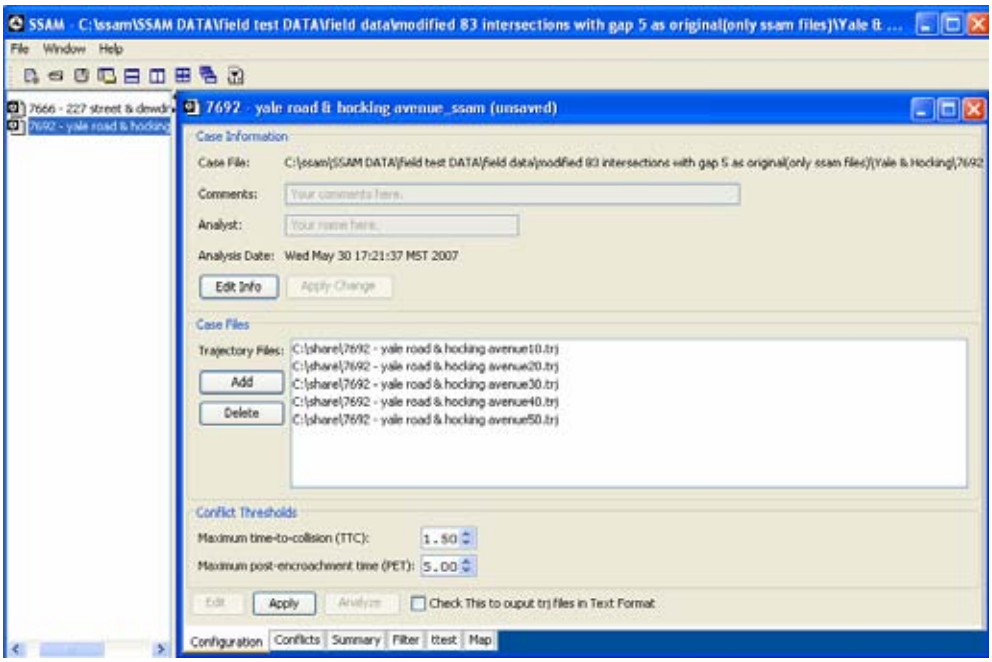


Figure 82. Screen Capture. SSAM Screen—Edit a Case Document.

To delete *yale road & hocking avenue101.trj,* select the file name then click **Delete**. *Yale road & hocking avenue101.trj* will be deleted from the case files section as shown in figure 83.

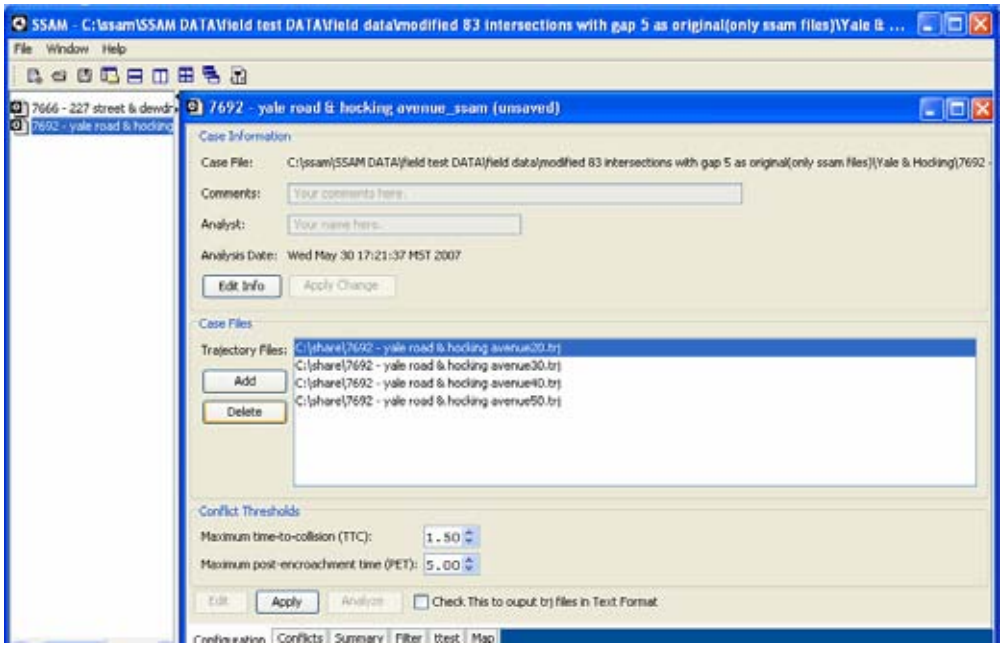


Figure 83. Screen Capture. SSAM Screen—Delete a .trj File.

Click **Apply** to apply the changes to the case document. This will activate the **Analyze** button. The case document is now ready to be analyzed again with the new case files. Note that applying changes does not save the case document. In order to save the case document, users must click **Save** or choose the **Save** option in the **File** menu.

Checking Filter Robustness

SSAM is robust in terms of checking user input errors. For example, if a user attempts to close an unsaved case document, the software will prompt the user to save the case document to disk. This section describes the robust features provided by the SSAM software filter. SSAM offers a robust filter which makes sure that the user sets the valid filters.

To apply a filter, click **Apply Filter**. When this button is clicked, SSAM checks if there is any data to which the filter can be applied. If the user attempts to apply a filter to nonexisting data, the software will inform the user that a case document must first be populated with conflict data which can be filtered. Figure 84 shows the error message for this user input error.

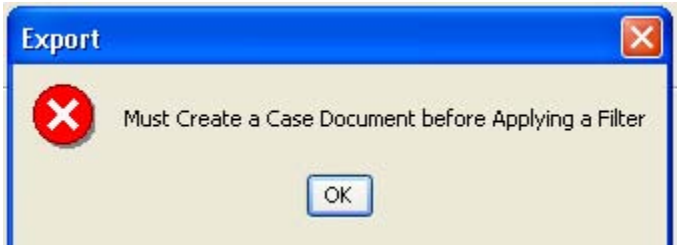


Figure 84. Screen Capture. SSAM Screen—Error Message for Nonexisting Data.

If the case document has been populated with conflict data, the SSAM software checks for the following user input errors:

- *Surrogate Thresholds*

  SSAM ensures that the user does not input invalid maximum and minimum values in the surrogate's threshold section. The surrogate threshold section of the filter allows the user to view conflict data that falls within a range for single or multiple surrogate measures. The filter thus allows the user to specify ranges for surrogate measures.

- *Conflict Types*

  SSAM checks the user selection of the conflict types for the filter. The user can select multiple conflict types. For example, the user can select the rear end and the lane change conflicts, which means that all rear end and lane change conflicts will be picked up in the **Conflict** tab. By default, the type *ALL* is selected. This means that the user can see all types of conflicts in the **Conflict** tab. The selection of any conflict type along with the *ALL* type is an invalid selection.

