Analysis Tool for Design Treatments to Address Nonrecurrent Congestion: Annotated Graphical User's Guide Version 2

AUTHORS

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SHRP 2 Reliability Project L07

Analysis Tool for Design Treatments to Address Nonrecurrent Congestion

Annotated Graphical User's Guide
Version 2

SHRP 2
STRATEGIC HIGHWAY RESEARCH PROGRAM
Accelerating solutions for highway safety, renewal, reliability, and capacity

TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

SHRP 2 Reliability Project L07

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SHRP 2 Project L07

Analysis Tool for Design Treatments to Address Nonrecurrent Congestion

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Version 2.0

INTRODUCTION

The SHRP 2 Project L07 Analysis Tool is designed to analyze the effects of highway geometric design treatments on nonrecurrent congestion using a reliability framework. The tool is a VBA interface (shown below) overlaying a Microsoft-based Excel spreadsheet (Excel 2007 and above).

The tool is designed to analyze a generally homogenous segment of a freeway (typically between successive interchanges). The tool allows the user to input data regarding site geometry, traffic demand, incident history, weather, special events, and work zones. Based on these data, the tool calculates base reliability conditions. The user can then analyze the effectiveness of a variety of treatments by providing fairly simple input data regarding the treatment effects and cost parameters. As outputs, the tool predicts cumulative travel time index (TTI) curves for each hour of the day, from which other reliability variables are computed and displayed. The tool also calculates cost-effectiveness by assigning monetary values to delay and reliability improvements and comparing these benefits to expected cost over the life of each treatment.

Note: This Guide uses the term "time-slice" in several places. A time-slice, in this tool, is a single-hour portion of a 24-hour day, considered over an entire year (excluding weekends and holidays). For example, "the hour from 6:00 a.m. to 7:00 a.m. for every non-holiday weekday between January 1 and December 31 of this year" is a time-slice. In this context, one way to think of a time-slice is as an "hour-year."

This User Guide is pictorial and annotated. It displays most of the entry screens presented to the user by the tool, with descriptions of their respective meanings and usage. Much of this help content (and additional guidance) is also embedded in the tool via information buttons.

The Guide is not exhaustive; it describes neither the underlying theory nor the research that led to the development of the tool. The tool should be used in conjunction with two companion documents: the Project L07 Final Report and Project L07 Treatment Guidebook. This tool is the first of its kind, and reliability analysis is still in its infancy. Therefore, this tool and its successors will become more sophisticated in the future.

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Navigating the Tool
Overview

The tool was designed to interactively predict reliability variables as a function of site conditions and traffic data, and allows the testing of the effects of different design treatments on reliability. To be viewed correctly, the screen resolution must be set to at least 1440x900. For Windows 7, make sure that on the Control Panel, under "Appearance and Personalization" \ "Display" \ "Make text and other items larger or smaller," the value is set to 100%.

Macro security: Excel may prevent you from opening this file if your security settings are configured to prevent macro-enabled files. In Excel's trust center, you must select "Enable all macros"; in Excel 2010, you must additionally select "Trust access to the VBA object model."

The main interface includes three main sections, as shown below; **Site Inputs**, **Treatment Data and Calculations**, and **Results**. Each of these sections is described in more detail later in this document.

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File Management

Although the L07 Analysis Tool is based in Excel, **data files are stored externally**. Excel is used as an interface and calculation engine, but the data are stored in files called projects that are saved with an ".L07" extension (using an XML file format).

What Is a Project?

A project is a single data file that can store multiple sets of tool inputs.   These sets are called scenarios. The tool allows three options:

- *New Project.* Creates a new .L07 file, and populates the tool's inputs with defaults. The user specifies the file name and which folder it should be placed in.

- *Open Project.* Opens an existing .L07 file and populates the tool's inputs with the project's first scenario.

- *Copy Project.* Creates a new .L07 file from the currently open project, saves the open project, and presents the new project for user input.

Note that there is no "Save Project" command. A project file is saved whenever data from a scenario is saved, via a command from the scenario menu.

What Is a Scenario?

A scenario is a single set of tool inputs that lead to a cost-benefit calculation. Multiple scenarios can be included in a single project. (A project can also contain only one scenario if desired.) Ways to use scenarios could include:

- *Multiple segments*—contain several segments of the same freeway for the same time horizon. (Example scenario names: "I-35_67th_to_75th," "I-35_75th_to_87th," etc.)

- *Varying treatment characteristics*—contain multiple options for the same treatment for the same segment of highway. For example, for the "Emergency Access Between Interchanges" treatment, the user may wish to analyze varying effects on emergency response time depending on treatment spacing. (Example scenario names: "reduction=5", "reduction=10")

Essentially, the scenario concept allows the user to store dozens of "mini-files" (scenarios) in one single larger file (project). The user can toggle between scenarios at will using the "Current Scenario" drop-down.

Scenarios can be added to a project, deleted from a project, copied within a project ("Save As"), or renamed.

Adding a scenario

Copying a scenario ("Save As")

Renaming a scenario

Deleting a scenario

Advanced Feature: Merge Demand Data from External File

A separate spreadsheet (L07DemandGen) has been created to allow the user to generate multiple demand scenarios (volumes and heavy vehicle percentages) without having to manually enter each of the 24 hours using the tool interface. The spreadsheet exports ".L07v" files that the user can then import into the tool using the "Merge Demand Data" item on the "Scenario" menu. The L07DemandGen spreadsheet includes an "Instructions" tab that serves as a user guide.

Navigating the Tool

Main Menu Bar

The Main Menu Bar appears constantly at the top of the screen. It includes basic file operations, calculation settings, scenario management, print options, and basic help.

Print Button

The user has the option to print one or more of the available pre-designed printouts. The following window will pop up when the user hits the Print button:

The user will then see a standard print pop-up, allowing selection of a printer and any relevant settings or options.

Project Name
Displays the name of the current project.

Current Scenario
Displays the name of the current scenario. The drop-down menu allows the user to select between the available scenarios for the current project.

Close Button
The "X" and Close buttons close the tool.

