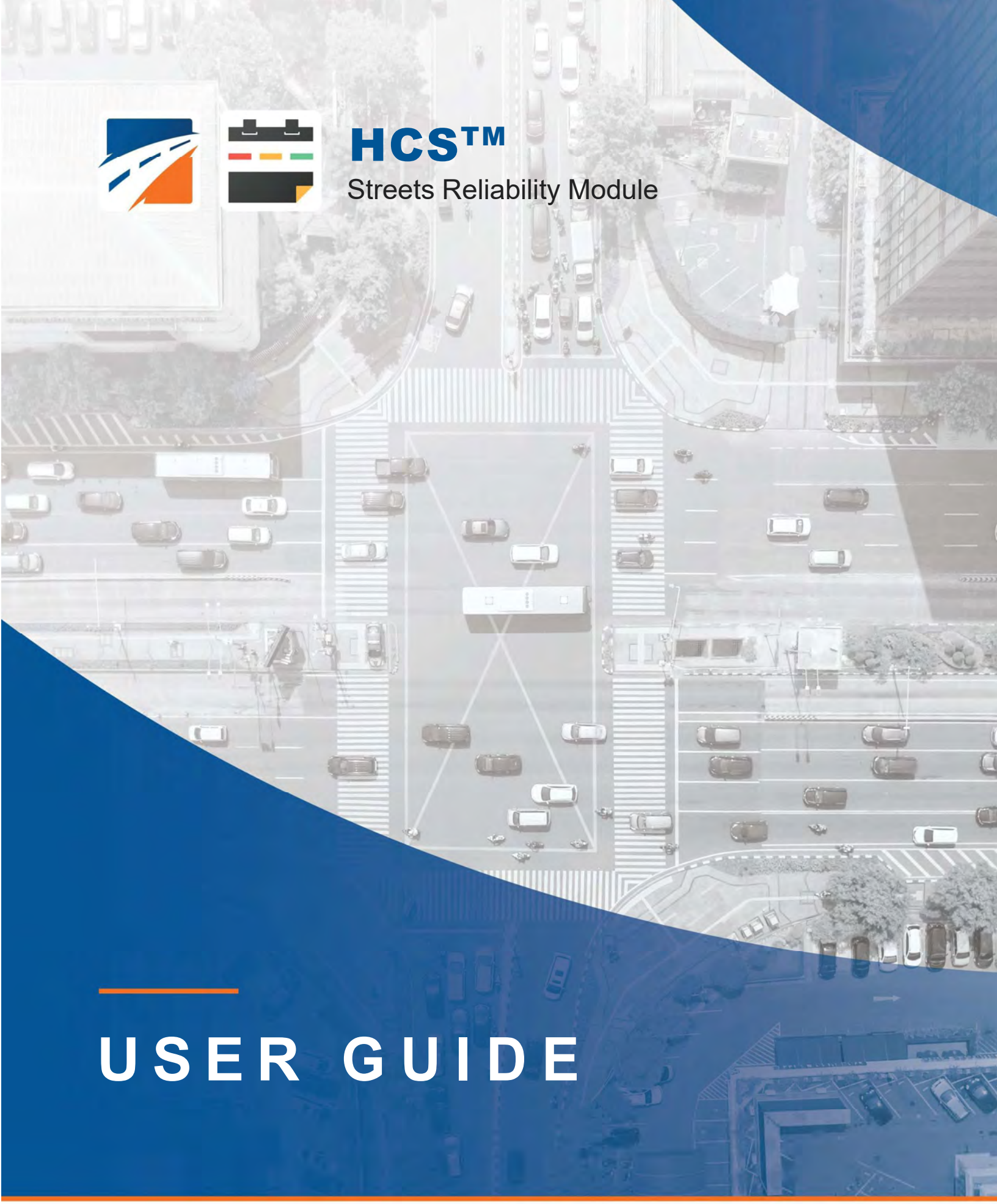

HCS™

Streets Reliability Module

USER GUIDE

UF Transportation Institute UNIVERSITY of FLORIDA | McTrans

Contents

Introduction

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Getting Started

Getting Started

Software Requirements

1. Windows 7 or higher
2. HCS Streets
3. Microsoft .NET 4.5 or higher

Note: Although HCS Streets Reliability may work on Windows Vista and Windows XP, detailed testing was not performed on these platforms.

Urban Street Reliability Analysis

Urban Street Reliability analyses evaluate the travel time reliability experienced by motorists on an urban street facility. Travel time reliability reflects the distribution of trip travel time over an extended period of time. The distribution arises from the occurrence of a number of factors that influence travel time (e.g., weather events, incidents, work zone presence, etc.) The distribution describes *how often* these factors occur and *how bad* operations are as a result. The methodology of the application uses the HCM Chapter 17 procedure.

General Controls

Menu Items

New – Creates a new Streets Reliability file (*.xsr) and starts a new analysis project; shortcut is Ctrl+N

Open – Opens an existing Streets Reliability file (*.xsr); shortcut is Ctrl+O

Example Folder – Opens folder with all HCS examples in File Explorer

Save – Saves an opened Streets Reliability file (*.xsr) using the current file name; shortcut is Ctrl+S

Save As… – Saves an opened Streets Reliability file (*.xsr) using a specified file name; shortcut is F12

Close – Closes an existing Streets Reliability file (*.xsr); shortcut is Ctrl+W

Units

USC Units – Changes the units of the current file to U.S. Customary

Metric Units – Changes the units of the current file to Metric

Print – Bring up printer selection and prints a USR report to the printer or specified file type; shortcut is Ctrl+P

Print Preview – Displays preview of current report before printing; shortcut is Ctrl+F2

Report

Formatted Report – Displays formatted report including the most important values; shortcut is F4

Text Report – Displays text report with all input, intermediary, and final results; shortcut is F6

Default Settings – Opens a dialog box for user to input defaults for Analyst, Agency, and Jurisdiction, which will be applied to all new files; also allows selection of USC or SI units, which will be applied to all new files; shortcut if Alt+F

Help

Contents – Provides access to glossary, acknowledgements, copyrights, and information on the Chapter HCM procedure; shortcut is Ctrl+F1

Index – Allows user to search for keywords within the glossary

Search – Allows user to search for keywords within the Contents

User Guide – Opens a comprehensive user guide in PDF format; shortcut is Ctrl+G

HCM6 Reference Guide – Opens the McTrans website in the default web browser to access the Highway Capacity Manual Reference Guide PDF

HCS Updates – Sends the HCS version number anonymously without any personally identifiable information to McTrans to check for a newer version

HCM/HCS Training - Opens the McTrans Training Page in the default web browser to view the latest training opportunities

HCQS Web Page – Opens the TRB Highway Capacity and Quality of Service Committee page in the default web browser

Support

Frequently Asked Questions – Opens the McTrans support page for HCS in the default web browser

HCS on the Web – Opens the McTrans HCS Overview page in the default web browser

McTrans on the Web – Opens the McTrans home page in the default web browser

E-mail McTrans – Composes a new e-mail addressed to McTrans in the default e-mail client with registration number, serial key, module, and version number already populated in the Subject field

About HCS – Opens an about window with software version information, EULA, general acknowledgements, contact information, and other relevant links

Exit – Exits the *HCS* Streets Reliability module; shortcut is Alt+F4

Urban Streets Reliability

HCM Chapter 17

The Highway Capacity Software (*HCS*) faithfully implements the methodology prescribed in the Highway Capacity Manual (HCM) for analyzing travel time reliability on an urban street. This chapter's methodology relies on methodologies in other HCM chapters to compute the desired performance measures. Specifically, the methodology for aggregating segment performance measures to obtain an estimate of facility performance is described in Chapter 16. The methodology for evaluating the individual segments is described in Chapter 18. The methodologies in Chapters 16 and 18 are applicable to an urban street facility that typically has a length of 1 mi (or 1.6 km in metric) or more in downtown areas and 2 mi (or 3.2 km in metric) or more in other areas.

At its core, the reliability methodology consists of hundreds of repetitions of the urban street facility methodology presented in Chapter 16. In contrast to the Chapter 16 methodology, where the inputs represent average values for a defined analysis period, the reliability caries the demand, capacity, geometry, and traffic control inputs to the facility methodology with each repetition (i.e., scenario).

The reliability methodology can be used to evaluate the following sources of unreliable travel time:

- Demand fluctuations,
- Weather,
- Traffic incidents,
- Work zones,
- Special events,
- Inadequate base capacity, and
- Traffic control devices on urban streets.

Demand fluctuations are represented in the methodology in terms of systematic and random demand variation by hour of day, day of week, and month of year. Fluctuations due to diversion are not addressed directly by the methodology but can be optionally provided by the analyst for work zones and special events through the demand specified in an alternative dataset.

LIMITATIONS OF THE METHODOLOGY

Because the reliability methodology is based on applying the urban streets methodologies multiple times, they inherit the limitations of those methodology, as described in Chapters 16, 18, and 19, respectively. The reliability methodology has additional limitations as described in the following paragraphs.

In general, the urban street reliability methodology can be used to evaluate the performance of most urban street facilities. However, the methodology does not address the events or conditions in the following list:

- Truck pickup and delivery (double parking);
- Signal malfunction;
- Railroad crossing;
- Railroad and emergency vehicle preemption;
- Signal plan transition; and
- Fog, dust storms, smoke, high winds, or sun glare.

Lane or shoulder blockage due to truck pickup-and-delivery activities in downtown urban areas can be considered incident-like in terms of the randomness of their occurrence and the temporal extent of the event. The dwell time for these activities can range from 10 to 20 min.

A signal malfunction occurs when one or more elements of the signal system are not operating in the intended manner. These elements include vehicles detectors, signal heads, and controller hardware. A failure of one or more of these elements typically results in poor facility operation.

A railroad crossing the facility at a midsegment location effectively blocks traffic flow while the train is present. Train crossing time can be lengthy (i.e., typically 5 to 10 min) and can result in considerable congestion extending for one or more subsequent analysis periods.

Railroad preemption occurs when a train crosses a cross-street leg of a signalized intersection. The signal operation is disrupted for several cycles after train clearance.

When a new timing plan is invoked, the controller goes through a transition from the previous plan to the new plan. The transition period can last several cycles, during which traffic progression is significantly disrupted.

Some weather conditions that restrict driver visibility or degrade vehicle stability are not addressed by the methodology. These conditions include fog, dust storms, smoke, and high winds.

Operational Data

Base Dataset

On the Base Dataset page, the user is required to load a base file to run an Urban Streets Reliability analysis. There are two options when using a base file: *Select Base File* and *Create Base File*. The program requires the HCS Streets module for both these options. The *Select Base File* button opens a dialog that allows users to open an existing HCS Streets (*.xus) files. The *Create Base File* button launches the Streets module where a user can create a new HCS Streets dataset. If HCS is already installed on the computer, then the Streets module should open when this button is clicked. If HCS is not installed, an error will popup and HCS will need to be installed on the computer to continue with the Urban Streets Reliability analysis.

The Base Dataset page shows a summary of the data from the Streets file. When a Streets file is loaded, the required information from the dataset is extracted for reliability analysis. Two sections appear when the Streets file is loaded: *Street intersections and segments graph* and *Street general information*. The number of intersections and segments, along with the distance between the intersections and the posted speed limit are displayed graphically in the first section. The second section lists out the Street Name, Analysis Name, Analysis Year, Analysis Date, Start Time, Period Duration, number of periods, File Name, and any comments taken directly from the Streets file.

Analysis

The Analysis page is used to specify the duration of the reliability reporting period. There are three main sections in the analysis page: *Reporting Period*, *Study Period*, and *Analysis Summary*.

The reliability reporting period represents the specific days over which the travel time distribution is to be computed, for example, all nonholiday weekdays in a year. The period is specified by start and end dates as well as by the days of week being considered. The start and end dates can be selected by clicking the calendar in the respective textbox and selecting the date on the calendar or by typing the date in the format MM/DD/YYYY. The days of week to be considered in a reliability analysis can be selected by clicking the checkboxes provided for each day of the week.

If these values are not changed by the user, the following defaults will be used:

- Start Date: 1/1/2011
- End Date: 1/1/2012
- Days of Week: Mon, Tue, Wed, Thu, Fri (all weekdays)

The number of days should be reflected under each month based on the information input for reporting period. The reliability reporting period is used with the study period to describe the temporal representation of the performance measure fully (e.g., average travel time on nonholiday weekdays from 4:00 to 6:00 p.m. for the current year).

The study period is the time interval (within a day) that is represented by the performance evalutation. It consists of one or more consecutive analysis periods. The default analysis Start Time is taken from the base dataset and can be edited if needed. The End Time is calculated based on the Start Time, number of periods, and duration of Period from the base dataset. End Time and Duration cannot be edited in the Streets Reliability program, but can instead be changed in the base dataset through Streets.

The analysis summary includes: *Total number of analysis days*, *Number of scenarios per day*, *Number of standard scenarios*, and *Total Number of scenarios*. The *Number of standard scenarios* is the *Total number of analysis days* multiplied by the *Number of scenarios per day*. The *Total Number of scenarios* is the number of standard scenarios and alternate scenarios (if any).

Weather

A main source of variability that leads to travel time unreliability is weather. Weather events can affect capacity and possibly demand. The Reliability methodology provides default values for use by location.

On the weather page, a drop-down list is located at the top left of the screen where a city with available weather data can be chosen. A city can also be typed into the search bar, which will then match and select the city from the drop down list.

Once a city is selected, *Load Regional Weather* needs to be selected for the weather data to be reflected in the page. This button automatically imports historical weather data for the selected city from a local database file that is distributed with the program. The fields in the table can edited if necessary. If a mistake is made and the user wants to revert back to the previous values, then the *Reset to Regional Default* can be selected to discard recent changes and restore default values for the selected city.

Under the Weather Data table are also weather factors affecting demand. These include: *Pavement runoff duration for snow event (h*), *Demand change factor for dry weather*, *Demand change factor for rain event*, and *Demand change factor for snow event*. The defaults for these are 0.5 hours, 1.0, 1.0, and 0.8, respectively. The user has the option of changing these values if necessary. The duration of pavement runoff for a snow event is required. An appropriate local value should be established for the subject facility if possible.

Demand

Another main source of variability that leads to travel time unreliability is the temporal variability in traffic demand—both regular variations by hour of the day, day of the week, and month or season of the year and random variations between hours and days. The Demand page is used to display user inputs related to demand and to specify demand factors.

One of the required inputs is the *Urban Street Funtional Class*. There are three urban street functional classes considered: *Expressway*, *Principal Arterial*, and *Minor Arterial*. The default in the program is *Expressway*. Once selected, the defaults for *Hours of the Day Ratios*, *Days of the Week Ratios*, and *Months of the Years Ratios* are displayed. Similar to the table on the Weather page, the fields in these tables can be edited if necessary. The *Base Dataset Traffic Count Date* is automatically set to the date found in the Streets base file, but can also be changed if necessary. Similar to the Analysis page, the date can be selected by clicking the calendar in the textbox and selecting the date on the calendar or by typing the date in the format MM/DD/YYYY. Depending on the date selected, the *Base Demand Ratio* is calculated using *Hours of the Day Ratios*, *Days of the Week Ratios*, and *Months of the Year Ratios*.

Incident

Another main source of variability that leads to travel time unreliability are incidents that block travel lanes or otherwise affect traffic operations and thus capacity. The Incident page is used to specify user inputs related to incidents, their frequencies, reponse time, clearance time, and distributions. There are three tabs within the Incident page: *General*, *Clearance Time*, and *Distribution*.

The *General* tab displays the crash frequency adjustment factors for different weather types, the incident response time in minutes for different weather types, the incident detection time in minutes, shoulder presence, and the average crashes per year for both segments and intersections. All these fields are pre-populated with the default values provided in Chapter 17. The shoulder presence checkbox is used to switch the different input tables for incident distirbutions. If the checkbox is checked, the input table under the Distribution tab will include *Shoulder* in the *Incident Location - Affected* column. If the checkbox is unchecked, the input table will only display *One Lane* and *2+ Lanes* under the *Incident Location - Affected* column. Rows form under "Average Crashes per Year" depending on the number of Segments and the number of Intersections coded in the Streets Base File loaded for analysis. Segments will display before Intersections.

The *Clearance Time* tab displays a table with the incident clearance time in minutes for different incident types, which are based on Street Location, Event Type, Lane Location, Severity, and Weather Type. *Street Location* includes *Segment* and *Intersection*. *Event Type* includes *Crash* or *Non-Crash*. *Lane Location* includes *One Lane*, *2+ Lanes*, or *Shoulder*. *Severity* types include fatality/injury (*FI*) and property-damage-only (*PDO*) if the Event Type is Crash, and *Breakdown* and *Other* if the Event Type is Non-crash. Weather Types include *Dry*, *Rainfall*, *Wet Pavement*, and *Snow or Ice*.

The *Distribution* tab displays a table with the incident proportions based on *Street Location*, *Incident Type*, *Incident Location*, and *Incident Severity*.

Scenarios

The Scenarios page displays two sections: *Scenario Generation Settings* and *Progress Status*.

The checkboxes in the *Scenario Generation Settings* indicate whether or not the user wants to include the corresponding variability in the reliability analysis. The three variables include: *Weather*, *Demand*, and *Incident*. If a checkbox is unchecked, then the variable is not considered in the analysis. For example, if the *Incident* checkbox is unchecked, then incident scenarios will not be generated. Unique seed numbers are separately established for weather events, demand variation, and incidents. A seed is used so that the sequence of random events can be reproduced. For a given set of three seed numbers, a unique combination of weather events, demand levels, and incidents is estimated for each analysis period in the reliability reporting period. The user can also specify to randomize demand volume for every analysis period by checking the checkbox. This checkbox is automatically checked for an Urban Streets Reliability File (*.xsr).

Progress Status displays the *Replication* number currently generating, the *Scenarios Generated* out of the total number of scenarios, and the time elapsed in seconds for generating scenarios. If the user chooses to stop generating scenarios, a Cancel button is located below *Time Elapsed*.

Once all scenarios are generated, "Scenario Generation Completed." will display after *Scenarios Generated*. The user may select Save or Close from the menu if saving the scenarios generated is needed. If the user selects Save, a pop-up will appear asking if the user wants to save the scenarios generated. If the user selects Close, a pop-up will appear asking if the user wants to save the reliability analysis. Then, a second pop-up will appear asking if the user wants to save the scenarios generated. If the user chooses to save the scenarios generated, then each of the Streets files will be saved to a folder, based on the replication (R1, R2, R3, etc.), where the Streets Reliability (*.xsr) file is saved.

Events

Once all scenarios are generated, the Events page will display event predictions. There are four tabs for the Event Predictions: *Summary*, *Weather*, *Demand*, and *Incident*. Tabs will be populated depending on which types of

scenarios were included under the *Scenario Generation Settings*. If the number of replications specified by the user was greater than 1, the drop-down list next to *Replication* can be used to switch between replications.

Under *Summary*, the user can specify how many scenarios per page to display by selecting a number from the drop-down list in the upper left hand corner of the section. Since all scenarios cannot be displayed on the page, navigation buttons (<< First, < Previous, Next >, and Last >>) can be found at the bottom of the screen. The current page out of the total number of pages is also displayed at the bottom of the screen. On each Summary page, a table will be displayed with the Analysis Period, Weather Event, Precipitation Rate, Demand Factor, Incident Occurrence, and Incident Count.

Under *Weather*, the user can specify how many Weather details per page are displayed by selecting a number from the drop-down list in the upper left hand corner of the section. Since all scenarios cannot be displayed on the page, navigation buttons (<< First, < Previous, Next >, and Last >>) can be found at the bottom of the screen. The current page out of the total number of pages is also displayed at the bottom of the screen. On each Weather page, a table will be displayed with the Date, Precipitaion RN, Precipitation (Yes/No), Temperature RN, Temperature (F), Snow/Rain, Precipitation Rate RN, Precipitation Rate (in./h), Total Precipitation RN, Total Precipitation (in.), Precipitation Start RN, Precipitation Start Time, Precipitation Duration (h), Time Wet After Precipitation (h), Day/Night?, Total Event Duration (h), End of Precipitation, and Wet Pavement End. A horizontal scroll bar is placed under the table to view all columns.

Under *Demand*, the user can specify how many Demand details per page are displayed by selecting a number from the drop-down list in the upper left hand corner of the section. Since all scenarios cannot be displayed on the page, navigation buttons (<< First, < Previous, Next >, and Last >>) can be found at the bottom of the screen. The current page out of the total number of pages is also displayed at the bottom of the screen. On each Demand page, a table will be displayed with the Analysis Period, Weather, Weather Factor, Hour Factor, Day Factor, Month Factor, Total Factor, and Total/Base. A horizontal sroll bar is placed under the table to view all columns.

Under *Incident*, there are two other tabs: *Crash Frequency* and *Other*. For each of the segments and intersections coded in the base dataset, the *Crash Frequency* tab displays the Observed Average Crash Frequency, Number of Years, Hours of Dry Weather, Hours of Rainfall, Hours of Wet Pavement, Hours of Snowfall, Hours of Snow Pavement, Crash Frequency Adjustment Factor for Rainfall, Crash Frequency Adjustment Factor for Wet Pavement, Crash Frequency Adjustment Factor for Snowfall, Crash Frequency Adjustment Factor for Snow Pavement, Crash Frequency for Dry Weather, Crash Frequency for Rainfall, Crash Frequency for Wet Pavement, Crash Frequency for Snowfall, and Crash Frequency for Snow Pavement.

The *Other* tab displays a Parameters section in which a user can set a date, a time, and a segment or intersection to gather information on incidents. Similar to the Analysis page and Demand page, the date can be selected by clicking the calendar in the textbox and selecting the date on the calendar or by typing the date in the format MM/DD/YYYY. A drop-down list with different hours of the day can be used to select a time and a drop-down list with the different segments and intersections can be used to select which segment or intersection is needed for information. Below these drop-downs is a Query button, which the user can click to check for incidents starting at the selected query hour. Once clicked, tables will appear for three subtabs: *Determination*, *Duration*, and *Location*.

The *Determination* tab displays *Proportion*, *Frequency per Hour*, *exp (-fi x pi)*, *Random Number*, and *Incident?* for different types of incidents.

The *Duration* tab displays values for the following variables: Location, Incident type, Number of lanes involved, Incident severity, Weather, Incident detection time (min), Incident response time, dry weather (min), Incident clearance time (min), Average incident duration (min), Standard deviation of incident duration (min), Average incident duration (h), Standard deviation of incident duration (h), Random number, Gamma function alpha parameter (mean^2/variance), Gamma function beta parameter (mean/variance), Duration (h), Rounded duration (nearest 15 min) (h), Incident start time, and Incident end time.

The *Location* tab displays values for the following variables: Incident number; Incident type, location and severity; Random number; Location index; Location; and Directional probabilities for EB, WB, NB, and SB.