- *Link types*

  The user can select multiple links in the Links Types section of the filter. By default, the type *ALL* is selected. This means that the user can see conflict data for all the links in the **Conflict** tab. The selection of any link along with the *ALL* type is an invalid selection.

If the tool finds all of the above filter errors, it will report all corresponding error messages.

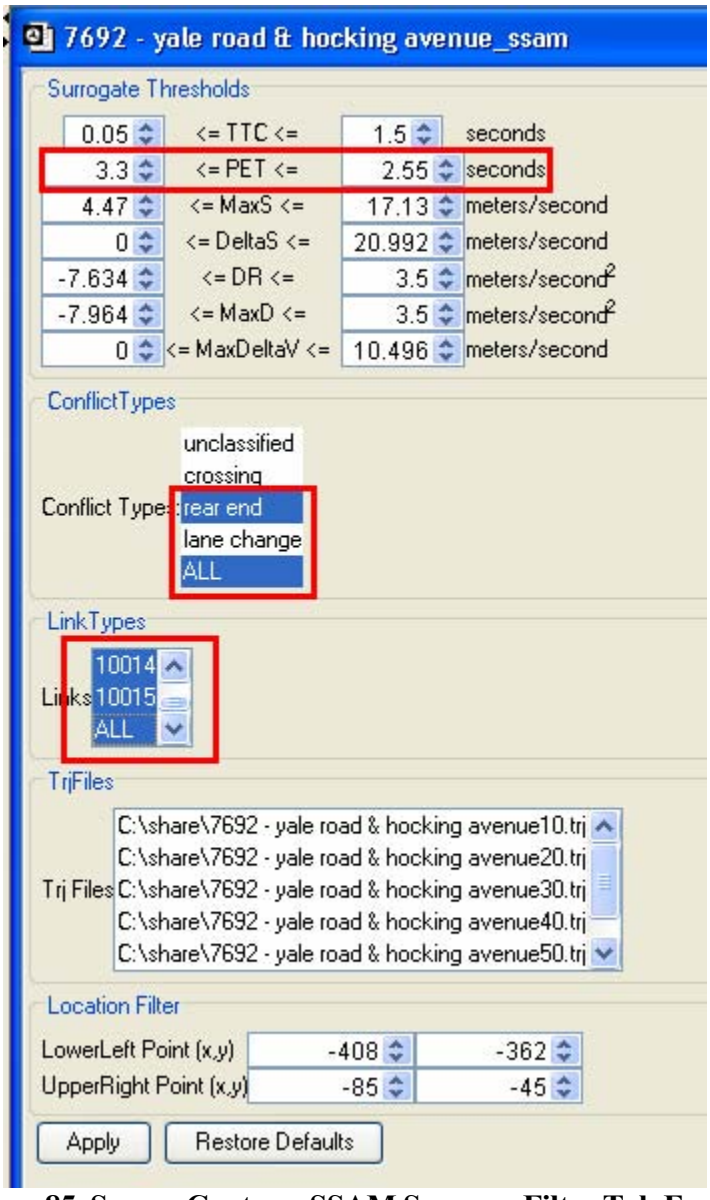


Figure 85. Screen Capture. SSAM Screen—Filter Tab Errors.

In figure 85 we can see the following errors in the filter settings:

- Range for the PET surrogate measure is invalid.
- The rear end conflict type is selected along with the ALL option.
- Links 100014 and 10015 are selected with the ALL option.

The following error message appears when the filter seen in figure 86 is applied.

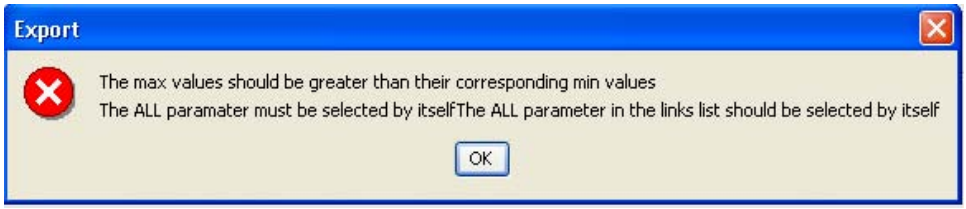


Figure 86. Screen Capture. SSAM Screen—Wrong Filter Settings Error Message.

Null Result Filter

Sometimes the filter settings applied by the user might not yield a result. For example, if there are no lane-change conflicts and the user wants to view only lane-change conflicts, no conflicts will be shown in the **Conflict** tab. In this case, the SSAM software will inform the user that the filter did not yield any results. However, the data in the **Conflict** tab and the **Summary** tab will remain unchanged. Figure 87 shows the message for this event.

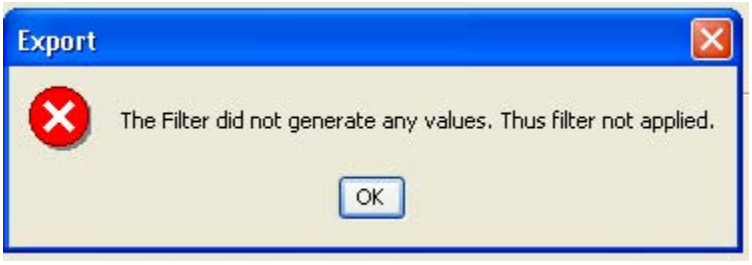


Figure 87. Screen Capture. SSAM Screen—No Results Error Message.

USABILITY

This section will demonstrate the SSAM software's ability to present documents in different ways. It will also describe the added functionality of exporting data from SSAM to a .csv format which can be viewed in Microsoft® Excel.

In this example, two case documents—*140 & 72_ssam* and *184 & fraser_ssam*—are open. Figure 88 shows three case documents in the workspace area and *140 & 72_ssam* open.