Choose Automatic Calculation
Selecting "Automatically Recalculate" directs the tool to automatically recalculate results any time an input is changed. Due to the complexity of the tool, calculation speeds may be slow, depending on the processing speed of the user's computer. Therefore, when "Automatically Calculate" is deselected, the tool will calculate only when the user changes/moves to a new tab.

Project Selection
The project selection menu allows the user to start a new (blank) project, open an existing project, or make a copy of an existing project.

Scenario Selection
Each project can contain multiple scenarios. The following window will pop up when the user hits the scenario button:

Help Button
The Help button provides an overview to guide the user through the steps of using the tool. The information found on the Help screen is similar to the information found in this User's Guide.

Adds a new scenario to the current project

New Scenario

Save Scenario

Save As Scenario

Rename Scenario

Delete Scenario
- -
Merge Demand Data

Creates a new scenario from the current scenario

Deletes the current scenario from the project

Saves the data for the current scenario (and saves the project). Note that scenarios are also automatically saved when the user switches to another scenario.

Changes the name of the current scenario

Imports demand data from an external "L07v" file into the current scenario, replacing any demand data already included in the scenario (See the page on "File Management.")

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Navigating the Tool
Common Features

Default Values

In many cases, the input fields used by the tool are initially populated with default values developed as part of Project L07 research. The user may choose either to use these default values or to modify them for the analysis. When site-specific data are available, it is recommended that the user modify the default values to obtain the best possible results. To modify the defaults, the user activates the desired entry field by checking the small checkbox next to it. As can be seen in the example below, edited values will be red.

Default Values

Percent of each incident type expected to be relocated to the accessible shoulder:

Crashes

PDO	50	% ☐
Minor Injury	30	% ☐
Major Injury & Fatal	10	% ☐

Non-Crash Incidents

Disabled Vehicle (lane-blocking)	60	% ☐
Other	25	% ☐

Modified Values

Percent of each incident type expected to be relocated to the accessible shoulder:

Crashes

PDO	70	% ☑
Minor Injury	20	% ☑
Major Injury & Fatal	0	% ☑

Non-Crash Incidents

Disabled Vehicle (lane-blocking)	40	% ☑
Other	15	% ☑

Information Buttons

Information buttons are scattered throughout the tool. The user can click on them to see pop-ups providing guidance on what inputs mean, how inputs are used, what outputs mean, how treatments operate, and other items.

Site Inputs

Geometry

On the Geometry tab, the user specifies basic information about the facility and provides basic geometric data allowing the tool to calculate speed and capacity.

Location

This information appears as headers on the printouts but is not used in any calculations.

Geometry

These data are primarily used in the calculation of free-flow speeds (based on HCM procedures) for use in capacity/TTI calculations. Each of these terms is as defined in the 2010 HCM.

Speed

If "Measured FFS" is checked, the user can enter the field-measured value. Note that for HCM computations, this speed will be rounded to the nearest 5 mph (as the HCM 2010 requires). If measured speeds are unavailable, the user can check "Base FFS" and the tool will calculate the value based on the Geometry inputs above.

Base Lane Capacity

By checking the box, the user may adjust the default lane capacity. Values are in passenger cars per hour per lane. If the box remains unchecked, the capacity is calculated based on the Speed values above. The capacity is used in d/c crit and other calculations.

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Navigating the Screens

Site Inputs

Demand

On the Demand tab, the user provides information regarding traffic demand for each hour of the day. Typically, these values are collected in the field. The Project L07 Final Report contains more information on calculating demand. These values ultimately feed the calculation of the demand-to-capacity ratio, d/c crit, used in the TTI prediction models.

Demand
Demand should be entered for the 30th-highest-hour of the year for the given time-slice. See the Project L07 Final Report for guidance on computing demand.

Peak-Hour Factor
Allows the conversion of hourly demand (D_{60}) to peak 15-minute demand (D_{15}). Currently unused by the tool.

Heavy Vehicle Percentages
These are equivalent to the percent of each time-slice's demand that is composed of trucks and recreational vehicles (RVs), respectively.

Time of Day
Beginning of time slice in 24-hour time.

Site Inputs

| Geometry | Demand | Incident | Weather | Event | Work Zn | Graphs |

	Demand (vph)	PHF	% Trucks	% RVs	15-min demand flow rate (pcph)
0:00	947	1.00	2.0	1.0	958
1:00	632	1.00	2.0	1.0	640
2:00	473	1.00	2.0	1.0	479
3:00	632	1.00	2.0	1.0	640
4:00	1,578	1.00	2.0	1.0	1,597
5:00	5,523	1.00	2.0	1.0	5,589
6:00	8,678	1.00	2.0	1.0	8,782
7:00	12,150	1.00	2.0	1.0	12,296
8:00	11,362	1.00	2.0	1.0	11,498
9:00	8,678	1.00	2.0	1.0	8,782
10:00	7,417	1.00	2.0	1.0	7,506
11:00	8,363	1.00	2.0	1.0	8,463
12:00	8,363	1.00	2.0	1.0	8,463
13:00	8,994	1.00	2.0	1.0	9,102
14:00	9,310	1.00	2.0	1.0	9,422
15:00	10,730	1.00	2.0	1.0	10,859
16:00	11,677	1.00	2.0	1.0	11,817
17:00	11,835	1.00	2.0	1.0	11,977
18:00	8,678	1.00	2.0	1.0	8,782
19:00	6,153	1.00	2.0	1.0	6,227
20:00	5,207	1.00	2.0	1.0	5,269
21:00	4,892	1.00	2.0	1.0	4,951
22:00	3,472	1.00	2.0	1.0	3,514
23:00	2,052	1.00	2.0	1.0	2,077
Total	157,796				159,690

Factor Demand

Demand Flow Rate
These values are calculated using HCM 2010 procedures based on the user inputs on this tab. The demand flow rate is expressed as passenger car equivalents per hour (pcph).

Factor Volumes
Clicking this button allows the user to adjust all 24 demand volumes up or down by a constant factor. To factor up, enter a positive percentage (e.g., 40% equals a 40% increase; all values will be multiplied by 1.4). To factor down, enter a negative percentage (e.g., -30% equals a 30% decrease; all values will be multiplied by 0.7).