Summary

Once all scenarios are generated, the *Summary* page will display Scenario Details. If the number of replications specified by the user was greater than 1, the drop-down list next to *Replication* can be used to switch between replications. In the Scenario Details, the following are displayed for each scenario: *Scenario ID*, Analysis *Period*, *Travel Time FWD (s)*, *Travel Time REV (s)*, *Travel Speed FWD (mi/h)*, *Travel Speed REV (mi/h)*, and *Facility Delay (veh-h)*. Hovering over each *Scenario ID* will show the path for the file location.

Urban Streets Reliability Report

The Report page displays the results of the analysis in the form of tables and graphs. There are two reports available to the user: the formatted report and the text report. The formatted report is initially displayed, but the user can switch to the text report by clicking the *Switch to Text Report* button located at the top of the screen. Similarly, if the user has the text report displayed, the *Switch to Formatted Report* button located at the top of screen can be used to display the formatted report instead.

The formatted report provides an overview of the results in a table. There are four sections in the table: Base Dataset Analysis, Realiability Input Summary, Reliability Performance Measure Results, and Travel Time results for each replication. Base Dataset Analysis provides general information that can be found in the base dataset. Reliability Input Summary provides general information on the reliability analysis and the random seed summary. The random seed numbers displayed on this report are for the first replication. Random seed numbers for each replication can be found in the text report. Reliability Performance Measure Results provides information on the following performance measures for each major street direction: Vehicle miles traveled (veh-m), Number of Scenarios, Base free-flow travel time (s), Mean TTI, 80th percentile TTI, 95th percentile TTI (PTI), Reliability rating (%), and Total delay (veh-h). The last section of the table includes information on travel time for each replication. The average travel time and the 95th percentile travel time is provided in the formatted report, but more information can be found in the text report. Below the table are two graphs displaying the Travel Time Frequency Distribution for both the Major Street Forward and Reverse directions.

The text report provides more detailed results. The results for the major street forward direction are displayed first and then the results for the other major street reverse direction is displayed. The following performance measures are displayed for each major street direction: Vehicle Miles Traveled (veh-mi), Base Free-Flow Speed (mi/h), Base Free-Flow Travel Time (s), Reliability Rating, and Number of Scenarios. Following this is information for each replication. Each replication displays the Random Number Seeds for Weather, Demand, and Incident. Then the Average, Standard Devaition, Skewness, Median, 5th Percentile, 10th Percentile, 80th Percentile, 85th Percentile, and 95th Percentile are displayed for Travel Time (s), Travel Speed (mi/h), Stop Rate (stops/veh), Running Time (s), Through Delay (s/veh), and Total Delay (veh-hr).

How To

Create a New File

1. From the Start screen, there are three options for creating a new file:

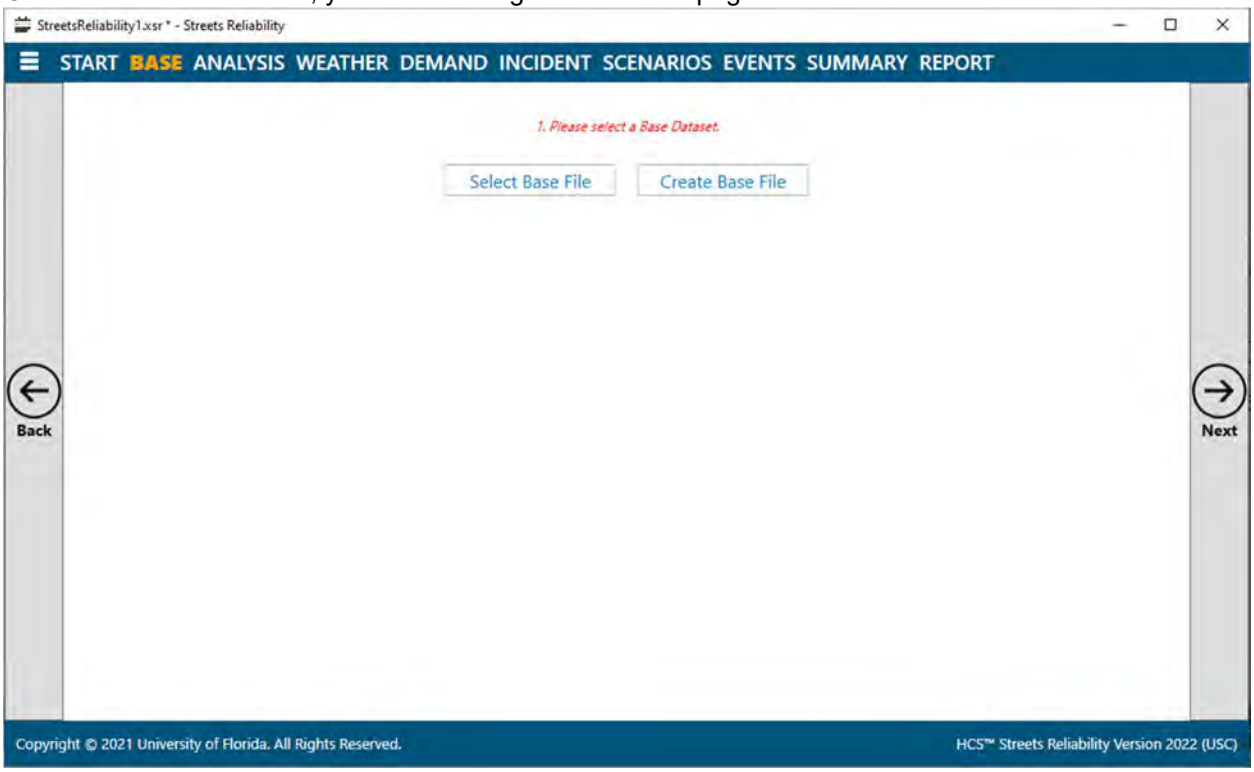
Note: A new file can be created if an existing file is already open; you do not need to start from the Start screen.

a. Selecting *File* > *New* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “New”

b. Selecting “New File…” from the Start screen; this can be found below in the red box

c. Using keyboard shortcut “Ctrl+N”

2. Once a new file is created, you will be brought to the Base page

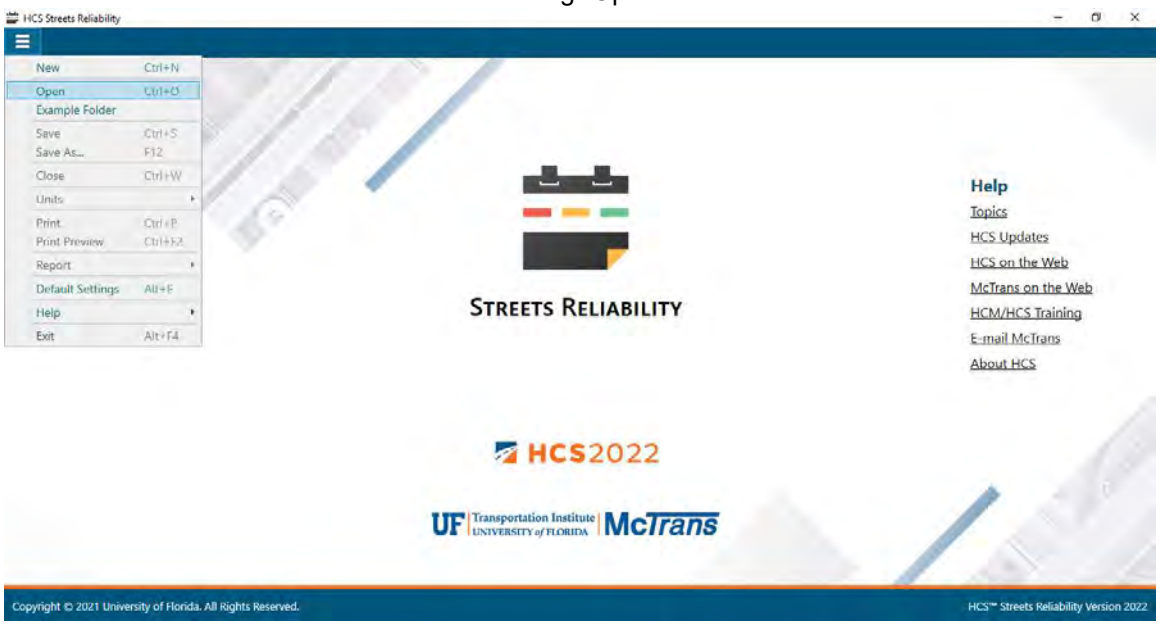


Open an Existing File

1. From the Start screen, there are six options for opening an existing file:

Note: A file can be opened even if another file is currently open; you do not need to start from the Start screen.

a. Selecting *File* > *Open* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Open”



b. Selecting “Open File…” from the Start screen; this can be found below in the red box

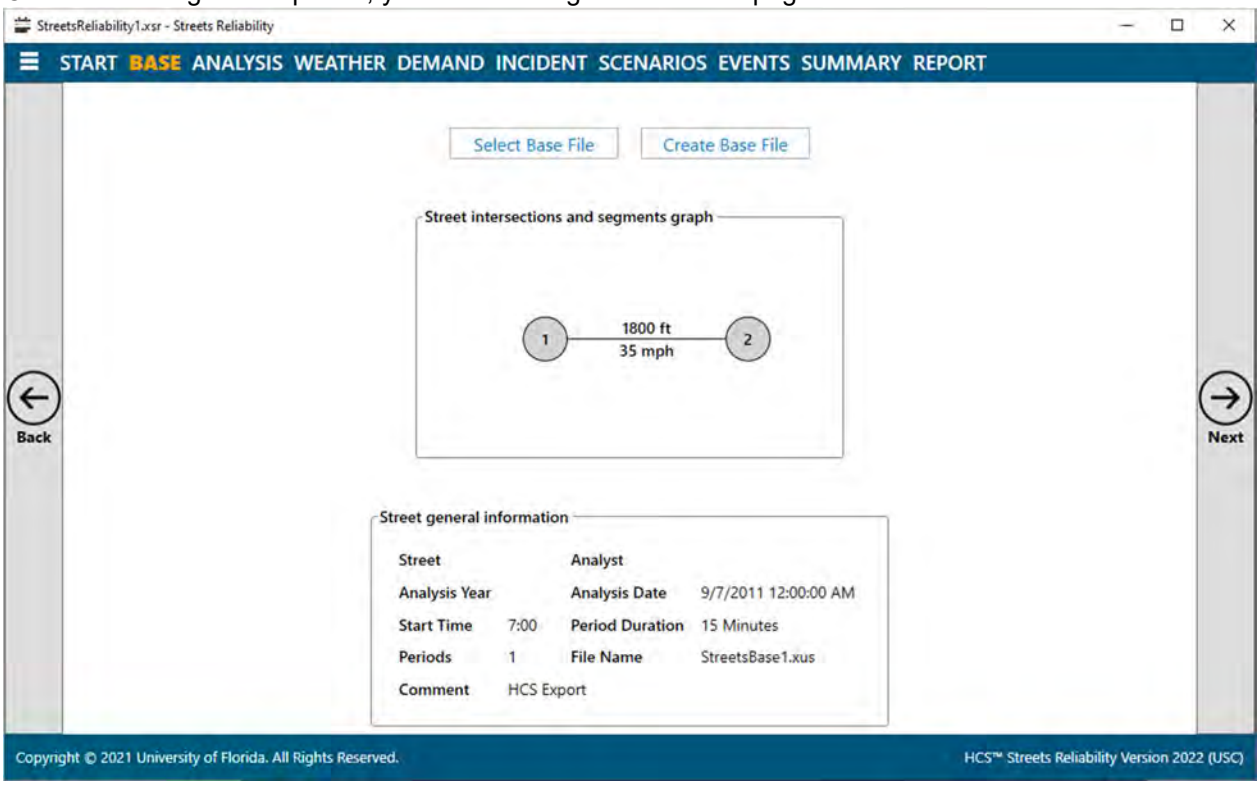
c. Using the keyboard shortcut “Ctrl+O”

d. Selecting a file under the Recent files list from the Start screen; this can be found below in the red box

e. Selecting *File* > *Example Folder* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Example Folder”. Opening the example folder will open the path of the HCS example files in File Explorer. The desired example file can be double-clicked or right-clicked and selecting ‘Open’, which will open the example file in the Streets Reliability program.

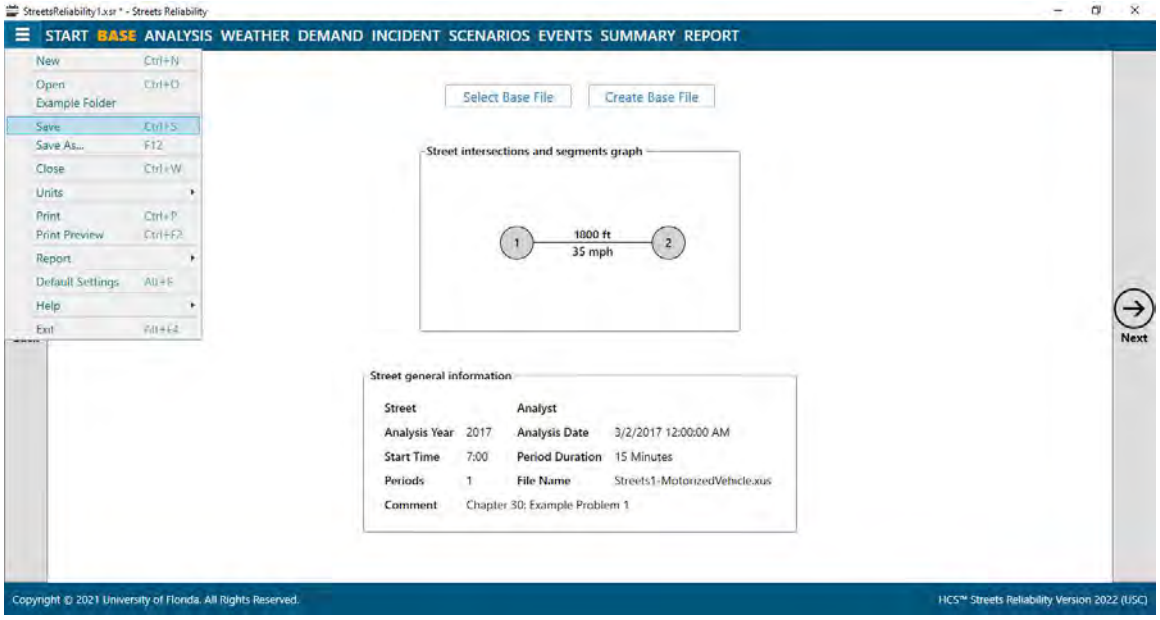
f. Selecting “Example Folder…” from the Start screen; this can be found below in the red box. Opening the example folder will open the path of the HCS example files in File Explorer. The desired example file can be double-clicked or right-clicked and selecting ‘Open’, which will open the example file in the Streets Reliability program.

2. Once an existing file is opened, you will be brought to the Base page

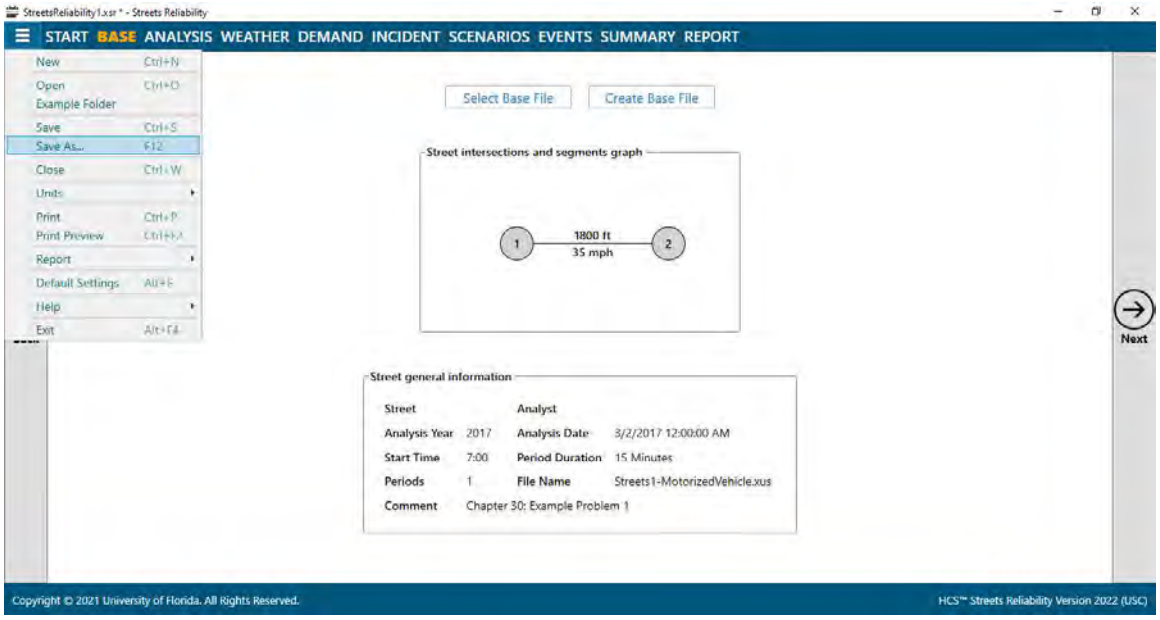


Save a File

1. There are five options for saving an open file:
    a. Selecting *File* > *Save* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Save”

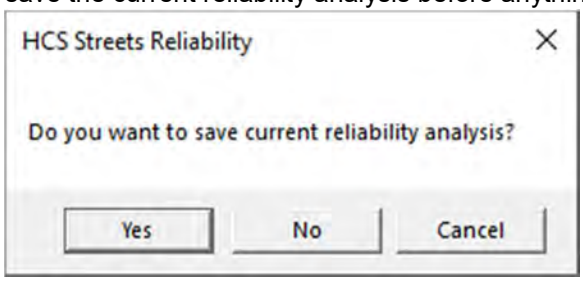


    b. Selecting *File* > *Save As…* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Save As…”



    c. Using the keyboard shortcut “Ctrl+S” for Save
    d. Using the keyboard shortcut “F12” for Save As

e. Exiting the program or closing the file without saving changes beforehand; this will prompt you to save the current reliability analysis before anything is closed

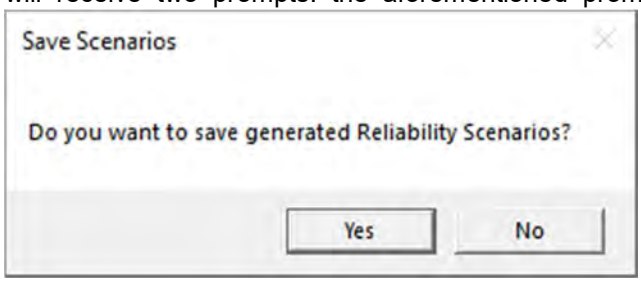


i. Selecting “Yes” will save the file if it is an existing file. If the file has not been previously saved, the Save As dialog box will pop up allowing you to change the file name and save it.

ii. Selecting “No” will exit the program or close the file without saving the file

iii. Selecting “Cancel” will prevent the file from closing

iv. If you have generated scenarios and then decide to exit the program or close the file, you will receive two prompts: the aforementioned prompt and a Save Scenarios prompt



1. Selecting “Yes” will save all the scenario files generated and create folders based on the number of replications

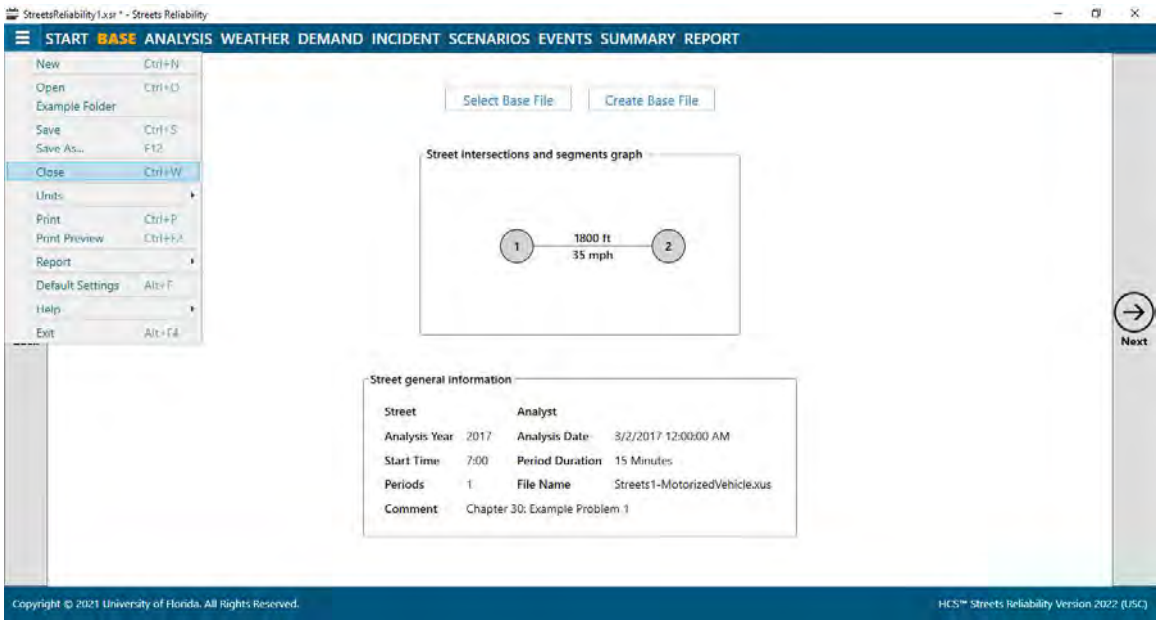
2. Selecting “No” will exit the program or close the file without saving the scenario files generated

Note: Using Save with an existing file will save a file without prompting you to specify a file name. Using Save with a new file will bring up the Save As dialog box for you to specify a file name for saving. Using Save As will always bring up the Save As dialog box for you to specify a file name for saving.

