



HCS™

Roundabouts Module

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 Email: mctrans@ce.ufl.edu

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Getting Started

System Requirements

HCS is designed for standard Windows installations. For optimal performance, the system should be Windows 10 or newer. While HCS may be compatible with older versions of Windows, any installation and operational issues arising from using these older versions will be the sole responsibility of the end user.

Getting Started

To begin, click on File then New (or the "New File" icon).

Normal Windows keyboard and mouse functions are available. The PgUp and PgDn keys will scroll the entry screen up and down respectively. Tabbing, clicking to a new field, or pressing the Enter key will trigger a recalculation and update the Report pane.

Roundabout Analysis

Roundabout intersection analyses will estimate Capacity and Level of Service (LOS) for a given set of traffic and geometric conditions. This type of analysis is oriented toward the evaluation of an existing or planned facility. The methodology and procedures of application use the HCM Chapter 22 procedures.

General Controls

Menu Items

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

Open – Opens an existing Roundabouts file (*.xro, *.xra); shortcut is Ctrl+O

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

Save – Saves an open Roundabouts file (*.xro) using the current file name; shortcut is Ctrl+S

Save As... – Saves an open Roundabouts file (*.xro) using a specified file name; shortcut is F12

Close – Closes an existing Roundabouts file (*.xro); shortcut is Ctrl+W

Units

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

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

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

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

View

Page View – Changes the view to display inputs and reports by pages; shortcut is F9

Full View

Report -> Right – Changes the view to display both the input screen and report simultaneously; the report is displayed on the right portion of the screen; shortcut is F10

Report -> Bottom – Changes the view to display both the input screen and report simultaneously; the report is displayed on the bottom portion of the screen; shortcut is F11

Report

Roundabout Formatted Report – Displays formatted report of the currently selected intersection including the most important values; shortcut is F4

Roundabout Text Report – Displays text report with all input, intermediary, and final results of the currently selected intersection; shortcut is F6

Segment Formatted Report – Displays formatted report of the currently selected segment including the most important values; shortcut is F7

Segment Text Report – Displays text report with all input, intermediary, and final results of the currently selected segment; shortcut is F8

Full Segments Report – Displays formatted report for all segments including the most important values; shortcut is F3

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

Help

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

Index – Allows user to search for keywords within the glossary

Search – Allows user to search for any word within the Contents

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

HCM Reference Guide – Opens a reference guide for the HCM 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 page in the default web browser

Support

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

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

McTrans Website – Opens the McTrans home page in the default web browser

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

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

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; shortcut is Ctrl+Shift+A

Generate TRF File – Saves an open Roundabouts file (*.xro) 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; shortcut is Ctrl+Shift+T

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

Roundabouts

HCM Chapter 22

Roundabouts are intersections with a generally circular shape, characterized by yield on entry and circulation around a central island (counterclockwise in the United States). Roundabouts have been used successfully throughout the world and are being used increasingly in the United States, especially since 1990. **Chapter 22, Roundabouts**, presents concepts and procedures for analyzing these types of intersections.

LIMITATIONS OF THE METHODOLOGY

The procedures presented in this chapter cover many of the typical situations that a user may encounter in practice. However, there are sometimes applications for which alternative tools can produce a more accurate analysis. The following limitations, stated earlier in this chapter, may be addressed by using available simulation tools. The conditions beyond the scope of this chapter that are treated explicitly by alternative tools include

- Pedestrian signals or hybrid beacons at roundabout crosswalks,
- Metering signals on one or more approaches,
- Adjacent signals or roundabouts,
- Priority reversal under extremely high flows,
- High pedestrian or bicycle activity levels,
- More than two entry lanes on an approach, or
Flared entry lanes.

HCM Chapter 33

Chapter 33 is the supplemental chapter for Chapter 22, Roundabouts, which is found in Volume 3 of the *Highway Capacity Manual* (HCM). This chapter presents detailed information about the following aspects of the Chapter 22 motorized vehicle methodology:

- Information about the large variability in U.S. driver behavior at roundabouts,
- Guidance on making an appropriate selection of a lane utilization factor, and
- Guidance on calibrating the capacity model to reflect local conditions.

This chapter also provides example problems that demonstrate the application of the Chapter 22 methodology to single-lane and multilane roundabouts.

Operational Data

This Highway Capacity Software (*HCS*) faithfully implements the methodology prescribed in the Highway Capacity Manual (HCM) for analyzing Roundabouts.

First, the user enters the Project Properties into the respective fields: Analyst, Agency, Date, Time Analyzed, Jurisdiction, Analysis Year, Project Description, and Facility Name. Then, the user enters the Intersection Data into the respective fields: Intersection Name, East/West Street Name, North/South Street Name, Analysis Time Period, Peak Hour Factor, and Proportion of CAVs. The Analysis Time Period is normally 15 minutes ($T=0.25$ hr) to represent the length of time the peak flow is constant.

Lane Designations

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. These are coded with the use of the Roundabouts lane graphic. Each approach allows for two lanes to be coded and one bypass lane, if necessary. Lanes for an approach will be disabled depending on what is already coded. Defining the number of lanes and usage is necessary to allow further analysis.

The Conflicting Lanes on Entry is specified for each approach as the number of lanes that pass directly in front of the subject entry. It can be coded by either clicking on the arrows within the roundabout or by changing the number in the textboxes below the graphic. The number of conflicting lanes on entry for an approach can be either 1 or 2.

If a right-turn bypass lane is necessary for an approach, the user can choose to code either a Yielding or a Non-Yield Right-Turn Bypass Lane. The yellow arrow represents a yielding right-turn bypass lane and the green arrow represents a non-yielding right-turn bypass lane. If a yielding right-turn bypass lane is coded for an approach, the corresponding textbox for Conflicting Lanes on Bypass Exit will enable, allowing the user to specify the number of lanes as 1 or 2.

Traffic Volumes

The Volume for each movement of the intersection is coded in vehicles per hour. An hourly volume is required for any movement to be included in the analysis. The Percent Heavy Vehicles (%HV) and Passenger Car Equivalent is entered for each movement. The Percent of Entry Vehicles Using Left Lane is also entered for each approach if there are two lanes coded for the approach and both lanes have the same movement. This field provides for the traffic split for the two lanes. For example, if there is a LT and TR coded for one approach, the Percent of Entry Vehicles Using Left Lane field will enable for the approach to allow the user to specify how the thru volume is distributed among the two lanes.

For queue length calculations, the Stored Passenger Car Length and Stored Heavy Vehicle Length are provided.

Pedestrian Volumes

The Number of Pedestrians Crossing Entry for each entry of the intersection is coded in pedestrians per hour.

Critical Headway and Follow-up Headway

The default values for Critical Headway and Follow-Up Headway depends on the roundabout geometry. To calibrate the capacity equations, these values can be adjusted from the default values.

Results

Level of Service (LOS) criteria for Roundabouts in control delay (s/veh):

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio ^a	
	$v/c \leq 1.0$	$v/c > 1.0$
0–10	A	F
>10–15	B	F
>15–25	C	F
>25–35	D	F
>35–50	E	F
>50	F	F

Note: ^a For approaches and intersectionwide assessment, LOS is defined solely by control delay.

Control Delay is computed for each critical lane, approach and the intersection as a whole. Critical lanes where the volume-to-capacity ratio is more than 1.0, LOS F is assigned regardless of control delay.

Roundabout Report

The report can be displayed in either Page or Full View. If displayed in Page View, the results will automatically update when the user switches to the Report page. From the Report page, the user can then switch between the formatted report and the text report using the button found at the bottom of the page. The formatted report shows the most important results in a presentable format, while the text report shows a detailed step-by-step analysis in plain text.

If displayed in Full View, the report can be displayed along with the input screen. The user has the choice of displaying the report to the right of the input screen or below the input screen. The report is dynamic and reacts to changes in the input screen. Like the Report page in Page View, the user can switch between the formatted report and the text report using the button found at the bottom of the report.

All or a portion of the reports can be copied to the Windows clipboard for insertion into other files by right-clicking into the Report pane and selecting Copy. The user can also change the display of the report through File Menu or with the use of shortcuts. See *General Controls*.

Roundabout Segments

HCM Chapter 30

Roundabout Segment methodology is a subsection in **Chapter 30, Urban Streets Segments**. It provides an overview of the methodology for evaluating the performance of the motorized vehicle mode on an urban street segment bounded by one or more roundabouts. The procedure is based on national research that measured the travel time performance of nine corridors containing three or more roundabouts in series. The procedure is designed to be integrated into the general computation process for urban street segments described in Chapter 18. Only the relevant deviations from the general procedure are provided in this subsection.

LIMITATIONS OF THE METHODOLOGY

The methodologies in this subsection are based on regression analyses of field-measured data. The limits of these field data are provided in Exhibit 30-40. The analyst is cautioned regarding the validity of the results when an input or intermediate calculated value is outside the range of the research data. In addition, the methodology does not account for capacity constraint caused by oversaturated conditions or the possible effects of an upstream signal on a downstream roundabout.

Operational Data

This Highway Capacity Software (*HCS*) faithfully implements the methodology prescribed in the Highway Capacity Manual (HCM) for analyzing Roundabout Segments.

The user enters all the information necessary in a normal Roundabouts dataset. When a second Roundabout is added, the program will recognize the dataset as a Roundabout Segments dataset and all the necessary fields for the Roundabout Segments procedure will appear.

Intersection/Segment Selection

In a Roundabout Segments dataset, at least two intersections need to be coded. In the upper right-hand corner of the screen, the user has the option to add and delete intersections in the dataset with the use of '+' and '-' buttons, respectively. Segments will be added based on the number of intersections added. The user also has the ability to change the display of the input screen and reports by switching between intersections and segments with the use of drop-down menus.

Roundabout Properties

In addition to the general Roundabout properties, Roundabout Segments also requires input of Width of Circulating Lanes and Inscribed Circle Diameter, both of which are in units of feet (or meters in metric units), and Speed Limit, which is in units of mi/h (or km/h in metric units). The information displayed on

the input screen and current report is dependent on which Roundabout Intersection is selected. Roundabout Intersection selection can be found in the upper right-hand corner of the screen.

Segment Properties

When more than one Roundabout is coded in a dataset, the program will recognize the analysis as a Roundabout Segments analysis. A Segment Properties intersection will appear on the input screen after the Roundabout Properties section. The Name of the segment can be input but is not necessary. Segment Length is a required input. For both the Forward and Reverse directions, required inputs include BFFS Calibration Factor, Restrictive Median, Right-Hand Curb, Right-Hand Access Points, and On-Street Parking, and Mid-Segment Demand Flow Rate.

Roundabout Segments Report

The report can be displayed in either Page or Full View. If displayed in Page View, the results will automatically be updated when the user switches to the Report page. In Full View, the report can be displayed along with the input screen. The user has the choice of displaying the report to the right of the input screen or below the input screen. The report is dynamic and reacts to changes in the input screen. The user can switch between the formatted report and the text report using the buttons found at the bottom of the report or using the buttons found in the menu items.

For the formatted report, there are two types of reports that can be displayed: the Segment or the Roundabout report. If the user chooses to display the Roundabout report, the intersection displayed for the report will depend on which intersection is currently displayed for the input screen. A dropdown menu in the upper right-hand corner of the screen allows the user to switch between intersections. If there are multiple segments and the user chooses to display the Segment report, the segment displayed for the report will depend on which segment is currently displayed for the input screen. Similarly, a dropdown menu in the upper right-hand corner of the screen allows the user to switch between segments.

For the text report, there are two types of reports that can be displayed: the Segment or the Roundabout report. If the user chooses to display the Roundabout report, the intersection displayed for the report will depend on which intersection is currently displayed for the input screen. A dropdown menu in the upper right-hand corner of the screen allows the user to switch between intersections. If there are multiple segments and the user chooses to display the Segment report, the segment displayed for the report will depend on which segment is currently displayed for the input screen. Similarly, a dropdown menu in the upper right-hand corner of the screen allows the user to switch between segments.

All or a portion of the reports can be copied to the Windows clipboard for insertion into other files by right-clicking into the Report pane and selecting Copy. The user can also change the display of the report through File Menu or with the use of shortcuts. See *General Controls*.

How To

Create a New File

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

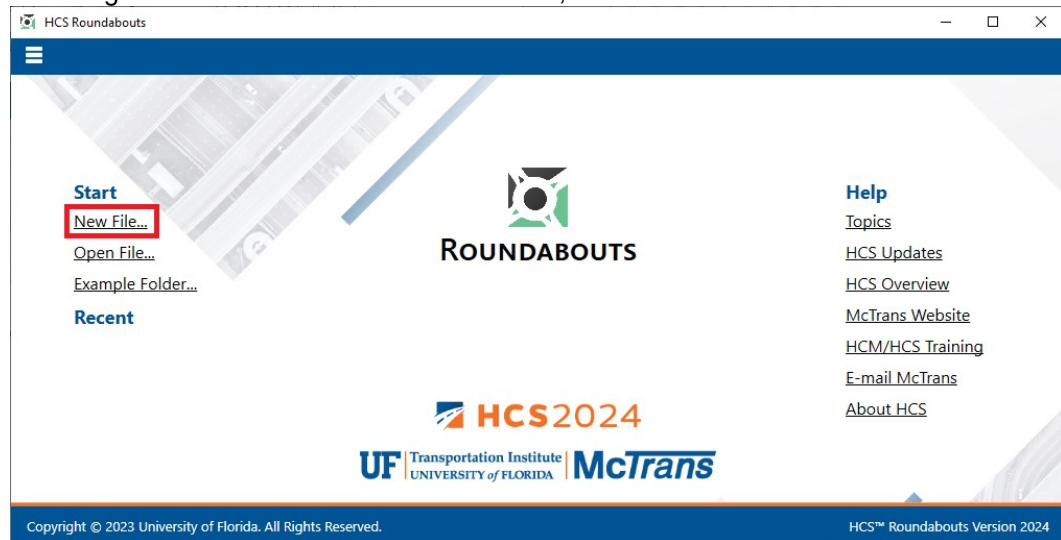


Note: A new file can be created if an existing file is already open; you do not need to start from the Start screen.