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Incident

On this tab, the user provides information regarding both crashes and non-crash incidents. Data regarding non-crash incidents is not always available; therefore, the tool provides some default options to assist with incident estimation. Incident data are used in calculating lane-hours lost (LHL), a parameter in the TTI prediction functions. Crash costs and totals are also used in the cost-effectiveness calculations.

Crashes

Enter annual crash totals by type (as typically recorded by highway agencies). The user can override the default average crash durations if better information is available.

The user can also enter a percentage that indicates what portion of all incidents are crashes. This need only be used if, in the non-crash incident area below, the user has selected "calculate based on relation to crash %." See the description at right for further details.

Crash Costs

Average incident costs by severity level are commonly available from state DOTs. The default values in the tool are based on national averages.

Totals

Based on the information entered above, the tool computes and displays annual totals.

Site Inputs

Geometry | Demand | Incident | Weather | Event | Work Zn | Graphs

Crashes

	Number/year	Avg Duration, min	% of All Incidents
Property Damage Only	31	28	12.4
Minor Injury	17	40	6.8
Major Injury & Fatal	7	45	2.8
Subtotal	55		22.0

Non-Crash Incidents

○ Input number/year.　　◉ Calculate based on relation to crash %.

	Number /year	Avg Duration, min	% of All Incidents
Disabled - Non-Lane Blocking	138	26	55.0
Disabled - Lane Blocking	33	20	13.0
Other	25	23	10.0
Subtotal	195		78.0

Note: % of all incidents must be <= 100

Crash Costs

PDO, $	5000
Minor Injury, $	25000
Major Injury & Fatal, $	1000000

Totals

Total Incidents/Year	250
Crash Rate/MVM	1.910
Incident Rate/MVM	8.681
Annual Crash Cost, $	7580000

Non-Crash Incidents

If the user selects "Input number/year", this section functions just like the Crashes section: the user enters the number of incidents/year, and can override the defaults for average duration if desired.

In the absence of specific knowledge of non-crash incident totals, the user can select "Calculate based on relation to crash %". The tool then supplies default values for the percent of each non-crash incident type with respect to all incidents (both crash and non-crash). In addition, above in the Crashes area, the tool supplies a default value for the percent of all incidents that are crashes. The user can override any of these defaults. Note that "Other" is automatically calculated so the total incidents sum to 100%. If the user enters a value that causes the total to exceed 100%, a pop-up will assist the user with rectifying the percentages.

Disabled - Non-Lane Blocking refers to a car broken down on the shoulder, **Disabled - Lane-Blocking** refers to a car broken down in a travel lane, and **Other** refers to incidents not involving breakdowns, such as rubbernecking.

Navigating the Screens
Site Inputs
Weather

Weather data are used in computing two precipitation variables used in the reliability prediction models: $R_{0.05''}$ (hours with rainfall exceeding 0.05 inches during the time-slice), and $S_{0.01''}$ (hours with snowfall exceeding 0.01 inches during the time-slice). The tool includes a built-in database of annual precipitation values at weather stations across the United States that can be used in the absence of detailed weather data. A 10-year average is used, which was collected from 2001–2010. The tool offers three options for entering precipitation data.

Precipitation Data Entry Options
Select one of these three options for entering weather (rain/snow) data for the site.

Option 1: Site Coordinates
If the first radio button is selected above, the user can enter the latitude and longitude of the treatment site. The tool will select precipitation data from the nearest weather station and populate the "# of Hours" fields.

Option 2: Nearest Proxy Site
If the second radio button is selected above, the user can choose a specific weather station location (city) that is nearest to the treatment site. The tool will populate the "# of Hours" fields with precipitation data from that station. The location selected is displayed below the drop-down box.

Option 3: Specific Weather Data
If the third radio button is selected, the user enters precipitation values for each of the 24 time-slices. As stated above: In the Rain column, enter the annual number of hours with rainfall exceeding 0.05 inches, for each time-slice. In the Snow column, enter the annual number of hours (within each time-slice) with snowfall exceeding 0.01 inches, for each time-slice.

For both rain and snow, the annual number should be normalized to a 250-day year of non-holiday weekdays.

Site Inputs

Geometry | Demand | Incident | Weather | Event | Work Zn | Graphs

- ○ Use default values for my location (lat/long)
- ● Use defaults, but allow me to pick nearest proxy location
- ○ I will specify values

Site Coordinates

Latitude	47.460
Longitude	-122.31

Nearest Proxy Site

: Agana
: Christiansted
: San Juan
AK: Annette
AK: Juneau
AK: Angoon
AK: Ketchikan
AK: Palmer
AK: Sitka
AK: Skagway
AK: Yakutat
AK: Kodiak
AK: King Salmon
AK: Iliamna
AK: Homer
AK: Cold Bay
AK: St Paul Island
AK: Fairbanks
AK: Northway
AK: Delta Junction/Ft Gree
AK: Gulkana
AK: Nenana

Location Selection
WA: Seattle

# of Hours Annually Exceeding x" of Precip

	Rain x=0.05"	Snow x=0.01"
0:00	10.5	1.3
1:00	10.7	1.1
2:00	10.4	0.7
3:00	10.7	0.6
4:00	11.7	1.5
5:00	11.8	1.4
6:00	11.6	1.0
7:00	10.8	1.3
8:00	8.9	1.5
9:00	10.0	1.3
10:00	8.7	1.1
11:00	10.5	1.0
12:00	10.2	0.8
13:00	9.8	1.4
14:00	11.2	1.4
15:00	11.1	1.3
16:00	10.6	1.1
17:00	12.2	1.0
18:00	12.0	1.3
19:00	10.3	1.1
20:00	10.2	1.3
21:00	10.6	1.4
22:00	11.1	1.7
23:00	9.7	1.7

Navigating the Screens

Site Inputs

Event

The Event tab allows the user to enter data on special events that cause demand to fluctuate appreciably from the 30th-highest-hour values entered on the Demand tab. Events can include sporting events, concerts, etc. Based on frequency, event data are used to adjust the values entered in the Demand tab prior to using them in the reliability computations.