Close a File

1. There are three options for closing an open file:

   a. Selecting *File* > *Close* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Close”



b. Using the keyboard shortcut “Ctrl+W”

c. Exiting the program itself; please see *How To: Exit the Program*

Exit the Program

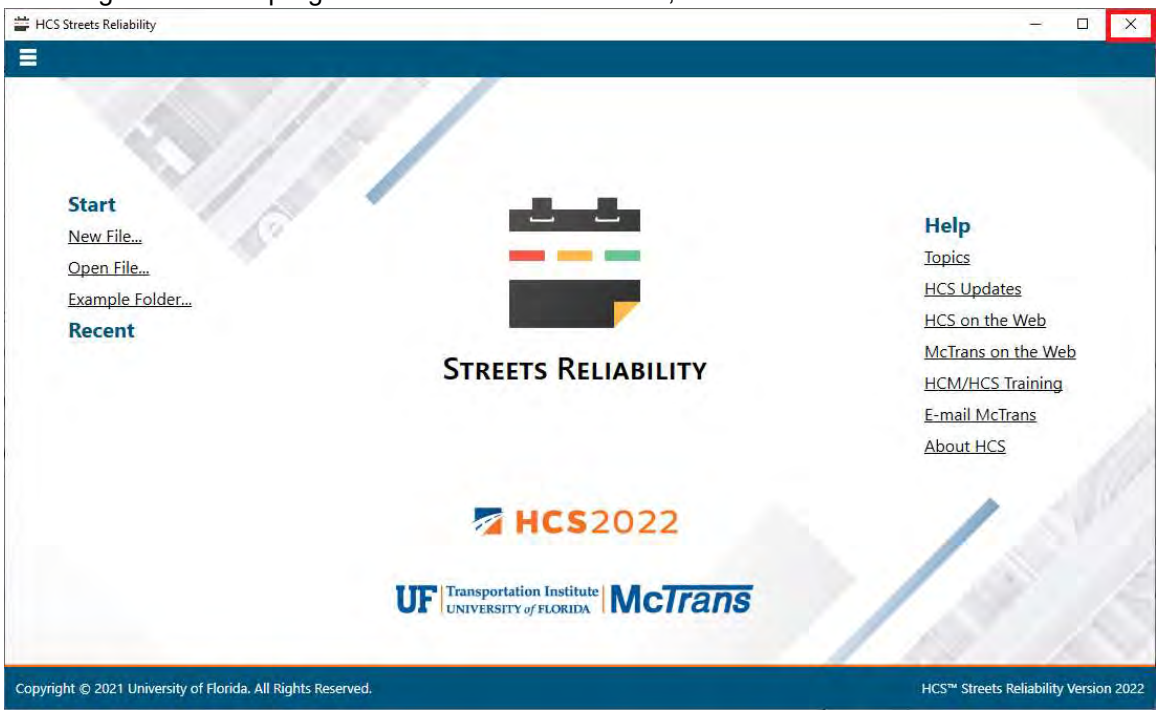
1. From the Start screen, there are three options for exiting the program:

Note: The program can be exited even if a file is still open; you do not need to start from the Start screen.

a. Selecting *File* > *Exit* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Exit”

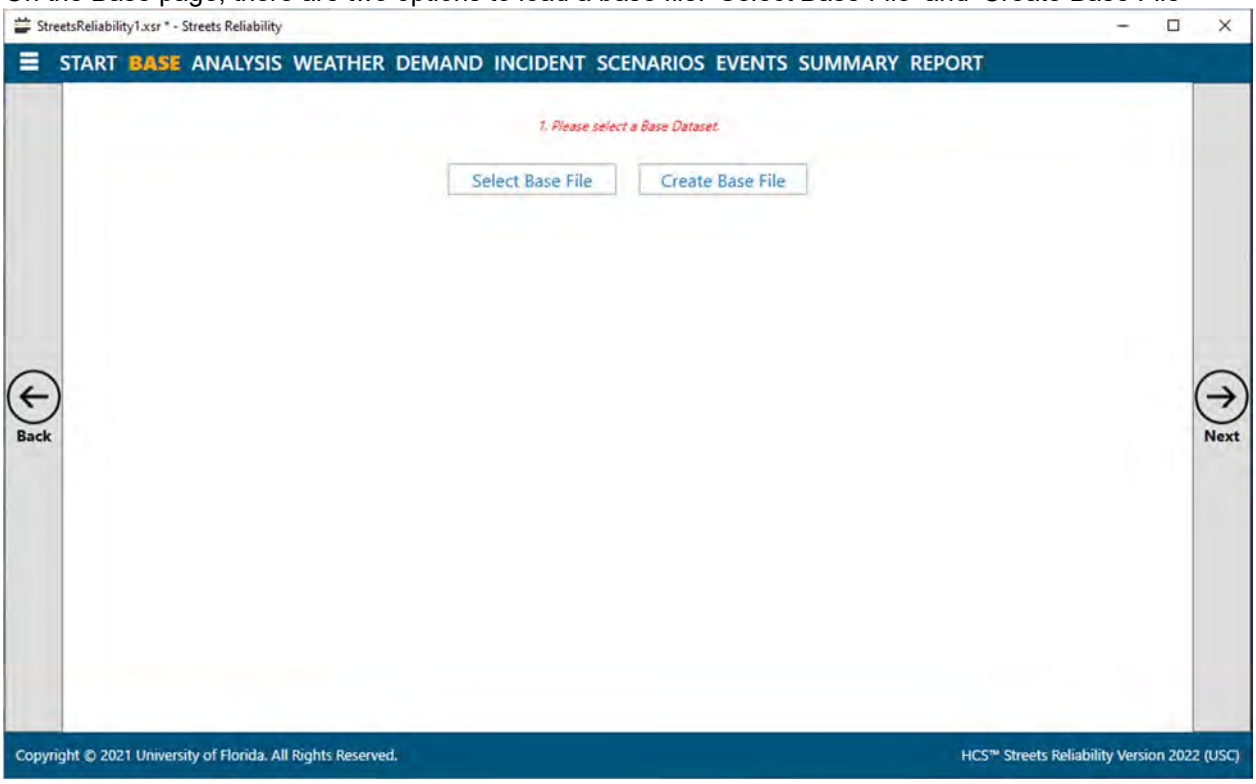
b. Using the keyboard shortcut “Alt+F4”

c. Selecting “X” in the top right-hand corner of the screen; this can be found below in the red box

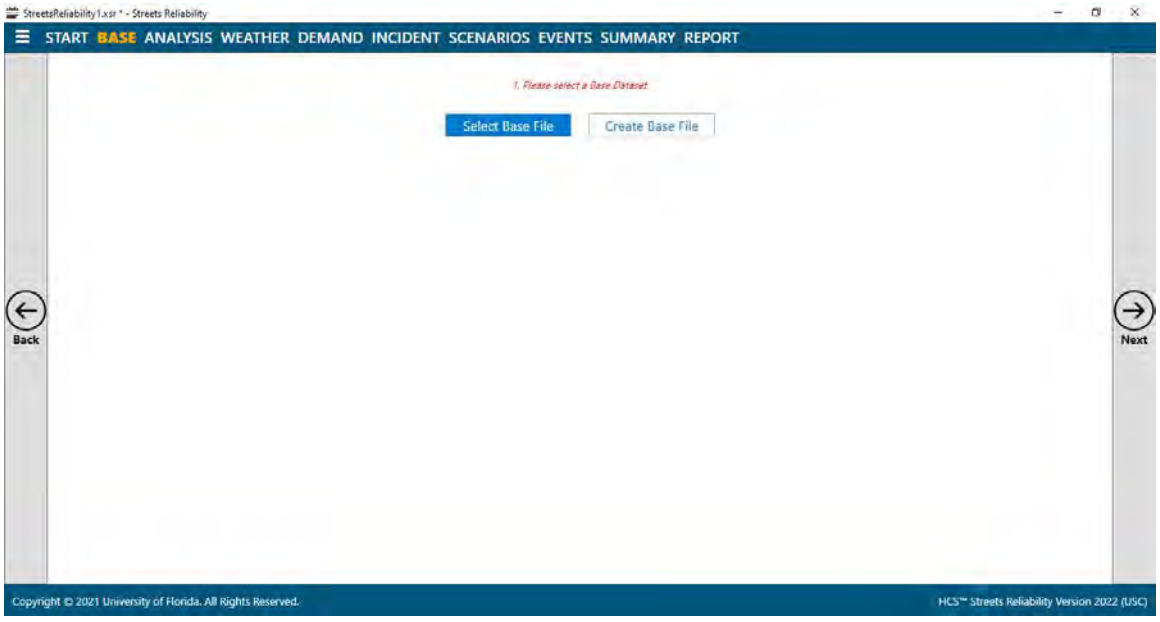


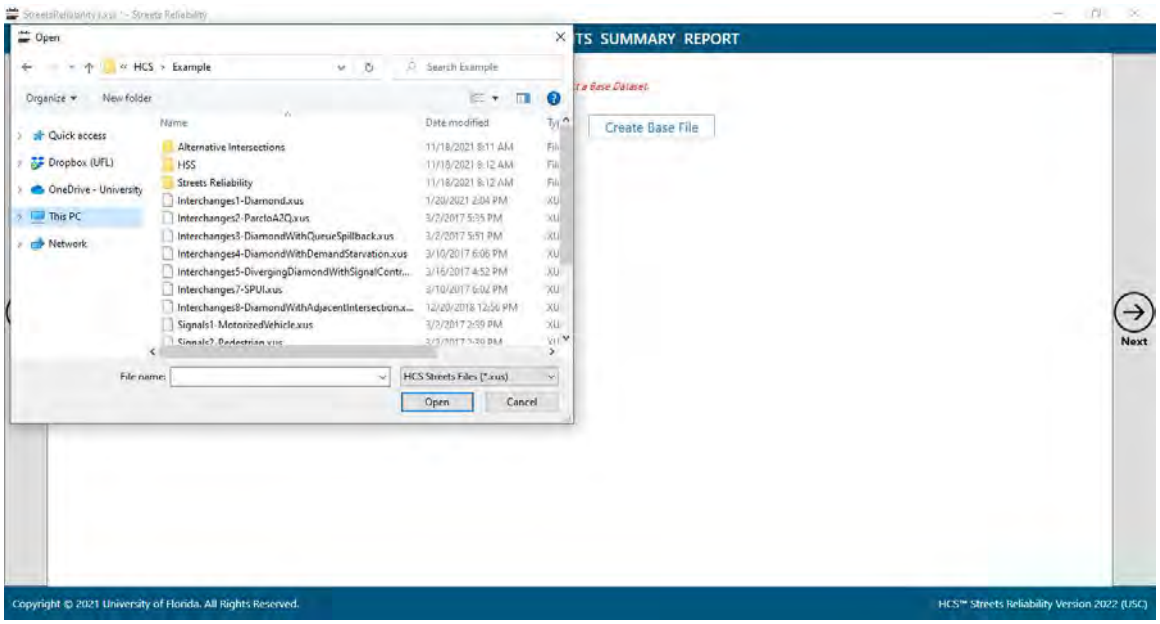
Load a Base File

1. On the Base page, there are two options to load a base file: ‘Select Base File’ and ‘Create Base File’

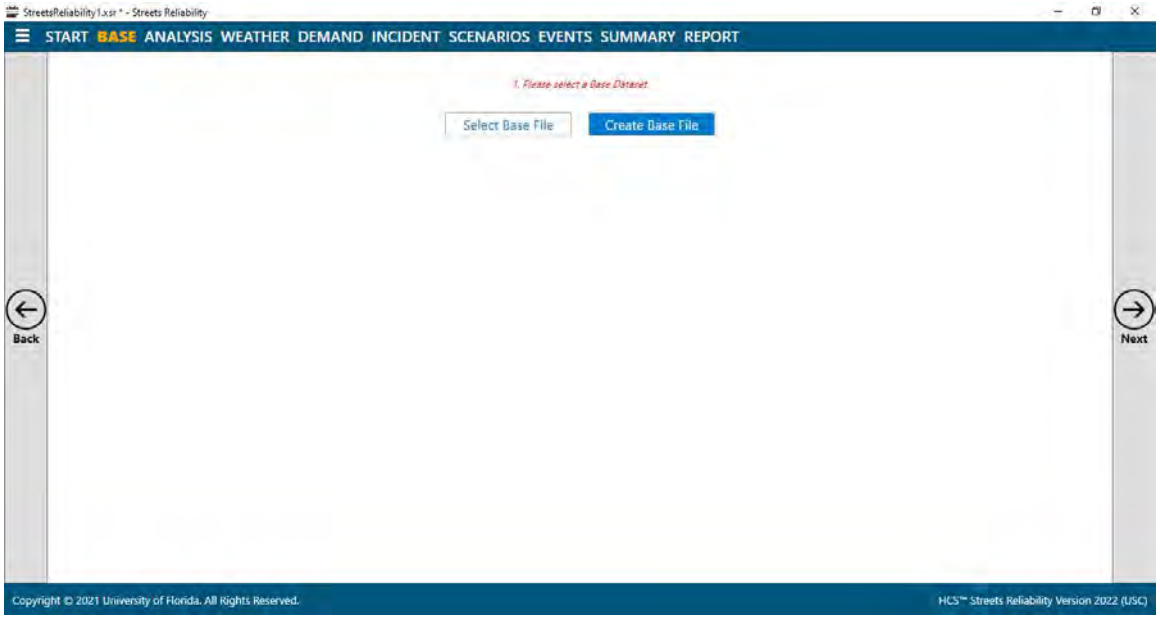


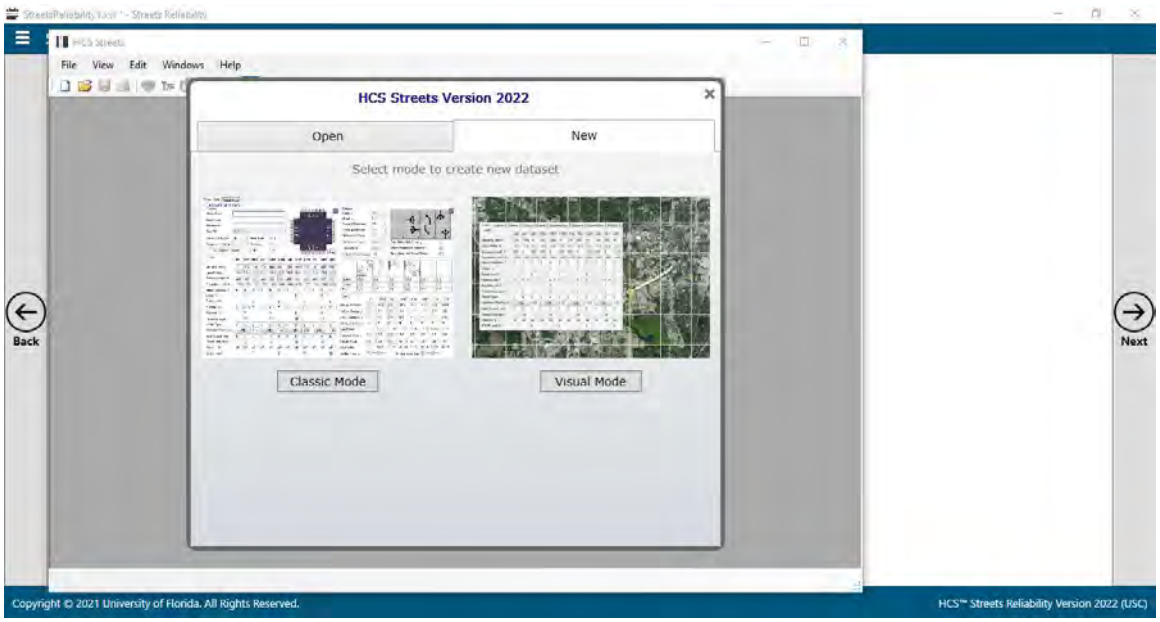
   a. ‘Select Base File’ will bring up an Open dialog box to allow selection of an existing Streets (*.xus) file





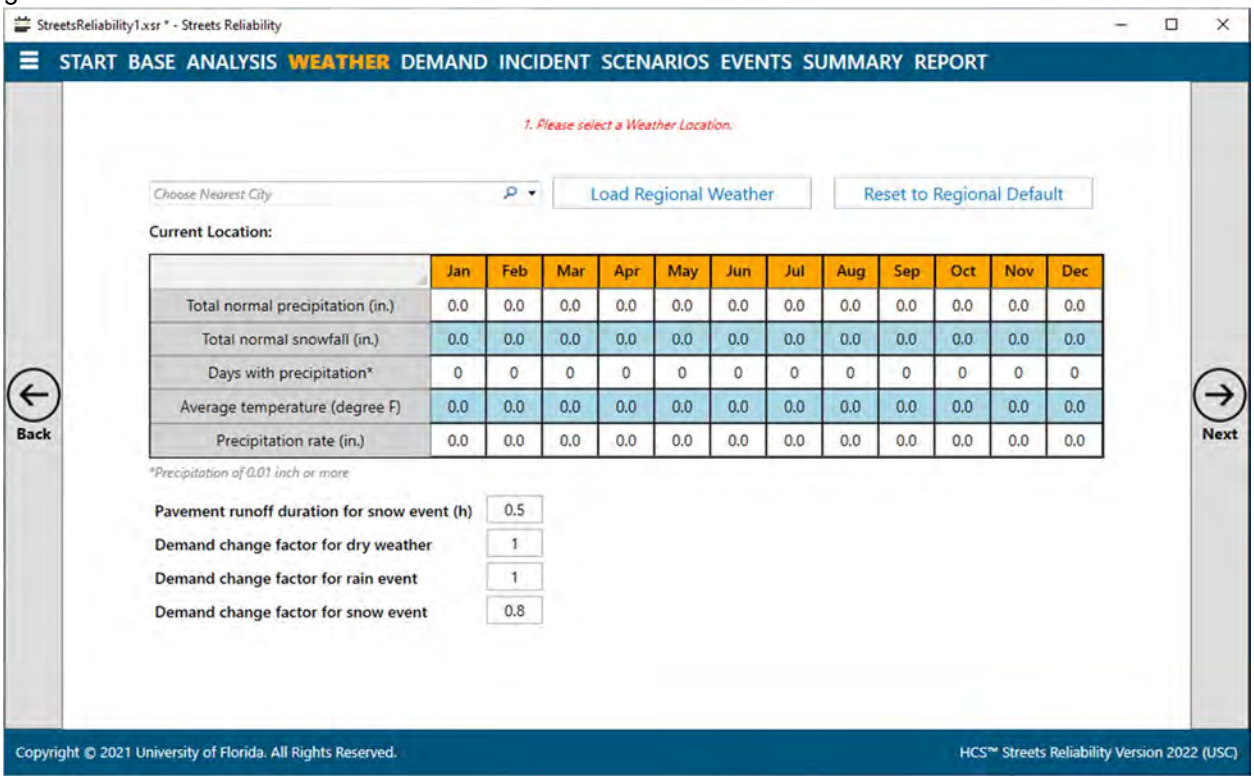
b. Create Base File' opens the *HCS Streets* program allowing you to create a Streets (*.xus) file which can then be saved and loaded into *HCS Streets Reliability* using the 'Select Base File' button





Load Regional Weather

1. On the Weather page, a weather location must be selected for an analysis if Weather is included in scenario generation.

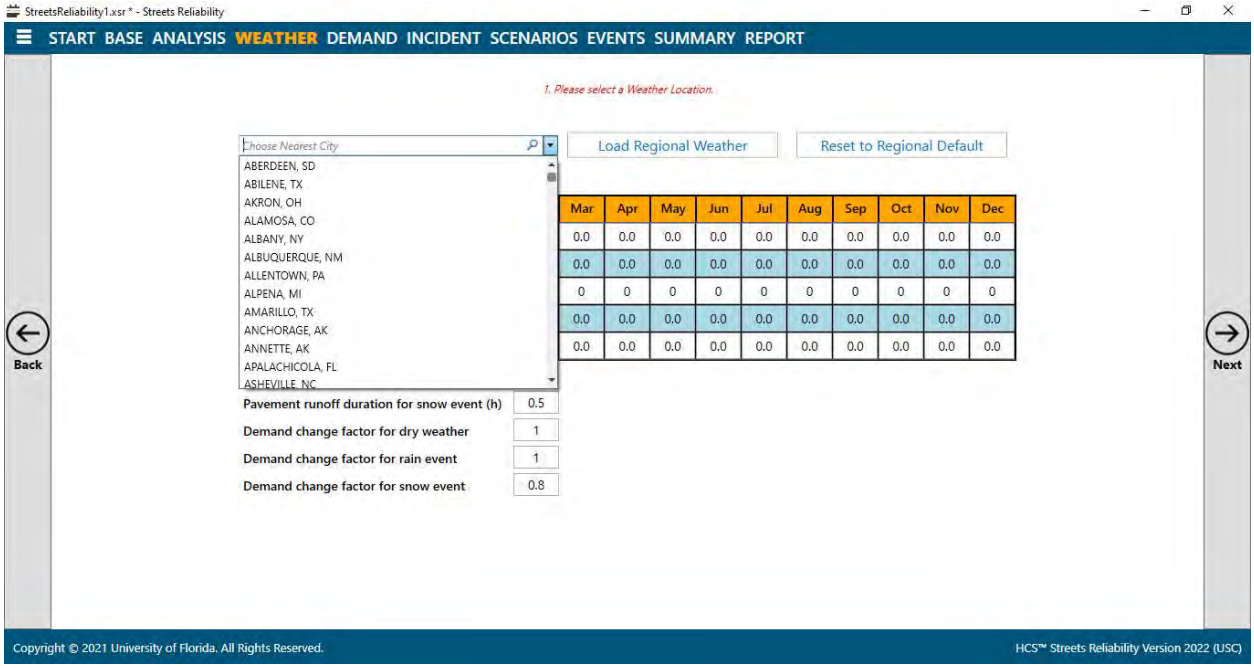


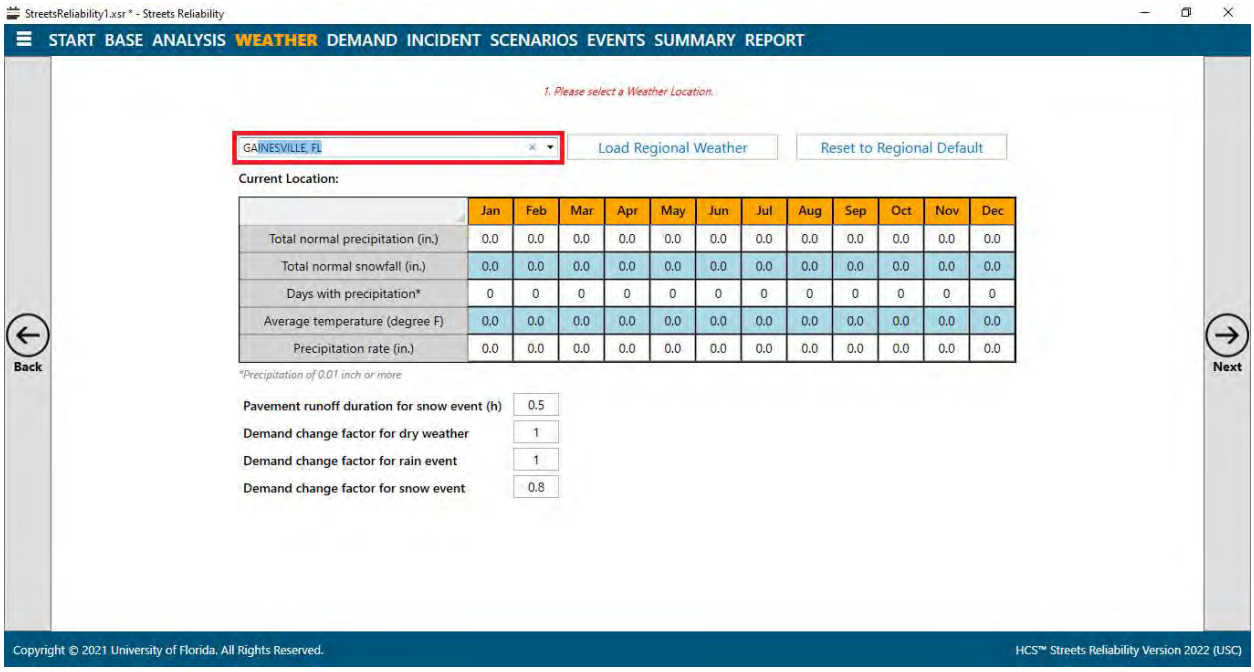
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Total normal precipitation (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total normal snowfall (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Days with precipitation*	0	0	0	0	0	0	0	0	0	0	0	0
Average temperature (degree F)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Precipitation rate (in.)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*Precipitation of 0.01 inch or more