Working with the Tiling Options

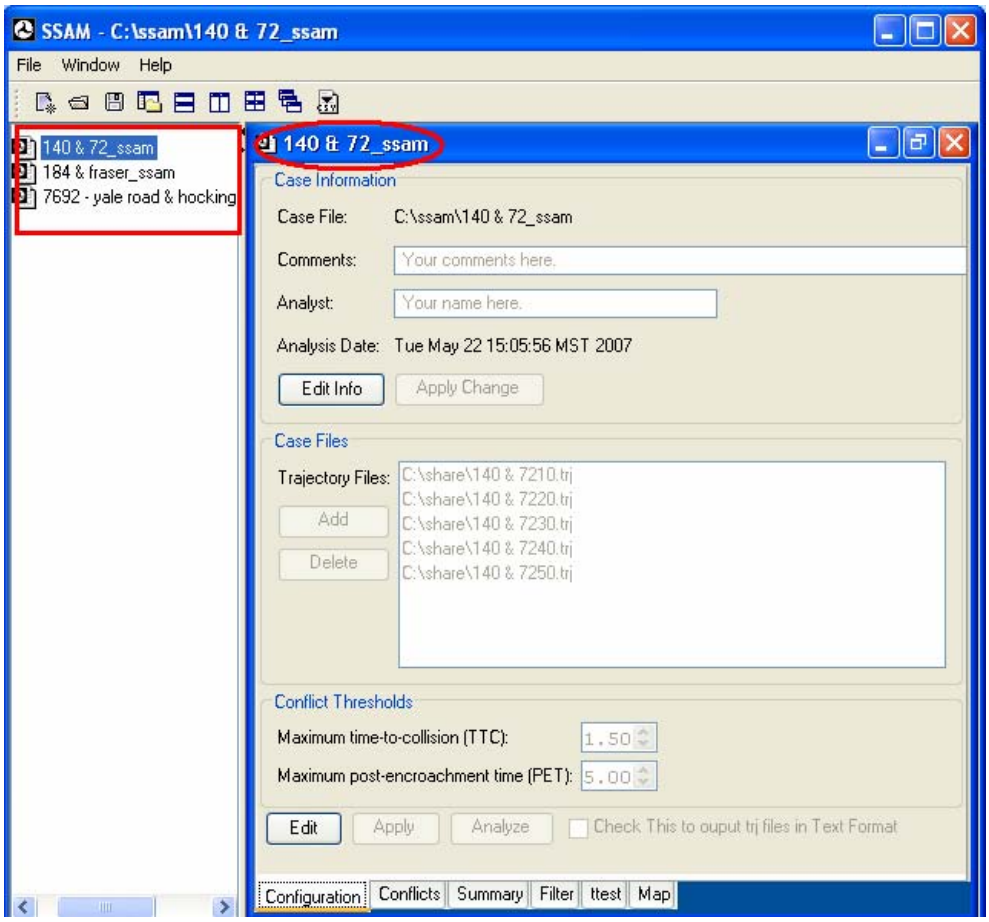


Figure 88. Screen Capture. SSAM Screen—Opening Case Documents.

The relevant information for the selected case document is seen in the internal frame. Notice in figure 88 that the name of the internal frame is the same as the name of the selected file. The SSAM software allows the user to view all open case documents at once. The user can tile the case documents in the following ways:

Using the Horizontal Tiling

To use horizontal tiling, click **Horizontal tile** in the toolbar. Users can also select **Horizontal** from the **Window** menu. Figure 89 shows three horizontally tiled case documents.

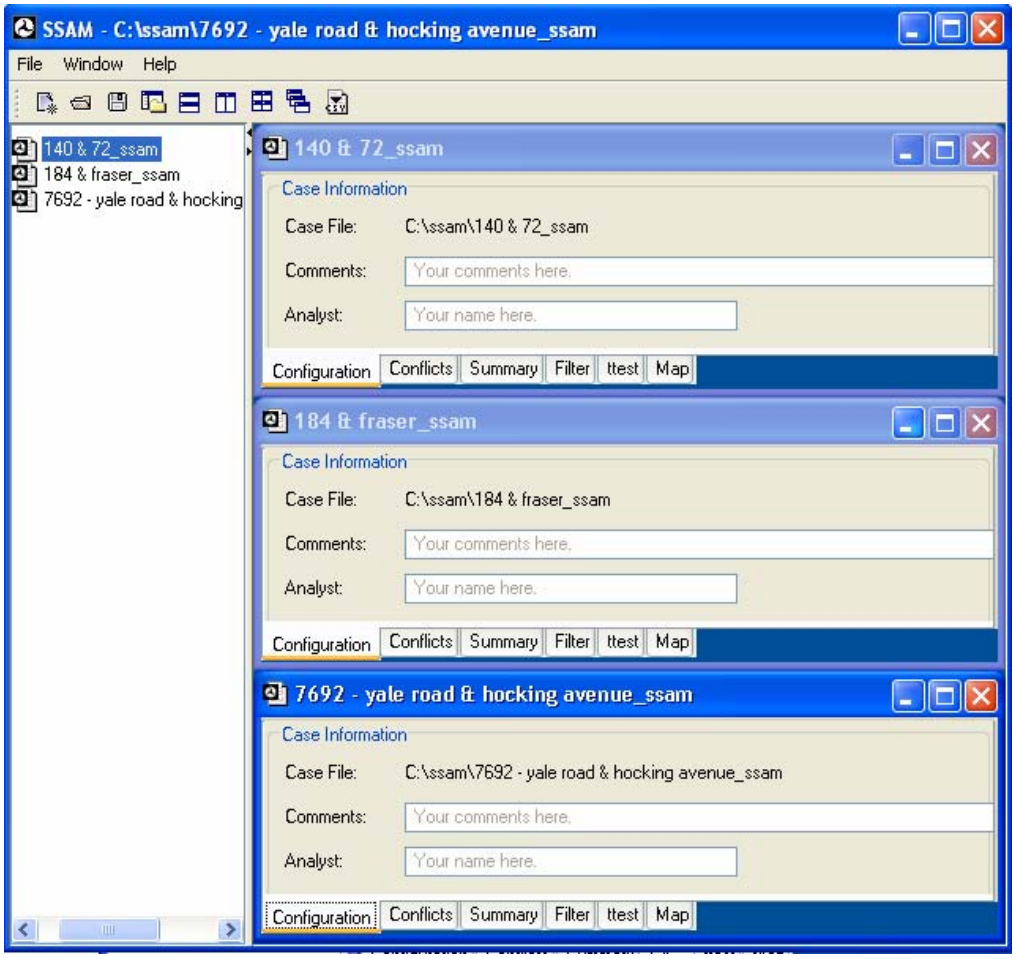


Figure 89. Screen Capture. SSAM Screen—Horizontal Tiling.

Using the Vertical Tiling

To use vertical tiling, click **Vertical tile** in the toolbar. Users can also select **Vertical** from the **Window** menu. Figure 90 shows three vertically tiled case documents.