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



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



- c. Using keyboard shortcut “Ctrl+N”
2. Once a new file is created, you will be brought to the General page if in Page View or the input screen split with the report either on the right or the bottom of the screen if in Full View

a. Page View

Roundabouts1.xro - HCS Roundabouts

START **GENERAL** GEOMETRY TRAFFIC REPORT

Intersection: 1> Segment:

Project Properties

Analyst: Jurisdiction:
 Agency: Analysis Year: 2023
 Date: 10/15/2023 Project Description:
 Time Analyzed: Units: U.S. Customary
 Facility Name:

Intersection Data

Intersection: Analysis Time Period: 0.25 hours
 East/West Street Name: Peak Hour Factor: 0.92
 North/South Street Name: Proportion of CAVs, %: 0

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b. Full View

Roundabouts1.xro - HCS Roundabouts

START **GENERAL** GEOMETRY TRAFFIC REPORT

Intersection: 1> Segment:

Project Properties

Analyst: Jurisdiction:
 Agency: Analysis Year: 2023
 Date: 10/15/2023 Project Description:
 Time Analyzed: Units: U.S. Customary
 Facility Name:

Intersection Data

Intersection: Analysis Time Period: 0.25 hours
 East/West Street Name: Peak Hour Factor: 0.92
 North/South Street Name: Proportion of CAVs, %: 0

Lanes

HCS Roundabouts Rep

General Information

Analyst:
 Agency or Co.:
 Date Performed: 10/15/2023
 Analysis Year: 2023
 Time Analyzed:
 Project Description:

Site Inform

Volume Adjustments and Site Characteristics

Approach	EB				WB			
	U	L	T	R	U	L	T	R
Movement								
Number of Lanes (N)	0	0	0	0	0	0	0	0
Lane Assignment								
Volume (V), veh/h								
Percent Heavy Vehicles, %								
Flow Rate (m/s), pch								
Right-Turn Bypass	None				None			
Conflicting Lanes								
Pedestrians Crossing, p/h								
Proportion of CAVs, %					0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB		
	Left	Right	Bypass	Left	Right	Bypass
Lane						
Critical Headway, s						

Switch to Text Report

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Open an Existing File

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



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

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



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



- c. Using the keyboard shortcut “Ctrl+O”
- d. Selecting a file under the Recent files list from the Start screen; this can be found below in the red box



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



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



2. Once an existing file is opened, you will be brought to the General page if in Page View or the input screen split with the report either on the right or the bottom of the screen if in Full View

a. Page View

Roundabouts1-SingleLaneFbtWithBypass.xro - HCS Roundabouts

START **GENERAL** GEOMETRY TRAFFIC REPORT

Intersection: 1> Segment:

Project Properties

Analyst: Jurisdiction:
 Agency: Analysis Year: 2022
 Date: 8/15/2022 Project Description: Chapter 33: Example Problem 1
 Time Analyzed: Units: U.S. Customary
 Facility Name:

Intersection Data

Intersection: Analysis Time Period: 0.25 hours
 East/West Street Name: Peak Hour Factor: 0.94
 North/South Street Name: Proportion of CAVs, %: 0

Back Next

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b. Full View

Roundabouts1-SingleLaneFbtWithBypass.xro - HCS Roundabouts

Intersection: 1> Segment:

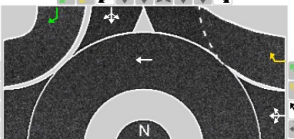
Project Properties

Analyst: Jurisdiction:
 Agency: Analysis Year: 2022
 Date: 8/15/2022 Project Description: Chapter 33: Exam
 Time Analyzed: Units: U.S. Customary
 Facility Name:

Intersection Data

Intersection: Analysis Time Period: 0.25 hours
 East/West Street Name: Peak Hour Factor: 0.94
 North/South Street Name: Proportion of CAVs, %: 0

Lanes

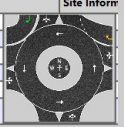


HCS Roundabouts Rep

General Information

Analyst:
 Agency or Co.:
 Date Performed: 8/15/2022
 Analysis Year: 2022
 Time Analyzed:
 Project Description: Chapter 33: Example Problem 1

Site Inform



Volume Adjustments and Site Characteristics

Approach	EB				WB			
	U	L	T	R	U	L	T	R
Movement	0	0	1	0	0	0	1	0
Number of Lanes (N)	0	0	1	0	0	0	1	0
Lane Assignment	LTR				LTR			
Volume (V), veh/h	50	190	280	85	20	110	395	610
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2
Flow Rate (vphs), pch	54	206	304	92	22	119	429	662
Right-Turn Bypass	None				Yielding			
Conflicting Lanes	1				1			
Pedestrians Crossing, p/h	0				0			
Proportion of CAVs, %	0				0			

Critical and Follow-Up Headway Adjustment

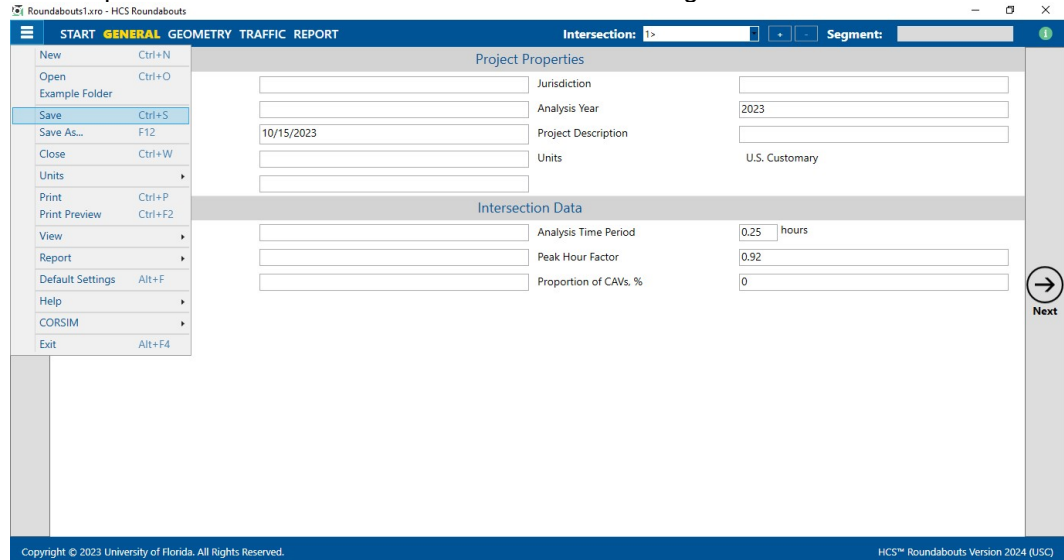
Approach	EB			WB		
	Left	Right	Bypass	Left	Right	Bypass
Lane						
Critical Headway, s	4.9763			4.9763		

Switch to Text Report

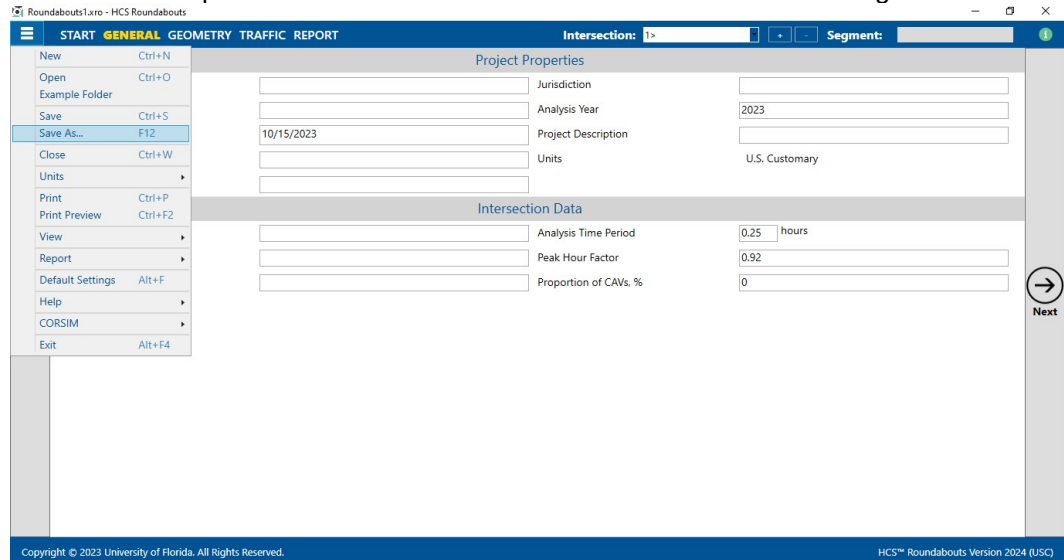
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Save a File

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



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



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

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

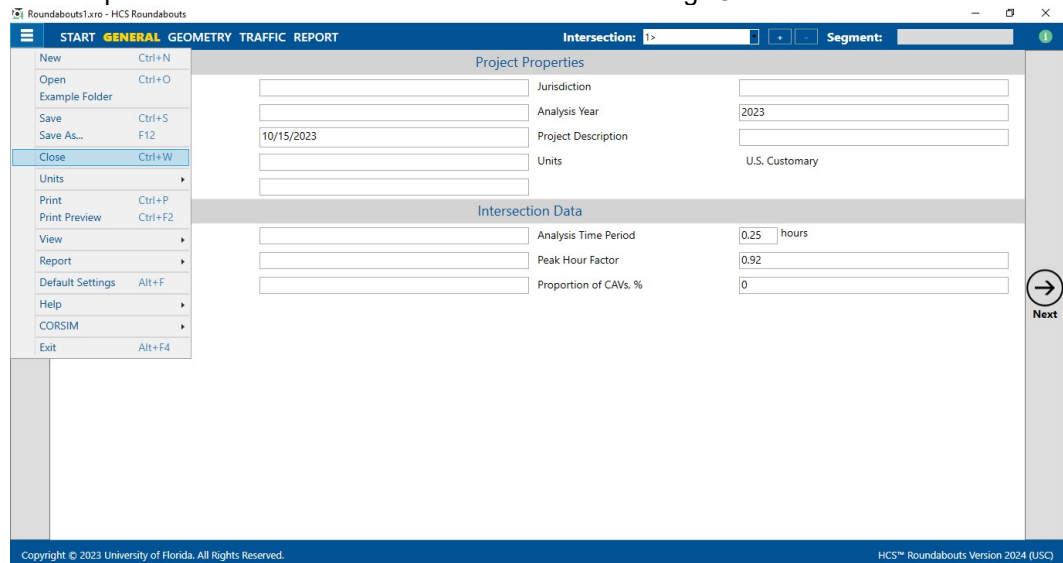


- i. Selecting "Yes" will save the file if it is an existing file. If the file has not been previously saved, the Save As dialog box will pop up allowing you to change the file name and save it.
- ii. Selecting "No" will exit the program or close the file without saving the file
- iii. Selecting "Cancel" 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 three options for closing an open file:
 - a. Selecting *File > Close* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting "Close"



- b. Using the keyboard shortcut "Ctrl+W"
- c. Exiting the program itself; please see *How To: Exit the Program*

Exit the Program

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



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

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



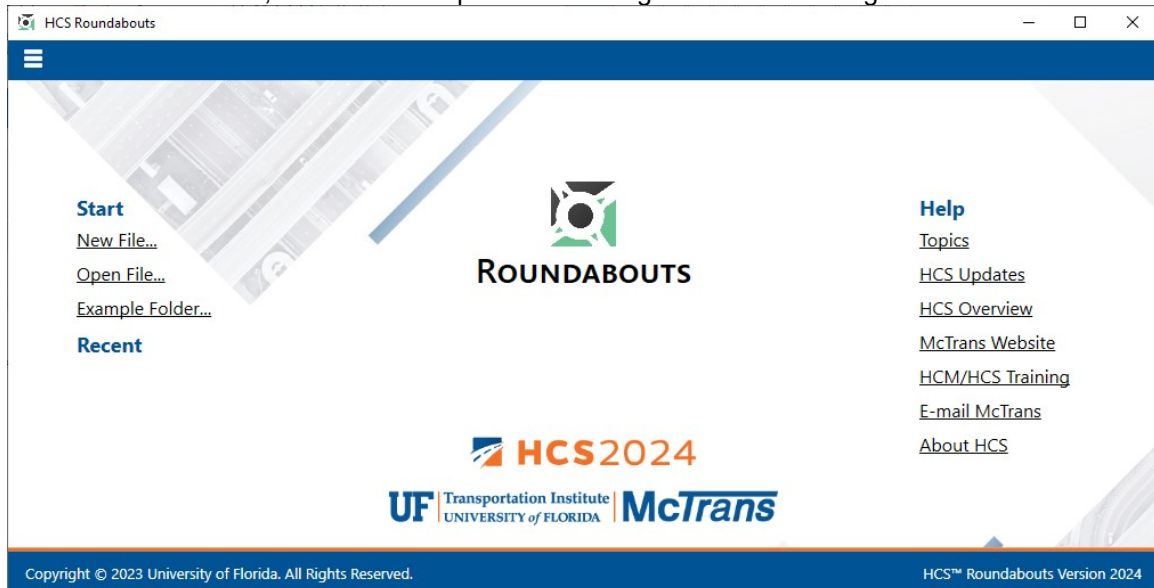
- b. Using the keyboard shortcut "Alt+F4"

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



Edit the Default Settings

1. From the Start screen, there are two options for editing the Default Settings:



Note: The Default Settings can be changed even if an existing file is already open; you do not need to start from the Start screen.