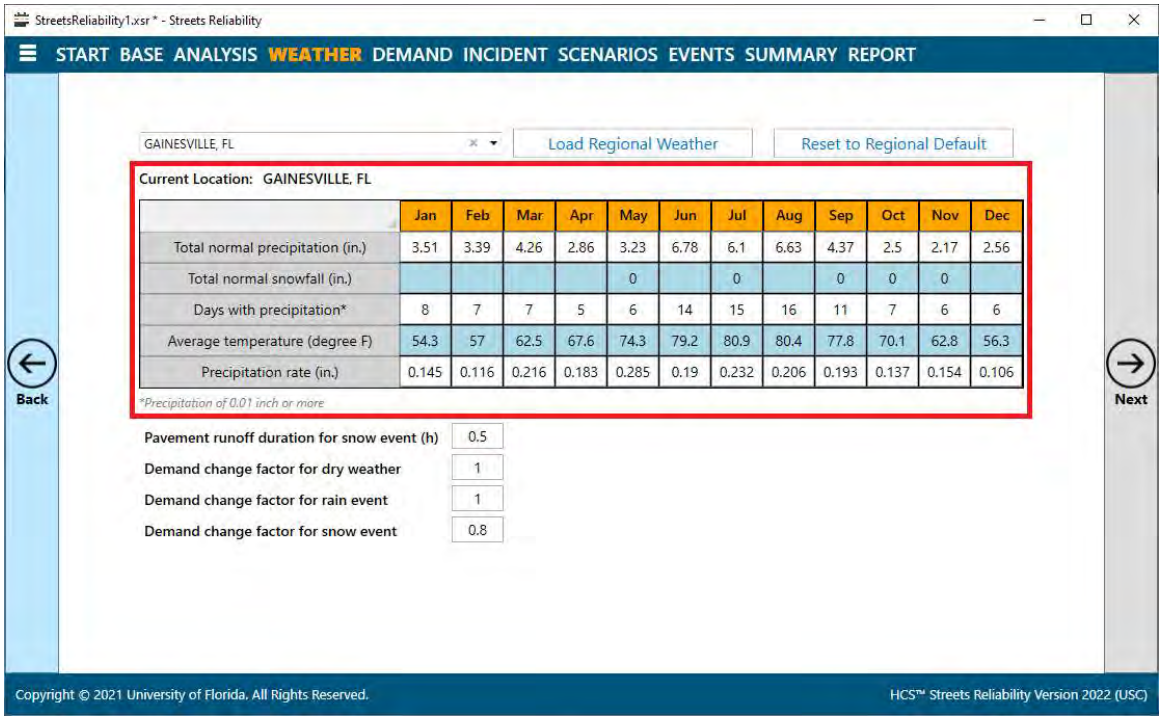
Pavement runoff duration for snow event (h)	0.5
Demand change factor for dry weather	1
Demand change factor for rain event	1
Demand change factor for snow event	0.8

2. A drop down list of U.S. cities is provided. You can open the list by selecting the down arrow and scrolling through to search for a particular city or you can type a city in the box which will find the location in the list.





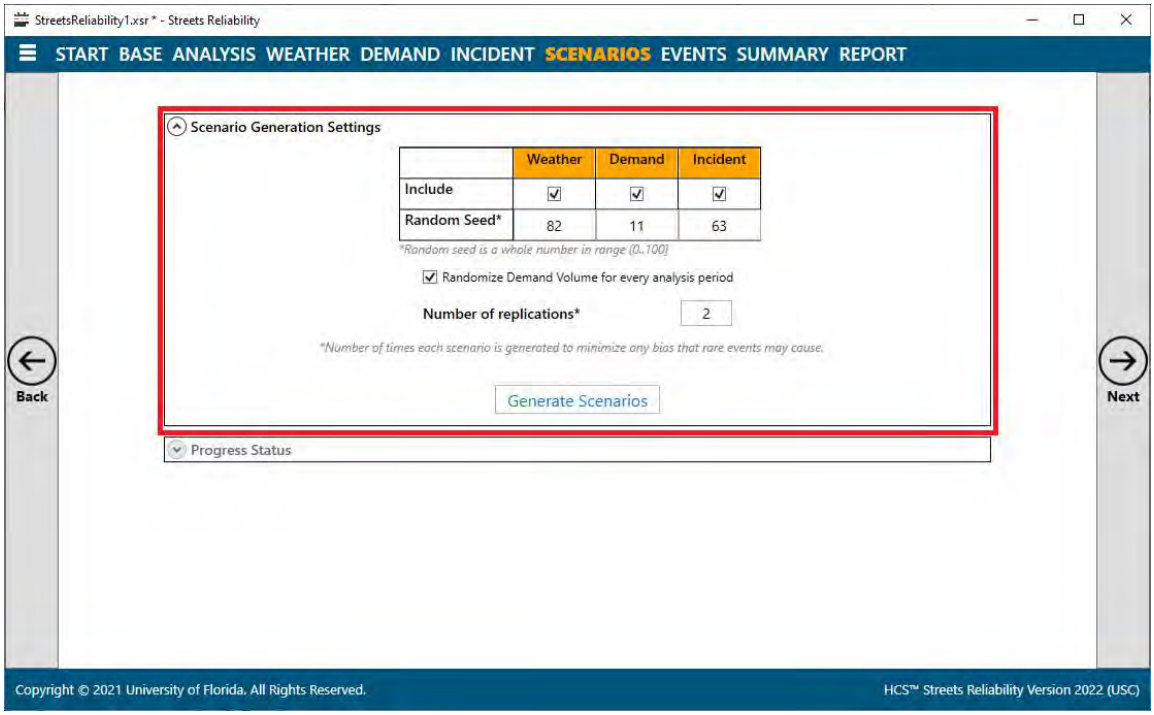
3. Once a city is selected, click the ‘Load Regional Weather’ button. This will populate the table below with information based on the location selected.



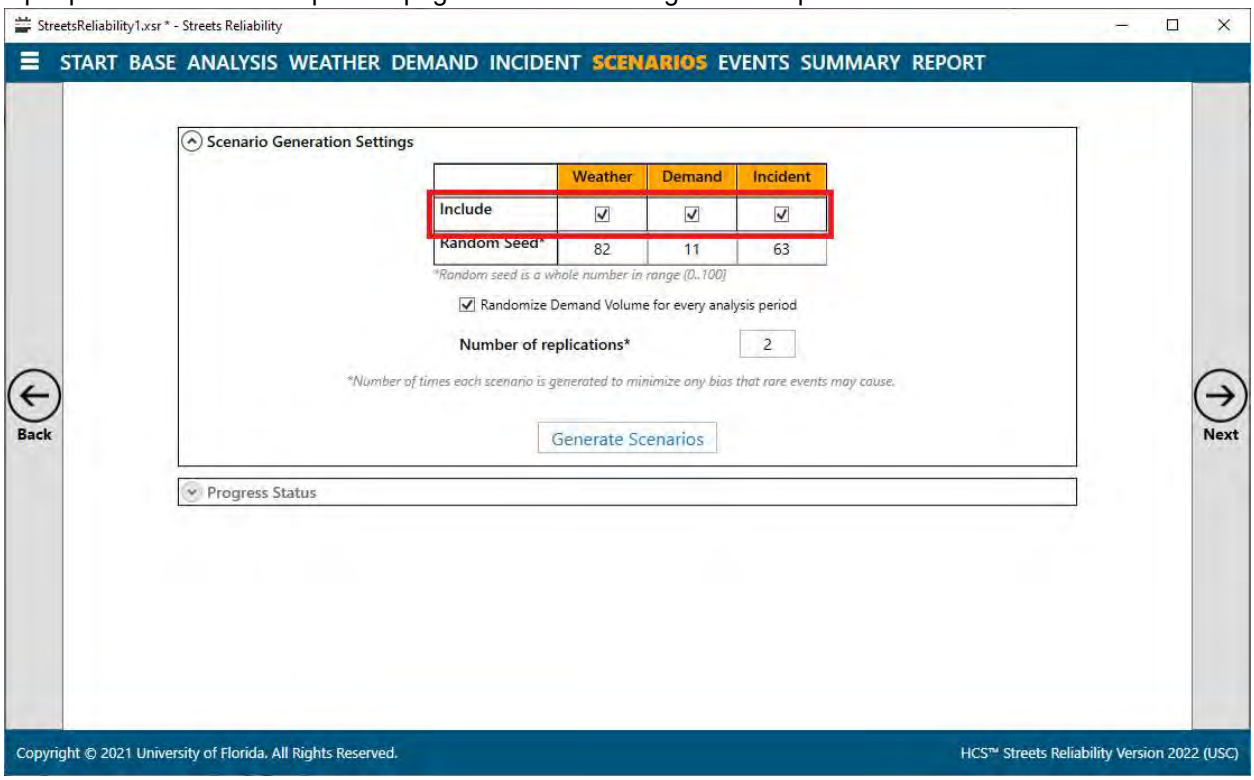
4. This table is editable so individual cells can be changed if necessary.
5. If cells are changed, and you wish to reload the defaults of your chosen location, a ‘Reset to Regional Default’ button is provided.

Generate Scenarios

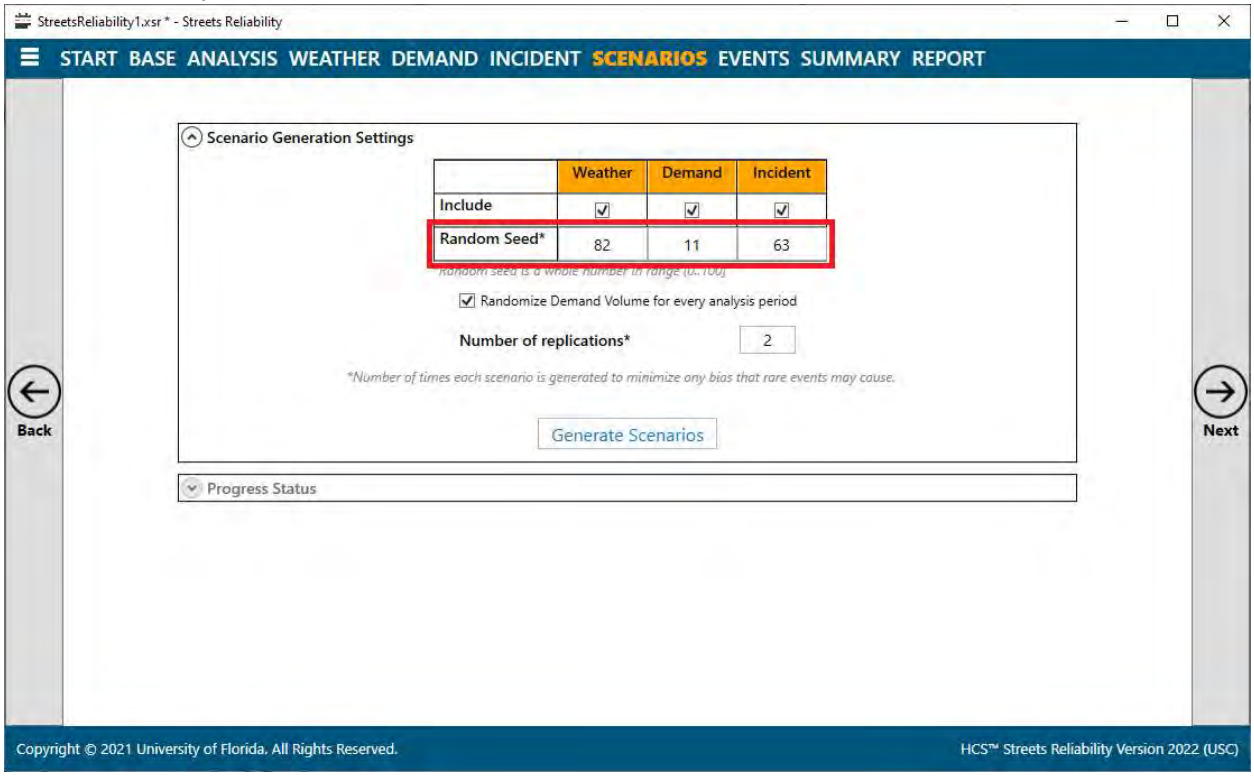
1. On the Scenarios page, Scenario Generations Settings are provided.



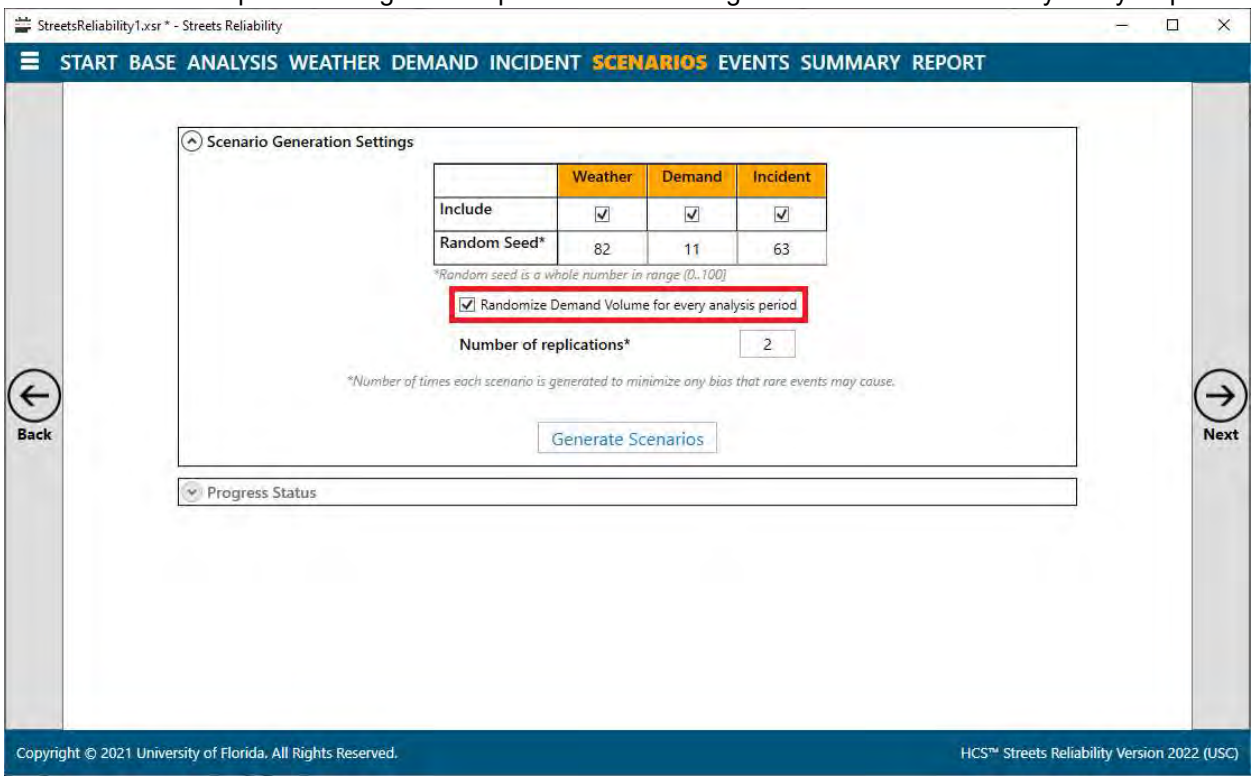
2. Checkboxes are provided for Weather, Demand, and Incident to indicate whether or not to consider the input provided on their respective pages in the scenario generation process.



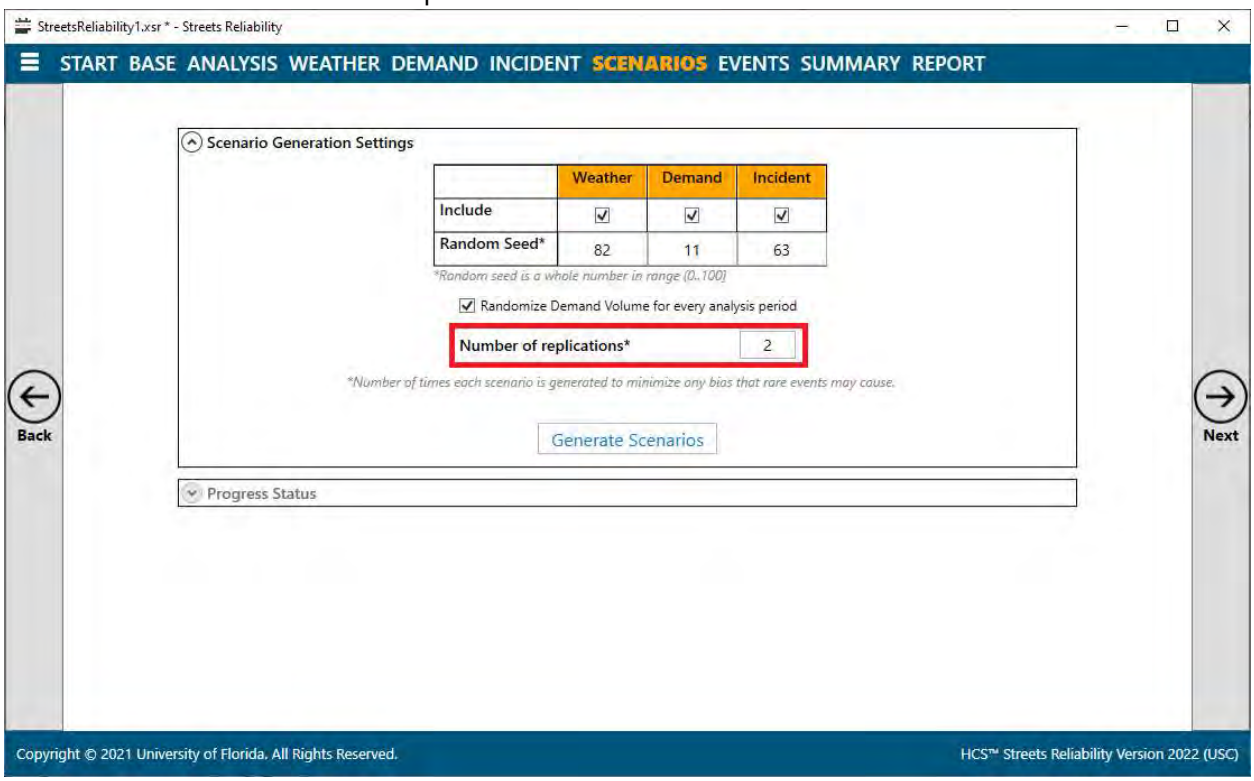
3. Random Seed numbers are provided for Weather, Demand, and Incident so that a sequence of random events can be reproduced.



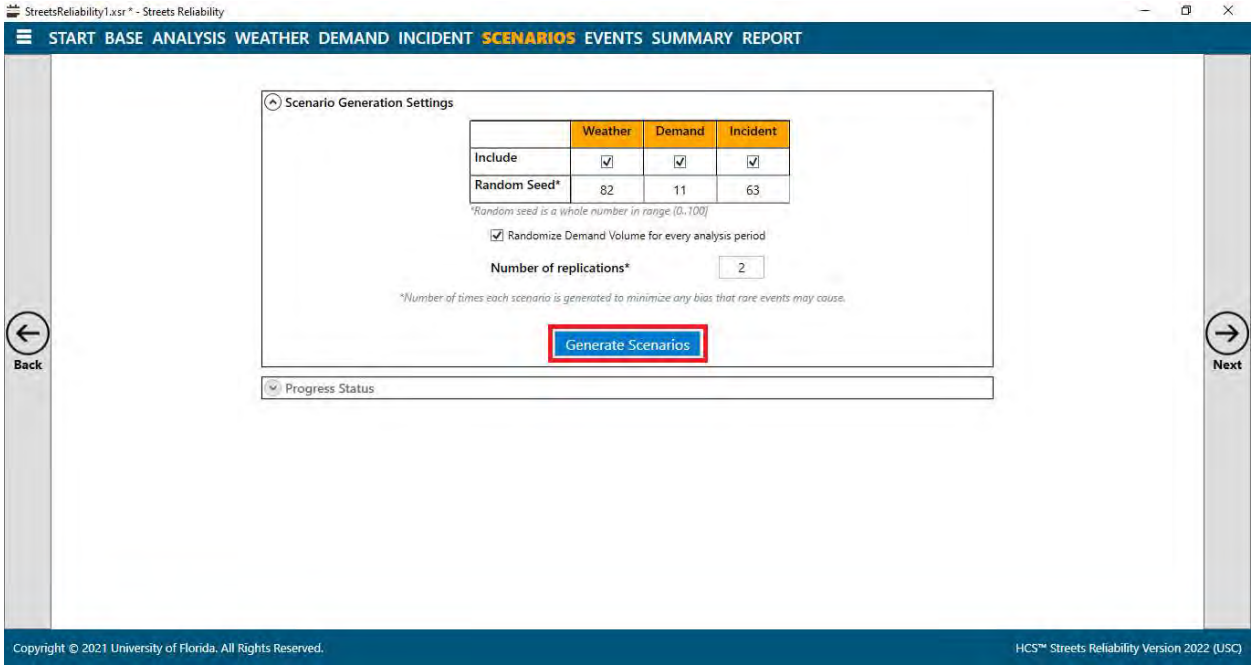
4. A checkbox is also provided to give the option of randomizing demand volume for every analysis period.