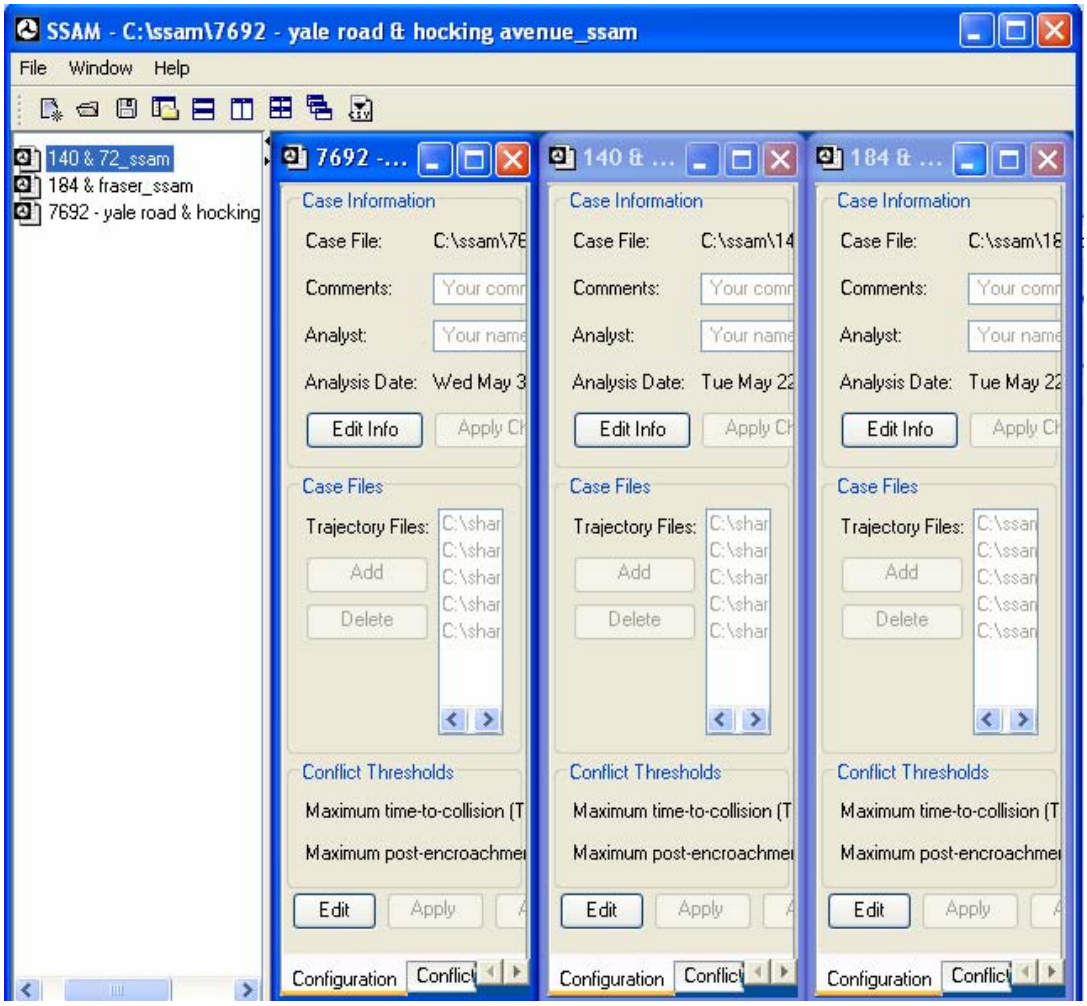


Figure 90. Screen Capture. SSAM Screen—Vertical Tiling.

Using the Grid Tiling

To use grid tiling, click **Grid tile** in the toolbar. Users can also select **Grid** from the **Window** menu. Figure 91 shows three case documents tiled in a grid.

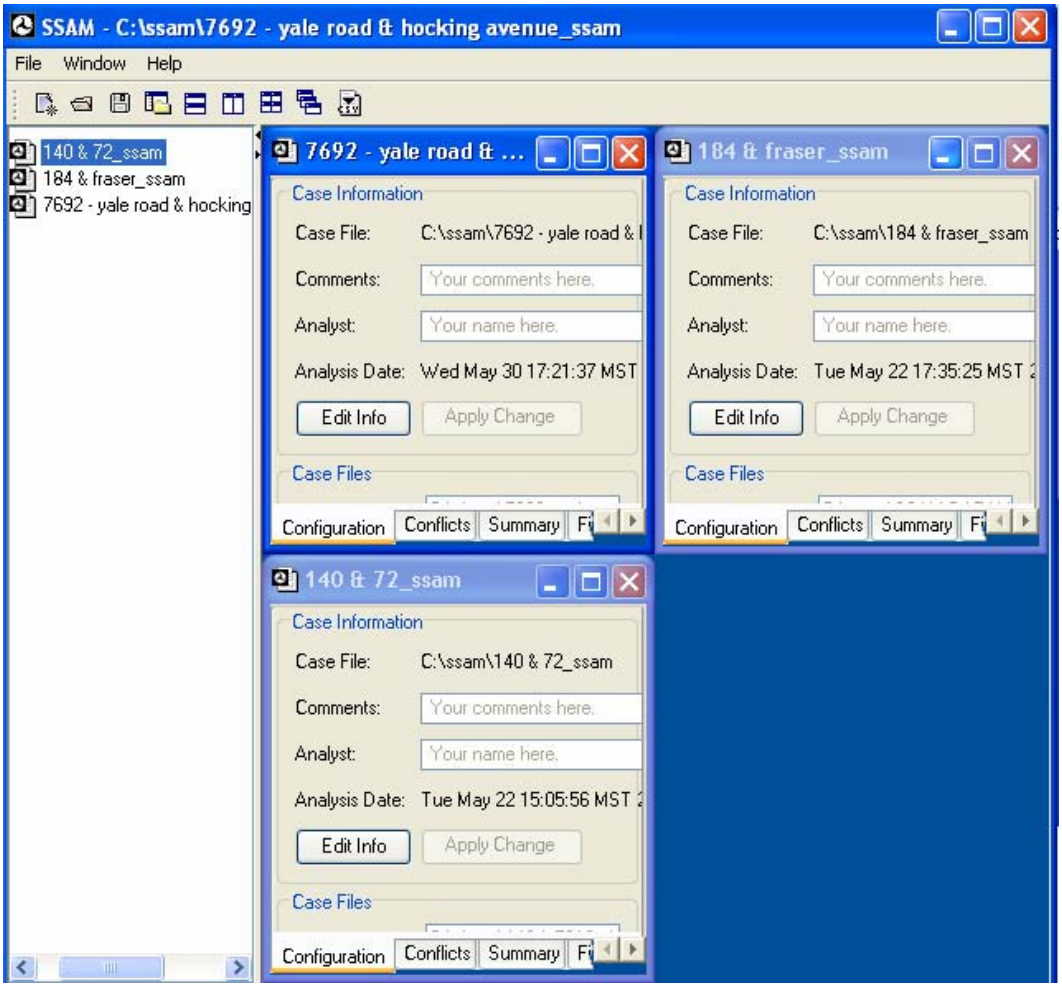


Figure 91. Screen Capture. SSAM Screen—Grid Tiling.

Using the Cascade Tiling

To use cascade tiling, click **Cascade tile** in the toolbar. Users can also select **Cascade** from the **Window** menu. Figure 92 shows three cascaded case documents.

