Today's Agenda

1. Introduction
2. What's New in Vistro 2022
3. HCM 7th Edition Overview
4. HCM 7th Edition Vistro Preview
5. Q&A

PTV GROUP
the mind of movement

PTV Vistro 2022 –What's New

Adam Lynch
Senior Product Manager for Traffic Engineering (Global)
Technical Product Manager for PTV Vistro

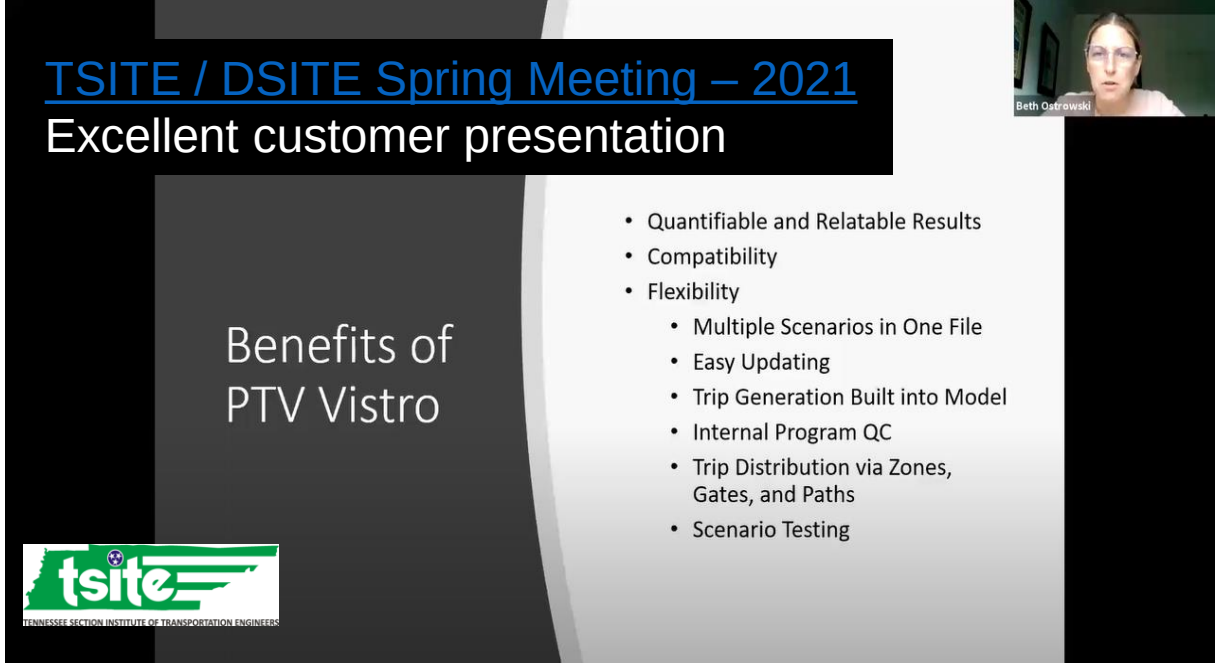
Social Activities

Community activities:

- Positive feedback on past improvements
  - Validates that we are heading in the right direction.
- Customers presenting Vistro at conferences
  - Very nice to see! Thanks! Keep it up!
- PTV Vistro LinkedIn forum
  - We would like to see more users sharing experiences.

PTV activities

- Institute of Transportation Engineers Journal
- PTV Talks – Vistro Edition
- PTV Blog – Silicon Valley VTA Story
- LinkedIn and information sharing



ITE Campaigns / PTV Talks

Market Standard ->Canada

CCG CANADIAN CAPACITY GUIDE

New Major Customers

Valley Transportation Authority

Montréal

CITY OF HOUSTON

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Increasing Knowledge-base

There is great feedback from long-time users and new customers about the videos and articles we've prepared.

- Features and Use Cases
- Web and Video Training
- Self-Learning
- Urban Mobility System

Excellent resources to share with new users.

Urban mobility system teaser

Interactive Demo Made for PTV Talks

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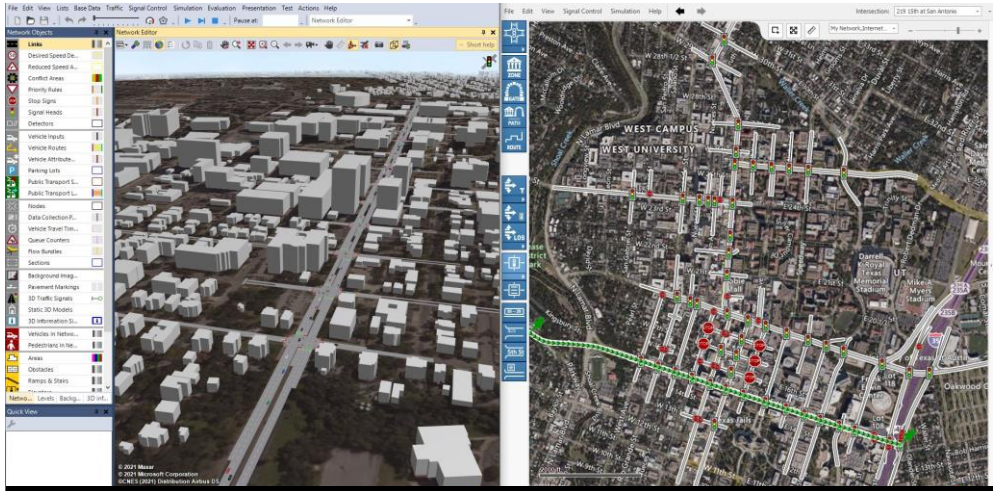
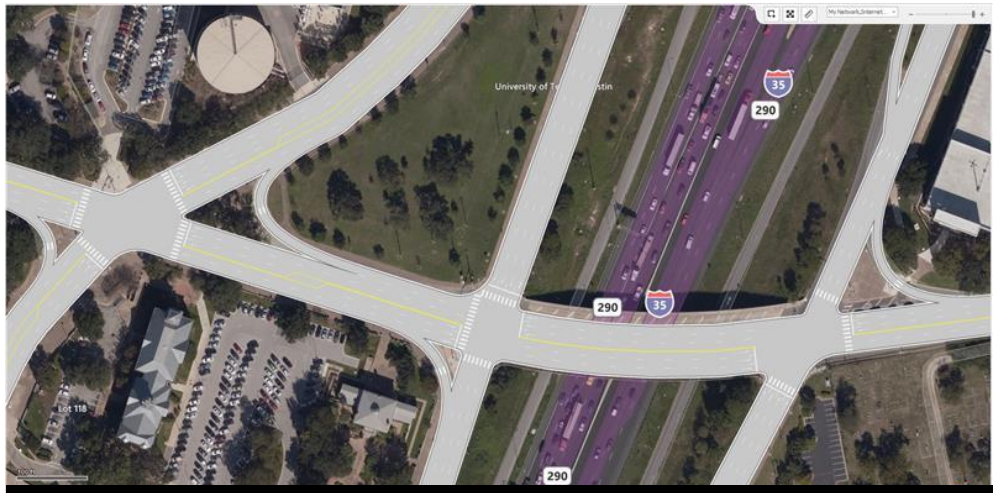
PTV Vistro 2022 - Release

- HCM 7 (new methods for Vistro/Visum)*
  - CAV Impacts –> Study CAVs in Vistro before simulation
- Vissim Integration Improvements
  - Export a Matrix from Trip Distributions to Vissim
  - Improved channelized radii and Vissim Export
  - Vissim select area (model are getting bigger)
- Map search
  - Quickly find locations in the model



Select Export Area (Vistro to Vissim)



Better Channelized Turn Visuals and Export

*Available after TRB publishes the new HCM update (early-January).

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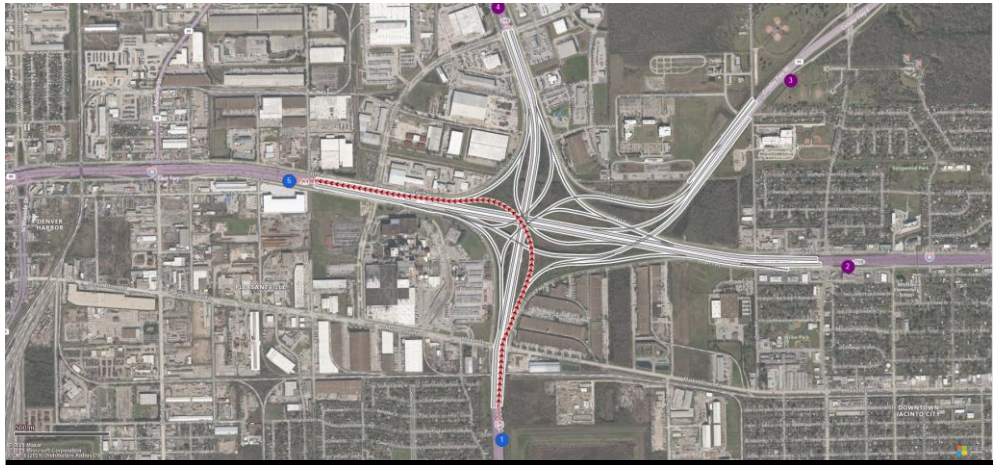
Trip Distribution Matrix: Import to PTV Vissim