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



- b. Using the keyboard shortcut “Alt+F”
2. Opening the Default Settings will cause a Default Settings window to pop up:

The screenshot shows the 'Default Settings' dialog box. It has a title bar with the HCS Roundabouts logo and a close button (X). The dialog contains four input fields: 'Analyst', 'Agency', and 'Jurisdiction', each with a text box. Below these is a 'Units' section with two radio buttons: 'USC' (selected) and 'Metric'. At the bottom, there are two buttons: 'OK' and 'Cancel'.

3. You can specify Analyst, Agency, and Jurisdiction by clicking on the corresponding text boxes and typing the desired text.
4. Under 'Units', you are given the option of running the analysis in either *U.S. Customary (USC)* or *SI (Metric)* units.
5. Clicking “OK” will save the changes made and close the Default Settings window; clicking “Cancel” will close the Default Setting window without saving and changes.
6. When a new file is created, the Analyst, Agency, and Jurisdiction fields will automatically be populated with the text specified in the Default Settings.
7. When starting a new file, the input and results will display according to the units specified in the Default Settings.

Change the View

1. When a file is open, there are three main options for the view of the program:
 - a. Page View: the inputs and results reports are separated into pages as seen below. You can navigate between pages using the “Back” and “Next” buttons or by clicking the page names found at the top of the screen.

- b. Full View with the report on the right of the screen: the screen is split with all inputs on the left side and the results reports on the right side. You can access all inputs and view all of the current report by using the corresponding scroll bars. There is also a screen splitter that can be moved to adjust the views of the input screen and results report.

Approach	EB				WB			
Movement	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0
Lane Assignment	LTR				LTR			
Volume (V) veh/h	50	190	280	85	20	110	395	610
Percent Heavy Vehicles, %	2	2	2	2	2	2	2	2
Flow Rate (v/s) pch	54	205	304	92	22	119	429	662
Right-Turn Bypass	None				Yielding			
Conflicting Lanes	1				1			
Pedestrians Crossing, p/h	0				0			
Proportion of CAVs, %	0				0			

Approach	EB			WB		
Lane	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s	4.9763			4.9763	4.9763	

- c. Full View with the report on the bottom of the screen: the screen is split with all inputs on the top of the screen and the results report on the bottom of the screen. You can access all inputs and view all of the current report by using the corresponding scroll bars. There is also a screen splitter that can be moved to adjust the view of the input screen and results report.

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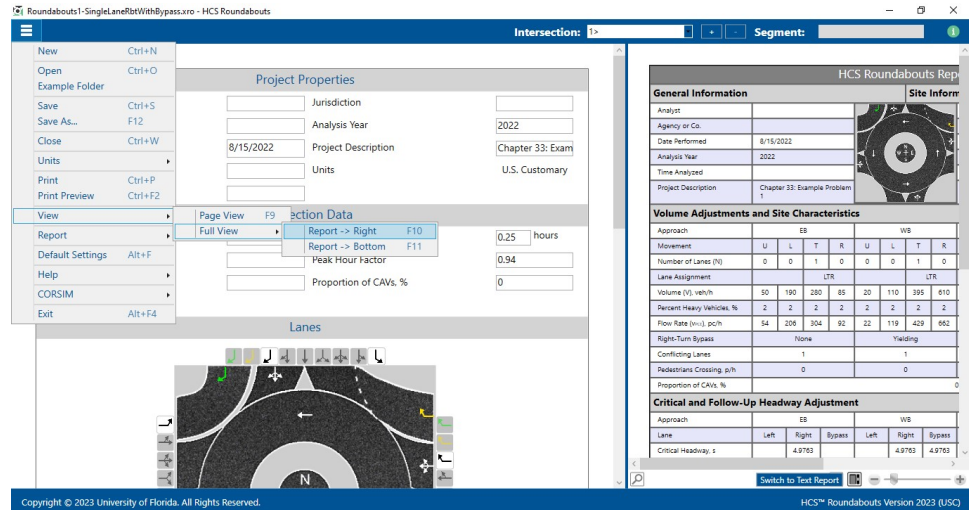
2. Views can be changed by using the main menu items or the keyboard shortcuts.

- a. Main Menu Items

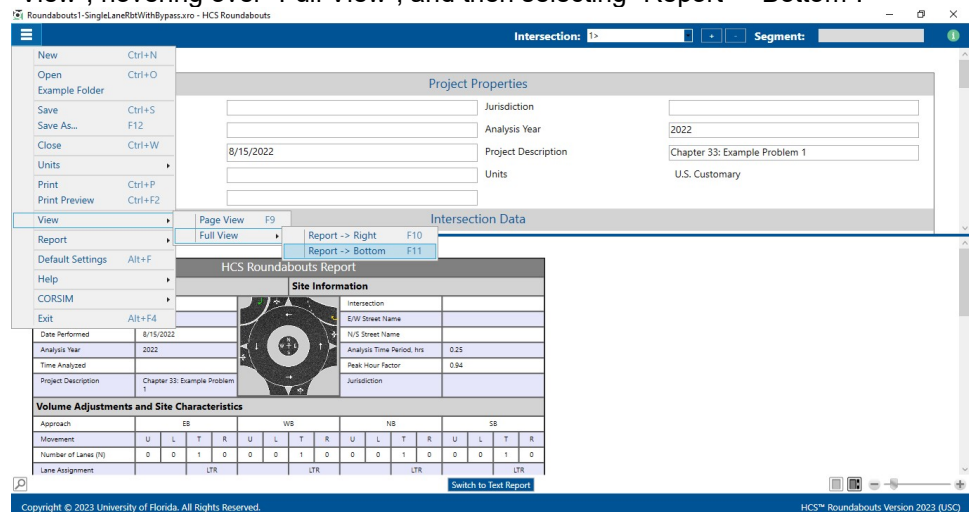
- i. To switch to Page View, select *File > View > Page View* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “View”, and then selecting “Page View”.

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



- iii. To switch to Full View with the report on the bottom of the screen, select *File > View > Full View > Report -> Bottom* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over "View", hovering over "Full View", and then selecting "Report -> Bottom".

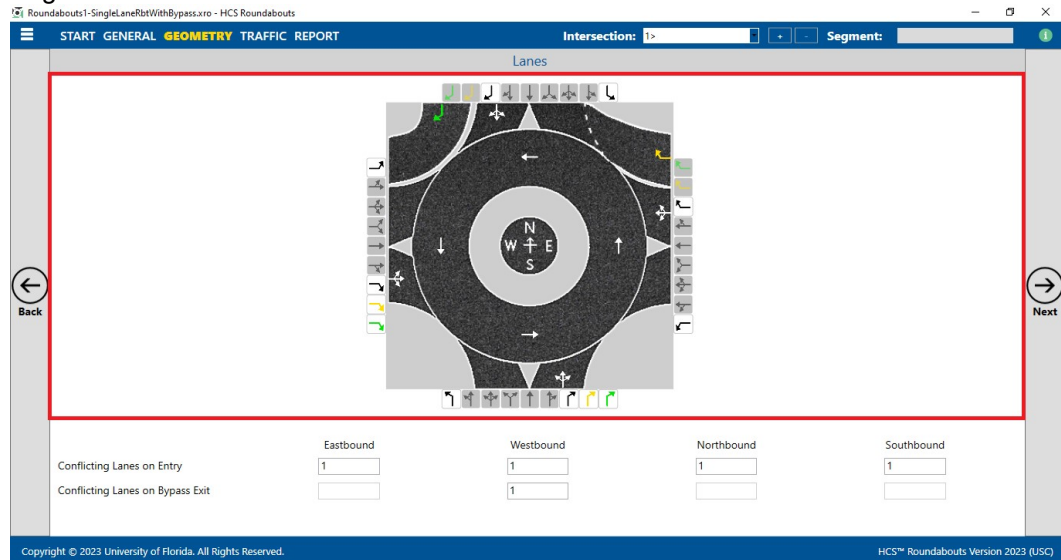


- b. Keyboard Shortcuts
 - i. Page View: keyboard shortcut is "F9"
 - ii. Full View with report on the right of the screen: keyboard shortcut is "F10"
 - iii. Full View with report on the bottom of the screen: keyboard shortcut is "F11"

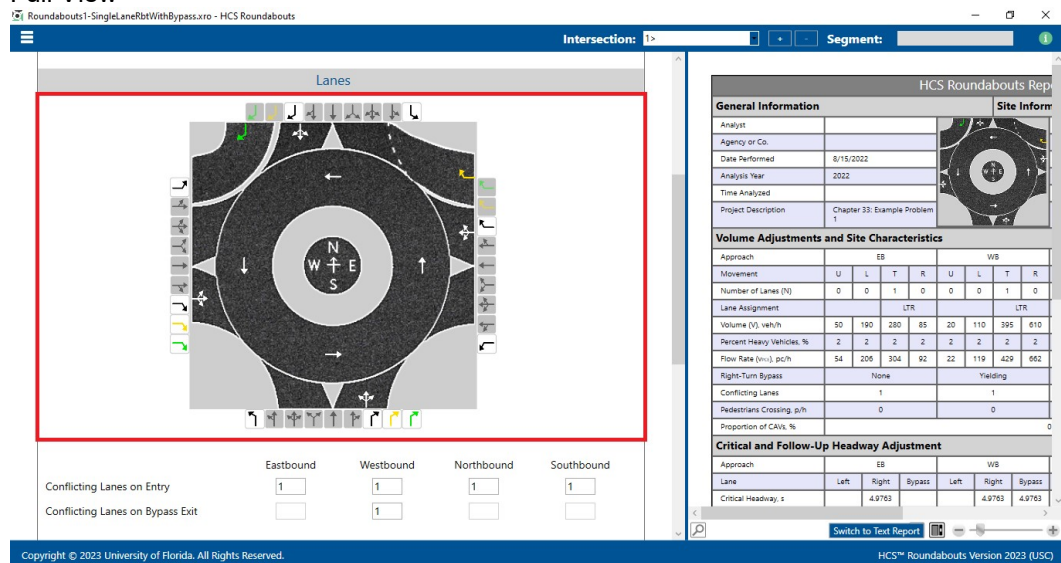
Change the Lane Configuration

1. When a new file is created or an existing file I opened, the lane configuration can be changed under the Lanes section. This can be found on the Geometry page if using Page View or the input portion of the split screen if using Full View.

a. Page View



b. Full View

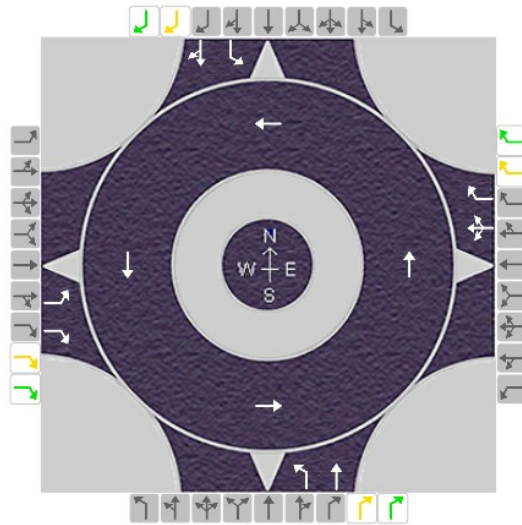


- To add lanes, click on the lane buttons (black, yellow, or green arrows within boxes) on the edges of the lanes graphic. If the background of a lane button is white, the lane is available to add to the corresponding approach. If the background of a lane button is gray, it is disabled and cannot be added to the corresponding approach based on the current lane configuration.

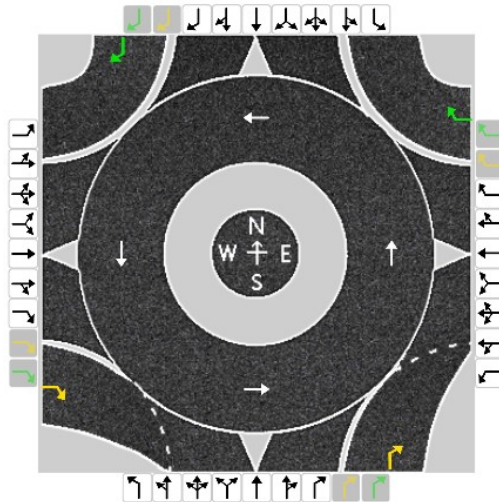


- The black arrows include all the standard lanes: exclusive left-turn (L), shared left-thru (LT), shared left-thru-right (LTR), shared left-right (LR), exclusive thru (T), shared thru-right (TR), and exclusive right (R) lanes.
- The yellow and green arrows include the right-turn bypass lanes. The yellow arrow indicates a yielding right-turn bypass lane; the green arrow indicates a non-yielding right-turn bypass lane.