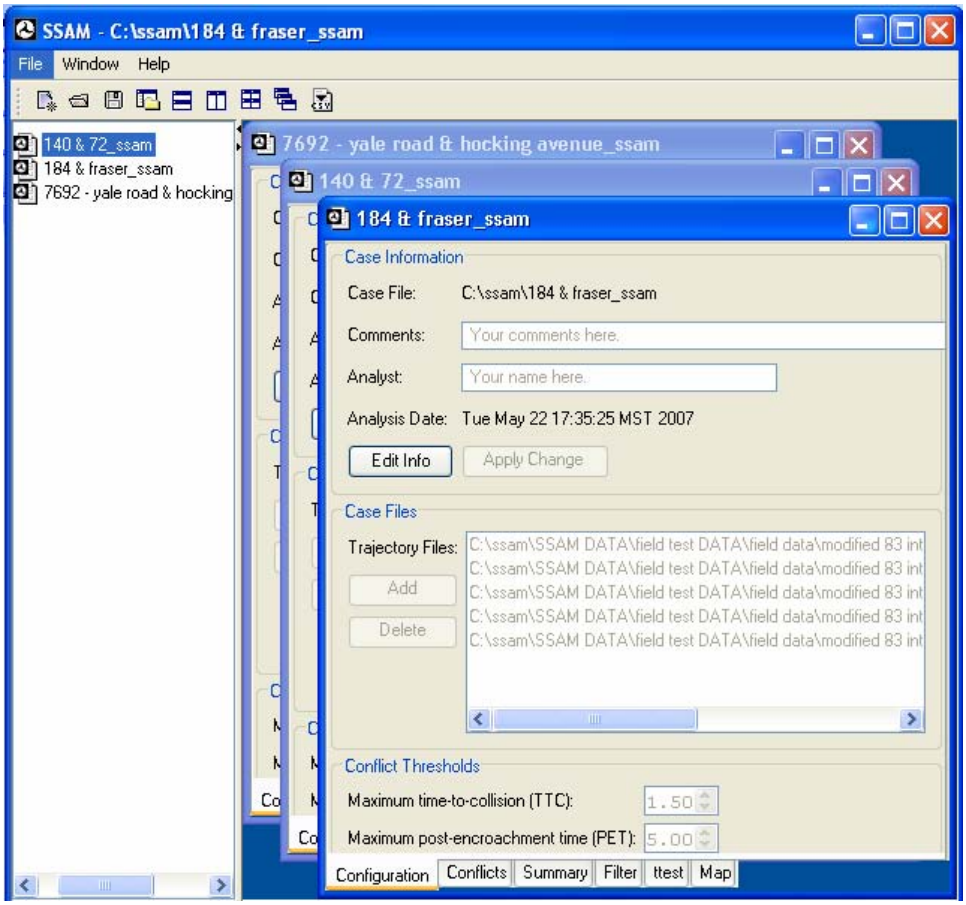


Figure 92. Screen Capture. SSAM Screen—Cascade Tiling.

All the documents must be opened to be seen in a tiled view. Each of the case document frames can be resized; however, the elements inside the internal window of a case document will not be resized according to the size of the frame. This can be seen in the figures above.

Toggling the Workspace Window

SSAM also allows the user to toggling the workspace. This can be done by clicking **Toggle Workspace** on the toolbar or selecting **Toggle Workspace** in the **Window** menu. Figure 93 shows the tool when the workspace window is toggled out.

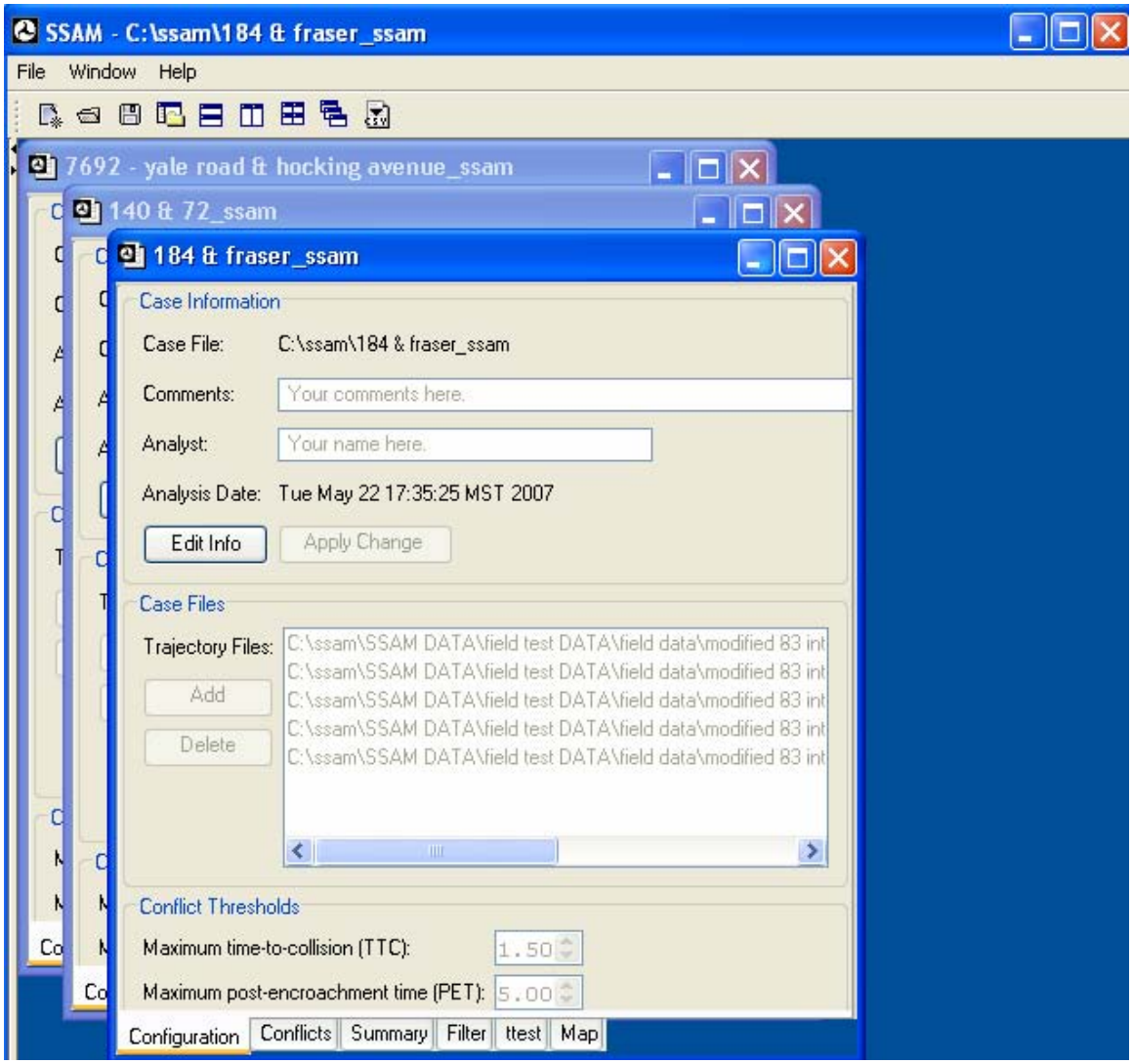


Figure 93. Screen Capture. SSAM Screen—Toggling the Workspace Window.

Exporting Data

SSAM allows the user to export the conflict data from the **Conflict** tab into a .csv file. Click **Export** to export the conflict data to a .csv file. Clicking the **Export** button will result in the file menu shown in figure 94. In this example, the export file is named *export.csv*. Click **Save** to save the file.