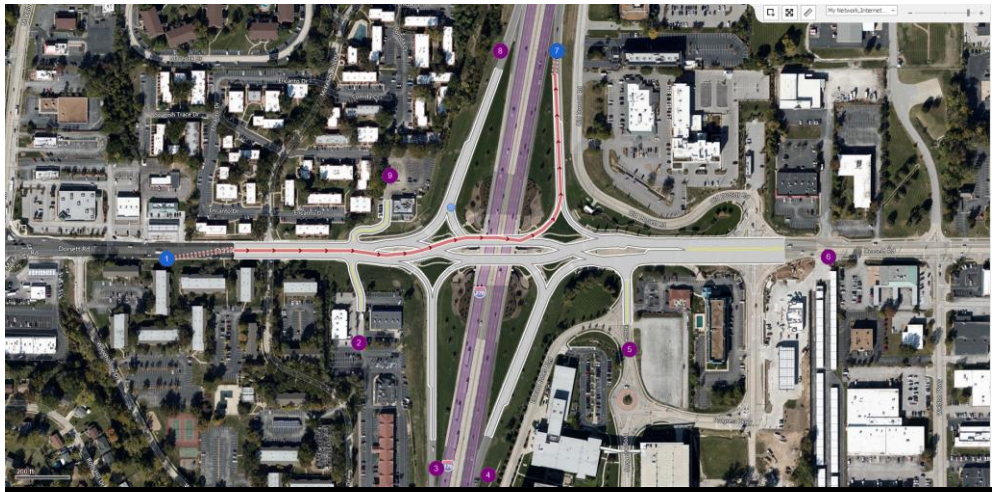
Benefits

- Use your collected Origin-Destination in PTV Vistro to build a Vissim model.
  - Use sources from INRIX, Streetlight Data ….
  - Large time savings in building a DTA model.
- Use distribution instead of balanced background counts. Useful on:
  - Innovative and alternative intersections/ interchanges
  - Corridors with tightly spaced intersections.
  - Saves time setting up Vissim static routing.

Note: Don't enter turn movement counts if using this method to create a DTA model in Vissim.



Interchanges to DTA Vissim Simulations



Advanced Corridors.

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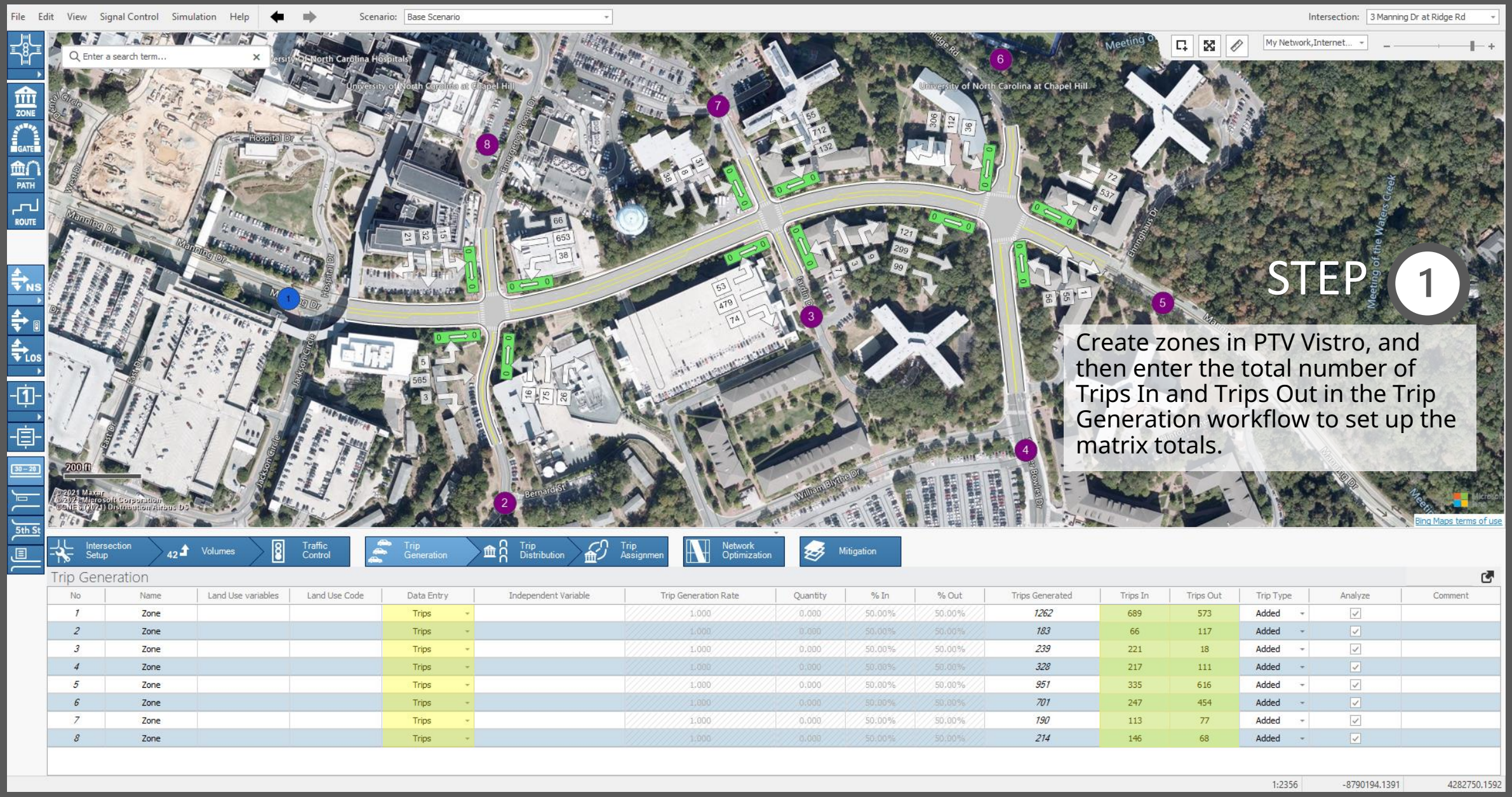
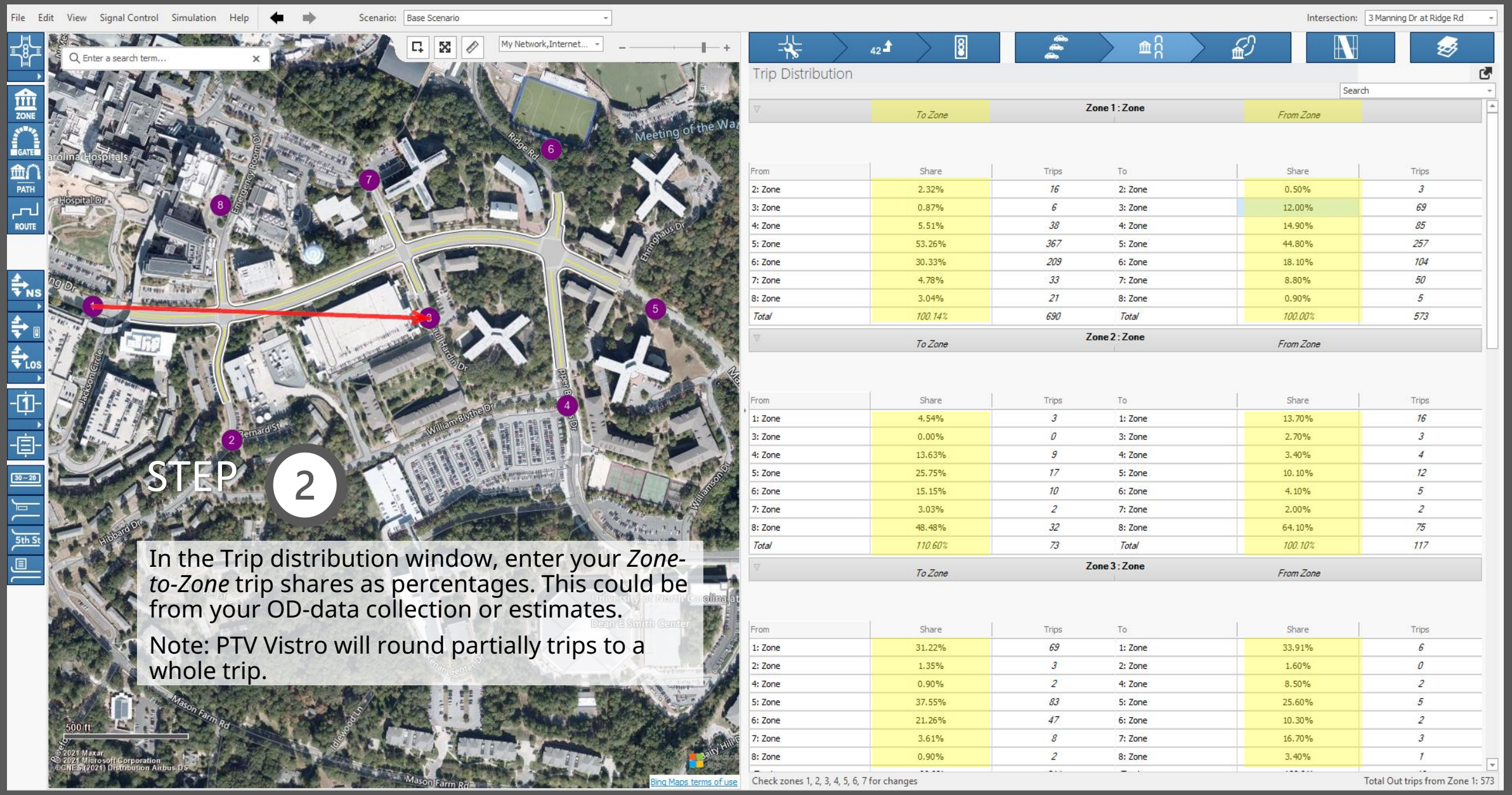