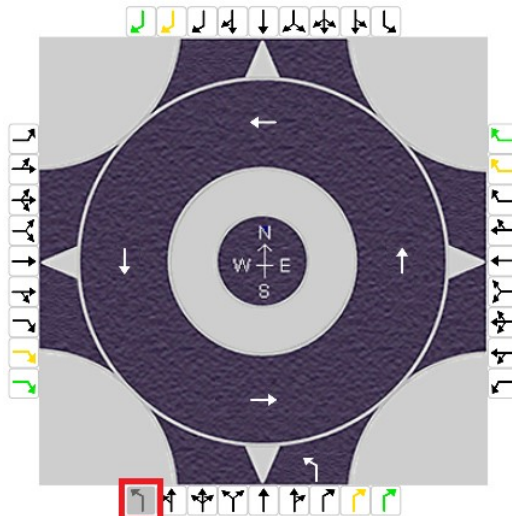
- c. Each approach allows up to two standard lanes to be added



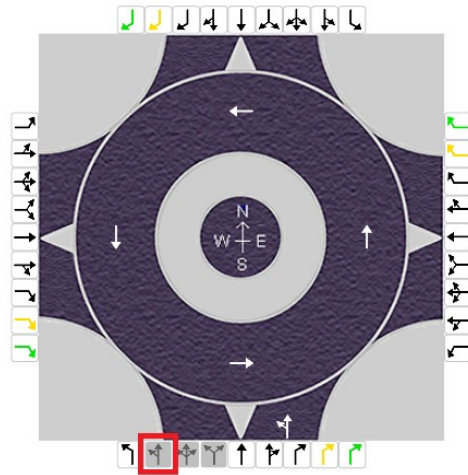
- d. Each approach allows up to one right-turn bypass lane to be added



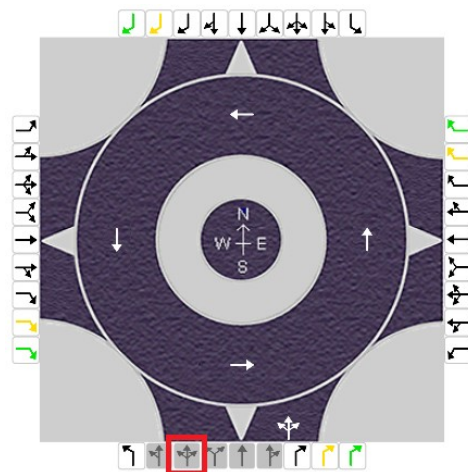
- e. Adding an exclusive left-turn (L) lane will disable the exclusive left-turn (L) lane



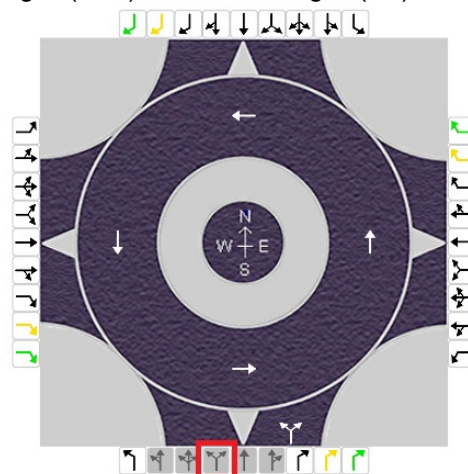
- f. Adding a shared left-thru (LT) lane will disable the shared left-thru (LT), shared left-thru-right (LTR), and shared left-right (LR) lanes



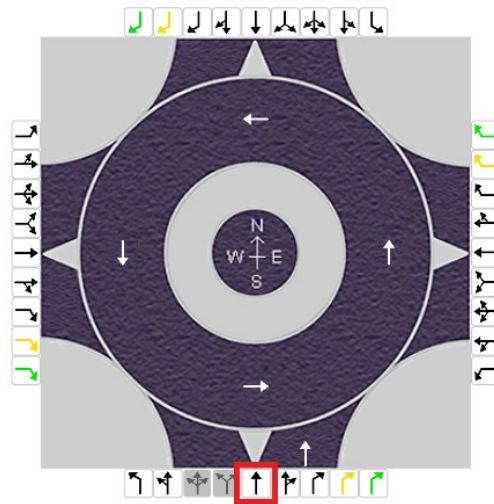
- g. Adding a shared left-thru-right (LTR) lane will disable the shared left-thru (LT), shared left-thru-right (LTR), shared left-right (LR), exclusive thru (T), and shared thru-right (TR) lanes



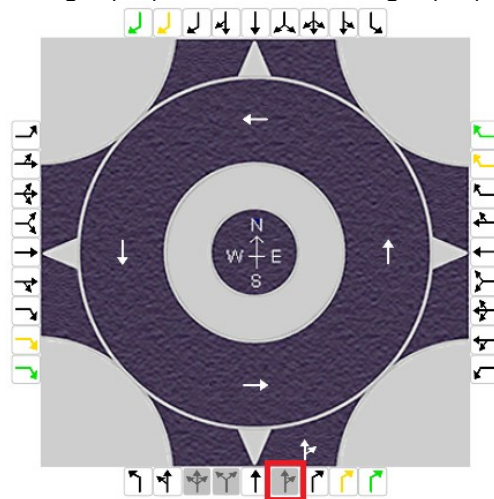
- h. Adding a shared left-right (LR) lane will disable the shared left-thru (LT), shared left-thru-right (LTR), shared left-right (LR), exclusive thru (T), and shared thru-right (TR) lanes



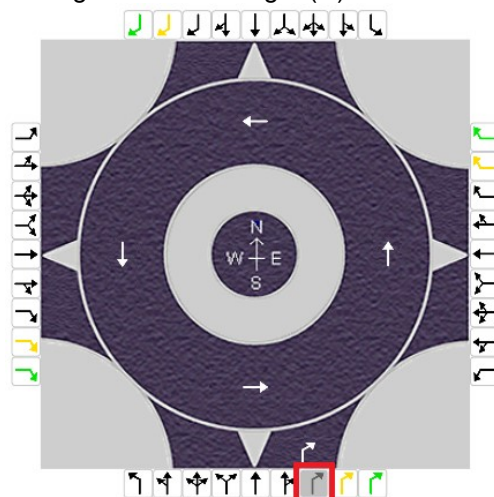
- i. Adding an exclusive thru (T) lane will disable the shared left-thru-right (LTR) and shared left-right (LR) lanes



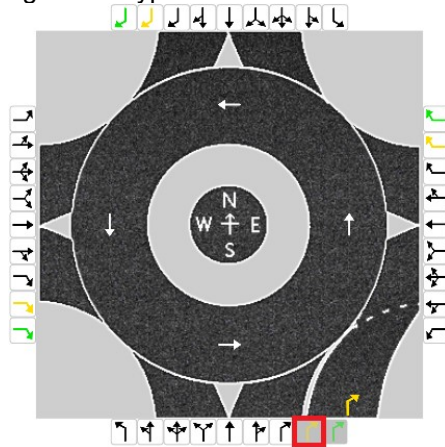
- j. Adding a shared thru-right (TR) lane will disable the shared left-thru-right (LTR), shared left-right (LR), and shared thru-right (TR) lanes



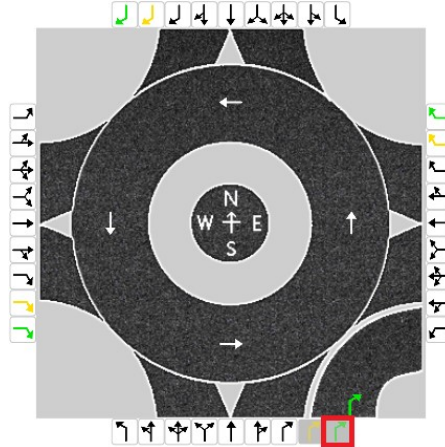
- k. Adding an exclusive right (R) will disable the exclusive right (R) lane



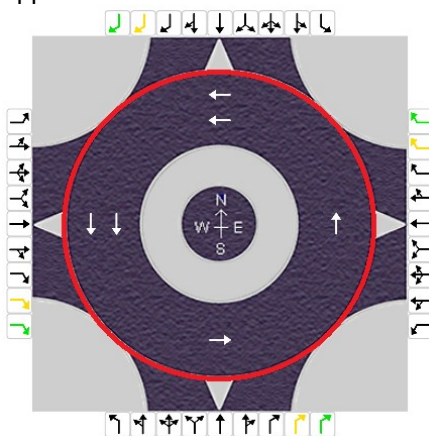
- l. Adding a yielding right-turn bypass lane will disable both the yielding and non-yielding right-turn bypass lanes



- m. Adding a non-yielding right-turn bypass lane will disable both the yielding and non-yielding right-turn bypass lanes



- To remove lanes, click on the lanes within the approach (white arrows and/or yellow or green arrows outside of the roundabout circle). Clicking on an arrow will immediately remove the lane and change which lane buttons are enabled/disabled for the corresponding approach.
- Within the roundabout circle are white arrows for each approach. These represent the number of circulating lanes. The circulating flow arrow(s) simply toggles between one and two lanes for each approach.



- Changes to the lane configuration on the lanes graphic in the input screen will be reflected on the lanes graphic in the formatted report and the lane information in both the formatted and text reports.

Add or Delete Roundabout Intersections

- In a roundabout analysis, there can be a single roundabout or multiple roundabouts. Whether in Page View or Full View, drop down menus for Intersection and Segment, along with plus (+) and minus (-) buttons are provided at the top right-hand corner of the window next to the information icon.

Roundabouts1.xro - HCS Roundabouts

Intersection: 1> Segment:

Project Properties

Analyst: Jurisdiction:
 Agency: Analysis Year: 2023
 Date: 10/15/2023 Project Description:
 Time Analyzed: Units: U.S. Customary
 Facility Name:

Intersection Data

Intersection: Analysis Time Period: 0.25 hours
 East/West Street Name: Peak Hour Factor: 0.92
 North/South Street Name: Proportion of CAVs, %: 0

Lanes

HCS Roundabouts Report

General Information

Analyst:
 Agency or Co.:
 Date Performed: 10/15/2023
 Analysis Year: 2023
 Time Analyzed:
 Project Description:

Volume Adjustments and Site Characteristics

Approach	EB				WB			
Movement	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	0	0
Lane Assignment								
Volume (V) veh/h								
Percent Heavy Vehicles, %								
Flow Rate (m/s), pc/h								
Right-Turn Bypass	None				None			
Conflicting Lanes								
Pedestrians Crossing, p/h								
Proportion of CAVs, %					0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB		
Lane	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s						

Switch to Text Report

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- When the current analysis only has one roundabout, the Segment drop down menu is disabled and the Intersection drop down menu will only have one choice.

Roundabouts1.xro - HCS Roundabouts

Intersection: 1> Segment:

Project Properties

Analyst: Jurisdiction:
 Agency: Analysis Year: 2023
 Date: 10/15/2023 Project Description:
 Time Analyzed: Units: U.S. Customary
 Facility Name:

Intersection Data

Intersection: Analysis Time Period: 0.25 hours
 East/West Street Name: Peak Hour Factor: 0.92
 North/South Street Name: Proportion of CAVs, %: 0

Lanes

HCS Roundabouts Report

General Information

Analyst:
 Agency or Co.:
 Date Performed: 10/15/2023
 Analysis Year: 2023
 Time Analyzed:
 Project Description:

Volume Adjustments and Site Characteristics

Approach	EB				WB			
Movement	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	0	0
Lane Assignment								
Volume (V) veh/h								
Percent Heavy Vehicles, %								
Flow Rate (m/s), pc/h								
Right-Turn Bypass	None				None			
Conflicting Lanes								
Pedestrians Crossing, p/h								
Proportion of CAVs, %					0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB		
Lane	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s						

Switch to Text Report

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- To add a roundabout to an analysis, select the plus (+) button next to the Intersection drop down menu. This will add a roundabout intersection after whichever roundabout is currently selected in the Intersection drop down menu. When a new intersection is added, it will also be listed in the drop down menu. If the Segment drop down menu was previously disabled, it will now be enabled and a new segment will be listed in the Segment drop down menu. For every intersection included in an analysis, there will be one less segment included. For example, an analysis with two intersections will have one segment and an analysis with three intersections will have two segments.

Intersection: 2> Segment: 1>

Project Properties

Analyst: _____ Jurisdiction: _____

Agency: _____ Analysis Year: 2023

Date: 10/15/2023 Project Description: _____

Time Analyzed: _____ Units: U.S. Customary

Facility Name: _____

Intersection Data

Intersection: _____ Analysis Time Period: 0.25 hours

East/West Street Name: _____ Peak Hour Factor: 0.92

North/South Street Name: _____ Proportion of CAVs, %: 0

Forward Direction: EB

Lanes

HCS Roundabouts Report

General Information

Analyst: _____

Agency or Co.: _____

Date Performed: 10/15/2023

Analysis Year: 2023

Time Analyzed: _____

Project Description: _____

Volume Adjustments and Site Characteristics

Approach	EB				WB			
Movement	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	0	0
Lane Assignment								
Volume (V), veh/h								
Percent Heavy Vehicles, %								
Flow Rate (v/s), pc/h								
Right-Turn Bypass	None				None			
Conflicting Lanes								
Pedestrians Crossing, p/h								
Proportion of CAVs, %					0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB		
Lane	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s						

Switch to Text Report Switch to Segment Report

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- The intersection selected in the Intersection drop down menu will be the current intersection displayed on the input screen and results report. Similarly, the segment selected in the Segment drop down menu will be the current segment displayed on the input screen and results report.

