



**HCS™**  
Streets Module

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# USER GUIDE

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# Introduction

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McTrans Center, University of Florida Transportation Institute  
PO Box 116585, Gainesville FL 32611-6585  
Telephone: 1-800-226-1013 Fax: 352-392-6629  
Web: [mctrans.ce.ufl.edu](http://mctrans.ce.ufl.edu) Email: [mctrans@ce.ufl.edu](mailto:mctrans@ce.ufl.edu)

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# HCM Chapter 18

The computational procedure in this chapter can be used to estimate the capacity and level of service (LOS) of urban street segments. The analysis considers a wide variety of conditions including but not limited to, the amount and distribution of traffic movements, traffic composition, geometric considerations, and details of movement phases and timing. Urban Street LOS is estimated as a function of arterial travel speed and arterial volume-to-capacity ratio. Signalized intersection operations are modeled largely on the basis of the HCM Chapter 19 procedures, albeit with key adjustments for signal coordination and platooned vehicle arrivals.

## Limitations of the Methodology

The HCM Chapter 18 procedure does not directly account for mid-block parking activity, mid-block significant grade, mid-block capacity constraints, queue spillback between intersections, and turn bay queue spillover. The HCM Chapter 18 procedure is also affected by the same limitations contained within the HCM Chapter 19 procedure.

# HCM Chapter 19

The procedure in this chapter can be used to analyze the capacity and level of service (LOS) of signalized intersections. The analysis considers a wide variety of conditions including, but not limited to, the amount and distribution of traffic movements, traffic composition, geometric considerations, and details of movement phases and timing. The primary focus is the determination of approach and intersection delay as well as the corresponding LOS. Signalized intersections, as addressed by HCM, are consistent with Urban Streets.

## Limitations of the Methodology

This chapter does not account for turn-bay overflow and queue spillback. A queue storage ratio is calculated, but does not provide any adjustments to the capacity of the adjacent through lane. Free right

turns for movements not under signal control are not modeled by this method. Right turn on red (RTOR) volumes are subtracted from the total right-turn flow since they are not processed during the green. The procedure does not allow for gap reduction or rest-in-walk for actuated signals.

# HCM Chapter 23

The computational procedure in this chapter can be used to estimate the capacity and level of service (LOS) of interchange ramp terminals and alternative intersections. The analysis considers a wide variety of conditions including but not limited to, the amount and distribution of traffic movements, traffic composition, geometric considerations, and details of movement phases and timing. Interchange Ramp Terminal LOS is estimated as combination of delays for a series of origin-destination movement pairs and the volume-to-capacity ratio and queue-storage ratio for each movement. Alternative Intersection LOS is dictated by the experienced travel time (ETT) for each origin-destination movement and the volume-to-capacity ratio and queue-storage ratio for each movement. Signalized intersection operations are modeled largely on the basis of the HCM Chapter 19 procedures, albeit with key adjustments for signal coordination and platooned vehicle arrivals.

## Limitations of the Methodology

This chapter does not account for turn-bay overflow and queue spillback. A queue storage ratio is calculated, but does not provide any adjustments to the capacity of the adjacent through lane. Right turn on red (RTOR) volumes are subtracted from the total right-turn flow since they are not processed during the green. HCS does not allow for gap reduction or rest-in-walk for actuated signals.

# Getting Started

To begin, click on File then New (or the “New File” icon). You will be presented with a dialog box to input the basic phase timing and base values for the intersection. (NOTE: It is important to set the Forward Direction as the direction for your project. The software does not allow for the user to change this information once the program starts.) Once these choices are made, click on “OK” to continue the input data process.

Normal Windows keyboard and mouse functions are available. Arrow keys now navigate through the data fields. Tabbing, clicking to a new field, or pressing the Enter key will trigger a recalculation and update the Report pane.

## Templates

The Signals and Streets modules of HCS provide the ability to import and export input data “templates”, to define intersections more efficiently. The Template feature allows important subsections of input data (lane configurations, phasing sequences, signal timings) to be automatically imported, or transferred between intersections, or transferred between datasets. If the desired data cannot be found within the existing templates, users can create and customize their own templates. When creating a brand-new dataset it is also possible to select a template on the Quick Start screen.

**Importing a Template** - Templates can be imported by selecting File > Import > Template and then choosing from a list of available templates. A short description is provided for each template. If a user has already created and exported a template, it can be found under the All Templates option and the specific category option within which it was created. For example if a template was exported as a Detailed Input template, it can be found under the Detailed Input option (as well as under the All Templates option) from the Import Template dialog.

**Exporting a Template** - Users can create and customize their own templates by selecting File > Export > Template. The subsequent menu will allow the user to specify a template file name, provide a short description, and then save the template into the appropriate folder. Once a template has been saved it can then be imported in the future as needed.

# General Controls

## File

**New** - Creates a new Streets file (\*.xus) and starts a new analysis project.

**Open** - Opens an existing HCS Streets file (\*.xus), HCS2010 Signals file (\*.xhs), or DAITA file (\*.xhd).

**Example Folder** - Opens folder with all HCS examples in File Explorer

**Recent Files** - Allows quick access to files that have recently been created or altered.

**Close** - Closes an existing Streets file (\*.xus).

**Save** - Saves an opened Streets file (\*.xus) using the current file name.

**Save As** - Saves an opened Streets file (\*.xus) using a specified file name.

**Print** - Prints a Signals/Streets report to the printer or specified electronic file.

**Print Preview** - Displays preview of current report before printing.

**Import**

**Streets CSV File** - Imports data from a Streets CSV file.

**QuickStreets CSV File** - Imports data from a QuickStreets file.  
**Synchro-To-Streets Converter** - Imports data from a Synchro file.  
**Streets Data Template** - Imports data from an existing template file.  
**DAITA File** - Imports data from a DAITA file.  
**CSV Import Wizard** - Opens import wizard for importing data from a Streets CSV file.  
**Export** - Exports data in template form.  
**Streets CSV File** - Exports data in a CSV file.  
**Streets Data Template** - Exports data in template form.  
**CORSIM**  
**View Animation** - Sends data to the TSIS-CORSIM program for simulation and/or animation purposes; TRAFVU can be opened within TSIS-CORSIM to allow user to view animation  
**Generate TRF File** - Saves an open Streets file (\*.xus) as a CORSIM file (\*trf), which is a file that contains the input data used to define a CORSIM network and to drive the CORSIM simulation for a single simulation case  
**TransModeler** - Sends data to the TransModeler program for simulation and/or animation purposes.  
**Exit** - Exits Streets.

## View

**Toolbar** - Toggles shortcuts from file menu near the top of the program.  
**Status Bar** - Provides additional information about the active input data field.  
**Startup Screen** - Opens the startup screen that initially showed when opening Streets  
**Reports** - Allows user to switch view of reports to either below or to the right of the input screen.  
**Classic / Visual Mode** - Toggles between Classic Mode and Visual Mode.  
**Primary Data** - Expands/collapses the screen to include/hide the primary data screen.  
**Detailed Data** - Expands/collapses the screen to include/hide the detailed input data screen.  
**Interchange Data** - Expands/collapses the screen to include/hide the detailed input data screen which includes interchange inputs  
**Multimodal Data** - Expands/collapses the screen to include/hide the multimodal input data screen.  
**Quick Lanes** - Toggles enlarged lanes input screen.  
**Quick Phases** - Toggles enlarged phases input screen.  
**Reports Panel** - Toggles view of the report panel.  
**Information** - Toggles view of information (error and warning messages) regarding the current file.  
**Auto-Calculate** - Activates auto-calculate mode for whenever input values are changed. Auto-calculate mode can sometimes slow down the program when there are multiple intersections and/or time periods.  
**Force Calculations** - Forces a calculation whenever the user needs to refresh output data. Force Calculations is only applicable when Auto-Calculate mode is turned off.  
**Quick Animation** - Exports data to TransModeler for animation purposes.  
**Quick Optimization** - Exports data to TRANSYT-7F to provide optimization of the urban street.  
**Full Optimization** - Internally performs HCM-based genetic algorithm optimization for the urban street.  
**Time-Space Diagram** - Provides a time-space diagram of the urban street.  
**Flow Profile Diagram** - Provides flow profile diagrams for the urban street.

## Edit

**Undo** - Reverse previous editing operation.  
**Redo** - Revert to previous editing operation.  
**Cut** - Deletes data and moves it to clipboard.  
**Paste** - Places data from clipboard into the input panes.  
**Settings** - Provides preferences for exporting data and appearance of data in the reports. Also provides defaults for Analyst, Agency/Co, Time Period, Jurisdiction, and units.

## Windows

**New Window** - Opens a new window for a new intersection.

**Cascade** - Places the current files into smaller windows to allow a better view to multiple files.

**Tile Vertical** - Files appear in column form for side-by-side analysis.

**Tile Horizontal** - Files appear in row form for side-by-side analysis.

**Close All** - Closes all windows, but leaves the HCS program open.

## Reports

**Signals/Streets Text Report** - The text report contains mostly unformatted text outputs, although zoom magnification is available. The text report also contains a small number of outputs that are not available in the formatted reports.

**Input Report** - The input report, which is formatted to display enhanced fonts and graphics, provides an echo of the input data.

**Results Report** - The results report, which is formatted to display enhanced fonts and graphics, provides a summary of the most important output measures of effectiveness from the Chapter 19 procedure.

**Intermediate Report** - The intermediate report, which is formatted to display enhanced fonts and graphics, provides additional outputs that are not available in the results report. Many of these outputs are called “intermediate” because they are computed prior to the final results, and because they are used to influence the final results.

**Graphical Summary** - The graphical summary, which is formatted to display enhanced fonts and graphics, provides a visual representation of the intersection delay, queue, and LOS.

**Messages Report** - The messages report contains warning messages and/or error messages, which are automatically generated by HCS upon analyzing the input/output data. These warning and error messages can also be viewed in a dialog screen by clicking on the “Information” toolbar icon. The messages report may also contain any user “comments” entered inside the Information screen.

**Full Report** - The full report is a combination of the input, results, intermediate, and messages reports.

**Safety and Emissions Report** - The safety and emissions report, which is formatted to display enhanced fonts and graphics, provide a summary of the most important output measures related to safety and emissions.

**Segment Report** - The segment report, which is formatted to display enhanced fonts and graphics, provides a summary of the most important output measures of effectiveness from the Chapter 18 procedure.

**Access Point Report** - This report provides information on each access point with lanes, volumes, balanced flow, proportion time blocked (for use in TWSC), and thru vehicle delay estimates.

**Street Heatmap** - The street heatmap, which is formatted to display enhanced fonts and graphics, provides a visual representation of the % of BFFS and LOS of the urban street.

**Flow Profile Data** – This report provides a text printout of flow profile values for each intersection and each segment.

**Interchanges Results** - The Interchanges report details demand, delay and LOS by origin-destination pairs, as well as providing input and results summaries for each signalized intersection.

**Alternative Intersections Report** - The alternative intersections report details flow rate, control delay, EDTT, ETT, and LOS by origin-destination, as well as providing input and results summaries for each intersection.

**Phasing and Time Summary** - The phasing and timing summary, which is formatted to display enhanced fonts and graphics, provides a summary of the phasing and timing of each intersection within the dataset.

**Intersection Summary** - The intersection summary, which is formatted to display enhanced fonts and graphics, provides a summary of each intersection within the dataset.

**None** - Blanks out the report pane, and sometimes allows for faster program operation.

## Help

**Contents** - Provides access to a glossary, acknowledgements, copyrights, information on Visual Mode, and information on the Chapter 18/19 procedures.

**Index/Search** - Allows user to search for key terms or phrases within the contents.

**User Guide** - Provides a comprehensive user guide in PDF format.

**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 website in the default web browser.

**Support** - Provides user access to any FAQ's, as well as McTrans contact information for any issues or concerns.

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

## Toolbar Icons

**New** - Creates a new Streets file (\*.xus) and starts a new analysis project.

**Open** - Opens an existing HCS Streets file (\*.xus), HCS2010 Signals file (\*.xhs), or DAITA file (\*.xhd).

**Save** - Saves an opened Streets file (\*.xus) using the current file name.

**Print** - Prints a Signals/Streets report to the printer or specified electronic file.

**Quick Animation** - Exports data to TransModeler for animation purposes.

**Quick Optimization** - Exports data to TRANSYT-7F to provide optimization of the urban street.

**Full Optimization** - Internally performs HCM-based genetic algorithm optimization for the urban street.

**Time-Space Diagram** - Provides a time-space diagram of the urban street.

**Flow Profile Diagram** - Provides flow profile diagrams for the urban street.

**Auto-Calculate** - Activates auto-calculate mode for whenever input values are changed. Auto-calculate mode can sometimes slow down the program when there are multiple intersections and/or time periods.

**Force Calculations** - Forces a calculation whenever the user needs to refresh output data. Force Calculations is only applicable when Auto-Calculate mode is turned off.

**Information** - Toggles view of information (error and warning messages) regarding the current file.

## Shortcuts

**Ctrl - N** = create a new file

**Ctrl - O** = open an existing file

**Ctrl - S** = save data to file

**Ctrl - P** = print report

**Ctrl - I** = pop up the "information" dialog

**Ctrl - F1** = view the "help contents"

**F5** = toggle between Classic Mode and Visual Mode

**F6** = collapse/expand the "detailed input data" section

**F7** = collapse/expand the "multimodal input data" section

**F8** = pop up the "quick lanes" dialog

**F9** = pop up the "quick phases" dialog

**F11** = toggle the "reports panel"

**Ctrl - Shift - A** = toggle the "auto-calculate" mode

**Ctrl - Shift - R** = force calculations (if auto-calculate is turned off)

**Ctrl - Shift - L** = launch "quick animation"

**Ctrl - Shift - O** = launch "quick optimization" via one-touch export to TRANSYT-7F

**Ctrl - Shift - F** = launch "full optimization" via HCM-based internal genetic algorithm

**Ctrl - Shift - T** = view the time-space diagram

**Ctrl - Shift - P** = view the flow profile diagrams

# Operational Data

## General

The user will first enter the General Information into the respective fields: Urban Street, Intersection and Project Description. The user may change the forward direction of the major street as well as the area type. The forward direction is important for relating the intersection to other intersections and upstream filtering when dealing with arterials or urban streets. The Area Type is defined as being in a “CBD or Similar” environment or not. Choosing this option will affect the Area Type Adjustment Factor for the saturation flow rate. The user may also enter the duration of the study and the peak hour factor (PHF). The duration is coded as the analysis period, which is normally 15 minutes ( $T=0.25$  hours) to represent the length of time the peak flow is constant. The PHF is coded to change the volumes into flow rates, generally for planning applications. For operational applications, demands are coded in vehicles per period for a multiple-period analysis without use of the PHF.

The input data screen and report screen are placed concurrently in the window. The user has the ability to place the report screen below or to the right of the input data screen.

**Note:** The Status Bar at the bottom of the screen will identify the current field, the possible range or choices to input into the field, and default values that the software provides for a new file.

The Quick Lanes control can be used for graphical coding of lane configuration data. Text input fields for number of lanes and shared lanes are also available under Detailed Input Data, if non-graphical coding of lane configuration data is needed. On the Quick Lanes control, lane combinations can be selected by clicking on the appropriate arrows to place them on the diagram for each approach. The geometry of each approach is described by coding the number of lanes and the movements allowed in each lane, including whether movements are exclusive or shared. This data is coordinated with the normal data entry screen, so changes in either view are reflected in the other. The Clear button can be used to delete all existing lanes if needed.

## Traffic

Demand is coded for each movement of the intersection. Arrival demand in vehicles per period is required for any movement to be included in the analysis. If actual demand data are not collected for congested conditions, the rate cannot exceed capacity (by definition) and the analysis can significantly underestimate delay and queue.

**Note:** Counting vehicles as they cross the stop line is not adequate for collecting data to analyze congested conditions. If demand approaches or exceeds capacity, arrival rate must be known to use demand in this methodology by collecting arrival data upstream of all queues associated with the approach, then reconciling the approach rate to each movement at the stop line.

Multiple-Period Analysis is necessary to analyze congested conditions and properly model the operation for reasonable delay, queue and level of service results. Otherwise, the initial queue (d3) delay that builds and dissipates over the peak period is not considered in these computations. This analysis must begin and end with undersaturated periods to capture the complete oversaturated process.

**Note:** If a user wishes to analyze additional time periods, they may add periods at the top of the screen. Adding a period will allow a user to change demand related data, but intersection geometry and phasing data will remain constant through all periods.

Lane Width is entered as an average width for all the lanes in the lane group.

Storage Length can be coded into the software and will have a direct effect on the Queue Storage Ratio (QSR). Users must take caution with the QSR. If the QSR exceeds 1.0, HCS will not identify that there will be spillovers into other lanes and cause unforeseen delays. If possible, any QSR above 1.0 should be alleviated prior to finalizing the analysis. If not possible, simulation is recommended.

Base Saturation Flow Rate is available by lane group, but one value for all lane groups is typical. In fact, this is normally a jurisdiction-wide parameter that should be calibrated for each local area. It is adjusted to account for different factors and prevailing conditions.

**Note:** Calibration from field data is detailed in HCM Chapter 31 and involves measuring the prevailing saturation flow rate for at least 15 cycles including a minimum of 8 vehicles in queue per cycle, excluding the first five vehicles (to account for start-up lost time) and permitted left turn lane groups (because of the complexity involved). The prevailing rate is compared with the computed rate to generate a proportion to apply to the base saturation flow rate to be used for any analyses performed within the jurisdiction. The HCM suggests this calibration be performed only every few years or when there is evidence of a change in driver behavior. Calibration of base saturation flow rate for local conditions is critical for accurate results within this procedure, since these rates can vary dramatically by jurisdiction. For example, larger cities typically have base rates well over 2000, while smaller towns can be well under 1600 – and this significantly changes the basis for capacity, ultimately used to compute delay and level of service.

Percent Heavy Vehicles is coded to adjust the saturation flow rate for the effects of heavy vehicles in the traffic stream. Heavy vehicles occupy more space and have different operating capabilities with respect to passenger cars. The Heavy Vehicle Factor typically assumes 2.0 passenger cars per heavy vehicle, but this can be modified under Detailed Input Data.

Percent Grade is entered for each approach to determine the Grade Adjustment Factor for saturation flow adjustment to account for the effects of grade on all vehicles.

Buses

Parking

Bicycles

Pedestrians

Arrival Type is used to describe the quality of traffic progression as it approaches the intersection in question. The arrival type ranges between 1 and 6 with 1 being poor progression, 2 being unfavorable progression, 3 being random arrivals, 4 being favorable progression, and 6 being exceptional progression. These values and descriptions can be found in Chapter 19 of the HCM.

Upstream Filtering (I) allows the user to select an upstream Signals data file for calculating the I-factor, for each approach with a signalized intersection within 0.6 miles.

If there is an Initial Queue (unmet demand from the previous period), this value is coded by lane group in units of total vehicles. This value will have a direct effect on the value of  $d_3$  in the intersection delay calculations.

Speed Limit

Detector Length

RTOR



## Phasing and Timing

The signal phasing sequence is specified by clicking on the dual-ring phasing diagram (phases 1 through 8), also known as “Quick Phases”. Only the left-turn phasing needs to be specified, because thru movements and right-turn movements are automatically added to the phasing sequence as a function of laneage. The dual-ring phasing diagram contains logic to prevent invalid phasing sequences from being entered, given the available laneage. Left-turn movements in odd-numbered phases are used to reflect protected left-turns (i.e., “green arrow”), whereas left-turn movements in even-numbered phases are used to reflect permitted left-turns (i.e., “green ball” or “flashing yellow arrow”). When exclusive right-turn lanes exist, shielded right-turns may be added by clicking twice on the corresponding odd-numbered phase. Green, yellow, and all-red clearance times may be entered in the group box labeled “Timing”. After the signal phasing and timing are entered a sequential phasing diagram (labeled “Phase Duration”) will display the phase durations as computed by the HCM procedure in an equivalent “single-ring” format.

**Note:** Phase Durations are average times calculated for the fifteen-minute analysis period and may not represent times for any one cycle. For phases with very low demand, the average green may be lower than the minimum specified because some cycles would serve the minimum and some cycles would skip the phase. And, if the average is equal to the clearance time, the green may be displayed as zero. This is necessary to both show the averages and have them sum to the cycle length.

Each distinct phase time is defined by coding the Phase Split (if coordinated), Maximum Green (if uncoordinated), Yellow Change, Red Clearance and Minimum Green times. Users may also code passage time and mark any movement for having a lag phase, dual entry, simultaneous gap out, or Dallas Phasing. For coordinated intersections the software will automatically update non-actuated phase splits, to reflect the cycle length and the actuated phase splits.

The software also allows users to input field-measured phase times to be used directly if the actual values are known, eliminating the phase duration estimation procedure. If an intersection is labeled as coordinated, the cycle length and offset time become available options to coincide with the corresponding intersections. The timing lists an overall Phase Split which will change to keep the cycle length consistent for all movements. For coordinated intersections, the non-actuated phases (typically 2+6) will be computed from the sum of the actuated phase times honoring the specified cycle length. Uncoordinated intersections will not have the option of a cycle length or offset since the timing only affects the intersection in question. The phase split now becomes a Maximum Green and each phase is independent, so the user has the ability to change each movement.

## Detailed Input Data

The user may input detailed information about the project including the Analyst, Agency or Company, Date, Time Period, Year and Jurisdiction of the Project. Many values within the Detailed Input Data screen are set values from the HCM, but the user has the ability to change any of them for local calibration.

Global Optimization contains an array of inputs for signal timing design, if desired. These inputs may affect Quick Optimization (via one-touch export to TRANSYT-7F) and/or Full Optimization (via HCM-based internal genetic algorithm).

## Multimodal Input Data

If an intersection contains data for pedestrians and/or bicycles, the user can enter Signals multimodal data to determine a level of service score and corresponding LOS. Similar to vehicle data, the user may input multimodal volumes and geometry for the intersection in question. By entering this data, the user can obtain multimodal outputs and level of service in the reports section of the software. If an urban street contains segment-based data for pedestrians, bicycles, or transit, the user may enter Streets multimodal data to determine a segment-based multimodal LOS. For “operations only” analyses, checkboxes (“Hide Results”) are available to hide multimodal outputs on the Results Report and the Intermediate Report.

## Interchange Ramp Terminals

Beyond coding the signalized intersection(s), the user codes information specific to an interchange by defining the Interchange Type, Interchange U-Turn Volume and Turn Radius for (normally) two intersections selected as Interchange Intersections.

## Alternative Intersections

To model an alternative intersection, the user first codes the inputs for a conventional intersection and then specifies the desired type of alternative intersection (e.g., MUT with TWSC, RCUT, DLT). This will convert the file to the specified alternative intersection, allow for additional inputs relevant to any supplemental junctions, and generate an alternative intersection report. *Note: Some alternative intersections such as MUT and RCUT require additional files to be attached before full results can be generated.*

## Signals/Streets Reports

The lower pane (or right pane depending on user preference) displays the analysis outputs in a dynamic form, reacting to changes in the upper (or left) Entry pane. The Report portion of the screen can be viewed simultaneously with the Entry pane. All or a portion of the report can be copied to the Windows clipboard for insertion into other files by right-clicking into the Report pane, selecting all, and copying. The Report pane can also be printed or saved to an electronic file through File > Print.

For signalized intersection analysis the user will have the option of viewing reports for Input Data, Results Summary, Intermediate Values, Messages and Comments, or a combination of all four reports. These formatted reports contain enhanced fonts and graphics, but a text option is also available. The text report contains mostly unformatted text outputs, although zoom magnification is available. The text report also contains a small number of outputs that are not available in the formatted reports. If results (e.g., Delay and Level of Service) do not appear on the Results Summary report, the user can review the Messages Report (or Information button) for possible errors within the input data.

For urban street analysis, the user can choose between a segment-based formatted report, and a segment-based text report. These reports also contain access point input and output data, if any access points exist. As with the signalized intersection reports, the segment text report also contains a small number of outputs that are not available in the formatted reports.

Users who wish to print any report should ensure that this report is displayed in the report pane of the software. Accessing the print option under the File menu will present the traditional printing options. A preview of all pages to be printed is recommended. Changing the margins of the report will allow more information to fit on fewer pages, as opposed to having very little information appear on an extra page.

It is also possible to view the reports in XPS format. This format provides an image to be seen by using a XPS Viewer or an Internet Browser such as Internet Explorer. Mozilla Firefox is not compatible with showing XPS files. This procedure can be done by selecting File > Print and choosing "Microsoft XPS Document Writer." This will allow a user to save the file in (\*.xps format) and can later be viewed by the recommended web browsers.

# Visual Mode

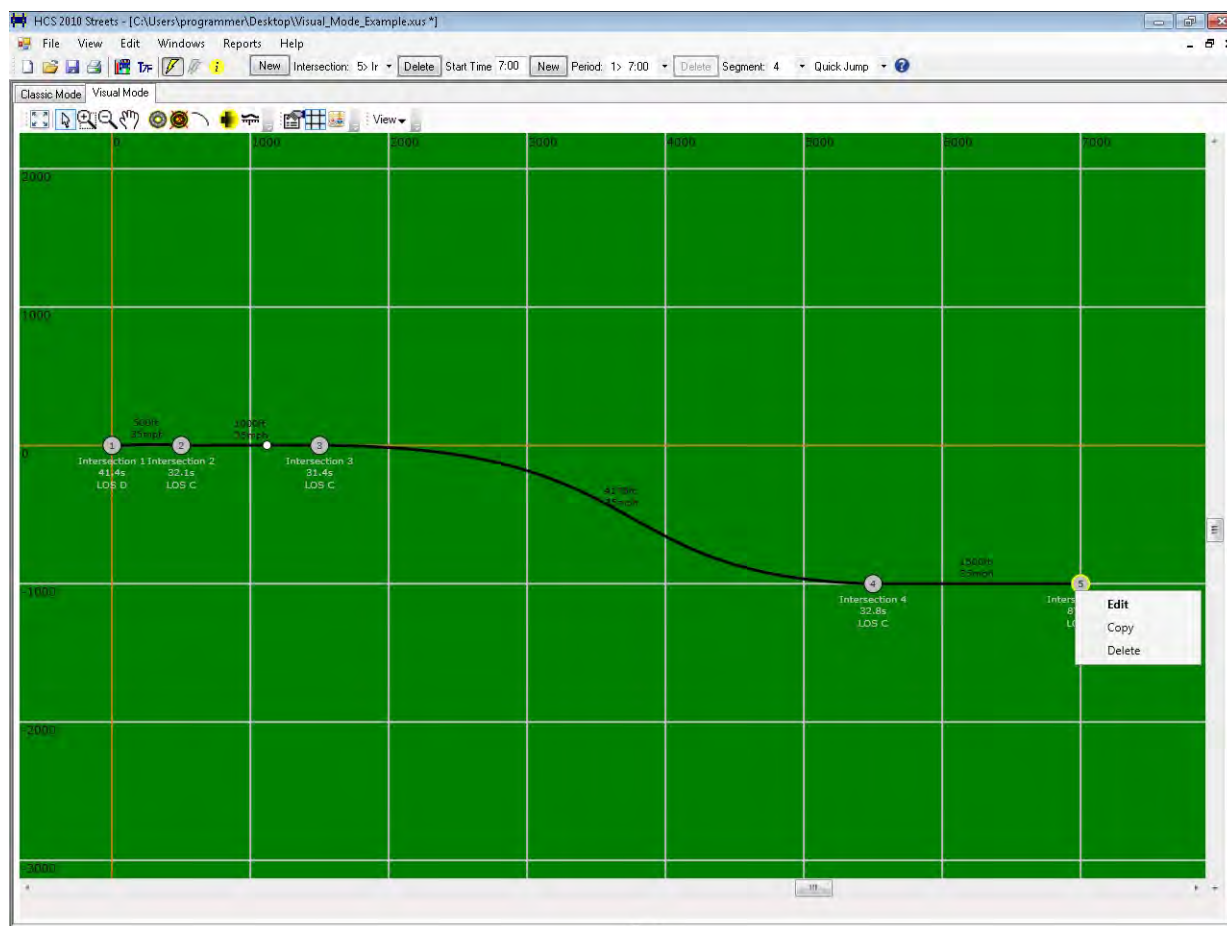
## Overview of Visual Mode

A map rendering screen ("Visual Mode") is available for displaying urban street geometry, and editing urban street input data. Visual Mode may allow the user to better understand the data entry process, and may assist in explaining the model to unfamiliar parties. In addition, the ability to display input and output data on the map can be useful for verification and validation of the model. User-supplied bitmap background images can be helpful for understanding the real-world signal system represented by the link-node diagram, and can be helpful when dragging and dropping intersections to their appropriate locations.

When an Urban Streets (\*.xus) input file is open, a tab for switching to Visual Mode is located next to the Classic Mode tab, near the upper left-hand corner of the program screen. Pressing the F5 key will also toggle between Visual Mode and Classic Mode. Visual Mode currently offers the following features:

- Adding curvature
- Adding a new access point
- Showing or hiding the grid
- Easy bitmap background scaling
- Map colors and layout properties
- Zoom in, zoom out, pan, show all
- Align intersections vertically or horizontally
- Graphical adding and deleting of intersections
- Select and move entire groups of intersections
- Ability to underlay user-supplied bitmap backgrounds and aerial photos
- Right-click or double-click on intersections to edit their properties (tabular view)
- View intersection delay and LOS by moving the mouse pointer over an intersection
- Copy-and-paste intersections, to avoid re-coding lane configuration, volumes, and timings
- View option for showing Intersection Name, Intersection LOS, Intersection Delay, Segment Length, Segment Name, Speed Limit, Access points and Access Point Name

An example of Visual Mode is illustrated below.



The default segment length is typically 1000 feet for brand-new data files. The first time Visual Mode is selected, intersections will be placed at 1000-foot increments, unless the user has already modified segment lengths within Classic Mode. Intersections will be oriented according to the Urban Street Forward Direction.

There are two methods (manual and graphical) for entering segment lengths. If segment lengths are entered manually, intersections will continue to be positioned in a straight line, consistent with the Urban Street Forward Direction. In Classic Mode, segment lengths can be entered manually after clicking on the “All Segment Lengths” button. The Segment Lengths dialog for manual specification of segment lengths is shown below.

Segment Lengths

×

Segment Number	Length, ft
1- 2	1000
2- 3	1000
3- 4	1000

OK

Cancel

Segment lengths are adjusted graphically whenever the user 1) drags and drops intersections into different positions, or 2) the user right-clicks on intersections to enter specific node coordinates, or 3) adds curvature to a segment. In this case, segment lengths will be automatically re-calculated by Visual Mode as a function of node coordinates, and any segment curvature that might exist. Segment lengths can be changed graphically at all times, but they can only be entered manually when intersections are positioned in a straight line with no curvature. The Segment Lengths dialog for manual specification of segment lengths will be disabled if curvature exists, or if intersections are not positioned in a straight line.

Link connections (a.k.a. segments) between intersections automatically appear whenever intersections are added. Intersection details can be specified by right-clicking and selecting the “Edit” option, or by switching back to Classic Mode.

When Visual Mode is initially opened, the Pointer icon is activated on the toolbar toward the top of the screen. When the Pointer icon is activated, the user can select individual intersections (or groups of intersections), drag-and-drop intersections, and right-click on intersections to edit their properties. Other toolbar icons may be used to superimpose input/output information on the map, add or delete intersections, add or delete curvature, or change the view (zoom in, zoom out, show all). Certain toolbar icons will cause the mouse cursor to change shape, to indicate a different mode of operation. For example, if the “Zoom In” icon is selected, the mouse cursor takes the shape of a magnifying glass. To return to the default Pointer mode at any point during the session, the user can either right-click on the general map area, or click back on the Pointer icon.

The Pointer icon can be used to draw a “rubber band” around groups of intersections. To do this, left-click on the general map area, hold the mouse button down without releasing, drag the rubber band around a group of intersections, and then release the mouse button. Any intersections within the rubber band area should become highlighted. This group of intersections can then be dragged-and-dropped across the map, or lined up to have the same X or Y coordinate. After modifying a particular group of intersections, you can “unselect” them by clicking anywhere in the general map area.

Available “hotkeys” include F5 (toggle between Visual Mode and Classic Mode), F8 (Quick Lanes), F9 (Quick Phases), and F11 (Reports). Scrolling up and down via scroll wheel results in zoom in and zoom out.

## Toolbar Icons in Visual Mode

### Show All

When Visual Mode is initially opened, the “Show All” function is automatically applied. Typically after zooming or scrolling the map for some time, the user will want to return to that initial view where the link-node diagram was centered within the screen. Clicking on the Show All icon accomplishes this. If the link-node diagram is too large to fit within the screen, the Zoom Factor will be reduced to the largest possible value that makes the entire link-node diagram visible.

### Pointer

The Pointer icon allows the user to select individual nodes (or groups of nodes), drag-and-drop nodes, and right-click on nodes to edit their properties. Groups of intersections can also be selected by dragging a rubber band around them.

### Zoom In

After clicking on the Zoom In icon, the user can drag a rubber band around a section of the map to be magnified. If the horizontal and vertical proportions of this rubber band area match the horizontal and vertical proportions of the screen, the selected area can become the exact viewing area on the entire screen. Secondly, analog zooming can be achieved by simply left-clicking once inside the general map area. When analog zoom is used, Visual Mode will zoom in on the clicked spot by a fixed percentage.

### Zoom Out

After clicking on the Zoom Out icon, the user can click on a map spot they wish to zoom out from. Visual Mode will then zoom out from the clicked spot by a fixed percentage.

### Pan

After clicking on the Pan icon, the user can then drag the entire map in any direction.

### New Intersection

After clicking on the New Intersection icon, the user can then drop a new intersection anywhere on the map. If the user wishes to add several new intersections in rapid succession, having the same default values, this can be performed by copying and pasting any chosen intersection.

### Delete Intersection

After the Delete Intersection icon is selected, the user can then click on the most recent intersection to be deleted.

### Add Curvature

After the Add Curvature icon is selected, two control points are automatically placed in the middle of each link (segment). Dragging and dropping either one of these control points will then create link curvature. When zooming and scrolling the map, link curvature is preserved. However, when dragging and dropping one or more nodes across the map, curvature control points are not automatically updated. Because of this, link curvature may need to be re-drawn after moving nodes across the map. It may be preferable to code link curvature after all nodes are already in their final positions. Curvature can also be added by left-clicking on any segment between two intersections.

### New Access Point

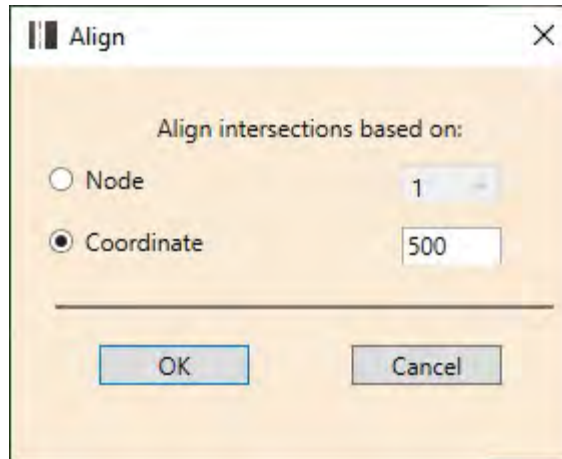
After clicking on the New Access Point icon, access points can then be added on to any given segment. Access point input data can then be entered by right-clicking on the access point and selecting Edit.

The screenshot shows the 'Segment Properties' dialog box with the 'Access Points' tab selected. The 'Access Point' section on the left contains input fields for Critical Headway (4.1), Follow-Up Headway (2.2), Right-Turn Equivalency Factor (2.20), Maximum Turn Bay Length (250.0), Deceleration Rate (6.7), and Right-Turn Speed (20.0). The 'Access Points' section on the right shows a table of access points with columns for direction (EBL, EBT, EBR, WBL, WBT, WBR, NBL, NBT, NBR, SBL, SBT, SBR) and values for Demand (veh/h) and Lanes. The 'PHF' is set to 1.00 and the 'Count' is 2. There are 'New' and 'Delete' buttons. The 'Name' field is empty and the 'Location, ft' is 600.0.

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Demand, veh/h	80	1050	100	80	1050	100	80	0	100	80	0	100
Lanes	0	2	0	0	2	0	1	0	1	1	0	1

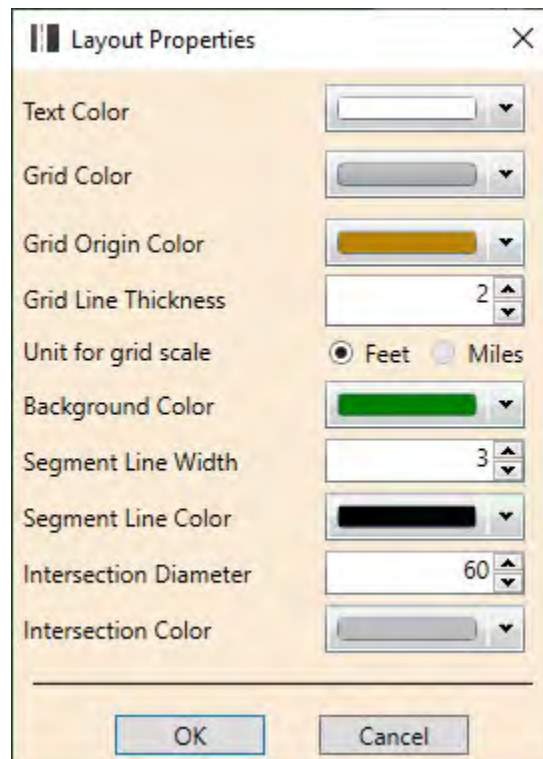
### Align Nodes

Selecting a group of intersections causes the Align Nodes Horizontally and Align Nodes Vertically icons to appear on the toolbar. The dialog shown below can then be used to align all intersections horizontally or vertically, if desired.



### Map Colors and Properties

This icon opens the Layout Properties dialog. Values and settings within this dialog are stored into memory on the computer every time the "OK" button is pressed.



### Show Grid

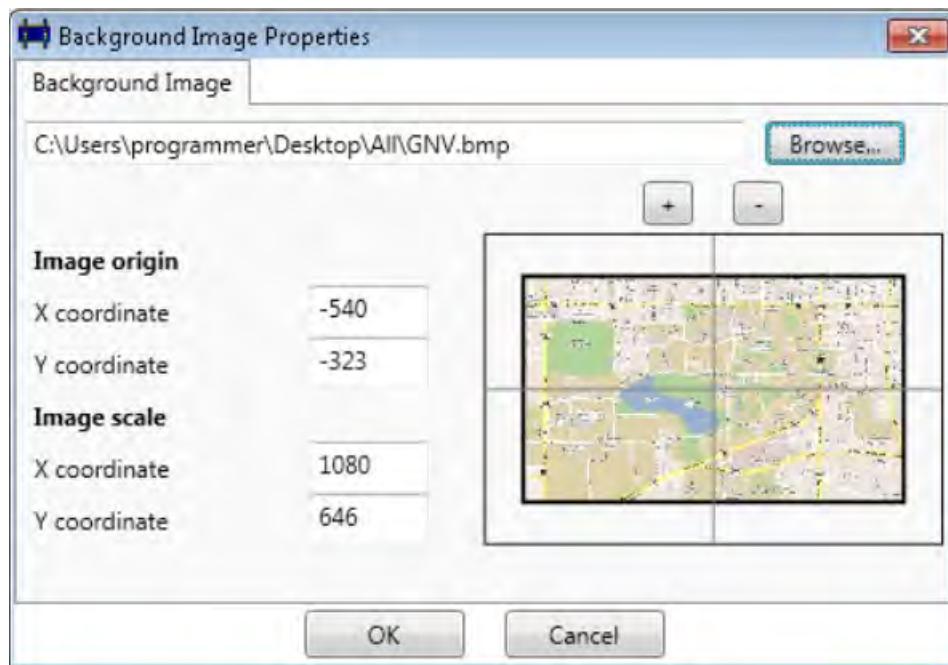
If the Show Grid icon is activated, horizontal and vertical gridlines will be displayed across the map. This can be helpful for understanding the amount of real-world distance represented by the map.

### Show Background Image

This icon can be used to show or hide the bitmap background. The icon is only enabled if a bitmap background image has been loaded (using Background Image Properties).

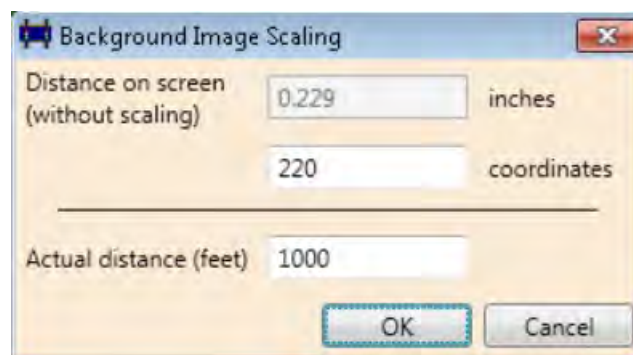
### Background Image Properties

The Background Image Properties dialog screen is shown below. The Browse button allows the user to search for available bitmap background files on the computer. Image origin specifies the lower left-hand X, Y coordinates of the bitmap background (the adjacent picture allows the user to change the origin via drag-and-drop). The Bitmap Scaling icon is probably a more effective mechanism for bitmap background scaling, but the image scale coordinates below allow for manual scaling of the bitmap background.



### Background Image Scaling

The Background Image Scaling icon is only enabled if a bitmap background image has been loaded (using Background Image Properties). After clicking on this icon, the user can draw a line between any two points on the map, where the distance between these two points is known. After the line has been drawn, the dialog screen shown below will pop up. After the actual distance (in units of feet) between these two points is entered, the bitmap background image will automatically scale itself to the proper size.





# Advanced Features

## Quick Animation

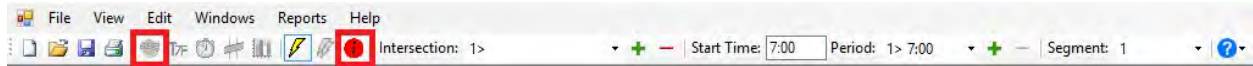
Please refer to the *TransModeler* section.