No	Name	Land Use variables	Land Use Code	Data Entry	Independent Variable	Trip Generation Rate	Quantity	% In	% Out	Trips Generated	Trips In	Trips Out	Trip Type	Analyze	Comment
1	Zone			Trips		1.000	0.000	50.00%	50.00%	1262	689	573	Added	☑	
2	Zone			Trips		1.000	0.000	50.00%	50.00%	183	66	117	Added	☑	
3	Zone			Trips		1.000	0.000	50.00%	50.00%	239	221	18	Added	☑	
4	Zone			Trips		1.000	0.000	50.00%	50.00%	328	217	111	Added	☑	
5	Zone			Trips		1.000	0.000	50.00%	50.00%	951	335	616	Added	☑	
6	Zone			Trips		1.000	0.000	50.00%	50.00%	701	247	454	Added	☑	
7	Zone			Trips		1.000	0.000	50.00%	50.00%	190	113	77	Added	☑	
8	Zone			Trips		1.000	0.000	50.00%	50.00%	214	146	68	Added	☑	


File Edit View Signal Control Simulation Help
Scenario: Base Scenario
Intersection: 3 Manning Dr at Ridge Rd
Enter a search term...
My Network,Internet...
ZONE
GATE
PATH
ROUTE
NS
LOS
30 – 20
5th St
Trip Distribution
Search
Zone 1 : Zone
To Zone
From Zone
From | Share | Trips | To | Share | Trips
2: Zone | 2.32% | 16 | 2: Zone | 0.50% | 3
3: Zone | 0.87% | 6 | 3: Zone | 12.00% | 69
4: Zone | 5.51% | 38 | 4: Zone | 14.90% | 85
5: Zone | 53.26% | 367 | 5: Zone | 44.80% | 257
6: Zone | 30.33% | 209 | 6: Zone | 18.10% | 104
7: Zone | 4.78% | 33 | 7: Zone | 8.80% | 50
8: Zone | 3.04% | 21 | 8: Zone | 0.90% | 5
Total | 100.14% | 690 | Total | 100.00% | 573
Zone 2 : Zone
To Zone
From Zone
From | Share | Trips | To | Share | Trips
1: Zone | 4.54% | 3 | 1: Zone | 13.70% | 16
3: Zone | 0.00% | 0 | 3: Zone | 2.70% | 3
4: Zone | 13.63% | 9 | 4: Zone | 3.40% | 4
5: Zone | 25.75% | 17 | 5: Zone | 10.10% | 12
6: Zone | 15.15% | 10 | 6: Zone | 4.10% | 5
7: Zone | 3.03% | 2 | 7: Zone | 2.00% | 2
8: Zone | 48.48% | 32 | 8: Zone | 64.10% | 75
Total | 110.60% | 73 | Total | 100.10% | 117
Zone 3 : Zone
To Zone
From Zone
From | Share | Trips | To | Share | Trips
1: Zone | 31.22% | 69 | 1: Zone | 33.91% | 6
2: Zone | 1.35% | 3 | 2: Zone | 1.60% | 0
4: Zone | 0.90% | 2 | 4: Zone | 8.50% | 2
5: Zone | 37.55% | 83 | 5: Zone | 25.60% | 5
6: Zone | 21.26% | 47 | 6: Zone | 10.30% | 2
7: Zone | 3.61% | 8 | 7: Zone | 16.70% | 3
8: Zone | 0.90% | 2 | 8: Zone | 3.40% | 1
Check zones 1, 2, 3, 4, 5, 6, 7 for changes
Total Out trips from Zone 1: 573
STEP 2
In the Trip distribution window, enter your Zone-to-Zone trip shares as percentages. This could be from your OD-data collection or estimates.
Note: PTV Vistro will round partially trips to a whole trip.
500 ft
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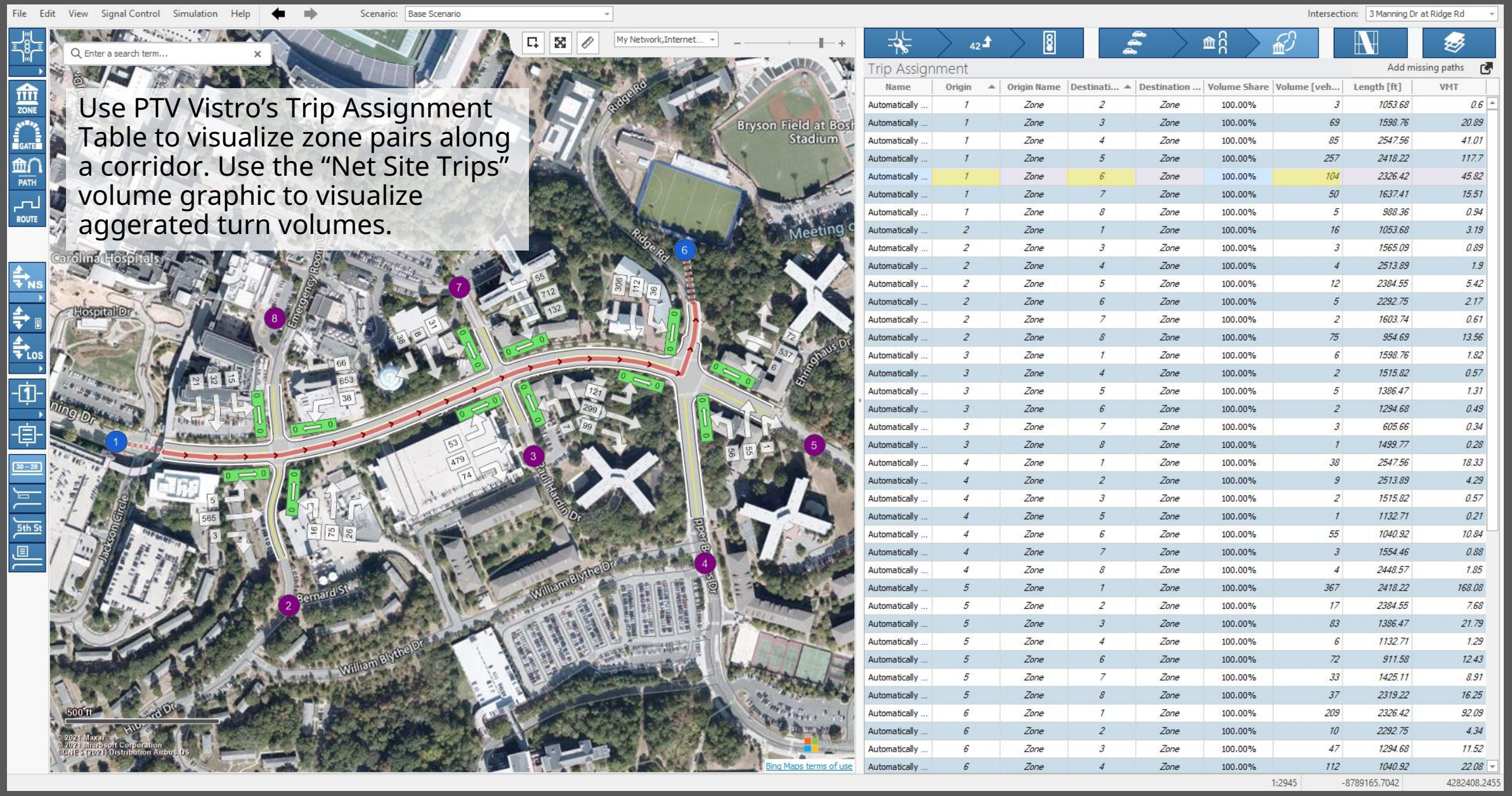
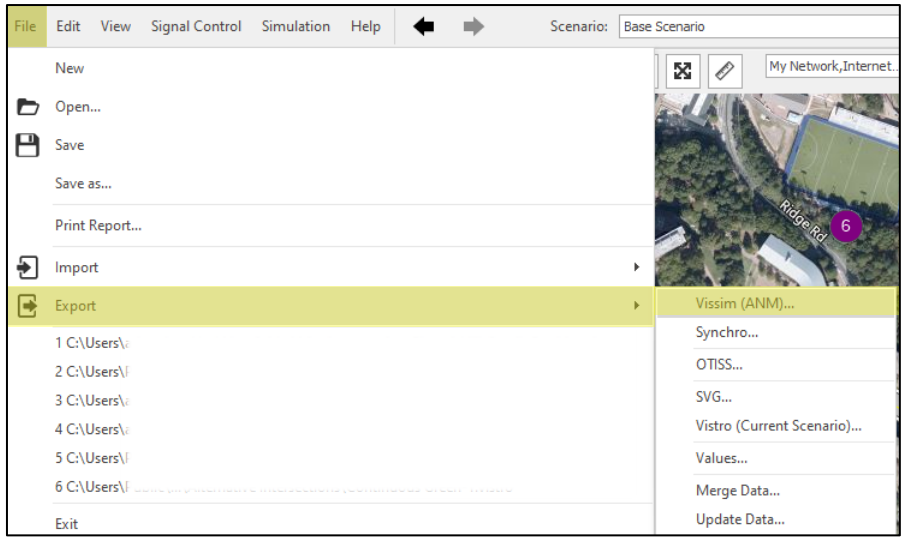
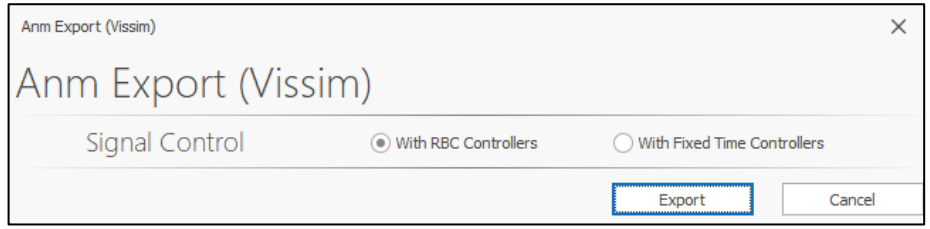
Bing Maps terms of use