Number of Active Events

An active (checked) event will be used by the tool in computations; an inactive (unchecked) event will not. These should be more broadly thought of as "event types" (e.g. baseball game, car race, etc.). Up to nine "event types" can be selected.

% Demand Increase

For each active (checked) event, enter the percent demand increase caused by the event for each hour of the day.

Example: for a baseball game, demand might increase 20% in the hour before the game, and 30% during the hour after the game. If the game typically starts at 7:00 p.m. and ends at 10:00 p.m., the user could enter "20" in the 18:00 box, "30" in the 22:00 box, and "0" in all other boxes.

Event Name

The user may enter a name for each active (checked) event (e.g., "NFL Game"), for clarity.

Event Frequency

Enter the number of days per year that each active (checked) event occurs (or is expected to occur).

Scroll Bar

The user can scroll horizontally to access up to nine different events.

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Work Zones – Short Term

The tool treats short-term (less than 30 days) work zones differently than long-term work-zones. The Work Zone tab allows the user to choose one or the other. For **short-term** work zones, the user enters data for work zones that reduce the capacity for the hours of the day when they are in place. These data are used in calculating lane-hours lost (LHL), a parameter used in the reliability prediction models.

Active Work Zones

An active (checked) short-term work zone will be used by the tool in computations; an inactive (unchecked) work zone will not. These should be more broadly thought of as "work zone types" (e.g., pothole repair, roadway widening, etc.). Up to nine "work zone types" can be selected.

Capacity per Lane

The user may adjust the default capacity per lane of 1600 veh/hr by checking the box and entering an alternate value.

Lanes Closed

For each short-term work zone, enter the number of mainline lanes closed for each hour of the day. For example, for a pothole repair that will close one lane from 4:00–6:00 a.m., the user enters "1" for Lanes Closed in the 4:00 and 5:00 boxes, and "0" for the remaining hours of the day.

Short vs. Long Term

This button toggles between the long-term and short-term work zone analysis screens.

Work Zone Title

The user may enter a name for each active (checked) short-term work zone (e.g., "Widening"), for clarity.

Days Active

Enter the number of days per year that each active (checked) short-term work zone is in place. Note that short-term work zones can operate continuously or intermittently; the tool does not distinguish between the two. In other words, for the purposes of the tool, a single six-hour work zone is equivalent to two three-hour work zones.

Scroll Bar

The user can scroll horizontally to access up to nine different short-term work zones.

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Navigating the Screens

Site Inputs

Work Zones – Long Term

The tool treats long-term (greater than 30 days) work zones differently than short-term work-zones. The Work Zone tab allows the user to choose one or the other. For **long-term** work zones, the user enters similar data defining capacity, but the work zone is treated as a "new normal" and is used as a base against which to compare treatments.

Site Inputs

| Geometry | Demand | Incident | Weather | Event | Work Zn | Graphs |

Long-Term Work Zone

Analyze Short-Term Work Zone

Length of Work Zone (days):	90
# of travel lanes closed:	1
Lateral clearance from edge of travel way to work zone (feet):	4
Lane width (feet):	10
Capacity Per Lane(pc/hr/ln):	1600
Speed (mph):	55.0

% traffic volume diverted to other routes:

0:00	0	%
1:00	0	%
2:00	0	%
3:00	0	%
4:00	0	%
5:00	0	%
6:00	0	%
7:00	0	%
8:00	0	%
9:00	0	%
10:00	0	%
11:00	0	%
12:00	0	%
13:00	0	%
14:00	0	%
15:00	0	%
16:00	0	%
17:00	0	%
18:00	0	%
19:00	0	%
20:00	0	%
21:00	0	%
22:00	0	%
23:00	0	%

Short vs. Long Term
This button toggles between the long-term and short-term work zone analysis screens.

Work Zone Data
It is expected that no more than one long-term work zone will occur at a given treatment site within a year; therefore, data for only one long-term work zone may be entered into the tool. The long-term analysis requires the user to enter many of the same inputs as the short-term analysis (length of work zone in days, number of lanes closed, and capacity per lane). In addition, the user should enter the lateral clearance (in feet) from edge of travel way to the work zone, the lane width (in feet), and the free-flow speed of the facility (in mph).

Diverted Traffic
If it is known that the long-term work zone will cause traffic to divert to other routes, enter the percent of the total demand that is diverted, for each hour of the day.

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Navigating the Screens

Site Inputs

Graphs

The Graphs tab is a display of the key input data as it varies by hour of the day, allowing the user to visually inspect the inputs from the other "Site Inputs" tabs.

Demand Graph
This graph displays the input demand and the calculated flow rate from the Demand tab.

Weather Graph
This graph displays the total number of hours per year in each time-slice that experiences rain and snow exceeding trace amounts, as entered in the Weather tab.

Short-Term Work Zone Graph
This graph displays the percent by which the capacity of the segment is reduced for each active (checked) short-term work zone (from the Work Zone tab).

Incident Graph
This graph displays daily distribution percentages for crash and non-crash incidents. The tool assumes that crashes are distributed in proportion to hourly density (calculated by the tool), and that non-crash incidents are distributed in proportion to hourly demand. More details on the distribution methodology are provided in the Project L07 Final Report.

Events Graph
This graph displays the percent by which the volume at the site is increased for each type of active (checked) event.

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Navigating the Screens

Treatment Data and Calculations

Title Bar

The treatment screens allow the user to test the effects of design treatments on site operations. The title bar contains elements that are common to the treatment analysis, allowing the user to select the treatments to be analyzed, the treatment to be viewed, and a description of the current treatment. The user can also enter default values for economic analysis.

Treatment Name
The name of the currently selected treatment is displayed here.

Treatment Tabs
This area of the screen includes one tab for each of the treatments to be analyzed for the site (selected from the Treatment List). Each tab is clickable and brings up its own individual screen where the user enters additional inputs (see following pages for input screens).

Manage Treatment List
This button pops up a list of treatments available for analysis. The user may select up to 10 treatments per site. For each treatment selected, a tab will appear in the Treatment Tabs.

Treatment Description
This button pops up a description of the currently selected treatment. Descriptions generally also contain photographs of the treatment and tips for analysis.