## TransModeler

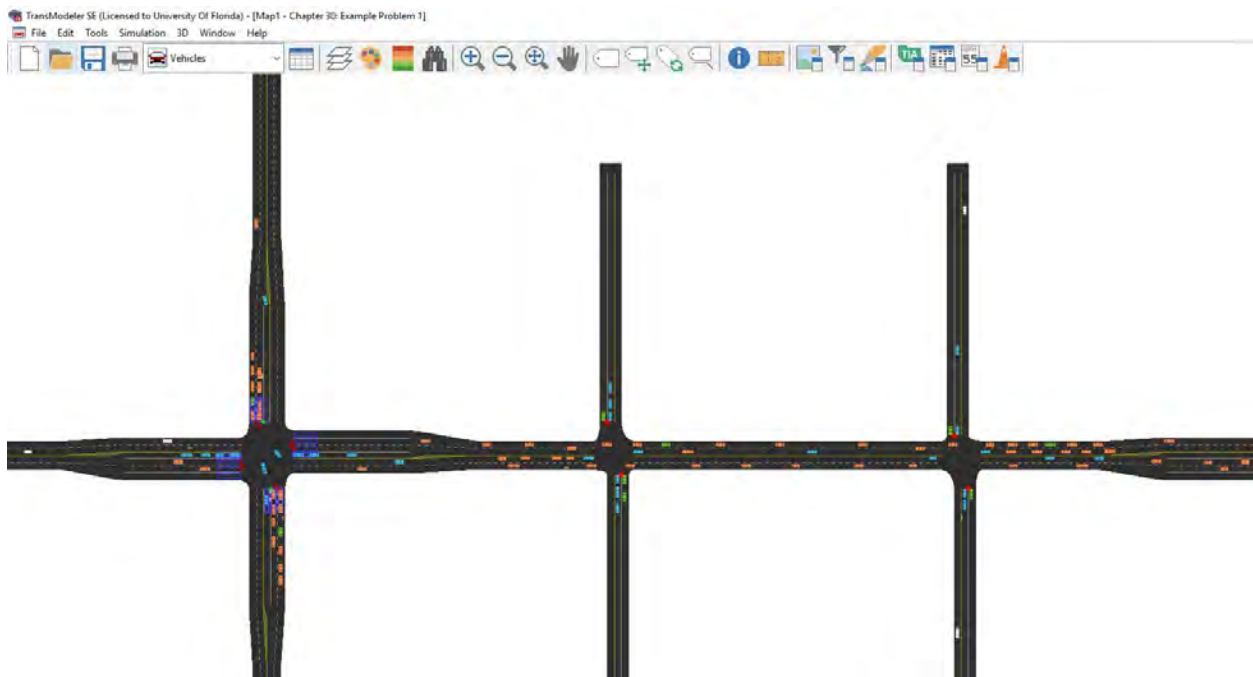
Clicking the TransModeler icon in the toolbar will open the TransModeler application by Caliper Corporation.



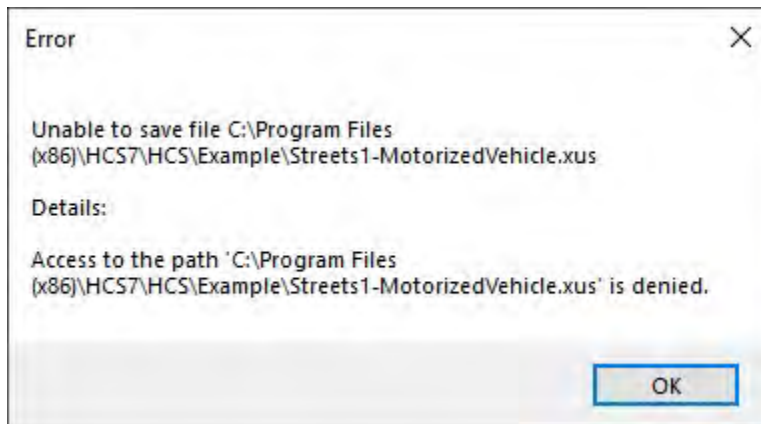
Selecting View > Quick Animation or File > TransModeler > View Animation are also other options for running the TransModeler application. When any of these options are chosen, the opened Streets file will automatically save and then run animation in TransModeler. If any errors exist in the Streets file, the information icon will turn red. Quick Animation will also be disabled and TransModeler cannot be run unless all errors in the Streets file are resolved.



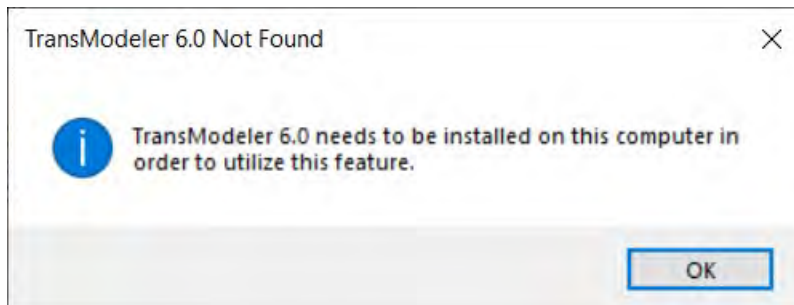
Once TransModeler opens, animation should begin immediately. It is not necessary to begin the simulation from the tools.



It is important to note that example files from the program files example folder cannot be overwritten. If TransModeler is run for one of these example files, Streets will generate an error similar to the one found below. If this error occurs, please save the file to a location where the file can be saved to run quick animation.

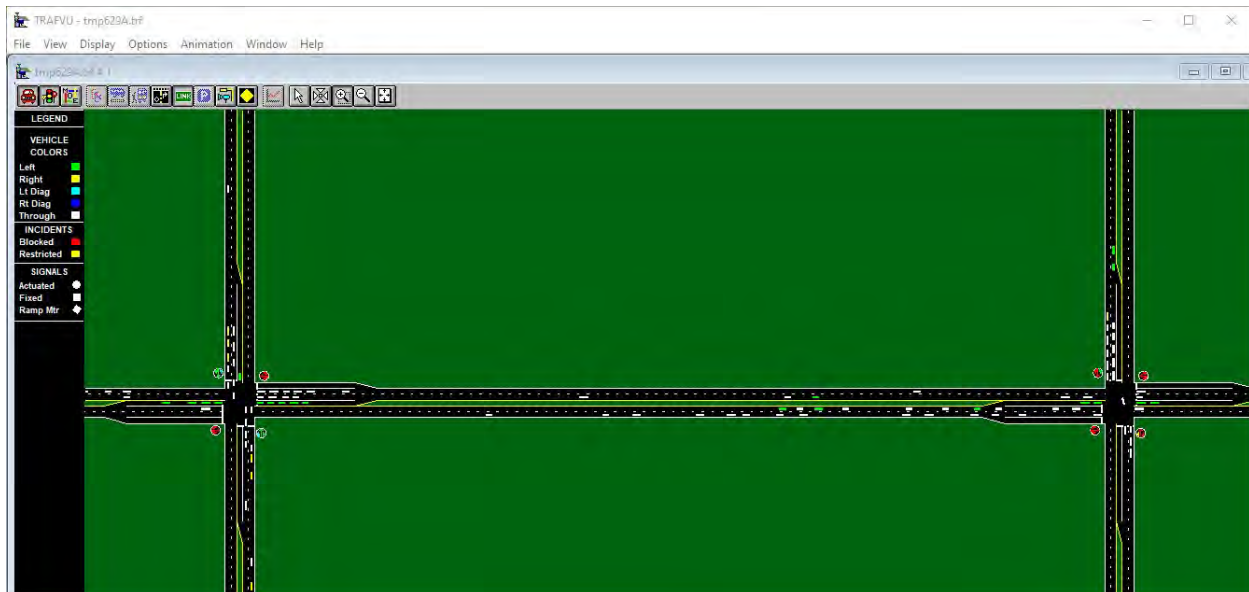


If TransModeler is not found on the user computer, the following prompt will appear:



## CORSIM

Selecting File > CORSIM > View Animation, will display CORSIM Animation (also known as TRAFVU) for the currently loaded HCS data file. HCS-Streets will automatically generate a CORSIM input (\*.trf) file, process the TRF file through CORSIM and then launch TRAFVU to provide animation of the urban street (or signalized intersection, if only one intersection exists in the dataset).



This overall process may take a few seconds. Once TRAFVU is loaded, the user will need to:

- Click on the red "Vehicle" icon to display vehicles
- Zoom in on a certain part of the link-node diagram
- Adjust the "APC settings" to slow down animation
- Press "Play" to begin animation

CORSIM and HCS contain different modeling methodologies, so the visible results (e.g., queue lengths) from CORSIM animation may not always be consistent with HCM procedure results from HCS.

TRAFVU graphics are very informative for learning about actuated control. By turning on the map adornment for Sensors, it is possible to show typical detector layouts for semi-actuated or fully-actuated control. Clicking on an actuated signal will reveal the dual-ring phasing sequence. For semi-actuated signals, pie charts are available for graphic display of permissive periods and force-offs.

The following HCS inputs are exported to CORSIM and displayed by TRAFVU: Peak adjusted traffic volumes, signal timing, lane configuration, adjusted saturation flow rates, start-up lost times, percent heavy vehicles, right-turns on red, duration of analysis, available queue storage, intersection names, and segment names. Link-specific mean discharge headways in CORSIM do not reflect any heavy vehicle or turn movement saturation flow rate adjustments from HCS, because this would constitute "double-counting" their effect on results.

The following HCS inputs are not exported to CORSIM: Average queue spacing, initial unmet demand, arrival type, I-factor, extension of effective green, pedestrian data

The following data ranges are enforced:

- Start-up lost time (0.0-9.9 seconds)
- Turn pocket or turn bay length (20-1000 feet)
- Link length (50-9999 feet)
- Saturation flow rate (1000-4000 vehicles per lane per hour)
- Number of turn pockets (maximum of 2 LT and 2 RT pockets)
- Volume (maximum of 9999 vehicles per hour)
- Green plus yellow time must be at least 8 seconds for non-overlap phases
- Green time must be at least 5 seconds for non-overlap phases

The following assumptions and limitations also exist: Vehicle arrivals to an isolated intersection in CORSIM are always random, and cannot be forced to be platooned by coding an "Arrival Type" other

than '3' in HCS. Link lengths and turn pocket lengths for CORSIM are taken from the "Available Queue Storage" fields in HCS. If no queue storage lengths are coded in HCS, link lengths are automatically set to 2000 feet. When a left-turn in HCS is opposed by a right-turn, but is not opposed by a thru movement, assumptions are made in CORSIM regarding left-turn protection and signal phasing. For actuated coordination, if dual lagging left-turns are present on the major street, it is assumed that any protected left-turns on the minor street will also lag their associated thru movements. If a protected right-turn green arrow moves in the same phase as a conflicting thru movement in HCS, CORSIM may not illustrate this. Green time in HCS should not be given to any turning movements whose "adjusted" volumes are equal to zero. T-intersections in CORSIM will sometimes be illustrated with four approaches, where one approach contains no moving traffic. If three or more exclusive left-turn lanes are coded in HCS-Signals, only two exclusive left-turn lanes will be transferred to CORSIM. If three or more exclusive right-turn lanes are coded in HCS-Signals, only two exclusive right-turn lanes will be transferred to CORSIM. If six or more thru lanes are coded in HCS-Signals, only five thru lanes will be transferred to CORSIM.

These are not limitations of CORSIM, because CORSIM itself can simulate these conditions. These are only limitations of the conversion process between HCS and CORSIM. If any of these assumptions or limitations do not match conditions in the field, the user can select File > CORSIM > Generate TRF File, and customize the CORSIM input data within TSIS.

If an error message says "This feature requires TSIS-CORSIM" even after TSIS has been installed, it may be necessary to first run TSIS in the standalone mode, so that TSIS-CORSIM can be properly registered on the computer. If the user does not have administrator rights, they may encounter an error message that says "ERROR: Failed to find file". This error message should not hinder animation, so the user should simply click "OK" and then view animation normally.

## Quick Optimization

There are two options for signal timing optimization: Quick Optimization (via one-touch export to TRANSYT-7F) and Full Optimization (via HCM-based internal genetic algorithm). Generally speaking, Quick Optimization is preferable for quickly finding a reasonable and effective timing plan, whereas Full Optimization is preferable for locating the "global optimum solution". The Minimum Cycle Length, Maximum Cycle Length, and Cycle Length Increment input fields (under Detailed Input Data > Global Optimization) can be used to automatically request cycle length optimization. When the user clicks on the Quick Optimization icon, volumes and timings from the HCS dataset are automatically transferred to a corresponding TRANSYT-7F dataset, and the optimization process begins immediately. Following optimization, outputs are automatically displayed in the dual-ring report shown below.

Dual-Ring Report (press Ctrl-P to print)

Node Number
1
System Cycle
100
Offset
0

Grn	16	42	5	23	
Yel	3	4	3	4	
Red	0	0	0	0	
Grn	16	42	5	23	
Yel	3	4	3	4	
Red	0	0	0	0	

Eastbound			Westbound			Northbound			Southbound		
Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Adjusted Volume (vph)											
200	1000	10	200	1000	10	100	500	50	100	500	50
Saturation Flow Rate (vphg)											
1800	3600	1800	1800	3600	1800	1800	3600		1800	3600	
Queue Length (veh)											
5.5	20.4	0.2	4.4	20.8	0.1	1.9	13.4		1.9	13.4	
Degree of Saturation (%)											
69	66	1	69	66	1	35	67		35	67	
Control Delay (sec/veh)											
45	25	17	53	14	4	23	36		23	36	
(Intersection Delay = 28)											
TRANSYT Level of Service											
D	C	B	D	B	A	C	D		C	D	
(TRANSYT Node LOS = C)											

TRANSYT-7F Release 12.1
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Analyst
Date Performed
Mar 2, 2017

Agency
Analysis Time Period

Jurisdiction

Run Title
Run Title

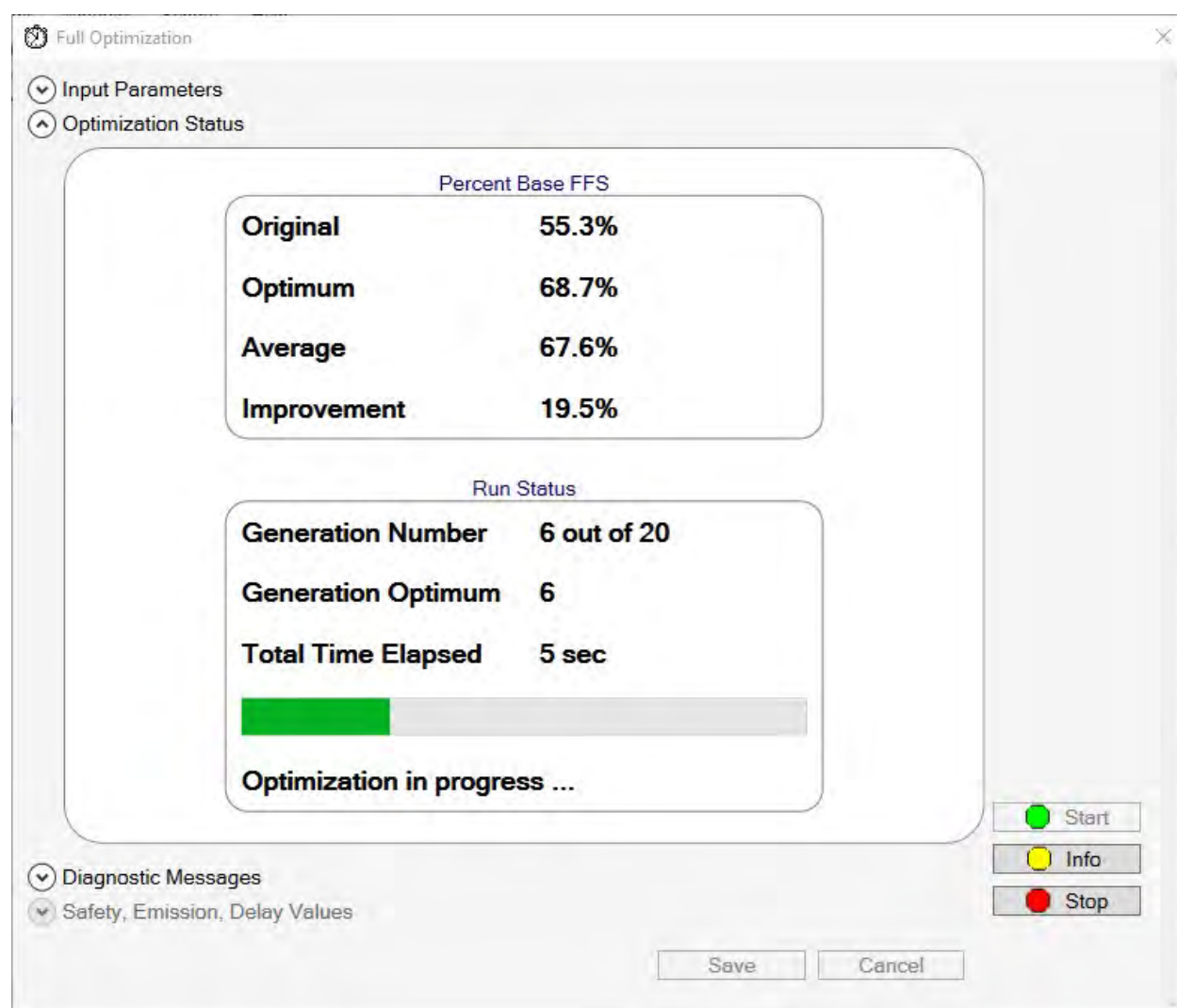
File Name
tmpAC87.tin

Compared to Full Optimization, the Quick Optimization feature has specific strengths and weaknesses. Quick Optimization employs the hill-climb optimization method, which is much faster than the genetic algorithm. However, the hill-climb method is also a less effective search technique than the genetic algorithm. Thus Quick Optimization is faster than Full Optimization, but may result in a less effective timing plan. Other miscellaneous advantages of Quick Optimization include queue spillback analysis and lane-by-lane analysis, which are innate features of TRANSYT-7F. Other disadvantages include model results that may differ from HCS (particularly in the case of permissive left-turns), and the inability to

optimize multi-period datasets. To circumvent the disadvantages related to hill-climb optimization and multi-period optimizations, the user may launch TRANSYT-7F in stand-alone mode and import the \*.xus files (s) from HCS. When running in stand-alone mode, TRANSYT-7F has the ability to perform genetic algorithm optimization and multi-period optimization; but such optimizations require more extensive run times on the computer, and would no longer be considered “quick optimization”.

## Full Optimization

Full optimizations may require extensive run times on the computer, but the user may terminate the optimization process at any time. The genetic algorithm search technique is specifically designed to locate the global optimum solution provided that 1) the original dataset already has a reasonable and effective timing plan, 2) the “number of generations” is sufficiently high, and 3) the detailed settings (population size, mutation probability, etc.) are reasonably tailored to the given urban street. Thus Full Optimization is slower than Quick Optimization, but it should result in a more effective timing plan. The optimization “dashboard” is shown below.



When the user clicks on the Full Optimization icon, the optimization dashboard will be displayed. The Input Parameters section of the dashboard will be displayed by default; the user will then have the



opportunity to adjust optimization settings before the optimization run. The Info button, which is linked to the Diagnostic Messages section, will be enabled if the dashboard detects any inputs that might make the optimization process less efficient. Clicking on the Start button will begin the optimization process. The dashboard value of “Generation Optimum” will increase each time a better signal timing plan is successfully located.

Currently there are three possible ways that the optimization process can terminate: 1) termination via convergence threshold, 2) termination via max number of generations, and 3) termination via user request. Termination via convergence threshold will occur whenever the optimization process detects that little additional improvement is possible. Termination via max number of generations will occur whenever the optimization process reaches the user-specified maximum number of generations. Termination via user request will occur whenever the user clicks on the Stop button. Because of the “start-stop-resume” feature, the user can stop and re-start the optimization process at any time.

Other miscellaneous advantages of Full Optimization include HCM-compliant modeling for each candidate timing plan, and optimized timings presented in the HCS format. Other disadvantages include the need to specify appropriate genetic algorithm settings for the given urban street, but the Info button (and Diagnostic Messages section) is designed to prevent the use of inefficient settings.

Larger urban streets will typically benefit from lower mutation probabilities, higher population sizes, and a larger number of generations. Apart from the number of generations, which must frequently be customized to match the amount of optimization needed, the default genetic algorithm settings should work well for most medium-sized urban streets. For a more detailed discussion of genetic algorithm theory, refer to Chapter 5 of the TRANSYT-7F User Guide.

Phasing sequence optimization is currently designed to optimize lead/lag phasing (and sometimes Dallas Phasing) on the major street, and will not modify phasing sequences on the minor street. If Full Optimization generates dual lagging left turns at one or more intersections, but the user’s original timing plan does not contain dual lagging left turns at any intersections, values of lead/lag and Dallas Phasing will revert to the user’s original values at the dual lagging intersections. If Full Optimization generates dual lagging left turns at one or more intersections, and the user’s original timing plan contained dual lagging left turns at one or more intersections, the dual lagging values will be allowed to stick, and Dallas Phasing will be turned off at these intersections.

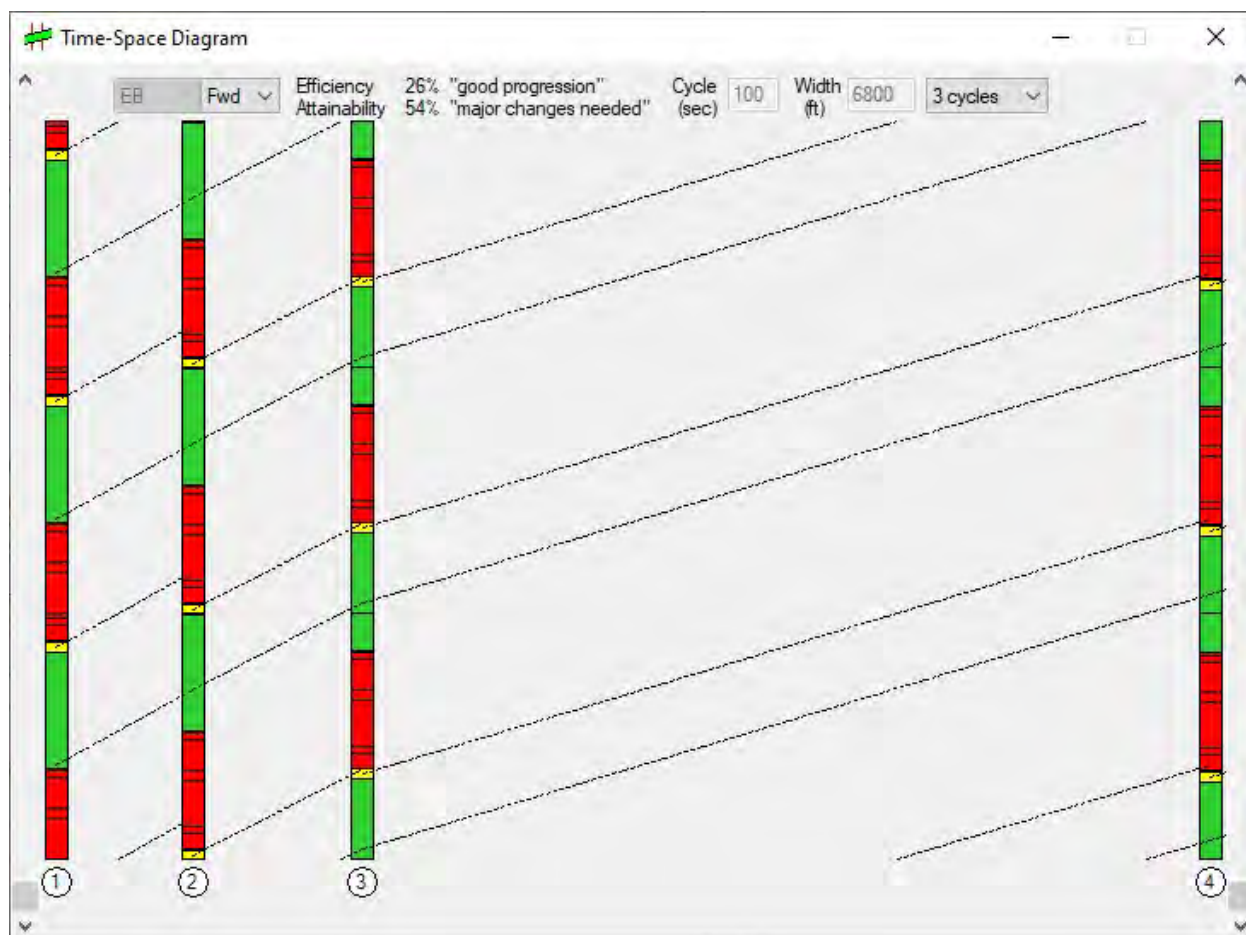
When performing phasing sequence optimization, the “Dallas Phasing Optimization” checkbox can be activated to prevent phasing sequences that would result in a “yellow trap” for the permissive left-turners. If the Phasing Sequence Optimization checkbox is selected without Dallas Phasing Optimization, the dashboard will post a warning message, but the optimization process will not modify the user’s original values of Dallas Phasing. If Phasing Sequence Optimization is selected with Dallas Phasing Optimization, the optimization process will turn on Dallas Phasing when a lagging left turn is opposed by a permissive left turn, and will turn off Dallas Phasing when both left turns are leading.

Although the Info button (linked to the Diagnostic Messages section) will be enabled when detecting inputs that might make the optimization process less efficient, there are some macroscopic strategies that the user should also consider. One such strategy could involve turning off the “Allow Optimization” checkbox at intersections that are already performing well (level of service A or B), so the optimization process can focus on re-timing the poorly-performing intersections. Another strategy could involve turning off phasing sequence optimization for arterials that already have an effective phasing sequence in place, so the optimization process can focus on fine-tuning the splits and offsets. Another strategy could involve using a more narrow range of minimum and maximum cycle length values, because examining a wide range of ineffective cycle length values could definitely make the optimization process less efficient.

After a Full Optimization run has been completed, the amount of optimization improvement over time can be plotted on the Flow Profile Diagram. Refer to the Flow Profile Diagram section of the documentation for more details.

## Time-Space Diagram

The Time-Space Diagram screen provides a mechanism for visualizing the available progression between intersections along the major street.



### Timing Plan Representation

Signal timing plans are painted vertically, with only the major street green times and yellow times colored green and yellow. Green and yellow intervals for all minor movements are painted red, usually resulting in the appearance of numerous discrete and consecutive red intervals. Node numbers are listed in the white circles at the bottom of the Time-Space Diagram screen. If an uncoordinated intersection (based on the “Uncoordinated Intersection” checkbox) is included within a progression route, the entire vertical distance will be painted red, which will terminate any incoming progression bands.

Signal timing plans are fitted to the screen vertically, such that the vertical distances of each “bar diagram” represent the background system cycle length of the urban street. Thus, the green time painted for each bar diagram represents the proportion of the cycle length occupied by the major street through movements. The vertical location of a green interval is a function of the offset and the reference phase. Scrollbars at the side of the screen can be used to simultaneously change vertical locations of all intervals and green bands, but have no net effect on the offsets and reference phases.

When progression bands are being drawn in one direction (forward or reverse) only, the Time-Space Diagram screen is capable of painting multiple green intervals for major route movements. For example, if the forward direction is Eastbound, and the eastbound through movement begins before the westbound through movement, the eastbound movement will have multiple forward progression green intervals.



When progression bands are being drawn in both directions, only the coordinated phase (with both major street segments moving simultaneously) is painted green.

### Interactive Coding of Offsets

Moving the mouse cursor inside any of the vertical bar diagrams will allow the user to click and drag timing plans vertically. This automatically modifies the corresponding offset within the \*.xus file. By adjusting the offsets interactively, it might be possible to quickly achieve an excellent bandwidth. When adjusting the offsets interactively, it is also helpful to take note of the efficiency and attainability values, as discussed later.

### Forward Direction

The urban street forward direction (NB, SB, EB, or WB) is displayed in a disabled combo box, in the upper left-hand corner of the screen. The progression band direction (Fwd, Rev, or Both) is displayed in a second combo box. When the Time-Space Diagram screen is first loaded, progression bands are drawn in the “forward” direction of travel only. The user can switch the progression band combo box to draw these lines in the reverse direction, or in both directions, if desired. For one-way streets, this combo box is disabled and only displays the forward direction.

### Efficiency and Attainability

When optimizing offsets interactively, the efficiency and attainability values at the top of the screen are updated automatically. By paying attention to comments such as “fair progression” and “increase shortest green”, it can be possible to determine whether further improvements are needed. If an uncoordinated intersection is present on the urban street, the screen will state that “This artery contains uncoordinated nodes”. Efficiency and attainability will always be zero for arteries that contain uncoordinated nodes, because it is not possible to achieve reliable progression through an uncoordinated intersection.

### Cumulative Bands

The initial progression bandwidth is based on the major street through movement’s green time at the “first” intersection only. As new intersections are encountered, it is possible to observe where the bandwidth is becoming partitioned, and gradually reduced.

Progression bands typically do not begin and end exactly when the major street green time begins and ends. Instead, the progression band begins a few seconds after the onset of green, and ends a few seconds after the onset of yellow. This is a reflection of the effective green time, which is affected by user-entered start-up lost times and extension of effective green times.

The progression bands are drawn as dashed lines across the screen; their slope is a function of segment length, and segment travel speed.

### Width

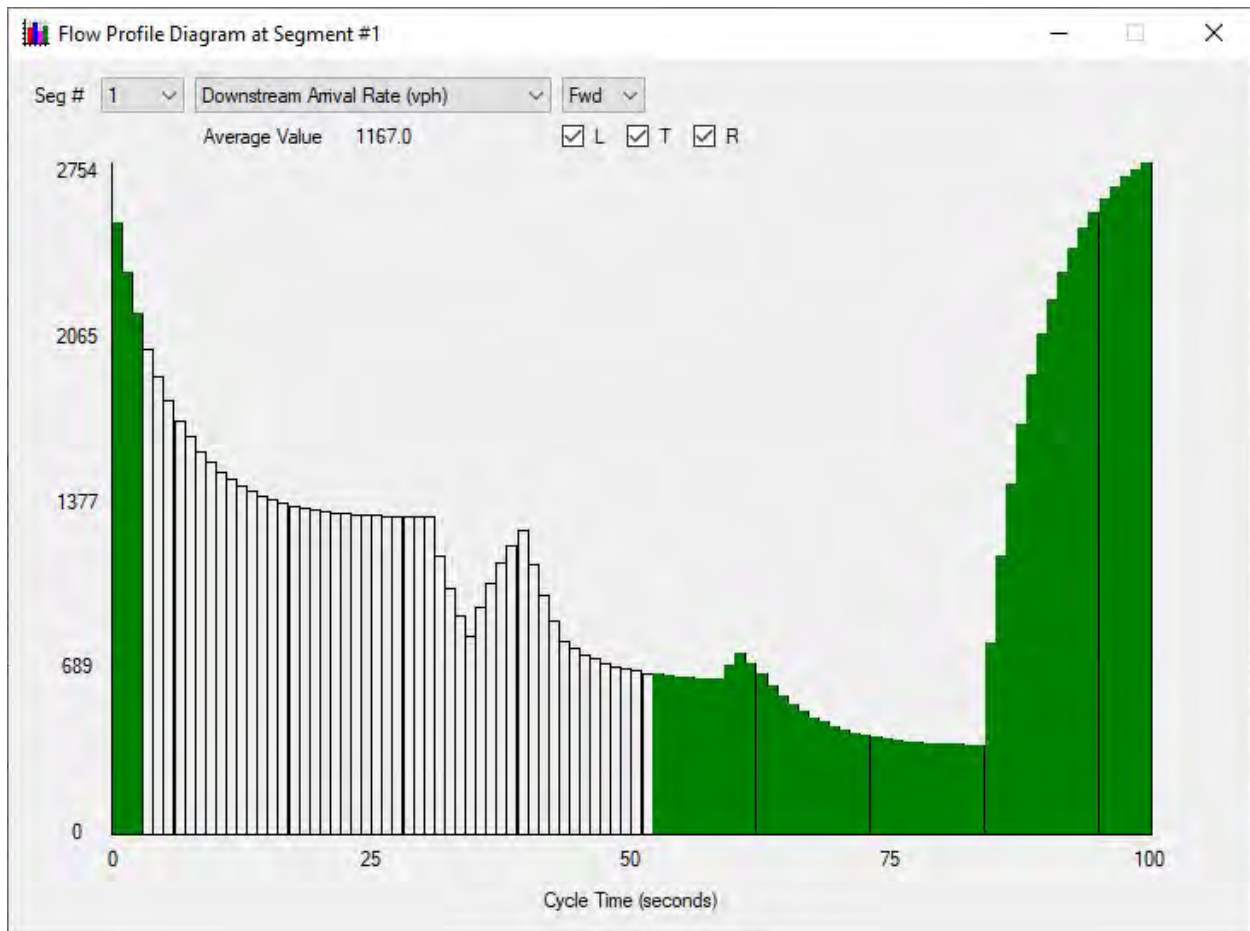
When the Time-Space Diagram screen is first loaded, the initial view is a “fit to screen” view. All intersections on the urban street should be horizontally visible on the screen at one time. The horizontal distance from one end of the urban street to the other is displayed in the Width field. Although the width of the software screen remains constant, the displayed value (in units of feet) indicates the “represented” real-world distance of the urban street.

### Number of Cycles

A drop-down combo box can be used to specify how many signal cycles will be displayed on the diagram. Note that displaying multiple cycles can cause the screen to operate more slowly, which could affect speed of the vertical scrollbars, or interactive offset adjustment.

## Flow Profile Diagram

The Flow Profile Diagram screen can be used to view static graphics that describe Streets simulation results. To operate this screen, the user can select their desired segment number within the urban street. The user can also select their desired flow profile category. Available flow profile categories include Downstream Arrival Rate, Downstream Projected Rate, Upstream Departure Rate, Access Point Arrival Rate, and Optimization Improvement. Optimization Improvement can only be plotted if a Full Optimization run has been performed recently.



After selecting the desired segment number and flow profile category, the user can select their desired direction of travel, which is either forward ("Fwd") or reverse ("Rev"). For example, if the user views the Downstream Arrival Rate for segment #1 in the forward direction, the Flow Profile Diagram will display the arrival rate of vehicles at downstream intersection #2. Finally, the user can select their desired intersection turn movements for plotting flow profiles. Up to four turn movements can be selected if the user wishes to view aggregated results for left-turn, thru, right-turn, and midblock traffic movements. The aggregated midblock traffic movements can only be plotted for the Downstream Projected Rate and the Upstream Departure Rate.

For multiple period analyses, flow profiles are displayed for the "active" time period within the Streets user-interface. On the X-axis, the system background cycle length is used to compute flow profile dimensions. The Y-axis is automatically scaled to display the highest flow profile value. Flow profiles will not be displayed for any intersections specified as uncoordinated intersections, based on the

“Uncoordinated Intersection” checkbox.

The Average Value displayed at the top of the screen represents the average profile value across every step of simulation. This can be useful for validating some of the simulation results. For example, the average input flow rate value of 1177 veh/h shown in the screen image above suggests that the hourly flow rate for this segment was 1177 veh/h, despite platoon dispersion that temporarily caused flow rates as high as 2755 veh/h.

When plotting the Downstream Arrival Rate, the green shaded area is used to indicate when green time is occurring at the downstream signalized intersection. When plotting the Downstream Projected Rate and the Upstream Departure Rate, access point “zero” is used to indicate downstream intersection flows that originated at the nearest upstream access point. Moreover, access point #1 is used to indicate access point flows that originated at the upstream signalized intersection. If more than one access point exists on the segment, access point #2 is used to indicate downstream access point flows that originated at upstream access point #1, and so forth. When plotting the Access Point Arrival Rate, access point “zero” is no longer applicable, and the access point number indicates which location along the segment is being plotted.



# Diverging Diamond Interchange (DDI)

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## Overview

The Diverging Diamond Interchange (DDI) is a variation of the traditional diamond interchange in which arterial traffic briefly drives on the opposite side of the road from what is customary. This innovative roadway geometry allows a two-phase signal timing operation, which provides significant operational and safety benefits. The DDI geometric design also allows left-turning traffic from the arterial to enter the freeway on-ramp without stopping.

Given the unique nature of DDI movements and free-flowing left turns, specific data entry methods are needed to achieve accurate modeling of DDIs in an HCM context. These data entry methods, which are outlined in this guide and in the example datasets, are summarized as follows for the HCS Streets software (hereinafter referred to as 'Streets'):

- Major-street split phasing is achieved by entering lead-lag phasing with no overlap. (*Section VI.*)
- Off-ramp left turns on to the arterial must be defined as right turns, so they can move concurrently with outbound arterial through movements. (*Section III.*)
- Turning radii for the off-ramp left turns must be modified accordingly, because the default right-turn radii will produce incorrect capacities. (*Section III.*)
- Arterial left turns on the freeway must be defined as exclusive lanes even if they are shares lanes, to allow the phasing to work properly (a special checkbox is provided to indicate shared lanes for this case, to achieve proper lane utilization adjustment factor). (*Section III.*)
- Streets allows entry of high start-up lost times, for when off-ramp movements must be held longer. (*Section III.*)
- Streets allows entry of negative extension of effective green times, for when off-ramp movements must terminate earlier. (*Section III.*)
- User inputs are now provided for extra distance travel time (EDTT). (*Section V.*)

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## Interchanges and Alternative Intersections

To define a DDI interchange in Streets, both intersections should be marked as Interchange Intersections, with the Interchange Type being set to Diverging Diamond. This input field is found under the Detailed Input Data section of Streets. Once these inputs are set, the Diverging Diamond Data and EDTT Data input buttons (details in a later section) become enabled.

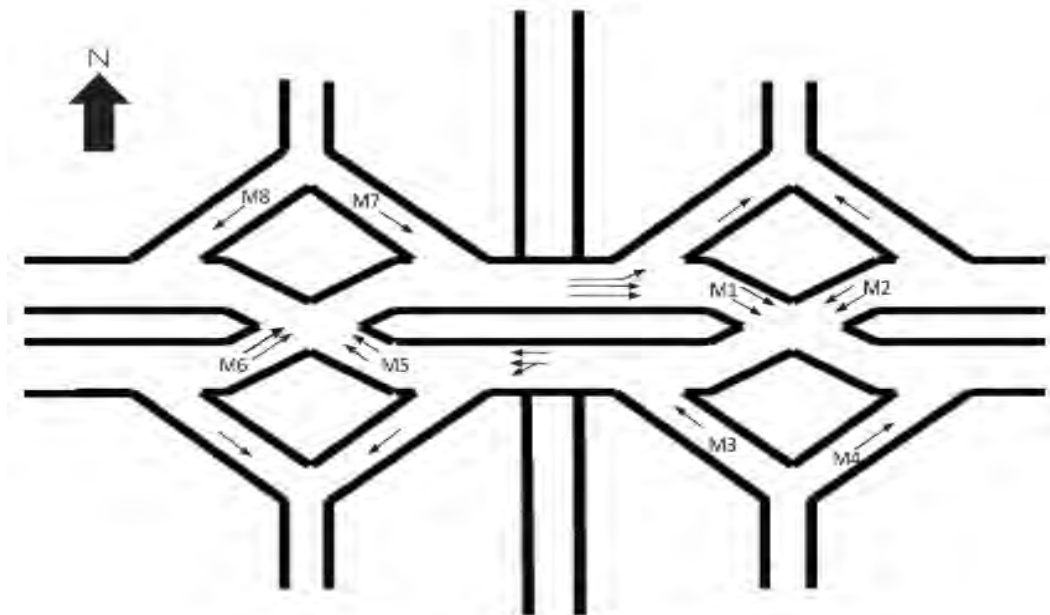
In Streets, this appears as shown below:

Interchanges and Alternative Intersections

Interchanges	Alternative
Interchange Intersection <input checked="" type="checkbox"/>	Alternative Intersection <input type="checkbox"/>
Interchange Type Diverging Diamond ▾	Intersection Type <input type="text"/>
<input type="button" value="Diverging Diamond Data"/>	
<input type="button" value="EDTT Data"/>	

## Coding Movements

Below is a generic example of a DDI:



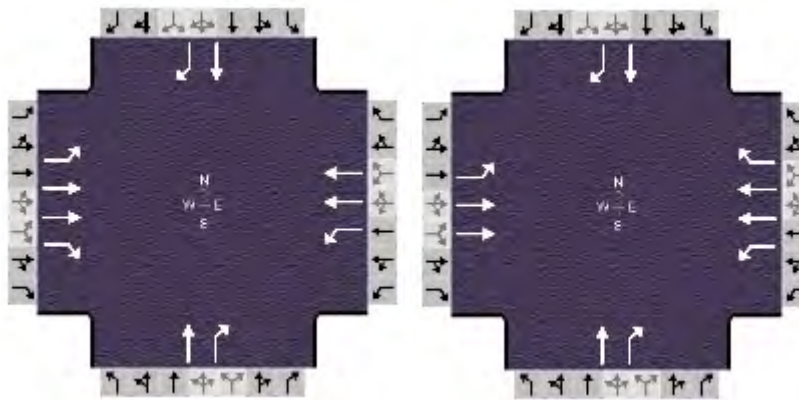
Source: HCM

Initially, DDI intersections should be coded in Streets as seen in real life. However, in order to analyze a DDI facility in Streets, adjustments need to be made to the coded intersections to allow for overlap phasing and general program function. Adjustments that need to be made are shown below:

- **M8/M4** – In addition to the off-ramp right turn, a through movement (with demand of zero vehicles per hour) should be added along the same direction to allow phasing to operate normally.
- **M7/M3** – In order to create overlap phasing with M5/M1, this movement should be coded on the approach opposite of M8/M4 (meaning that if M8/M4 is a southbound movement, then M7/M3 should be a northbound movement, and vice versa). Once the direction is set, the approach lane configuration is coded as one through lane with demand of 1 veh/h, and one or more exclusive right turn lanes. Note that because these right-turn movements are in fact left turns in real life, the user should edit the right-turn radius so it reflects the actual off-ramp left-turning radius. Accepting the defaults right-turn radius in this situation will produce incorrect capacity estimates.

- **M6/M2** – In order to create overlap phasing with M8/M4, an exclusive left turn lane (with demand of 1 veh/h) should be added to the approach. Additionally, the on-ramp right turn movement should be marked as an Unsignalized Movement.
- **M5/M1** – The on-ramp left-turn movement should be coded as an exclusive left-turn lane and marked as an Unsignalized Movement. If the on-ramp left-turn movement is made from a shared lane in real life, it must be coded as an exclusive left-turn lane and an additional through lane. A subsequent check box (described later) is available to indicate the exclusive left-turn lane and through lane as a shared lane.

Below are the adjusted lane configurations for both DDI intersections, as viewed within Streets, for the above example:



With the exception of specific demands mentioned in the prior list of adjustments, all other demands should be coded normally. Most other inputs such as Lane Width, Heavy Vehicle percentage, Turn Radius, etc. can be applied normally. However, off-ramp movements that flow towards the middle of the DDI are coded on the opposite sides of the intersection (e.g., northbound right turn instead of southbound left turn at intersection #1 in the above example, and southbound right turn instead of northbound left turn at intersection #2 in the above example), so their accompanying movement-specific characteristics should also be coded on the opposite sides of the intersection.