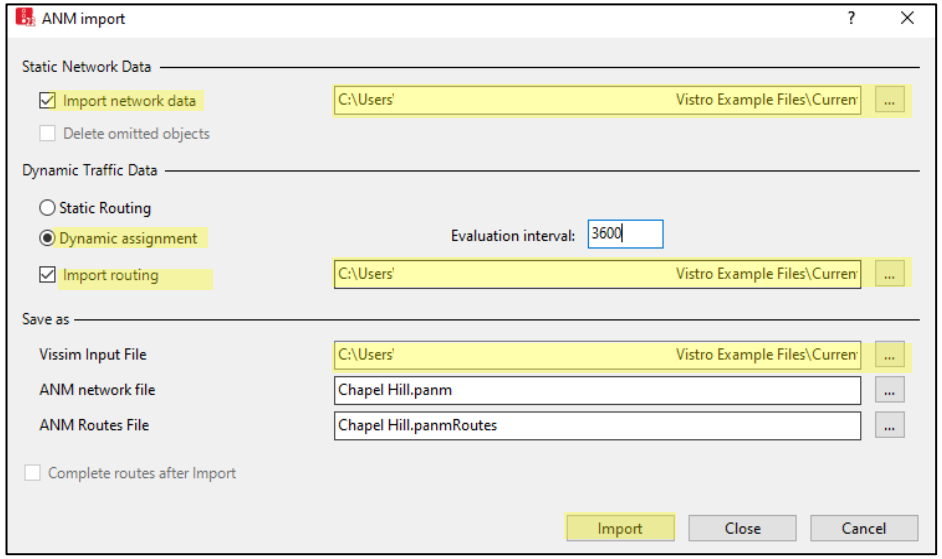

File Edit View Signal Control Simulation Help
Scenario: Base Scenario
Intersection: 3 Manning Dr at Ridge Rd
Use PTV Vistro's Trip Assignment Table to visualize zone pairs along a corridor. Use the "Net Site Trips" volume graphic to visualize aggerated turn volumes.
Trip Assignment
Add missing paths
Name | Origin | Origin Name | Destinati... | Destination ... | Volume Share | Volume [veh... | Length [ft] | VMT
Automatically ... | 1 | Zone | 2 | Zone | 100.00% | 3 | 1053.68 | 0.6
Automatically ... | 1 | Zone | 3 | Zone | 100.00% | 69 | 1598.76 | 20.89
Automatically ... | 1 | Zone | 4 | Zone | 100.00% | 85 | 2547.56 | 41.01
Automatically ... | 1 | Zone | 5 | Zone | 100.00% | 257 | 2418.22 | 117.7
Automatically ... | 1 | Zone | 6 | Zone | 100.00% | 104 | 2326.42 | 45.82
Automatically ... | 1 | Zone | 7 | Zone | 100.00% | 50 | 1637.41 | 15.51
Automatically ... | 1 | Zone | 8 | Zone | 100.00% | 5 | 988.36 | 0.94
Automatically ... | 2 | Zone | 1 | Zone | 100.00% | 16 | 1053.68 | 3.19
Automatically ... | 2 | Zone | 3 | Zone | 100.00% | 3 | 1565.09 | 0.89
Automatically ... | 2 | Zone | 4 | Zone | 100.00% | 4 | 2513.89 | 1.9
Automatically ... | 2 | Zone | 5 | Zone | 100.00% | 12 | 2384.55 | 5.42
Automatically ... | 2 | Zone | 6 | Zone | 100.00% | 5 | 2292.75 | 2.17
Automatically ... | 2 | Zone | 7 | Zone | 100.00% | 2 | 1603.74 | 0.61
Automatically ... | 2 | Zone | 8 | Zone | 100.00% | 75 | 954.69 | 13.56
Automatically ... | 3 | Zone | 1 | Zone | 100.00% | 6 | 1598.76 | 1.82
Automatically ... | 3 | Zone | 4 | Zone | 100.00% | 2 | 1515.82 | 0.57
Automatically ... | 3 | Zone | 5 | Zone | 100.00% | 5 | 1386.47 | 1.31
Automatically ... | 3 | Zone | 6 | Zone | 100.00% | 2 | 1294.68 | 0.49
Automatically ... | 3 | Zone | 7 | Zone | 100.00% | 3 | 605.66 | 0.34
Automatically ... | 3 | Zone | 8 | Zone | 100.00% | 1 | 1499.77 | 0.28
Automatically ... | 4 | Zone | 1 | Zone | 100.00% | 38 | 2547.56 | 18.33
Automatically ... | 4 | Zone | 2 | Zone | 100.00% | 9 | 2513.89 | 4.29
Automatically ... | 4 | Zone | 3 | Zone | 100.00% | 2 | 1515.82 | 0.57
Automatically ... | 4 | Zone | 5 | Zone | 100.00% | 1 | 1132.71 | 0.21
Automatically ... | 4 | Zone | 6 | Zone | 100.00% | 55 | 1040.92 | 10.84
Automatically ... | 4 | Zone | 7 | Zone | 100.00% | 3 | 1554.46 | 0.88
Automatically ... | 4 | Zone | 8 | Zone | 100.00% | 4 | 2448.57 | 1.85
Automatically ... | 5 | Zone | 1 | Zone | 100.00% | 367 | 2418.22 | 168.08
Automatically ... | 5 | Zone | 2 | Zone | 100.00% | 17 | 2384.55 | 7.68
Automatically ... | 5 | Zone | 3 | Zone | 100.00% | 83 | 1386.47 | 21.79
Automatically ... | 5 | Zone | 4 | Zone | 100.00% | 6 | 1132.71 | 1.29
Automatically ... | 5 | Zone | 6 | Zone | 100.00% | 72 | 911.58 | 12.43
Automatically ... | 5 | Zone | 7 | Zone | 100.00% | 33 | 1425.11 | 8.91
Automatically ... | 5 | Zone | 8 | Zone | 100.00% | 37 | 2319.22 | 16.25
Automatically ... | 6 | Zone | 1 | Zone | 100.00% | 209 | 2326.42 | 92.09
Automatically ... | 6 | Zone | 2 | Zone | 100.00% | 10 | 2292.75 | 4.34
Automatically ... | 6 | Zone | 3 | Zone | 100.00% | 47 | 1294.68 | 11.52
Automatically ... | 6 | Zone | 4 | Zone | 100.00% | 112 | 1040.92 | 22.08
1:2945 -8789165.7042 4282408.2455



In PTV Vistro, export the Vissim ANM.

Select the type of PTV Vissim traffic signal controllers.

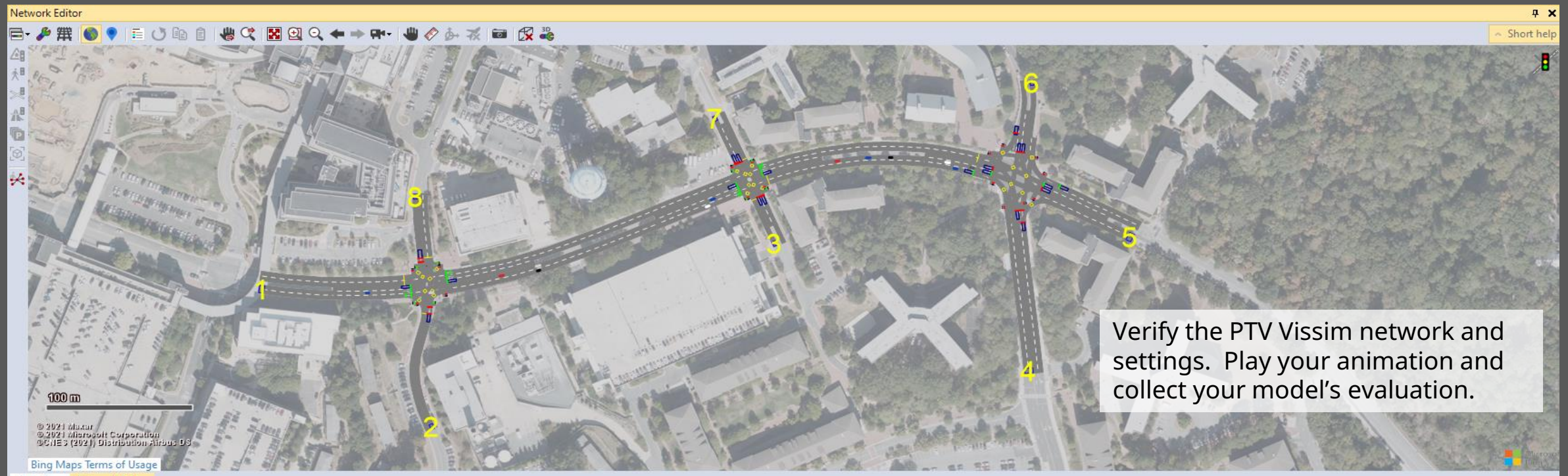




Open PTV Vissim and select **File->Import -> ANM** and your .ANM and .ANMRoutes files.

STEP 3

Export PTV Vistro to PTV Vissim for an “Out-of-the-box” simulation model with dynamic assignment.



Verify the PTV Vissim network and settings. Play your animation and collect your model's evaluation.