Intersection: 2> Segment: 1>

Project Properties

Analyst: _____ Jurisdiction: _____

Agency: _____ Analysis Year: 2023

Date: 10/15/2023 Project Description: _____

Time Analyzed: _____ Units: U.S. Customary

Facility Name: _____

Intersection Data

Intersection: _____ Analysis Time Period: 0.25 hours

East/West Street Name: _____ Peak Hour Factor: 0.92

North/South Street Name: _____ Proportion of CAVs, %: 0

Forward Direction: EB

Lanes

HCS Roundabouts Report

General Information

Analyst: _____

Agency or Co.: _____

Date Performed: 10/15/2023

Analysis Year: 2023

Time Analyzed: _____

Project Description: _____

Volume Adjustments and Site Characteristics

Approach	EB				WB			
Movement	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	0	0	0	0	0	0
Lane Assignment								
Volume (V), veh/h								
Percent Heavy Vehicles, %								
Flow Rate (v/s), pc/h								
Right-Turn Bypass	None				None			
Conflicting Lanes								
Pedestrians Crossing, p/h								
Proportion of CAVs, %					0			

Critical and Follow-Up Headway Adjustment

Approach	EB			WB		
Lane	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s						

Switch to Text Report Switch to Segment Report

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- To delete a roundabout from an analysis, select the minus (-) button next to the Intersection drop down menu. This will remove whichever roundabout intersection is currently selected in the Intersection drop down menu.

The screenshot shows the HCS Roundabouts software interface. The top bar includes a menu icon, the title "Roundabouts1.xrt - HCS Roundabouts", and fields for "Intersection: 2" and "Segment: 1". The minus button next to the Intersection dropdown is highlighted with a red box. The main area is divided into three sections: "Project Properties", "Intersection Data", and "Lanes". The "Project Properties" section includes fields for Analyst, Agency, Date, Time Analyzed, Facility Name, Jurisdiction, Analysis Year, Project Description, Units, and U.S. Customary. The "Intersection Data" section includes fields for Intersection, Analysis Time Period, East/West Street Name, Peak Hour Factor, North/South Street Name, Proportion of CAVs, and Forward Direction. The "Lanes" section shows a diagram of a roundabout with lane markings. The right sidebar contains the "HCS Roundabouts Report" with sections for General Information, Site Information, Volume Adjustments and Site Characteristics, and Critical and Follow-Up Headway Adjustment.

View Results of the Analysis

- After editing all the necessary inputs, results of the analysis can be found in the form of reports. Reports can be found on the Report page if using Page View or on the results portion of the split screen if using Full View.
 - Page View with Report page displayed

The screenshot shows the HCS Roundabouts software interface with the "REPORT" tab selected. The report content is displayed in a table format. The top bar includes a menu icon, the title "Roundabouts1-SingleLaneRbtWithBypass.xrt - HCS Roundabouts", and fields for "Intersection: 1" and "Segment: 1". The main area is divided into two sections: "General Information" and "Site Information". The "General Information" section includes fields for Analyst, Agency or Co., Date Performed, Analysis Year, Time Analyzed, Project Description, and Chapter 33: Example Problem 1. The "Site Information" section includes fields for Intersection, E/W Street Name, N/S Street Name, Analysis Time Period, Peak Hour Factor, and Jurisdiction. The report content is displayed in a table format with sections for Volume Adjustments and Site Characteristics, and Critical and Follow-Up Headway Adjustment.

b. Full View with the report on the right of the screen

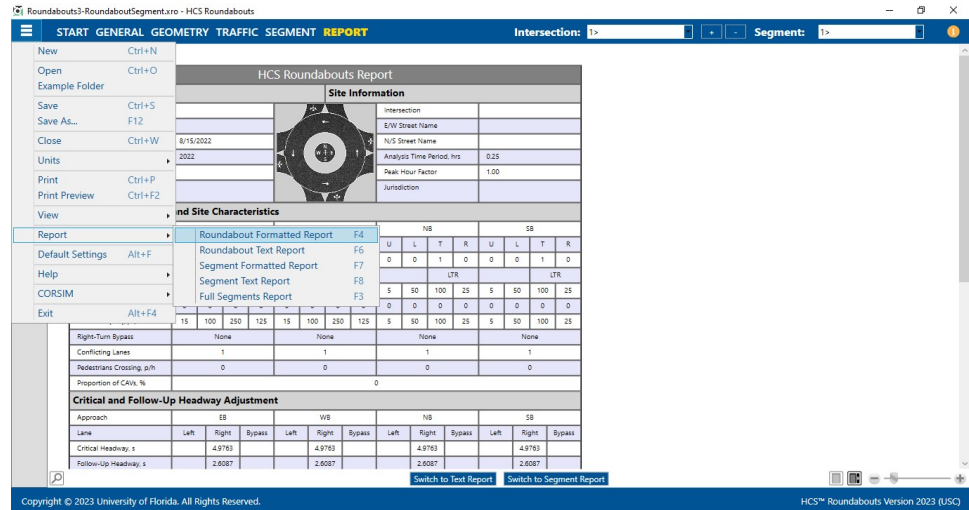
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c. Full View with the report on the bottom of the screen

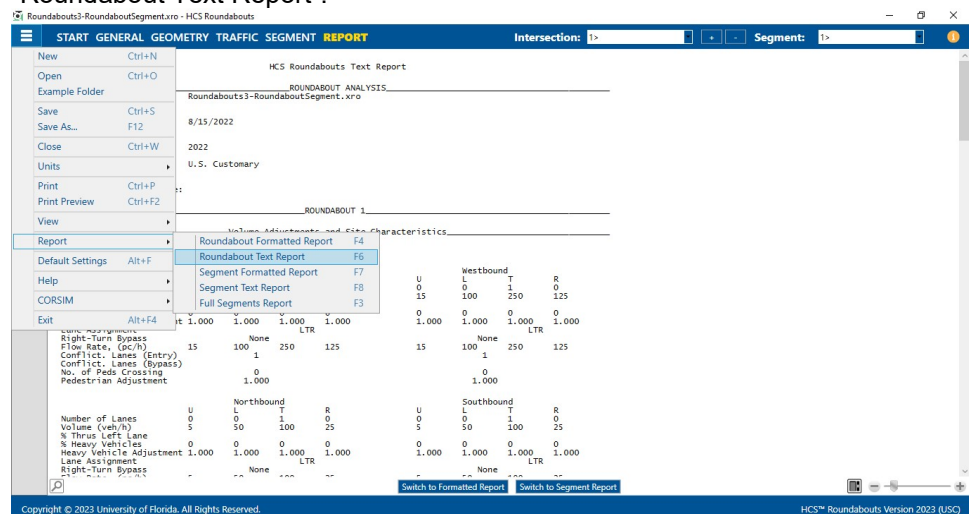
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2. There are two types of reports: Formatted and Text

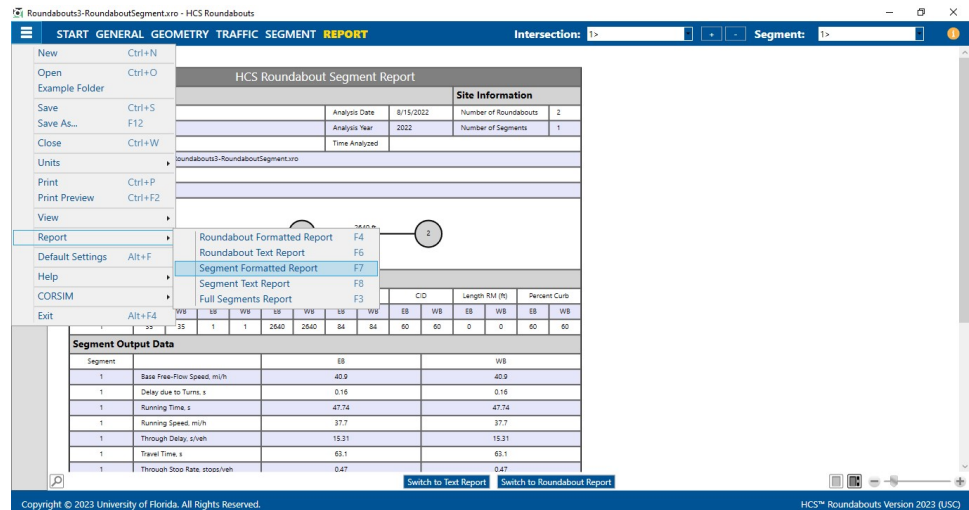
- Formatted reports show the most important results in a presentable format. Options available for formatted reports include: Roundabout Formatted Report, Segment Formatted Report, and Full Segments Report.



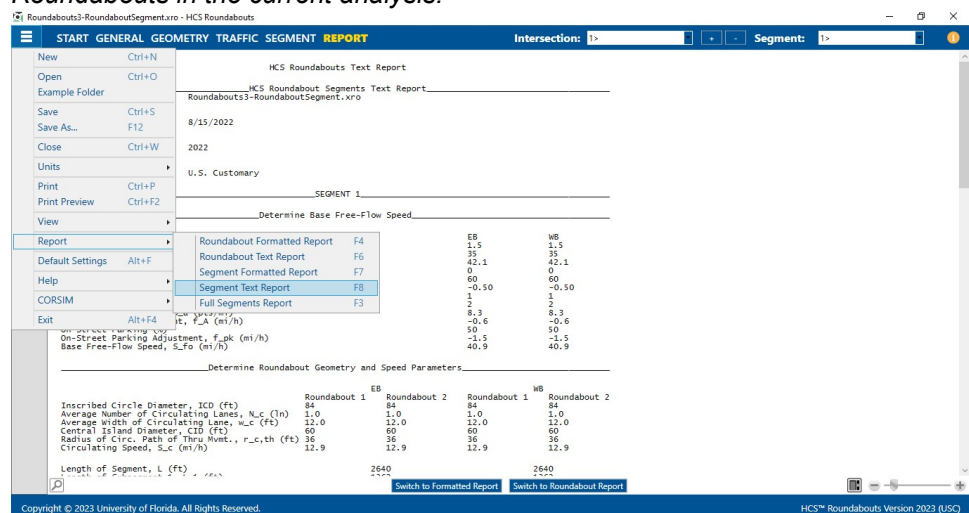
- ii. To switch to the Roundabout Text Report, select *File > Report > Roundabout Text Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report”, and then selecting “Roundabout Text Report”.



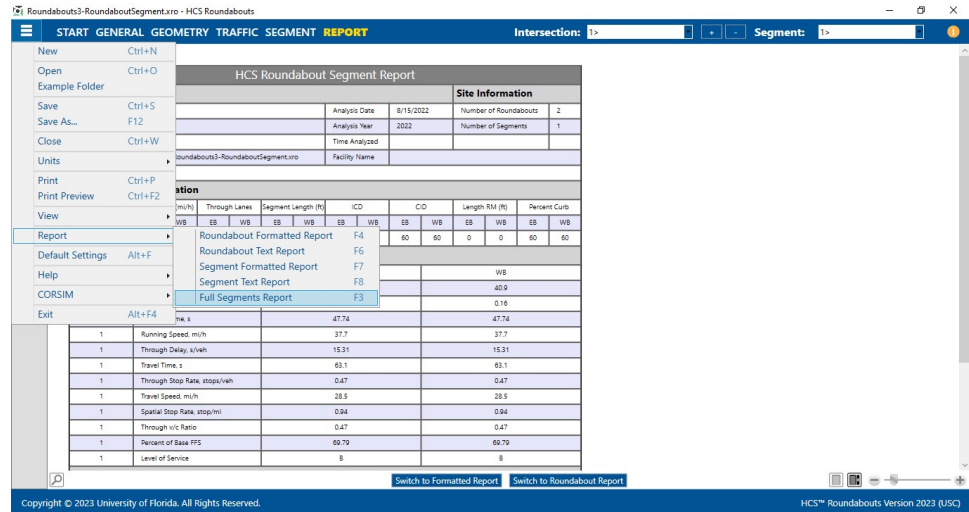
- iii. To switch to the Segment Formatted Report, select *File > Report > Segment Formatted Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report”, and then selecting “Segment Formatted Report”. *Note: This will only be enabled if there are multiple Roundabouts in the current analysis.*



- iv. To switch to the Segment Text Report, select *File > Report > Segment Text Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report”, and then selecting “Segment Text Report”. *Note: This will only be enabled if there are multiple Roundabouts in the current analysis.*



- v. To switch to the Full Segments Report, select *File > Report > Full Segments Report* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen, hovering over “Report” and then selecting “Full Segments Report”. *Note: This will only be enabled if there are multiple Roundabouts in the current analysis.*

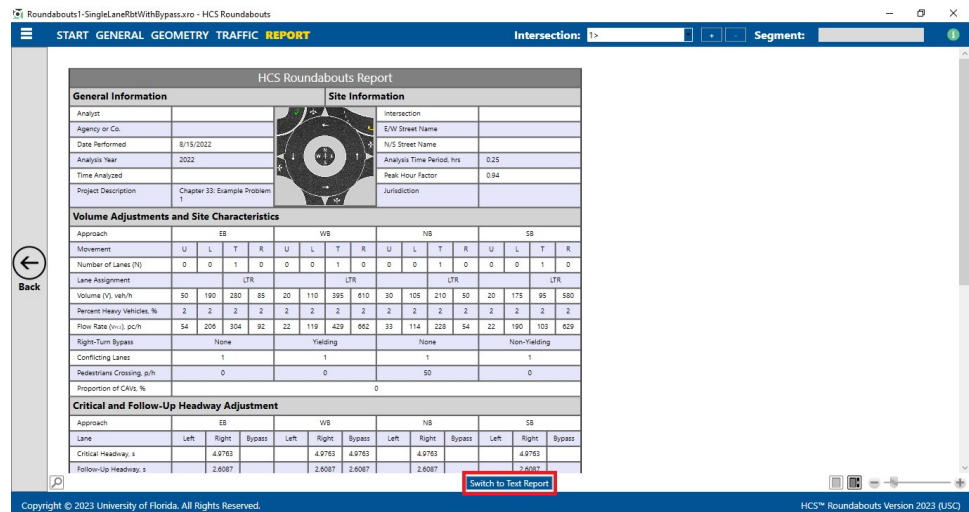


b. Keyboard Shortcuts

- Formatted Report: keyboard shortcut is “F4”
- Text Report: keyboard shortcut is “F6”

c. Report Toggle Buttons

- Whether viewing the report in Page View or Full View, a toggle button(s) will be available at the bottom of the screen underneath the report.
- If there is a single roundabout in the current analysis and the roundabout formatted report is currently being displayed, one toggle button will be displayed and will say “Switch to Text Report” which will allow you to display the roundabout text report if clicked.