*Note: The HCM does not provide a procedure to model any queue blockage that would delay left-turning vehicles from a DDI to a freeway on-ramp. For such cases, the use of alternative tools is advised.*

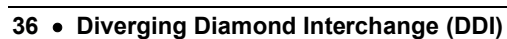
*Automation for the DDI Additional Lost Time procedure is not completed as of this release. In order to temporarily compensate for this, please compute overlap lost time on the Diverging Diamond Data screen (details in a later section) and estimate the other lost times. Once this is completed, then manually code the appropriate values of Start-Up Lost Time in order to model these effects.*

## Diverging Diamond Data

The purpose of this function is to determine lost time for the off-ramp movements (M7/M8/M3/M4) for each intersection in a DDI. Additionally, if a shared lane is present and was coded as an exclusive left-turn lane and an additional through lane, the check box available to indicate the exclusive left-turn lane and through lane as a shared lane is found here.

In Streets, this appears as shown below:

The remaining input fields shown above are represented graphically in the image below:

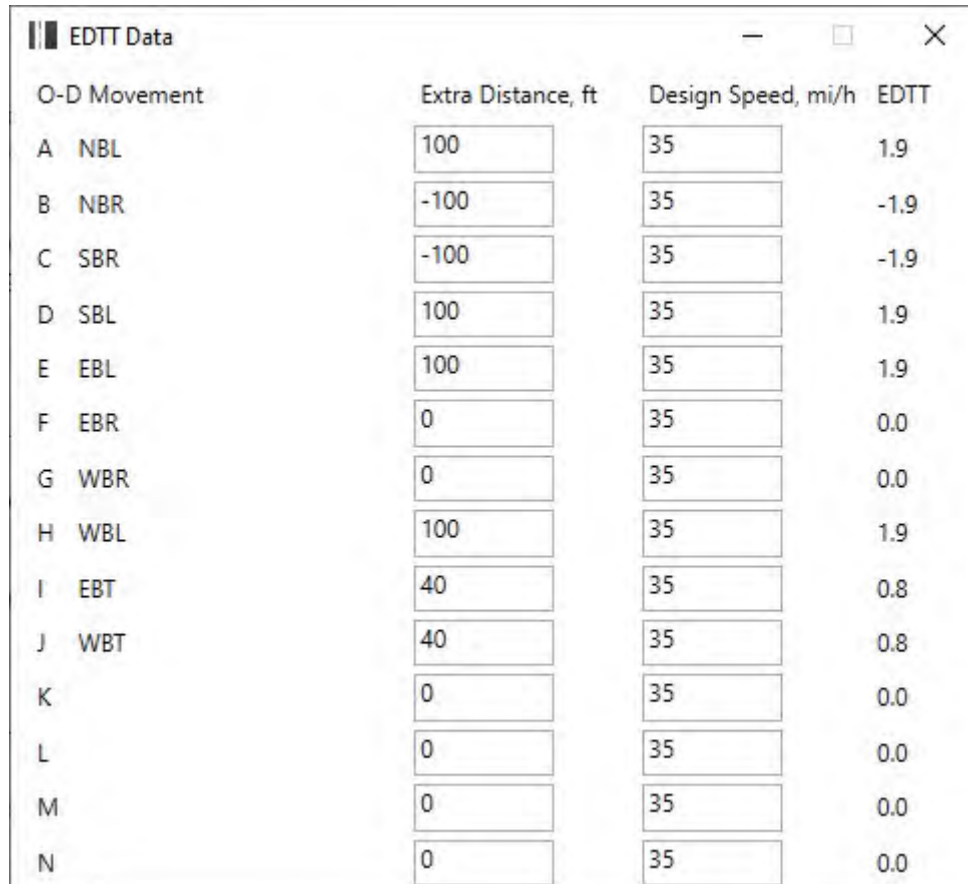




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## EDTT Data

The purpose of this function is to calculate the Extra Distance Travel Time (EDTT) for each origin-destination (O-D) Movement. The EDTT is then applied to the Total Control Delay to find the Experienced Travel Time (s/veh) for each O-D Movement. The extra distance traveled (ft) and the design speed (mi/h) for each O-D Movement, which can be measured from design drawings or aerial images, is used to calculate the Extra Distance Travel Time (EDTT). In Streets, this appears as shown below:



O-D Movement	Extra Distance, ft	Design Speed, mi/h	EDTT
A NBL	100	35	1.9
B NBR	-100	35	-1.9
C SBR	-100	35	-1.9
D SBL	100	35	1.9
E EBL	100	35	1.9
F EBR	0	35	0.0
G WBR	0	35	0.0
H WBL	100	35	1.9
I EBT	40	35	0.8
J WBT	40	35	0.8
K	0	35	0.0
L	0	35	0.0
M	0	35	0.0
N	0	35	0.0

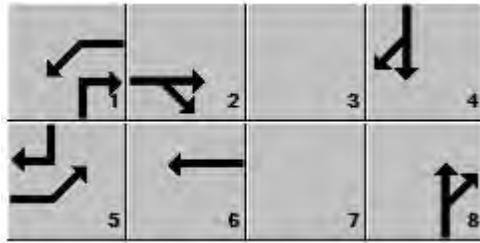
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## Signal Timing Inputs

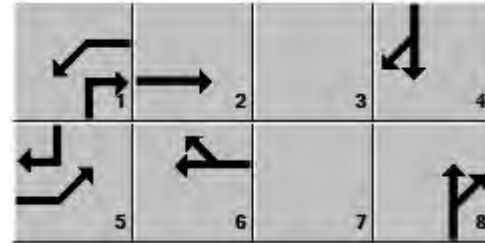
The input settings listed below are strongly recommended. HCM example problem datasets (automatically installed along with the software) are available to demonstrate these coding techniques, and all other coding techniques described within this guide.

- Major-Street Split Phasing
  - The user-entered Phase Split for phase 1 should be equal to the user-entered Phase Split for phase 5. Additionally, one of the two major-street left-turn phases should be designated as the Lag Phase. Similarly, the user-entered Phase Split for phase 2 should be equal to the user-entered Phase Split for phase 6.
- Field-Measures Phase Times (this checkbox should be turned on)

A typical example of signal phasing entry is shown below.



Intersection: 1



Intersection: 2

Phases 1 and 5 are the overlap phases created by the adjustments made to M6/M2 and M7/M3. Signal phasing must be entered for both DDI intersections individually. Generally it will be necessary for phases 1 and 5 to be coded as overlap phases at both intersections. Additionally, there should not be any Permitted Left-Turn Phases in either intersection.

Timing inputs should be associated with the following movements:

- M6/M1 – EBT
- M5/M2 – WBT
- M8/M3 – EBL (Due to overlap phasing)
- M7/M4 – WBL (Due to overlap phasing)

For the 'dummy' through movements with a demand of 1 veh/h (NBT/SBT in the above example), these are represented by phases 4 and 8. The following timing is recommended to minimize their impact:

	NBL	NBT	SBL	SBT
Assigned Phase		(8)		(4)
Phase Split, s	0.0	1.0	0.0	1.0
Yellow Change, s	4.0	0.0	4.0	0.0
Red Clearance, s	0.0	0.0	0.0	0.0
Minimum Green, s	1	1	1	1

## Output Reports

Results for a DDI are provided in both the Interchanges Text Report and the Interchanges Results Report. Once again, due to the unique nature of DDIs, there are differences in these reports from the ones generated for other interchanges. An explanation of the unique characteristics of each report is given below:

*Interchanges Text Report* – The text report provides detailed intermediate outputs that are required components of the DDI procedure, but are too extensive to fit on the formatted reports. These intermediate outputs include saturation flow rate adjustment factors, effective green times, queue storage ratios, and lost times for each movement and timer. The following adjustments to the base saturation flow rate are specifically related to the DDI procedure:

- DDI Factor ( $f_{DDI}$ ) – an adjustment factor of 0.913 for the crossover through movements in a DDI
- Lane Utilization Adjustment Factor ( $f_{LU}$ ) – the procedure for a DDI differs from other interchanges as the adjustments for the external crossover are a function of left-turn demand ratio at the internal crossover. Additionally, this procedure takes into consideration the lane configuration of the DDI and distinguishes between exclusive and shared lane configurations.
- Traffic Pressure Adjustment Factor ( $f_V$ )

An example of the Interchanges Text Report is shown below:

Current Interchange Intersection Intermediate Results												
Movement:	EBL 5	EBT 2	EBR 12	WBL 1	WBT 6	WBR 16	NBL 3	NBT 8	NBR 18	SBL 7	SBT 4	SBR 14
Lane Util. Adj. f_LU	1.000	0.729	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Left-Turn Adj. f_LT	0.952	0.000		0.952	0.000		1.000	1.000		1.000	1.000	
Right-Turn Adj. f_RT		0.000	0.847		1.000	1.000		0.000	0.962		0.000	0.935
DDI Adj. f_DDI	1.000	0.913	1.000	1.000	0.913	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Additional Lost Time		NaN		0	0						0	
Effective Green	34.3	30.1	30.1	25.2	25.2			0.7	16.1		0.7	30.0
Queue Storage Ratio RQ	0.00	0.00			0.00			0.00	0.00		0.00	0.00
Timer:		1	2		3	4		5	6		7	8
Assigned Phase		1	2		0	4		6	5		0	8
Left-Turn Perm f_V		0.97	1		1	1		1	0.93		1	1
Left-Turn Prot f_V		1	1		1	1		1	1		1	1
Thru f_V		1	0.97		1	0.93		0.96	1		1	0.93
Right-Turn f_V		1	0.95		1	0.95		1	1		1	0.96

**Interchanges Results Report** – The formatted report summarizes the most important inputs and outputs associated with the DDI procedure. The relevant input information includes project-specific information, demand volumes at both DDI intersections, lane geometries at both DDI intersections, and signal timings at both DDI intersections. Relevant output data includes performance measures for each individual movement, O-D movement, and intersection within the DDI. The full report is shown in the next page:

## HCS Interchanges Results Summary

General Information										Interchange Information																							
Agency										Interchange Type										Diverging Diamond													
Analyst										Analysis Date										Nov 30, 2021													
Jurisdiction										Duration, h										0.250													
Intersection										PHF										0.95													
File Name										Interchanges5-DivergingDiamondWithSignalControl.xus										Arterial Direction		East-West											
Project Description																																	
Demand										EBL		EBT		EBR		WBL		WBT		WBR		NBL		NBT		NBR		SBL		SBT		SBR	
Intersection One Demand ( v ), veh/h										1		1300		200		300		500						0		300				0		200	
Intersection Two Demand ( v ), veh/h										600		1000				1		450		300				0		200				0		350	
Signal One Information																																	
Cycle, s		70.0																															
Offset, s		0																															
Uncoordinated		No																															
Force Mode		Fixed																															
		Green	25.0	34.0	1.0	0.0	0.0	0.0	0.0																								
		Yellow	4.0	4.0	0.0	0.0	0.0	0.0	0.0																								
		Red	1.0	1.0	0.0	0.0	0.0	0.0	0.0																								
Signal Two Information																																	
Cycle, s		70.0																															
Offset, s		0																															
Uncoordinated		No																															
Force Mode		Fixed																															
		Green	34.0	25.0	1.0	0.0	0.0	0.0	0.0																								
		Yellow	4.0	4.0	0.0	0.0	0.0	0.0	0.0																								
		Red	1.0	1.0	0.0	0.0	0.0	0.0	0.0																								
Interchange Results																																	
O-D	PHF-Adjusted Demand (veh/h)	Movement	Control Delay Components	Total Control Delay (s/veh)	Extra Distance (ft)	EDTT (s/veh)	ETT (s/veh)	LOS																									
A	368	NBL	M3 + M5	39.6	100	1.9	41.6	C																									
B	211	NBR	M4	23.7	-100	-1.9	21.8	B																									
C	211	SBR	M8	15.0	-100	-1.9	13.0	A																									
D	316	SBL	M7 + M1	61.5	100	1.9	63.5	D																									
E	632	EBL	M6	26.5	100	1.9	28.4	B																									
F	211	EBR	N/A	0.0	0	0.0	0.0	A																									
G	316	WBR	N/A	0.0	0	0.0	0.0	A																									
H	316	WBL	M2	29.7	100	1.9	31.6	C																									
I	737	EBT	M6 + M1	38.1	40	0.8	38.9	C																									
J	158	WBT	M2 + M5	47.8	40	0.8	48.6	C																									
M	--	--	--	--	--	--	--	--																									
N	--	--	--	--	--	--	--	--																									
Interchange ETT (s/veh) and LOS							30.8		C																								
Signalized Intersection One Results																																	
Approach Movement										EB		WB		NB		SB																	
Control Delay ( d ), s/veh										L	T	R	L	T	R	L	T	R	L	T	R												
Level of Service (LOS)										A	C	A	A	B				D			B												
Approach Delay, s/veh / LOS										22.9		C	11.3		B	49.9		D	15.0		B												
Intersection Delay, s/veh / LOS										21.9					C																		
Signalized Intersection Two Results																																	
Approach Movement										EB		WB		NB		SB																	
Control Delay ( d ), s/veh										L	T	R	L	T	R	L	T	R	L	T	R												
Level of Service (LOS)										A	B		B	C	A			C			C												
Approach Delay, s/veh / LOS										7.2		A	17.8		B	23.7		C	21.5		C												
Intersection Delay, s/veh / LOS										12.8					B																		

# Alternative Intersections

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## Modeling Capability in HCS

HCS has the capability of modeling five types of alternative intersections supported by HCM:

- Restricted Crossing U-Turn Intersections (RCUT) with Signals
- Restricted Crossing U-Turn Intersections (RCUT) with Stop Signs
- Restricted Crossing U-Turn Intersections (RCUT) with Merges
- Median U-Turn Intersections (MUT) with Stop Signs
- Partial Displaced Left-Turn Intersections (DLT)

The computations procedure for each type of alternative intersection can be used to estimate the control delay, extra distance travel time (EDTT), and experienced travel time (ETT) per origin-destination (O-D) demand movement. The level of service (LOS) for alternative intersections is dictated by the ETT value. RCUT with Signals, MUT with Stop Signs, and Partial DLT are applicable to the Streets module.

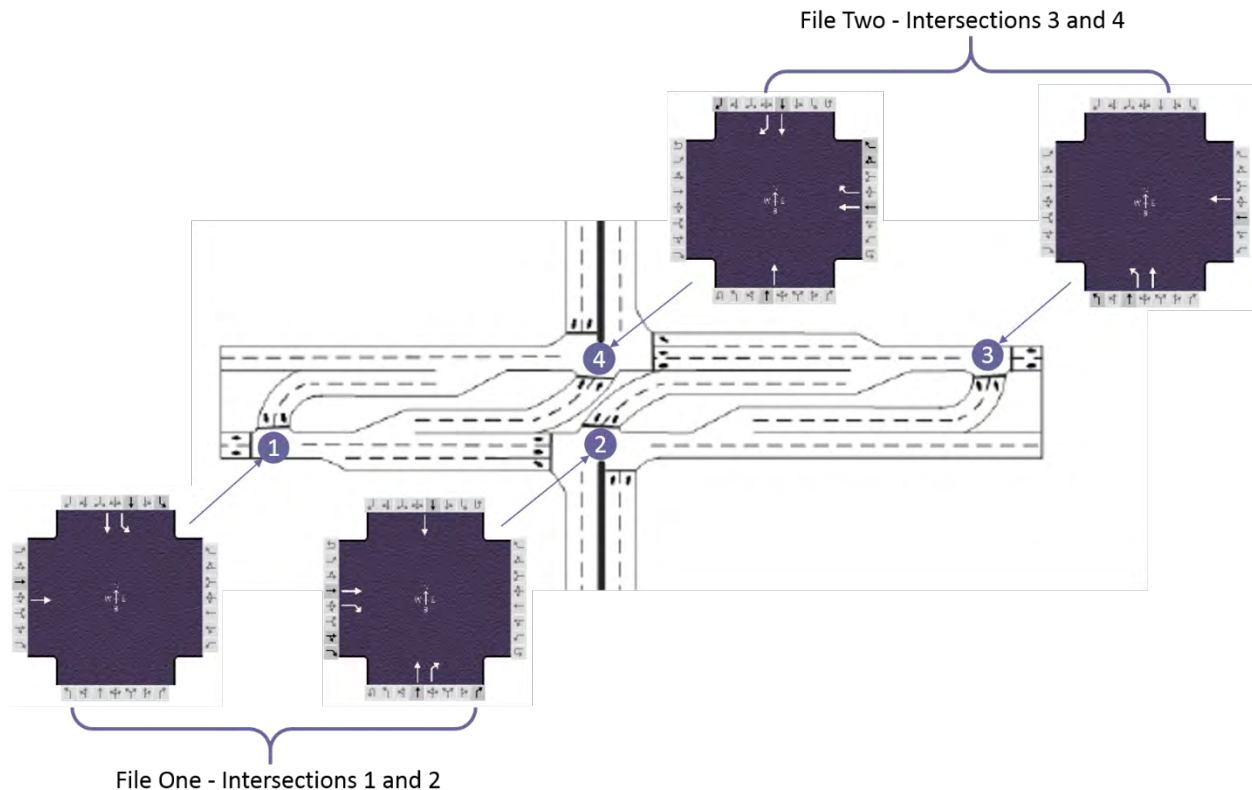
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## Creating New Alternative Intersection Datasets

### Steps to Build an RCUT with Signals

To conduct a full RCUT analysis, two separate Streets (\*.xus) files are needed. Each file will contain two intersections, essentially splitting the 4-intersection RCUT in half. The second file must have a forward direction opposite of the first file. The figure below presents the structure of the two RCUT files along with the lane configurations for each intersection.





1. Create a new Streets (\*.xus) file. This will serve as the conventional intersection file. Enter the conventional intersection demand and any desired universal inputs such as the peak hour factor, % heavy vehicles, speed limit, and timing data.
  - a. The universal inputs will be copied over to the two intersections generated by converting the conventional file to RCUT
  - b. The demand input, outlined in red below, will be redistributed to the two intersections generated by converting the conventional file to RCUT

PRIMARY INPUT DATA

General

Urban Street

Intersection

Description

Forward Direction SB Area Type Other

Segment Length, ft  Duration 0.25

All Segment Lengths PHF 0.93

Traffic


	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Demand, veh/h	20	300	10	30	100	200	150	420	10	60	1900	50

2. **Save the conventional intersection file.** This file will be used to create the first set of RCUT intersections (1&2), but it is also needed to create the second set of RCUT intersections (3&4). **Do not overwrite the conventional intersection file.**

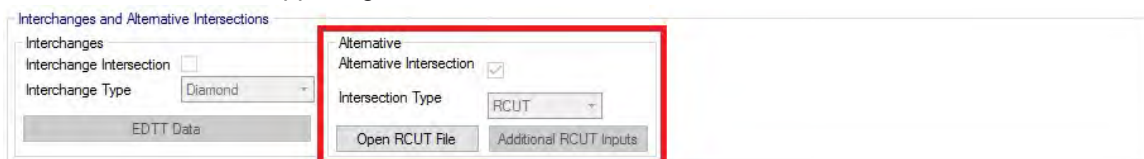
3. Go to the Alternative group box, which is found in the Detailed Input Data. Check the Alternative Intersection box.



4. The Intersection Type dropdown will now become editable. Select RCUT and click Yes on the confirmation pop-up message.
5. The file is now of type RCUT.
6. Use the **Save As** command to save the current RCUT file.
7. Open the original conventional intersection file. It will now be used to create the second set of RCUT intersections, as mentioned in Step 2.
8. Change the forward direction to the opposing direction as the first RCUT file. For example, if the forward direction was SB for the first RCUT conversion, switch it to NB for this conversion.



9. Repeat steps 3 – 6.
10. Now that there are two separate RCUT files containing two intersections each, the full RCUT can be constructed. In either RCUT file, navigate back to the Alternative group box and select Open RCUT File. Select the opposing RCUT file.



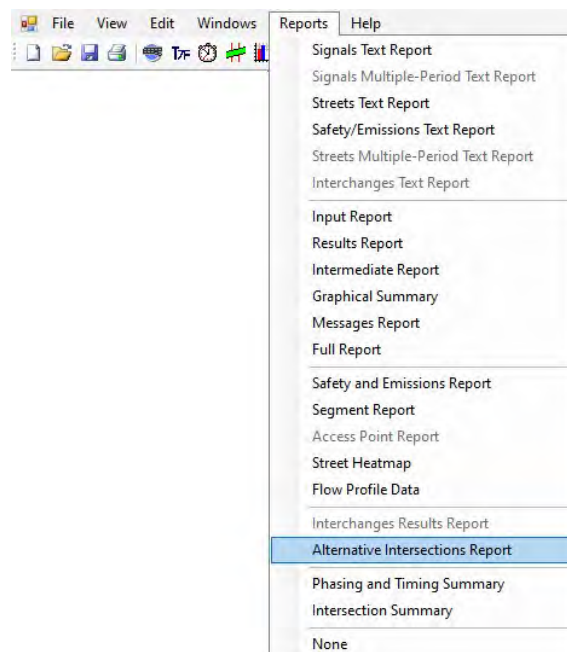
11. Upon opening the opposing RCUT file, a pop-up titled Additional RCUT Inputs will appear.

Specify the type of median at the U-Turn crossover. This is used to apply a saturation adjustment factor to the crossover movement. Conventional demand fields are already populated with the demand values from the conventional intersection file, as shown in Step 1. Any desired changes to the original conventional demand values may be edited here.

- a. *Note: Streets automatically redistributes the Conventional RCUT Demand to the two intersections in the currently active file. The individual intersection demand input fields are greyed out but populated with the redistributed demand, as displayed below. This is by design and implemented to keep in accordance with the HCM procedure. If changing individual intersection demands is desired, the Conventional RCUT Demands in **both** of the RCUT files must be edited. Similarly, if the U-Turn Crossover Median Widths differ from Typical, this must be specified in each of the RCUT files.*

- b. *Note: The Additional RCUT Inputs button only becomes active once a second RCUT file has been opened.*

12. To view results, go to the Reports dropdown in the top menu and select Alternative Intersections Report.





13. *Note: The EDTT for RCUT is calculated based on the Field Free-Flow Speed. This input field is found in the Segment group box of the Detailed Input Data. Please edit this field in each of the RCUT intersections – coding the speed limit will not change the EDTT.*

Segment Name	NB	SB
Upstream Width, ft	50	50
Restrictive Median, ft	0	0
Right-Hand Curb, %	70	70
Right-Hand Access Points	0	0
Mid-Segment Delay, s/veh	0.0	0.0
Field Travel Speed, mi/h	21.79	42.25
Field Free-Flow Speed, mi/h	50.00	50.00
On-Street Parking, %	0	0
Speed Calibration Factor, mi/h	0.0	0.0

## Steps to Build an MUT with Stop Signs

To conduct an MUT with stop signs analysis, both the Streets module and the Two-Way Stop Control module are used. The main intersection is coded in a Streets (\*.xus) file, while the upstream and downstream crossover junctions are coded in TWSC (.xtw) files. The TWSC files are then attached in the Streets module.

- Start a new Streets (\*.xus) file and enter the conventional intersection demand.
  - Note: The demand entered now will automatically be redistributed to the MUT intersection after conversion.*
- Go to the Alternative group box which is found in the Detailed Input Data. Check the Alternative Intersection box.

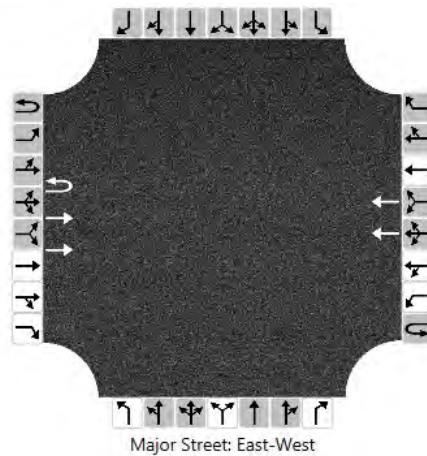
Interchanges and Alternative Intersections	
Interchanges	Alternative
Interchange Intersection <input type="checkbox"/>	Alternative Intersection <input checked="" type="checkbox"/>
Interchange Type <span>Diamond</span>	Intersection Type <span></span>
EDTT Data	

- The Intersection Type dropdown will now become editable. Select MUT with TWSC and click Yes on the confirmation pop-up message.
- Return to the Alternative group box to attach the upstream and downstream stop-controlled intersection files, which are created in the TWSC module.

Interchanges and Alternative Intersections		Segment	
Interchanges	Alternative	Segment 1	Segment 2
Interchange Intersection <input type="checkbox"/>	Alternative Intersection <input checked="" type="checkbox"/>	Free-Flow Speed, mph	50.0
Interchange Type <span>Diamond</span>	Intersection Type <span>MUT with TW</span>	Length, ft	800
EDTT Data			

- If these files have not been created, open the TWSC module and code the upstream/downstream crossovers. *Note: TWSC crossover junctions should only have major street through lanes and a single major street U-Turn coded. Streets will not accept files*

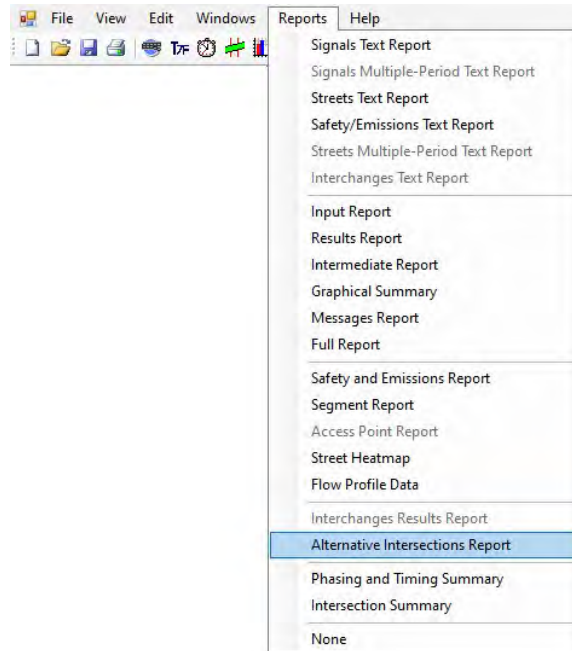
coded differently. The image below presents a sample downstream crossover configuration for an East-West arterial with an EB forward direction specified in Streets. Keep in mind that the upstream/downstream TWSC files created should be relative to the forward direction specified in Streets.



- b. Enter the redistributed volume for the movements at the crossover. *Note: The crossover volume distribution must be determined manually. Neither TWSC nor Streets automatically redistributes conventional demand in the crossover files. See Example Problem 15 in Chapter 34 of the HCM for reference.*
  - c. Once all input data has been coded in the two crossover junctions and the files have been saved, return to the Streets module.
5. Navigate back to the Alternative group box and use the Upstream/Downstream buttons to attach the respective TWSC (.xtw) files. A confirmation message with inputs and results from the crossover file will appear if the file was opened successfully.

6. In the Segment group box, edit the Free-Flow Speed and Length fields as appropriate. *Note: EDTT is calculated using these inputs.*

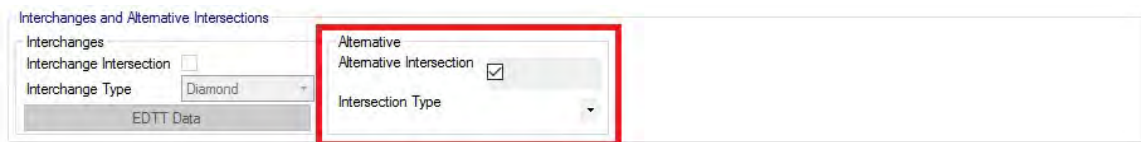
7. To view results, go to the Reports dropdown in the top menu and select Alternative Intersections Report. *Note: The Alternative Intersections Report only becomes accessible after at least one TWSC crossover file has been attached using the Upstream/Downstream buttons.*



## Steps to Build a Partial DLT

To conduct a partial DLT analysis, one Streets (\*.xus) file is needed. This file will then be converted to a DLT composed of three intersections: an upstream crossover, a main intersection, and a downstream crossover.

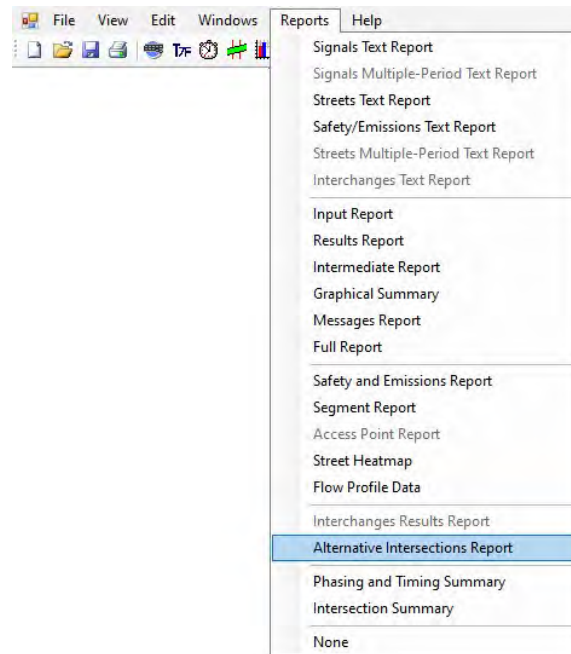
1. Start a new Streets (\*.xus) file. This will serve as the conventional intersection file. Enter the conventional intersection demand and any desired universal inputs such as the peak hour factor, % heavy vehicles, speed limit, and timing data.
  - a. The universal inputs will be copied over to the three intersections generated by converting the conventional file to DLT.
  - b. The demand input will be redistributed to the three intersections generated by converting the conventional file to DLT.
2. Go to the Alternative group box which is found in the Detailed Input Data. Check the Alternative Intersection box.



3. The Intersection Type dropdown will now become editable. Select DLT and click Yes on the confirmation pop-up message.
4. The file is now of type DLT.
  - a. *Note: After converting the conventional intersection to a partial DLT alternative intersection with a set of three intersections, there may be an error generated by Streets. It is due to the existing data in the conventional file that causes a phase split summation*

*error after conversion. This can be easily corrected by adjusting the phase split values at Intersection Two. Intersections One and Three may also show errors due to a refreshing issue. Navigating to the upstream and downstream intersection once, or twice in some cases, will eliminate those errors.*

- b. Note: Offsets at the upstream and downstream intersections are disabled. This is by definition. The DLT procedure automatically calculates offsets at the supplemental intersections based on free-flow travel times, phase durations, reference phases, reference points, and the background cycle length.*
5. To view the results, go to the Reports dropdown in the top menu and select Alternative Intersections Report.



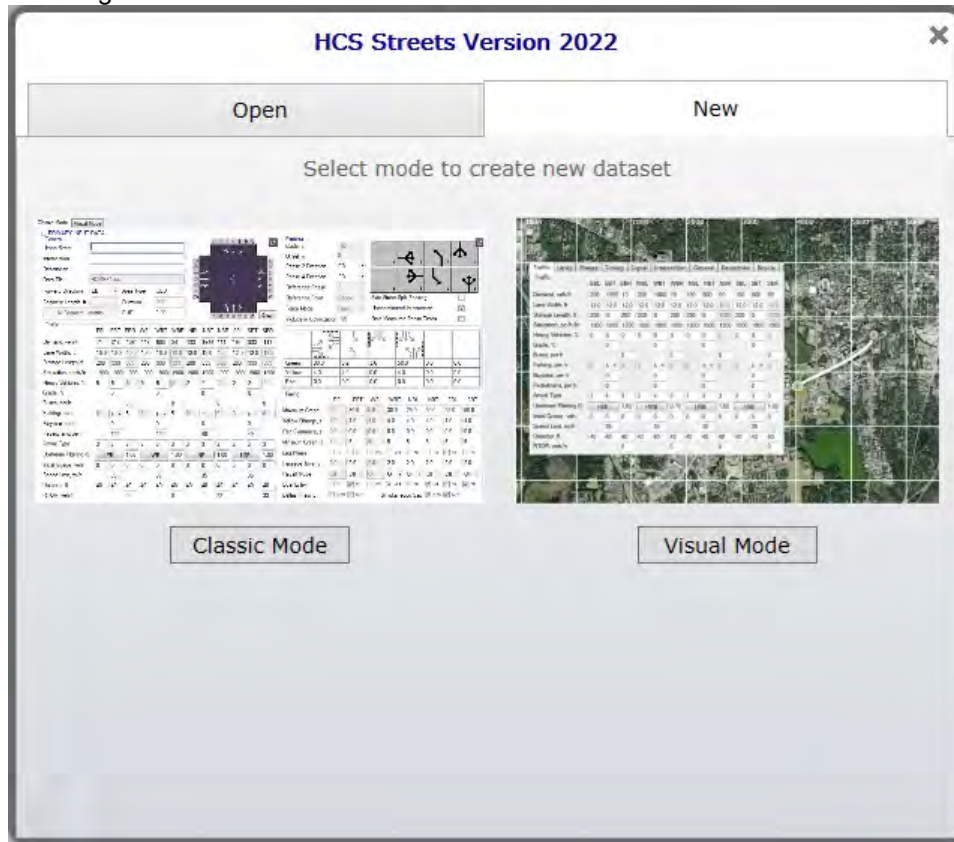
# How To

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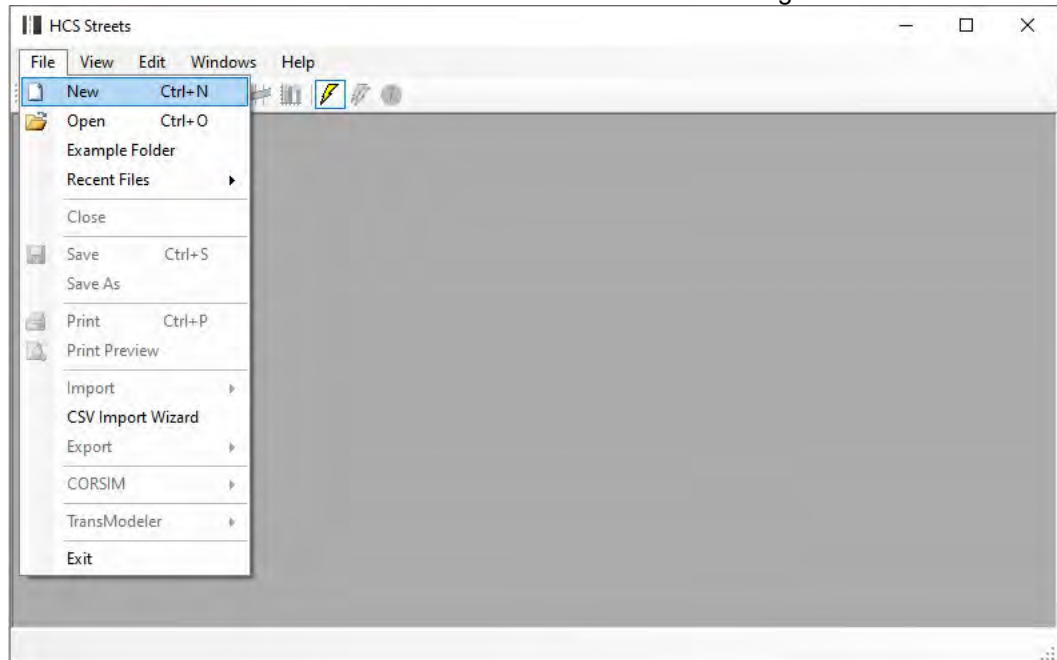
## Create a New File

1. There are four options for creating a new file:

- a. Selecting the New tab in the initial window when first opening the Streets program and selecting the mode to create a new dataset



- b. Selecting **File > New** from the main menu; this can be found by selecting "File" in the top left-hand corner of the screen above the toolbar and then selecting "New"



- c. Using the keyboard shortcut "Ctrl+N" for New



- d. Selecting the New icon in the toolbar; this can be found in the top left-hand corner of the screen in the toolbar; it is the first icon from the left and has an image of a blank paper



2. Once a new file is created, a Quick Start window will appear allowing you to specify general inputs for the new file; these inputs can be changed after the file is created. When finished changing any of the necessary defaults, select OK.

Default Selections	
Number of Intersections	1
Forward Direction	EB
Number of Periods	1
Analysis Duration, h	0.250
Base Saturation Flow, pcphpl	1900
Speed Limit, mi/h	35
Units	<input checked="" type="radio"/> US Customary <input type="radio"/> Metric Units
Cycle Length, s	120
Minimum Green, s	6
Yellow Change, s	4.0
Red Clearance, s	0.0
Passage Time, s	2.0
Detector Length, ft	40

Template Help

3. A Forward Direction dialog box will appear confirming if you want to proceed with the Forward Direction you selected. Select 'Yes' if you want to proceed or 'No' if you do not want to proceed. This message can be hidden in the future when creating new files if the 'Do not show this again' checkbox is checked.

**Forward Direction**

The urban street forward direction has been specified as eastbound (EB). Once this direction has been chosen it can only be reversed from now on, in this particular dataset. Northbound and southbound will no longer be available for selection in this dataset. Are you sure you want to proceed with eastbound (EB) as the forward direction?

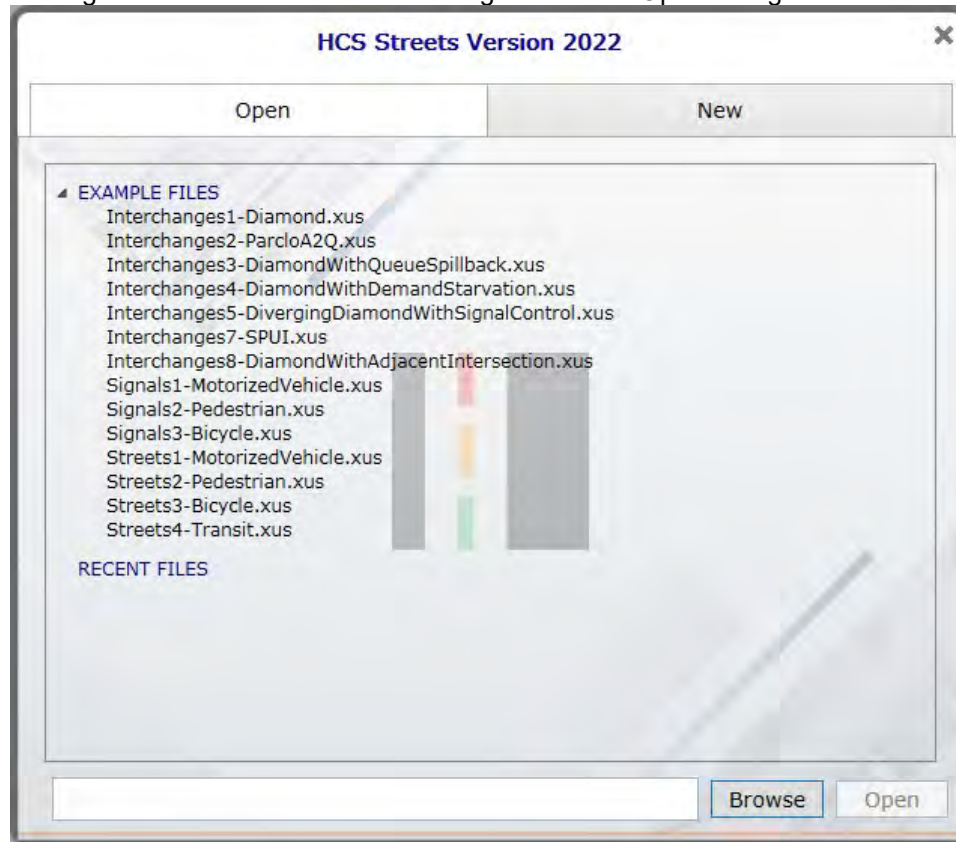
☐ Do not show this again

- a. Selecting 'Yes' will create a new file with the inputs specified in the Quick Start dialog box.
- b. Selecting 'No' will bring you back to the Quick Start dialog box to make any changes.
4. A new file will be created and you will be brought to whichever mode was last used if not specified using the first option.

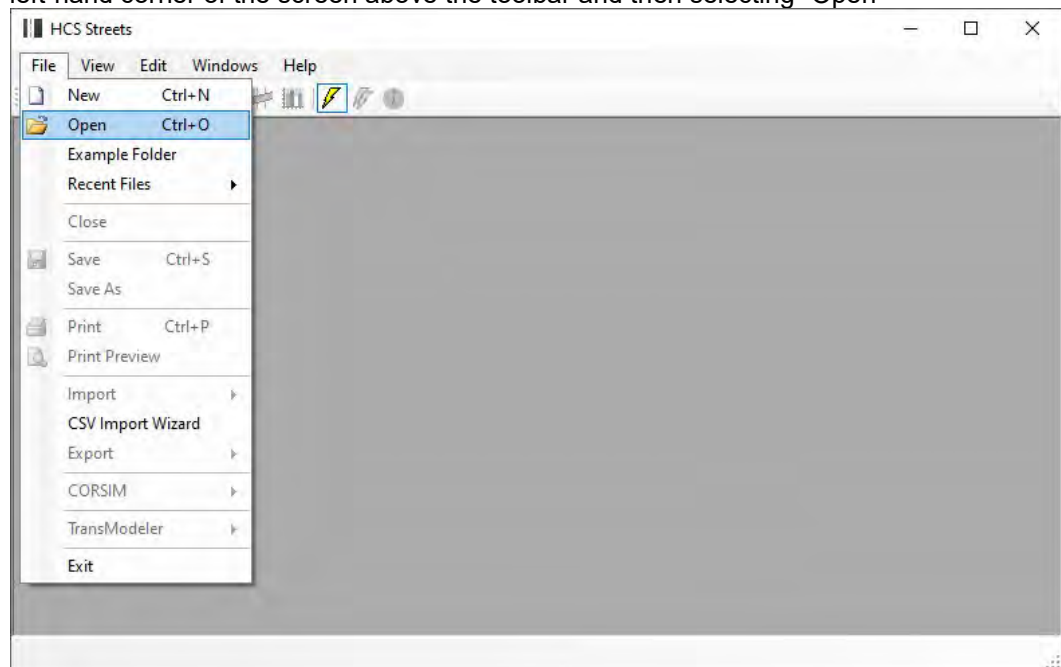
## Open an Existing File

1. There are six options for opening an existing file:
  - a. Selecting the Open tab in the initial window when first opening the Streets program and selecting a file from either the 'EXAMPLE FILES' list or 'RECENT FILES' list, or by

clicking the 'Browse' button and selecting a file in the Open dialog box.