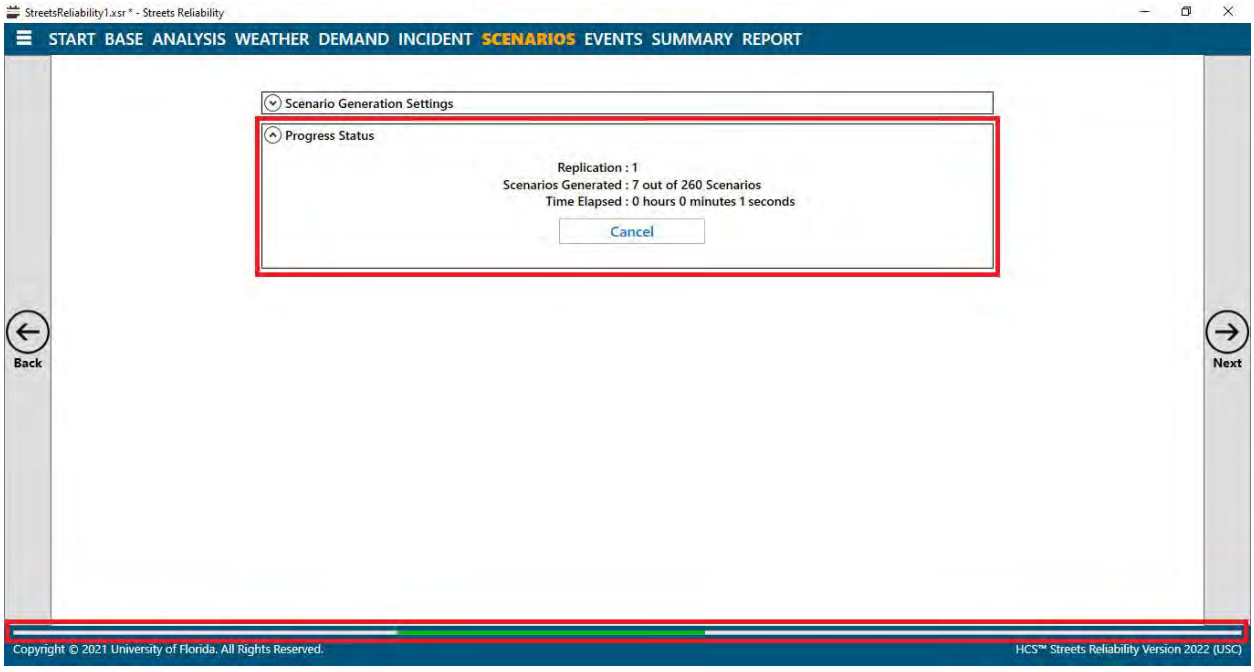
5. The number of replications can be indicated before scenario generation. This is the number of times each scenario is generated to minimize any bias that rare events may cause. For example, if there are 260 scenarios in an analysis and 2 replications, each replication will have 260 scenarios or a total of 520 scenarios. The default number of replications is 1.



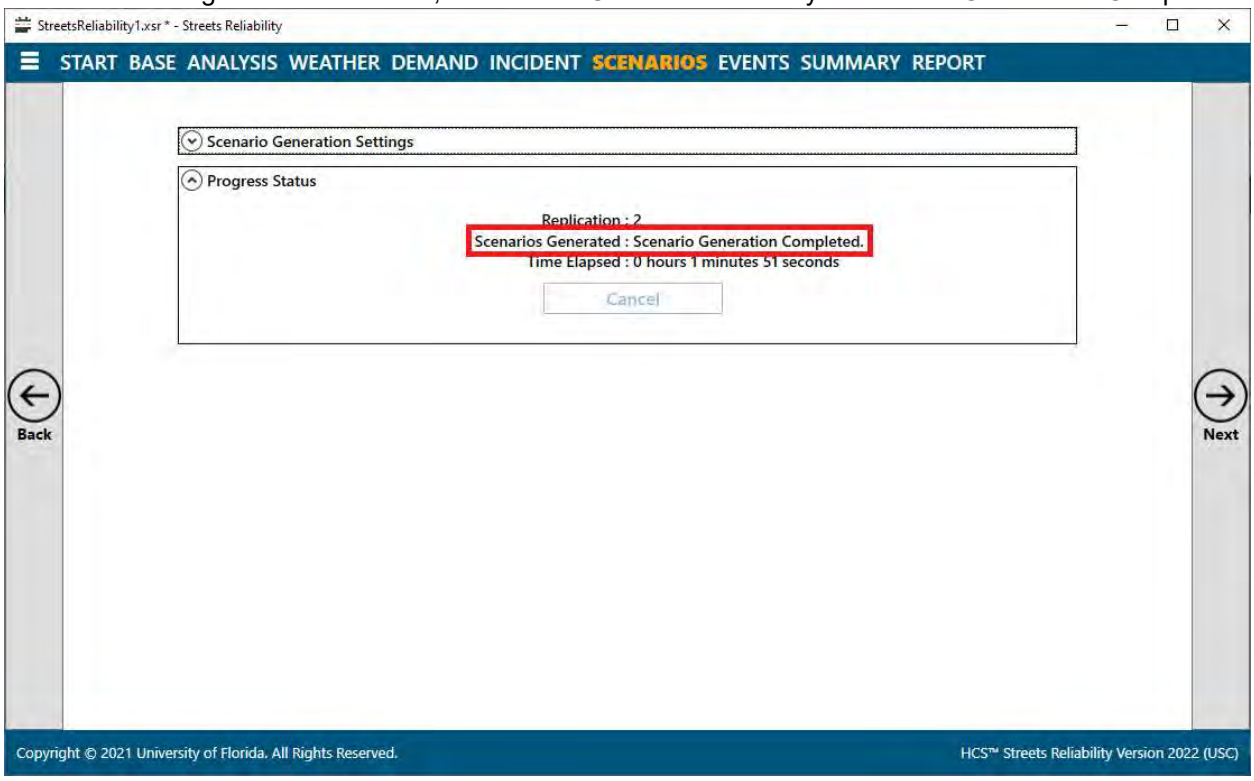
6. Once everything is set, click on the ‘Generate Scenarios’ button to start the scenario generation process.



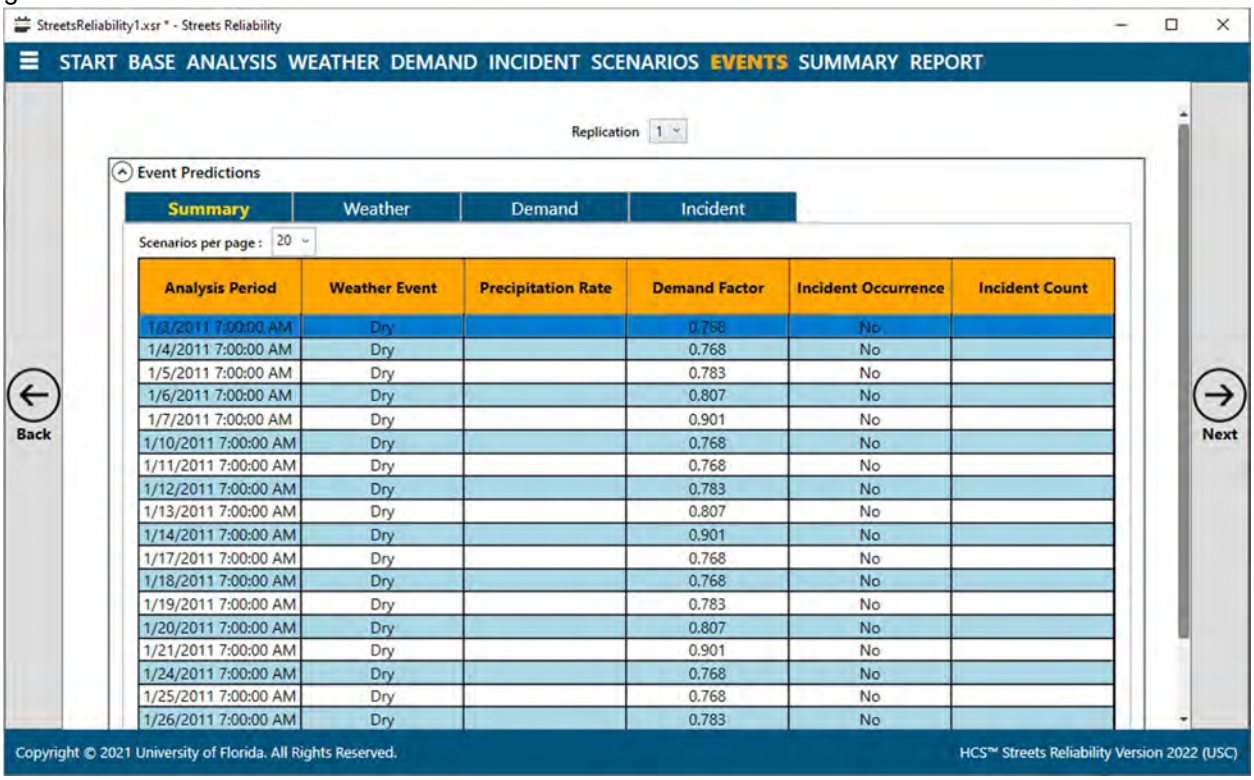
7. When scenario generation starts, the Progress Status section will indicate the current replication generating scenarios, the current number of scenarios generated within the replication, and the time elapsed for scenario generation. There is also a progress bar at the bottom of the window to indicate scenario generation is in progress.

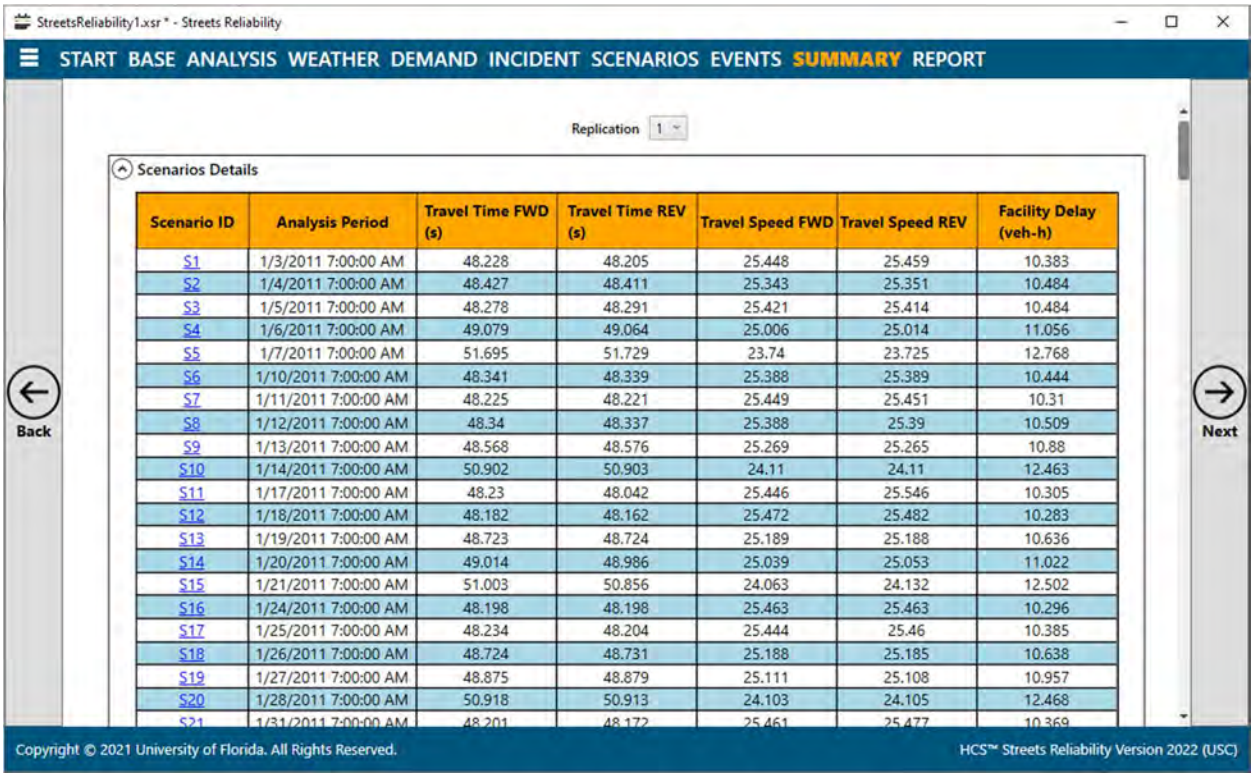


8. When scenario generation is done, Scenarios Generated will say “Scenario Generation Completed.”

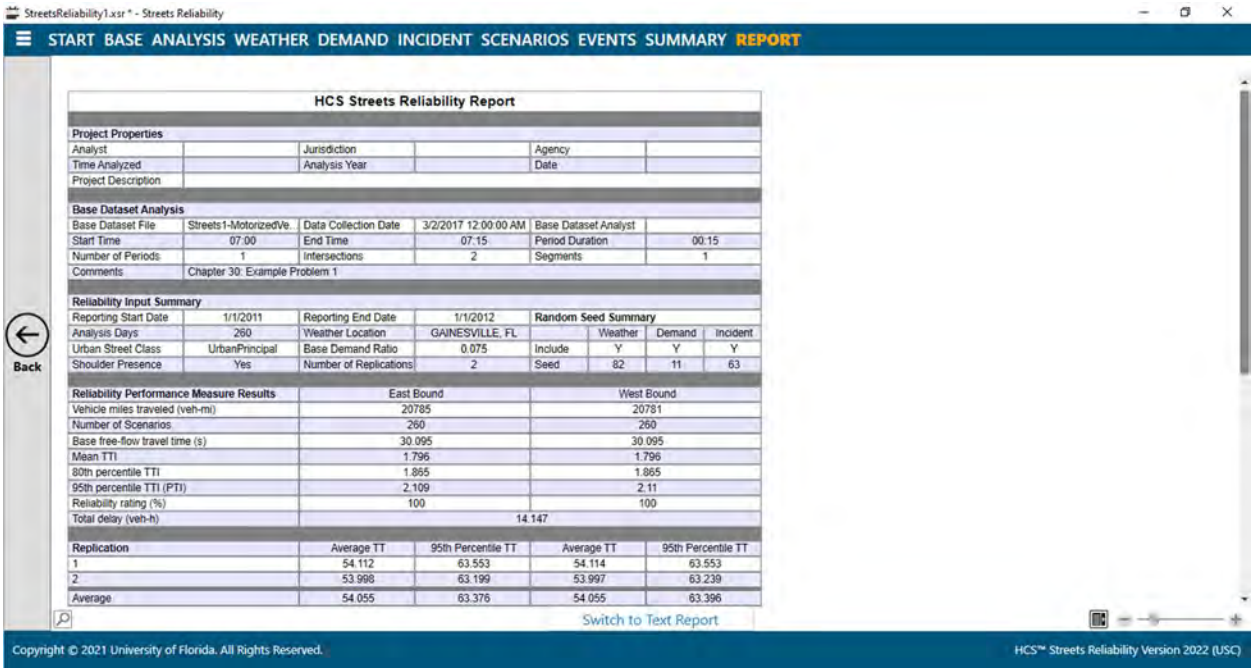


9. The Events, Summary, and Report pages will be populated with results after completion of scenario generation.





Scenario ID	Analysis Period	Travel Time FWD (s)	Travel Time REV (s)	Travel Speed FWD	Travel Speed REV	Facility Delay (veh-h)
S1	1/3/2011 7:00:00 AM	48.228	48.205	25.448	25.459	10.383
S2	1/4/2011 7:00:00 AM	48.427	48.411	25.343	25.351	10.484
S3	1/5/2011 7:00:00 AM	48.278	48.291	25.421	25.414	10.484
S4	1/6/2011 7:00:00 AM	49.079	49.064	25.006	25.014	11.056
S5	1/7/2011 7:00:00 AM	51.695	51.729	23.74	23.725	12.768
S6	1/10/2011 7:00:00 AM	48.341	48.339	25.388	25.389	10.444
S7	1/11/2011 7:00:00 AM	48.225	48.221	25.449	25.451	10.31
S8	1/12/2011 7:00:00 AM	48.34	48.337	25.388	25.39	10.509
S9	1/13/2011 7:00:00 AM	48.568	48.576	25.269	25.265	10.88
S10	1/14/2011 7:00:00 AM	50.902	50.903	24.11	24.11	12.463
S11	1/17/2011 7:00:00 AM	48.23	48.042	25.446	25.546	10.305
S12	1/18/2011 7:00:00 AM	48.182	48.162	25.472	25.482	10.283
S13	1/19/2011 7:00:00 AM	48.723	48.724	25.189	25.188	10.636
S14	1/20/2011 7:00:00 AM	49.014	48.986	25.039	25.053	11.022
S15	1/21/2011 7:00:00 AM	51.003	50.856	24.063	24.132	12.502
S16	1/24/2011 7:00:00 AM	48.198	48.198	25.463	25.463	10.296
S17	1/25/2011 7:00:00 AM	48.234	48.204	25.444	25.46	10.385
S18	1/26/2011 7:00:00 AM	48.724	48.731	25.188	25.185	10.638
S19	1/27/2011 7:00:00 AM	48.875	48.879	25.111	25.108	10.957
S20	1/28/2011 7:00:00 AM	50.918	50.913	24.103	24.105	12.468
S21	1/31/2011 7:00:00 AM	48.201	48.172	25.461	25.477	10.369



HCS Streets Reliability Report

Project Properties					
Analyst		Jurisdiction		Agency	
Time Analyzed		Analysis Year		Date	
Project Description					

Base Dataset Analysis					
Base Dataset File	Streets1-MotorizedVe..	Data Collection Date	3/2/2017 12:00:00 AM	Base Dataset Analyst	
Start Time	07:00	End Time	07:15	Period Duration	00:15
Number of Periods	1	Intersections	2	Segments	1
Comments	Chapter 30: Example Problem 1				

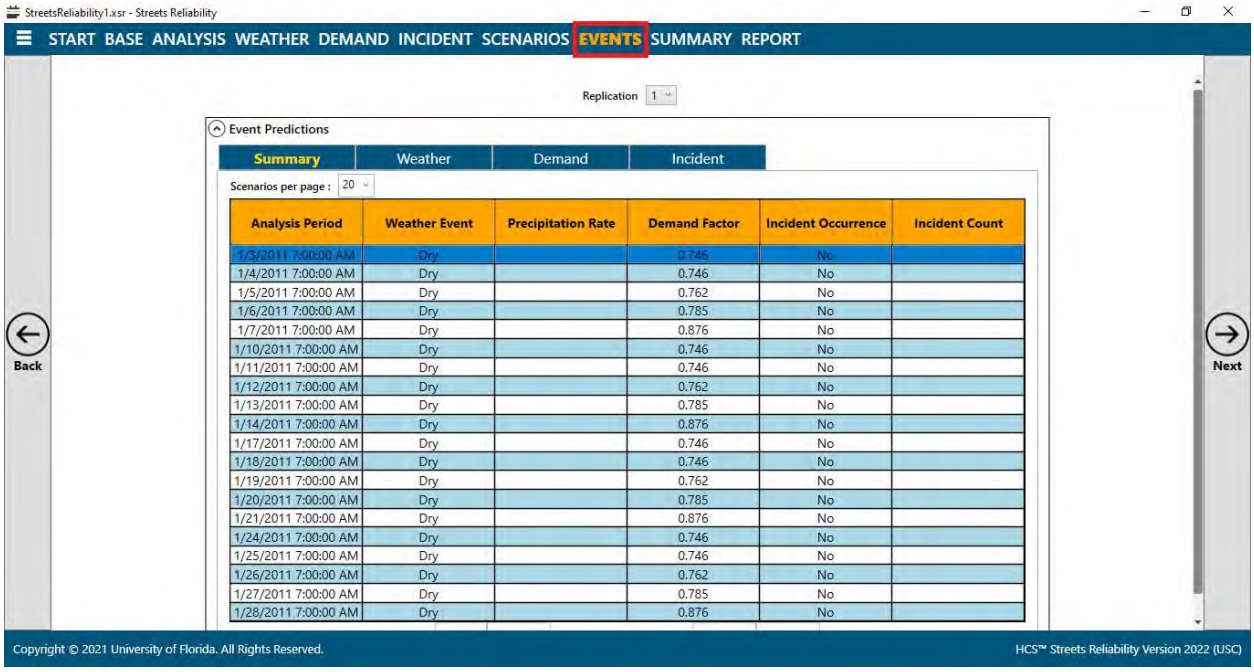
Reliability Input Summary							
Reporting Start Date	1/1/2011	Reporting End Date	1/1/2012	Random Seed Summary			
Analysis Days	260	Weather Location	GAINESVILLE, FL		Weather	Demand	Incident
Urban Street Class	UrbanPrincipal	Base Demand Ratio	0.075	Include	Y	Y	Y
Shoulder Presence	Yes	Number of Replications	2	Seed	82	11	63

Reliability Performance Measure Results	East Bound	West Bound
Vehicle miles traveled (veh-mi)	20785	20781
Number of Scenarios	260	260
Base free-flow travel time (s)	30.095	30.095
Mean TTI	1.796	1.796
80th percentile TTI	1.865	1.865
95th percentile TTI (PTI)	2.109	2.11
Reliability rating (%)	100	100
Total delay (veh-h)	14.147	

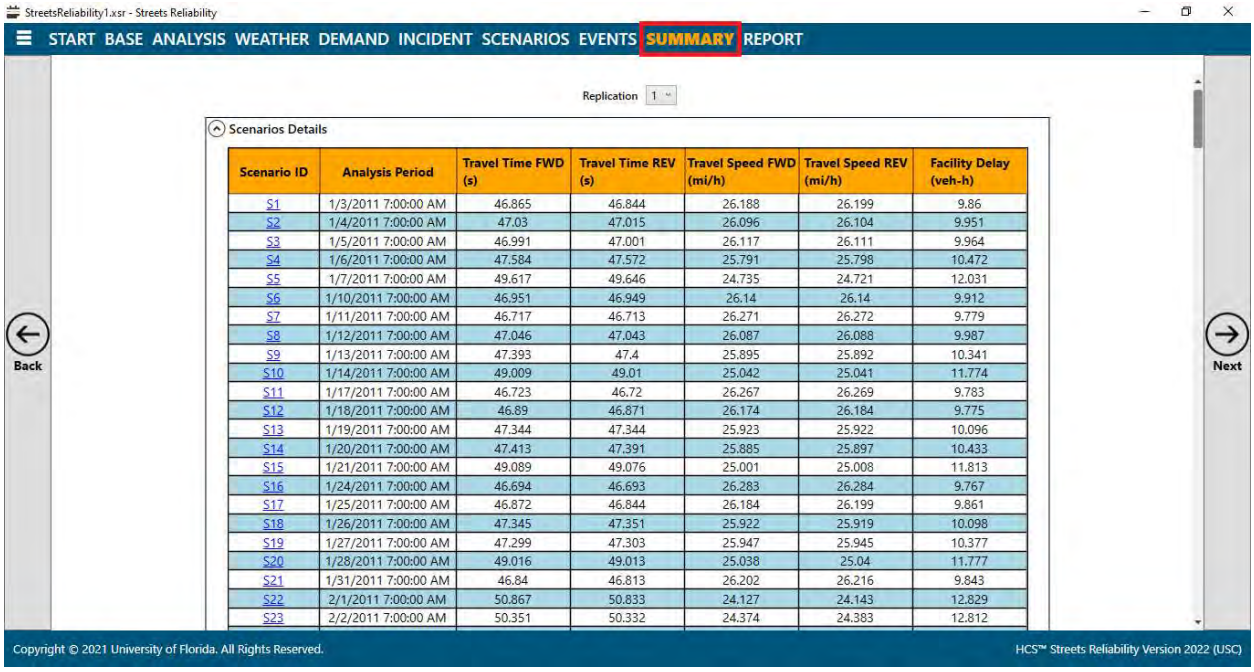
Replication	Average TT	95th Percentile TT	Average TT	95th Percentile TT
1	54.112	63.553	54.114	63.553
2	53.998	63.199	53.997	63.239
Average	54.055	63.376	54.055	63.396

View Results of the Analysis

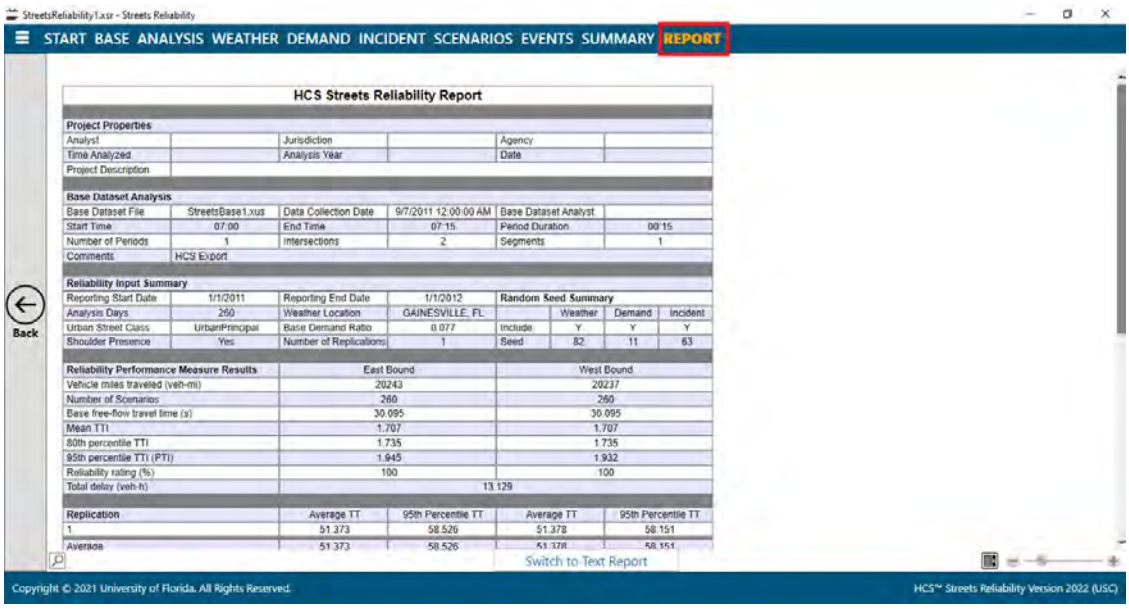
1. After editing all the necessary inputs and generating scenarios, results of the analysis can be found in the form of tables on the Events and Summary pages, and in the form of reports on the Report page.