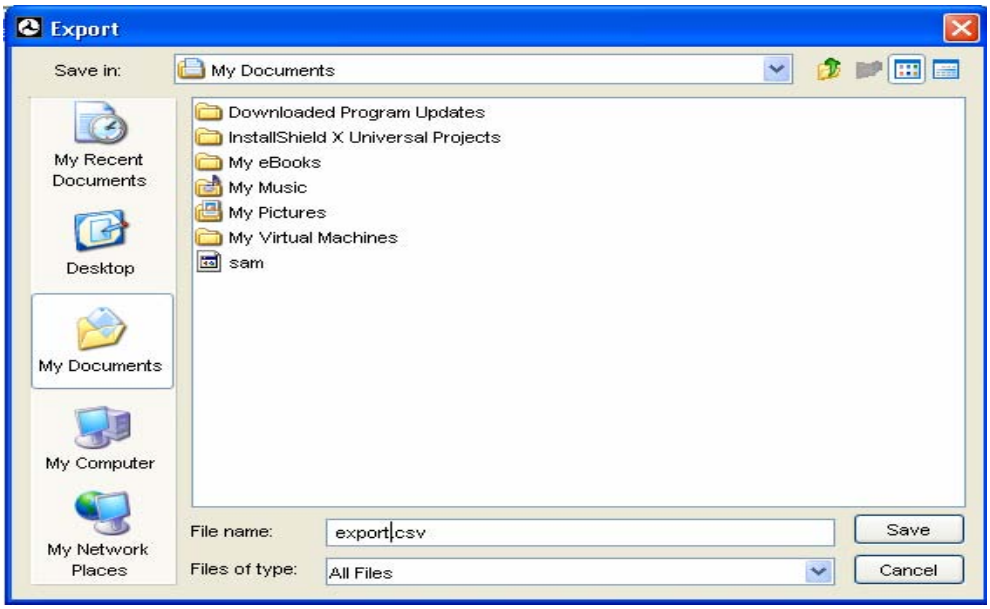
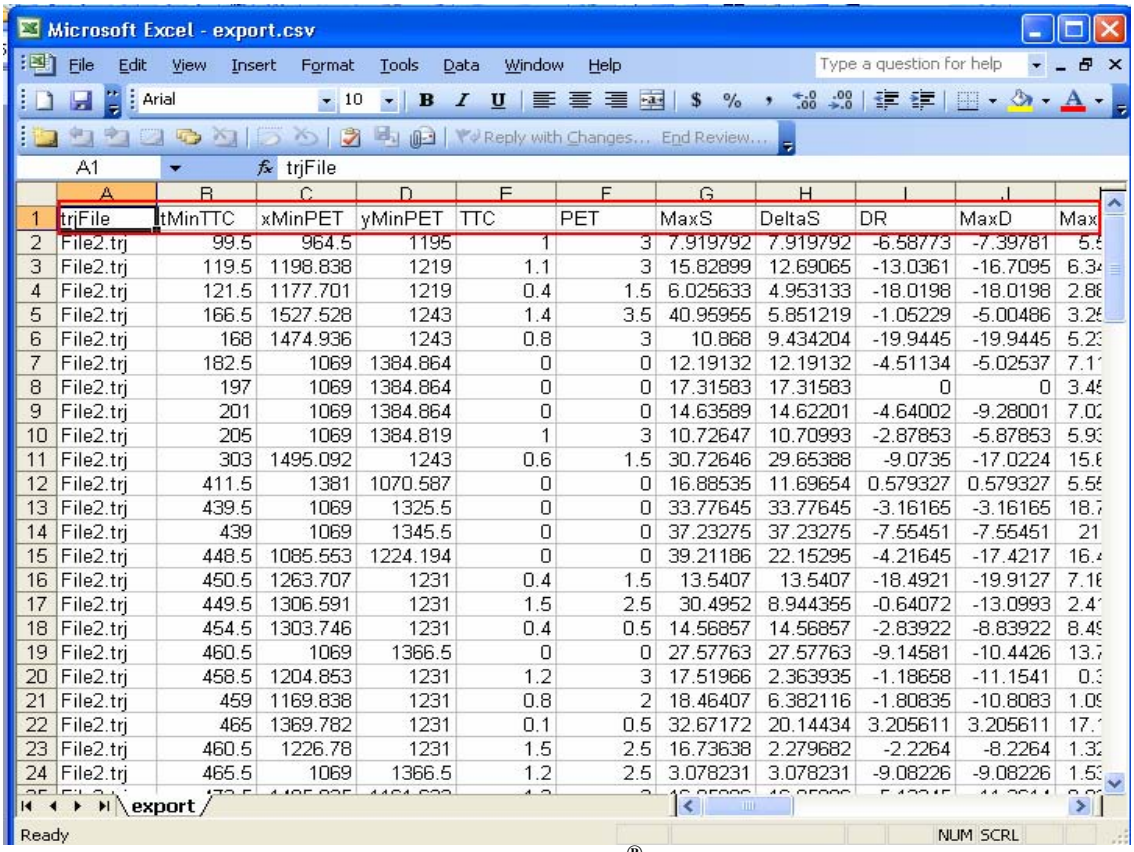


Figure 94. Screen Capture. Export Conflict Table to .csv File.

Figure 95 shows the *export.csv* file when it is open in Microsoft® Excel. The first row of the .csv file is marked in figure 95 to show the column names as seen in the **Conflict** tab of the case document.



	A	B	C	D	E	F	G	H	I	J	
1	trjFile	tMinTTC	xMinPET	yMinPET	TTC	PET	MaxS	DeltaS	DR	MaxD	Max
2	File2.trj	99.5	964.5	1195	1	3	7.919792	7.919792	-6.58773	-7.39781	5.5
3	File2.trj	119.5	1198.838	1219	1.1	3	15.82899	12.69065	-13.0361	-16.7095	6.3
4	File2.trj	121.5	1177.701	1219	0.4	1.5	6.025633	4.953133	-18.0198	-18.0198	2.8
5	File2.trj	166.5	1527.528	1243	1.4	3.5	40.95955	5.851219	-1.05229	-5.00486	3.2
6	File2.trj	168	1474.936	1243	0.8	3	10.868	9.434204	-19.9445	-19.9445	5.2
7	File2.trj	182.5	1069	1384.864	0	0	12.19132	12.19132	-4.51134	-5.02537	7.1
8	File2.trj	197	1069	1384.864	0	0	17.31583	17.31583	0	0	3.4
9	File2.trj	201	1069	1384.864	0	0	14.63589	14.62201	-4.64002	-9.28001	7.0
10	File2.trj	205	1069	1384.819	1	3	10.72647	10.70993	-2.87853	-5.87853	5.9
11	File2.trj	303	1495.092	1243	0.6	1.5	30.72646	29.65388	-9.0735	-17.0224	15.6
12	File2.trj	411.5	1381	1070.587	0	0	16.88535	11.69654	0.579327	0.579327	5.5
13	File2.trj	439.5	1069	1325.5	0	0	33.77645	33.77645	-3.16165	-3.16165	18.7
14	File2.trj	439	1069	1345.5	0	0	37.23275	37.23275	-7.55451	-7.55451	21
15	File2.trj	448.5	1085.553	1224.194	0	0	39.21186	22.15295	-4.21645	-17.4217	16.4
16	File2.trj	450.5	1263.707	1231	0.4	1.5	13.5407	13.5407	-18.4921	-19.9127	7.1
17	File2.trj	449.5	1306.591	1231	1.5	2.5	30.4952	8.944355	-0.64072	-13.0993	2.4
18	File2.trj	454.5	1303.746	1231	0.4	0.5	14.56857	14.56857	-2.83922	-8.83922	8.4
19	File2.trj	460.5	1069	1366.5	0	0	27.57763	27.57763	-9.14581	-10.4426	13.7
20	File2.trj	458.5	1204.853	1231	1.2	3	17.51966	2.363935	-1.18658	-11.1541	0.3
21	File2.trj	459	1169.838	1231	0.8	2	18.46407	6.382116	-1.80835	-10.8083	1.0
22	File2.trj	465	1369.782	1231	0.1	0.5	32.67172	20.14434	3.205611	3.205611	17.1
23	File2.trj	460.5	1226.78	1231	1.5	2.5	16.73638	2.279682	-2.2264	-8.2264	1.3
24	File2.trj	465.5	1069	1366.5	1.2	2.5	3.078231	3.078231	-9.08226	-9.08226	1.5