- b. Selecting *File > Open* from the main menu; this can be found by selecting "File" in the top left-hand corner of the screen above the toolbar and then selecting "Open"

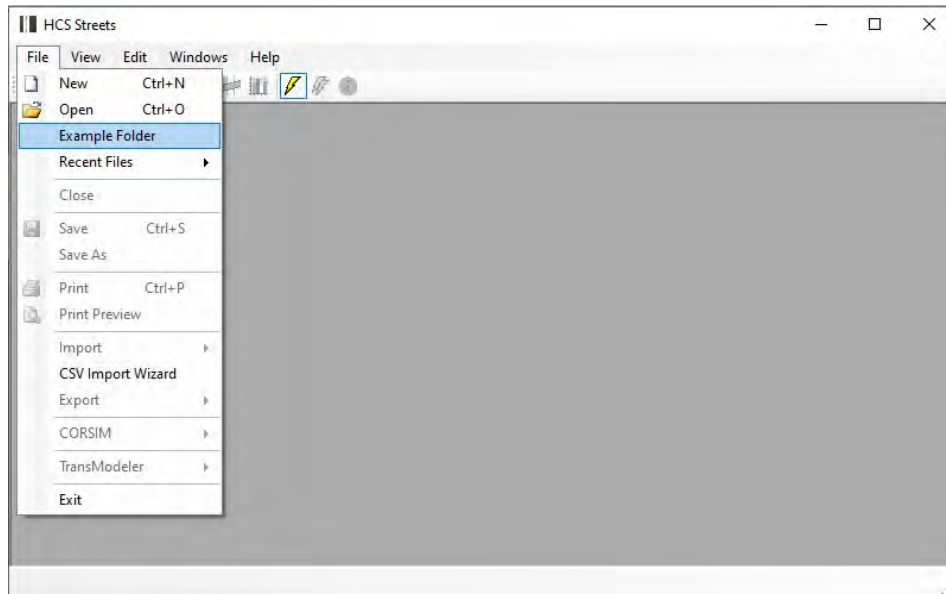


- c. Using the keyboard shortcut "Ctrl+O" for Open

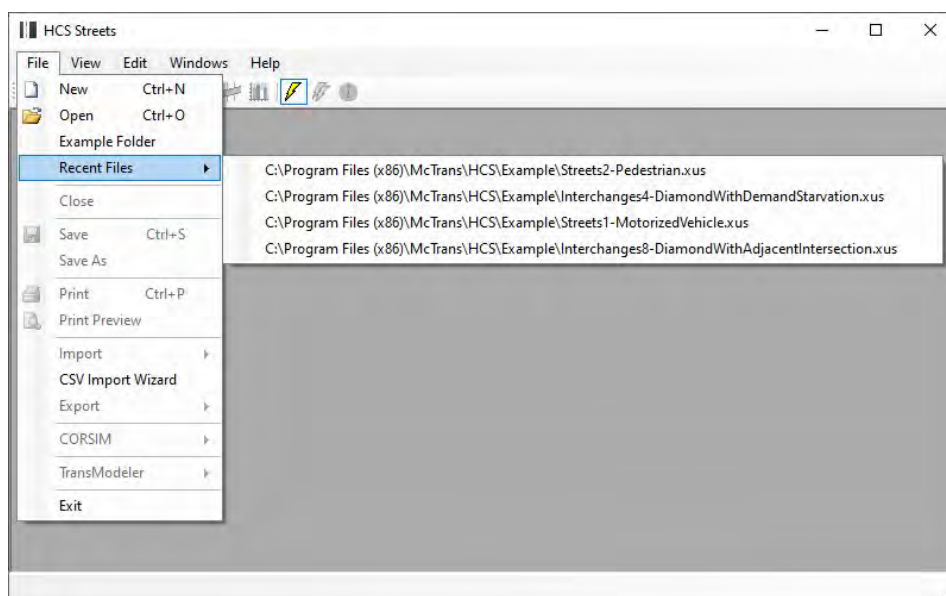
- d. Selecting the Open icon in the toolbar; this can be found in the top left-hand corner of the screen in the toolbar; it is the second icon from the left and has an image of an open folder with an arrow



- e. Selecting *File > Example Folder* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar 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 program.



- f. Selecting *File > Recent Files > \*.xus* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar, hovering over “Recent Files”, and then selecting the desired Streets file.

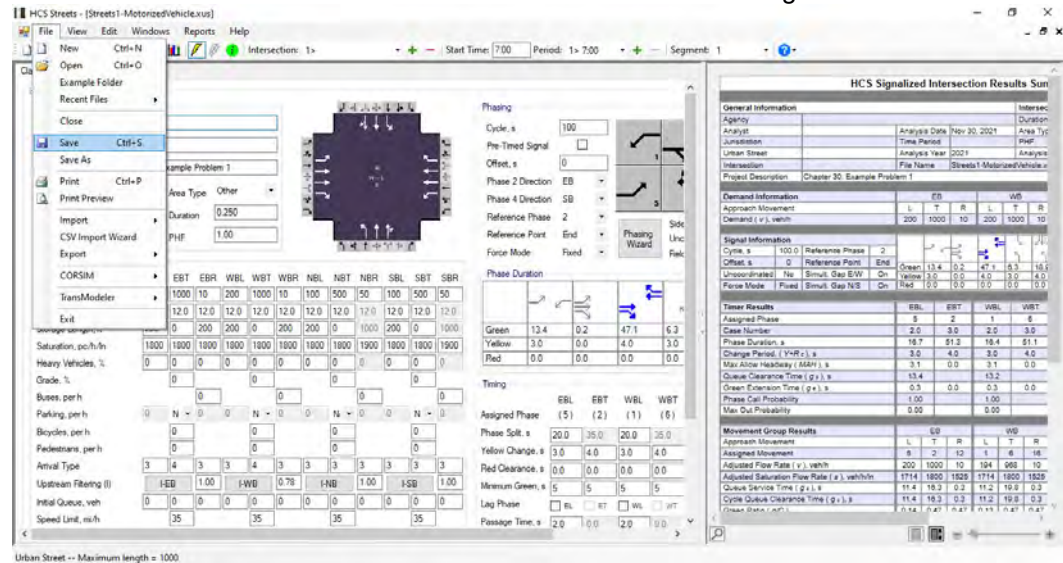




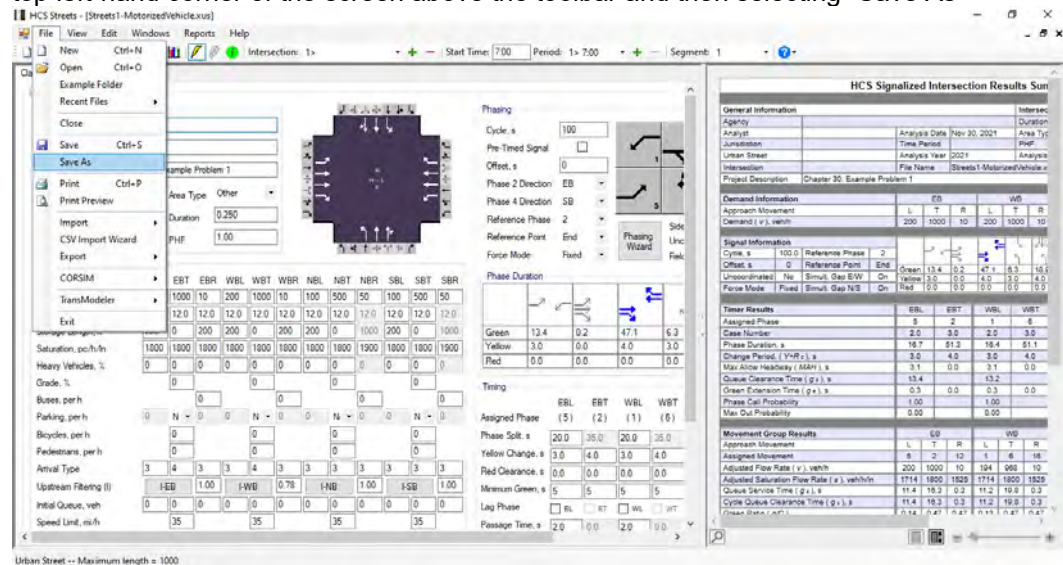
- Once an existing file is opened, you will be brought to whichever mode was last used.

## Save a File

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



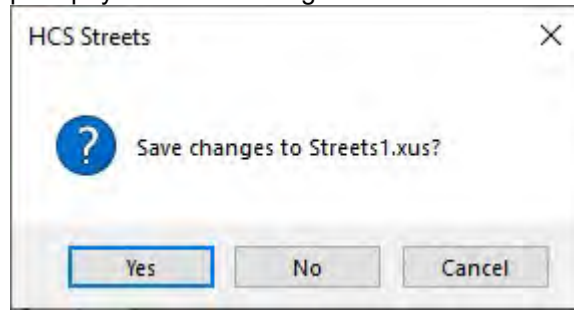
- Selecting **File > Save As** from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar and then selecting “Save As”



- Using the keyboard shortcut “Ctrl+S” for Save
- Selecting the Save icon in the toolbar; this can be found in the top left-hand corner of the screen in the toolbar; it is the third icon from the left and has an image of a floppy disk



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

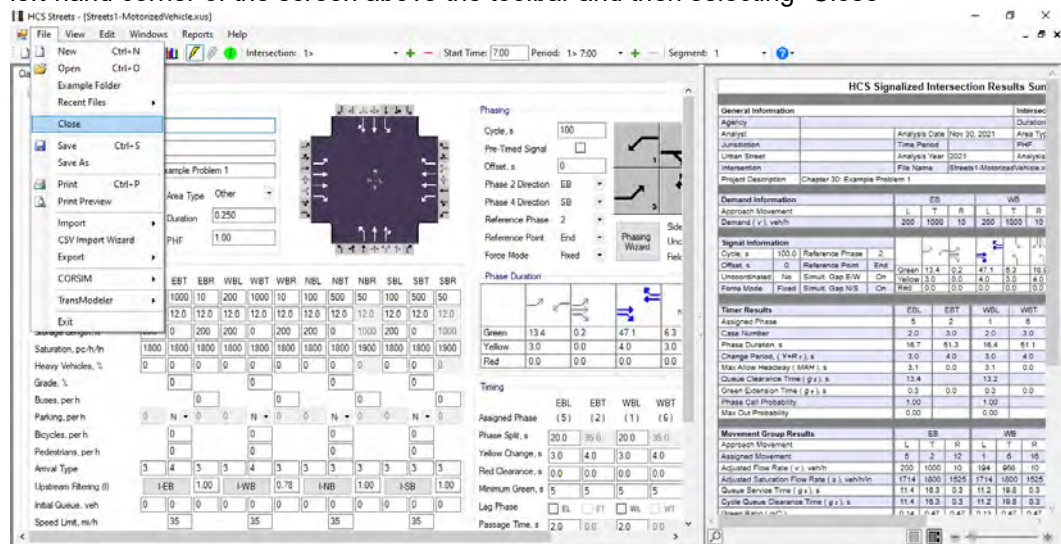


- i. Selecting “Yes” will save the file if it is an existing file. If the file has not been previously saved, the Save As dialog box will pop up allowing you to change the file name and save it.
- ii. Selecting “No” will exit the program or close the file without saving the file
- iii. Selecting “Cancel” will prevent the file from closing

*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 four options for closing a file:
  - a. Selecting *File > Close* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar and then selecting “Close”



- b. Selecting *Windows > Close All* from the main menu; this can be found by selecting “Windows” in the top left-hand corner of the screen above the toolbar and then selecting

HCS Streets - [Streets-Motorized/Vehicle.xus]

File View Edit Windows Reports Help

New Window Cascade Tile Vertical Tile Horizontal Close All

General

Urban Street

Intersection

Description

Forward Direction EB

Segment Length, s 1000

Duration 0.250

All Segment Lengths Fix 1.00

Traffic and Geometry

	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Demand, veh/s	200	1000	10	200	1000	10	100	500	50	100	500	50
Lane Width, ft	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Storage Length, ft	200	0	200	200	0	200	200	0	1000	200	0	1000
Saturation, c/s/veh	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0
Grade, %	0	0	0	0	0	0	0	0	0	0	0	0
Bus, per/h	0	0	0	0	0	0	0	0	0	0	0	0
Parking, per/h	0	N	0	0	N	0	0	N	0	0	N	0
Bicycles, per/h	0	0	0	0	0	0	0	0	0	0	0	0
Pedestrians, per/h	0	0	0	0	0	0	0	0	0	0	0	0
Animal Type	3	4	3	3	4	3	3	3	3	3	3	3
Upstream Filtering (I)	1EB	1.00	1WB	0.75	1NB	1.00	1SB	1.00				
Initial Queue, veh	0	0	0	0	0	0	0	0	0	0	0	0
Speed Limit, mi/h	35		35		35		35					

Start Time: 7:00 Period: 1>7:00 Segment: 1

Phasing

Cycle, s 100

Pre-Timed Signal

Offset, s 0

Phase 2 Direction EB

Phase 4 Direction SB

Reference Phase 2

Reference Point End

Force Mode Fixed

Phasing Wizard

Side St Unlco Field Inp

Phase Duration

	EBL	EBT	WBL	WBT
Green	12.4	0.2	47.1	6.3
Yellow	3.0	0.0	4.0	3.0
Red	0.0	0.0	0.0	0.0

Timing

	EBL	EBT	WBL	WBT
Assigned Phase	(5)	(2)	(1)	(6)
Phase Split, s	20.0	35.0	20.0	35.0
Yellow Clearance, s	3.0	4.0	3.0	4.0
Red Clearance, s	0.0	0.0	0.0	0.0
Minimum Green, s	5	5	5	5
Lag Phase, s	EL	ET	WL	WT
Passage Time, s	2.0	0.0	2.0	0.0

HCS Signalized Intersection Results Summary

General Information

Agency	Duration	Area Type
Analysis Date: Nov 30, 2021		
Jurisdiction	Time Period	File Name
Urban Street	Analysis Year: 2021	Streets-Motorized/Vehicle.xus
Intersection	Chapter 30 Example Problem 1	

Demand Information

	EB	WB	NB	SB
Approach Movement	L T R	L T R	L T R	L T R
Demand (v/s), veh/h	200 1000 10	200 1000 10	100 500 50	100 500 50

Signal Information

	EB	WB	NB	SB
Cycle, s	100.0	Reference Phase	2	
Offset, s	0	Reference Point	End	
Unsaturation	Unsat'd Gap: 5.0 ft	On		
Force Mode	Fixed	Simult. Gap N/S	On	

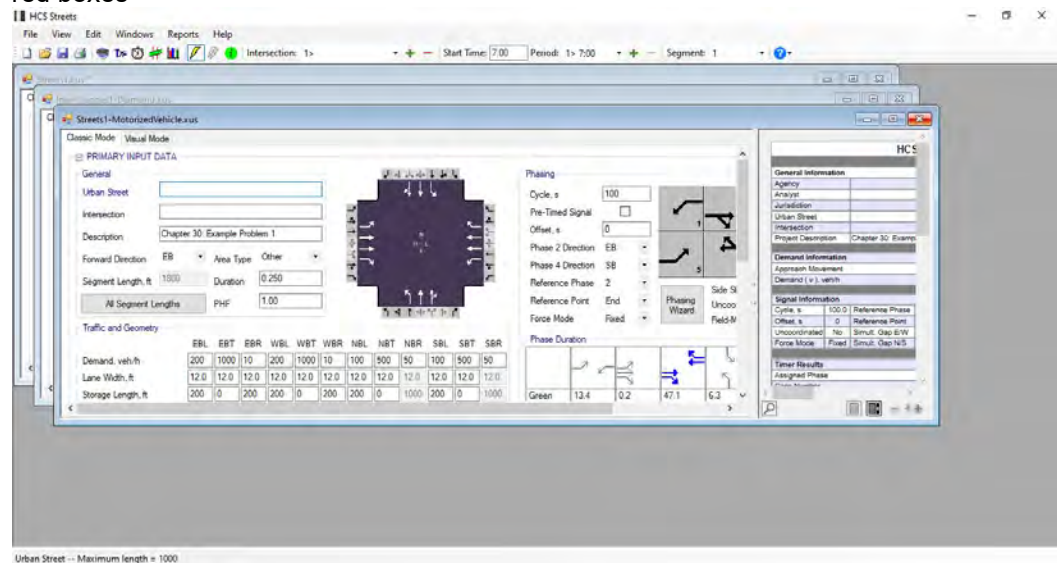
Timing Parameters

	EBL	EBT	WBL	WBT
Assigned Phase	5	2	1	6
Case Number	2.0	3.0	2.0	3.0
Phase Duration, s	10.1	51.3	16.4	51.1
Change Period, s (N/S)	3.5	4.0	3.0	4.0
Max Allow Headway (M/H), s	3.1	5.0	3.1	5.0
Queue Clearance Time (g + s)	13.4	13.2		
Green Extension Time (g + s)	0.0	0.0	0.0	0.0
Phase Call Probability	1.00	1.00		
Max Out Probability	0.00	0.00		

Movement Group Results

	EB	WB	NB	SB
Approach Movement	L T R	L T R	L T R	L T R
Assigned Movement	5 2 1	1 6 2	1 6 2	1 6 2
Adjusted Flow Rate (v/s), veh/h	200 1000 10	194 968 10		
Adjusted Saturation Flow Rate (s/c), veh/h				

- i. “Windows” is the fourth menu item from the left
  - ii. Selecting “Close All” will close all open files
- c. Selecting “x” in the top right-hand corner of the file window; this can be found below in the red boxes



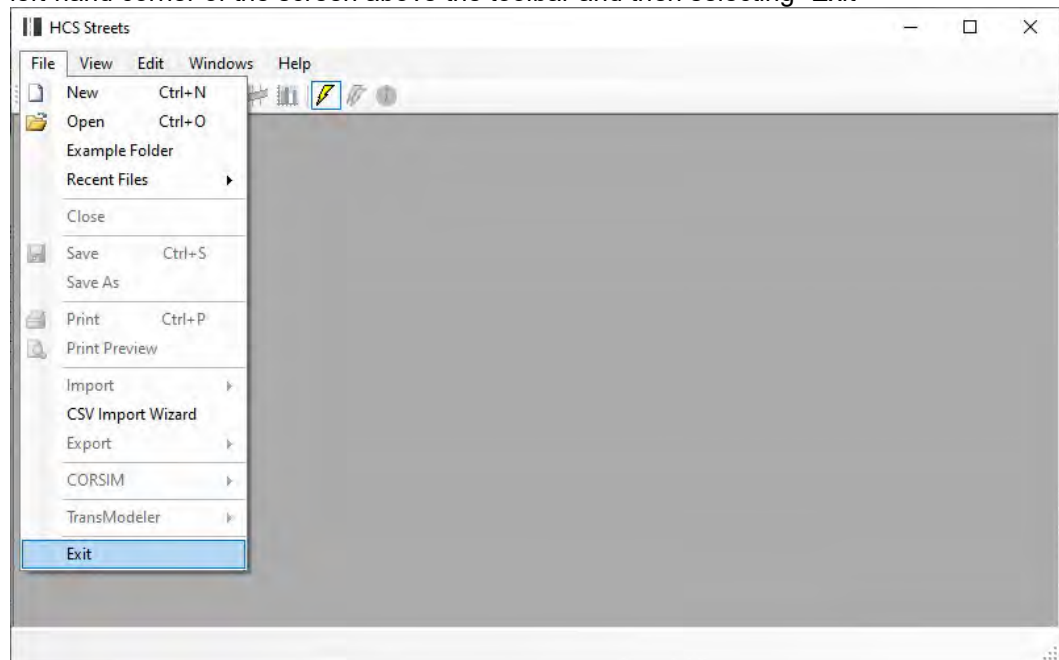
- d. Exiting the program itself; please see *How To: Exit the Program*

## Exit the Program

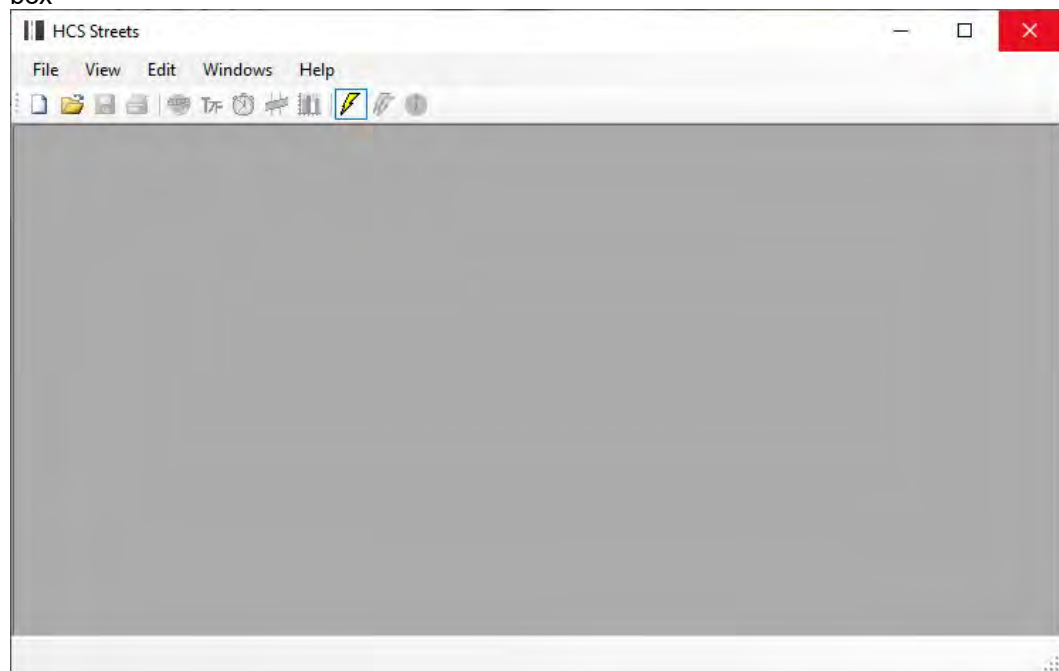
1. There are three options for exiting the program:



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



- b. Using the keyboard shortcut “Alt+F4” for Exit
- c. Selecting “X” in the top right-hand corner of the screen; this can be found below in the red box

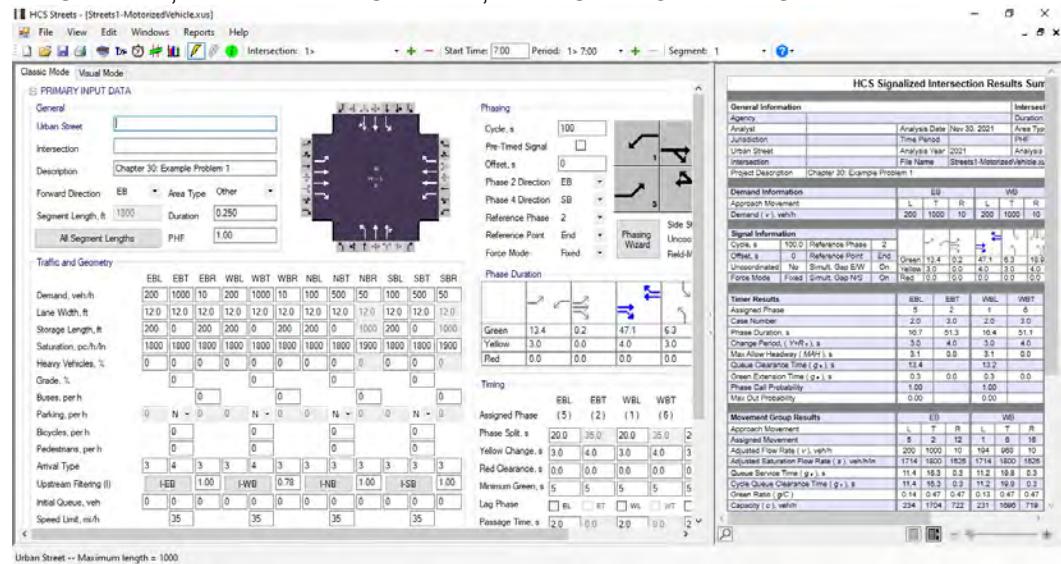


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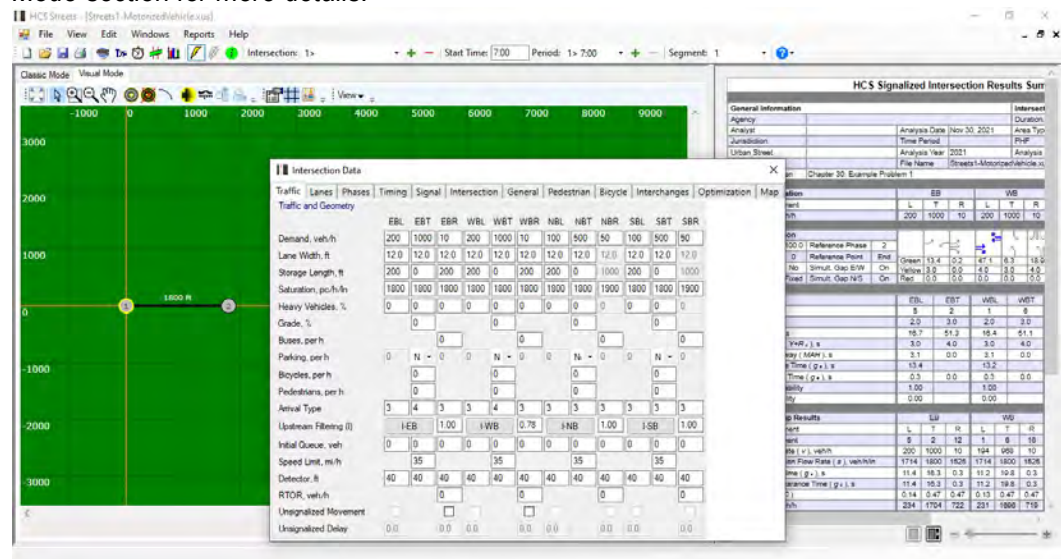
## Change the Mode

1. There are two main mode options: Classic and Visual

- a. Classic Mode: provides a split screen of all inputs with a results report located either to the right of the inputs or below the inputs; the inputs are sectioned off into PRIMARY INPUT DATA, DETAILED INPUT DATA, and MULTIMODAL INPUT DATA

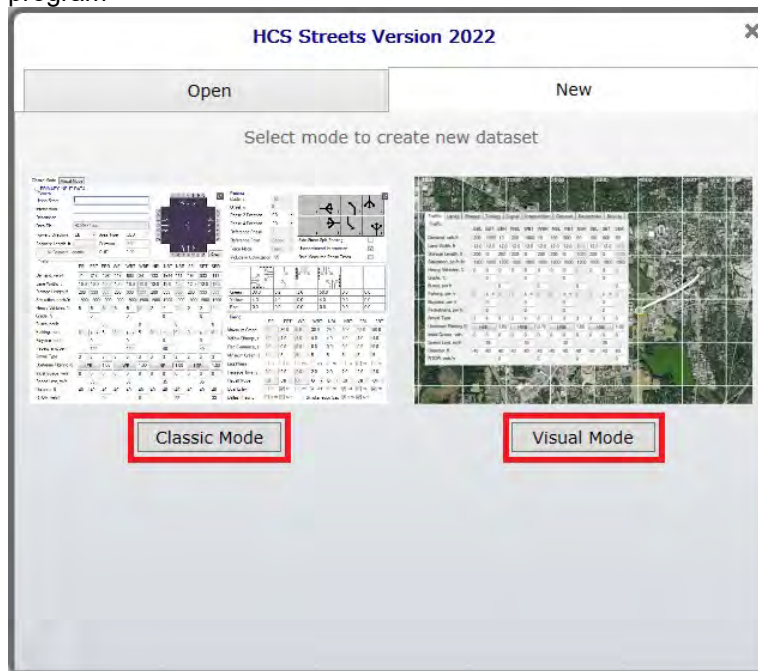


- b. Visual Mode: provides a split screen of a map of the intersection(s) and segment(s) with a results report located either to the right of the map or below the map; the inputs can be accessed by either double clicking the intersection nodes or segment lines within the map or by right clicking them and selecting Edit from the menu. *Note: Please see the Visual Mode section for more details.*

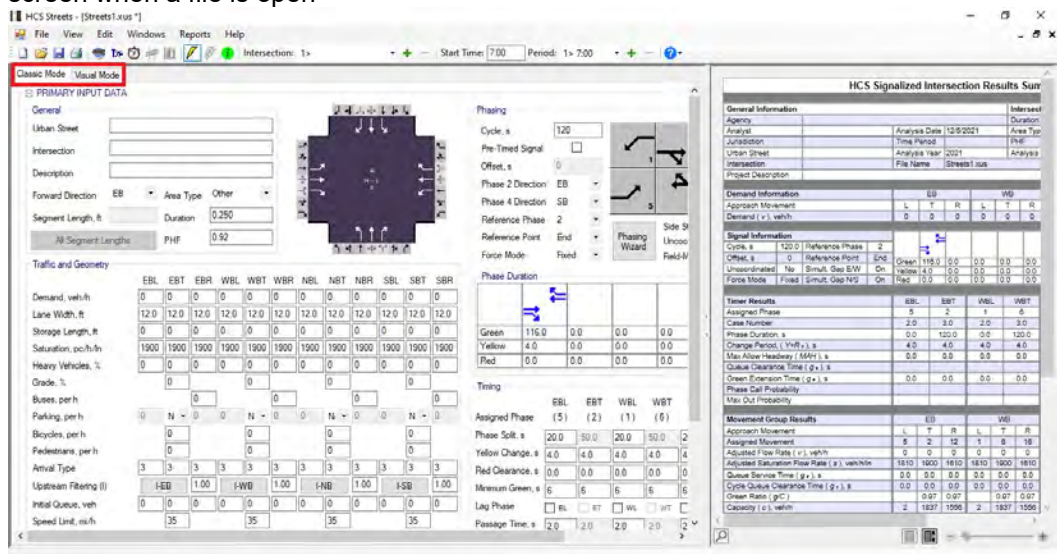


2. To change between modes, there are four options:

- a. Selecting the desired mode when creating a New file on the initial start of the Streets program

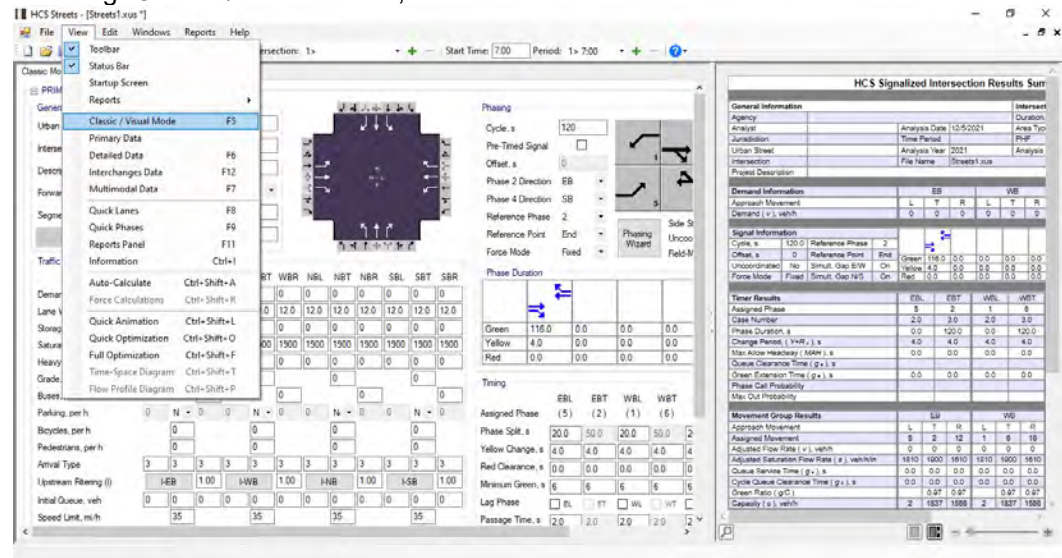


- b. Selecting the desired mode by selecting one of the tabs at the top left-hand corner of the screen when a file is open



- c. Selecting *View > Classic / Visual Mode* from the main menu; this can be found by selecting "View" in the top left-hand corner of the screen above the toolbar and then

selecting “Classic / Visual Mode”; “View” is the second menu item from the left

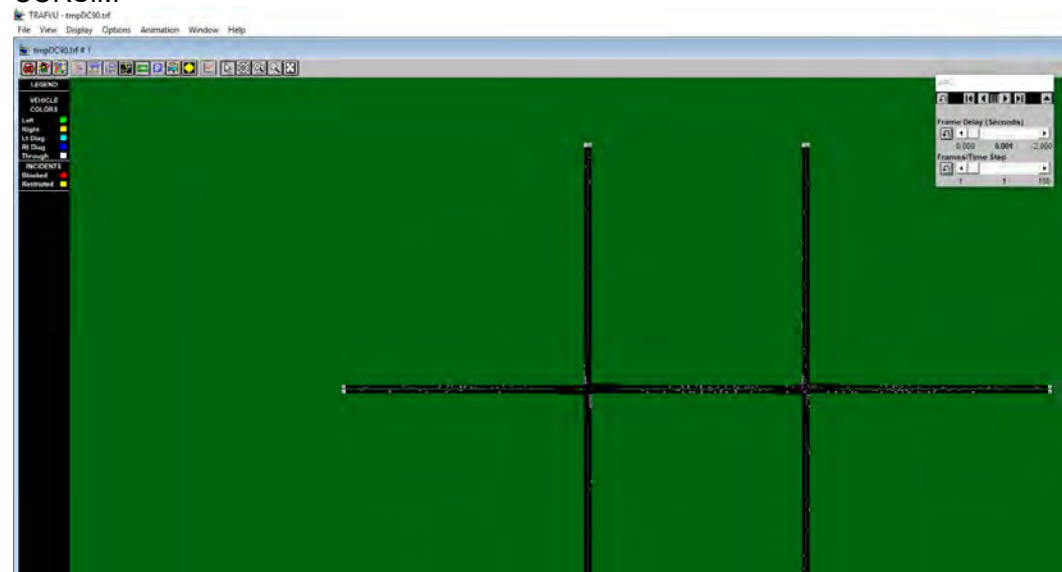


d. Using the keyboard shortcut F5 to switch between the two modes

## Run Animation

1. There are two main options for running animation: CORSIM and TransModeler

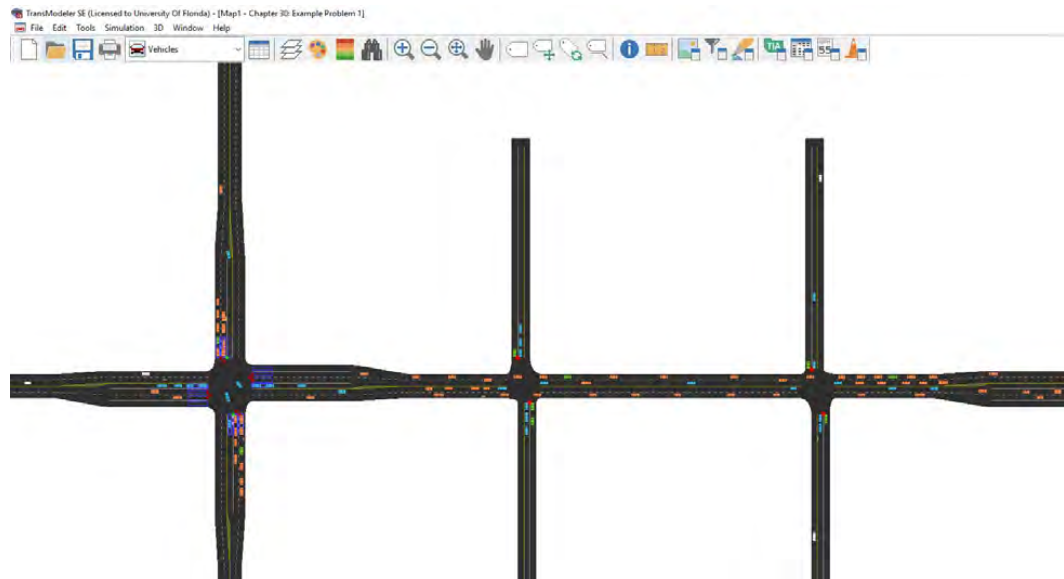
a. CORSIM



Note: Please see *CORSIM* under the *Advanced Features* section for more details.



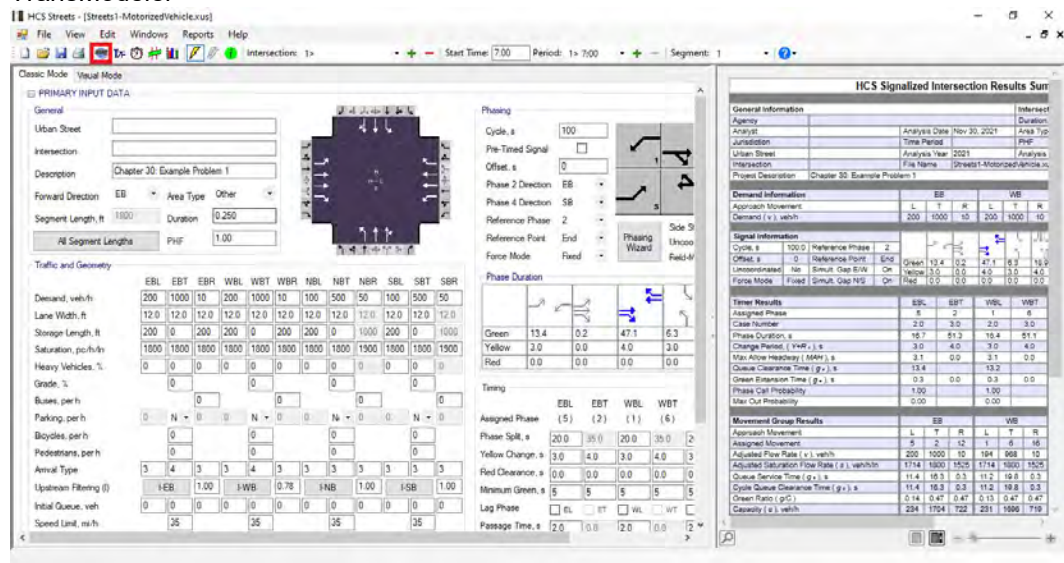
## b. TransModeler



Note: Please see *TransModeler* under the *Advanced Features* section for more details.

## 2. There are five options for running animation through Streets:

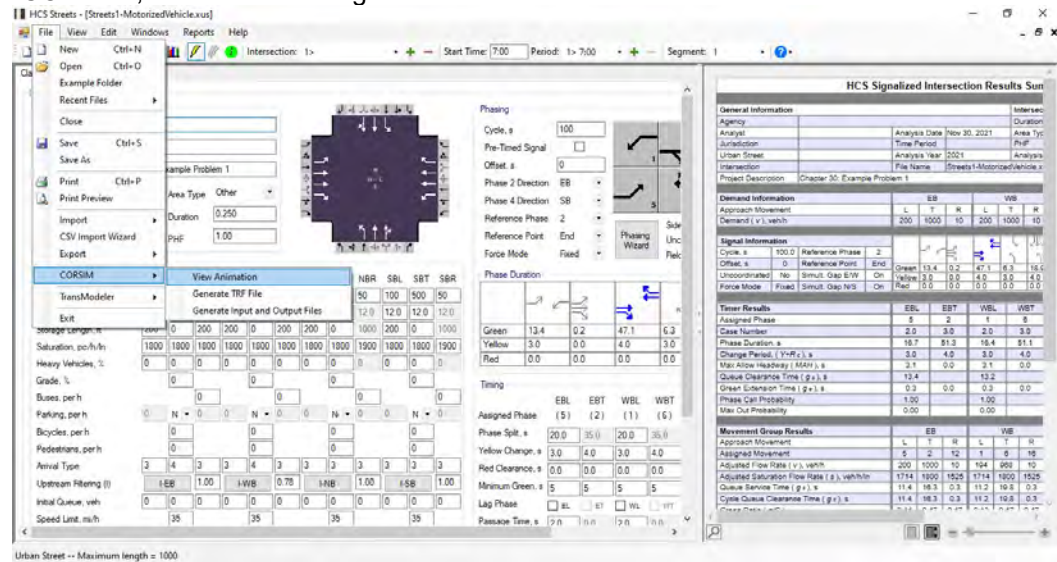
- a. Selecting the Quick Animation button from the toolbar; this will run animation with TransModeler



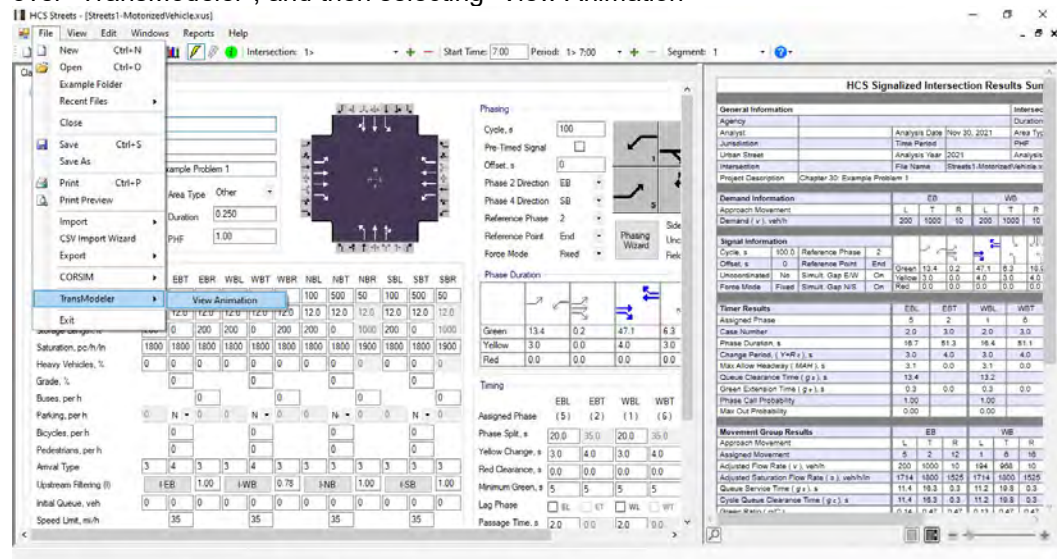
- b. Selecting *File > CORSIM > View Animation* from the main menu; this can be found by selecting "File" in the top left-hand corner of the screen above the toolbar, hovering over



“CORSIM”, and then selecting “View Animation”

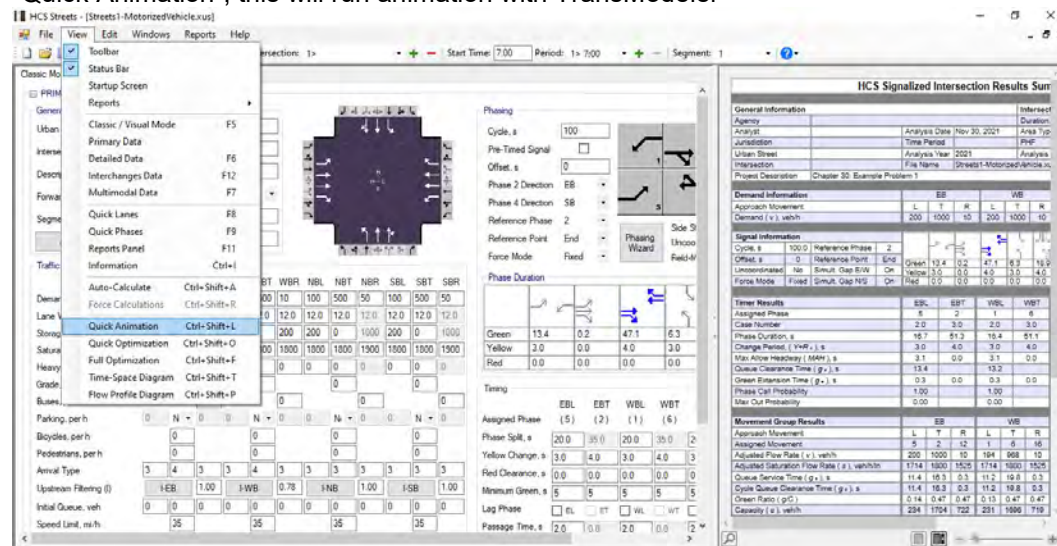


- c. Selecting **File > TransModeler > View Animation** from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar, hovering over “TransModeler”, and then selecting “View Animation”



- d. Selecting **View > Quick Animation** from the main menu; this can be found by selecting “View” in the top left-hand corner of the screen above the toolbar and then selecting

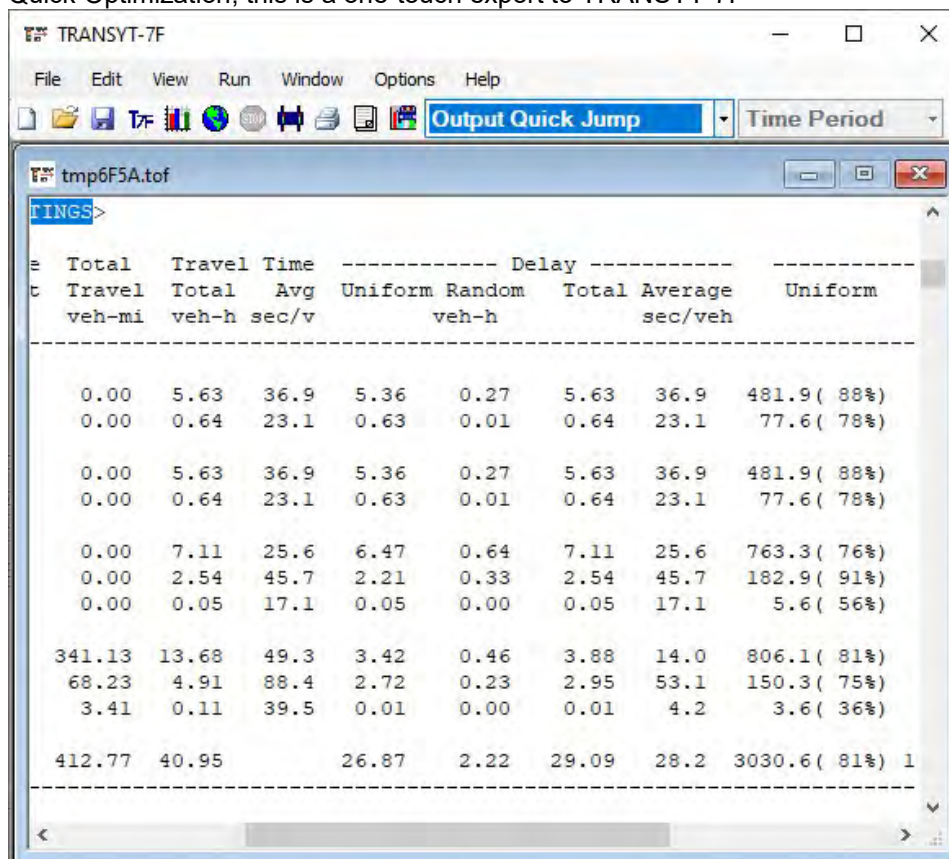
“Quick Animation”; this will run animation with TransModeler



e. Using the keyboard shortcut Ctrl+Shift+L; this will run animation with TransModeler

## Run Optimization

1. There are two main options for running optimization: Quick Optimization and Full Optimization
  - a. Quick Optimization; this is a one-touch export to TRANSYT-7F



Dual-Ring Report (press Ctrl-P to print)

Node Number

1

System Cycle

100

Offset

0

Grn	16	42	5	23	
Yel	3	4	3	4	
Red	0	0	0	0	
Grn	16	42	5	23	
Yel	3	4	3	4	
Red	0	0	0	0	

Eastbound			Westbound			Northbound			Southbound		
Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Peak Adjusted Volume (vph)											
200	1000	10	200	1000	10	100	500	50	100	500	50
Saturation Flow Rate (vphg)											
1800	3600	1800	1800	3600	1800	1800	3600		1800	3600	
Queue Length (veh)											
5.5	20.4	0.2	4.4	20.8	0.1	1.9	13.4		1.9	13.4	
Degree of Saturation (%)											
69	66	1	69	66	1	35	67		35	67	
Control Delay (sec/veh)											
45	25	17	53	14	4	23	36		23	36	
(Intersection Delay = 28)											
TRANSYT Level of Service											
D	C	B	D	B	A	C	D		C	D	
(TRANSYT Node LOS = C)											

TRANSYT-7F Release 12.1

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Analyst

Agency

Jurisdiction

Run Title

File Name

Date Performed

Analysis Time Period

Nov 30, 2021

Run Title

File Name

tmp6F5A.tin

Note: Please see *Quick Optimization* under the *Advanced Features* section for more details.



b. Full Optimization; this is an HCM-based internal genetic algorithm

The 'Full Optimization' window displays the 'Input Parameters' section. It includes a table of optimization parameters and several control buttons.