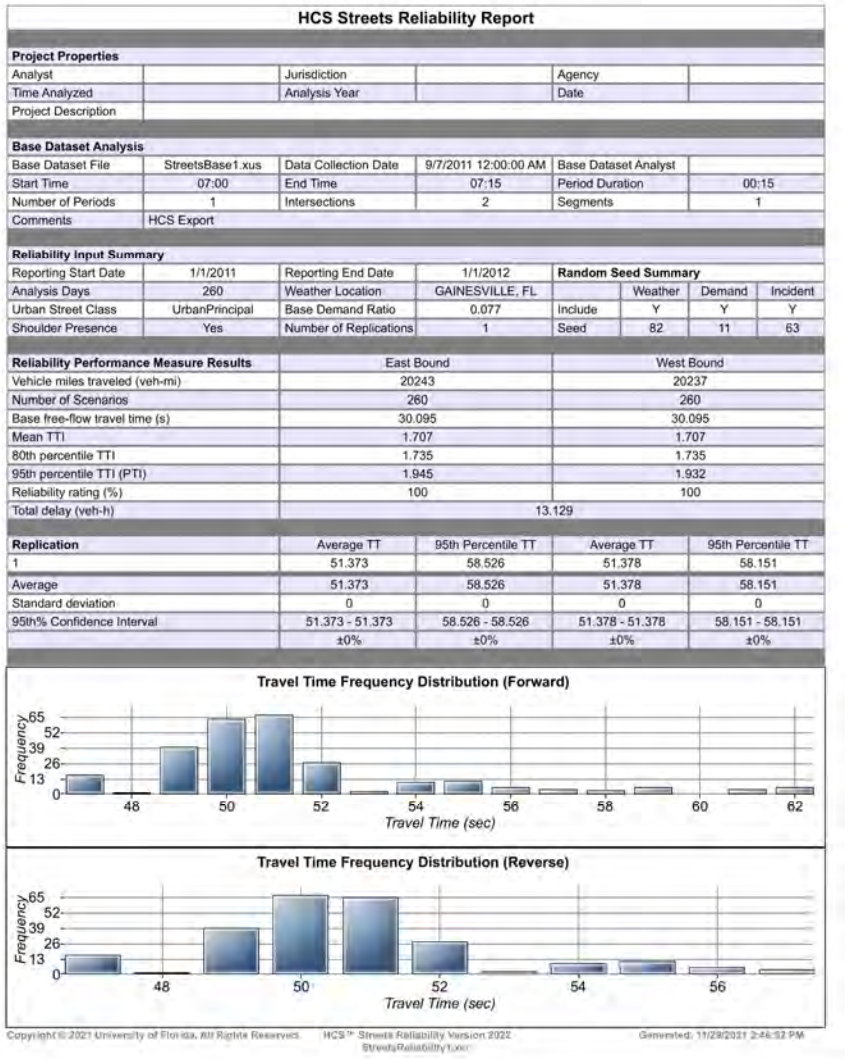
Analysis Period	Weather Event	Precipitation Rate	Demand Factor	Incident Occurrence	Incident Count
1/3/2011 7:00:00 AM	Dry		0.746	No	
1/4/2011 7:00:00 AM	Dry		0.746	No	
1/5/2011 7:00:00 AM	Dry		0.762	No	
1/6/2011 7:00:00 AM	Dry		0.785	No	
1/7/2011 7:00:00 AM	Dry		0.876	No	
1/10/2011 7:00:00 AM	Dry		0.746	No	
1/11/2011 7:00:00 AM	Dry		0.746	No	
1/12/2011 7:00:00 AM	Dry		0.762	No	
1/13/2011 7:00:00 AM	Dry		0.785	No	
1/14/2011 7:00:00 AM	Dry		0.876	No	
1/17/2011 7:00:00 AM	Dry		0.746	No	
1/18/2011 7:00:00 AM	Dry		0.746	No	
1/19/2011 7:00:00 AM	Dry		0.762	No	
1/20/2011 7:00:00 AM	Dry		0.785	No	
1/21/2011 7:00:00 AM	Dry		0.876	No	
1/24/2011 7:00:00 AM	Dry		0.746	No	
1/25/2011 7:00:00 AM	Dry		0.746	No	
1/26/2011 7:00:00 AM	Dry		0.762	No	
1/27/2011 7:00:00 AM	Dry		0.785	No	
1/28/2011 7:00:00 AM	Dry		0.876	No	



Scenario ID	Analysis Period	Travel Time FWD (s)	Travel Time REV (s)	Travel Speed FWD (mi/h)	Travel Speed REV (mi/h)	Facility Delay (veh-h)
S1	1/3/2011 7:00:00 AM	46.865	46.844	26.188	26.199	9.86
S2	1/4/2011 7:00:00 AM	47.03	47.015	26.096	26.104	9.951
S3	1/5/2011 7:00:00 AM	46.991	47.001	26.117	26.111	9.964
S4	1/6/2011 7:00:00 AM	47.584	47.572	25.791	25.798	10.472
S5	1/7/2011 7:00:00 AM	49.617	49.646	24.735	24.721	12.031
S6	1/10/2011 7:00:00 AM	46.951	46.949	26.14	26.14	9.912
S7	1/11/2011 7:00:00 AM	46.717	46.713	26.271	26.272	9.779
S8	1/12/2011 7:00:00 AM	47.046	47.043	26.087	26.088	9.987
S9	1/13/2011 7:00:00 AM	47.393	47.4	25.895	25.892	10.341
S10	1/14/2011 7:00:00 AM	49.009	49.01	25.042	25.041	11.774
S11	1/17/2011 7:00:00 AM	46.723	46.72	26.267	26.269	9.783
S12	1/18/2011 7:00:00 AM	46.89	46.871	26.174	26.184	9.775
S13	1/19/2011 7:00:00 AM	47.344	47.344	25.923	25.922	10.096
S14	1/20/2011 7:00:00 AM	47.413	47.391	25.885	25.897	10.433
S15	1/21/2011 7:00:00 AM	49.089	49.076	25.001	25.008	11.813
S16	1/24/2011 7:00:00 AM	46.694	46.693	26.283	26.284	9.767
S17	1/25/2011 7:00:00 AM	46.872	46.844	26.184	26.199	9.861
S18	1/26/2011 7:00:00 AM	47.345	47.351	25.922	25.919	10.098
S19	1/27/2011 7:00:00 AM	47.299	47.303	25.947	25.945	10.377
S20	1/28/2011 7:00:00 AM	49.016	49.013	25.038	25.04	11.777
S21	1/31/2011 7:00:00 AM	46.84	46.813	26.202	26.216	9.843
S22	2/1/2011 7:00:00 AM	50.867	50.833	24.127	24.143	12.829
S23	2/2/2011 7:00:00 AM	50.351	50.332	24.374	24.383	12.812



2. There are two options for reports: Formatted and Text
    a. Formatted reports show the most important results in a presentable format.



HCS Streets Reliability Report

Project Properties					
Analyst		Jurisdiction		Agency	
Time Analyzed		Analysis Year		Date	
Project Description					

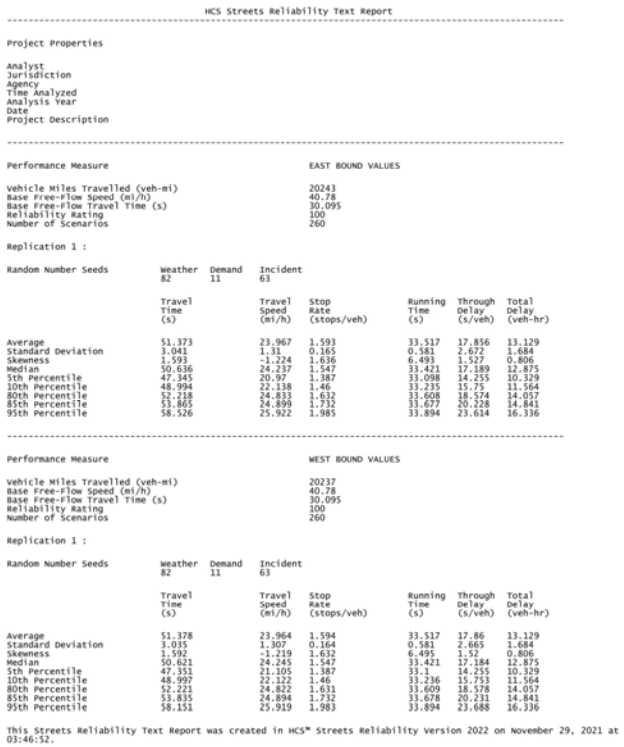
Base Dataset Analysis					
Base Dataset File	StreetsBase1.xus	Data Collection Date	9/7/2011 12:00:00 AM	Base Dataset Analyst	
Start Time	07:00	End Time	07:15	Period Duration	00:15
Number of Periods	1	Intersections	2	Segments	1
Comments	HCS Export				

Reliability Input Summary							
Reporting Start Date	1/1/2011	Reporting End Date	1/1/2012	**Random Seed Summary**			
Analysis Days	260	Weather Location	GAINESVILLE, FL		Weather	Demand	Incident
Urban Street Class	UrbanPrincipal	Base Demand Ratio	0.077	Include	Y	Y	Y
Shoulder Presence	Yes	Number of Replications	1	Seed	82	11	63

Reliability Performance Measure Results	East Bound	West Bound
Vehicle miles traveled (veh-mi)	20243	20237
Number of Scenarios	260	260
Base free-flow travel time (s)	30.095	30.095
Mean TTI	1.707	1.707
80th percentile TTI	1.735	1.735
95th percentile TTI (PTI)	1.945	1.932
Reliability rating (%)	100	100
Total delay (veh-h)	13.129	

Replication	Average TT	95th Percentile TT	Average TT	95th Percentile TT
1	51.373	58.526	51.378	58.151
Average	51.373	58.526	51.378	58.151
Standard deviation	0	0	0	0
95th% Confidence Interval	51.373 - 51.373	58.526 - 58.526	51.378 - 51.378	58.151 - 58.151
	±0%	±0%	±0%	±0%

b. Text reports show a more detailed analysis in plain text.



HCS Streets Reliability Text Report

Project Properties

Analyst
Jurisdiction
Agency
Time Analyzed
Analysis Year
Date
Project Description

Performance Measure	EAST BOUND VALUES
Vehicle Miles Travelled (veh-mi)	20243
Base Free-Flow Speed (mi/h)	40.78
Base Free-Flow Travel Time (s)	30.095
Reliability Rating	100
Number of Scenarios	260

Replication 1 :

Random Number Seeds	Weather	Demand	Incident
	82	11	63

	Travel Time (s)	Travel Speed (mi/h)	Stop Rate (stops/veh)	Running Time (s)	Through Delay (s/veh)	Total Delay (veh-hr)
Average	51.373	23.967	1.593	33.517	17.856	13.129
Standard Deviation	3.041	1.31	0.165	0.581	2.672	1.684
Skewness	1.593	-1.224	1.636	6.493	1.527	0.806
Median	50.636	24.237	1.547	33.421	17.189	12.875
5th Percentile	47.345	20.97	1.387	33.098	14.255	10.329
10th Percentile	48.994	22.138	1.46	33.235	15.75	11.564
80th Percentile	52.218	24.833	1.632	33.608	18.574	14.057
85th Percentile	53.865	24.899	1.732	33.677	20.228	14.841
95th Percentile	58.526	25.922	1.985	33.894	23.614	16.336

Performance Measure	WEST BOUND VALUES
Vehicle Miles Travelled (veh-mi)	20237
Base Free-Flow Speed (mi/h)	40.78
Base Free-Flow Travel Time (s)	30.095
Reliability Rating	100
Number of Scenarios	260

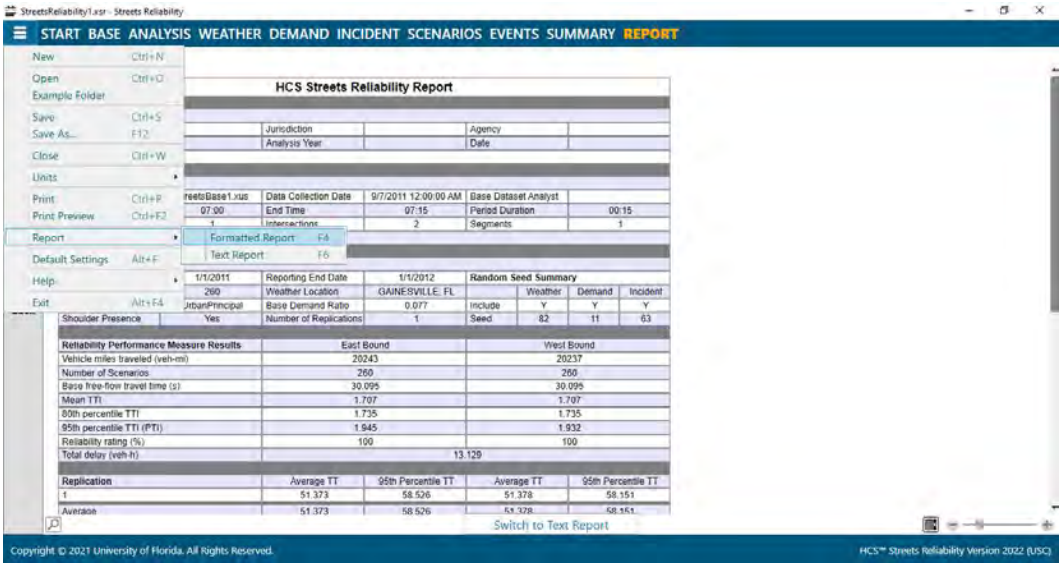
Replication 1 :

Random Number Seeds	Weather	Demand	Incident
	82	11	63

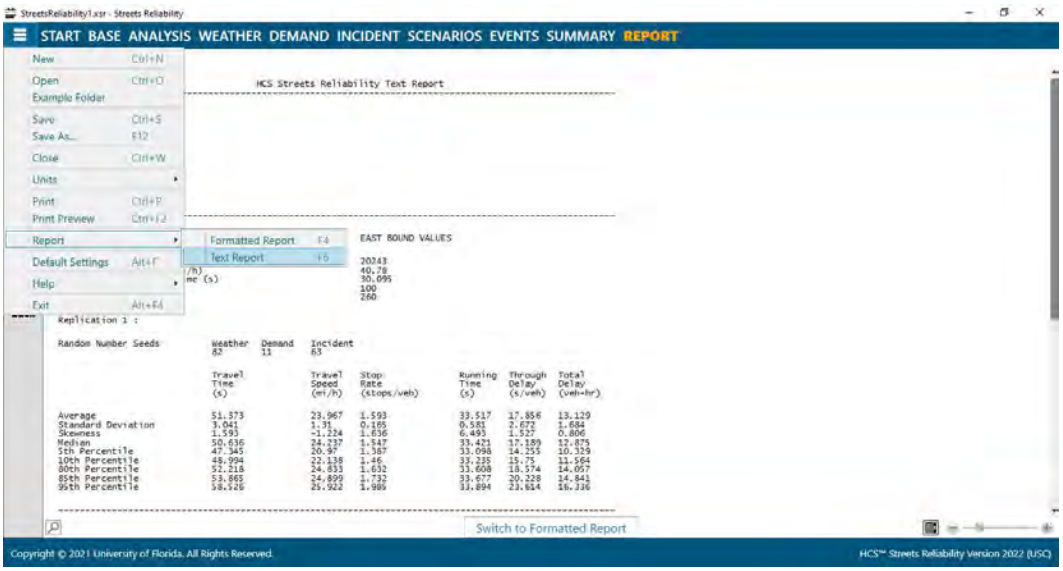
	Travel Time (s)	Travel Speed (mi/h)	Stop Rate (stops/veh)	Running Time (s)	Through Delay (s/veh)	Total Delay (veh-hr)
Average	51.378	23.964	1.594	33.517	17.86	13.129
Standard Deviation	3.035	1.307	0.164	0.581	2.665	1.684
Skewness	1.592	-1.219	1.632	6.495	1.52	0.806
Median	50.621	24.245	1.547	33.421	17.184	12.875
5th Percentile	47.351	21.105	1.387	33.1	14.255	10.329
10th Percentile	48.997	22.122	1.46	33.236	15.753	11.564
80th Percentile	52.221	24.822	1.631	33.609	18.578	14.057
85th Percentile	53.835	24.894	1.732	33.678	20.231	14.841
95th Percentile	58.151	25.919	1.983	33.894	23.688	16.336

This Streets Reliability Text Report was created in HCS™ Streets Reliability version 2022 on November 29, 2021 at 03:46:52.

3. The type of report displayed can be changed by using the main menu items, keyboard shortcuts, or toggle buttons found under the report
    a. Main Menu Items
        i. To switch to the Formatted Report, select *File* > *Report* > *Formatted Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report”, and then selecting “Formatted Report”.



        ii. To switch to the Text Report, select *File* > *Report* > *Text Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report”, and then selecting “Text Report”.



b. Keyboard Shortcuts

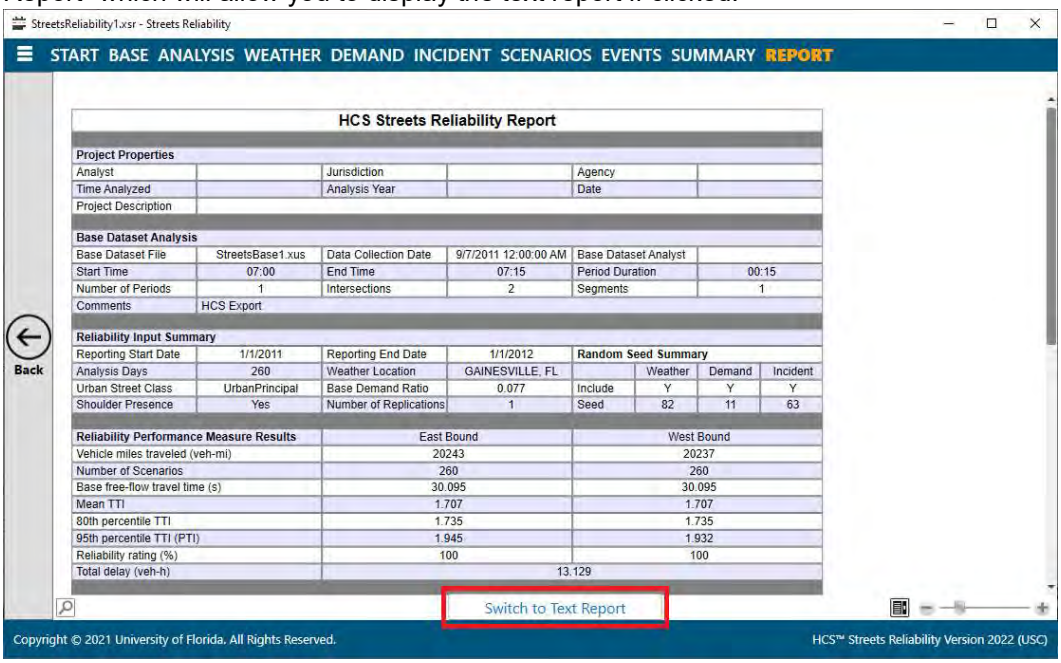
   i. Formatted Report: keyboard shortcut is “F4”

   ii. Text Report: keyboard shortcut is “F6”

c. Report Toggle Buttons

   i. A toggle button is available at the bottom of the screen underneath the report.

   ii. If the formatted report is currently being displayed, the toggle button will say “Switch to Text Report” which will allow you to display the text report if clicked.