Figure 95. Screen Capture. Microsoft® Excel—Exported .csv File.

APPENDIX. TERMS AND DEFINITIONS

This appendix serves as a glossary, defining several surrogate safety measures and other terms used within SSAM.

Case document is a file which contains the required information for analyzing trajectory data. It also contains the result set of the analysis. The required information for creating a case document is as follows:

- Name of the case document.
- Name of analyst.
- Comments.
- Analysis date.
- A list of trajectory files to be analyzed.
- Threshold values (TTC and PET).

All of the above are configured via the **Configuration** tab in the SSAM software.

The result set obtained after analyzing a single or a group of trajectory files in the case document comprises of the following information:

- List of conflicts.
- List of summary data.

A case document can be overwritten and saved.

The following surrogate safety measures are ordered according to their column-wise appearance (from left-to-right) in the conflicts table on the **Conflicts** tab.

trjFile is the name of the trajectory file (i.e.,.trj file) where this conflict was identified.

tMinTTC is the simulation time where the minimum TTC (time-to-collision) value for this conflict was observed. At the beginning of each simulation, the time is (generally) 0 and advances in increments of 0.1 to 1.0 seconds per time step depending on the resolution of the simulation software.

xMinPET is the x-coordinate specifying the approximate location of the conflict at the time when the minimum PET (post encroachment time) was observed. More specifically,

this location corresponds to the center of the (first) vehicle, where the subsequent arrival of the second vehicle to the same location was the shortest encroachment observed.

yMinPET is the y-coordinate specifying the approximate location of the conflict at the time when the minimum PET (post encroachment time) was observed. More specifically, this location corresponds to the center of the (first) vehicle, where the subsequent arrival of the second vehicle to the same location was the shortest encroachment observed.

TTC is the minimum time-to-collision value observed during the conflict. This estimate is based on the current location, speed, and trajectory of two vehicles at a given instant.

PET is the minimum post encroachment time observed during the conflict. Post encroachment time is the time between when the first vehicle last occupied a position and the second vehicle subsequently arrived at the same position. A value of 0 indicates an actual collision.

MaxS is the maximum speed of either vehicle throughout the conflict (i.e., while the TTC is less than the specified threshold). This value is expressed in feet per second or meters per second, depending on the units specified in the corresponding trajectory file.

DeltaS is the difference in vehicle speeds as observed at **tMinTTC**. More precisely, this value is mathematically defined as the magnitude of the difference in vehicle velocities (or trajectories), such that if $\boldsymbol{v_1}$ and $\boldsymbol{v_2}$ are the velocity vectors of the first and second vehicles respectively, then **DeltaS** = $\| \boldsymbol{v_1} - \boldsymbol{v_2} \|$. Consider an example where both vehicles are traveling at the same speed, $\boldsymbol{v}$. If they are traveling in the same direction, **DeltaS** = 0. If they have a perpendicular crossing path, **DeltaS** = $(\sqrt{2})\boldsymbol{v}$. If they are approaching each other head on, **DeltaS** = $2\boldsymbol{v}$.

DR is the initial deceleration rate of the second vehicle. Note that in actuality, this value is recorded as the instantaneous acceleration rate. If the vehicle brakes (i.e., reacts), this is the first negative acceleration value observed during the conflict. If the vehicle does not brake, this is the lowest acceleration value observed during the conflict. This value is expressed in feet per second or meters per second, depending on the units specified in the corresponding trajectory file.

MaxD is the maximum deceleration of the second vehicle. Note that in actuality, this value is recorded as the minimum instantaneous acceleration rate observed during the conflict. A negative value indicates deceleration (braking or release of gas pedal). A positive value indicates that the vehicle did not decelerate during the conflict. This value is expressed in feet per second or meters per second, depending on the units specified in the corresponding trajectory file.

MaxDeltaV is the maximum **DeltaV** value of either vehicle in the conflict (see **FirstDeltaV** or **SecondDeltaV** for more information).

ConflictAngle is an approximate angle of hypothetical collision between conflicting vehicles, based on the estimated heading of the each vehicle (see explanation of **FirstHeading**). The angle, expressed in the perspective of the first vehicle to arrive at the conflict point, conveys the direction from which the second vehicle is approaching the first vehicle, as shown in figure 96. The angle ranges from -180 ° to +180 °, where a negative angle indicates approach from the left and a positive angle indicates approach from the right. An angle of 180 ° (or -180 °) indicates a direct head-on approach, and an angle of 0 ° (or -0 °) indicates a direct rear approach.

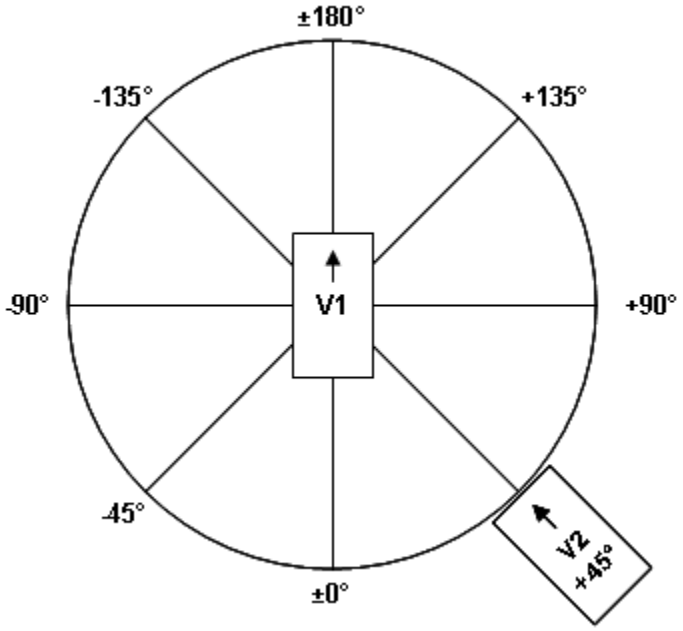


Figure 96. Illustration. Conflict Angle.