Cost-Benefit Defaults
This button pops up a window with default values used in cost-benefit analysis. The user can modify the value of time (VOT), reliability ratio (the ratio between the value of reliability (VOR) and the VOT), and discount rate.

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Operational Inputs

For each non-custom treatment, the left column contains Operational Inputs. These vary by treatment, but a guide to the types the user will encounter is included below.

Crash Data

Enter the percent of each crash type that is expected to be affected by the treatment (in the way described for that treatment). Some treatments require additional information, as shown at right.

Crashes

PDO	5	% ☐
Minor Injury	15	% ☐
Major Injury & Fatal	25	% ☐

Crashes

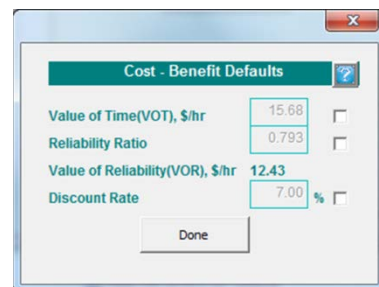|	% treatment used		Avg Duration Redux	
PDO	5 % ☐		5 min ☐
Minor Injury	10 % ☐		5 min ☐
Major Injury & Fatal	20 % ☐		5 min ☐

Crashes

	Total	% eliminated by barrier	
PDO	2	100	% ☐
Minor Injury	5	75	% ☐
Major Injury & Fatal	5	75	% ☐

Non-Crash Incident Data

Enter the percent of each non-crash incident type expected to be affected by the treatment (in the way described for that treatment). Many treatments do not allow modification of all three types, because some treatments are not expected to affect some types of incidents.

Non-Crash Incidents

Disabled Vehicle			
non-lane-blocking	0	75	% ☐
lane-blocking	1	75	% ☐
Other	1	75	% ☐

Shoulder Capacity, vph	1600	☐

Typical time between incident start and deployment screen:

	20	min ☐

Apply Treatment to Work Zones

Other Data

For certain treatments, additional inputs and application decisions are required.

Custom Raw Treatment

There are three custom treatment types available. For each of these, the left column looks quite different than what is shown on the typical treatment entry screen.

The Custom Raw Treatment is the most complex of the three, requiring a deeper understanding of the TTI prediction models than the other two. It allows the user to directly manipulate the four model variables: lane-hours lost (LHL), hours of snowfall (S01), hours of rainfall (R01), and critical demand/capacity ratio (D/C crit). Thus, the effect of any treatment (or even condition) that can be mapped to these variables can be analyzed.

Custom Raw Treatment

Untreated Conditions

These fields are automatically calculated and filled based upon the data in the Site Inputs portion of the tool, and are provided for reference.

Treated Conditions

The user can manually enter/manipulate treated values. Essentially this allows the user to "create" a treatment if the user has knowledge of that treatment's effects on the four key variables. This is also a way for the user to test base capacity improvements, ITS/operational strategies, and other improvements that might not fall under the category of "highway design to address non-recurrent congestion," but that may have an impact on reliability.

The TTI models are presented in the Project L07 final report, but can also be seen by clicking the Treatment Description button for this treatment.

	Untreated				Treated			
	LHL	S01	R05	D/Ccrit	LHL	S01	R05	D/Ccrit
0:00	0.6	1.3	10.5	0.12	8.4	0.6	3.0	0.09
1:00	0.7	1.1	10.7	0.08	8.6	0.6	2.8	0.09
2:00	0.7	0.7	10.4	0.06	8.6	0.7	3.3	0.09
3:00	0.7	0.6	10.7	0.08	8.6	0.5	2.5	0.10
4:00	0.7	1.5	11.7	0.20	8.6	0.6	3.0	0.15
5:00	0.8	1.4	11.8	0.70	0.6	0.5	2.3	0.09
6:00	3.2	1.0	11.6	1.10	4.0	0.3	1.7	0.08
7:00	5.1	1.3	10.8	1.54	5.0	0.4	1.9	0.12
8:00	4.7	1.5	8.9	1.44	4.8	0.4	1.9	0.13
9:00	3.5	1.3	10.0	1.10	4.2	0.5	2.4	0.14
10:00	3.9	1.1	8.7	0.94	4.4	0.5	2.7	0.15
11:00	3.5	1.0	10.5	1.06	4.2	0.5	2.6	0.16
12:00	2.7	0.8	10.2	1.06	3.5	0.5	2.3	0.18
13:00	2.3	1.4	9.8	1.14	2.5	0.7	3.7	0.19
14:00	2.7	1.4	11.2	1.18	3.6	0.7	3.7	0.85
15:00	4.8	1.3	11.1	1.36	4.9	0.8	3.8	0.25
16:00	9.7	1.1	10.6	1.48	5.9	0.6	2.8	0.30
17:00	9.7	1.0	12.2	1.50	5.9	0.6	3.2	0.40
18:00	5.1	1.3	12.0	1.10	5.0	0.8	3.8	0.20
19:00	3.9	1.1	10.3	0.78	4.5	0.6	3.2	0.09
20:00	2.3	1.3	10.2	0.66	2.5	0.6	3.1	0.09
21:00	1.9	1.4	10.6	0.62	1.6	0.6	2.9	0.09
22:00	1.5	1.7	11.1	0.44	1.1	0.7	3.3	0.09
23:00	1.1	1.7	9.7	0.26	0.8	0.8	3.8	0.09

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Custom Treatment - Flow

There are three custom treatment types available. For each of these, the left column looks quite different than what is shown on the typical treatment entry screen.

The Custom Treatment-Flow tab allows the user to manually input the treated values for Capacity and Demand, thus allowing prediction of effectiveness for treatments that are known to influence either or both of these values.