HCS Streets Reliability Report							
Project Properties							
Analyst		Jurisdiction		Agency			
Time Analyzed		Analysis Year		Date			
Project Description							
Base Dataset Analysis							
Base Dataset File	StreetsBase1.xus	Data Collection Date	9/7/2011 12:00:00 AM	Base Dataset Analyst			
Start Time	07:00	End Time	07:15	Period Duration	00:15		
Number of Periods	1	Intersections	2	Segments	1		
Comments	HCS Export						
Reliability Input Summary							
Reporting Start Date	1/1/2011	Reporting End Date	1/1/2012	**Random Seed Summary**			
Analysis Days	260	Weather Location	GAINESVILLE, FL		Weather	Demand	Incident
Urban Street Class	UrbanPrincipal	Base Demand Ratio	0.077	Include	Y	Y	Y
Shoulder Presence	Yes	Number of Replications	1	Seed	82	11	63

Reliability Performance Measure Results	East Bound	West Bound
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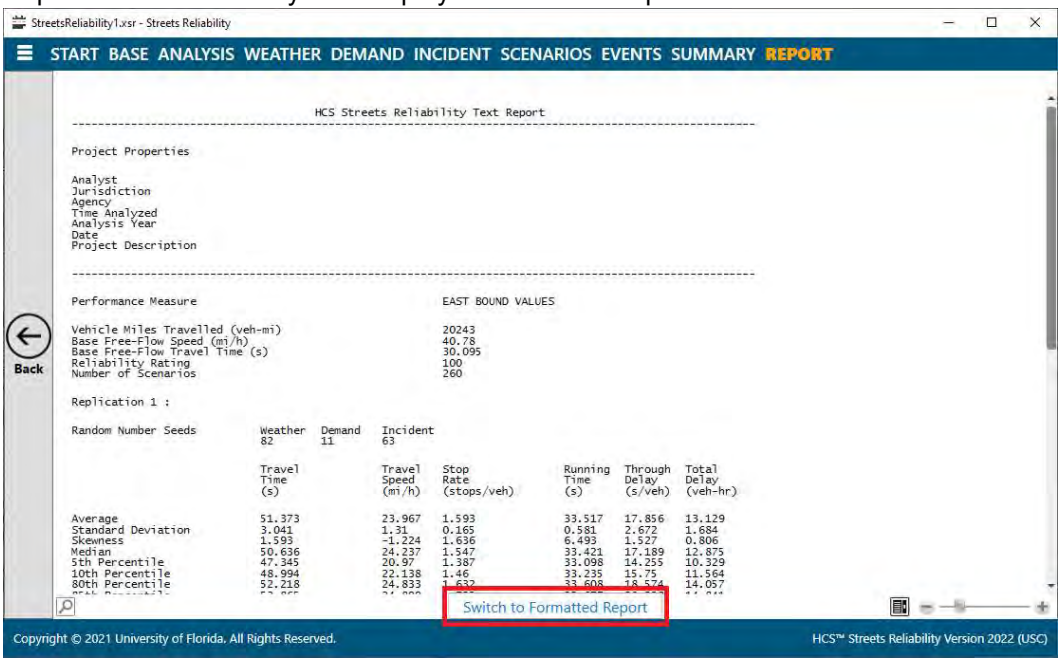
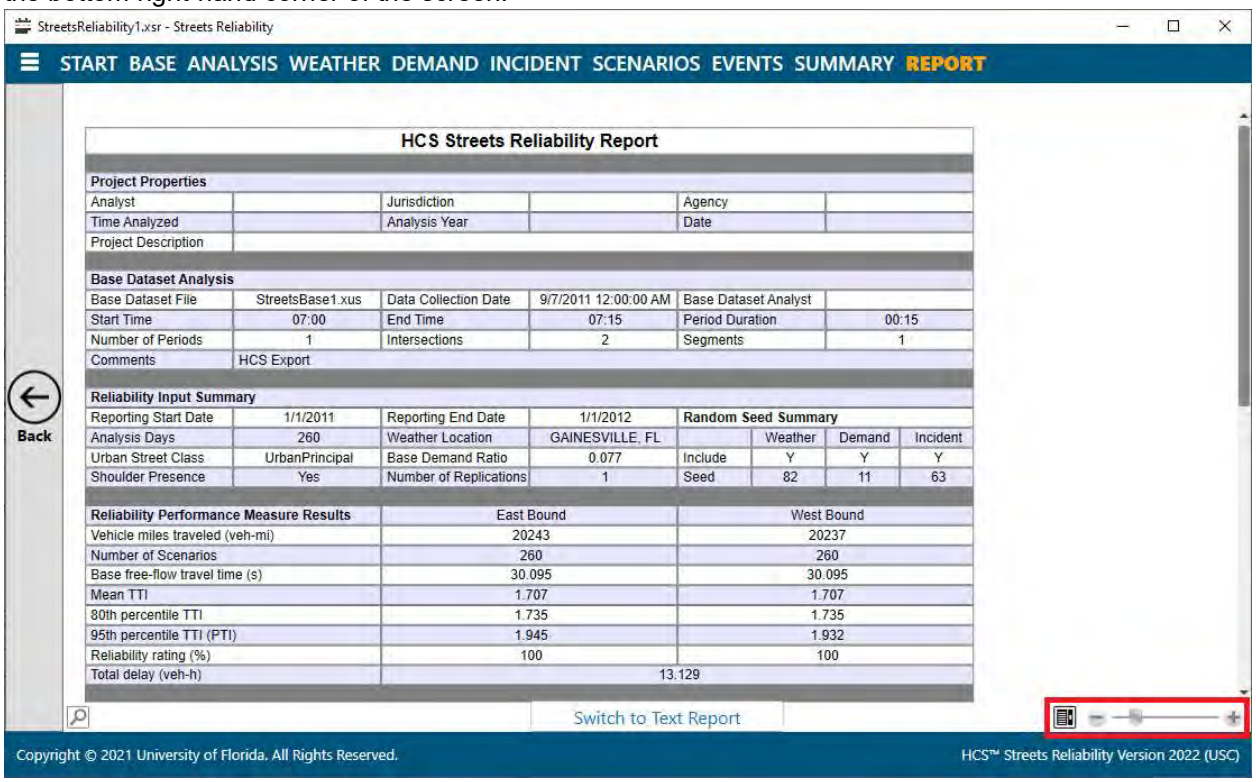
80th percentile TTI	1.735	1.735
95th percentile TTI (PTI)	1.945	1.932
Reliability rating (%)	100	100
Total delay (veh-h)	13.129	

iii. If the text report is currently being displayed, the toggle button will say “Switch to Formatted Report” which will allow you to display the formatted report if clicked.



4. The magnification of the report currently being displayed can be changed using the zoom slider found at the bottom right-hand corner of the screen.



a. To zoom in, drag the slider to the right; to zoom out, drag the slider to the left

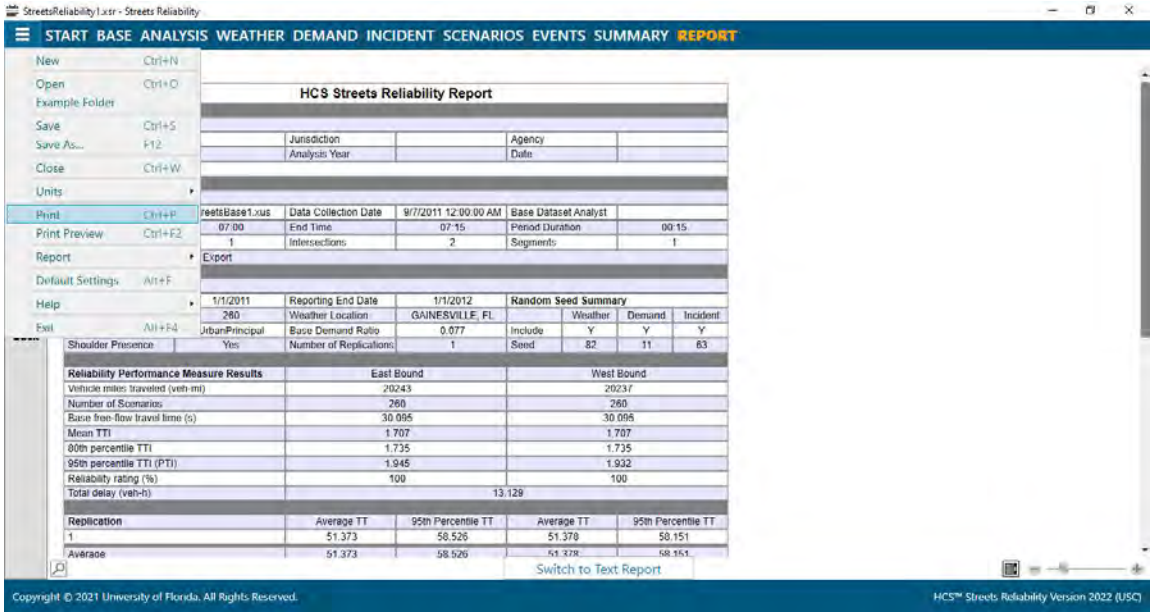
b. Clicking the plus (+) button will zoom in; clicking the minus (-) button will zoom out

c. Holding down “ctrl” on the keyboard and scrolling up on the mouse wheel will zoom in; holding down “ctrl” on the keyboard and scrolling down on the mouse wheel will zoom out

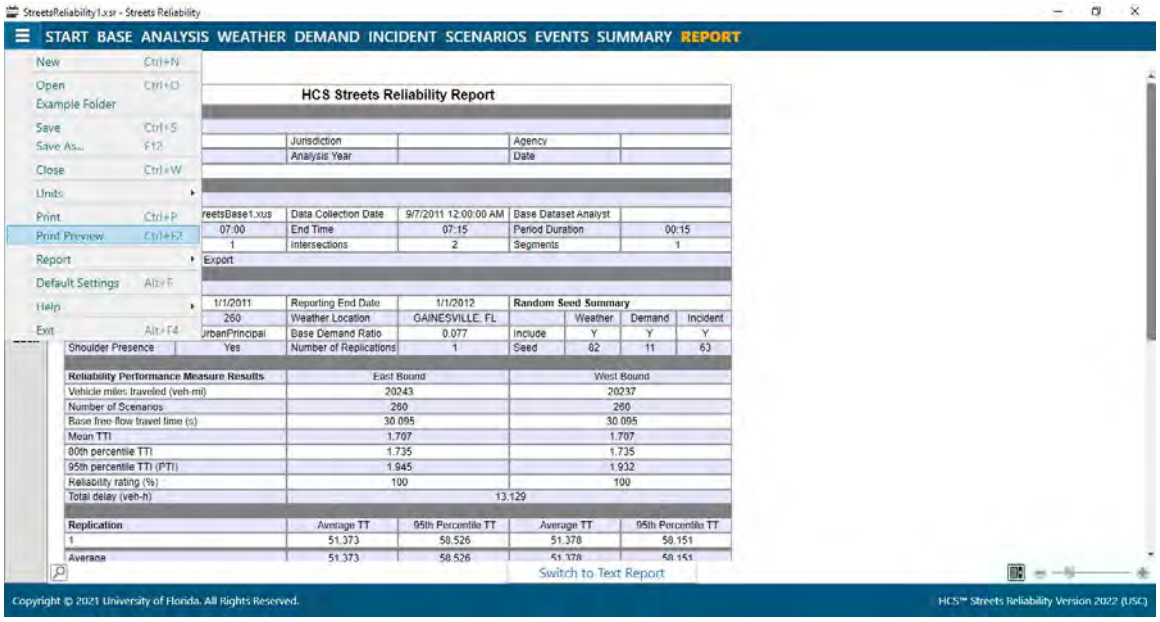
Print a Report

1. There are four options for printing a report:

    a. Selecting *File* > *Print* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Print”



    b. Selecting *File* > *Print Preview* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting “Print Preview”

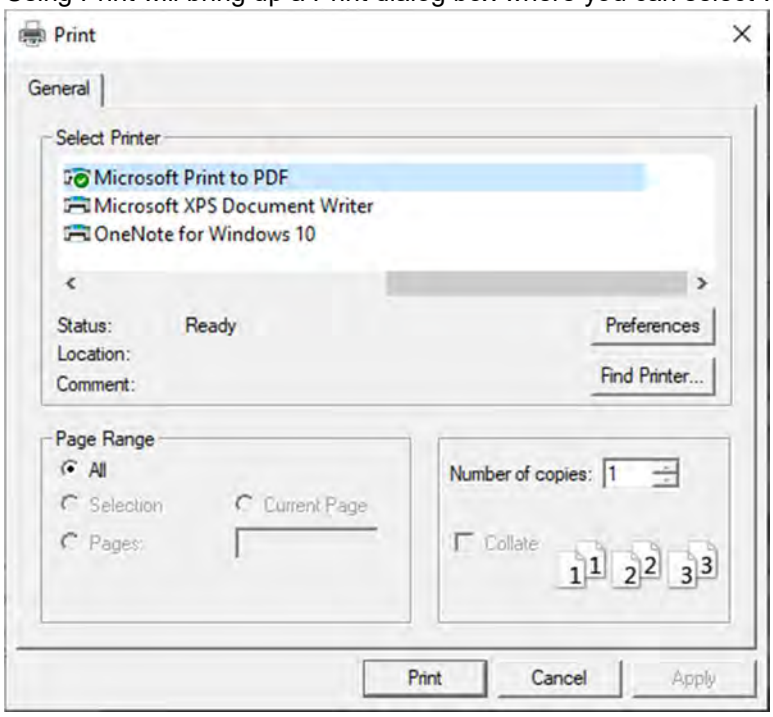


    c. Using keyboard shortcut “Ctrl+P” for Print

    d. Using keyboard shortcut “Ctrl+F2” for Print Preview

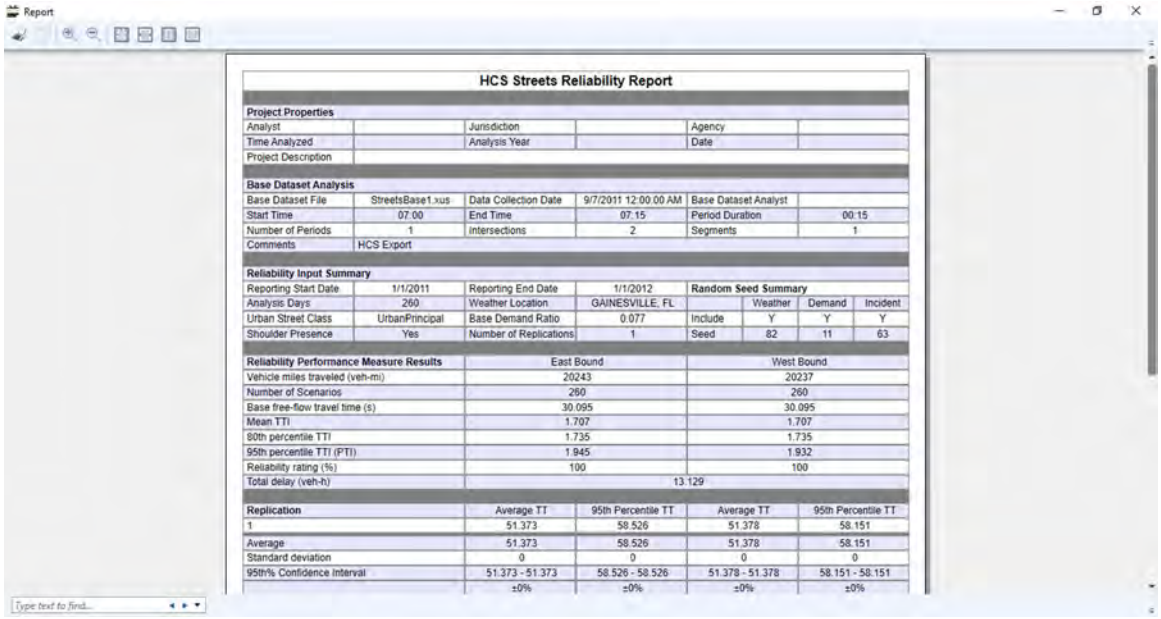
2. Print

    a. Using Print will bring up a Print dialog box where you can select which printer to print to



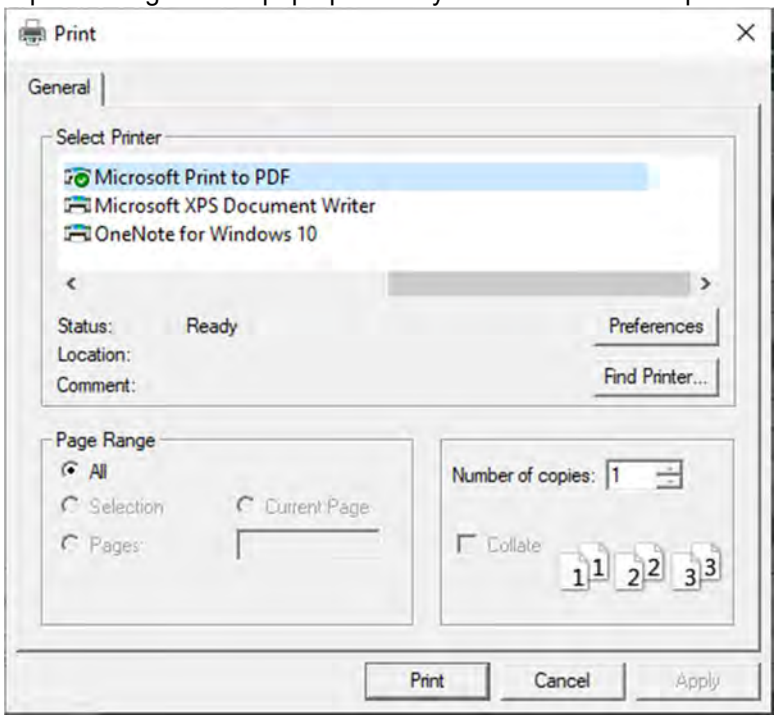
3. Print Preview

    a. Using Print Preview will bring up a window where you can view how the report will look on paper before sending it to the printer



    b. The print icon in the toolbar found in the top left-hand corner can then be selected

c. A print dialog box will pop up where you can select which printer to print to



Glossary of Terms

50th Percentile TTI

The ratio of the 50th percentile highest travel time to the travel time at the base free-flow speed. This measure can be used for trend analysis and to demonstrate changes in performance resulting from an operational strategy, capacity improvement, or change in demand.

80th Percentile TTI

The ratio of the 80th percentile highest travel time to the travel time at the base free-flow speed. This measure has been found to be more sensitive to operational changes than the PTI, which makes it useful for comparison and prioritization purposes.

95th Percentile TTI

See *Planning Time Index (PTI)*.

Agency

This field is provided to document the agency or company associated with this analysis or project.

Analysis Period

The time interval used for the performance evaluation. It can range from 15 min to 1 h, with longer durations in this range sometimes used for planning analyses. A shorter duration in this range is typically used for operational analyses.

Analysis Year

This field is provided to document the year for which the analysis is being performed.

Analyst

The field is provided to document the name of the analyst.

Annual Delay

Annual delay represents the average vehicle hours of travel or person hours of travel occurring minus what would occur under free-flow conditions. Delay is useful because economic analyses have a long history of monetizing delay.

Base Crash Frequency

The methodology requires the base crash frequency for each segment and for each intersection along the subject facility. The base crash frequency is an estimate of the expected crash frequency for the segment or intersection when no work zones are present or special events occur. The estimated should include all severity levels, including property-damage-only (PDO) crashes. Crash frequency is provided in units of crashes per year, regardless of the duration of the reliability reporting period.

Base File

The base file provides all the required input data for the urban street segments methodology described in HCM Chapter 18. The base file contains the required input data to execute HCM Chapter 17's reliability methodology. It consists of all the data needed to evaluate the base HCM facility methodology for a single study period, plus data that describe the variations in demand, weather, and so forth that occur over the course of the reliability reporting period, along with the frequency of a particular event's occurrence. The majority of the reliability-specific input data can be defaulted when they are not available locally, but the analyst is encouraged to supply facility-specific data whenever feasible.

The user has the option to load a base file or create a base file. Clicking on 'Load Base File' will open a dialog box to allow the user to select a Streets (*.xus) file for the user to open and load into the Streets Reliability program. Once loaded, a Street intersections and segments graph of the base file will be displayed on the page, along with general information. Clicking on the 'Create Base File' will open the HCS Streets program to allow the user to create a new base file for use in the Streets Reliability program.

Please also see *Data Depository*.

Crash Frequency Adjustment Factors for Inclement Weather

Inclement weather conditions can increase the likelihood of crashes. Crash frequency adjustment factors are required for the following conditions:

- Rainfall,
- Snowfall,
- Wet pavement (not raining), and
- Snow or ice on pavement (not snowing).

The crash frequency adjustment factor is the ratio of hourly crash frequency during the weather event to the hourly crash rate during clear, dry hours. It is computed by using one or more years of historical weather data and crash data for the region in which the subject facility is located.

The adjustment factor for a specific weather condition is computed from (*a*) the number of hours for which the weather condition exists for the year and (*b*) the count of crashes during those hours. An hourly crash frequency for the weather condition $f_{c,wea}$ is computed by dividing the crash count by the number of hours. By a similar technique, the hourly crash frequency is computed for dry pavement hours $f_{c,dry}$. The crash frequency adjustment factor for the weather condition $CFAF_{wea}$ is computed as the ratio of the two frequencies (i.e., $CFAF_{wea} = f_{c,wea}/f_{c,dry}$).

The crash frequency adjustment factor includes consideration of the effect of the weather even on traffic volume (i.e., volume may be reduced because of bad weather) and on crash risk (i.e., wet pavement may increase the potential for a crash).

The following are the default values for the crash frequency adjustment factor of each weather condition:

- Rainfall: 2.0
- Wet pavement (not raining): 3.0
- Snowfall: 1.5
- Snow or ice on pavement (not snowing): 2.75

Crash Location Categories

The categorization of crashes by location is determined by using the definitions given in *Highway Safety Manual* (HSM) Section A.2.3, found in Appendix A of HSM Volume 2. The HSM states that "Intersection crashes include crashes that occur at an intersection (i.e., within the curb limits) and crashes that occur on the intersection legs and are intersection related. All crashes that are not classified as intersection or intersection-related crashes are considered to be roadway segment crashes."

Data Depository

Every reliability analysis requires a base dataset. This dataset describes the traffic demand, geometry, and signal timing conditions for the intersections and segments along the facility during the study period, when no work zones are present and no special events occurs.

Please also see *Base File*.

Date

This field is provided to document the date when the analysis is performed.

Day-of-Week Demand Ratios

The following HCM exhibit provides the default day-of-week demand ratios (ADT/AADT):

Day	Demand Ratio
Sunday	0.87
Monday	0.98
Tuesday	0.98
Wednesday	1.00
Thursday	1.03
Friday	1.15
Saturday	0.99

Source: Hallenbeck et al. (*9*).

See also *Time Period Adjustment Factors*.

Demand Change Factors

The three "demand change factors" account for a change in traffic demand due to weather conditions. One factor describes demand change during dry weather (by definition it has a values of 1.0). A second factor describes the demand change during a rain event. The third factor describes the demand change for a snow event. During a step of the methodology, the demand volume is multiplied by the demand change factor corresponding to the weather associated with a given analysis period. A factor less than 1.0 corresponds to a reduction in demand during the event.