Optimization	
Include this Intersection in Optimization	<input checked="" type="checkbox"/>
Objective Function	Percent Base FFS
Cycle Length	<input type="checkbox"/>
Splits	<input checked="" type="checkbox"/>
Offsets	<input checked="" type="checkbox"/>
Phasing Sequence	<input type="checkbox"/>
Dallas Phasing	<input checked="" type="checkbox"/>
Master Intersection	<input type="checkbox"/>
Forward Weighting, %	50
Reverse Weighting, %	50
Minimum Cycle, s	100
Maximum Cycle, s	100
Cycle Increment, s	10
Number of Generations	20
Population Size	10
Crossover Probability, %	30
Mutation Probability, %	1.0
Convergence Threshold, %	0.010
Random Number Seed	7781

Buttons: Start (green circle), Info (yellow circle), Stop (red circle), Save, Cancel.

Note: Please see *Full Optimization* under the *Advanced Features* section for more details.

- Inputs for optimization can be found under the Optimization section in the DETAILED INPUT DATA but can again be accessed in the Full Optimization window under Input Parameters

- The Full Optimization window includes four drop down sections:

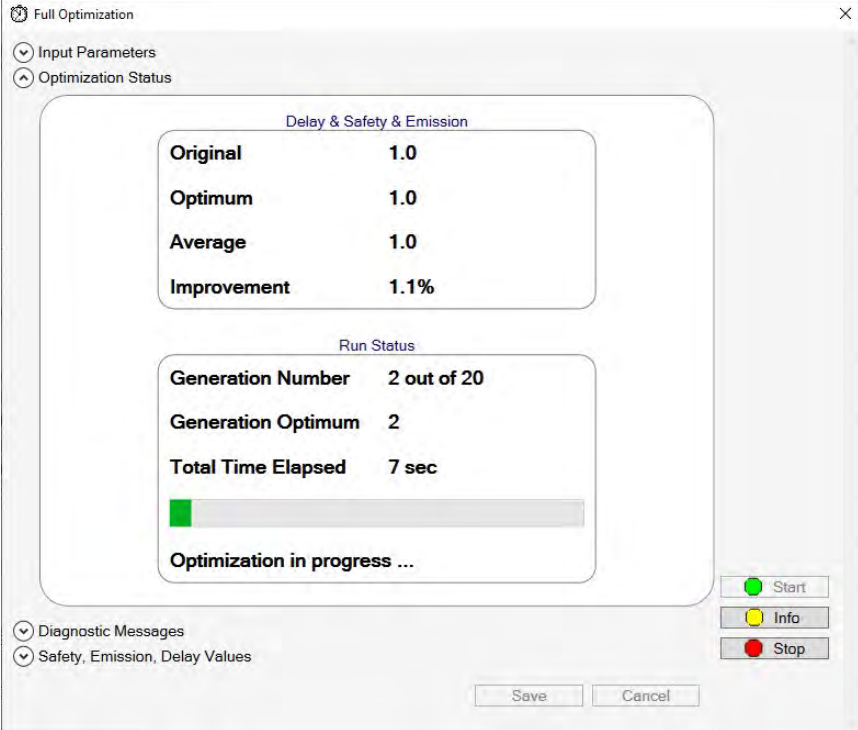
1. Input Parameters

The 'Full Optimization' window displays the 'Input Parameters' section. The 'Objective Function' dropdown menu is set to 'Delay & Safety & Err'.

Optimization	
Include this Intersection in Optimization	<input checked="" type="checkbox"/>
Objective Function	Delay & Safety & Err
Cycle Length	<input type="checkbox"/>
Splits	<input checked="" type="checkbox"/>
Offsets	<input checked="" type="checkbox"/>
Phasing Sequence	<input type="checkbox"/>
Dallas Phasing	<input checked="" type="checkbox"/>
Master Intersection	<input type="checkbox"/>
Forward Weighting, %	50
Reverse Weighting, %	50
Minimum Cycle, s	100
Maximum Cycle, s	100
Cycle Increment, s	10
Number of Generations	20
Population Size	10
Crossover Probability, %	30
Mutation Probability, %	1.0
Convergence Threshold, %	0.010
Random Number Seed	7781

Buttons: Start (green circle), Info (yellow circle), Stop (red circle), Save, Cancel.

## 2. Optimization Status



The 'Full Optimization' window shows the 'Optimization Status' tab selected. It displays two summary boxes: 'Delay & Safety & Emission' and 'Run Status'. The 'Delay & Safety & Emission' box shows 'Original' at 1.0, 'Optimum' at 1.0, 'Average' at 1.0, and 'Improvement' at 1.1%. The 'Run Status' box shows 'Generation Number' as 2 out of 20, 'Generation Optimum' as 2, and 'Total Time Elapsed' as 7 sec. A progress bar is partially filled with green. Below these boxes, there are three buttons: 'Start' (green), 'Info' (yellow), and 'Stop' (red). At the bottom, there are 'Save' and 'Cancel' buttons. The left sidebar shows 'Input Parameters' and 'Optimization Status' as selected options.

Delay & Safety & Emission	
Original	1.0
Optimum	1.0
Average	1.0
Improvement	1.1%

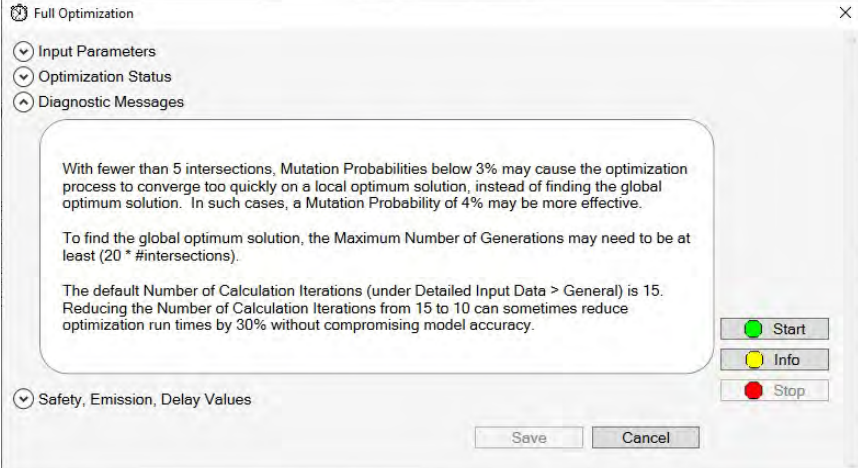
Run Status	
Generation Number	2 out of 20
Generation Optimum	2
Total Time Elapsed	7 sec

Optimization in progress ...

Start Info Stop

Save Cancel

## 3. Diagnostic Messages



The 'Full Optimization' window shows the 'Diagnostic Messages' tab selected. It displays a text box with the following content: 'With fewer than 5 intersections, Mutation Probabilities below 3% may cause the optimization process to converge too quickly on a local optimum solution, instead of finding the global optimum solution. In such cases, a Mutation Probability of 4% may be more effective. To find the global optimum solution, the Maximum Number of Generations may need to be at least (20 \* #intersections). The default Number of Calculation Iterations (under Detailed Input Data > General) is 15. Reducing the Number of Calculation Iterations from 15 to 10 can sometimes reduce optimization run times by 30% without compromising model accuracy.' Below the text box, there are three buttons: 'Start' (green), 'Info' (yellow), and 'Stop' (red). At the bottom, there are 'Save' and 'Cancel' buttons. The left sidebar shows 'Input Parameters', 'Optimization Status', and 'Diagnostic Messages' as selected options.

With fewer than 5 intersections, Mutation Probabilities below 3% may cause the optimization process to converge too quickly on a local optimum solution, instead of finding the global optimum solution. In such cases, a Mutation Probability of 4% may be more effective.

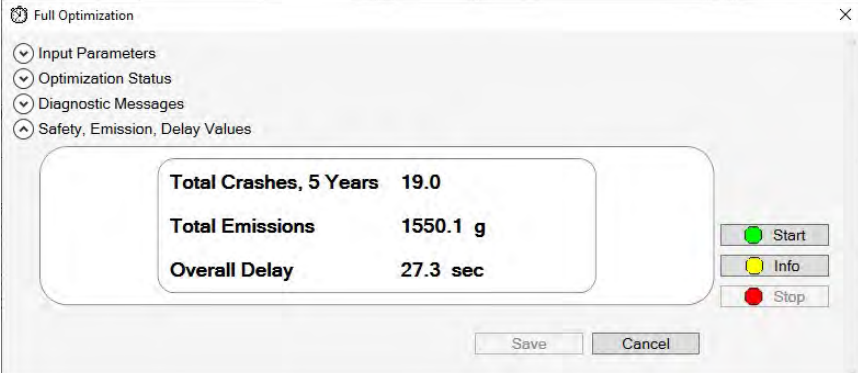
To find the global optimum solution, the Maximum Number of Generations may need to be at least (20 \* #intersections).

The default Number of Calculation Iterations (under Detailed Input Data > General) is 15. Reducing the Number of Calculation Iterations from 15 to 10 can sometimes reduce optimization run times by 30% without compromising model accuracy.

Start Info Stop

Save Cancel

## 4. Safety, Emission, Delay Values



The 'Full Optimization' window shows the 'Safety, Emission, Delay Values' tab selected. It displays a table with the following data: 'Total Crashes, 5 Years' at 19.0, 'Total Emissions' at 1550.1 g, and 'Overall Delay' at 27.3 sec. Below the table, there are three buttons: 'Start' (green), 'Info' (yellow), and 'Stop' (red). At the bottom, there are 'Save' and 'Cancel' buttons. The left sidebar shows 'Input Parameters', 'Optimization Status', 'Diagnostic Messages', and 'Safety, Emission, Delay Values' as selected options.

Total Crashes, 5 Years	19.0
Total Emissions	1550.1 g
Overall Delay	27.3 sec

Start Info Stop

Save Cancel

iii. There Full Optimization window includes five buttons:

1. Start; clicking this will start running full optimization using the inputs specified under Input Parameters

The 'Full Optimization' window displays the 'Input Parameters' tab. It contains various settings for optimization, including checkboxes for 'Include this Intersection in Optimization', 'Cycle Length', 'Splits', and 'Offsets'. There are also input fields for 'Minimum Cycle, s', 'Maximum Cycle, s', 'Cycle Increment, s', 'Master Intersection', 'Forward Weighting, %', 'Reverse Weighting, %', 'Number of Generations', 'Population Size', 'Crossover Probability, %', 'Mutation Probability, %', 'Convergence Threshold, %', and 'Random Number Seed'. On the right side, there are three buttons: 'Start' (green circle), 'Info' (yellow circle), and 'Stop' (red circle). The 'Start' button is highlighted with a red box. At the bottom, there are 'Save' and 'Cancel' buttons.

2. Info; clicking this will show the Diagnostic Messages

The 'Full Optimization' window displays the 'Diagnostic Messages' tab. It contains a text area with the following information:

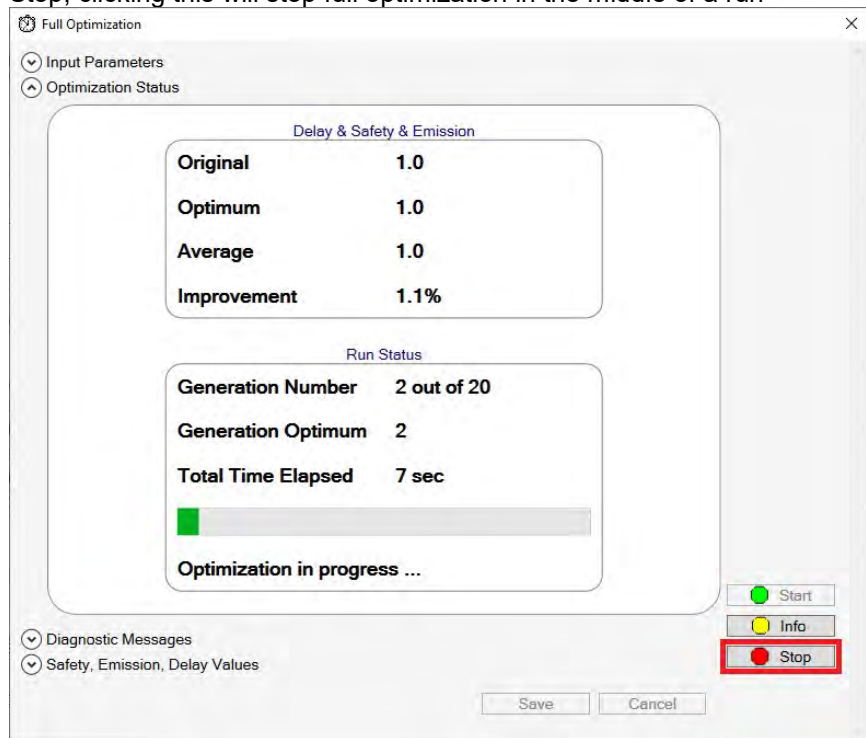
With fewer than 5 intersections, Mutation Probabilities below 3% may cause the optimization process to converge too quickly on a local optimum solution, instead of finding the global optimum solution. In such cases, a Mutation Probability of 4% may be more effective.

To find the global optimum solution, the Maximum Number of Generations may need to be at least (20 \* #intersections).

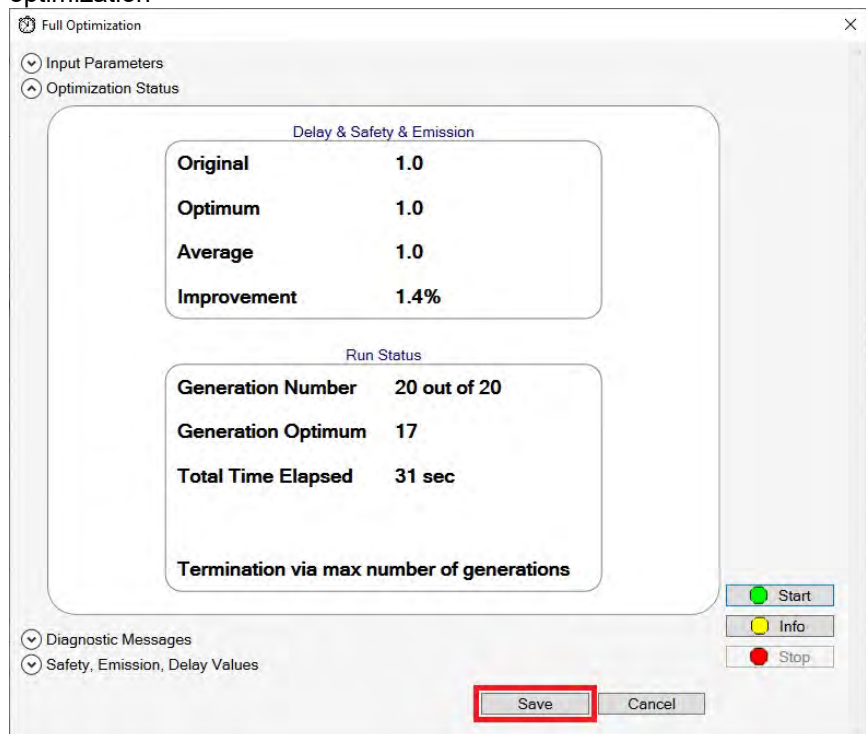
The default Number of Calculation Iterations (under Detailed Input Data > General) is 15. Reducing the Number of Calculation Iterations from 15 to 10 can sometimes reduce optimization run times by 30% without compromising model accuracy.

On the right side, there are three buttons: 'Start' (green circle), 'Info' (yellow circle), and 'Stop' (red circle). The 'Info' button is highlighted with a red box. At the bottom, there are 'Save' and 'Cancel' buttons.

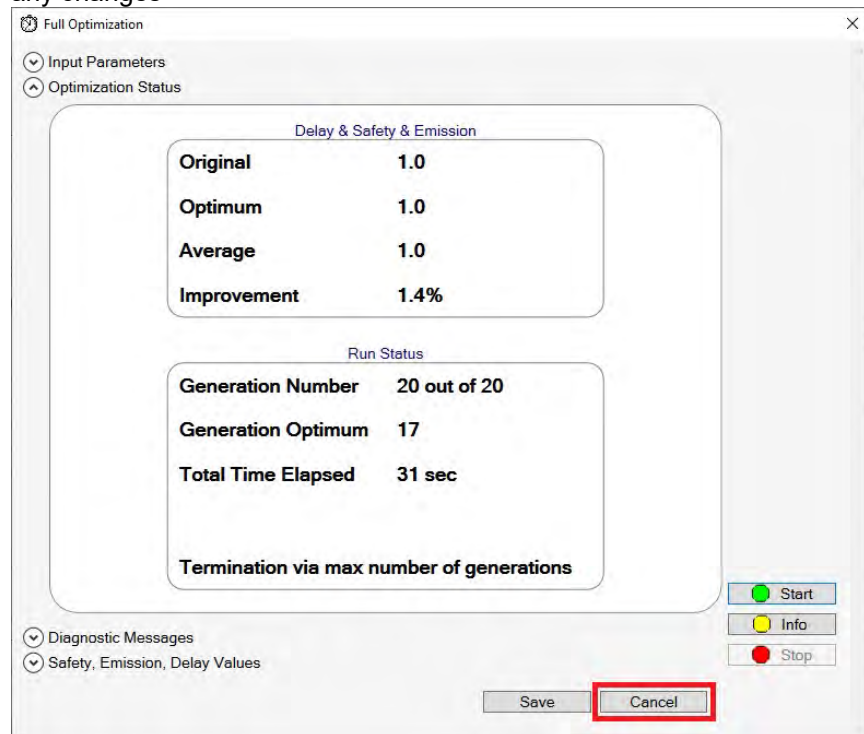
3. Stop; clicking this will stop full optimization in the middle of a run



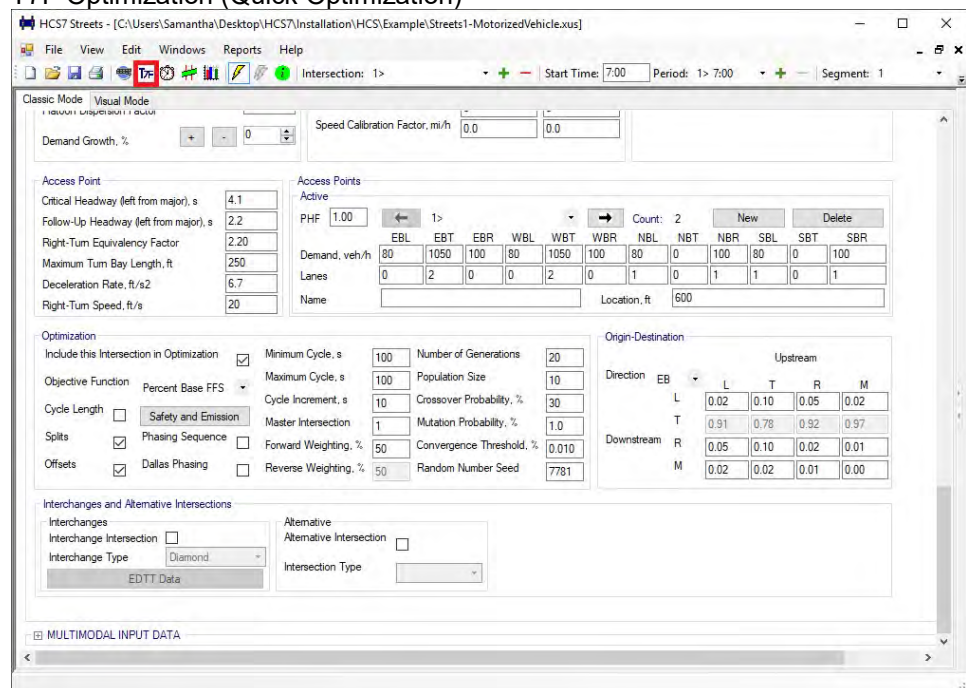
4. Save; clicking this will save the changes as a result of running optimization



5. Cancel; clicking this will exit the Full Optimization window without saving any changes

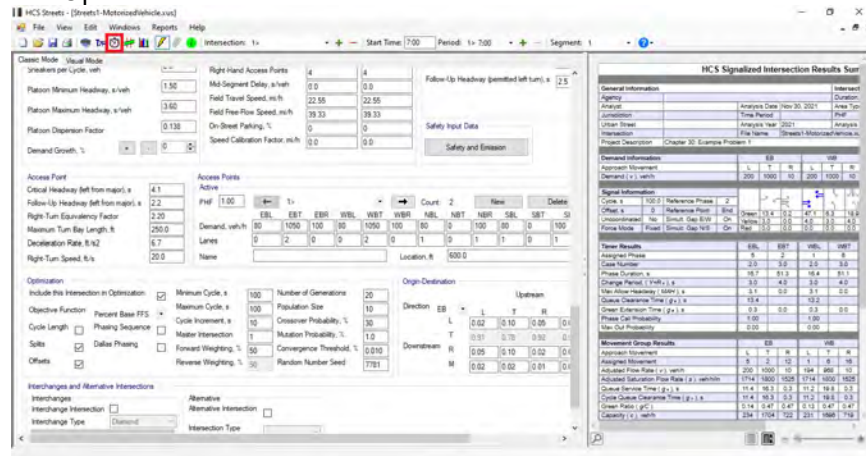


2. There are multiple ways to run optimization for a Streets file:
  - a. Using the toolbar icons
  - i. T7F Optimization (Quick Optimization)



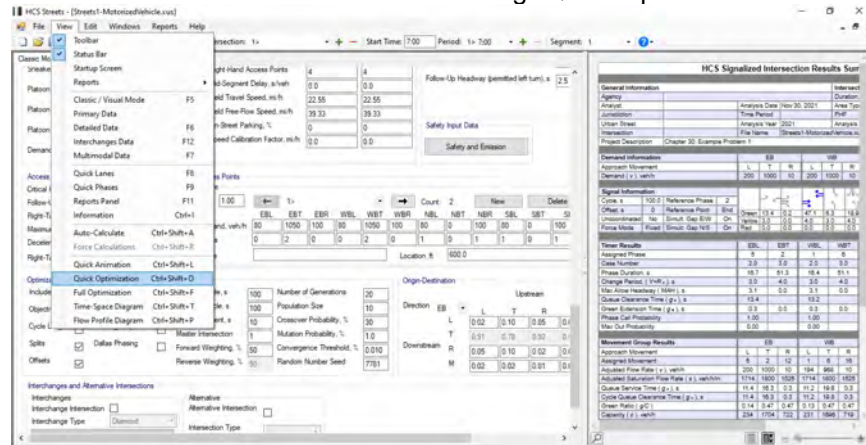


## ii. Full Optimization

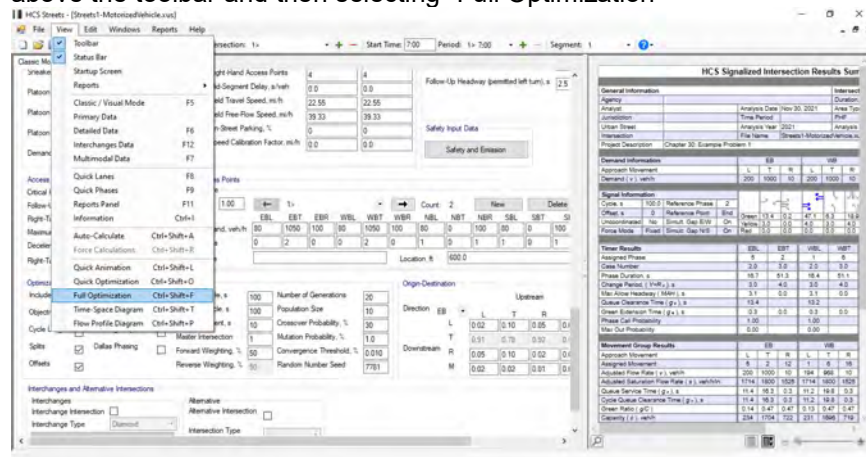


## b. Using the View menu items

- To run Quick Optimization, select **View > Quick Optimization** from the main menu; this can be found by selecting "View" in the top left-hand corner of the screen above the toolbar and then selecting "Quick Optimization"



- To run Full Optimization, select **View > Full Optimization** from the main menu; this can be found by selecting "View" in the top left-hand corner of the screen above the toolbar and then selecting "Full Optimization"



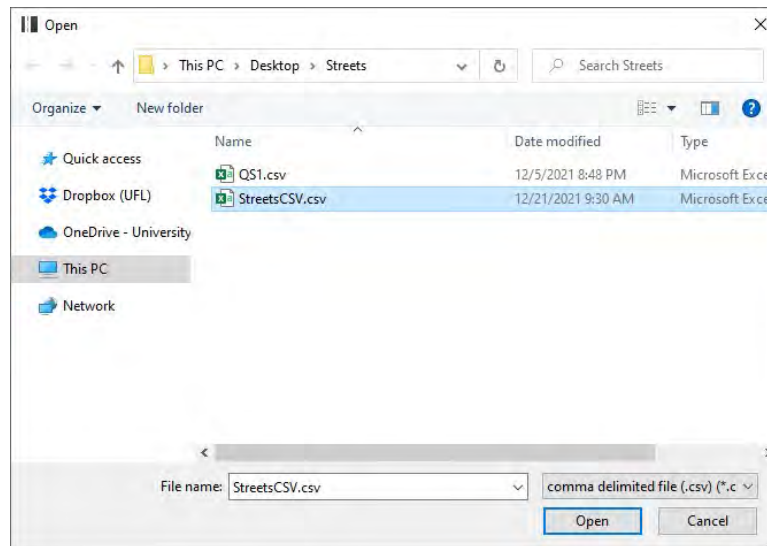
## c. Using keyboard shortcuts

- i. Quick Optimization: keyboard shortcut is Ctrl+Shift+O
- ii. Full Optimization: keyboard shortcut is Ctrl+Shift+F

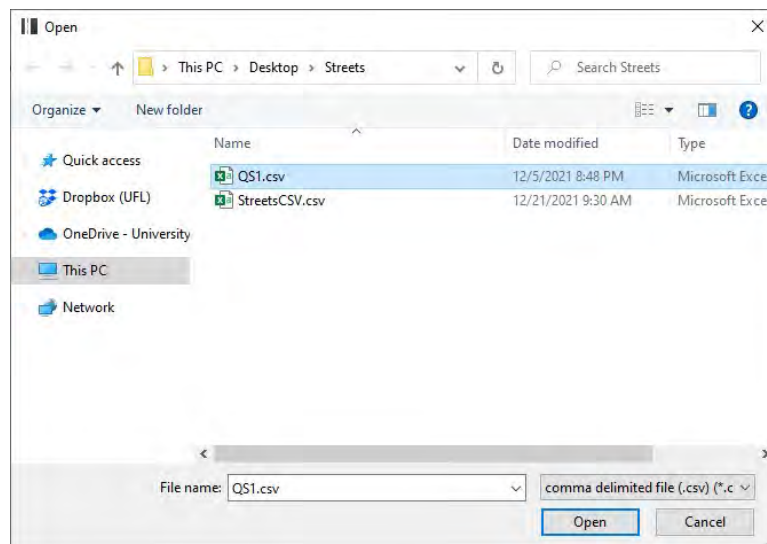
---

## Import

1. There are five options for import: Streets CSV File, QuickStreets CSV File, Synchro-To-Streets Converter, Streets Data Template, and DAITA File
  - a. Import Streets CSV File; this imports input data from a Streets CSV file to the current Streets dataset



- a. Import QuickStreets CSV File; this imports data from a QuickStreets file to the current Streets dataset



- b. Import with Synchro-To-Streets Converter; this imports data from a Synchro file to the current Streets dataset



**SYNCHRO-TO-STREETS**

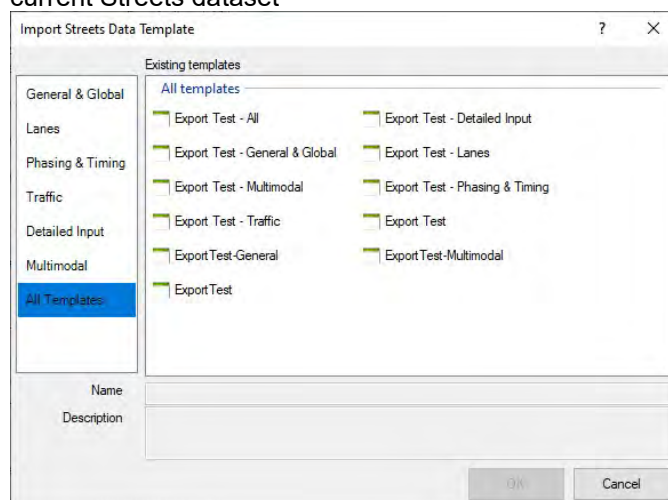
Please select a 'File' or 'Folder'

☒ File ☐ Folder

Please select the 'Forward Direction'

☒ EB ☐ WB ☐ NB ☐ SB

- c. Import Streets Data Template; this imports input data from an existing template to the current Streets dataset



Import Streets Data Template

Existing templates

All templates

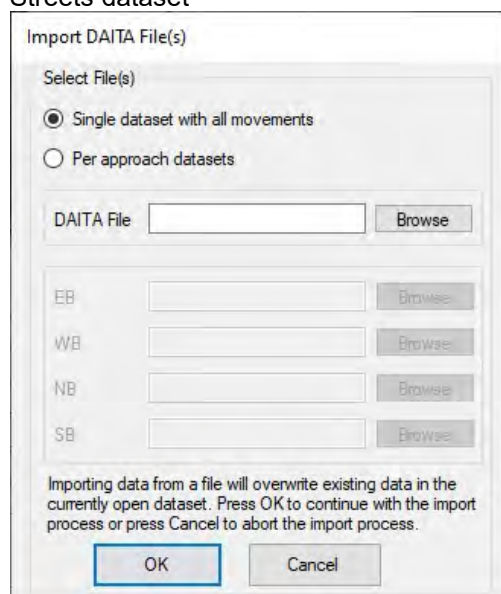
- Export Test - All
- Export Test - General & Global
- Export Test - Multimodal
- Export Test - Traffic
- ExportTest-General
- ExportTest
- Export Test - Detailed Input
- Export Test - Lanes
- Export Test - Phasing & Timing
- Export Test
- ExportTest-Multimodal

Name

Description

Note: Please see *Templates* under the *Getting Started* section for more details.

- d. Import DAITA File; this imports traffic counts from a DAITA file (\*.xhd) to the current Streets dataset



Import DAITA File(s)

Select File(s)

☒ Single dataset with all movements

☐ Per approach datasets

DAITA File

EB

WB

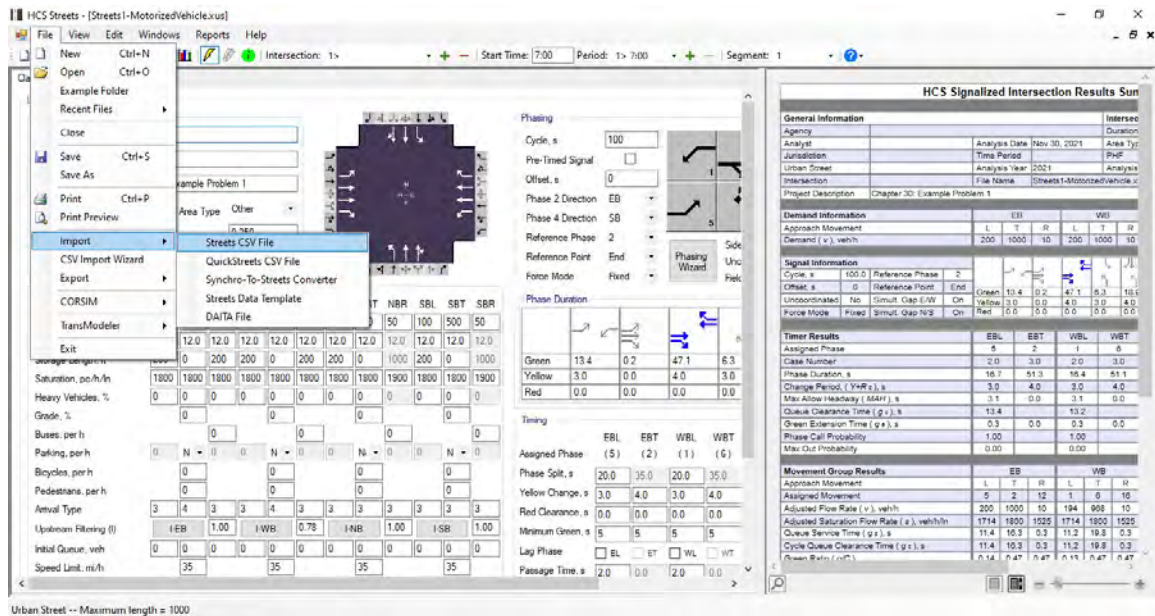
NB

SB

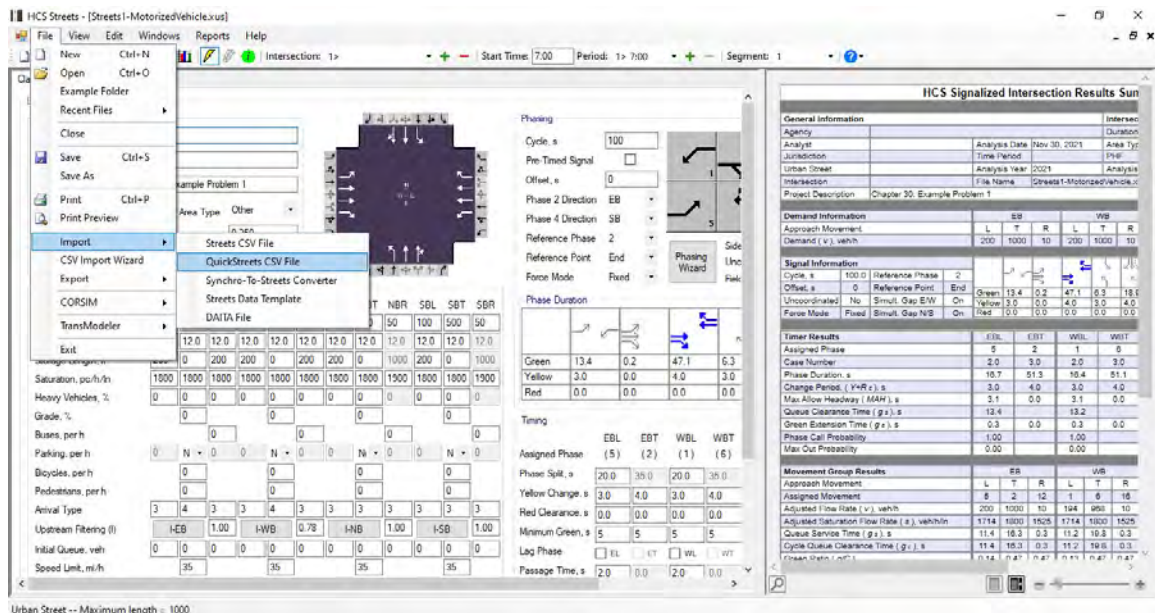
Importing data from a file will overwrite existing data in the currently open dataset. Press OK to continue with the import process or press Cancel to abort the import process.



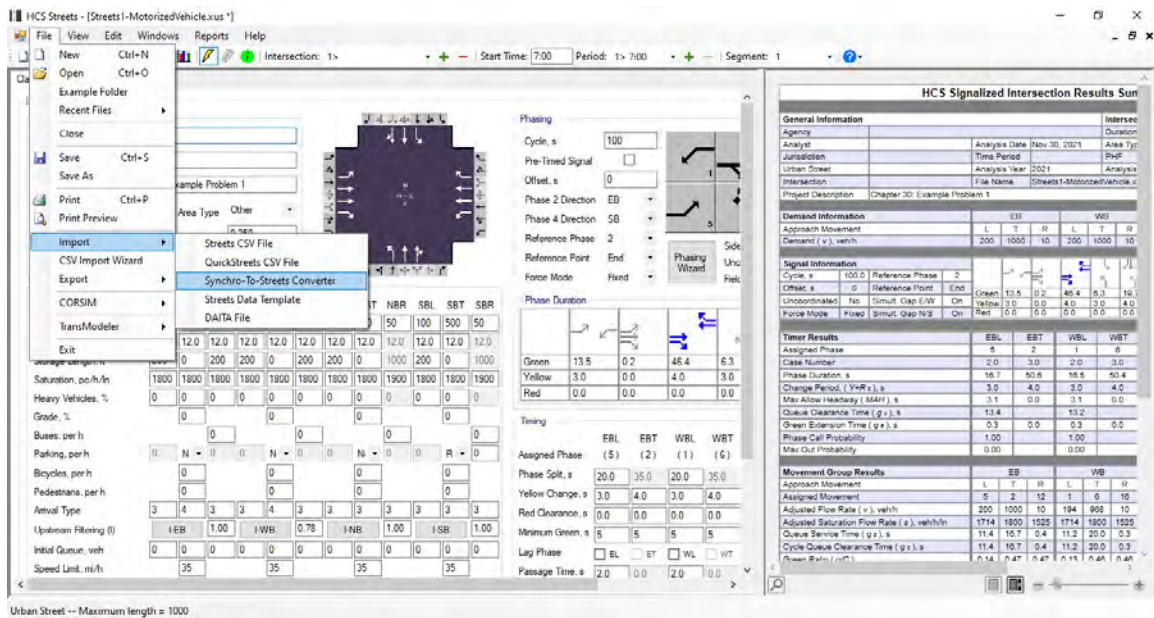
- To import a Streets CSV File, select **File > Import > Streets CSV File** from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar, hovering over “Import”, and then selecting “Streets CSV File”. *Note: Please close the CSV file in other applications, such as Microsoft Excel, before importing.*



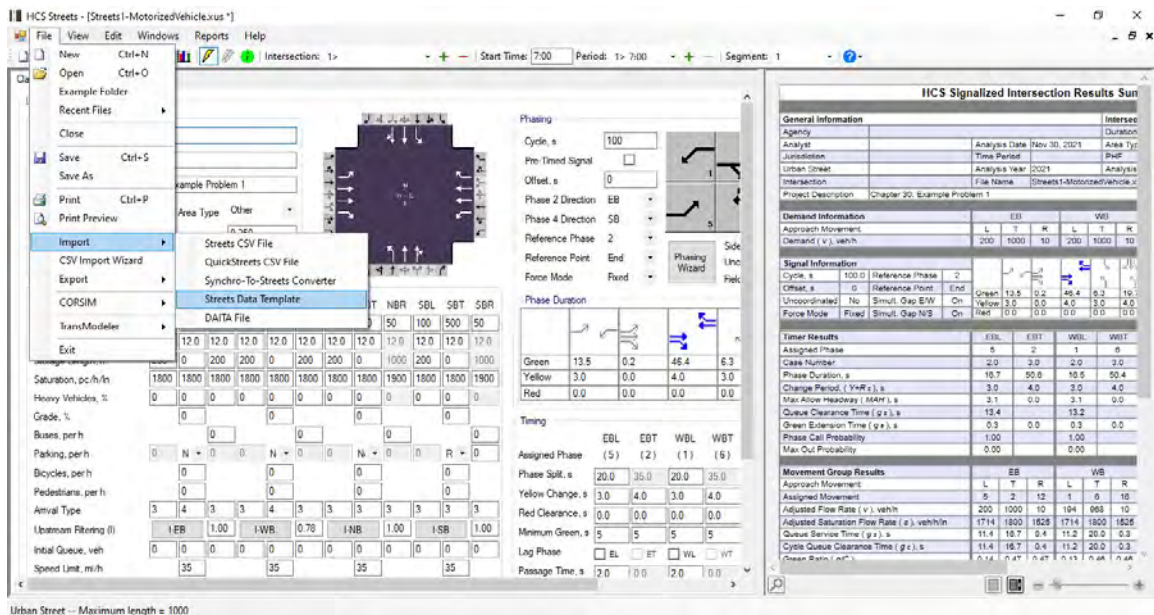
- To import a QuickStreets CSV File, select **File > Import > QuickStreets CSV File** from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar, hovering over “Import”, and then selecting “QuickStreets CSV File”. *Note: Please close the CSV file in other applications, such as Microsoft Excel, before importing.*



- To import with the Synchro-To-Streets Converter, select **File > Import > Synchro-To-Streets Converter** from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar; hovering over “Import”, and then selecting “Synchro-To-Streets Converter”.