Custom Treatment FLow

	Untreated		Treated	
	15-min flow rate (pcph)	Capacity	15-min flow rate (pcph)	Capacity
0:00	959	8,000	1667	15120
1:00	640	8,000	1876	15120
2:00	479	8,000	1876	15120
3:00	640	8,000	1876	15120
4:00	1,597	8,000	2084	15120
5:00	5,590	8,000	2397	15120
6:00	8,784	8,000	8609	15120
7:00	12,298	8,000	10761	15120
8:00	11,501	8,000	10467	15120
9:00	8,784	8,000	9123	15120
10:00	7,508	8,000	9635	15120
11:00	8,465	8,000	9095	15120
12:00	8,465	8,000	7560	15120
13:00	9,104	8,000	6480	15120
14:00	9,424	8,000	7759	15120
15:00	10,861	8,000	10530	15120
16:00	11,819	8,000	12870	15120
17:00	11,979	8,000	12870	15120
18:00	8,784	8,000	10753	15120
19:00	6,228	8,000	9677	15120
20:00	5,271	8,000	6452	15120
21:00	4,952	8,000	5376	15120
22:00	3,514	8,000	4301	15120
23:00	2,077	8,000	3226	15120

Untreated Conditions

These fields are automatically calculated and filled based upon site inputs and are provided for reference.

Treated Conditions

The user can manually input treated demand and capacity values for each hour of the day. This allows the user to model any treatment or condition that is known to reduce demand or improve capacity.

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Custom Treatment - Incidents

There are three custom treatment types available. For each of these, the left column looks quite different than what is shown on the typical treatment entry screen.

The Custom Treatment - Incidents tab allows the user to manually input the number of Crashes and Non-Crash Incidents expected under treated conditions, and to adjust durations. This allows the user to model any treatment or condition that is known to reduce crash rates or durations.

Custom Treatment Incidents

Operational Inputs

Untreated

Crashes	Number/ year	Avg Duration, min
Property Damage Only	31	28
Minor Injury	17	40
Major Injury & Fatal	7	45
Subtotal	55	

Non-Crash Incidents		
Non-Lane Blocking	138	26
Lane Blocking	33	20
Other	25	23
Subtotal	195	

Untreated Conditions
These fields are automatically calculated and filled based upon site inputs, and are provided for reference.

Treated

Crashes	Number/ year	Avg Duration, min
Property Damage Only	25	28
Minor Injury	15	40
Major Injury & Fatal	5	45
Subtotal	45	

Non-Crash Incidents	Number/ year	Avg Duration, min
Non-Lane Blocking	45	26
Lane Blocking	30	20
Other	10	23
Subtotal	85	

Treated Conditions
The user can manually input values based on treated conditions.

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Cost-Effectiveness

For all treatments (including custom treatments), the right column summarizes the cost-effectiveness analysis and has an identical layout for all treatments. The user is asked for several inputs related to treatment life, treatment costs, and treatment benefits.

Cost Data

Enter the cost to construct the treatment, as well as the annual cost to maintain the treatment. The tool calculates a total annualized cost that is ultimately converted to a Net Present Value in the "Cost Effectiveness" section.

Benefits

The tool calculates the Annual Delay Reduction and Standard Deviation Change Indicator based on the operational improvements predicted for the treatment. From these, using the Value of Time and Value of Reliability, respectively, the tool calculates the Annual Operational Benefit.

The Annual Safety Benefit is calculated based on the indirect effect of congestion reduction on crash rates, and on the direct effect of the treatment itself on reducing or eliminating certain types of crashes.

Inputs

Enter the expected service life of the treatment (how long the treatment will function before needing to be replaced, in years).

The discount rate (essentially an annual interest rate that allows the computation of present economic value) can be user-modified (see Title Bar page).

The Uniform Series Present Worth Factor (USPWF) is calculated by the tool and is used to convert an annual uniform cash flow to a present value.

Cost-Effectiveness

This section of the tool converts the annualized costs and benefits to Net Present Values (using the USPWF), and then calculates the Net Present Benefit of the treatment by subtraction, and the Benefit-Cost (B/C) Ratio by division.

Inputs	
Treatment Service Life, yrs	20
Discount Rate	7.0%
Uniform Series Present Worth Factor	10.6

Costs	
Construction Cost, $	195000
Annualized Construction Cost, $	$18,407
Annual Maintenance Cost, $	1000
Total Annual Cost, $	**$19,407**

Benefits	
Annual Delay Reduction, veh-hr	1,310
Standard Dev. Change Indicator	0.2
Annual Operational Benefit (AOB), $	
Delay Component	$20,540
Reliability Component	$309
Total AOB	$20,849
Annual Safety Benefit (ASB), $	
Benefits due to Congestion Reduction	
Fatal/Maj Inj	$20,465
Minor Injury	$6,276
PDO	$1,200
Benefits due to Treatment Effects	
Fatal/Maj Inj	$0
Minor Injury	$0
PDO	$0
Total ASB	$27,941
Other Annual Benefits, $ (User-Specified)	0
Total Annual Benefits,	**$48,790**

Cost Effectiveness	
Net Present Value of Cost	$205,594
Net Present Value of Benefits	$516,879
Net Present Benefit	**$311,285**
B/C Ratio	**2.51**