- If there is a single roundabout in the current analysis and the roundabout text report is currently being displayed, one toggle button will be displayed and will say “Switch to Formatted Report” which will allow you to display the roundabout formatted report if clicked.

Roundabouts1-SingleLaneRbtWithBypass.xro - HCS Roundabouts

START GENERAL GEOMETRY TRAFFIC REPORT Intersection: 1> Segment:

HCS Roundabouts Text Report

ROUNDABOUT ANALYSIS

File Name: Roundabouts1-SingleLaneRbtWithBypass.xro
 Analyst:
 Date Performed: 8/15/2022
 Time Analyzed:
 Jurisdiction:
 Analysis Year: 2022
 Project Description: Chapter 33: Example Problem 1
 Units:
 Intersection Name:
 East/West Street Name:
 North/South Street Name:

Volume Adjustments and Site Characteristics

Peak Hour Factor, PHF 0.94
 Analysis Time Period, T 0.25

Back

	Eastbound					Westbound			
	U	L	T	R		U	L	T	R
Number of Lanes	0	0	1	0		0	0	1	0
Volume (veh/h)	50	190	280	85		20	110	395	610
% Thru Left Lane									
% Heavy Vehicles	2	2	2	2		2	2	2	2
Heavy Vehicle Adjustment	0.980	0.980	0.980	0.980		0.980	0.980	0.980	0.980
Lane Assignment			LTR					LTR	
Right-Turn Bypass									
Flow Rate (pc/h)	54	206	304	92		22	119	429	662
Conflict Lanes (Entry)			1					1	
Conflict Lanes (Bypass)									
No. of Peds Crossing			0					0	
Pedestrian Adjustment			1.000					1.000	

	Northbound					Southbound			
	U	L	T	R		U	L	T	R
Number of Lanes	0	0	1	0		0	0	1	0
Volume (veh/h)	90	105	210	50		20	175	95	580
% Thru Left Lane									
% Heavy Vehicles	2	2	2	2		2	2	2	2
Heavy Vehicle Adjustment	0.980	0.980	0.980	0.980		0.980	0.980	0.980	0.980
Lane Assignment			LTR					LTR	
Right-Turn Bypass									
Flow Rate (pc/h)	33	114	228	54		22	Non-Yielding	150	629
Conflict Lanes (Entry)			1					1	
Conflict Lanes (Bypass)									

Switch to Formatted Report

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- iv. If there are multiple roundabouts in the current analysis and the roundabout formatted report is currently being displayed, two toggle buttons will be displayed. One will say “Switch to Text Report” which will allow you to display the roundabout text report if clicked. The other will say “Switch to Segment Report” which will allow you to display the segment formatted report if clicked.

Roundabouts3-RoundaboutSegment.xro - HCS Roundabouts

START GENERAL GEOMETRY TRAFFIC SEGMENT REPORT Intersection: 1> Segment: 1>

HCS Roundabouts Report

General Information

Analyst:
 Agency: GSC
 Date Performed: 8/15/2022
 Time Analyzed:
 Jurisdiction:
 Project Description:

Site Information

Intersection:
 E/W Street Name:
 N/S Street Name:
 Analysis Time Period, hrs 0.25
 Peak Hour Factor 1.00

Volume Adjustments and Site Characteristics

Back

	EB				WB				NB				SB			
	U	L	T	R	U	L	T	R	U	L	T	R	U	L	T	R
Number of Lanes (N)	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0
Lane Assignment			LTR				LTR				LTR				LTR	
Volume (V), veh/h	15	100	250	125	15	100	250	125	5	50	100	25	5	50	100	25
Percent Heavy Vehicles, %	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flow Rate (vpl), pc/h	15	100	250	125	15	100	250	125	5	50	100	25	5	50	100	25
Right-Turn Bypass			None				None				None				None	
Conflicting Lanes			1				1				1				1	
Pedestrians Crossing, p/h			0				0				0				0	
Proportion of CAVs, %																

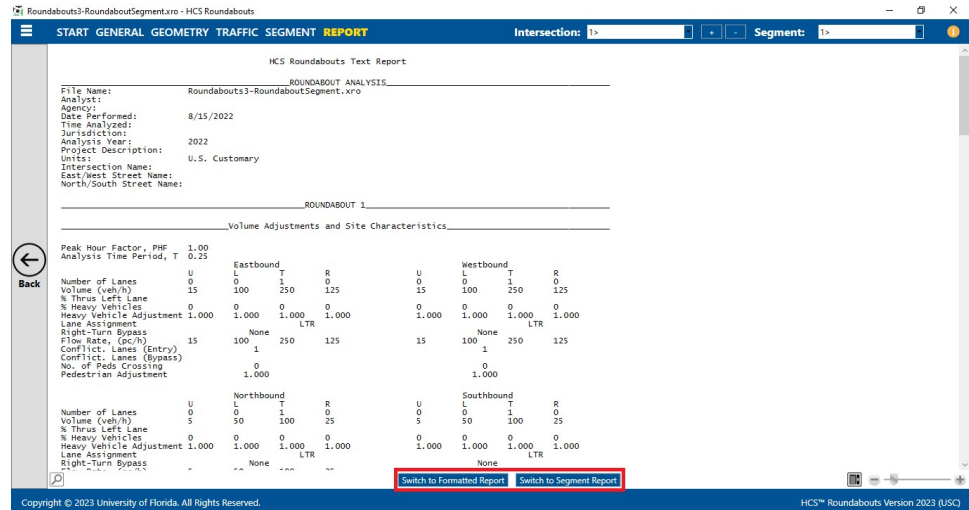
Critical and Follow-Up Headway Adjustment

	EB			WB			NB			SB		
	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass	Left	Right	Bypass
Critical Headway, s		4.9763			4.9763			4.9763			4.9763	
Follow-Up Headway, s		2.6087			2.6087			2.6087			2.6087	

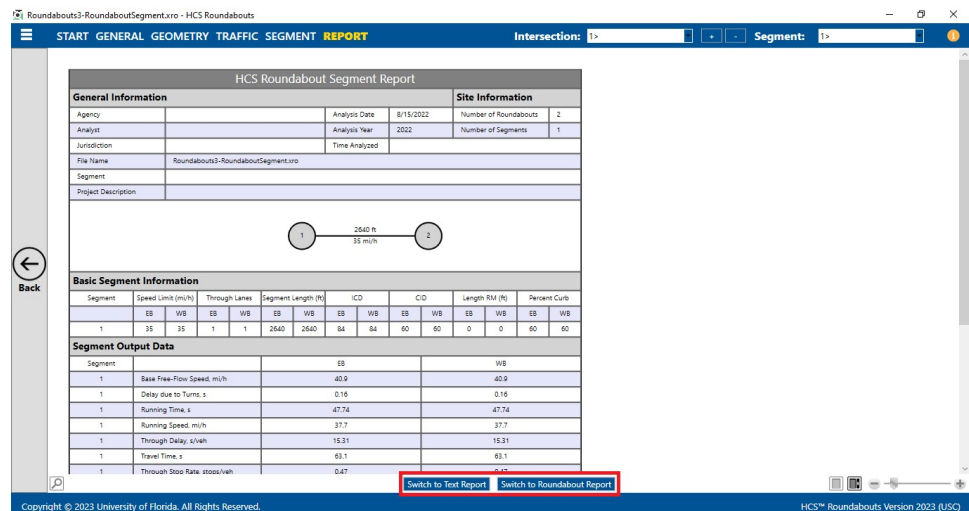
Switch to Text Report Switch to Segment Report

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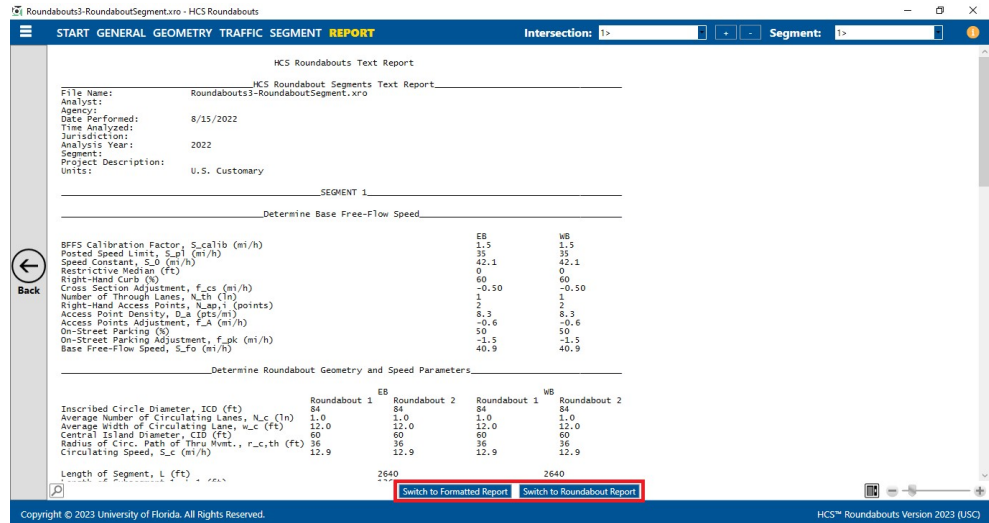
- v. If there are multiple roundabouts in the current analysis and the roundabout text report is currently being displayed, two toggle buttons will be displayed. One will say “Switch to Formatted Report” which will allow you to display the roundabout formatted report if clicked. The other will say “Switch to Segment Report” which will allow you to display the segment text report if clicked.



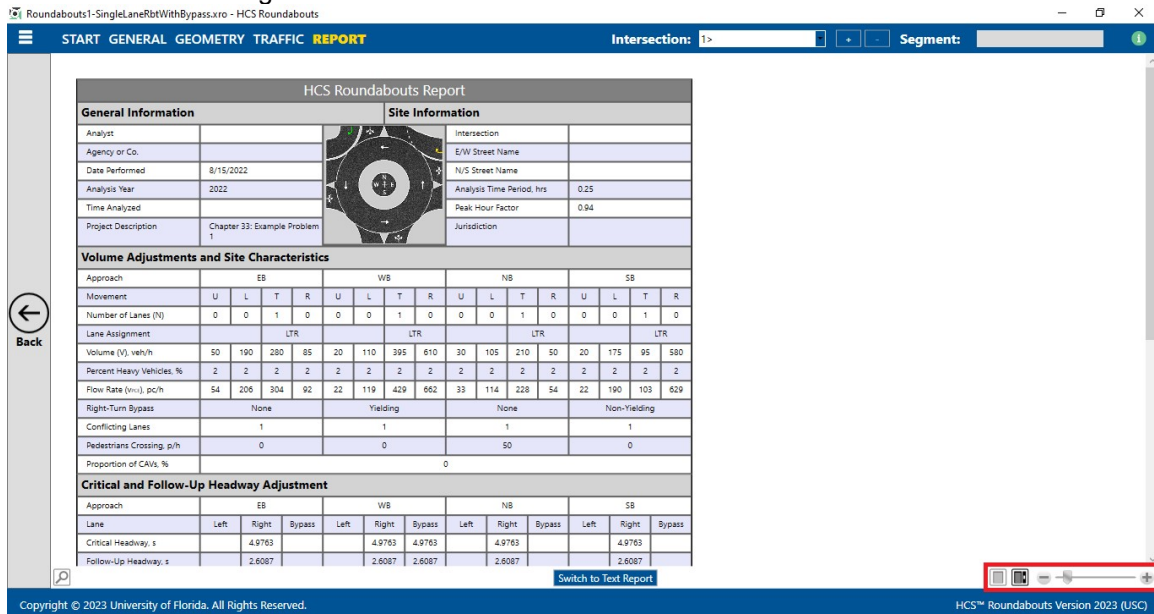
- vi. If there are multiple roundabouts in the current analysis and the segment formatted report is currently being displayed, two toggle buttons will be displayed. One will say “Switch to Text Report” which will allow you to display the segment text report if clicked. The other will say “Switch to Roundabout Report” which will allow you to display the roundabout formatted report if clicked.



- vii. If there are multiple roundabouts in the current analysis and the segment text report is currently being displayed, two toggle buttons will be displayed. One will say “Switch to Formatted Report” which will allow you to display the segment formatted report if clicked. The other will say “Switch to Roundabout Report” which will allow you to display the roundabout text report if clicked.