Matrix Editor (Matrix '1: 200_0900_1200')

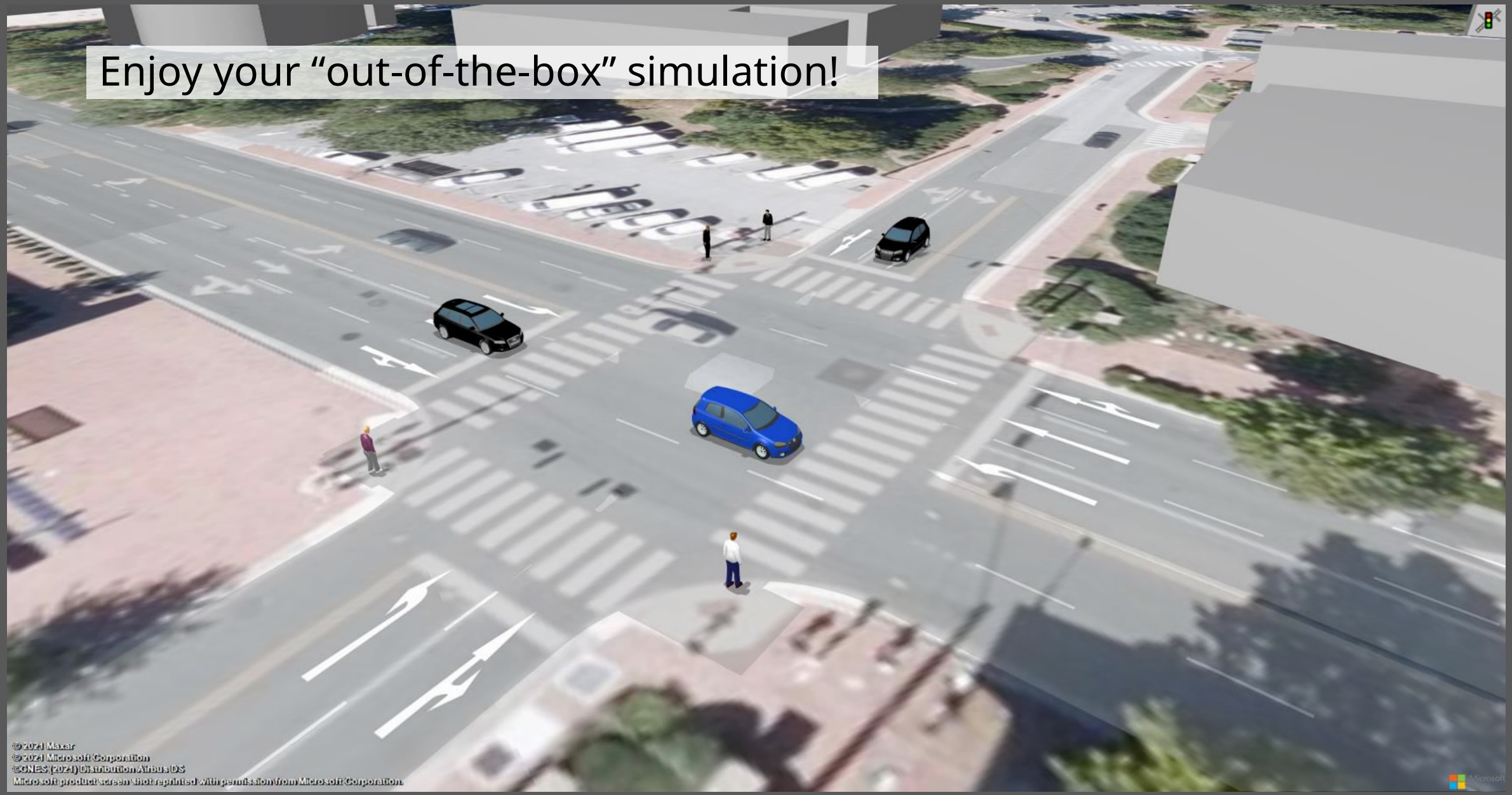
8 x 8			1	2	3	4	5	6	7	8
	Name		ANM zone 1	ANM zone 2	ANM zone 3	ANM zone 4	ANM zone 5	ANM zone 6	ANM zone 7	ANM zone 8
		Sum	2070.00	219.00	642.00	651.00	1008.00	744.00	333.00	438.00
1	ANM zone 1	1719.00	0.00	9.00	207.00	255.00	771.00	312.00	150.00	15.00
2	ANM zone 2	351.00	48.00	0.00	9.00	12.00	36.00	15.00	6.00	225.00
3	ANM zone 3	57.00	18.00	0.00	0.00	6.00	15.00	6.00	9.00	3.00
4	ANM zone 4	336.00	114.00	27.00	6.00	0.00	3.00	165.00	9.00	12.00
5	ANM zone 5	1845.00	1101.00	51.00	249.00	18.00	0.00	216.00	99.00	111.00
6	ANM zone 6	1362.00	627.00	30.00	141.00	336.00	108.00	0.00	57.00	63.00
7	ANM zone 7	231.00	99.00	6.00	24.00	18.00	54.00	21.00	0.00	9.00
8	ANM zone 8	204.00	63.00	96.00	6.00	6.00	21.00	9.00	3.00	0.00

← Matrix now in Vissim. Customize your simulation start time, intervals, evaluations, and durations.

Matrices

Count: 1	No	Name	FromTime	ToTime
1	1	200_...	09:00:00	12:00:00

← Adjust the 3 hour start and end time window.


Enjoy your “out-of-the-box” simulation!
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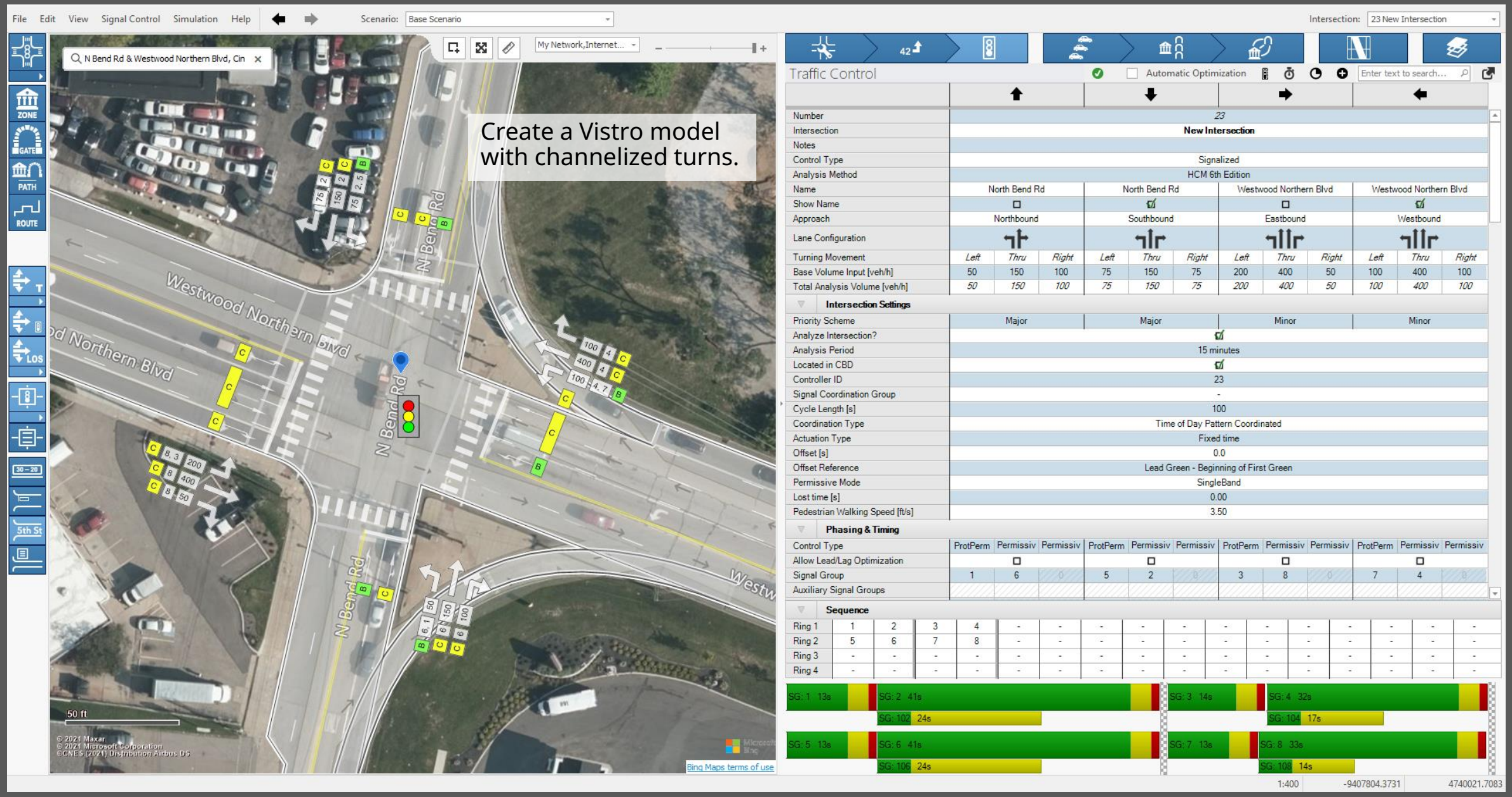
Improved Channelization

Benefits:

- Better visualization of channelized turns
- Crosswalks now shown
- More accurate Vissim ANM.