Research indicates that urban street traffic demand tends to drop 15% to 30% during snow events. These motorists likely altered the start time of their commute or stayed home to avoid the bad weather. In the absence of local data, a default value of 0.80 may be used for snow events.

The research is less clear on the effect of rain on traffic demand. The effect of rain may vary with the trip purpose and the annual frequency of rain events in the vicinity of the subject facility. A default factor values of 1.0 is recommended for rain events. These default values are summarized in the following HCM exhibit:

Input Data Item	Default Value
Demand change factor for dry weather	1.00
Demand change factor for rain event	1.00
Demand change factor for snow event	0.80
Pavement runoff duration for snow event	0.5 h

See *Duration of Pavement Runoff* for the input data item in the last row.

Demand Pattern Data

Demand pattern data are used by the reliability method to adjust the demand volumes in the base and alternative datasets to reflect demands during all the other time periods in the reliability reporting period. The data include (*a*) adjustment factors to account for demand variation by hour of day, day of week, and month of year; and (*b*) adjustment factors to account for change in traffic demand due to weather conditions.

Details per page

A drop down selection is provided to indicate how many scenario results to show on the page.

Duration of Pavement Runoff

The duration of pavement runoff for a snow event is required. It is defined as the period of time after the snow stops falling that snowpack (or ice) covers the pavement. After this time period elapses, the pavement is exposed and drying begins. This time is likely a function traffic volume, snow depth, and agency snow removal capabilities. An appropriate local value should be established for the subject facility if that is possible. If such a value is not available, the default value provided in the last row of the HCM exhibit can be used. See *Demand Change Factors* for the exhibit.

Facility Evaluation

The facility evaluation stage consists of two tasks that are repeated in sequence for each analysis period. The analysis periods are evaluated in chronological order.

First, the dataset associated with a given analysis period is evaluation by using the urban street facility methodology. The performance measures output by the methodology are then archived.

Second, the dataset associated with the next analysis period is modified, if necessary, on the basis of the results of the current analysis period. Specifically, the initial queue input value for the next analysis period is set equal to the residual queue for the current analysis period.

Failure or On-Time Measures

The percent of trips (or percent of time) with space mean speeds above (on time) or below (failure) one or more target values (e.g., 35, 45, and 50 mi/h; or 56, 72, 80 km/h in metric). These measures address how often trips succeed or fail in achieving a desired travel time or speed.

Functional Class

The functional class of the subject facility is a required input when the analyst chooses to use the default time period adjustment factors. These factors are used for estimating the traffic volume during each of the various scenarios that make up the reliability reporting period.

The following functional classes are considered:

- Urban expressway,
- Urban principal arterial street, and

- Urban minor arterial street.

An urban principal arterial street emphasizes mobility over access. It serves intra-area travel, such as that between a central business district and outlying residential areas or that between a freeway and an important activity center. It is typically used for relatively long trips within the urban area or for through trips that enter, leave, or pass through the city. An urban minor arterial street provides a balance between mobility and access. It interconnects with and augments the urban principal arterial street system. It is typically used for trips of moderate length within relatively small geographic areas.

The methodology addresses roadways that (*a*) have one of the aforementioned classes and (*b*) do not have full access control. If a roadway has full access control then it is considered to be a freeway and the analyst should use the Freeway methodology.

Hour-of-Day Demand Ratios

The following HCM exhibit provides the default hour-of-day demand ratios (ADT/AADT):

Hour	Expressway		Principal Arterial		Minor Arterial	
Starting	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Midnight	0.010	0.023	0.010	0.023	0.010	0.028
1 a.m.	0.006	0.015	0.006	0.014	0.006	0.023
2 a.m.	0.004	0.008	0.005	0.010	0.004	0.021
3 a.m.	0.004	0.005	0.005	0.006	0.002	0.008
4 a.m.	0.007	0.005	0.009	0.006	0.002	0.005
5 a.m.	0.025	0.009	0.030	0.010	0.007	0.005
6 a.m.	0.058	0.016	0.054	0.017	0.023	0.011
7 a.m.	0.077	0.023	0.071	0.024	0.067	0.018
8 a.m.	0.053	0.036	0.058	0.035	0.066	0.030
9 a.m.	0.037	0.045	0.047	0.046	0.054	0.048
10 a.m.	0.037	0.057	0.046	0.056	0.051	0.054
11 a.m.	0.042	0.066	0.050	0.054	0.056	0.057
Noon	0.045	0.076	0.053	0.071	0.071	0.074
1 p.m.	0.045	0.073	0.054	0.071	0.066	0.071
2 p.m.	0.057	0.074	0.063	0.072	0.060	0.069
3 p.m.	0.073	0.075	0.069	0.073	0.062	0.067
4 p.m.	0.087	0.075	0.072	0.073	0.063	0.071
5 p.m.	0.090	0.071	0.077	0.073	0.075	0.068
6 p.m.	0.068	0.063	0.062	0.063	0.070	0.067
7 p.m.	0.049	0.051	0.044	0.052	0.053	0.056
8 p.m.	0.040	0.043	0.035	0.044	0.044	0.049
9 p.m.	0.037	0.037	0.033	0.038	0.035	0.040
10 p.m.	0.029	0.032	0.026	0.033	0.033	0.035
11 p.m.	0.019	0.023	0.021	0.026	0.019	0.024

Source: Hallenbeck et al. (*9*).

See also *Time Period Adjustment Factors*.

Incident Clearance Time

The Time from the arrival of the first response vehicle to the time when the incident and service vehicles no longer directly affect travel on the roadway. This time varies by incident location, type, and severity. Clearance times are weather-dependent. Incident clearance times are reported in minutes and for street location (segment or intersection), incident type (crash or noncrash), lane location (shoulder, one lane, two or more lanes), severity

(fatal/injury or PDO), and weather condition (dry, rainfall, wet pavement, snowfall or snow or ice on pavement) (96 total values).

Default values for incident clearance time are provided in the following HCM exhibit:

Street Location	Event Type	Lane Location	Severity[a]	Clearance Time by Weather Condition (min)			
				Dry	Rain-fall	Wet Pavement	Snow Or Ice[b]
Segment	Crash	One lane	FI	56.4	42.1	43.5	76.7
			PDO	39.5	28.6	29.7	53.7
		2+ lanes	FI	56.4	42.1	43.5	76.7
			PDO	39.5	28.6	29.7	53.7
		Shoulder	FI	56.4	42.1	43.5	76.7
			PDO	39.5	28.6	29.7	53.7
	Non-crash	One lane	Breakdown	10.8	5.6	5.7	14.7
			Other	6.7	2.4	2.8	9.1
		2+ lanes	Breakdown	10.8	5.6	5.7	14.7
			Other	6.7	2.4	2.8	9.1
		Shoulder	Breakdown	10.8	5.6	5.7	14.7
			Other	6.7	2.4	2.8	9.1
Signalized intersection	Crash	One lane	FI	56.4	42.1	43.5	76.7
			PDO	39.5	28.6	29.7	53.7
		2+ lanes	FI	56.4	42.1	43.5	76.7
			PDO	39.5	28.6	29.7	53.7
		Shoulder	FI	56.4	42.1	43.5	76.7
			PDO	39.5	28.6	29.7	53.7
	Non-crash	One lane	Breakdown	10.8	5.6	5.7	14.7
			Other	6.7	2.4	2.8	9.1
		2+ lanes	Breakdown	10.8	5.6	5.7	14.7
			Other	6.7	2.4	2.8	9.1
		Shoulder	Breakdown	10.8	5.6	5.7	14.7
			Other	6.7	2.4	2.8	9.1

Source: Zegeer et al. (*1*).
Notes: [a] FI = fatal or injury crash; PDO = property-damage-only crash.
[b] Applies to snowfall and to snow or ice on pavement (but not snowing).

Incident Detection Time

The time period starting with the occurrence of the incident and ending when the response officials are notified of the incident. Incident detection time is reported in minutes. The default incident detection time for all weather conditions is 2.0 minutes.

Incident Location Distribution

The incident location distribution is used by the incident generation procedure to assign incident to specific locations on the facility. Research indicated that this distribution varies by incident location, type, and severity. The following incident proportions are required:

- Proportion of crash and noncrash incidents by street location (segment or intersection) (four total values); proportions should total 1.000 for a given street location;
- Proportion of shoulder, one-lane, and two-or-more-lane incidents by street location and event type (crash or noncrash) (12 total values); proportions should total 1.000 for a given street location and event type

combination; a 0.000 proportion should be assigned to values involving a shoulder location if no shoulders exist on the facility;

- Proportion of fatal/injury and PDO crashes by street location and lane location (12 total values); proportions should total 1.000 for a given street location and lane location combination; and
- Proportion of breakdown and other noncrash incident by street location and lane location (12 total values); proportions should total 1.000 for a given street location and lane location combination.

The four proportions identified in the previous list are multiplied together to obtain the desired incident location distribution factors. One factor is obtained for each combination of street location, incident type, incident location, and incident severity. The computed factors should total 1.000 for a given street location.

The default incident distribution with shoulder presence is provided in the following HCM exhibit:

Street Location	Incident Type		Incident Location		Incident Severity		
	Type	Proportion	Lanes Affected	Proportion	Severity[a]	Proportion	Joint Proportion
Segment	Crash	0.358	1 lane	0.335	FI	0.304	0.036
					PDO	0.696	0.083
			2+ lanes	0.163	FI	0.478	0.028
					PDO	0.522	0.030
			Shoulder	0.502	FI	0.111	0.020
					PDO	0.889	0.160
	Non-crash	0.642	1 lane	0.849	Breakdown	0.836	0.456
					Other	0.164	0.089
			2+ lanes	0.119	Breakdown	0.773	0.059
					Other	0.227	0.017
			Shoulder	0.032	Breakdown	0.667	0.014
					Other	0.333	0.007
						Total:	1.000
Signalized intersection	Crash	0.310	1 lane	0.314	FI	0.378	0.037
					PDO	0.622	0.061
			2+ lanes	0.144	FI	0.412	0.018
					PDO	0.588	0.026
			Shoulder	0.542	FI	0.109	0.018
					PDO	0.891	0.150
	Non-crash	0.690	1 lane	0.829	Breakdown	0.849	0.486
					Other	0.151	0.086
			2+ lanes	0.141	Breakdown	0.865	0.084
					Other	0.135	0.013
			Shoulder	0.030	Breakdown	0.875	0.018
					Other	0.125	0.003
						Total:	1.000

Source: Zegeer et al. (*1*).
Note: [a] FI = fatal or injury crash; PDO = property-damage-only crash; other = not breakdown (e.g., debris).

The default incident distribution without shoulder presence is provided in the following HCM exhibit:

Street Location	Incident Type: Type	Incident Type: Proportion	Incident Location: Lanes Affected	Incident Location: Proportion	Incident Severity: Severity[a]	Incident Severity: Proportion	Joint Proportion
Segment	Crash	0.358	1 lane	0.837	FI	0.304	0.091
					PDO	0.696	0.209
			2+ lanes	0.163	FI	0.478	0.028
					PDO	0.522	0.030
	Non-crash	0.642	1 lane	0.881	Breakdown	0.836	0.473
					Other	0.164	0.093
			2+ lanes	0.119	Breakdown	0.773	0.059
					Other	0.227	0.017
						Total:	1.000
Signalized intersection	Crash	0.310	1 lane	0.856	FI	0.378	0.100
					PDO	0.622	0.165
			2+ lanes	0.144	FI	0.412	0.018
					PDO	0.588	0.026
	Non-crash	0.690	1 lane	0.859	Breakdown	0.849	0.503
					Other	0.151	0.089
			2+ lanes	0.141	Breakdown	0.865	0.084
					Other	0.135	0.013
						Total:	1.000

Source: Zegeer et al. (*1*).
Note: [a] FI = fatal or injury crash; PDO = property-damage-only crash; other = not breakdown (e.g., debris).

Incident Query

For event predictions, the user can set parameters to check for incidents “starting” at the query hour. The date, time, and segment/intersection must be specified. Then a ‘Query’ button can be selected, which will display any incidents for that query.

Incident Response Time

The time period from the receipt of incident notification by officials to the time the first response vehicle arrives at the scene of the incident. This time will likely vary among jurisdictions and facilities, depending on the priority placed on street system management and the connectivity of the street system. Response times are weather-dependent. Incident response times are reported in minutes and for five weather categories (dry, rainfall, wet pavement, snowfall, snow or ice on pavement).

The following are the default response times for the five weather categories:

- Clear, dry: 15.0 min
- Rainfall: 15.0 min
- Wet pavement (not raining): 15.0 min
- Snowfall: 20.4 min
- Snow or ice on pavement (not snowing): 20.4 min

Jurisdiction

This field is provided to document any jurisdiction convention or project related information.

Mean TTI

The ratio of the average travel time to the travel time at the base free-flow speed. This measure can be used for the same purposes as the 50th percentile TTI. However; the mean TTI will typically have somewhat higher values than the 50th percentile TTI because of the influence of rare, very long travel times in the distribution.

Misery Index

This measure is useful as a descriptor of near-worst-case conditions on rural facilities.

Month-of-Year Demand Ratios

The following HCM exhibit provides the default month-of-year demand ratios (ADT/AADT):

Month	Expressway	Principal Arterial	Minor Arterial
January	0.802	0.831	0.881
February	0.874	1.021	0.944
March	0.936	1.030	1.016
April	0.958	0.987	0.844
May	1.026	1.012	1.025
June	1.068	1.050	1.060
July	1.107	0.991	1.150
August	1.142	1.054	1.110
September	1.088	1.091	1.081
October	1.069	0.952	1.036
November	0.962	0.992	0.989
December	0.933	0.938	0.903

Source: Hallenbeck et al. (*9*).

See also *Time Period Adjustment Factors*.

Nearest City

The nearest city is a required input when the analyst chooses to use the default weather data. The analyst selects from 284 U.S. cities. Please see *Regional Weather* for additional information.

Please see *Regional Weather* for additional information.

Number of Replications

The number of replications indicates the number of times each scenario is generated to minimize any bias that rare events may cause.

Planning Time Index (PTI)

The ratio of the 95th percentile highest travel time to the travel time at the base free-flow speed. This measure is useful for estimating how much extra time travelers must budget to ensure an on-time arrival and for describing near-worst-case conditions on urban facilities. Also *95th Percentile TTI*.

Project Description

This field is provided for the user to document the analysis with any information for identification purposes.

Random Number Seed

A random number seed is used with the Monte Carlo methods in the reliability methodology. A seed is used so that the sequence of random events can be reproduced. Unique seed numbers are separately established for weather events, demand variation, and incidents. For a given set of three seed numbers, a unique combination of weather events, demand levels, and incidents is estimated for each analysis period in the reliability reporting period.

Regional Weather

The nearest city is a required input when the analyst chooses to use the default weather data. The analyst selects from 284 U.S. cities. A search bar and/or drop down menu is provided for the user to select a city. Once a city is selected, the 'Load Regional Weather' button needs to be selected for city-specific data to be applied to the weather event statistics table. If certain values need to be overridden, the user has the option to edit the data. However, if values need to be reset, a 'Reset to Regional Default' button is provided to reapply the city-specific values. See *Weather Event Statistics* for more information.

Reliability Rating

The percentage of vehicle-miles traveled on the facility associated with a TTI less than 2.50. This threshold approximated the point beyond which urban street facility travel times become much more variable (i.e., unreliable).

Reliability Reporting Period

The specific days over which reliability is to be computed, for example, all weekends in a year. A typical reporting period for a reliability evaluation is 6 to 12 months. The period is specified by start and end dates as well as by the days of week being considered. The reliability reporting period is used with the study period to describe the temporal representation of the performance measure fully (e.g., average travel time on weekdays from 4:00 to 6:00 p.m. for the current year).

Replication Selection

A drop down selection is provided to indicate which results to show based on the replication number.

Running Time

The time a vehicle spends in motion.

Scenario

A unique combination of traffic demand, capacity, geometry, and traffic control conditions. It can represent one or more analysis periods, provided that all periods have the same combination of demand, capacity, geometry, and control.

Scenario Dataset Generation

The scenario dataset generation procedure uses the results from *Scenario Generation*, *Weather Event Generation*, *Traffic Demand Variation Generation*, and *Traffic Incident Generation* to develop one HCM dataset for each analysis period in the reliability reporting period. Each analysis period is considered to be one scenario. The base dataset is modified to reflect conditions present during a given analysis period. Traffic volumes are modified at each intersection and driveway. Saturation flow rates are adjusted at intersections influenced by an incident or a weather event, and speed are adjusted for segments influenced by an incident or a weather event. Dates and times represent a common basis for tracking events and conditions from one analysis period to the next.

Scenario Generation

The scenario generation stage consists of four sequential procedures: (*a*) weather event generation, (*b*) traffic demand variation generation, (*c*) traffic incident generation, and (*d*) scenario dataset generation. Each procedure generates in chronological order the set of analysis periods that make up the reliability reporting period.

Checkboxes are provided to indicate whether or not to include weather, demand, and/or incidents when generating scenarios. The user can also choose whether or not to randomize demand volume for every analysis period. Once these are specified, along with the random seed numbers and the desired number of replications, the user can click the 'Generate Scenarios' button to start the scenario generation process.

Semi-Standard Deviation

A one-sided standard deviation, with the reference point at the base free-flow speed instead of the mean. It provides the variability distance from free-flow conditions.

Shoulder Presence

The indication of the presence of outside (i.e., right-side) shoulders is a required input when the analyst chooses to use the default incident location data. This input is specified for the facility.

For a shoulder to be considered present, it must be wide enough to store a disabled vehicle (so that the vehicle does not block traffic flow in the adjacent traffic lane). If on-street parking is allowed, the analyst will need to determine whether occupancy would need to be less than 30% to provide reasonable assurance of the opportunity to move a disabled vehicle from the through lanes to an open stall.

Special Event

Short-term events that produce intense traffic demands on a facility for limited periods of time. These demands may be addressed by temporary changes in the facility's geometry or traffic control characteristics, or both. Example special events include major sporting events, concerts, and festivals.

Standard Deviation

The standard statistical measure.

Stop Rate

The average number of full stops per vehicle. A *full stop* is defined to occur at a signalized intersection when a vehicle slows to zero (or a crawl speed, if in queue) as a consequence of the change in signal indication from green to red, but not necessarily in direct response to an observed red indication. A *full stop* is defined to occur at an unsignalized intersection when a vehicle slows to zero (or a crawl speed, if in queue) as a consequence of the control device used to regulate the approach.

Study Period

The time interval (within a day) that is represented by the performance evaluation. It consists of one or more consecutive analysis periods. A typical study period is 1.0 to 6.0 h in duration and is stated to represent specific times of the day and days of the week (e.g., weekdays from 4:00 to 6:00 p.m.). If oversaturated conditions occur during the study period, at least the first analysis period should be undersaturated. The maximum study period duration is 24 h.

The geometric design elements and traffic control features of the facility must be unchanged during the study period. Thus, the intersection lane assignments and signal timing plan should be the same throughout the study period. In addition, if the directional distribution of traffic volume changes significantly during the day, separate study periods should be established for each time period where the directional distribution is relatively constant.

Study Section

The length of facility over which reliability is to be computed. Since reliability is computed through traffic only, the length of the facility should not be so long that through traffic is a low percentage of total traffic on the facility. The length of facility to be evaluated should be less than the distance a vehicle traveling at the average speed can achieve in 15 min.

Through Delay

Through delay represents the sum of two delay sources. One source is the delay due to the traffic control at the boundary intersection. It is called control delay. The other delay is that due to the negotiation of intersection geometry, such as curvature. It is called geometric delay.

Time Analyzed

This field is provided to document the time frame of the analysis as morning peak, afternoon peak, existing conditions, future projections, etc.

Time Period Adjustment Factors

The methodology requires day-of-week and month-of-year factors, expressed as ratios of the average day-of-week and average month-of-year demand. Also required are hour-of-day factors expressed as a percentage of AADT. The specific factors needed are described in the following list.

- Hour-of-day factors for each hour of the study period (up to 24, but typically six or fewer in practice),
- Day-of-week factors for each day included as part of the reliability reporting period (up to seven), and
- Month-of-year factors for each month included as part of the reliability reporting period (up to 12).

Default hour-of-day, day-of-week, and month-of-year traffic demand adjustment factors are given in HCM exhibits. The factors should be replaced with data from permanent traffic count stations whenever available for streets that are similar to the subject facility and located near it. See also *Hour-of-Day Demand Ratios*, *Day-of-Week Demand Ratios*, and *Month-of-Year Ratios*.

Traffic Counts

The date and time of the traffic count represented in the base dataset is a required input. If the base dataset demands are computed by using planning procedures, they are assumed to represent average day volumes. In this case, a date does not need to be provided by the analyst. However, the time of day for which the estimated volumes apply is still needed. The date and time of the traffic count represented in an alternative dataset is also a required input.

Traffic Demand Variation Generation

The traffic demand variation procedure identifies the appropriate traffic demand adjustment factors for each analysis period in the reliability reporting period. A set of factors accounts for systematic demand variation by hour of day, day of week, and month of year.

Traffic Incident Generation

The traffic incident procedure generates incident dates, times, and durations. It also determines incident types (i.e., crash or noncrash), severity levels, and locations on the facility. Location is defined by the intersection or segment on which the incident occurs and whether the incident occurs on the shoulder, in one lane, or in multiple lanes. The procedure incorporates weather and traffic demand variation information from the previous procedures in generating incidents.

Travel Speed

The ratio of segment length to through-movement travel time.

Travel Time

Travel time is a versatile measure, since it can be monitored over time (for trend analysis), monetized (in calculating benefits), and used in the calculation of other measures (e.g., delay), Facility lengths usually remain the same over time, allowing apples-to-apples comparisons of travel times estimated for a facility in different years or under different circumstances. Travel time is measured in minutes. Travel time is computed as the sum of segment running time and through-movement control delay at the downstream boundary intersection.

Travel Time Index (TTI)

The ratio of the actual travel time on a facility to the travel time at the base free-flow speed.

Weather Event Generation

The weather event procedure generates rain and snow events during the reliability reporting period. The dates, times, types (i.e., rain or snow), and durations of severe weather events are generated. These data are used to adjust the saturation flow rate and speed of facility traffic for each analysis period. The procedure also predicts the time after each weather event that the pavement remains wet or covered by snow or ice, since the presence of these conditions influences running speed and intersection saturation flow rate.

Weather Event Statistics

A reliability evaluation requires the weather data identified in the following list. These data represent averages by month of year for a recent 10-year period

- Total normal precipitation (in., or cm. in metric),
- Total normal snowfall (in., or cm. in metric),
- Number of days with precipitation of 0.01 in. (or 0.025 cm. in metric) or more (days),
- Normal daily mean temperatures (°F, or °C in metric), and
- Precipitation rate (in./h, or cm./h in metric).

Default values for the aforementioned statistics are available from the National Climatic Data Center (NCDC) for 284 locations in the United States.

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