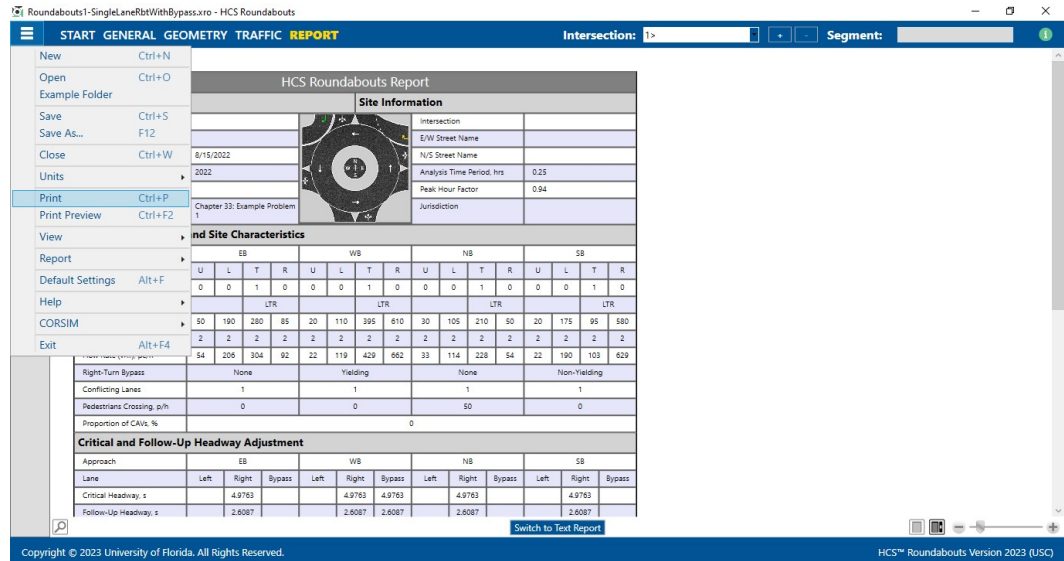
4. The magnification of the report currently being displayed can be changed using the zoom slider found at the bottom right-hand corner of the screen.



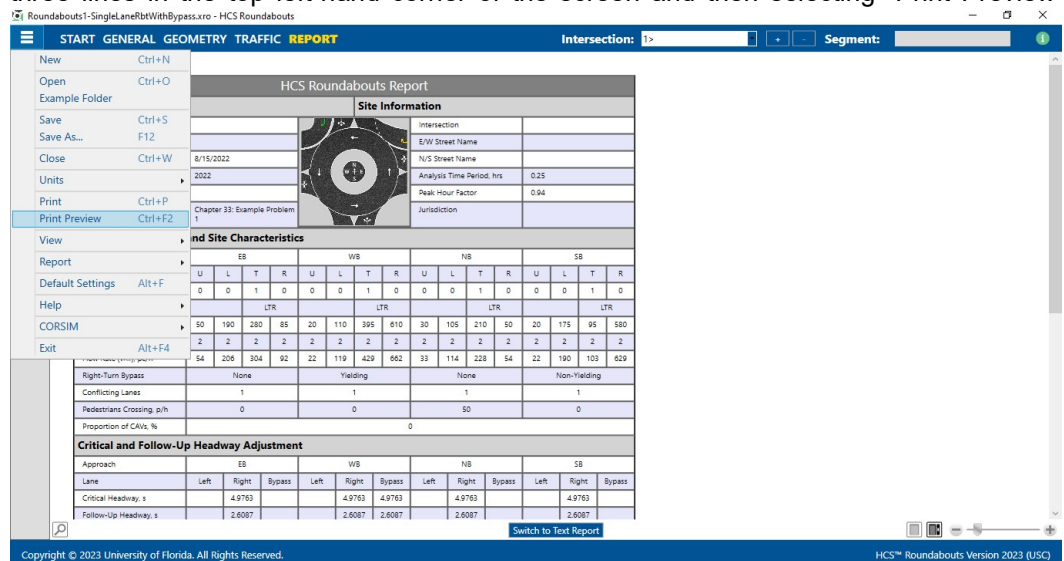
- a. To zoom in, drag the slider to the right; to zoom out, drag the slider to the left
- b. Clicking the plus (+) button will zoom in; clicking the minus (-) button will zoom out
- c. Holding down "ctrl" on the keyboard and scrolling up on the mouse wheel will zoom in; holding down "ctrl" on the keyboard and scrolling down on the mouse wheel will zoom out

Print a Report

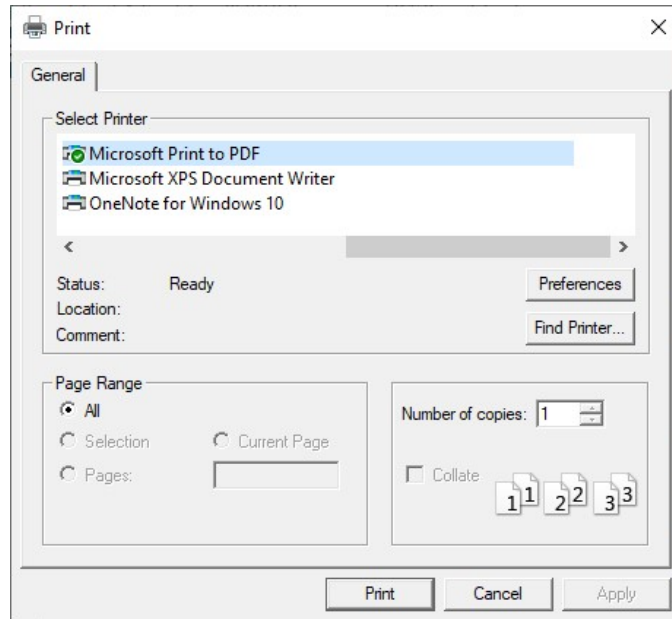
1. There are four options for printing a report:
 - a. Selecting *File > Print* from the main menu; this can be found by selecting the three lines in the top left-hand corner of the screen and then selecting "Print"



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

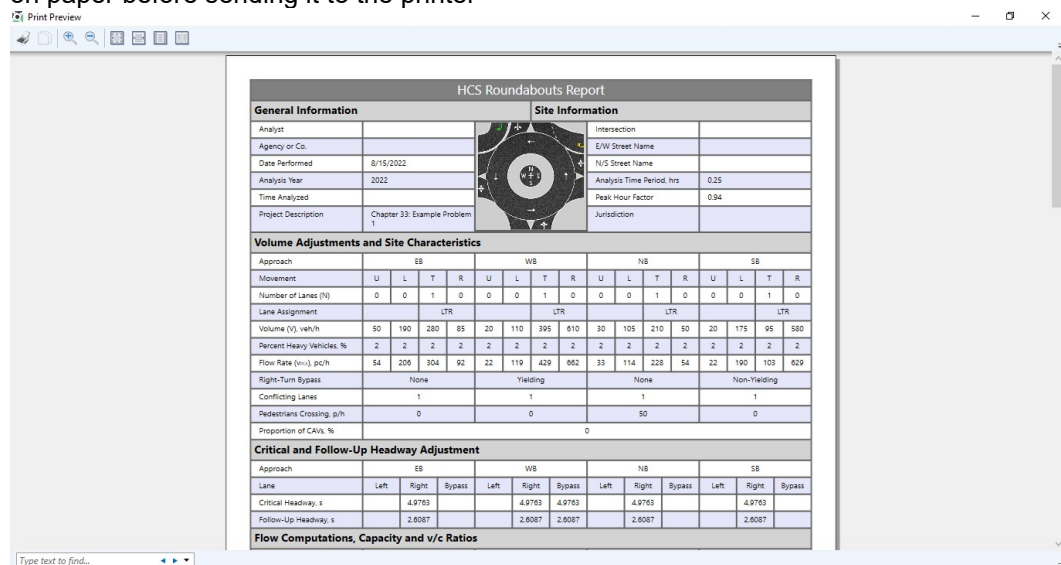


- c. Using keyboard shortcut “Ctrl+P” for Print
 - d. Using keyboard shortcut “Ctrl+F2” for Print Preview
2. Print
 - a. Using Print will bring up a Print dialog box where you can select which printer to print to



3. Print Preview

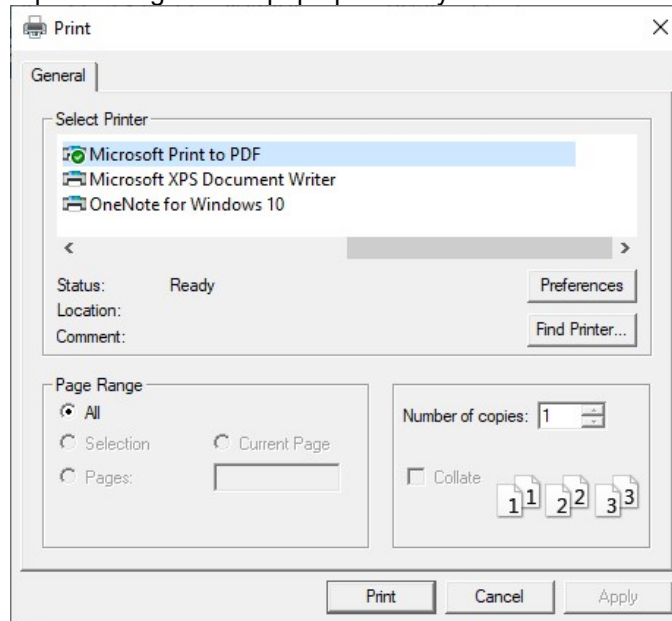
- a. Using Print Preview will bring up a window where you can view how the report will look on paper before sending it to the printer



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



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



Glossary of Terms

Agency

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

Analysis Time Period

The length of time (T) the peak flow remains constant (usually 0.25 hr) and is used in the delay equations

Analysis Year

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

Analyst

This field is provided to document the individual performing the analysis.

Base Free-Flow Speed Calibration Factor

The Base Free-Flow Speed Calibration Factor, S_{calib} , is used to adjust Base Free-Flow Speed and is in units of miles per hour (or kilometers per hour in metric). The Base-Free Flow Speed equation has been calibrated using data for many urban street segments collectively located throughout the U.S., so the default value of 0.0 mi/h (or km/h in metric) for S_{calib} is believed to yield results that are reasonably representative of driver behavior in most urban areas. However, if desired, a locally representative value can be determined from field-measured estimates 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.

Capacity

The maximum sustainable hourly flow rate at which persons or vehicles can be reasonably expected to traverse a point or a uniform section of a lane or roadway during a given time period under prevailing roadway, environmental, traffic, and control conditions.

CAVs

Connected and automated vehicles, or CAVs, integrate two separate types of technology, communications and automation. The combination of these technologies is required to achieve roadway capacity increases, as described below:

- *Connected vehicles* transmit data about their status to their surroundings (e.g., roadside infrastructure, other road users). They also receive information about their surroundings (e.g., traffic conditions, weather conditions, presence of potential conflicting vehicles, traffic signal timing) that motorists can use to adjust their driving behavior in response to conditions present at a given time and location. The exchange of information offers potential safety, fuel economy, and environmental benefits. However, it is not clear how connectivity affects car following and driver behavior and subsequently intersection movement capacity.
- *Automated vehicles* take over all or a portion of the driving task. Depending on the level of automation, a human may still need to take over under certain conditions. In the absence of connectivity, the information available to automated vehicles is limited to that which can be gathered by on-board sensors, which is typically constrained by a sensor's line of sight and the rate at which the sensor takes measurements (e.g., 10 times per second). As a result, for both safety and passenger comfort reasons, current adaptive cruise control systems offer minimum time gaps that are similar to, or longer than, the gaps used by human drivers, and thus may decrease roadway capacity when in widespread use.
- *Connected and automated vehicles* communicate with each other and with roadside infrastructure. The connectivity element provides automated driving systems with more complete information about a vehicle's surroundings and enables cooperative vehicle maneuvers that improve roadway operations. The vehicle's enhanced detection capabilities, as well as redundancy in detection, enable an automated driving system to operate more efficiently and more safely than with only an on-board system.

Conflicting Lanes on Bypass Exit

Conflicting Lanes on Bypass Entry are the lanes that pass directly in front of the subject yielding bypass lane. For this field, select the number of conflicting lanes.

Conflicting Lanes on Entry

The Conflicting Lanes of Entry are the lanes that pass directly in front of the subject entry. For this field, select the number of conflicting lanes.

Control Delay

The portion of total delay attributed to traffic control measures

Critical Headway

The minimum headway in the traffic stream that will allow entry of one vehicle into the roundabout. Critical headway is used in determining capacity equations:

$$c_{pce} = Ae^{(-Bv_c)}$$

$$A = \frac{3,600}{t_f}$$

$$B = \frac{t_c - (t_f/2)}{3,600}$$

where

- C_{pce} = lane capacity, adjusted for heavy vehicles (pc/h),
- v_c = conflicting flow (pc/h)
- t_c = critical headway (s), and
- t_f = follow-up headway (s).

Current Intersection

A drop-down menu is provided for the current intersection to allow the user to change which intersection information to display on the input screen and for the reports.

Current Segment

A drop-down menu is provided for current segment to allow the user to change which segment information to display on the input screen and for the reports.

Date

The date will default to the computer's date, but may be edited. The format of the date is determined by the user's 'Short date style' preferences (regional setting icon on the Control Panel).

Delay

The difference between the travel time actually experienced and the reference travel time that would result during conditions with ideal geometric characteristics and in the absence of incidents, control, and traffic

Delay Due to Turns

The delay due to turns is the delay to through vehicles that follow vehicles turning from the major street into an unsignalized access point intersection. This delay can be incurred at any access point intersection along the street. For right-turn vehicles, the delay results when the following vehicles' speed is reduced to accommodate the turning vehicles. For left-turn vehicles, the delay results when the following vehicles must wait in queue while a vehicle ahead executes a left-turn maneuver at the access point. This delay occurs primarily on undivided streets; however, it can also occur on divided streets when the left-turn queue exceeds the available storage and spills back into the inside through lane.

The delay estimation process consists of the following two procedures:

- Delay due to left turns, and
- Delay due to right turns

East/West Street Name

This field is provided to document the name of the east/west intersecting street of the intersection being analyzed.

Entry Flow

The traffic flow entering a roundabout on the subject approach

Facility Name

This field is provided to document a name for the facility.

Follow-Up Headway

The time between the departure of one vehicle from an approach and the departure of the next vehicle using the same critical headway, under a condition of continuous queueing.