Increased visualization


File
Edit
View
Signal Control
Simulation
Help
Scenario:
Base Scenario
Intersection:
23 New Intersection
N Bend Rd & Westwood Northern Blvd, Cin
My Network,Internet...
Create a Vistro model with channelized turns.
Westwood Northern Blvd
N Bend Rd
50 ft
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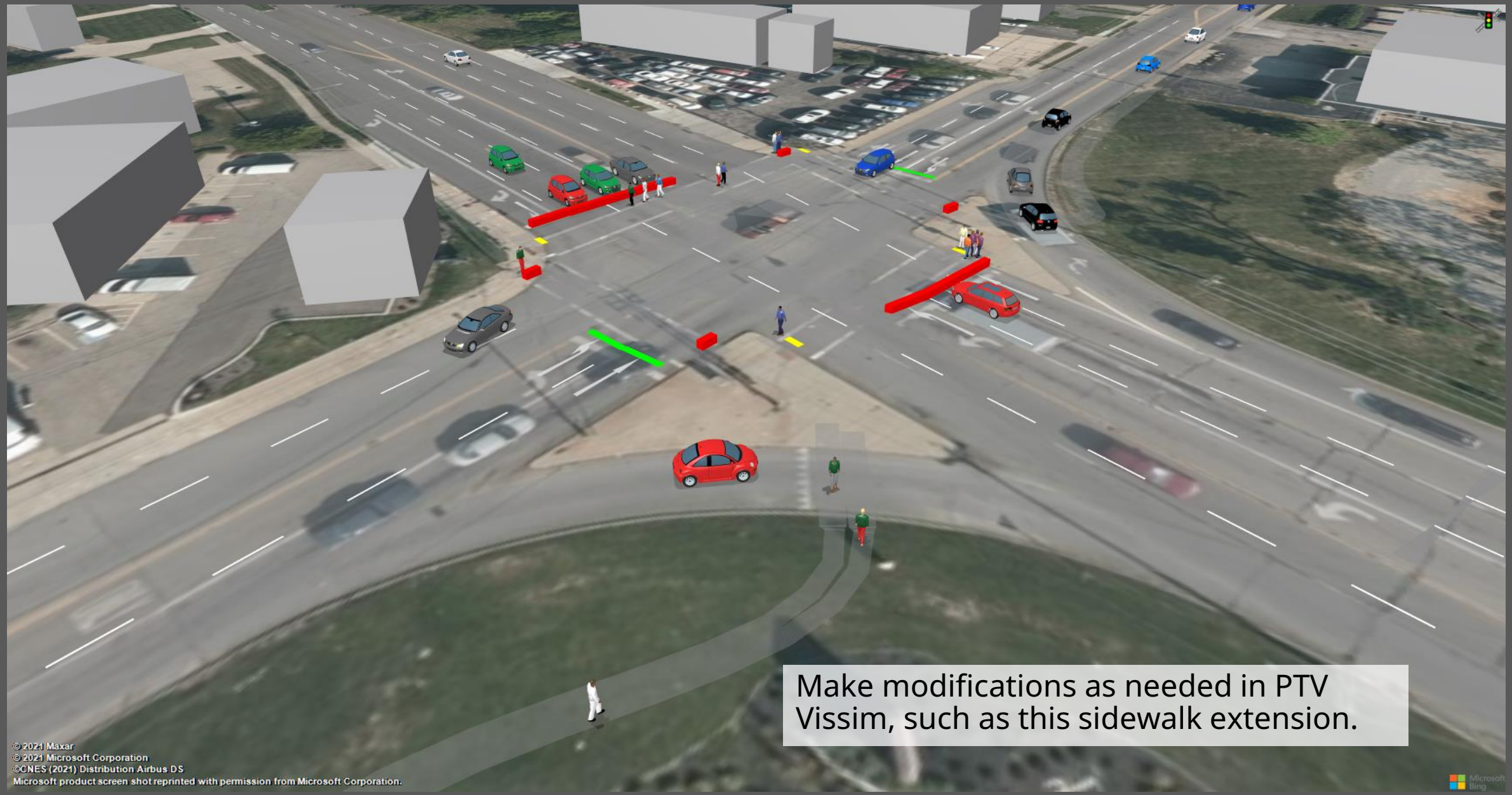
Bing Maps terms of use
Traffic Control
Automatic Optimization
Enter text to search...
Number
23
Intersection
New Intersection
Notes
Control Type
Signalized
Analysis Method
HCM 6th Edition
Name
North Bend Rd
North Bend Rd
Westwood Northern Blvd
Westwood Northern Blvd
Show Name
Approach
Northbound
Southbound
Eastbound
Westbound
Lane Configuration
Turning Movement
Left
Thru
Right
Base Volume Input [veh/h]
50 150 100 75 150 75 200 400 50 100 400 100
Total Analysis Volume [veh/h]
50 150 100 75 150 75 200 400 50 100 400 100
Intersection Settings
Priority Scheme
Major
Major
Minor
Minor
Analyze Intersection?
Analysis Period
15 minutes
Located in CBD
Controller ID
23
Signal Coordination Group
-
Cycle Length [s]
100
Coordination Type
Time of Day Pattern Coordinated
Actuation Type
Fixed time
Offset [s]
0.0
Offset Reference
Lead Green - Beginning of First Green
Permissive Mode
SingleBand
Lost time [s]
0.00
Pedestrian Walking Speed [ft/s]
3.50
Phasing & Timing
Control Type
ProtPerm Permissiv Permissiv ProtPerm Permissiv Permissiv ProtPerm Permissiv Permissiv ProtPerm Permissiv Permissiv
Allow Lead/Lag Optimization
Signal Group
1 6 0 5 2 0 3 8 0 7 4 0
Auxiliary Signal Groups
Sequence
Ring 1 1 2 3 4 - - - - - - - - - - - - -
Ring 2 5 6 7 8 - - - - - - - - - - - - -
Ring 3 - - - - - - - - - - - - - - - - -
Ring 4 - - - - - - - - - - - - - - - - -
SG: 1 13s
SG: 2 41s
SG: 102 24s
SG: 3 14s
SG: 4 32s
SG: 104 17s
SG: 5 13s
SG: 6 41s
SG: 106 24s
SG: 7 13s
SG: 8 33s
SG: 108 14s
1:400
-9407804.3731
4740021.7083


Make modifications as needed in PTV Vissim, such as this sidewalk extension.
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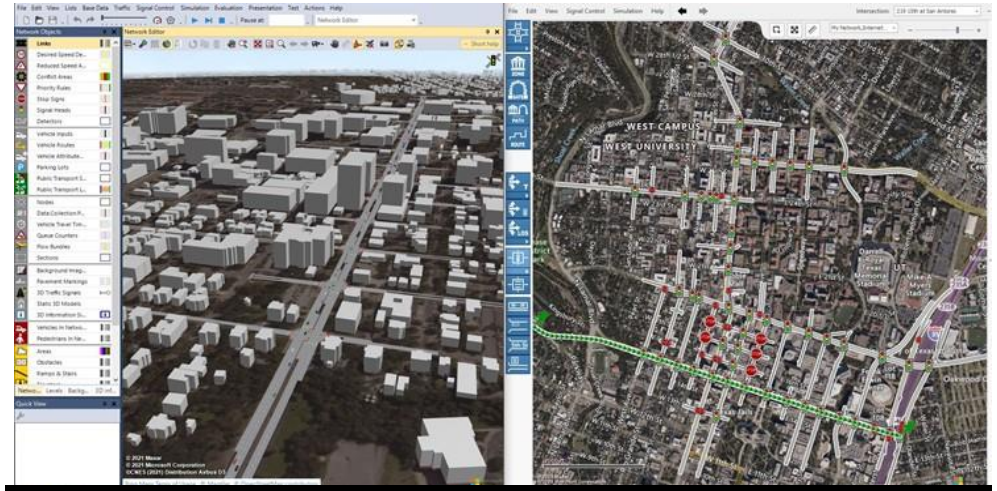
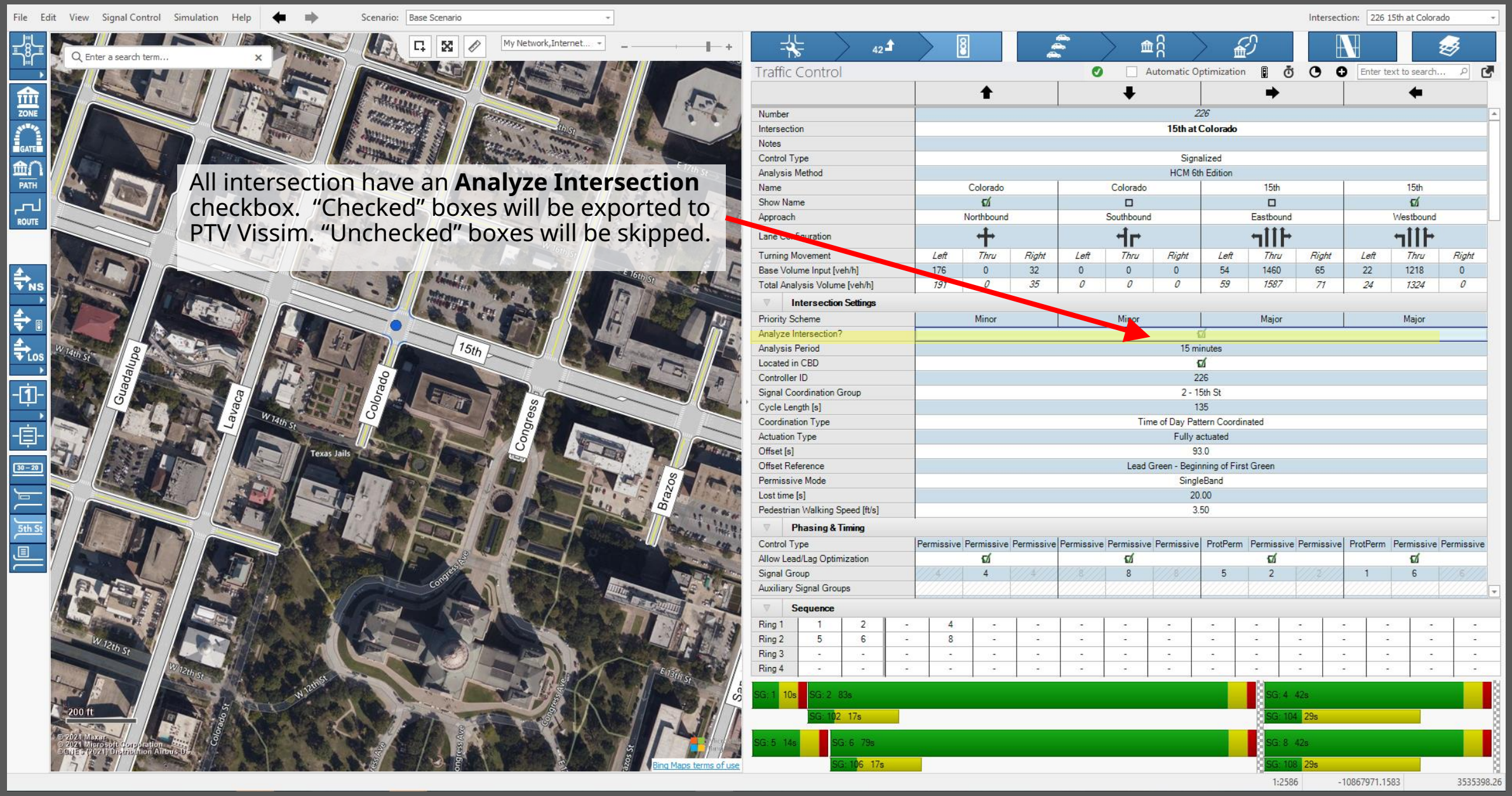
Select intersections to export to PTV Vissim

Benefits:

- Easy selection of intersections to export.
- Supplement Vissim models with specific intersections.
- Easy to add and test urban mobility elements in PTV Vissim.
- Use scenario management to save selection sets.