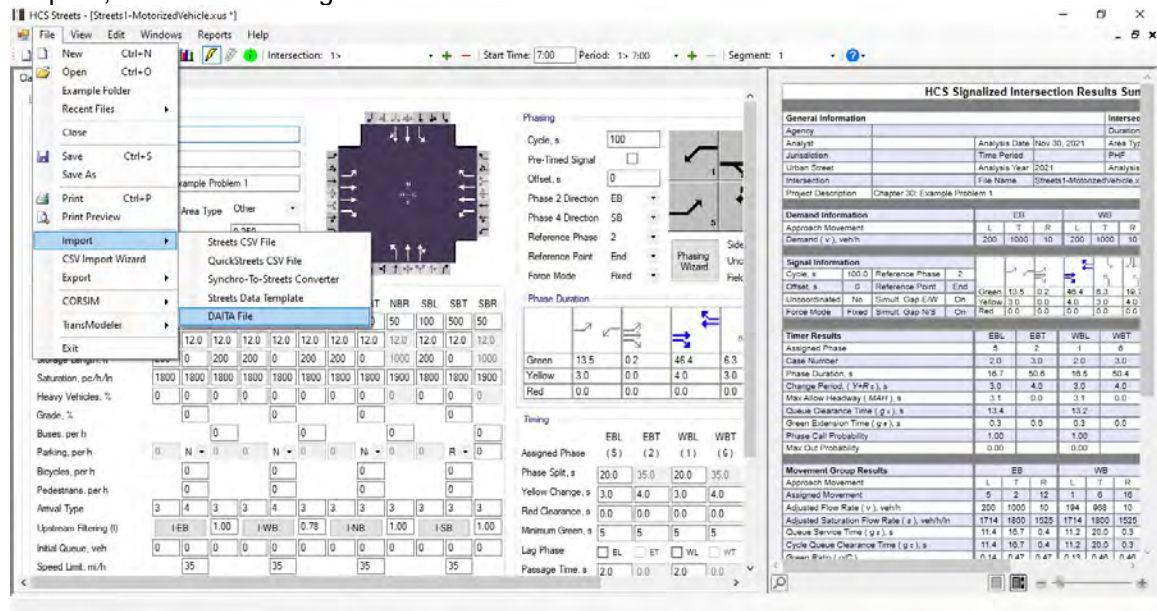
- To import a Streets Data Template, select *File > Import > Streets Data Template* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar, hovering over “Import”, and then selecting “Streets Data Template”.



- To import a DAITA File, select *File > Import > DAITA File* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the toolbar, hovering over

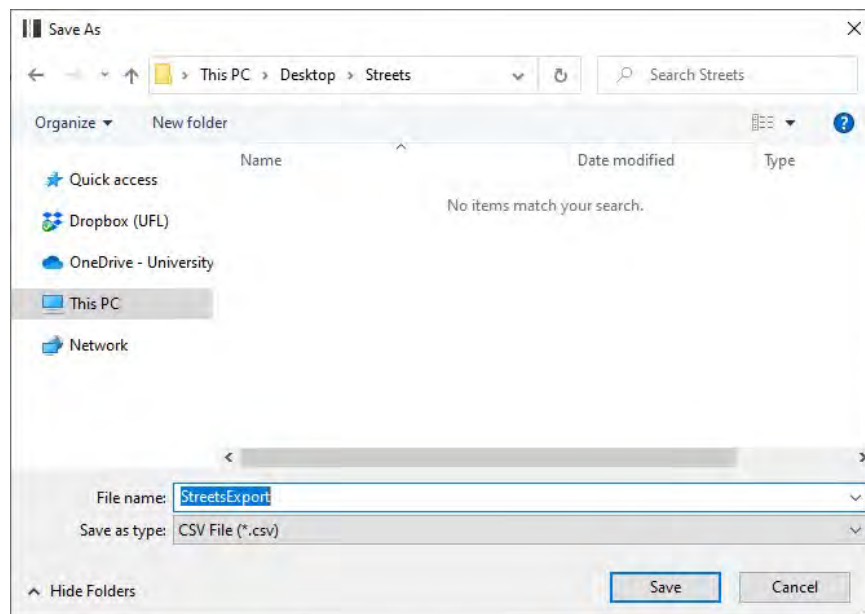


“Import”, and then selecting “DAITA File”.

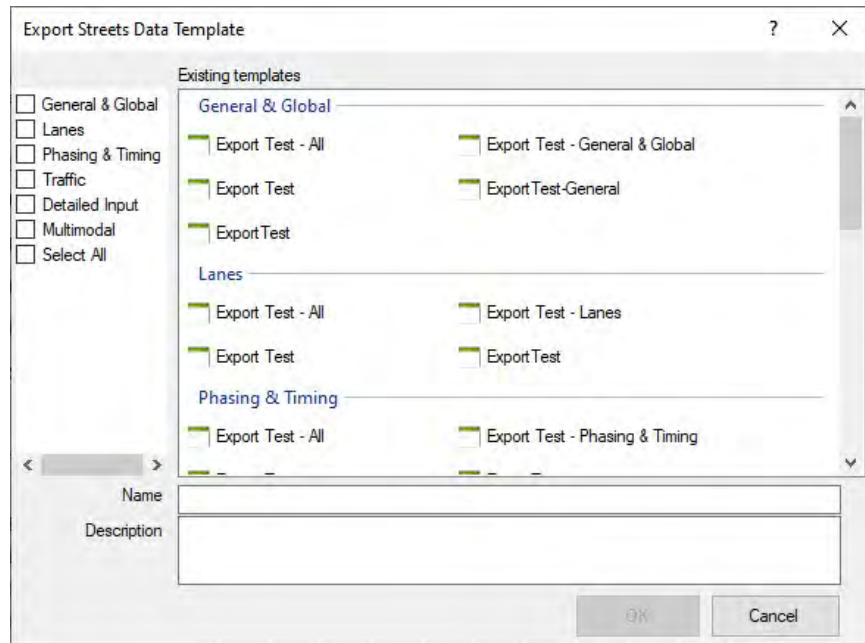


## Export

2. There are two options for export: Streets CSV File and Streets Data Template
  - a. Export Streets CSV File; this exports input data from the Streets file to a CSV file

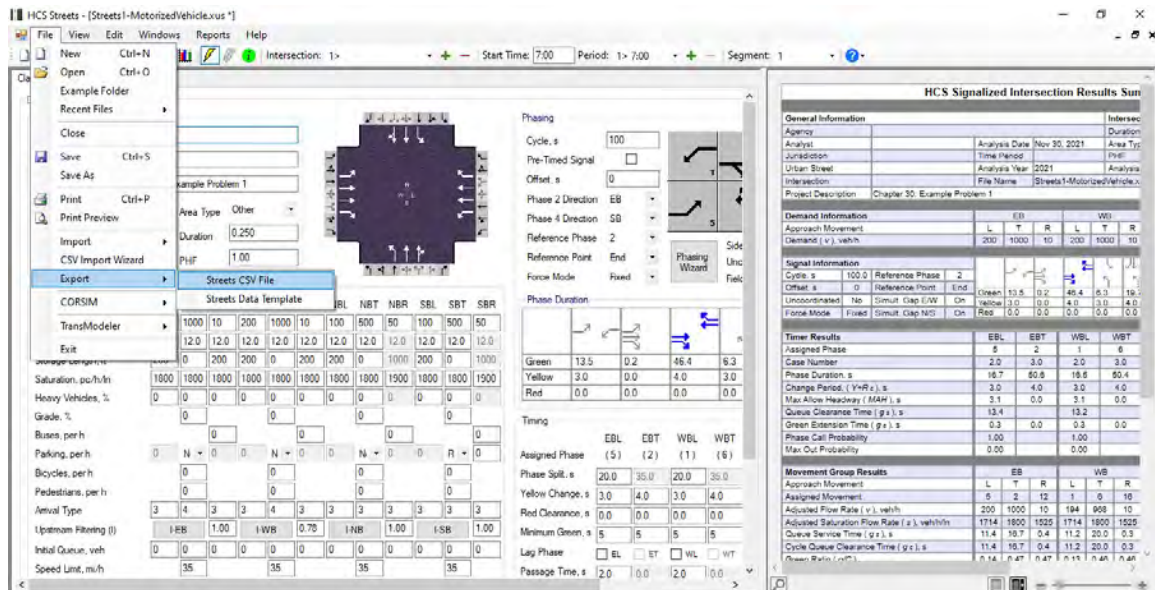


- b. Export Streets Data Template; this exports input data from the Streets file to a template file



Note: Please see *Templates* under the *Getting Started* section for more details.

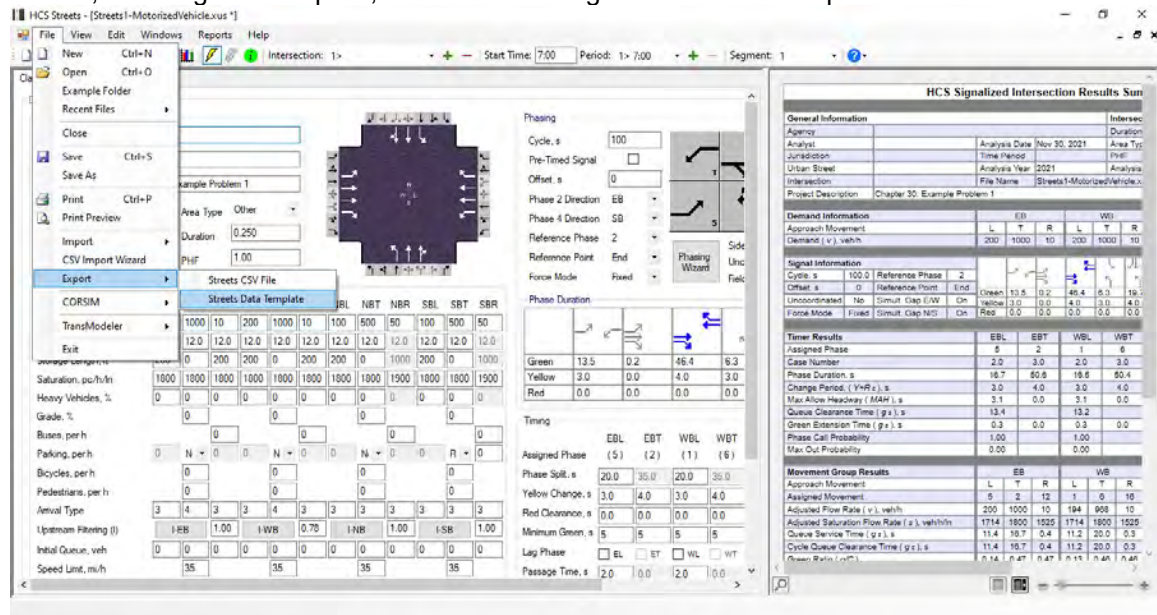
3. To export a Streets CSV File, select *File > Export > Streets CSV File* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the tool bar, hovering over “Export”, and then selecting “Streets CSV File”.



4. To export a Streets Data Template, select *File > Export > Streets Data Template* from the main menu; this can be found by selecting “File” in the top left-hand corner of the screen above the

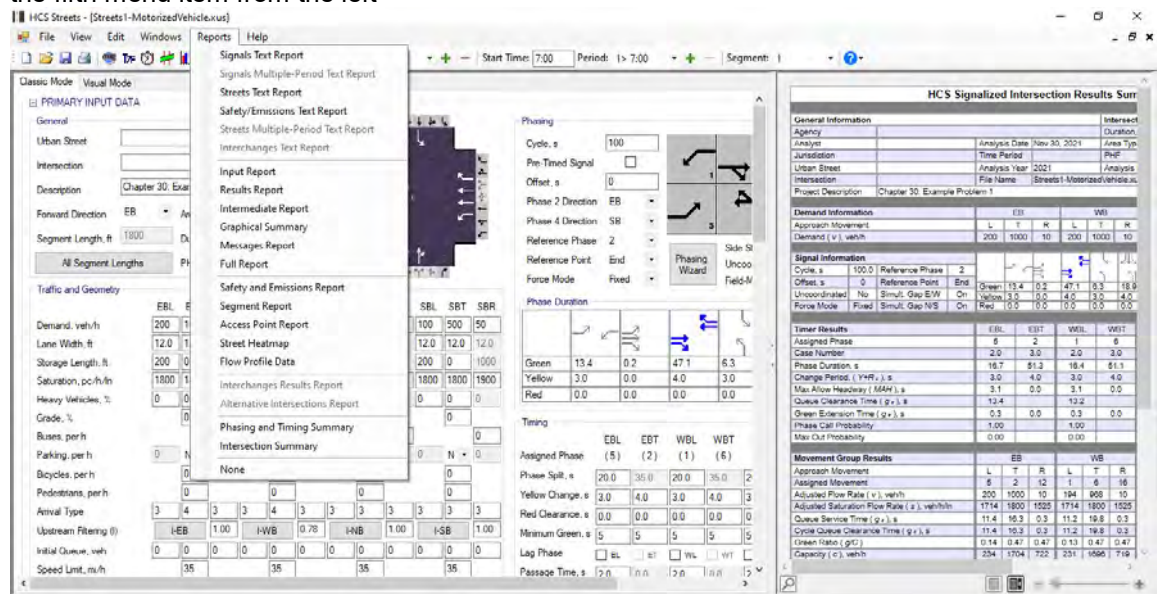


toolbar, hovering over “Export”, and then selecting “Streets Data Template”.



## View Results of the Analysis

1. After editing all the necessary inputs, results of the analysis can be found in the form of reports.
2. Reports can be found in the Reports menu in the top left-hand corner of the screen; “Reports” is the fifth menu item from the left

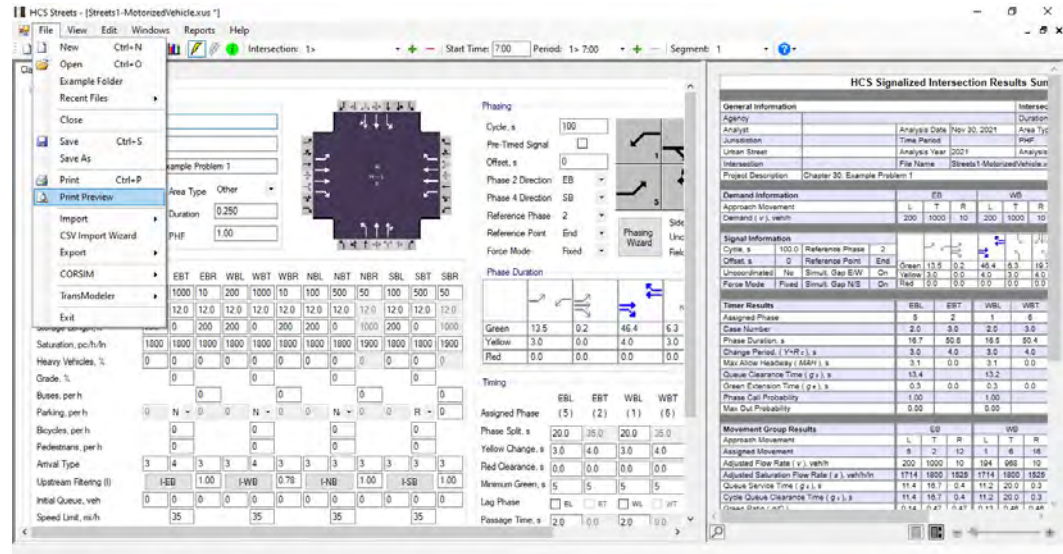


3. There are multiple options for reports:
  - a. Signals Text Report
  - b. Signals Multiple-Period Text Report
  - c. Streets Text Report
  - d. Streets Multiple-Period Text Report

- ## Print a Report

-

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



- c. Using the keyboard shortcut “Ctrl+P” for Print
- d. Selecting the Print icon in the toolbar; this can be found in the top left-hand corner of the screen in the toolbar; it is the fourth icon from the left and has an image of a printer



## 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

## Acceleration Rate

**Description:** This entry specifies the average constant acceleration rate.

**Impact on model results:** Accel-decel delays affect the computation of uniform stops and uniform queue. This entry also affects access point operations.

## Access Point Critical Gap Time

**Description:** This entry specifies the critical gap required for left-turners from the major street at an access point.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Deceleration Rate

**Description:** This entry specifies the average constant deceleration rate in response to turning vehicles.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Dropdown

**Description:** The access point dropdown control allows the user to switch between active access points, for editing input data.

**Impact on model results:** None

## Access Point Follow Up Time

**Description:** This entry specifies the follow-up time required for left-turners from the major street at an access point.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Lanes

**Description:** This entry specifies lane geometry at the active (i.e., more than 10 veh/h) unsignalized access point.

**Impact on model results:** Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Location

**Description:** This entry specifies the distance from the active (i.e., more than 10 vph) unsignalized access point to the upstream signalized intersection.

**Impact on model results:** Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Maximum Bay Length

**Description:** This entry specifies the maximum length of a turn bay, at an access point.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Name

**Description:** This entry is used to document the name of the active (i.e., more than 10 vph) unsignalized access point.

**Impact on model results:** None

## Access Point Peak Hour Factor

**Description:** This entry specifies the proportion of access point volume occurring in the peak 15 minutes. Peak 15-minute volume is computed as the hourly volume divided by four times the PHF.

**Impact on model results:** The PHF (when lower than 1.0) simply factors up the associated movement volume, to reflect increased flow rates during the peak 15-minute period. Access point volumes affect the proportion of arrivals on green for downstream major-street movements.

## Access Point Right Turn Equivalency

**Description:** This entry specifies the ratio of through to right-turn saturation flow rate, at an access point.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Right Turn Speed

**Description:** This entry specifies the average turn speed for a right-turn maneuver at an access point.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Access Point Volumes

**Description:** This entry specifies movement volumes at the active (i.e., more than 10 vph) unsignalized access point. When the analysis contains more than one time period, access point volumes can be entered in units of vehicles per period.

**Impact on model results:** Access point operations affect the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Additional RCUT Inputs

**Description:** This button opens a dialog box for the user to input the U-Turn Crossover Median Width and Conventional RCUT Demands.

**Impact on model results:** This button is only applicable to RCUT alternative intersection and is necessary for the completion of one RCUT alternative intersection.

## Agency or Company

**Description:** This entry documents the agency or company associated with this analysis or project.

**Impact on model results:** None

## All Segment Lengths

**Description:** This pop-up dialog allows the user to specify all segment lengths on one form. This dialog is only available when intersections can be assumed to be located in a straight line, and when intersection drag-and-drop has not been performed within Visual Mode. Segments are only relevant when there is more than one intersection within the analysis.

**Impact on model results:** Segment lengths are used in the computation of travel speeds and vehicle delays.

## Allow Optimization

**Description:** This checkbox allows the user to suppress optimization at certain intersections, during an optimization run. Turning off the Allow Optimization checkbox at intersections that are already performing well (level of service A or B) can sometimes make the optimization process more efficient, by allowing it to focus on re-timing the poorly-performing intersections.

**Impact on model results:** This entry is only applicable to optimization runs.

## Alternative Intersection

**Description:** This checkbox allows the user to convert a conventional intersection into one of the available alternative intersections. Checking this will enable the Intersection Type combo box.

**Impact on model results:** None



## Analysis Time Period

**Description:** This entry documents the time period covered by the analysis.

**Impact on model results:** None

## Analysis Time Period Duration

**Description:** This entry specifies the length of time (T) during which flow is assumed to remain constant. If T is equal to one hour, the PHF for each movement should be set to 1.00.

**Impact on model results:** If the degree of saturation (v/c) exceeds 0.90, control delay is significantly affected by the value of T.

## Analysis Year

**Description:** This entry documents the year for which the analysis is being performed.

**Impact on model results:** None

## Analyst

**Description:** This entry documents the individual performing the analysis.

**Impact on model results:** None

## Area Type

**Description:** This entry specifies whether or not the intersection is in a central business district (CBD) type of environment. An intersection is considered to be in a CBD, or a similar type of area, when its characteristics include narrow street rights-of-way, frequent parking maneuvers, vehicle blockages, taxi and bus activity, small-radius turns, limited use of exclusive turn lanes, high pedestrian activity, dense population, and mid-block curb cuts. The average saturation headway of vehicles at intersections in areas with these characteristics will be significantly longer than those found at similar intersections but in more suburban settings.

**Impact on model results:** The "CBD or similar" selection decreases the saturation flow rate for all movements by 10%, resulting in higher delays, travel times, queues, etc. The "Other" selection has no impact on model results, except to avoid saturation flow rate reductions that would have been caused by "CBD or similar".

## Arrival Type

**Description:** Arrival type is used to describe the quality of signal progression for the corresponding movement group. Values of arrival type range from 1 to 6. An arrival type of 1 represents poor progression, whereas an arrival type of 6 represents excellent progression. An arrival type of 3 represents random vehicle arrivals. Arrival type 1 is characterized by a dense platoon of more than 80 percent of the movement group volume arriving at the start of the red interval. This arrival type is often associated with shorter segments. If the two signals are not coordinated, then poor progression will likely exist for both travel directions. If coordination is provided for only one direction of travel, then poor progression may exist for the other direction. Arrival type 2 is characterized by a moderately dense platoon arriving in the middle of the red interval or a dispersed platoon containing 40 to 80 percent of the movement group volume arriving throughout the red interval. Arrival type 3 describes one of two conditions. If the signals bounding the segment are coordinated, then this arrival type is characterized by a platoon containing less than 40 percent of the movement group volume arriving partially during the red interval and partly during the green interval. If the signals are not coordinated, then this arrival type is characterized by platoons that arrive at the subject intersection at different points in time over the course of the analysis period such



that arrivals are effectively random. Arrival type 4 is characterized by a moderately dense platoon arriving in the middle of the green interval or a dispersed platoon containing 40 to 80 percent of the movement group volume arriving throughout the green interval. Arrival type 5 is characterized by a dense platoon of more than 80 percent of the movement group volume arriving at the start of the green interval. This arrival type may occur on shorter segments with a low-to-moderate number of side street entries and good signal coordination. Arrival type 6 is characterized by a dense platoon of more than 80 percent of the movement group volume arriving during the green interval. This arrival type occurs only on short segments with negligible side street entries and near-ideal signal coordination. It is reserved for exceptional progression quality on routes with near-ideal characteristics.

**Impact on model results:** Within the computational procedure, arrival type (AT) is first converted to a platoon ratio ( $R_p = AT / 3$ ) for each movement. Next, platoon ratio is converted to a proportion of arrivals on green ( $ProportionOnGreen = R_p * g / C$ ) for each movement. If upstream signal information has been entered, *PortionOnGreen* is automatically recalculated to reflect the expected vehicle arrival pattern from the upstream intersection. *PortionOnGreen* impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Average Passenger Trip Length (multimodal)

**Description:** This entry specifies the average passenger trip length along a particular transit route.

**Impact on model results:** Average passenger trip length is used to determine the impact of late departures on overall trip speed, and is used to compute the perceived travel time factor.

## Base Saturation Flow Rate

**Description:** The base saturation flow rate represents the expected average flow rate for a through traffic lane having geometric and traffic conditions that correspond to a value of 1.0 for each adjustment factor. Typically, one base rate is selected to represent all signalized intersections in the jurisdiction (or area) within which the subject intersection is located.

**Impact on model results:** Adjusted saturation flow rates affect capacities and queue service times, which in turn affect many aspects of the overall model; including control delay, time until onset of queue spillback, queue lengths, and travel time.

## Base Travel Time Rate (multimodal)

**Description:** This entry should specify 6.0 min/mi (or 3.73 min/km in metric) for the central business district of a metropolitan area with 5 million persons or more; otherwise use 4.0 min/mi (or 2.49 min/km in metric).

**Impact on model results:** Base travel time rate is used to compute the transit wait-ride score.

## Bicycle Lane Width (multimodal)

**Description:** This entry specifies the width of the bicycle lane (adjacent to the outside thru vehicle lane) on the subject approach.

**Impact on model results:** The bicycle lane width affects the cross section width adjustment factor.

## Bicycle Running Speed (multimodal)

**Description:** This entry specifies an estimate of the average bicycle running speed. The best basis for this estimate is a field measurement of mid-segment bicycle speed on representative streets in the vicinity of the subject street. There are many factors that might affect bicycle speed including adjacent motor

vehicle traffic, adjacent on-street parking activity, commercial and residential driveways, lateral obstructions, and significant grades.

**Impact on model results:** Bicycle running speed is used to compute bicycle travel speed. Bicycle travel speed is an output measure of effectiveness, and is not used to determine bicycle level of service.

## Bicycles per Hour

**Description:** This entry specifies the number of bicycles whose travel path is crossed by vehicles turning right from the subject approach during the analysis period. These bicycles may travel on the shoulder or in a bike lane. Any bicycle traffic operating in the right lane with automobile traffic should not be included in this count. Rather, they are ignored in the analysis because this interaction is not modeled by the procedure. The count is divided by the analysis period duration to yield an hourly flow rate.

**Impact on model results:** Non-zero bicycles per hour decrease the saturation flow rate for associated movements, resulting in higher delays, travel times, queues, etc.

## Buffer Object Spacing (multimodal)

**Description:** The buffer is the distance between the outside edge of the paved roadway (or face of curb, if present) and the near edge of the sidewalk. This element of the cross section is not designed for use by pedestrians or motorized vehicles. It may be unpaved or include various vertical objects that are continuous (e.g., barrier) or discontinuous (e.g., trees, bollards) to prevent pedestrian use. If vertical objects are in the buffer, then the average spacing of those objects that are 3 feet (or 0.9 meters in metric) or more in height should be recorded.

**Impact on model results:** The buffer width coefficient determination is based on the presence of a continuous barrier in the buffer. When making this determination, repetitive vertical objects (e.g., trees, bollards, etc.) are considered to represent a continuous barrier if they are at least 3 feet (or 0.9 meters in metric) high and have an average spacing of 20 feet (or 6.1 meters in metric) or less.

## Buffer Width (multimodal)

**Description:** This entry specifies the distance between the outside edge of the paved roadway (or face of curb, if present) and the near edge of the sidewalk. This element of the cross section is not designed for use by pedestrians or motorized vehicles. It may be unpaved or include various vertical objects that are continuous (e.g., barrier) or discontinuous (e.g., trees, bollards) to prevent pedestrian use. If vertical objects are in the buffer, then the average spacing of those objects that are 3 feet (or 0.9 meters in metric) or more in height should also be recorded.

**Impact on model results:** Buffer width is used to compute the available sidewalk width.

## Bus Blockage Time

**Description:** The saturation flow rate adjustment factor for bus blockage accounts for the impact of local transit buses that stop to discharge or pick up passengers at a near-side or far-side bus stop within 250 feet (or 76.2 meters in metric) of the stop line (upstream or downstream). This factor should only be used when stopping buses block traffic flow in the subject lane group. The bus blockage adjustment factor assumes an average bus blockage time of 14.4 seconds during the green indication.

**Impact on model results:** Higher bus blockage times decrease saturation flow rates for their associated movements; resulting in higher delays, travel times, queues, etc.

## Bus Stops per Hour

**Description:** This entry specifies the number of local buses that block traffic flow in a movement group within 250 feet (or 76.2 meters in metric) of the stop line (upstream or downstream), as measured during the analysis period. A local bus is a bus that stops to discharge or pick up passengers at a bus stop. The stop can be on the near side or the far side of the intersection. If more than 250 buses per hour exist, a practical limit of 250 should be used.

**Impact on model results:** Non-zero bus stops per hour decrease the saturation flow rate for associated movements, resulting in higher delays, travel times, queues, etc.

## Calculate Emissions

**Description:** This button updates the Emissions Output displayed in the Safety and Emission dialog box.

**Impact on model results:** None

## Calculate Safety

**Description:** This button updates the Safety Output displayed in the Safety and Emission dialog box.

**Impact on model results:** None

## Circulating Pedestrian Volume (multimodal)

**Description:** This entry specifies the total number of pedestrians traversing the corner but never entering the intersection. For example, on the eastbound approach, circulating pedestrians on the eastbound sidewalk will turn southbound upon reaching the southwest intersection corner. Also on the eastbound approach, circulating pedestrians on the northbound (western-most) sidewalk will turn westbound upon reaching the southwest corner. Eastbound circulating volume is thus the summation of eastbound sidewalk pedestrians who turn southbound (upon reaching the southwest corner) and northbound sidewalk pedestrians who turn westbound (upon reaching the southwest corner).

**Impact on model results:** Circulating pedestrian volume affects the corner circulation area per pedestrian.

## Clear

**Description:** The Clear button automatically deletes all lanes from the active intersection. In some cases this may allow for faster specification of certain lane configurations.

**Impact on model results:** Intersection laneage has a fundamental effect on all aspects of the model results.

## Conventional RCUT Demands

**Description:** The Conventional RCUT Demand inputs are enabled only for files specified as type RCUT in the Alternative group box. These input fields represent the movement demands at a standard 4-leg intersection.

**Impact on model results:** This entry is only applicable to RCUT alternative intersections. Conventional RCUT Demands are used to calculate redistributed demands (found in the greyed out individual RCUT junction demand fields) and to calculate experienced travel times.

## Convergence Threshold

**Description:** This entry specifies the (genetic algorithm) convergence threshold in a signal timing optimization run. During optimization, the optimal function value and average function value are constantly recomputed. The optimal function value represents the best objective function value when considering all candidate timing plans in that particular generation. The average function value is the average performance index value from all candidate solutions in that particular generation. During successive generations, the optimal function value and the average function value tend to improve due to the genetic selection process. The average function value can occasionally become worse due to a "bad mutation", but the optimal function value should always stay the same or improve. Convergence is achieved when the average function value becomes sufficiently close to the optimal function value. Increasing the maximum number of generations (or decreasing the convergence threshold) tends to produce longer program running times, but better timing plans. Of course, once the global optimum solution has been reached, additional generations and tighter convergence thresholds have no additional benefit. Complex traffic networks tend to require substantially more generations of candidate solutions before an optimal solution is obtained.

**Impact on model results:** This entry is only applicable to optimization runs.

## Corner Radius (multimodal)

**Description:** The corner radius describes radius of curvature at the sidewalk corner.

**Impact on model results:** Corner radius affects the available corner time-space.

## Critical Left Turn Gap Time

**Description:** This entry specifies the critical gap time required for permissive left-turners at a signalized intersection.

**Impact on model results:** This entry affects saturation flow rates and actuated phase times for left-turns operating under protected-permissive or permissive-only phasing.

## Critical Merge Gap

**Description:** This entry specifies the minimum gap required for merging into an adjacent lane.

**Impact on model results:** Critical merge gap affects the distribution of volumes and saturation flow rates among shared lane groups, and also affects access point operations.

## Crossover Probability

**Description:** This entry specifies the (genetic algorithm) crossover probability in a signal timing optimization run. The genetic algorithm initially considers a trial population of signal timing plan candidates. Within this population a competition takes place where the weak candidates are discarded, and the strong candidates are allowed to breed and perform crossover. Following crossover, a new generation of candidate solutions is born. Low crossover probabilities result in younger generations of solutions that are more similar to the older generations, whereas high crossover probabilities result in younger generations that are less similar to the older generations. This entry may affect the number of generations needed to locate the global optimum solution.

**Impact on model results:** This entry is only applicable to optimization runs.

## Crosswalk Closed (multimodal)

**Description:** If the subject crosswalk is closed in the signalized intersections procedure, then the pedestrian delay is estimated as the value obtained for the subject crosswalk, plus two increments of the delay for the perpendicular crosswalk. This adjustment reflects the additional delay pedestrians incur when crossing the other three legs of the intersection so that they can continue walking in the desired direction. The urban streets procedure must know the “distance to nearest signal-controlled crossing” if there is an identifiable pedestrian path that (a) intersects the segment and continues on beyond the segment and (b) on which most crossing pedestrians travel. This entry defines the distance pedestrians must travel along the segment should they divert from the path to cross the segment at the nearest signalized crossing. The crossing will typically be at a signalized intersection. However, it may also be at a signalized crosswalk provided at a mid-segment location. If the crossing is at a signalized intersection, it will likely occur in the crosswalk on the side of the intersection that is nearest to the segment. Occasionally, it will be on the far side of the intersection because the near-side crosswalk is closed (or a crossing at this location is otherwise prohibited). This distance is measured along one side of the subject segment; the methodology accounts for the return distance once the pedestrian arrives at the other side of the segment.

**Impact on model results:** Crosswalk Closed is used to compute the pedestrian diversion delay.

## Crosswalk Length (multimodal)

**Description:** Crosswalk length is measured from outside edge to outside edge of road pavement (or curb to curb, if present) along the marked pedestrian travel path.

**Impact on model results:** Crosswalk length affects the available crosswalk time-space, and the pedestrian service time.

## Crosswalk Width (multimodal)

**Description:** The crosswalk width represents an effective width. Unless there is a known width constraint, the crosswalk’s effective width should be the same as its physical width. A width constraint may be found when vehicles are observed to regularly encroach into the crosswalk area, or when an obstruction in the median (e.g., a signal pole, or reduced-width cut in the median curb) narrows the walking space.

**Impact on model results:** Crosswalk width affects the available crosswalk time-space, the time-space occupied by turning vehicles, and the pedestrian service time.

## Curb-to-Curb Street Width (multimodal)

**Description:** This entry specifies the width of the cross street as measured along the outside through vehicle lane on the subject approach, between the extended curb line limits of the cross street.

**Impact on model results:** The street width affects the cross section width adjustment factor.

## Cycle Length Increment

**Description:** This entry specifies the cycle length increments to be considered in a signal timing optimization run. For example, for cycle lengths in the range of 80-100 seconds with a 5-second increment, the optimization process would consider cycle lengths of 80, 85, 90, 95, and 100 seconds.

**Impact on model results:** This entry is only applicable to optimization runs.

## Cycle Length Optimization Flag

**Description:** This entry specifies whether or not cycle lengths are to be optimized in a signal timing optimization run.

**Impact on model results:** This entry is only applicable to optimization runs.

## Dallas Phasing

**Description:** This entry potentially allows left-turn movements to operate in the protected-permitted mode without causing a “yellow trap” safety concern. It effectively ties the left-turn’s permitted period signal indication to the opposing through signal indication.

**Impact on model results:** The Dallas phasing mode is considered when computing queue service times and effective green times for permissive-only and protected-permissive left-turn movements. This in turn potentially affects actuated phase times and control delays for all movements.

## Dallas Phasing Optimization

**Description:** This checkbox allows the user to request “Dallas Phasing” optimization during a Full Optimization run. When performing phasing sequence optimization, Dallas Phasing Optimization can be activated to prevent phasing sequences that would result in a “yellow trap” for the permissive left-turners. If the Phasing Sequence Optimization checkbox is selected without Dallas Phasing Optimization, the dashboard will post a warning message, but the optimization process will not modify the user’s original values of Dallas Phasing. If Phasing Sequence Optimization is selected with Dallas Phasing Optimization, the optimization process will turn on Dallas Phasing when a lagging left turn is opposed by a permissive left turn, and will turn off Dallas Phasing when both left turns are leading.

**Impact on model results:** This entry is only applicable to optimization runs.

## Date

**Description:** This entry documents the date on which the analysis was performed.

**Impact on model results:** None

## Deceleration Rate

**Description:** This entry specifies the average constant deceleration rate in response to a red indication.

**Impact on model results:** Accel-decel delays affect the computation of uniform stops and uniform queue.

## Delete Access Point

**Description:** This button is used to delete access points from the analysis. Access points can also be deleted graphically within Visual Mode.

## Delete Intersection

**Description:** This button is used to delete intersections from the analysis. Intersections can also be deleted graphically within Visual Mode.



## Delete Time Period

**Description:** This button is used to delete existing time periods from the analysis. When the button is clicked, the final time period will be deleted. When oversaturated conditions exist, a multiple-period analysis can more accurately capture the effects of traffic congestion. The number of time periods should be chosen such that the first and last time periods are undersaturated.

## Demand

**Description:** This entry specifies vehicular demand for each movement. Demand flow rate represents the flow rate of vehicles arriving at the intersection. When measured in the field, this flow rate is based on a traffic count taken upstream of the queue associated with the subject intersection. This distinction is important when counting during congested periods because the count of vehicles departing from a congested approach will produce a demand flow rate that is lower than the true rate. (All uses of the word “volume” or the phrase “volume-to-capacity ratio” refer to demand volume or demand volume-to-capacity ratio.)

Demand must be provided as an hourly flow rate (veh/h) when a single analysis period is considered with HCS. If a multi-period analysis is applied (more than one analysis period), the demand input format will automatically be changed to veh/p (vehicles per analysis period). For example, for a typical 15-min analysis, the user must provide the 15-min turning movement counts.

**Impact on model results:** The movement demands affect most aspects of the overall model; including control delay, time until onset of queue spillback, queue lengths, and travel time.

## Demand Growth

**Description:** This entry automatically modifies the vehicular demand volume for each movement.

**Impact on model results:** The movement volumes affect most aspects of the overall model; including control delay, time until onset of queue spillback, queue lengths, and travel time.

## Design Speed

**Description:** This entry specifies the design speed of the loop ramp or diverted movement. The speed used should provide safe passage of the conflict zone for the vast majority of drivers. If a DDI is newly constructed, the design speed of the curve should be utilized to provide an estimate of speed; however, to provide safe crossing for the slowest of vehicles, it should be decreased by 5 mi/h (or 1.6 km/h in metric).

**Impact on model results:** The design speed is used in the computation of extra distance travel time (EDTT) for each O-D movement, which in turn is used in the computation of experienced travel time (ETT) for each O-D movement.

## Design Vehicle Length

**Description:** This entry specifies the design length of a vehicle in feet (or meters in metric). The design vehicle length is typically 20 feet (or 6.1 meters in metric).

**Impact on model results:** This entry is only applicable to DDI alternative intersections. Along with free-flow speeds, clear zone widths, and the space between ramp stop bar and conflict zone, vehicle lengths contribute to the calculation of lost times that are applied to DDI off-ramp movements.

## Detected Vehicle Length

**Description:** This entry specifies the detected length of a vehicle.

**Impact on model results:** Detected vehicle length is used to compute maximum allowable headways (MAH) for each actuated movement. MAH impacts many aspects of the overall model; including actuated phase times, and control delays. Detected vehicle length is also used to compute queue storage ratio.

## Detector Length

**Description:** This entry typically specifies the length of a presence detector at the stop line. If the detector length is set equal to 1 foot, pulse mode detection is assumed. The stop line detector length represents the length of the detection zone used to extend the green indication for queue service. This detection zone is typically located near the stop line and may have a length greater than 40 feet (or 12.2 meters in metric). However, it can be located some distance upstream of the stop line and be as short as 6 feet (or 1.8 meters in metric) in length. This latter configuration typically requires a long minimum green or use of the controller's variable initial setting. If a video-image vehicle detection system is used to provide stop line detection, then the length that is input should reflect the physical length of roadway that is monitored by the video detection zone plus an additional length of 5 to 10 feet (or 1.5 to 3.1 meters in metric) to account for the projection of the vehicle image into the plane of the pavement (with larger values in this range used for wider intersections).

**Impact on model results:** Detector lengths affect the calculation of actuated phase times. The HCM Chapter 19/31 procedures do not recognize advance detection, detector setbacks, or volume-density control. In cases such as this, where the HCM procedures may have trouble estimating phase times accurately, the "Field Measured Phase Times" feature can be used.

## Diverging Diamond Data

**Description:** This button opens a dialog box with inputs relevant to a Diverging Diamond Interchange intersection. It will only appear when Diverging Diamond is selected under Interchange Type.

**Impact on model results:** None

## Downstream

**Description:** This button open a dialog box for the user to select and open the downstream crossover junction file coded in TWSC. Once opened, the TWSC file (.xtw) becomes attached in the Streets module.

**Impact on model results:** This button is only applicable to MUT with TWSC alternative intersections and is necessary for the completion of one MUT with Stop Signs alternative intersection.

## Downstream Intersection Width (multimodal)

**Description:** This entry specifies the width of the downstream intersection.

**Impact on model results:** Downstream intersection width affects diversion distance in cases where pedestrians choose to cross at the farthest downstream crosswalk.

## Dual Entry

**Description:** This entry specifies whether or not a phase is to be activated (green) even though it has not received a call for service. A phase operating in dual entry is available to be called by the controller, even if no actuations have been received for this phase. A phase operating in single entry will only be called if actuations have been received. When timing a cycle, a point is reached where the next phase (or phases) to be timed is on the other side of a barrier. At this point, the controller will check the phases in each ring and determine which phase to activate. If a call does not exist in a ring, a phase designated as dual entry in that ring will be activated by the controller. If two phases are designated as dual entry in this ring, then the first phase to occur in the phase sequence is activated.