Follow-up headway is used in determining capacity equations:

$$c_{pce} = Ae^{(-Bv_c)}$$

$$A = \frac{3,600}{t_f}$$

$$B = \frac{t_c - (t_f/2)}{3,600}$$

where

c_{pce} = lane capacity, adjusted for heavy vehicles (pc/h),

v_c = conflicting flow (pc/h)

t_c = critical headway (s), and

t_f = follow-up headway (s).

Forward Direction

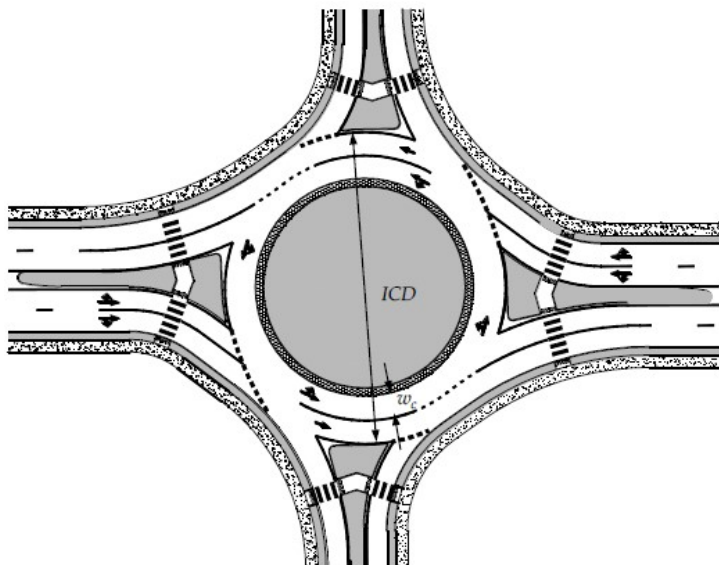
This specifies the direction the segments run and the direction for segment calculations such as running time, through delay, travel speed, etc. There are four choices for Forward Direction: EB, WB, NB, and SB. If EB is the Forward Direction, then WB is the Reverse Direction, and vice versa. Similarly, if NB is the Forward Direction, then SB is the Reverse Direction, and vice versa.

Geometry

Geometry is a graphic data entry screen for coding lane configuration data. Lane combinations can be selected by clicking on the appropriate arrows to place them on the central diagram for each approach. Clicking on an arrow on the central diagram will remove it. As arrows are selected, others may become disabled as appropriate. For right-turn bypass lanes, the yellow right-turn arrow is used for yielding and the green right-turn arrow is used for non-yielding. While these will show just outside of the approach, clicking on them will also remove them. The circulating flow arrow simply toggles between one and two lanes for each approach.

Inscribed Circle Diameter

The inscribed circle diameter, ICD, is the diameter of the largest circle that can be inscribed within the outer edges of the circulatory roadway. The ICD serves as the width of the roundabout and is measured in feet (or meters in metric). This is illustrated in the following:



Intersection

The name of the intersection, usually defined by the two intersecting streets, is coded to document the intersection being analyzed and will be printed on the report.

Intersection Delay

The Intersection Delay is the total additional travel time experienced by drivers, passengers, or pedestrians as a result of control measures and interaction with other users of the facility, divided by the volume departing from the corresponding cross section of the facility.

Jurisdiction

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

Level of Service (LOS)

A level of service is a letter designation that describes a range of operating conditions on a particular type of facility. Six levels of service are defined; using the letters A through F. Level of service A represents the best level of service, and generally describes operation of free flow and very low delay. Level of service F represents the worst operating conditions.

LOS criteria for Roundabouts are given in the exhibit below.

Control Delay (s/veh)	LOS by Volume-to-Capacity Ratio ^a	
	$v/c \leq 1.0$	$v/c > 1.0$
0–10	A	F
>10–15	B	F
>15–25	C	F
>25–35	D	F
>35–50	E	F
>50	F	F

Note: ^a For approaches and intersectionwide assessment, LOS is defined solely by control delay.

Midsegment Demand Flow Rate

The number of vehicles or other roadway users passing the middle of the segment.

North/South Street Name

This field is provided to document the name of the north/south intersecting street of the intersection being analyzed.

Number of Circulating Lanes

The number of circulating lanes represents the count of circulating lanes immediately downstream of the entry that forms the end of the segment under study.

On-Street Parking

The percentage of the segment with on-street parking represents that percent of the link length that has parking stalls (either marked or unmarked) available along the right side of the segment. The user enters this value as a percentage, which is converted into a proportion. 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.

Passenger Car Equivalent

The number of passenger cars that will result in the same operational conditions as a single heavy vehicle of a particular type under identical roadway, traffic, and control conditions.

Peak Hour Factor

The hourly volume during the analysis hour divided by the peak 15-min flow rate within the analysis hour; a measure of traffic demand fluctuation within the analysis hour. The peak-hour factor is entered for the intersection to compute peak flow rates.

Pedestrians Crossing Entry

The number of pedestrians per hour crossing the approach entry

Percent Heavy Vehicles

The percentage of heavy vehicles is entered for each movement. This value is used to adjust flow rate for heavy vehicles.

Percent of Entry Vehicles Using Left Lane

When the corresponding approach has two lanes coded with the same movement, the field is activated to specify the percentage of vehicles using the left lane.

Project Description

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

Proportion of CAVs

This is the proportion of CAVs in the traffic stream. CAV is a connected and automated vehicle, defined here as a vehicle with an operating cooperative adaptive cruise control system. The range of proportion of CAVs in the traffic stream is from 0 to 100.

CAVs may improve the capacity of roundabout approaches through their potential to safely accept smaller gaps in traffic than human drivers. The proportion of the traffic stream that is composed of CAVs will influence the achievable capacity increase. The greater the proportion of CAVs in the traffic stream, the more frequently the benefits of connectivity can be realized, because more vehicles will be able to accept smaller gaps safely.

The proportion of CAVs is used in determining the adjustment factor for the intercept parameter (f_A) and the adjustment factor for the slope parameter (f_B), which are then used in determining the entry lane capacity. The HCM exhibit below is used to determine f_A and f_B .

Proportion of CAVs in Traffic Stream	1-Lane Entry				2-Lane Entry					
	1 Circulating Lane		2 Circulating Lanes ^a		1 Circulating Lane, Both Lanes ^a		2 Circulating Lanes, Left Lane		2 Circulating Lanes, Right Lane	
	f_A	f_B	f_A	f_B	f_A	f_B	f_A	f_B	f_A	f_B
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.05	0.99	1.03	0.99	1.05	0.99	1.03	0.99	1.05	0.96
40	1.12	0.97	1.08	0.96	1.12	0.97	1.08	0.96	1.12	0.93
60	1.22	0.94	1.18	0.92	1.22	0.94	1.18	0.92	1.20	0.87
80	1.29	0.90	1.28	0.89	1.29	0.90	1.28	0.89	1.27	0.84
100	1.35	0.85	1.38	0.85	1.35	0.85	1.38	0.85	1.34	0.80

Notes: ^a These cases were not specifically analyzed in the research and thus are suggested approximations.

CAV = connected and automated vehicle, defined here as a vehicle with an operating cooperative adaptive cruise control system.

Interpolate for other CAV proportions.

Assumptions: Human-driven vehicles operate with average gaps calibrated to the entry lane capacity given by Chapter 22.

Restrictive Median Length

The restrictive median length represents the length, in feet (or meters in metric), of street with a restrictive median (e.g., raised curb). This length is measured from median nose to median nose along the centerline of the street. It does not include the length of any median openings on the street. This is specified for both the Forward and the Reverse Directions.

Right-Hand Access Points

The number of access point approaches along a segment represents the count of all unsignalized driveway and public-street approaches to the segment, regardless of whether the access point is considered to be "active." This number is counted separately for each side of the segment. It must equal or exceed the number of "active" access point approaches for which delay to segment through vehicles is computed.

Right-Hand Curb

The percentage of the segment with curb represents that percent of the link length that has curb along the right side of the segment and this curb is within 4 feet of the traveled way (i.e., within 4 feet of the nearest edge of traffic lane). The user enters this value as a percentage, which is converted into a proportion. This proportion is computed as the length of street with a curb present (and within 4 feet) divided by the link length. The length of street with a curb present is measured from the start of the curbed cross section to the end of the curbed cross section on the link. The width of driveway openings is not deducted from this length. This proportion is computed separately for each direction of travel along the segment.

Right-Turn Bypass

Right-turn bypass lanes can either be yielding or non-yielding. A yielding right-turn bypass lane terminates at a high angle, with right-turning traffic yielding to exiting traffic. A non-yielding right-turn bypass lane merges at a low angle with exiting traffic or forms a new lane adjacent to exiting traffic.

Roundabout

A roundabout is an intersection with a generally circular shape, characterized by yield on entry and circulation around a central island.

Segment Length

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

Segment Name

This field is provided to document the name of the segment being analyzed.

Speed Limit

The posted speed limit along the direction of travel in miles per hour (or kilometers per hour in metric). Speed limit influences Base Free-Flow Speed and is used to determine the Speed Constant in the Base Free-Flow Speed calculation. The range of speed limits is restricted to 25 through 50 mi/h (or 40.2 through 80/5 km/h in metric). The following table shows how to determine the Speed Constant based on the Speed Limit.

Speed Limit (mi/h)	Speed Constant S_0 (mi/h) ^a	Percent with Restrictive Median (%)		Adjustment for Cross Section f_{CS} (mi/h) ^b	
		Median Type		No Curb	Curb
25	37.4	Restrictive	20	0.3	-0.9
30	39.7		40	0.6	-1.4
35	42.1		60	0.9	-1.8
40	44.4		80	1.2	-2.2
45	46.8		100	1.5	-2.7
50	49.1	Nonrestrictive	Not applicable	0.0	-0.5
		No median	Not applicable	0.0	-0.5

Access Density D_a (points/mi)	Adjustment for Access Points f_A by Lanes N_{th} (mi/h) ^c			Percent with On-Street Parking (%)	Adjustment for Parking (mi/h) ^d
	1 Lane	2 Lanes	3 Lanes		
0	0.0	0.0	0.0	0	0.0
2	-0.2	-0.1	-0.1	20	-0.6
4	-0.3	-0.2	-0.1	40	-1.2
10	-0.8	-0.4	-0.3	60	-1.8
20	-1.6	-0.8	-0.5	80	-2.4
40	-3.1	-1.6	-1.0	100	-3.0
60	-4.7	-2.3	-1.6		

Notes: ^a $S_0 = 25.6 + 0.47S_{PL}$ where S_{PL} = posted speed limit (mi/h).
^b $f_{CS} = 1.5 p_{rm} - 0.47 p_{curb} - 3.7 p_{curb} p_{rm}$ where p_{rm} = proportion of link length with restrictive median (decimal) and p_{curb} = proportion of segment with curb on the right-hand side (decimal).
^c $f_A = -0.078 D_a / N_{th}$ with $D_a = 5,280 (N_{ap,s} + N_{ap,o}) / (L - ICD)$ where D_a = access point density on segment (points/mi); N_{th} = number of through lanes on the segment in the subject direction of travel (ln); $N_{ap,s}$ = number of access point approaches on the right side in the subject direction of travel (points); $N_{ap,o}$ = number of access point approaches on the right side in the opposing direction of travel (points); and ICD = inscribed circle diameter of roundabout (ft).
^d $f_{pk} = -3.0 \times$ proportion of link length with on-street parking available on the right-hand side (decimal).

Stored Heavy Vehicle Length

The lane length in feet, or meters in metric, occupied by a queued heavy vehicle; this affects the computation of queue length

Stored Passenger Car Length

The lane length in feet, or meters in metric, occupied by a queued passenger car; this affects the computation of queue length

Time Analyzed

This field is provided to document the time period over which the analysis was conducted.

v/c Ratio

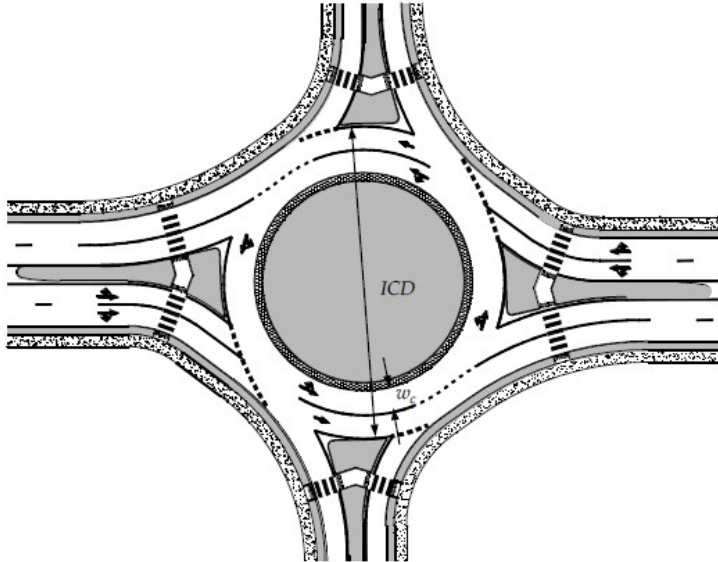
The v/c ratio is the volume-to-capacity ratio, which is the volume of one movement (or shared-lane movements) divided by the movement capacity of the movement (or shared-lane movements).

Volume

The total number of vehicles or other roadway users that pass over a given point or section of a lane or roadway during a given time interval. The volumes (V) for each movement are coded in vehicles per hour (veh/h).

Width of Circulating Lanes

The width of circulating lanes is measured in the section of circulatory roadway immediately downstream of the entry, that is, the same location where the number of circulating lanes is counted. It is measured in feet (or meters in metric). This is illustrated in the following:



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