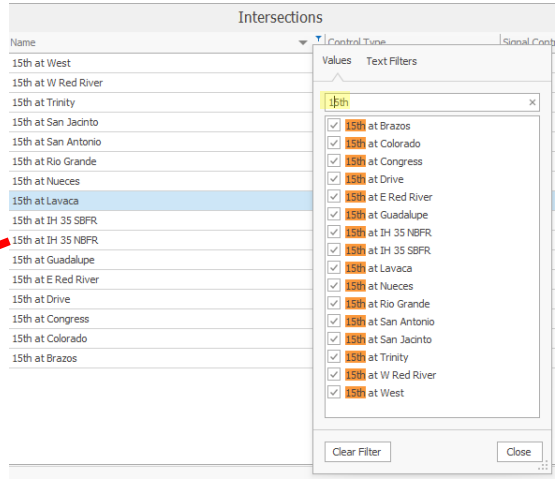


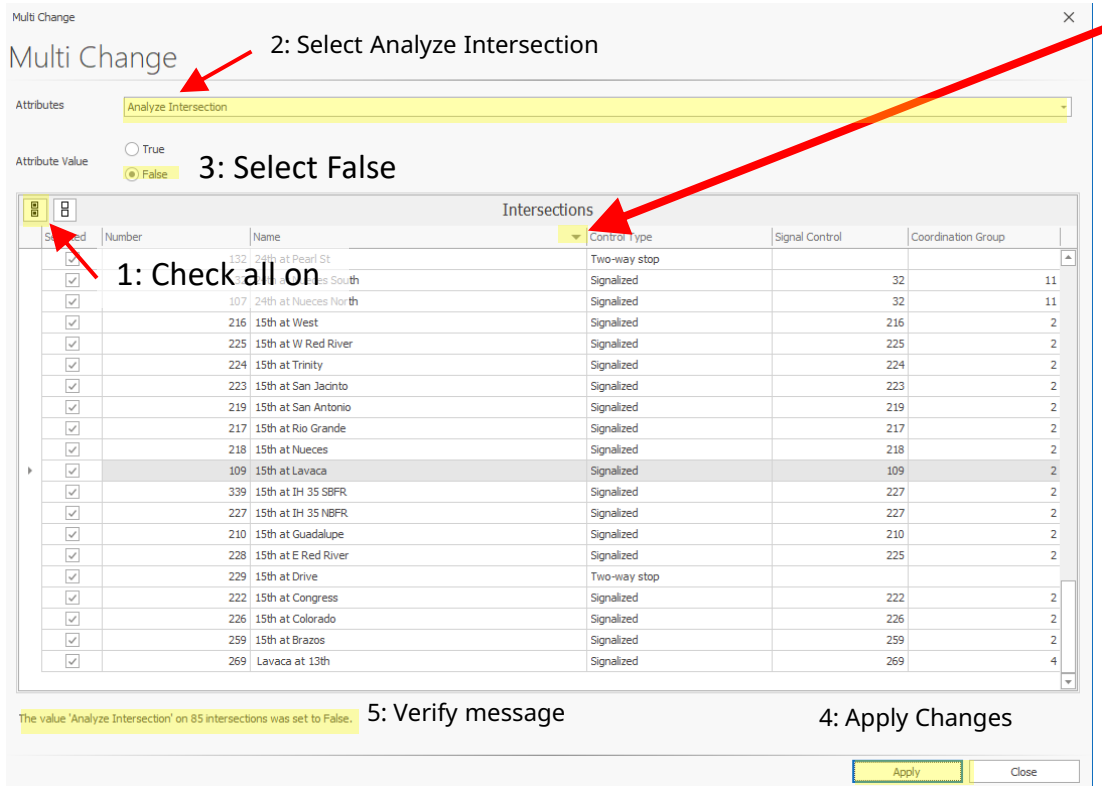
Take what you want to Vissim.

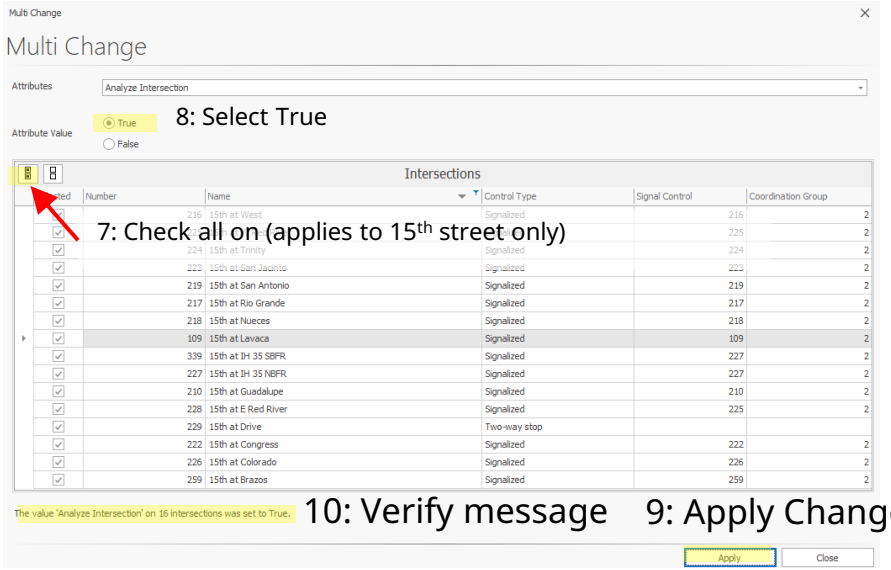

All intersection have an **Analyze Intersection** checkbox. "Checked" boxes will be exported to PTV Vissim. "Unchecked" boxes will be skipped.
File Edit View Signal Control Simulation Help
Scenario: Base Scenario
Intersection: 226 15th at Colorado
Traffic Control
Automatic Optimization
Number 226
Intersection 15th at Colorado
Notes
Control Type Signalized
Analysis Method HCM 6th Edition
Name Colorado Colorado 15th 15th
Show Name
Approach Northbound Southbound Eastbound Westbound
Lane Configuration
Turning Movement Left Thru Right Left Thru Right Left Thru Right Left Thru Right
Base Volume Input [veh/h] 176 0 32 0 0 0 54 1460 65 22 1218 0
Total Analysis Volume [veh/h] 191 0 35 0 0 0 59 1587 71 24 1324 0
Intersection Settings
Priority Scheme Minor Minor Major Major
Analyze Intersection?
Analysis Period 15 minutes
Located in CBD
Controller ID 226
Signal Coordination Group 2 - 15th St
Cycle Length [s] 135
Coordination Type Time of Day Pattern Coordinated
Actuation Type Fully actuated
Offset [s] 93.0
Offset Reference Lead Green - Beginning of First Green
Permissive Mode SingleBand
Lost time [s] 20.00
Pedestrian Walking Speed [ft/s] 3.50
Phasing & Timing
Control Type Permissive Permissive Permissive Permissive Permissive Permissive ProtPerm Permissive Permissive ProtPerm Permissive Permissive
Allow Lead/Lag Optimization
Signal Group 4 4 4 8 8 8 5 2 2 1 6 6
Auxiliary Signal Groups
Sequence
Ring 1 1 2 - 4 - - - - - - - - - - - -
Ring 2 5 6 - 8 - - - - - - - - - - - -
Ring 3 - - - - - - - - - - - - - - - -
Ring 4 - - - - - - - - - - - - - - - -
SG: 1 10s
SG: 2 83s
SG: 4 42s
SG: 102 17s
SG: 104 29s
SG: 5 14s
SG: 6 79s
SG: 8 42s
SG: 106 17s
SG: 108 29s
15th
Colorado
Lavaca
Guadalupe
Congress
Brazos
W 14th St
W 12th St
Texas Jails
Congress Ave
200 ft
1:2586
-10867971.1583
3535398.26