ClockAngle is an alternative expression of the conflict angle in terms of a more familiar clock hand positions. Again, the angle is expressed in the perspective of the first vehicle, with the clock time indicating the angle from which the second vehicle is approaching, as shown in figure 97. The 12:00 position is direct ahead of the first vehicle, 3:00 is to the right, 6:00 is directly behind, and 9:00 is to the left.

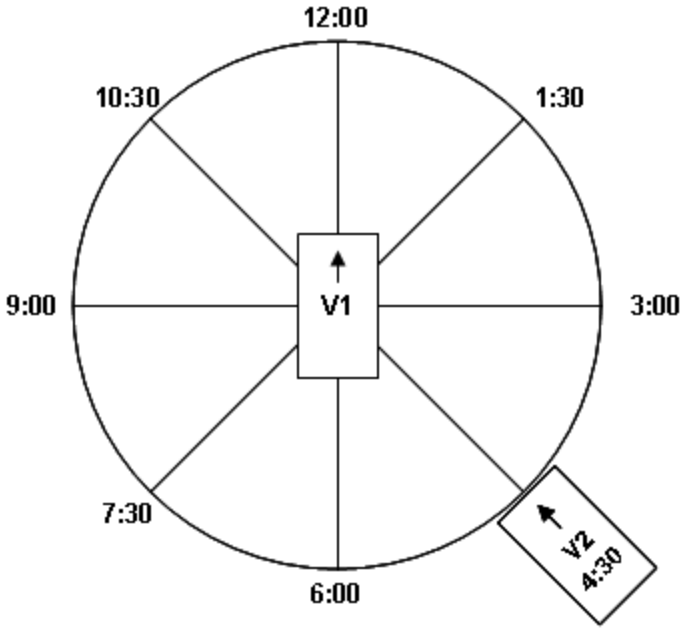


Figure 97. Illustration. Clock Angle.

ConflictType describes whether the conflict is the result of a rear end, lane change, or crossing movement. If link and lane information is not available for both vehicles, then the event type is classified based solely on the absolute value of the **ConflictAngle** as follows. The type is classified as a rear-end conflict if ||**ConflictAngle**|| < 30 °, a crossing conflict if ||**ConflictAngle**|| > 85 °, or otherwise a lane-changing conflict. However, the simulation model that produced the vehicle trajectory data can generally provide link and lane information for both vehicles—though the coding of these values may vary significantly from one simulation vendor to the next. If link and lane information is available, that information is utilized for classification in the case that the vehicles both occupy the same lane (of the same link) at either the start or end of the conflict event. If the vehicles both occupy the same lane at the start *and* end of the event, then it is classified as a rear-end event. If either vehicle ends the conflict event in a different lane than it started (while having not changed links), then the event is classified as a lane-change. If either of the vehicles changes links over the course of the event, then the conflict angle determines the classification as previously described, with the following possible exception). For two vehicles that begin the conflict event in the same lane, but change links over the course of the event, the classification logic considers only rear-end or lane-change types, based on the conflict angle (using the threshold value previously mentioned). Note that vehicle maneuvers such as changing lanes into an adjacent turn bay lane or entering into an intersection area may be consider changing links, depending on the underlying simulation model. In some cases, vehicles which appear to be traveling in the same lane may actually by considered by the simulation model as traveling on different links that happen to overlap.

PostCrashV is an estimate of the post collision velocity of both vehicles. This estimate assumes that the vehicles did crash, at the estimated **ConflictAngle**, at velocities observed at the **tMinTTC**, and assuming an inelastic collision between the center of mass

of both vehicles, where both vehicles subsequently deflect in the same direction and at the same velocity.

PostCrashHeading is the estimated heading of both vehicles following a hypothetical collision (as discussed in **PostCrashV**). This heading is expressed as the angle measured counterclockwise from the x-axis (which is assumed to point right), such that 0 ° is right, 90 ° is up, 180 ° is left, and 270 ° is down. The angle ranges from 0 ° to 360 °.

FirstVID (SecondVID) is the vehicle identification number of the first (second) vehicle. The first vehicle is the vehicle that arrives to the conflict point first. The second vehicle subsequently arrives to the same location. In rare cases (actually collisions) both vehicles may arrive to a location simultaneously, in which case the tie between first and second vehicle in broken arbitrarily.

FirstLink (SecondLink) is a number indicating which link the first (second) vehicle is traveling on at **tMinTTC**.

FirstLane (SecondLane) is a number indicating in which lane the first (second) vehicle is traveling on at **tMinTTC**.

FirstLength (SecondLength) is the length of the first (second) vehicle in feet or meters.

FirstWidth (SecondWidth) is the width of the first (second) vehicle in feet or meters.

FirstHeading (SecondHeading) is the heading of the first (second) vehicle during the conflict. This heading is approximated by the change in position from the start of the conflict to the end of the conflict. Note that in most non-rear-end conflicts, at least one vehicle is turning throughout the conflict. Its actual heading would vary accordingly throughout the conflict. If the vehicle does not move during the conflict, then the direction in which it is facing is taken as the heading. This heading is expressed as the angle measured counterclockwise from the x-axis (which is assumed to point right), such that 0 ° is right, 90 ° is up, 180 ° is left, and 270 ° is down. The angle ranges from 0 ° to 360 °.

FirstVMinTTC (SecondVMinTTC) is the velocity (speed) of the first (second) vehicle at **tMinTTC**.

FirstDeltaV (SecondDeltaV) is the change between conflict velocity (given by speed **FirstVMinTTC** and heading **FirstHeading**) and the post-collision velocity (given by speed **PostCrashV** and heading **PostCrashHeading**). This is a surrogate for the severity of the conflict, calculated assuming a *hypothetical* collision of the two vehicles in the conflict.

xFirstCSP (xSecondCSP) is the x-coordinate of the first (second) vehicle at the conflict starting point (CSP). The CSP is the location of the vehicle at **tMinTTC**.

yFirstCSP (ySecondCSP) is the y-coordinate of the first (second) vehicle at the conflict starting point (CSP). The CSP is the location of the vehicle at **tMinTTC**.

xFirstCEP (xSecondCEP) is the x-coordinate of the first (second) vehicle at the conflict ending point (CEP). The CEP is the location of the vehicle at either the last time step where the TTC value is below the specified threshold or where the last post-encroachment value was observed, whichever occurs later in the conflict timeline.

yFirstCEP (ySecondCEP) is the y-coordinate of the first (second) vehicle at the conflict ending point (CEP). The CEP is the location of the vehicle at either the last time step where the TTC value is below the specified threshold or where the last post-encroachment value was observed, whichever occurs later in the conflict timeline.

Recycled
Recycled

HRDS-05/05-08(WEB)E