**Impact on model results:** Dual entry affects the amount of vehicular and pedestrian calling flow for each actuated phase, potentially affecting actuated phase times and control delays.

## Dwell Time (multimodal)

**Description:** This entry specifies the time that the transit vehicle is stopped at the curb to serve passenger movements, including the time required to open and close the doors. It does not include time spent stopped after passenger movements have ceased (e.g., waiting for a traffic signal or waiting for a gap in traffic to re-enter the travel lane). Dwell times are typically in the range of 10-60 seconds, depending on boarding and alighting demand.

**Impact on model results:** Dwell time is used to compute the total delay due to the transit stop.

## EDTT Data

**Description:** This button opens a dialog box with inputs relevant to Extra Distance Travel Time (EDTT) Data for a Single-Point Urban Interchange or a Diverging Diamond Interchange intersection. This button will only enable when either SPUI or Diverging Diamond is selected under Interchange Type.

**Impact on model results:** None

## Excess Wait Time (multimodal)

**Description:** This entry specifies the average number of minutes passengers must wait at a stop past the scheduled departure time. It is measured in the field as the sum of the differences between the scheduled and actual departure times at the preceding timepoint, divided by the number of transit vehicle arrivals.

**Impact on model results:** Excess wait time is used to compute the perceived travel time factor, which in turn affects the transit LOS score.

## Exclusive Pedestrian Phase Time

**Description:** This entry specifies the amount of cycle time to be used by an exclusive pedestrian phase at each intersection. Currently, this calculation is only supported for uncoordinated intersections.

**Impact on model results:** For uncoordinated (Chapter 19) operations, exclusive pedestrian phase times affect the cycle length computed by the procedure. The cycle length and vehicular phase times affect most aspects of the overall model; including control delay, queue lengths, and travel time.

## Extension of Effective Green Time

**Description:** This entry specifies the amount of the change and clearance interval at the end of the phase for a lane group, usable by its vehicles.

**Impact on model results:** Extension of effective green times affect the calculation of actuated phase times and queue service times.

## Extra Distance

**Description:** The entry specifies the distance traveled along the loop ramp or diverted movement in an interchange.

**Impact on model results:** The extra distance is used in the computation of extra distance travel time (EDTT) for each O-D movement, which in turn is used in the computation of the experienced travel time (ETT) for each O-D movement.

## Field Free-Flow Speed

**Description:** This value can be field measured following the guidance in HCM Chapter 30 Section 5 and coded here to override the parameter computed by the procedure.

**Impact on model results:** This value is used to compute Percent Free-Flow Speed, which determines Level of Service using HCM Exhibit 18-1.

## Field Proportion Arriving on Green

**Description:** Proportion arriving on green is the proportion of vehicles that arrive during the green signal indication. A procedure is described in Section 3 of Chapter 30 that can be used to estimate the arrival flow profile for an intersection approach when this approach is evaluated as part of an urban street segment. The procedure uses the profile to compute the proportion of arrivals during the green indication.

**Impact on results:** Control delay and queue size at a signalized intersection are highly dependent on the proportion of vehicles that arrive during the green and red signal indications. Delay and queue size are smaller when a larger proportion of vehicles arrive during the green indication.

## Field Travel Speed

**Description:** This value can be field measured following the guidance in HCM Chapter 30 Section 5 and coded here to override the parameter computed by the procedure.

**Impact on model results:** This value is used to compute Percent Free-Flow Speed, which determines Level of Service using HCM Exhibit 18-1.

## Field-Measured Phase Times

**Description:** This entry specifies that user-entered phase splits and/or maximum greens will not be modified, as they normally would be, by the computational procedure to estimate signal phase durations.

**Impact on model results:** This entry allows delays and other output values to reflect actuation, but also allows average phase times to be directly user-entered as they were in the HCM 2000.

## Follow Up Left Turn Time

**Description:** This entry specifies the follow-up time required for permissive left-turners at a signalized intersection.

**Impact on model results:** This entry affects saturation flow rates and actuated phase times for left-turns operating under protected-permissive or permissive-only phasing.

## Force Mode

**Description:** For uncoordinated (Chapter 19) operations, the force mode is not used. For coordinated (Chapter 18) operations, this entry specifies the force-off mode (fixed or floating), which governs reallocation of green time within the cycle. The controller calculates the phase force-off point for each actuated phase based on the force mode and the phase splits. When set to the fixed mode, each actuated phase has its force-off point set at a fixed time in the cycle, relative to time zero on the system master. This operation allows unused split time to revert to the following phase. When set to the floating mode, each actuated phase has its force-off point set at the split time after the phase first becomes active. This operation allows unused split time to revert to the coordinated phase via an early return to green.

**Impact on model results:** Changing the force mode would potentially reallocation of green time within the cycle, possibly changing the amount of green time available to each movement. The amount of

available green time impacts most aspects of the overall model; including queue lengths, stops, and control delays.

## Forward Segment Length

**Description:** This entry specifies distance from the subject intersection to the next downstream intersection, typically in the "phase 2" direction of travel.

**Impact on model results:** The forward segment length impacts many aspects of the overall model; including the proportion of vehicles arriving on green, time until onset of queue spillback, and travel time.

## Forward Weighting

**Description:** This entry specifies the forward arterial weighting in a signal timing optimization run. For example, if "Travel Time" were chosen as the objective function, and if "Both Major Street Directions" were chosen as the objective function direction, the optimization process would attempt to find a timing plan that would minimize travel times that were multiplied by the forward and reverse weighting factors. This entry has no effect on the approach-specific objective functions (approach stops, approach delay).

**Impact on model results:** This entry is only applicable to optimization runs.

## Free-Flow Speed of Vehicle

**Description:** This entry specifies the average speed of vehicles on a given segment, measured under low-volume conditions, when drivers are free to drive at their desired speed and are not constrained by the presence of other vehicles or downstream traffic control devices.

**Impact on model results:** This entry is only applicable to DDI alternative intersections. Along with clear-zone widths, vehicle speeds, and the space between ramp stop bar and conflict zone, free-flow speeds contribute to the calculation of lost times that are applied to DDI off-ramp movements.

## Heaviest Lane Volume

**Description:** This entry specifies the single-lane volume with the highest volume of each movement group.

**Impact on model results:** Heaviest lane volume affects the lane utilization adjustment factor, which in turn affects the adjusted saturation flow rates.

## Heavy Vehicle Equivalency

**Description:** This entry specifies the ratio of passenger car to heavy vehicle saturation flow rate, at signalized intersections. The equivalent number of passenger cars for each heavy vehicle is typically 2.0.

**Impact on model results:** This entry affects the heavy vehicle adjustment factor and the adjusted saturation flow rate.

## Hide Multimodal Results (multimodal)

**Description:** For "operations only" analyses, this checkbox can be used to hide multimodal outputs on the Results Report and the Intermediate Report.

**Impact on model results:** None.

## Incoming Pedestrian Volume (multimodal)

**Description:** This entry specifies the number of pedestrians walking in the reverse direction of travel. For example, on the eastbound approach, incoming pedestrians will travel westbound on the southern-most crosswalk.

**Impact on model results:** Incoming pedestrian volume affects the number of pedestrians arriving at each intersection corner during each cycle, and the total number of circulating pedestrians at each corner.

## Initial Queue Length

**Description:** This entry specifies the initial queue at the beginning of the first analysis period, either observed in the field or carried over from the computations of a previous analysis period. The initial queue for the subject period is the unmet demand from the previous period and represents the number of vehicles present in the movement group at the start of the analysis period. The value entered represents the total number of vehicles observed in the subject traffic lanes at the start of this time period. The initial queue value should not include vehicles in queue due to random, cycle-by-cycle fluctuations. Initial queue is estimated as the queue count at the start of the red indication. Whether or not an initial queue value is coded for the first time period, unmet demand will be computed for each period and will be carried forward as the initial queue for the subsequent period.

**Impact on model results:** Initial queue analyses (in which one or more movements are coded with a non-zero initial queue length) invoke a substantially more extensive computational procedure than analyses with no initial queues. Model results (from initial queue analyses) are more likely to reflect the increased congestion caused by period-to-period unmet demand.

## Inside Object Effective Width (multimodal)

**Description:** This entry specifies the effective width of fixed objects on the inside of the sidewalk. These objects include light poles, traffic signs, planter boxes, etc.

**Impact on model results:** Inside object effective width is used to compute the effective sidewalk width.

## Interchange Intersection

**Description:** This entry specifies whether or not this intersection can be classified as being part of an interchange ramp terminal facility.

**Impact on model results:** Interchange intersections are potentially affected by the traffic pressure adjustment factor, additional lost time from queue spillback, additional lost time from demand starvation, and lane utilization adjustments based on the interchange type.

## Interchange Type

**Description:** If this intersection has been flagged as an interchange intersection, this entry specifies the type of an interchange ramp terminal facility (e.g., Parclo, Diamond, SPUI).

**Impact on model results:** Lane utilization adjustments are based on the interchange type.

## Intersection Depth

**Description:** This is the distance between the stop bar on the approach and the beginning of the downstream intersection leg.

**Impact on model results:** This variable defines intersection size, as: (a) Small: depth of 82 ft (or 25.0 m in metric) or less (1 or 2 lanes per approach); (b) Medium: depth between 82 ft (or 25.0 m in metric) and



131 ft (or 39.9 m in metric) (2 lanes per approach); and (c) Large: depth larger than 131 ft (or 39.9 m in metric) (3 or more lanes for at least two approaches).

## Intersection Dropdown

**Description:** The intersection dropdown control allows the user to switch between active intersections for editing input data, and for viewing reports.

**Impact on model results:** None

## Intersection Name

**Description:** This entry documents the name of the intersection being analyzed. These names can then be viewed within output reports, and within Quick Animation.

**Impact on model results:** None

## Intersection Type

**Description:** When the Alternative Intersection checkbox is checked, this combo box will enable, allowing the user to convert a coded conventional intersection into an alternative intersection. The choices of Intersection Type include MUT with TWSC, RCUT, and DLT.

*Median U-Turn (MUT) intersections with Two-Way Stop-Control (TWSC):* At-grade intersections at which major- and minor-street left turns are rerouted. Minor-street through movements are not rerouted. U-Turn crossovers are stop-controlled instead of signalized.

*Restricted Crossing U-Turn (RCUT) intersections:* At-grade intersections at which minor-street left-turn and through movements are rerouted. Major-street left turns are not rerouted.

*Displaced Left-Turn (DLT) intersections:* At-grade intersections where left-turning vehicles cross opposing through traffic before reaching the main intersection, thus reducing conflicts at the main intersection.

**Impact on model results:** This entry is only applicable to Alternative Intersections.

## Jurisdiction

**Description:** This entry documents the jurisdiction for which the analysis is being performed.

**Impact on model results:** None

## K Factor, %

**Description:** The K factor is the proportion of the annual average daily traffic (AADT) that occurs in the peak hour. It is used by Streets to convert the hourly demand used by the HCM methodologies to AADT, which is used by the crash prediction model.

**Impact on model results:** Higher values for this variable indicate higher concentration of traffic in the peak hours and, consequently, lower AADT year-round. Since all safety models predict crashes proportionally to AADT, the higher the K factor, the lower the expected number of yearly crashes.

## Lag Phase

**Description:** This entry specifies whether or not the associated left-turn phase occurs immediately after the opposing (through movement) phase terminates. If split phasing is in effect, this entry indicates which through movement phase (4 or 8) occurs first.

**Impact on model results:** Changing the phasing sequence (via Lag Phase) would potentially shift the window of major street green time to a different part of the cycle, possibly changing the proportion of arrivals on green for one or more movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays. The minor street phasing sequence could also affect the times during which cross street vehicles are released on to the major street, again affecting the proportion of arrivals on green.

## Lane Width

**Description:** This entry specifies the average width of lanes represented in a movement group. The minimum average lane width is 8 feet (or 2.4 meters in metric). Standard lane widths are 12 feet (or 3.7 meters in metric). Lane widths greater than 16 feet can be included; however, the analyst should consider whether the wide lane actually operates as two narrow lanes. The analysis should reflect the way in which the lane width is actually used or expected to be used.

**Impact on model results:** Lane widths below 10 feet (or 3.0 meters in metric) decrease the saturation flow rate for the associated movement, resulting in higher delays, travel times, queues, etc. Lane widths above 12.9 feet (or 3.93 meters in metric) increase the saturation flow rate for the associated movement, resulting in lower delays, travel times, queues, etc.

## Left Turn Equivalency

**Description:** This entry specifies the ratio of through to left-turn saturation flow rate, at signalized intersections.

**Impact on model results:** Left turn equivalency affects the distribution of saturation flow rates among lanes, which in turn affects many aspects of the overall model. Left turn equivalency also affects the computation of maximum allowable headways (MAH) for each actuated movement, which impacts actuated phase times.

## Legal Mid-Segment Crossing (multimodal)

**Description:** This entry indicates whether a pedestrian can cross the segment at any point along its length, regardless of location. If it is illegal to make this crossing at any point, then the pedestrian is assumed to be required to divert to the nearest signalized intersection to cross the segment.

**Impact on model results:** If mid-segment crossing is not legal, pedestrian waiting delay should be zero. If mid-segment crossing is legal, pedestrian waiting delay should be estimated by the analyst or computed using Chapter 20 procedures.

## Map X/Y Coordinate

**Description:** These entries specify node coordinate locations for drawing link-node geometry on the map and are only available in Visual Mode. The X coordinate is the horizontal value in a pair of coordinates and describes how far along left or right the point is from the origin (0,0). The Y coordinate is the vertical value in a pair of coordinates and describes how far or up or down the point is from the origin. (0,0).

**Impact on model results:** Segment lengths will be automatically re-calculated by Visual Mode as a function of node coordinates, and any segment curvature that might exist.

## Map X/Y Curve Point 1 and Point 2

**Description:** These entries specify control point for drawing roadway curvature on the map.

**Impact on model results:** None

## Master Intersection Number

**Description:** This entry specifies the master intersection number for a signal timing optimization run. Offsets for the master intersection will not be modified during an optimization run. If desired the master intersection number can be set to zero, thus allowing offsets to be modified at all intersections during an optimization run. This entry will be ignored if the master intersection number does not match any of the intersection numbers within the dataset.

**Impact on model results:** This entry is only applicable to optimization runs.

## Maximum Cycle Length

**Description:** This entry specifies the maximum candidate cycle length to be considered in a signal timing optimization run.

**Impact on model results:** This entry is only applicable to optimization runs.

## Maximum Green

**Description:** For uncoordinated (Chapter 19) operations, this entry specifies the maximum amount of time that a green signal indication can be displayed in the presence of conflicting demand. For coordinated (Chapter 18) operations, maximum green is not used.

**Impact on model results:** The amount of available green time impacts most aspects of the overall model; including queue lengths, stops, and control delays. This entry is applicable only when Uncoordinated Intersection is checked.

## Maximum Number of Generations

**Description:** This entry specifies the (genetic algorithm) maximum number of generations in a signal timing optimization run. During optimization, the optimal function value and average function value are constantly recomputed. The optimal function value represents the best objective function value when considering all candidate timing plans in that particular generation. The average function value is the average performance index value from all candidate solutions in that particular generation. During successive generations, the optimal function value and the average function value tend to improve due to the genetic selection process. The average function value can occasionally become worse due to a "bad mutation", but the optimal function value should always stay the same or improve. Convergence is achieved when the average function value becomes sufficiently close to the optimal function value. Increasing the maximum number of generations (or decreasing the convergence threshold) tends to produce longer program running times, but better timing plans. Of course, once the global optimum solution has been reached, additional generations and tighter convergence thresholds have no additional benefit. Complex traffic networks tend to require substantially more generations of candidate solutions before an optimal solution is obtained.

**Impact on model results:** This entry is only applicable to optimization runs.

## Maximum Platoon Headway

**Description:** This entry specifies the maximum time headway that defines a platooned vehicle.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Median Type (multimodal)

**Description:** The median type is designated as undivided, non-restrictive (e.g., two-way left-turn lane), or restrictive (e.g., raised curb).

**Impact on model results:** Median type affects the cross section width adjustment factor.

## Mid-Segment 85th-Percentile Speed (multimodal)

**Description:** The 85th percentile speed represents the speed of the vehicle whose speed is exceeded by only 15% of the population of vehicles. The speed of interest is that of vehicles traveling along the street approaching the subject intersection. It is measured at a location that is sufficiently distant from the intersection that speed is not influenced by intersection operation. This speed is likely to be influenced by traffic conditions, so it should reflect the conditions present during the analysis period.

**Impact on model results:** The 85th percentile speed affects the motorized vehicle speed adjustment factor.

## Minimum Cycle Length

**Description:** This entry specifies the minimum candidate cycle length to be considered in a signal timing optimization run.

**Impact on model results:** This entry is only applicable to optimization runs.

## Minimum Green

**Description:** This entry specifies the shortest amount of time that a green signal indication will be displayed for a movement. It is input for each non-coordinated signal phase. Its duration is based on considerations of driver reaction time, queue length, and driver expectancy. Minimum green may be as short as 3 seconds for a left-turn phase, and 5 to 10 seconds for a through movement. For intersections without pedestrian push buttons, the minimum green interval may also need to be sufficiently long to allow a pedestrian to cross during the concurrent vehicular phase.

**Impact on model results:** Minimum green time affects the amount of available green time, which impacts most aspects of the overall model; including queue lengths, stops, and control delays. Minimum green time may also affect the probability of traffic accidents under certain conditions.

## Minimum Platoon Headway

**Description:** This entry specifies the minimum time headway between vehicles traveling in a platoon.

**Impact on model results:** This entry affects access point operations. Access point operations are used to modify the proportion of arrivals on green for downstream major-street movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## MUT Segment Free-Flow Speed

**Description:** When the Alternative Intersection checkbox is checked and the Intersection Type selected is MUT with TWSC, fields for Segment Free-Flow Speed will enable.

**Impact on model results:** This entry affects the Extra Distance Travel Time (EDTT) for the movements that are rerouted as a result of converting to the alternative intersection.

## MUT Segment Length

**Description:** When the Alternative Intersection checkbox is checked and the Intersection Type selected is MUT with TWSC, fields for Segment Length will enable.

**Impact on model results:** This entry affects the Extra Distance Travel Time (EDTT) for the movements that are rerouted as a result of converting to the alternative intersection.

## Mutation Probability

**Description:** This entry specifies the (genetic algorithm) mutation probability in a signal timing optimization run. Mutation is an arbitrary modification of randomly selected genes. The proportion of mutated genes is affected by the mutation probability. The mutation process prevents the gene pool from becoming stale and failing to recognize new possibilities. In addition, the mutation process allows the genetic algorithm to locate the global optimum solution instead of a local optimum solution. Beware that excessively high mutation probabilities may significantly increase the amount of time required for optimization, or may prevent optimization altogether. If the optimization process is converging too quickly, or if the analyst wishes to examine a wider range of timing plan possibilities, then increasing the mutation probability may be helpful. If the optimization process is not converging quickly enough, or if the analyst wishes to acquire a reasonable and effective local optimum solution, then decreasing the mutation probability may be helpful.

**Impact on model results:** This entry is only applicable to optimization runs.

## Nearest Signal Distance (multimodal)

**Description:** This input parameter is needed if there is an identifiable pedestrian path that (a) intersects the segment and continues on beyond the segment and (b) on which most crossing pedestrians travel. This entry defines the distance pedestrians must travel along the segment should they divert from the path to cross the segment at the nearest signalized crossing. The crossing will typically be at a signalized intersection. However, it may also be at a signalized crosswalk provided at a mid-segment location. If the crossing is at a signalized intersection, it will likely occur in the crosswalk on the side of the intersection that is nearest to the segment. Occasionally, it will be on the far side of the intersection because the near-side crosswalk is closed (or a crossing at this location is otherwise prohibited). This distance is measured along one side of the subject segment; the methodology accounts for the return distance once the pedestrian arrives at the other side of the segment.

**Impact on model results:** Nearest signal distance is used to compute diversion delay.

## New Access Point

**Description:** This button is used to add new access points to the analysis. New access points can also be added graphically within Visual Mode.

## New Intersection

**Description:** This button is used to add new intersections to the analysis. New intersections can also be added graphically within Visual Mode.

## New Time Period

**Description:** This button is used to add new time periods to the analysis. When the button is clicked a new, final time period will be added at the end of all existing time periods. When oversaturated conditions exist, a multiple-period analysis can more accurately capture the effects of traffic congestion. The number of time periods should be chosen such that the first and last time periods are undersaturated.

## Number of Active Access Points

**Description:** This entry specifies the number of active access points on the segment. Unlike the “non-active” access points for which volumes, laneage, and locations are not coded, these access points serving more than 10 vehicles per hour.

**Impact on model results:** Active access points affect the proportion of vehicles arriving on green at the downstream intersection.

## Number of Intersections

**Description:** This entry specifies the number of intersections in a brand-new dataset. After the new dataset is created, intersections can be added or deleted at any time.

## Number of Iterations

**Description:** This entry specifies a number of model iterations for the computation of actuated phase times. Queue service times are dependent on green interval durations. This dependency introduces a circularity in the calculation process. Thus, the procedure is iterative, where an initial estimate of green interval duration is provided and the green interval duration is re-computed. The computed duration is compared with the initial estimate and, if they are different, then the computed value becomes the new initial estimate and the procedure is repeated. Iterations are repeated until the initial estimate and computed green interval duration are equal.

**Impact on model results:** If the number of model iterations is too small, this could compromise the accuracy of the model. Higher numbers of model iterations may require longer computation times on the computer. The number of model iterations may have no impact on the model results of intersections under pre-timed operation (indicated by max recall on every phase).

## Number of Lanes

**Description:** This entry specifies the number of intersection lanes available for use by each movement. For through movements, this would include shared L+T, T+R, and L+T+R lanes. For left-turn and right-turn movements, only the number of exclusive (non-shared) turn lanes should be entered. The procedure does not explicitly allow specification of L+R approaches with zero through vehicles; such as a one-lane approach with L+R, or a two-lane approach with LT-only and RT-only. Mechanics of the analysis for a one lane approach with L+R should be the same as for a one-lane approach with L+T+R and a through volume equal to 1 vph. Mechanics of the analysis for a two-lane approach with LT-only and RT-only should be the same as when the approach is coded having one exclusive left-turn lane (LT-only), one shared through-right lane T+R, and a through volume equal to 1 vph. Alternatively, mechanics of the analysis for a two-lane approach with LT-only and RT-only should also be the same as when the approach is coded as having two lanes with L+T+R and a through volume equal to 1 vph.

**Impact on model results:** Intersection laneage has a fundamental effect on all aspects of the model results.

## Number of Periods

**Description:** This entry specifies the number of time periods in a brand-new dataset. After the new dataset is created, periods can be added or deleted at any time.

## Number of Receiving Lanes

**Description:** This entry specifies the count of lanes departing the intersection. This number should be separately determined for each left-turn and right-turn movement. Experience indicates that proper turning cannot be executed at some intersections because a receiving lane is frequently blocked by



double-parked vehicles. For this reason, the number of receiving lanes should be determined from field observation whenever possible.

**Impact on model results:** The number of receiving lanes affects the ped-bike saturation flow rate adjustment calculations.

## Number of Right-Turn Islands (multimodal)

**Description:** This entry specifies the number of right-turn channelizing islands along the crosswalk.

**Impact on model results:** The number of right-turn islands affects the motorized vehicle volume adjustment factor.

## Number of Transit Stops (multimodal)

**Description:** This entry specifies the number of transit stops on the segment for the subject route.

**Impact on model results:** The number of transit stops affects the transit vehicle segment running speed.

## O-D Seeds

**Description:** This entry specifies the average proportion of vehicle volumes that travel from each upstream (origin) movement to each downstream (destination) movement.

The volume of traffic that arrives at a downstream intersection for a given downstream movement represents the combined volume from each upstream point of entry weighted by its percentage contribution to the downstream exit movement. The distribution of these contribution percentages between each upstream and downstream pair is represented as an origin-destination distribution matrix.

The origin-destination matrix is important for estimating the arrival pattern of vehicles at the downstream intersection. Hence, the focus here is on upstream entry movements that are signalized, because (a) they are typically the higher-volume movements and (b) the signal timing influences their time of arrival downstream. For these reasons, the origin-destination distribution is focused on the three upstream signalized movements. All other movements (i.e., unsignalized movements at the boundary intersections, access point movements, RTOR movements) are combined into one equivalent movement—referred to hereafter as the “access point” movement—that is assumed to arrive uniformly throughout the signal cycle.

The use of seed percentages allows the procedure to adapt the origin-destination volume estimates to factors or geometric situations that induce greater preference for some entry-exit combinations than is suggested by simple volume proportion (e.g., a downstream freeway on-ramp). The default seed proportions are listed in HCM Exhibit 30-2:

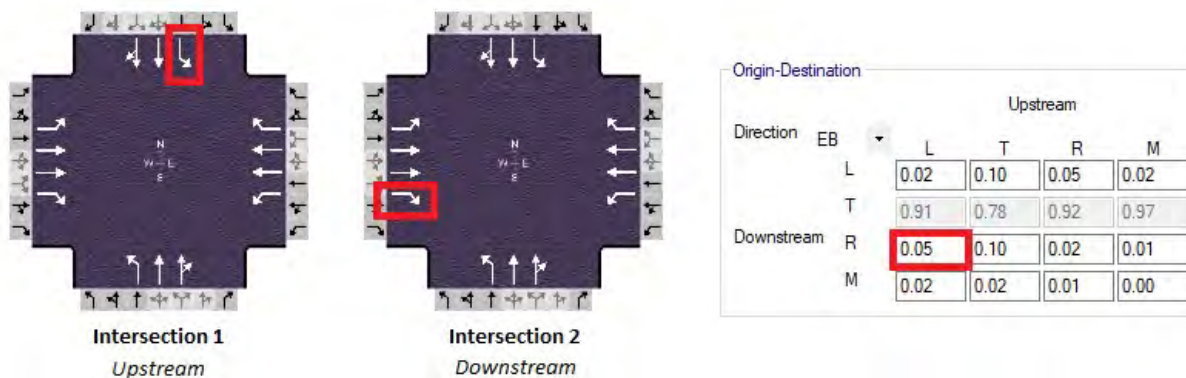
Seed Proportion by Origin Movement			
Left	Through	Right	Access Point
0.02	0.10	0.05	0.02
0.91	0.78	0.92	0.97
0.05	0.10	0.02	0.01
0.02	0.02	0.01	0.00

Movements within the O-D matrix are dependent on the major-street and Forward Direction. The upstream intersection movements refer to the movements heading toward the downstream intersection. The downstream intersection movements refer to the movements in the downstream intersection of the forward direction approach. For example, when the major-street is East-West and the Forward Direction

is EB, the Upstream Intersection 1 movements are as follows: L refers to SBL, T refers to EBT, R refers to NBR, and M refers to “access point” movements. The Downstream Intersection 2 are as follows: L refers to EBL, T refers to EBT, R refers to EBR, and M refers to “access point” movements.

Example of corresponding movements in O-D matrix:

Left Origin and Right Destination: if the major-street is East-West and the Forward Direction is EB, then the 0.05 found below in red in the O-D matrix refers to the southbound left-turn movement from Intersection 1 (upstream intersection) and the eastbound right-turn movement from Intersection 2 (downstream intersection).



**Impact on model results:** This entry is not used unless more than one intersection is being analyzed by the (Chapter 18) procedure. Changing the O-D seeds could affect the proportion of arrivals on green throughout the urban street system. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Offset

**Description:** This entry specifies the difference between the start of green time for the reference interval at the subject intersection, and a specified time datum in a system of signalized intersections. The offset is used to coordinate timing plans at adjacent intersection along an urban street, ideally allowing vehicles to pass through multiple intersection without stopping.

**Impact on model results:** For uncoordinated (Chapter 19) operations, the offset is not used. For coordinated (Chapter 18) operations, offsets affect many aspects of the overall model; including travel speeds, travel times, stops, and control delays.

## Offset Optimization Flag

**Description:** This entry specifies whether or not offsets are to be optimized in a signal timing optimization run.

**Impact on model results:** This entry is only applicable to optimization runs.

## On-Ramp Left Lane Shared

**Description:** This checkbox indicated if the specified left-turn movement is in a shared left-thru lane.

**Impact on results:** This entry is only applicable to DDI intersection. For DDI in Streets, a coded major-street exclusive left-turn lane is necessary for the lane configuration. However, this checkbox allows the user to specify if that left-turn is in a shared lane. If true, calculation are done internally with consideration of the shared lane.

## On-Street Parking

**Description:** This entry specifies the percent of on-street parking on the link, which is converted to a proportion for calculations. The proportion of the segment with on-street parking represents that portion of the link length that has parking stalls (either marked or unmarked) available along the right side of the segment. This proportion is computed as the length of street with parking stalls divided by the link length. Parking stalls considered include those described as having either a parallel or angle design. This proportion is separately computed for each direction of travel along the segment.

**Impact on model results:** On-Street Parking is used in the computation of segment free-flow speed; which in turn affects segment running times, and the proportion of vehicle arrivals on green.

## Open RCUT File

**Description:** This button opens a dialog box for the user to select and open the second RCUT file to complete the coded RCUT.

**Impact on model results:** This button is only applicable to RCUT alternative intersections and is necessary for the completion of one RCUT alternative intersection.

## Opposing Right-Turn Lane Influence

**Description:** This entry specifies whether or not permitted left turners are influenced by exclusive right-turn lanes on the opposing approach. This determination should be based on knowledge of local driver behavior, traffic conditions, and intersection geometry.

**Impact on model results:** When opposing right-turn lane influence exists, this decreases permitted left-turn capacity. When opposing right-turn lane influence does not exist, this increases permitted left-turn capacity.

## Optimization Objective Function

**Description:** This entry specifies the objective function to be considered in a signal timing optimization run. For example, if “travel time” were chosen as the objective function, the optimization process would attempt to find a timing plan that would minimize travel time.

**Impact on model results:** This entry is only applicable to optimization runs.

## Optimization Objective Function Direction

**Description:** This entry specifies the objective function direction to be considered in a signal timing optimization run. The available options are “Both Major Street Directions”, “Forward Major Street Direction”, “Reverse Major Street Direction”, and “All Approaches”. For example, if “Travel Time” were chosen as the objective function, and if “Reverse Major Street Direction” were chosen as the objective function direction, the optimization process would attempt to find a timing plan that would minimize travel times in the urban street reverse direction. The “Forward Major Street Direction” and “Reverse Major Street Direction” selections are tantamount to applying 100% objective function weighting to the chosen direction, and 0% objective function weighting to the opposite direction. If the “Both Major Street Directions” selection or “All Approaches” selection is chosen in conjunction with arterial objective functions (travel speed, travel time, spatial stops), the default arterial weighting is 50% in each direction. The analyst can specify unequal arterial weightings using the “Forward Direction Weighting” and “Reverse Direction Weighting” entries, if desired.

**Impact on model results:** This entry is only applicable to optimization runs.

## Outgoing Pedestrian Volume (multimodal)

**Description:** This entry specifies the number of pedestrians walking in the forward direction of travel. For example, on the eastbound approach, outgoing pedestrians will travel eastbound on the southern-most crosswalk.

**Impact on model results:** Outgoing pedestrian volume affects the number of pedestrians arriving at each intersection corner during each cycle, and the total number of circulating pedestrians at each corner.

## Outside Object Effective Width (multimodal)

**Description:** This entry specifies the effective width of fixed objects on the outside of the sidewalk.

**Impact on model results:** Outside object effective width is used to compute the effective sidewalk width.

## Outside Thru Lane Width (multimodal)

**Description:** This entry specifies the width of the outside thru vehicle lane on the subject approach.

**Impact on model results:** The outside thru lane width affects the cross section width adjustment factor.

## Parking Exists

**Description:** This entry indicates that on-street parking spaces exist within 250 feet (76.2 meters in metric) of the intersection (regardless of whether or not parking maneuvers take place). This entry indicates whether on-street parking is allowed along the curb line adjacent to a movement group and within 250 feet (76.2 meters in metric) upstream of the stop line during the analysis period. On a one-way street with no exclusive turn lanes, the presence of on-street parking is separately noted for each side of the street.

**Impact on model results:** The existence of parking decreases the saturation flow rate for associated movements, resulting in higher delays, travel times, queues, etc. Note that parking conditions with zero maneuvers have a different impact than a no-parking situation.

## Parking Lane Width (multimodal)

**Description:** This entry specifies the width of the parking lane on the subject approach.

**Impact on model results:** The parking lane width affects the cross section width adjustment factor.

## Parking Maneuver Time

**Description:** This entry specifies the amount of time (default: 18 seconds) needed by a driver to execute a parking maneuver.

**Impact on model results:** The parking maneuver time affects the parking adjustment factor, which is used to adjust the saturation flow rates.

## Parking Maneuvers per Hour

**Description:** This entry specifies the number of parking maneuvers that occur directly adjacent to a movement group and within 250 feet (76.2 meters in metric) upstream of the stop line, as measured during the analysis period. A maneuver occurs when a vehicle enters or exits a parking stall. If more than 180 maneuvers per hour exist, a practical limit of 180 should be used. On a one-way street with no exclusive turn lanes, maneuvers are separately counted for each side of the street. The count is divided by the analysis period duration to yield an hourly flow rate.

**Impact on model results:** Non-zero parking maneuvers per hour decrease the saturation flow rate for associated movements, resulting in higher delays, travel times, queues, etc. Note that parking conditions with zero maneuvers have a different impact than a no-parking situation.

## Passage Time

**Description:** This entry specifies the maximum amount of time one vehicle actuation can extend the green interval when green is displayed. It is input for each non-coordinated signal phase. It is also referred to as vehicle interval, extension interval, extension, or unit extension. The passage timer starts to time from the instant the vehicle actuation is removed. A subsequent actuation will reset the passage timer. When the passage timer reaches the passage time setting and there is an actuation on a conflicting phase, the phase will terminate by gap out. Passage time values are typically chosen based on consideration of detection zone length, detection zone location (relative to the stop line), number of lanes served by the phase, and vehicle speed. Longer passage times are often used with shorter detection zones, greater distance between the zone and stop line, fewer lanes, and slower speeds. The objective when determining the passage time value is to make it large enough to ensure that all queued vehicles are served but to not make it so large that it extends for randomly arriving traffic. On high-speed approaches, this objective is broadened to include not making the passage time so large that the phase frequently extends to its maximum setting (i.e., maxes-out) such that safe phase termination is compromised.

**Impact on model results:** Passage time is used to compute maximum allowable headways (MAH) for each actuated movement. MAH impacts many aspects of the overall model; including actuated phase times, and control delays.

## Passenger Load Factor (multimodal)

**Description:** This entry specifies the number of passengers occupying the transit vehicle divided by the number of seats on the vehicle. If the number of passengers equals the number of seats, then the load factor equals 1.0. This factor should be measured in the field or obtained from the agency serving the transit route. It is an average value for all of the scheduled fixed route transit vehicles that travel along the segment during the analysis period.

**Impact on model results:** Passenger load factor is used to compute the perceived travel time rate.

## Paved Shoulder Width (multimodal)

**Description:** This entry specifies the width of the paved outside shoulder on the subject approach.

**Impact on model results:** The paved shoulder width affects the cross section width adjustment factor.

## Pavement Condition Rating (multimodal)

**Description:** This entry, which ranges from 0.0 to 5.0, describes the road surface in terms of ride quality and surface defects. PCR values of 4.0 or higher imply new or nearly new superior pavement; free of cracks and/or patches, and allowing a good ride. PCR values of 1.0 or lower imply distress over at least 75% of the surface; with large potholes and/or deep cracks, and an uncomfortable ride.

**Impact on model results:** Pavement condition rating affects the bicycle level of service score for the “link”.

## Peak-Hour Factor

**Description:** This entry specifies the proportion of peak-hour volume occurring in the peak 15 minutes. Peak 15-minute volume is computed as the hourly volume divided by four times the PHF.

**Impact on model results:** The PHF (when lower than 1.0) simply factors up the associated movement volume, to reflect increased flow rates during the peak 15-minute period.

## Pedestrian Free-Flow Speed (multimodal)

**Description:** This entry specifies the average desired walking speed of all pedestrians on this particular sidewalk.

**Impact on model results:** The (average) free-flow walk speed is used to compute the (average) actual walk speed. Increasing two-way pedestrian volumes cause actual walk speeds to become increasingly lower than free-flow walk speeds. Decreasing effective sidewalk widths cause actual walk speeds to become increasingly lower than free-flow walk speeds.

## Pedestrian Signal Head (multimodal)

**Description:** The presence of a pedestrian signal head influences pedestrian crossing behavior. If a pedestrian signal head is provided, then pedestrians are assumed to use the crosswalk during the WALK and flashing DON'T WALK indications. If no pedestrian signal heads are provided, then pedestrians will cross during the green indication provided to vehicular traffic.

**Impact on model results:** The presence of a pedestrian signal head affects the effective walk time for all phases.

## Pedestrian Waiting Delay (multimodal)

**Description:** This entry specifies the delay incurred when pedestrians wait at an uncontrolled crossing location, if this type of crossing is legal.

**Impact on model results:** Pedestrian waiting delay affects the roadway crossing difficulty factor.

## Pedestrians per Hour

**Description:** This entry specifies the number of pedestrians traveling in the crosswalk that is crossed by vehicles turning right from the subject approach during the analysis period. For example, the pedestrian flow rate for the westbound approach would describe the pedestrian flow in the crosswalk on the north leg. The count is divided by the analysis period duration to yield an hourly flow rate.

**Impact on model results:** Non-zero pedestrians per hour decrease the saturation flow rate for associated movements, resulting in higher delays, travel times, queues, etc.

## Percent Grade

**Description:** Approach grade defines the average grade along the approach, as measured along a line parallel to the direction of travel and from the stop line to a point 100 feet (30.5 meters in metric) upstream of the stop line. An uphill condition has a positive grade, and a downhill condition has a negative grade.

**Impact on model results:** Upgrades (above zero) decrease the saturation flow rate for associated movements, resulting in higher delays, travel times, queues, etc. Downgrades (below zero) increase the saturation flow rate for associated movements, resulting in lower delays, travel times, queues, etc.

## Percent Trucks

**Description:** This entry specifies the percentage of trucks (heavy vehicles) in the traffic stream for each movement. A heavy vehicle is defined as any vehicle with more than four tires touching the pavement. Local buses that stop near the intersection (as defined in a subsequent section) are not included in the

count of heavy vehicles. The percentage of heavy vehicles represents the number of heavy vehicles that arrive during the analysis period divided by the total vehicle count for the same period. This percentage is provided for each intersection traffic movement; however, one representative value for all movements may be used for a planning analysis.

**Impact on model results:** Non-zero truck percentages decrease the saturation flow rate for the associated movement, resulting in higher delays, travel times, queues, etc. For the multimodal (bicycles) procedure, truck percentages are used to compute the motorized vehicle speed adjustment factor.

## Percent Turns in Shared Lane

**Description:** These entries specify the percentage of left-turn or right-turn vehicles using the shared lane instead of the exclusive lane. These entries are only applicable to shared-plus-exclusive lane configurations.

**Impact on model results:** The vehicular demands affect most aspects of the overall model; including control delay, time until onset of queue spillback, queue lengths, and travel time.

## Percent Unopposed Left Turns

**Description:** Because the HCM procedures do not explicitly support unopposed major-street left turns on a one-way street, these conditions can be approximated by adding left-turn volume into the thru volume. However, when doing this, saturation flow rates must also be adjusted to account for left turns in the traffic stream. This entry allows the user to specify the percentage of major-street left turns within the thru movement, which can then automatically adjust saturation flow rates for the thru movement. This entry is not applicable for minor side streets, and is not applicable for two-way major streets. This entry is also not applicable for one-way major streets on which left turns do not exist.

**Impact on model results:** The percentage of unopposed left turns is used as a multiplier for the left-turn equivalency, which defaults to 1.05. For example, thru movement saturation flow rate would be reduced by 2.5% if the percent unopposed left turns were coded as 50%. Similarly, thru movement saturation flow rate would be reduced by 0.5% if the percent unopposed left turns were coded as 10%.

## Period Dropdown

**Description:** The time period dropdown control allows the user to switch between active time periods for editing input data, and for viewing reports.

**Impact on model results:** None

## Permitted Left-Turn Flow (multimodal)

**Description:** This entry specifies the count of vehicles that turn left permissively. A permitted left-turn movement can occur with either the permitted or the protected-permitted left-turn mode. For left-turn movements served by the permitted mode, the permitted left-turn flow rate is equal to the left-turn demand flow rate. For left-turn movements served by the protected-permitted mode, the permitted left-turn flow rate should be measured in the field because its value is influenced by many factors.

**Impact on model results:** Permitted left-turn flow affects the effective available crosswalk time-space, and the motorized vehicle volume adjustment factor.

## Phase 2 Direction

**Description:** This entry specifies the direction of "phase 2" in the timing plan. The phase 2 direction does not need to be identical to the urban street forward direction. However, if the urban street forward direction is eastbound or westbound, the phase 2 direction must either be eastbound or westbound. If the



urban street forward direction is northbound or southbound, the phase 2 direction must either be northbound or southbound.

**Impact on model results:** Reversing the phase 2 direction would cause input controller settings for phases 1, 2, 5, and 6 to apply to the opposite direction.

## Phase 4 Direction

**Description:** This entry specifies the direction of "phase 4" in the timing plan. The phase 4 direction must be perpendicular to the urban street forward direction.

**Impact on model results:** Reversing the phase 4 direction would cause input controller settings for phases 3, 4, 7, and 8 to apply to the opposite direction.

## Phase Movement

**Description:** This entry specifies which movements are active during the given signal phase.

**Impact on model results:** Left-turns are typically active during the odd-numbered signal phases. Right-turns and through movements are typically active during even-numbered signal phases. The main exception to this is protected-permissive or permissive-only left-turn phasing, in which left-turners are activated (allowed to search for gaps in opposing traffic) during even-numbered phases. Protected-permissive left-turn phasing is known to allow for lower delays experienced by left-turning vehicles (assuming sufficiently low opposing traffic volumes), when compared to protected-only left-turn phasing. However, timing plans allowing permissive left-turners are also known to increase the probability of traffic accidents under certain conditions, when compared to protected-only left-turn phasing.

## Phase Split

**Description:** This entry specifies a "split" time provided for each non-coordinated phase. A phase split represents the sum of the green, yellow change, and red clearance intervals for the phase. The rationale for determining the appropriate green interval duration varies among agencies; however, it is often equated to the optimum fixed green duration that is obtained from a signal timing optimization software program. The phase split for each phase in a concurrent pair (i.e., 1 and 5, 3 and 7, 4 and 8) is not required to be equal in most modern controllers; however, it is typically set at the same value. It is assumed in this procedure that each phase in the pair has the same split value (split values may vary among pairs).