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Navigating the Screens

Results

Reliability Inputs

To compute reliability results, the tool uses four variables: critical demand/capacity ratio (dc crit), lane-hours lost (LHL), hours with rainfall exceeding 0.05 inches ($R_{0.05"}$), and hours with snowfall exceeding 0.01 inches ($S_{0.01"}$). The Reliability Inputs tab includes graphs of these variables computed for each of the 24 time-slices, both in the untreated condition and with the treatment indicated at the top of the screen. For both conditions, the minimum and maximum values are indicated on the right side of each graph, along with the hours during which they occur.
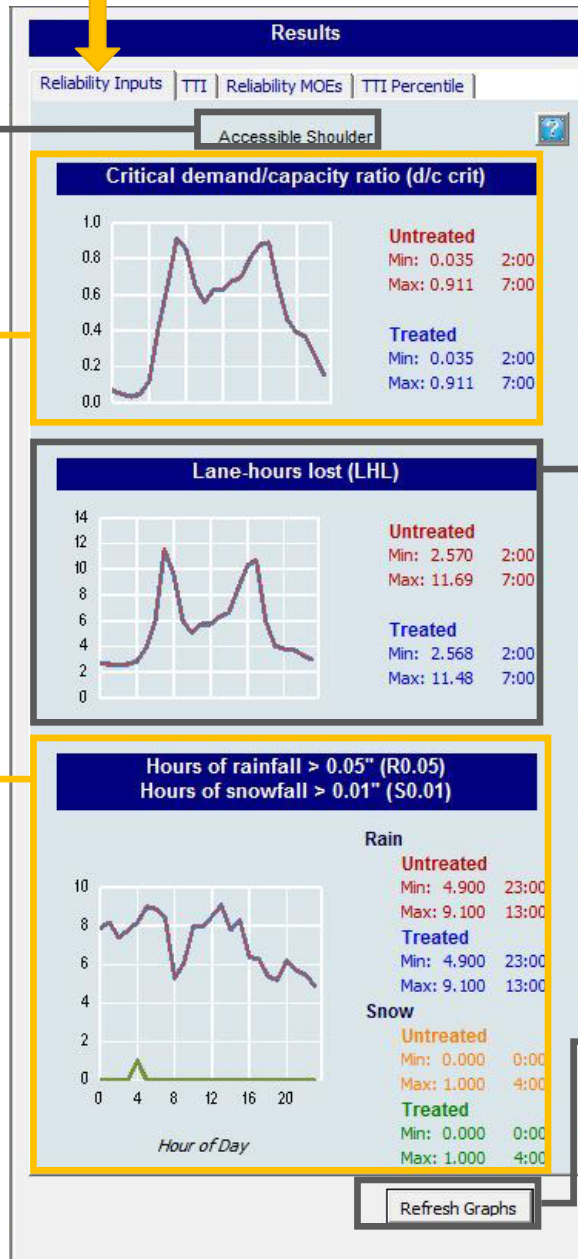
Treatment Name
Name of treatment for which reliability inputs are being shown.

Critical Demand/ Capacity Ratio (dc crit)

For the purposes of this tool, dc crit is the ratio of demand to capacity for a given hour.

Number of Hours with Precipitation Exceeding Trace Values ($R_{0.05"}$ and $S_{0.01"}$)

$R_{0.05"}$ indicates how many hours experience 0.05 inches or more of rain during the time-slice. Similarly, $S_{0.01"}$ indicates how many hours experience 0.01 inches or more of snow during the time-slice.

Lane-Hours Lost (LHL)
LHL has two components: annual lane-hours lost due to incidents (ILHL) and annual lane-hours lost due to work zones (WZLHL). Untreated ILHL is based on data input on the Incident tab, and untreated WZLHL is based on short-term work-zone data input on the Work Zone tab. Treated values are based on the expected effects of the treatment.

Refresh Graphs
If graphs disappear (a quirk of Excel), this button can be used redraw them.

Results

Reliability Inputs | TTI | Reliability MOEs | TTI Percentile

Accessible Shoulder

Critical demand/capacity ratio (d/c crit)

Untreated
Min: 0.035   2:00
Max: 0.911   7:00

Treated
Min: 0.035   2:00
Max: 0.911   7:00

Lane-hours lost (LHL)

Untreated
Min: 2.570   2:00
Max: 11.69   7:00

Treated
Min: 2.568   2:00
Max: 11.48   7:00

Hours of rainfall > 0.05" (R0.05)
Hours of snowfall > 0.01" (S0.01)

Rain
Untreated
Min: 4.900   23:00
Max: 9.100   13:00
Treated
Min: 4.900   23:00
Max: 9.100   13:00
Snow
Untreated
Min: 0.000   0:00
Max: 1.000   4:00
Treated
Min: 0.000   0:00
Max: 1.000   4:00

Hour of Day

Refresh Graphs

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Navigating the Screens
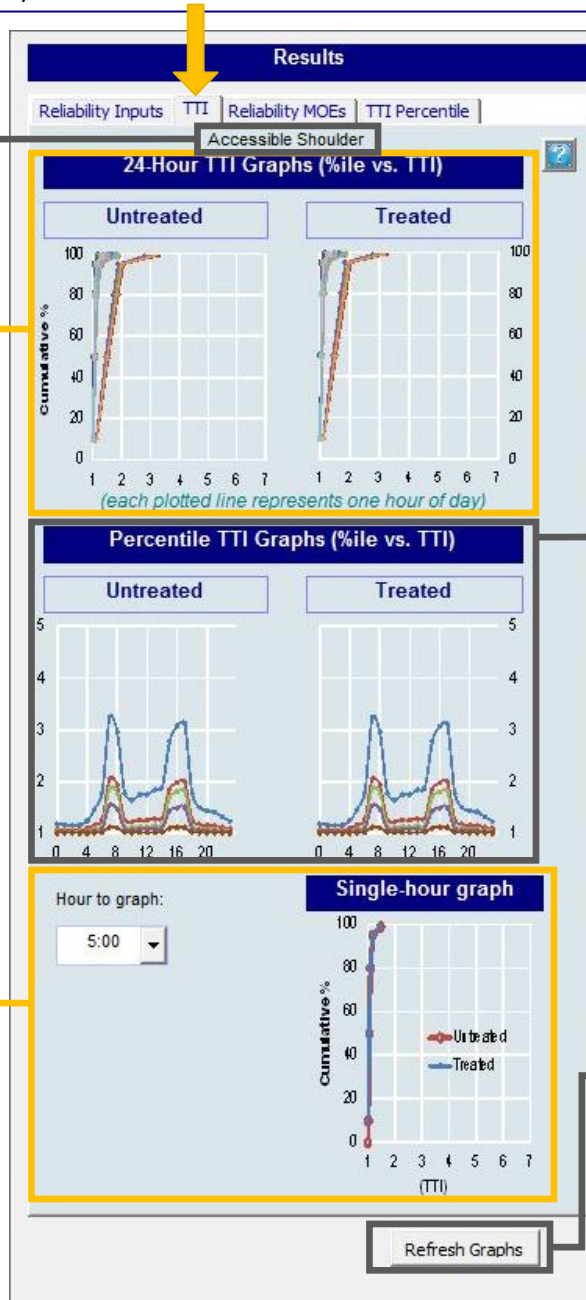
Results

Travel Time Index

The Travel Time Index (TTI) is defined as the ratio of the actual travel time on a highway segment to the free-flow travel time. A segment operating at free-flow would have a TTI of 1.0; a segment on which cars traveled at half the free-flow speed (therefore taking twice as long to traverse the segment) would have a TTI of 2.0. The curvature of the graph is related to the reliability of a facility; the less the curve bends to the right, the more reliable the facility is. A perfectly vertical curve would represent a "perfectly reliable" facility.