**Impact on model results:** The amount of available green time impacts most aspects of the overall model; including queue lengths, stops, and control delays.

## Phasing Sequence Optimization Flag

**Description:** This entry specifies whether or not (lead-lag) phasing sequences are to be optimized in a signal timing optimization run.

**Impact on model results:** This entry is only applicable to optimization runs.

## Phasing View

The signal phasing sequence is specified by clicking on the dual-ring phasing diagram (phases 1 through 8), also known as "Quick Phases". Green, yellow, and all-red clearance times may be entered in the group box labeled "Timing". After the signal phasing and timing are entered a sequential phasing diagram (labeled "Phasing View") will display the overall timing plan in an equivalent "single-ring" format.

The HCM procedure to calculate the average duration of an actuated phase generates the green times in the Phasing View. This procedure is used for estimating the average phase duration for an intersection

that is operating with actuated control. Where appropriate, the description is extended to include techniques for estimating the duration of non-coordinated and coordinated phases. A series of calculations (Volume Computations; Queue Accumulation Polygon; Maximum Allowable Headway; Equivalent Maximum Green; Average Phase Duration; and Probability of Max Out) is completed in sequence as defined in HCM Chapter 31 to obtain estimates of average phase duration and the probability of phase termination by extension to its maximum green limit.

**Note:** The Phasing View presents average phase times over the analysis period (typically 15 minutes) that may not necessarily represent what might be displayed for any given cycle. For example, if a given phase has little demand, it may serve the minimum green some cycles and be skipped other cycles, yielding an average below the minimum. Also, if the average is less than the clearance time, only the green may be displayed with zero shown for the clearance time. And, if the average is equal to the clearance time, the green may be displayed as zero. This is necessary to both show the averages and have them sum to the cycle length.

Increasing the “Number of Calculation Iterations” (the default value is 15 iterations) may improve the accuracy of phase time estimation under complex conditions, but may increase the amount of time required for re-calculation. For pre-timed signals (“Recall Mode” set equal to “Max” for each phase), phase durations will usually reflect user-specified maximum green times if the number of iterations is high enough. Alternatively, phase durations may be taken directly from user-entered data, by turning on the checkbox called “Field-Measured Phase Times”.

## Phasing Wizard

**Description:** The phasing wizard is available to help determine what is coded in the Quick Phases diagram. The Quick Phases diagram will automatically populate based on the answers provided for the following questions along with the lanes coded in the Quick Lanes diagram:

- Protected Left-Turn Phases?
- Permitted Left-Turn Phases?
- Right-Turn Overlap Phases?
- Lagging Left-Turn Phases?

Indicating “Yes” for any of these questions will cause the additional question of “Which Approaches?” to appear. Checkboxes for all four approaches (i.e., EB, WB, NB, SB) will appear but will only enable if the lanes coded in Quick Lanes allow it.

## Platoon Dispersion Factor

**Description:** This entry specifies the calibration factor for platoon dispersion.

**Impact on model results:** Platoon dispersion affects the proportion of arrivals on green. This impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Population Size

**Description:** This entry specifies the (genetic algorithm) population size in a signal timing optimization run. The population size is the number of individuals within each generation. For example, if 200 generations of optimization were performed with a population size of 10, this would result in a total of 2000 model runs. Lower population sizes sometimes allow for faster program running times on the computer, but higher population sizes may facilitate genetic diversity and faster optimization of certain networks. If the optimization process is converging too quickly, or if the user wishes to examine a wider range of timing plan possibilities, then increasing the population size may be helpful. If the optimization process is not converging quickly enough, or if the user wishes to acquire a reasonable and effective local optimum solution, then decreasing the population size may be helpful.

**Impact on model results:** This entry is only applicable to optimization runs.

## Presence of Bike Facilities

**Description:** Presence of bicycle facilities, including bike lane only, shared bicycle and vehicle lane or bicycle storage areas at the approaches.

**Impact on model results:** Overall, bike facilities increase the frequency of left-turn against crashes. For large intersections, it is also related to more rear-end crashes, while for medium or small intersection, less rear-end crashes are expected (see intersection depth definition for intersection size determination).

## Presence of Continuous Barrier (multimodal)

**Description:** This entry specifies presence of any continuous barrier (at least 3 feet, or 0.9 meters in metric, high) located between the sidewalk and the outside edge of roadway.

**Impact on model results:** Continuous barrier presence affects the buffer area coefficient, which in turn affects the cross section width adjustment factor.

## Presence of Curb (multimodal)

**Description:** This entry specifies whether a curb is present next to the paved outside shoulder on the subject approach.

**Impact on model results:** Curb presence affects the adjusted width of paved outside shoulder, which in turn affects the cross section width adjustment factor.

## Presence of Mast Arm Signal Display

**Description:** DEFINES the study area as residential. This option is only available when the Area Type option at the (PRIMARY INPUT DATA / General) is not set as CBD.

**Impact on model results:** Overall, this factor is associated to a reduction on right angle crashes.

## Presence of Median Island

**Description:** Reflects elevated median islands designed for pedestrian safety and traffic separation.

**Impact on model results:** Decreases the proportion of right angle crashes while slightly increasing left-turn against crashes.

## Presence of Merge on Exit Side

**Description:** This variable reflect the situation where the downstream road width decreases due to lane drops, blockages, incidents or road works. If, at the Main Input screen, the number of lanes decreases from the upstream segment to the next, this variable is automatically checked.

**Impact on model results:** This factor increases loss-of-control crashes.

## Presence of Sidewalk (multimodal)

**Description:** This entry specifies whether a sidewalk is present along the subject segment. A sidewalk is a paved walkway that is provided at the side of the roadway. It is assumed that pedestrians will walk in the street if a sidewalk is not present.

**Impact on model results:** Sidewalk presence affects the adjusted available sidewalk width, which in turn affects the pedestrian LOS score.

## Presence of upstream bus bay within 330 ft of stop bar

**Description:** This variable represents the existence of a bus stop with frequent use within 330 ft (or 100.6 m in metric) of the stop bar.

**Impact on model results:** The presence of bus bays close to the stop bar has been found to increase the frequency of rear-end crashes at small intersections, with little to no effect on larger ones.

## Presence of upstream parking within 330 ft of stop bar

**Description:** This variable represents the existence of continuous curbside parking on either side of the road within 330 ft (or 100.6 m in metric) of the stop bar. This includes parallel and angle parking.

**Impact on model results:** The presence of parking has not been associated with the increase of any type of crash, though reducing run-offs and thus, loss-of-control crashes.

## Pre-Timed Signal Flag

**Description:** A checkbox is provided to indicate whether a signal is a pretimed control, which is a fixed sequence of phases that are displayed in repetitive order. The duration of each phase is fixed. However, the green interval duration can be changed by time of day or day of week to accommodate traffic variations. The combination of a fixed phase sequence and fixed duration produces a constant cycle length. When a signal is pretimed in Streets, the color of the arrows in the Phase Duration graphic will be blue.

**Impact on model results:** Indicating pretimed operation for a signal is the equivalent of using maximum recall on all phases, which affects the amount of available green time and in turn, impacts most aspects of the overall model, including queue lengths, stops, and control delay.

## Project Description

**Description:** This entry documents the analysis with information for identification purposes.

**Impact on model results:** None

## Proportion of On-Street Parking Occupied (multimodal)

**Description:** This entry specifies the proportion of the intersection's right-side curb line that has parked vehicles present during the analysis period. It is based on a zone that extends from a point 250 feet (or 76.2 meters in metric) upstream of the intersection to the intersection, and a second zone that extends from the intersection to a point 250 feet (or 76.2 meters in metric) downstream of the intersection. If parking is not allowed in these two zones, then this proportion equals 0.0.

**Impact on model results:** The proportion of on-street parking affects the cross section width adjustment factor.

## Proportion of Pedestrians who Push Button

**Description:** This entry specifies the proportion of pedestrians who will push the intersection crossing button for service.

**Impact on model results:** The pedestrian calling rate is used to compute the probability of a phase call. This in turn potentially affects actuated phase times and control delays for all movements.

## Queue Length Percentile

**Description:** This entry specifies the probability that a computed queue length will not be exceeded during any one signal cycle.

**Impact on model results:** Queue length percentile affects the back-of-queue adjustment factor; which in turn affects queue storage ratio, uniform queue length, and incremental queue length.

## Quick Jump

**Description:** The Quick Jump combo box allows the user to jump to certain sections of the Classic Mode user-interface screen.

**Impact on model results:** None

## Quick Lanes

**Description:** Quick Lanes provides a graphical data entry mechanism for specifying lane configuration. Lane use combinations can be selected by clicking on the appropriate arrows to place them on the central diagram for each approach. To remove a selected arrow combination, simply click on the white arrow on the approach itself.

**Impact on model results:** Intersection laneage has a fundamental effect on all aspects of the model results.

## Quick Phases

The signal phasing sequence is specified by clicking on the dual-ring phasing diagram (phases 1 through 8), also known as “Quick Phases”. Only the left-turn phasing needs to be specified, because thru movements and right-turn movements are automatically added to the phasing sequence as a function of laneage. The dual-ring phasing diagram contains logic to prevent invalid phasing sequences from being entered, given the available laneage. Left-turn movements in odd-numbered phases are used to reflect protected left-turns (i.e., “green arrow”), whereas left-turn movements in even-numbered phases are used to reflect permitted left-turns (i.e., “green ball”). When exclusive right-turn lanes exist, shielded right-turns may be added by clicking twice on the corresponding odd-numbered phase. Green, yellow, and all-red clearance times may be entered in the group box labeled “Timing”. After the signal phasing and timing are entered a sequential phasing diagram (labeled “Phasing View”) will display the overall timing plan in an equivalent “single-ring” format.

## Random Number Seed

**Description:** This entry specifies the (genetic algorithm) random number seed in a signal timing optimization run. Crossover, mutation, and the competition between individuals involve a certain degree of randomization. If the random number seed value is left unchanged by the analyst, multiple runs with the same input data should always generate the same optimal design. If the random number seed is changed by the analyst, this may change the amount of time required to locate the optimal solution. Given the necessary G.A. parameter values (i.e., a high maximum number of iterations together with a low convergence threshold), the algorithm is designed to converge on the (one and only) global optimum solution. In order to obtain internal processes that are truly “mathematically random”, it is recommended that the random number seed value should end in a '1', '3', '7', or '9'.

**Impact on model results:** This entry is only applicable to optimization runs.

## Ratio of Average Speed to Free Flow Speed

**Description:** This entry specifies the assumed ratio of the posted speed limit to the free-flow speed.

**Impact on model results:** Within the computational procedure, speed limits are first converted to free-flow speeds (AverageSpeedtoFFSRatio = 0.90 by default) for each movement. Next, the free-flow speeds are then used to compute maximum allowable headways (MAH) for each actuated movement. MAH impacts many aspects of the overall model; including actuated phase times, and control delays. Speed limits are also used to compute accel-decel delays, which affect the computation of uniform stops and uniform queue.

## Recall Mode

**Description:** This entry specifies whether or not the controller will automatically place a call for a specified phase each time the controller is servicing a conflicting phase. When “no recall” is entered, phases are eligible to be skipped in the absence of vehicular demand. Otherwise, there are three types of recalls: minimum recall, maximum recall, and pedestrian recall. Invoking minimum recall causes the controller to place a continuous call for vehicle service on the phase, and then service the phase until its minimum green interval times out. The phase can be extended if actuations are received. Invoking maximum recall causes the controller to place a continuous call for vehicle service on the phase. It results in the presentation of the green indication for its maximum duration every cycle. Using maximum recall on all phases yields an equivalent pre-timed operation. Invoking pedestrian recall causes the controller to place a continuous call for pedestrian service on the phase and then service the phase for at least an amount of time equal to its walk and pedestrian clear intervals (more if vehicle detections are received). Pedestrian recall is used for phases that have a high probability of pedestrian demand every cycle and no pedestrian detection.

**Impact on model results:** Recall mode affects the amount of available green time, which impacts most aspects of the overall model; including queue lengths, stops, and control delays. Minimum green time may also affect the probability of traffic accidents under certain conditions.

## Red Time

**Description:** This entry specifies the all-red clearance interval duration displayed by the signal for the given phase.

**Impact on model results:** Red time affects the amount of available green time, which impacts most aspects of the overall model; including queue lengths, stops, and control delays. Red time may also affect the probability of traffic accidents under certain conditions.

## Re-Entry Delay (multimodal)

**Description:** This entry specifies the time (in seconds) a transit vehicle spends waiting for a gap to re-enter the adjacent traffic stream. Re-entry delay is zero at on-line stops.

**Impact on model results:** Re-entry delay is used to compute the overall delay due to a transit stop.

## Reference Phase

**Description:** For uncoordinated (Chapter 19) operations, the reference phase is not used. For coordinated (Chapter 18) operations, this entry specifies the coordinated phase number (must be either 2 or 6) to which the offset is referenced.

**Impact on model results:** Changing the reference phase number would potentially shift the window of major street green time to a different part of the cycle, possibly changing the proportion of arrivals on green for one or more movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.



## Reference Point

**Description:** For uncoordinated (Chapter 19) operations, the reference point is not used. For coordinated (Chapter 18) operations, this entry specifies the location (beginning of green or end of green) to which the offset is referenced.

**Impact on model results:** Changing the reference point would potentially shift the window of major street green time to a different part of the cycle, possibly changing the proportion of arrivals on green for one or more movements. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays.

## Residential Area Use

**Description:** DEFINES the study area as residential. This option is only available when the Area Type option at the (PRIMARY INPUT DATA / General) is not set as CBD.

**Impact on model results:** Overall, this factor is associated to a reduction on loss-of-control crashes.

## Rest in Walk Enabled (multimodal)

**Description:** A phase with the rest-in-walk mode enabled will dwell in walk as long as there are no conflicting calls. When a conflicting call is received, the pedestrian clear interval will time to its setting value before ending the phase. This mode can be enabled for any actuated phase. Signals that operate with coordinated-actuated operation may be set to use a coordination mode that enables the rest-in-walk mode. Typically, the rest-in-walk mode is not enabled. In this case, the walk and pedestrian clear intervals each time to their respective setting values, and then the pedestrian signal indication dwells in a steady DON'T WALK indication until a conflicting call is received.

**Impact on model results:** Rest-in-walk affects the effective walk time for actuated phases.

## Reverse Segment Length

**Description:** This entry specifies distance from the subject intersection to the next downstream intersection, typically in the "phase 6" direction of travel.

**Impact on model results:** The reverse segment length impacts many aspects of the overall model; including the proportion of vehicles arriving on green, time until onset of queue spillback, and travel time.

## Reverse Weighting

**Description:** This entry specifies the reverse arterial weighting in a signal timing optimization run. For example, if "Travel Time" were chosen as the objective function, and if "Both Major Street Directions" were chosen as the objective function direction, the optimization process would attempt to find a timing plan that would minimize travel times that were multiplied by the forward and reverse weighting factors. This entry has no effect on the approach-specific objective functions (approach stops, approach delay).

**Impact on model results:** This entry is only applicable to optimization runs.

## Right Turn Equivalency

**Description:** This entry specifies the ratio of through to right-turn saturation flow rate, at signalized intersections.

**Impact on model results:** Right turn equivalency affects the distribution of saturation flow rates among lanes, which in turn affects many aspects of the overall model. Right turn equivalency also affects the

computation of maximum allowable headways (MAH) for each actuated movement, which impacts actuated phase times.

## Right Turns on Red

**Description:** This entry specifies the count of vehicles that turn right at the intersection when the signal indication is red, divided by the analysis period duration. It is expressed as an hourly flow rate, but may represent a time period shorter than one hour. It is difficult to predict the right-turn-on-red (RTOR) flow rate because it is based on many factors that vary widely from intersection to intersection. These factors include approach lane allocation (shared or exclusive right-turn lane), right-turn flow rate, sight distance available to right-turning drivers, volume-to-capacity ratio for conflicting movements, arrival patterns during the signal cycle, left-turn signal phasing on the conflicting street, and conflicts with pedestrians. Given the difficulty of estimating the RTOR flow rate, it is recommended that this flow rate be measured in the field whenever possible. If the analysis is dealing with future conditions or if the RTOR flow rate is not known from field data, then the RTOR flow rate for each right-turn movement can be assumed to equal zero veh/h. This is a conservative assumption because it may indicate a slightly longer delay than may actually be incurred.

**Impact on model results:** The coded value is subtracted from the right-turn demand before the adjusted flow rate is computed.

## Right-Hand Curb

**Description:** This entry specifies the percentage of the segment length with a right-hand curb present.

**Impact on model results:** Right-hand curb presence is used in the computation of segment free-flow speeds.

## Safety and Emission

**Description:** This button opens a dialog box for inputs relevant to signal timing optimization with consideration of environment and safety impacts. Outputs are also provided in this dialog box. However, changing inputs will not automatically show the updated outputs. Buttons are provided for separately calculating Safety outputs and Emission outputs.

**Impact on model results:** None

## Saturation Flow Rate

**Description:** This value specifies the maximum steady flow rate at which previously stopped passenger cars can cross the stop line of a signalized intersection under typical conditions, assuming that the green signal is available and no lost times are experienced.

## Segment “Other” Delays

**Description:** This entry specifies the average extra vehicle delay caused by “other” mid-segment sources, such as parking.

**Impact on model results:** This entry is used to compute segment running times, and the proportion of vehicle arrivals on green.

## Segment Dropdown

**Description:** The segment dropdown control allows the user to switch between active segments for editing input data, and for viewing reports.

**Impact on model results:** None

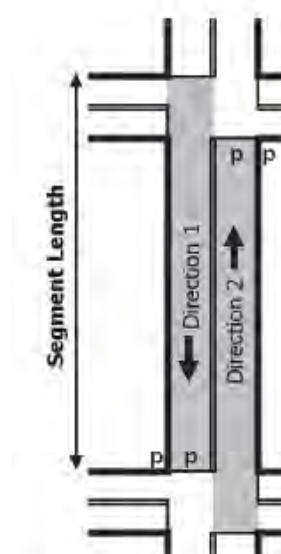
## Segment Length

**Description:** This entry specifies length of the active segment, which is indicated by the segment dropdown. Segments are only relevant when there is more than one intersection within the analysis.

For the purpose of analysis, the roadway is separated into individual elements that are physically adjacent and operate as a single entity in serving travelers. Two elements are commonly found on an urban streets system: points and links. A *point* is the boundary between links and is represented by an intersection or ramp terminal. A *link* is a length of roadway between two points. A link and its boundary points are referred to as a *segment*.

Segment length is the distance between the boundary intersections that define the segment. The point of measurement at each intersection is the stop line, the yield line, or the functional equivalent in the subject directions of travel. This length is measured along the centerline of the street. If it differs in the two travel directions, an average length is used.

The *link length* is used in some calculations. It is computed as the segment length minus the width of the upstream boundary intersection.



**Impact on model results:** Segment lengths are used in the computation of travel speeds and vehicle delays.

## Segment Length with Non-Restrictive Median

**Description:** This entry specifies the amount of segment length that contains a non-restrictive median.

**Impact on model results:** Segment median lengths are used in the computation of segment free-flow speeds, which in turn affect the proportion of vehicle arrivals on green.

## Segment Length with Restrictive Median

**Description:** This entry specifies the amount of segment length that contains a restrictive median.

**Impact on model results:** Segment median lengths are used in the computation of segment free-flow speeds; which in turn affect segment running times, and the proportion of vehicle arrivals on green.

## Segment Name

**Description:** This entry documents the name of the segment being analyzed. These names can then be viewed within output reports, and within Quick Animation.

**Impact on model results:** None

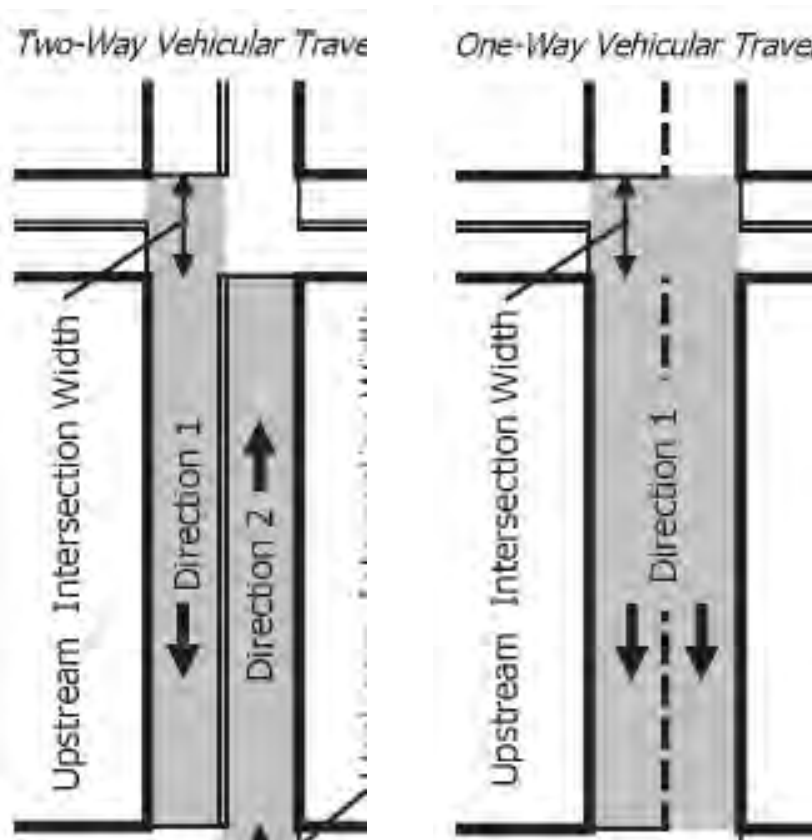
## Segment Number of Access Points on Right

**Description:** This entry specifies the number of access points on the right-hand side of the segment. Unlike the “active” access points for which volumes, laneage, and locations are coded, this total number of access points may also include “non-active” access points (serving fewer than 10 vehicles per hour).

**Impact on model results:** The total number of access points is used in the computation of segment free-flow speeds; which in turn affect segment running times, and the proportion of vehicle arrivals on green.

## Segment Width of Intersection

**Description:** This entry specifies the width of the upstream intersection. The intersection width applies to the upstream boundary for a given direction of travel and is the effective width of the cross street. On a two-way street, it is the distance between the stop (or yield) line for the two opposing segment through movements at the boundary intersection, as measured along the centerline of the segment. On a one-way street, it is the distance from the stop line to the far side of the most distant traffic lane on the cross street.



**Impact on model results:** Intersection width is used in the computation of segment free-flow speed; which in turn affects segment running times, and the proportion of vehicle arrivals on green.

## Shared Lanes

**Description:** This entry specifies the existence of shared left-turn lanes and shared right-turn lanes.

**Impact on model results:** Approach lane configuration affects the adjusted volumes and saturation flow rates, thus having a fundamental impact on all aspects of the computational procedure. When analyzing “shared-plus-exclusive” configurations, the “Percent Turns in Shared Lane” input parameter is used to specify a percentage of left-turn or right-turn vehicles using the shared lane.

## Shortest Distance

**Description:** This entry specifies the distance measured from the ramp movement stop bar to the conflict point in feet (or meters in metric), measured along the centerline of the off-ramp approach.

**Impact on model results:** This entry is only applicable to DDI alternative intersections. Along with free-flow speeds, clear-zone widths, and vehicle lengths, the space between ramp stop bar and conflict zone contributes to the calculation of lost times that are applied to DDI off-ramp movements.

## Sidewalk Length Adjacent to Building (multimodal)

**Description:** This entry specifies the proportion of sidewalk length adjacent to a building face.

**Impact on model results:** This proportion is used to calculate the effective sidewalk width.

## Sidewalk Length Adjacent to Fence (multimodal)

**Description:** This entry specifies the proportion of sidewalk length adjacent to a fence or low wall.

**Impact on model results:** This proportion is used to calculate the effective sidewalk width.

## Sidewalk Length Adjacent to Window (multimodal)

**Description:** This entry specifies the proportion of sidewalk length adjacent to a window display.

**Impact on model results:** This proportion is used to calculate the effective sidewalk width.

## Simultaneous Gap Out

**Description:** This entry specifies the manner in which phases are terminated before the barrier can be crossed to serve a conflicting call. Depending on the operating circumstances, this mode can be enabled or disabled. It is a phase-specific setting; however, it is typically set the same for all phases that serve the same street. Simultaneous gap-out dictates controller operation when a barrier must be crossed to serve the next call and one phase is active in each ring. If simultaneous gap-out is enabled, it requires that both phases reach a point of being committed to terminate (via gap out, max out, or force-off) at the same time. If one phase is able to terminate because it has gapped out, but the other phase is not able to terminate, then the gapped-out phase will reset its extension timer and restart the process of timing down to gap-out. If the simultaneous gap-out feature is disabled, then each phase can reach a point of termination independently. In this situation, the first phase to commit to termination maintains its active status while waiting for the other phase to commit to termination. Regardless of which mode is in effect, the barrier is not crossed until both phases are committed to terminate.

**Impact on model results:** The simultaneous gap-out mode is considered when computing maximum allowable headways (MAH) for each actuated movement. MAH impacts many aspects of the overall model; including actuated phase times, and control delays.

## Sneakers

**Description:** This entry specifies the number of left-turns completed at the end of a permissive period.

**Impact on model results:** Sneakers affect the capacity of left-turn movements operating under protected-permissive or permissive-only phasing. Left-turn capacity then affects queue length and control delay for the left-turn movement.

## Speed Calibration Factor

**Description:** This entry is specified by the user to adjust base free-flow speed. The default is 0.0 mi/h. However, if desired, a locally representative value can be determined from field-measured estimated of the base-free flow speed for several street segments. The local default value can be established for typical street segments, or for specific street types. This calibration factor is determined as the one value that provides a statistically based best-fit between the prediction from Equation 18-3 and the field measured estimates.

**Impact on model results:** The Speed Calibration Factor is used in the computation of segment free-flow speed; which in turn affects segment running times, and the proportion of vehicle arrivals on green.

## Speed Limit

**Description:** This entry specifies the posted speed limit applicable to each movement. Speed is used in the methodology to estimate the maximum allowable headway of the arriving traffic stream. Speed limit is highly correlated with the environmental and geometric factors that have a direct influence on driver speed choice. As such, it represents a single input variable that is highly correlated with operating speed and is used as a convenient way to limit the need for numerous environmental and geometric input data to estimate operating speed. The convenience of using speed limit as an input variable comes with a caution - the analyst must not infer a cause-and-effect relationship between the input speed limit and the estimated performance measures. More specifically, the computed change in performance resulting from a change in the input speed limit is not likely to be indicative of performance changes that will actually be realized. Research indicates that a change in speed limit has a proportionally smaller effect on the actual operating speed. The methodology is based on the assumption that the posted speed limit is: (1) consistent with that found on other streets in the vicinity of the subject intersection and (2) consistent with agency policy regarding specification of speed limits. If it is known that the posted speed limit does not satisfy these assumptions, then the speed limit value that is input to the procedure should be adjusted such that it is consistent with the assumptions.

**Impact on model results:** Within the computational procedure, speed limits are first converted to free-flow speeds (AverageSpeedtoFFSRatio = 0.90 by default) for each movement. Next, the free-flow speeds are then used to compute maximum allowable headways (MAH) for each actuated movement. MAH impacts many aspects of the overall model; including actuated phase times, and control delays. Speed limits are also used to compute accel-decel delays, which affect the computation of uniform stops and uniform queue.

## Split Optimization Flag

**Description:** This entry specifies whether or not phase splits are to be optimized in a signal timing optimization run.

**Impact on model results:** This entry is only applicable to optimization runs.

## Split Phase

**Description:** This entry specifies whether or not the split phasing is in effect for phases 4 and 8, meaning that phases 4 and 8 occur sequentially instead of concurrently. Split phasing is generally not



used on the major street (phases 2 and 6). Split phasing is commonly used to reduce the probability of accidents at intersections with sight distance problems.

**Impact on model results:** Changing the minor street phasing sequence (via Split Phase) could affect the times during which cross street vehicles are released on to the major street, affecting the proportion of arrivals on green. The proportion of arrivals on green impacts many aspects of the overall model; including queue service times, actuated phase times, and control delays. To the extent that split phasing is used in lieu of standard phasing, it will typically increase queue lengths and control delays at the subject intersection. However, this is sometimes seen as an acceptable price to pay for reducing the probability of accidents (at intersections with sight distance problems).

## Start Time

**Description:** This entry specifies the clock time (hh:mm) at the beginning of the analysis period. For example, 17:00 could be used to indicate the beginning of the 5:00 PM peak hour. Start times are listed at the top of the formatted reports.

**Impact on model results:** None

## Start-Up Lost Time

**Description:** This entry specifies the additional time consumed by the first few vehicles in a queue at a signalized intersection, above and beyond the saturation headway, because of the need to react to the initiation of the green phase (and to accelerate).

**Impact on model results:** Start-up lost times affect the calculation of actuated phase times and queue service times.

## Stop Speed

**Description:** This entry specifies the speed below which a vehicle is said to be stopped.

**Impact on model results:** Stop speed affects the calculation of accel-decel delays, which in turn affect the computation of uniform stops and uniform queue.

## Stops with Benches (multimodal)

**Description:** This entry specifies the proportion of transit stops that provide benches to sit on. A shelter with a bench is counted twice, once as a shelter and a second time as a bench.

**Impact on model results:** The proportion of transit stops with benches is used to compute the perceived travel time rate.

## Stops with Shelters (multimodal)

**Description:** This entry specifies the proportion of transit stops that provide a structure with a roof and three enclosed sides that protect occupants from wind, rain, and sun. A shelter with a bench is counted twice, once as a shelter and a second time as a bench.

**Impact on model results:** The proportion of sheltered transit stops is used to compute the perceived travel time rate.

## Stored Heavy Vehicle Length

**Description:** This entry specifies the lane length occupied by a queued heavy vehicle.

**Impact on model results:** Stored heavy vehicle length affects the computation of queue storage ratio.

## Stored Vehicle Length

**Description:** This entry specifies the lane length occupied by a queued vehicle.

**Impact on model results:** Stored vehicle length is considered when estimating the amount of time until onset of queue spillback. Stored vehicle length also affects access point operations.

## System Cycle Length

**Description:** This entry specifies the background cycle length applicable to the urban street system. The cycle length represents the total time for a signal to complete one cycle.

**Impact on model results:** For uncoordinated (Chapter 19) operations, the cycle length input data entry is not used; instead, the cycle length is automatically recomputed by the procedure. For coordinated (Chapter 18) operations, the cycle length applies to all intersections, and will not be recomputed by the procedure. The cycle length affects most aspects of the overall model; including control delay, queue lengths, and travel time.

## Total Number of Access Points (multimodal)

**Description:** This entry specifies the number of access point approaches on the right side in the subject direction of travel.

**Impact on model results:** The total number of access points affects the bicycle LOS score for the segment.

## Total Walkway Width (multimodal)

**Description:** The total walkway width is measured from the outside edge of the road pavement (or face of curb, if present) to the far edge of the sidewalk (as sometimes delineated by building face, fence, or landscaping).

**Impact on model results:** Total walkway width is used to compute the effective sidewalk width.

## Transit Frequency (multimodal)

**Description:** This entry specifies the count of scheduled fixed route transit vehicles that stop on or near the segment during the analysis period. Scheduled transit vehicles can be considered “local” or “nonlocal.” Local transit vehicles make regular stops along the street (typically every 0.25 miles, or 0.402 kilometers in metric, or less); although they do not necessarily stop within the analysis segment when segment lengths are short, or when stops alternate between the near and far sides of boundary intersections. They are always counted, regardless of whether they stop within the subject segment. Non-local transit vehicles operate on routes with longer stop spacing than local routes (e.g., limited-stop, bus rapid transit, or express routes). They are only counted when they stop within the subject segment.

**Impact on model results:** Transit frequency is used to compute the transit wait-ride score.

## Transit Stop Near Side (multimodal)

**Description:** This entry specifies whether a transit stop is located on the near side of a boundary intersection or elsewhere. A portion of the time required to serve a near-side transit stop at a boundary intersection may overlap with the control delay incurred at the intersection.

**Impact on model results:** Transit stop location is used to compute the transit stop delay due to acceleration and deceleration.

## Transit Stop On-Line (multimodal)

**Description:** This entry specifies whether a transit stop is *on-line*, where the bus stops entirely or mostly in the travel lane and does not have to yield to other vehicles upon exiting the stop, or *off-line*, where the bus pulls out of the travel lane to serve the stop and may have to yield to other vehicles upon exiting.

**Impact on model results:** Transit stop position is used to compute the delay due to a transit stop.

## Turn Bay Length and Segment Length

**Description:** For left-turns and right-turns this entry specifies turn pocket lengths for each approach. For through movements this entry specifies segment lengths for each approach. Turn bay length represents the length of the bay for which the lanes have full width and in which queued vehicles can be stored. The turn bay length does not include the bay taper. Bay length is measured parallel to the roadway centerline. If a two-way left-turn lane is provided for left-turning vehicle storage and adjacent access points exist, then the bay length entered should represent the “effective” storage length available to the subject left-turn movement. The effective length must consider adjacent access points and their associated left-turn vehicles, which may also store in the two-way left-turn lane.

**Impact on model results:** Turn bay lengths and segment lengths affect the “queue storage ratio” output, and the time until onset of queue spillback.

## Turn Radius

**Description:** This entry specifies the left-turn radius and right-turn radius.

Traffic movements that discharge along a curved travel path do so at rates lower than those of through movements. The equivalent number of thru cars for a protected turn-movement is calculated with the following equation:

$$E = 1 + (5.61/R)$$

where  $R$  is the radius of curvature of the left- or right-turning path (at the center of the path), in feet.

The default value of 112 ft (or 34.1 m in metric) for left-turn movements yields left-turn equivalency factor  $E_L = 1.05$  and the default value of 32 ft (or 9.8 m in metric) for right-turn movements yields right-turn equivalency factor  $E_R = 1.18$ .

**Impact on model results:** Turn radius affects the left-turn equivalency factor (typically 1.05), and the right-turn equivalency factor (typically 1.18). These equivalency factors affect the saturation flow rate of left-turn movements and right-turn movements.

## Two-Way Pedestrian Volume (multimodal)

**Description:** This entry specifies total pedestrian volume traveling along the urban street segment, between boundary intersections.

**Impact on model results:** Two-way pedestrian volume affects the pedestrian flow per unit width of sidewalk.

## Unblocked Lanes

**Description:** This entry specifies the number of open lanes when blockage is present along the segment.

**Impact on model results:** The number of unblocked lanes is used in the computation of midsegment capacity, which in turn is used in the computation of the adjustment factor for downstream lane blockage.

## Uncoordinated Flag

**Description:** If an intersection is flagged as uncoordinated, it will be analyzed in accordance with Chapter 19 (signalized intersections) procedures. If an intersection is flagged as coordinated, it will be analyzed in accordance with Chapter 18 (urban streets) procedures.

**Impact on model results:** For uncoordinated (Chapter 19) operations, each intersection is analyzed independently of all other intersections, and the cycle length is variable. For coordinated (Chapter 18) operations, each intersection is potentially affected by the operation of nearby intersections, and the cycle length is constant.

## Unsignalized Delay

**Description:** When a movement is marked as Unsignalized, this field will enable, allowing the user to manually input control delay for the movement, instead of having the signalized control delay calculated.

**Impact on model results:** Unsignalized delay will affect the approach and intersection delay.

## Unsignalized Movement

**Description:** This checkbox allows the user to mark a movement as Unsignalized. If the movement is considered as Unsignalized, it is considered as not controlled by traffic signals and all relevant signalized calculations will be hidden for the specified movement.

**Impact on model results:** Marking a movement as unsignalized will affect the approach and intersection delay.

## Upstream

**Description:** This button opens a dialog box for the user to select and open the upstream crossover junction file coded in TWSC. Once opened, the TWSC file (.xtw) becomes attached in the Streets module.

**Impact on model results:** This button is only applicable to MUT with TWSC alternative intersections and is necessary for the completion of one MUT with Stop Signs alternative intersection.

## Upstream Filtering Adjustment Factor

**Description:** This entry accounts for the effect of “filtered” arrivals from upstream signals on delay. In other words, the upstream filtering adjustment factor ( $I$ ) reflects the way that an upstream signal decreases the variance in the number of arrivals per cycle at the subject intersection. The decrease in variance can reduce cycle failure frequency and resulting delay. The filtering adjustment factor varies in value from 0.09 to 1.0. A value of 1.0 is appropriate for an isolated intersection (i.e., one that is at least one mile, or 1.6 kilometers in metric, from the nearest upstream signalized intersection). A value of less than 1.0 is appropriate for non-isolated intersections. The equation  $I = 1.0 - 0.91X_u^{2.68}$  is used to compute  $I$  for non-isolated intersections. The variable  $X_u$  is computed as the weighted volume-to-capacity ratio of all upstream movements contributing to volume in the subject movement group. This ratio is computed as a weighted average with the volume-to-capacity ratio of each contributing upstream movement weighted by its discharge volume. The procedure automatically performs this calculation for internal movements with an upstream signal. If desired the user may override the computed value with their own entered value, or restore the computed value by blanking out the input field. For planning and preliminary design analyses,  $X_u$  can be approximated as the weighted volume-to-capacity ratio of the movement groups serving through movements at the upstream signalized intersection. **Note:** The adjacent button will open a file dialog screen to identify the Signals file for the upstream signal. If a file is selected, the appropriate volume-to-capacity ratios will be averaged as described above and the  $I$ -factor computed automatically.

**Impact on model results:** The upstream filtering adjustment factor (also known as the I-factor) is used in the calculation of incremental delay, incremental queue, and incremental stops. **Note:** Since flow rates and signal timing can affect the volume-to-capacity ratio of the upstream signal due to changes in the flow profile, changes to these values in the subject intersection can cause the I-factor to change in the subject intersection.

## Urban Street

**Description:** This entry is used to document the name of the urban street.

**Impact on model results:** None

## Urban Street Forward Direction

**Description:** This entry typically specifies the direction of "phase 2" in the timing plan.

**Impact on model results:** Reversing the urban street forward direction could cause forward direction segment-specific MOEs (e.g., running speed, travel time) to be reported for the reverse direction, and vice-versa.

## U-Turn Crossover Median Width

**Description:** This entry specifies the U-turn crossover median width range for RCUT alternative intersections.

**Impact on model results:** This entry is only applicable to RCUT alternative intersections. U-turn crossover median width affects the saturation flow rate of the u-turn crossover movements.

## U-Turn Volume

**Description:** This entry specifies the U-turn volume for interchange ramp terminals. Please note that this field is for the interchange (not intersection) U-turn demands – the traffic exiting the freeway in one direction, then navigating the arterial to reenter the freeway traveling in the opposite direction. Typically, each intersection would include one value as appropriate for the interchange design.

**Impact on model results:** U-turn volume affects the lane utilization adjustment factor for interchange ramp terminals.

## Walk plus Pedestrian Clear Setting

**Description:** The walk interval is intended to give pedestrians adequate time to perceive the WALK indication and depart the curb before the pedestrian change interval begins. The walk setting is typically 7 seconds, or more, for an actuated or a non-actuated coordinated phase. Longer walk durations should be considered in school zones and areas with large numbers of elderly pedestrians. It is assumed that the rest-in-Walk mode is not enabled for actuated phases and non-coordinated phases. For a pre-timed phase, the walk interval is often set at a value equal to the green interval duration less the pedestrian clear setting (provided that it exceeds the minimum time need for pedestrian perception and reaction). For a coordinated phase, the controller is sometimes set to use a coordination mode that extends the walk interval for most of the green interval duration. This functionality is not explicitly modeled in the automobile methodology but it can be approximated by setting the walk interval to a value equal to the phase split less the pedestrian clear setting and less the change period (i.e., the yellow change interval plus the red clearance interval). If the walk and pedestrian clear settings are provided for a phase, then it is assumed that a pedestrian signal head is also provided. If these settings are not used, then it is assumed that any pedestrian accommodation needed is provided in the minimum green setting. The pedestrian clear interval (also referred to as the pedestrian change interval) is intended to provide time for pedestrians that depart the curb during the WALK indication to reach the opposite curb (or the median).

Some agencies set the pedestrian clear equal to the “crossing time,” where crossing time equals the curb-to-curb crossing distance in ft (or m in metric) divided by the pedestrian walking speed of 3.5 ft/s (1.07 m/s in metric). Other agencies set the pedestrian clear equal to the crossing time less the change period. This choice is dependent on agency policy. A flashing DON’T WALK indication is displayed during this interval.

**Impact on model results:** The Walk + PC interval is used to compute the probability of a phase call. This in turn potentially affects actuated phase times and control delays for all movements.

## Walkway Width (multimodal)

**Description:** The total walkway width is measured from the outside edge of the road pavement (or face of curb, if present) to the far edge of the sidewalk (as sometimes delineated by building face, fence, or landscaping).

**Impact on model results:** Walkway width affects the available corner time-space.

## Weights, %

**Description:** Defines the weight given to each performance measure to the objective function used by Streets optimization algorithm. Must add up to 100%.

**Impact on model results:** Changing the weight scheme may lead to slightly different timing results when different feasible results exist.

## Width of Clear Zone

**Description:** This entry specifies the width of the clear zone for the longest vehicle path in feet (or meters in metric), measured along the centerline of the outside lane, which is the closest conflicting vehicle path to the ramp.

**Impact on model results:** This entry is only applicable to DDI alternative intersections. Along with free-flow speeds, vehicle lengths, and the space between ramp stop bar and conflict zone, clear-zone widths contribute to the calculation of lost times that are applied to DDI off-ramp movements.

## Work Zone Approach Width

**Description:** The approach width during the work zone is coded in feet (or meters in metric) for all open left, thru and right lanes.

**Impact on model results:** This generates the saturation flow rate adjustment for approach width during work zone presence. This value is used in the computation of the overall saturation flow rate adjustment factor for work zone presence to further reduce the default of 0.858 if applicable.

## Work Zone Left Thru Lanes Open

**Description:** The number of left and thru lanes open during the work zone is used to compare with the number coded for normal operations.

**Impact on model results:** This generates the saturation flow rate adjustment for reducing lanes during work zone presence. This value is used in the computation of the overall saturation flow rate adjustment factor for work zone presence to further reduce the default of 0.858 if applicable.

## Work Zones

**Description:** Identifying an approach as having a work zone implements a series of equations to compute a saturation flow rate adjustment factor.



**Impact on model results:** The saturation flow rate adjustment factor is applied to lane groups associated with the approach, to model the work zone presence.

## Yellow Time

**Description:** This entry specifies the yellow (or amber) change interval duration displayed by the signal for the given phase.

**Impact on model results:** Yellow time affects the amount of available green time, which impacts most aspects of the overall model; including queue lengths, stops, and control delays. Yellow time may also affect the probability of traffic accidents under certain conditions.

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- Windows 9
- Work Zone Approach Width 125
- Work Zone Left Thru Lanes Open 125
- Work Zones 125

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- Yellow Time 126