Treatment Name
Name of treatment for which TTI graphs are being shown.

24-Hour TTI Graphs
These graphs show TTI curves for all 24 time-slices, both in untreated and treated conditions. The tool calculates multiple TTI percentile values: 10th, 50th, 80th, 95th, and 99th. The values are connected to form the cumulative curve. The differences between the treated and untreated curves form the basis for the annual treatment benefit computations on the "Treatment Data and Calculations" tabs.

Percentile TTI Graphs
These graphs represent the 24-hour graphs in a different form, with one curve for each of the five percentiles, for the untreated and treated conditions.

Single-Hour TTI Graph
This graph allows the user to select a single time-slice with which to compare treated and untreated TTI curves.

Refresh Graphs
If graphs disappear (a quirk of Excel), this button can be used redraw them.

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Reliability MOEs

This tab displays graphs illustrating how several reliability measures of effectiveness (MOEs) vary by time of day, for both untreated and treated conditions. It also illustrates the difference between treated and untreated MOEs for each hour of the day. The MOEs are defined in more detail in the help menu.

Treatment Name
Name of treatment for which MOE graphs are being shown.

Active Reliability Measures
The user selects which reliability measures appear on the graphs below. Multiple measures can be graphed simultaneously.

Difference Graph
This graph subtracts the untreated MOE values from the treated MOE values for the selected measures. Positive values indicate an increase in the MOE value with the treatment; negative values indicate a decrease.

MOE Graphs
Based on the user's selection, the tool graphs the reliability measures for both untreated and treated conditions.

Refresh Graphs
If graphs disappear (a quirk of Excel), this button can be used redraw them.

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Navigating the Screens

Results

TTI Percentile

This tab displays the TTI Percentile for each hour of the day in numerical format for both the treated and untreated conditions. This is the same data used to create the graphs on the "TTI" tab.

Results

Reliability Inputs | TTI | Reliability MOEs | TTI Percentile

Accessible Shoulder

Treatment Name
Name of treatment for which TTI Percentiles are being shown.

	Untreated						Treated					
	Mean	99%	95%	80%	50%	10%	Mean	99%	95%	80%	50%	10%
0:00	1.03	1.18	1.07	1.04	1.02	1.00	1.03	1.18	1.07	1.04	1.02	1.00
1:00	1.03	1.17	1.07	1.04	1.02	1.00	1.03	1.17	1.07	1.04	1.02	1.00
2:00	1.03	1.16	1.06	1.03	1.02	1.00	1.03	1.16	1.06	1.03	1.02	1.00
3:00	1.03	1.17	1.07	1.04	1.02	1.00	1.03	1.17	1.07	1.04	1.02	1.00
4:00	1.04	1.25	1.10	1.05	1.03	1.01	1.04	1.25	1.10	1.05	1.03	1.01
5:00	1.08	1.47	1.17	1.09	1.06	1.01	1.08	1.47	1.17	1.09	1.06	1.01
6:00	1.12	1.80	1.27	1.14	1.09	1.02	1.12	1.79	1.27	1.14	1.09	1.02
7:00	1.63	3.25	2.06	1.87	1.54	1.13	1.63	3.24	2.06	1.87	1.53	1.13
8:00	1.55	2.97	1.94	1.77	1.47	1.11	1.55	2.96	1.93	1.77	1.47	1.11
9:00	1.11	1.78	1.26	1.14	1.08	1.02	1.11	1.78	1.26	1.14	1.08	1.02
10:00	1.10	1.65	1.23	1.12	1.07	1.01	1.10	1.64	1.23	1.12	1.07	1.01
11:00	1.11	1.75	1.26	1.13	1.08	1.02	1.11	1.75	1.26	1.13	1.08	1.02
12:00	1.11	1.76	1.26	1.13	1.08	1.02	1.11	1.75	1.26	1.13	1.08	1.02
13:00	1.12	1.84	1.28	1.15	1.09	1.02	1.12	1.84	1.28	1.15	1.09	1.02
14:00	1.13	1.88	1.29	1.15	1.09	1.02	1.13	1.88	1.29	1.15	1.09	1.02
15:00	1.51	2.78	1.86	1.71	1.43	1.10	1.50	2.77	1.85	1.70	1.43	1.10
16:00	1.58	3.07	1.98	1.81	1.50	1.12	1.58	3.07	1.98	1.80	1.49	1.12
17:00	1.60	3.13	2.01	1.83	1.51	1.12	1.59	3.12	2.00	1.82	1.50	1.12
18:00	1.11	1.78	1.26	1.14	1.08	1.02	1.11	1.77	1.26	1.14	1.08	1.02
19:00	1.08	1.50	1.18	1.09	1.06	1.01	1.08	1.50	1.18	1.09	1.06	1.01
20:00	1.07	1.44	1.16	1.08	1.05	1.01	1.07	1.44	1.16	1.08	1.05	1.01
21:00	1.07	1.41	1.15	1.08	1.05	1.01	1.07	1.41	1.15	1.08	1.05	1.01
22:00	1.05	1.32	1.12	1.06	1.04	1.01	1.05	1.32	1.12	1.06	1.04	1.01
23:00	1.04	1.24	1.09	1.05	1.03	1.01	1.04	1.24	1.09	1.05	1.03	1.01

Untreated Results
The mean TTI and five TTI percentiles for each of the 24 hours of the day for the **untreated** condition. These data are graphed in the "Untreated" graphs on the "TTI" tab.

Treated Results
The mean TTI and five TTI percentiles for each of the 24 hours of the day for the **treated** condition. These data are graphed in the "Treated" graphs on the "TTI" tab.

Refresh Graphs

Refresh Graphs
If graphs disappear (a quirk of Excel), this button can be used redraw them.

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