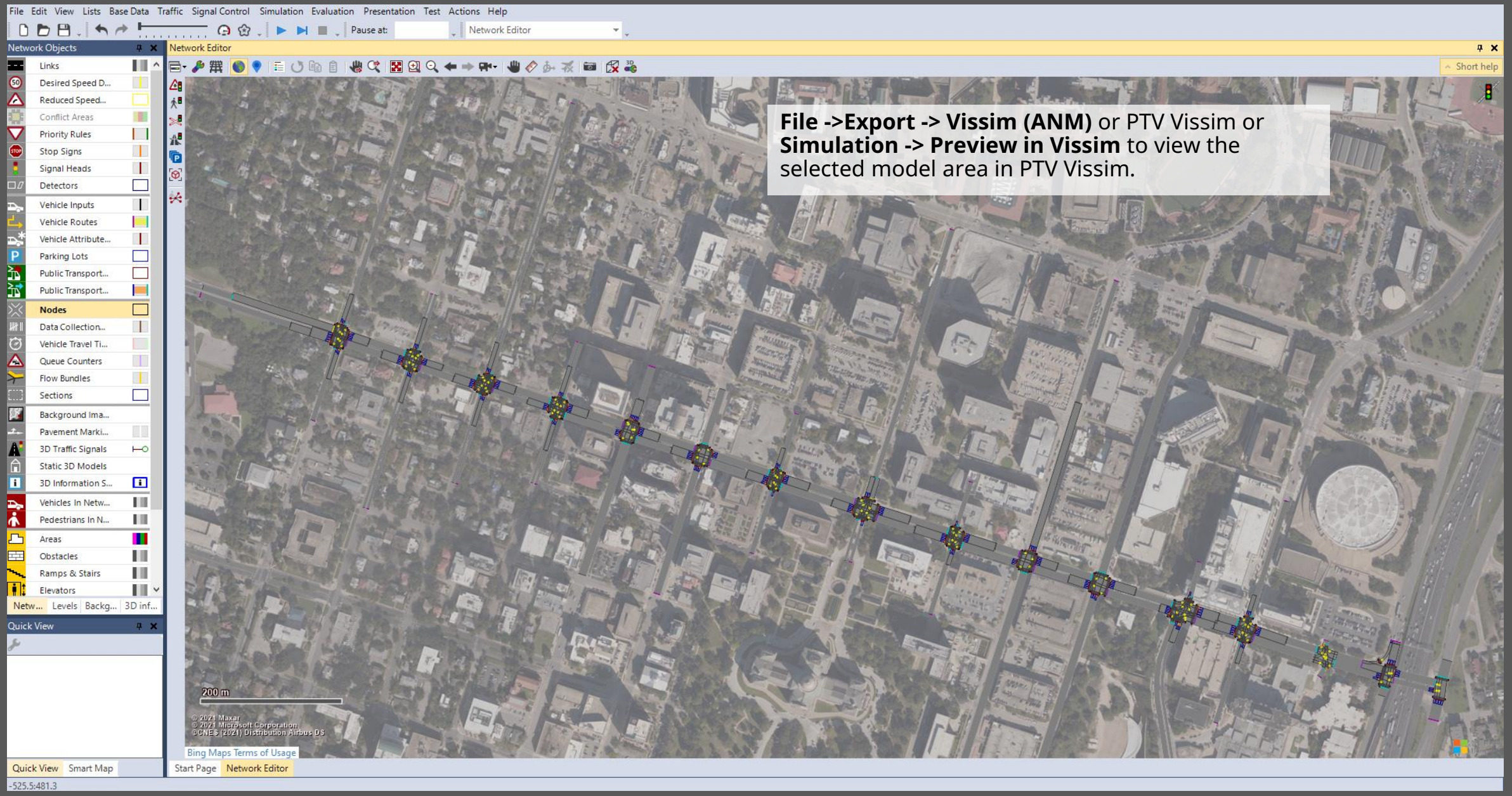
Analyze Intersection boxes can be “checked” or “unchecked” individually or modified in bulk with **Edit->Multi Change with** a few clicks.

6: Filter Streets by 15th Street. Hold down shift to select multiple intersections.








File ->Export -> Vissim (ANM) or PTV Vissim or Simulation -> Preview in Vissim to view the selected model area in PTV Vissim.
File Edit View Lists Base Data Traffic Signal Control Simulation Evaluation Presentation Test Actions Help
Pause at:
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Links
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Conflict Areas
Priority Rules
Stop Signs
Signal Heads
Detectors
Vehicle Inputs
Vehicle Routes
Vehicle Attribute...
Parking Lots
Public Transport...
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Nodes
Data Collection...
Vehicle Travel Ti...
Queue Counters
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Pavement Marki...
3D Traffic Signals
Static 3D Models
3D Information S...
Vehicles In Netw...
Pedestrians In N...
Areas
Obstacles
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3D inf...
Quick View
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Short help
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© 2021 Maxar
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©CNES (2021) Distribution Airbus DS
Bing Maps Terms of Usage
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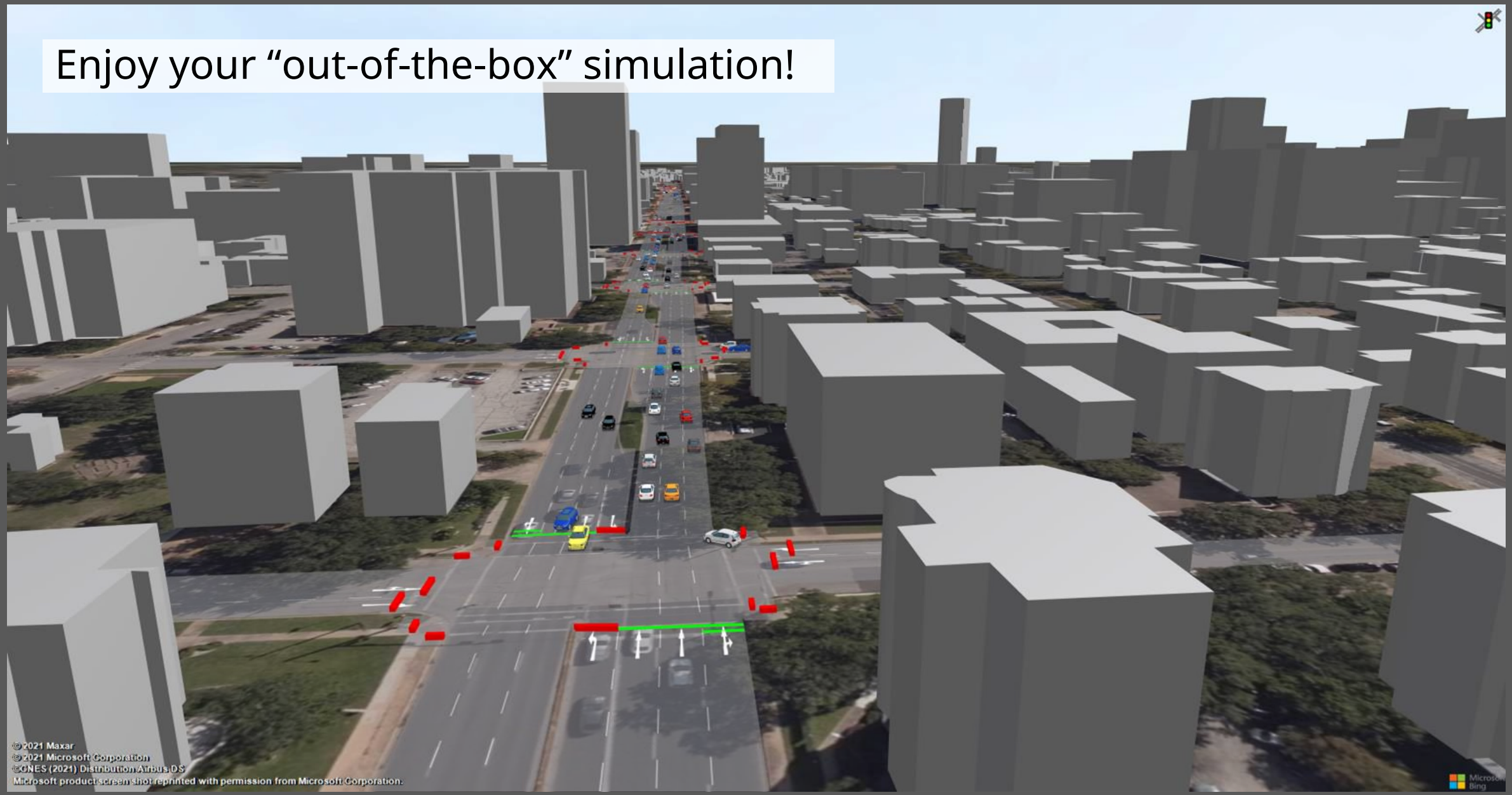
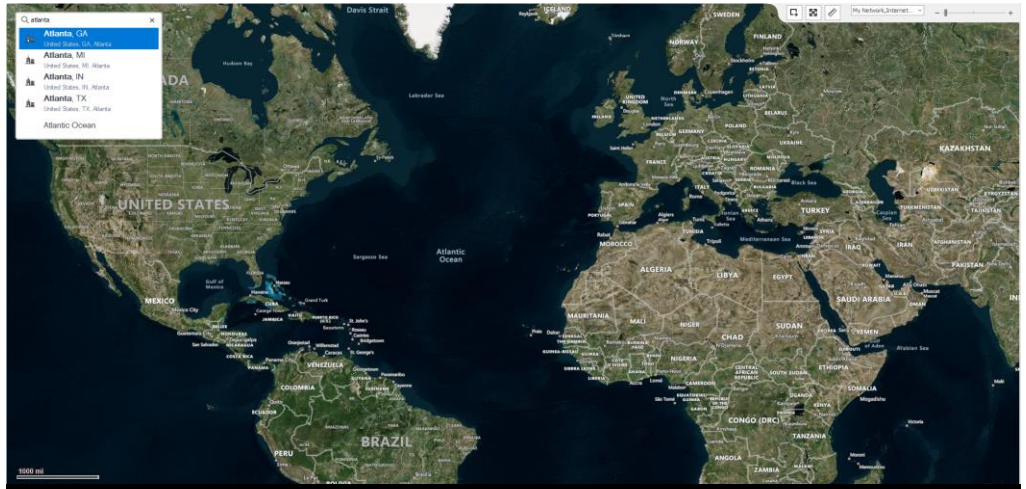
Enjoy your “out-of-the-box” simulation!

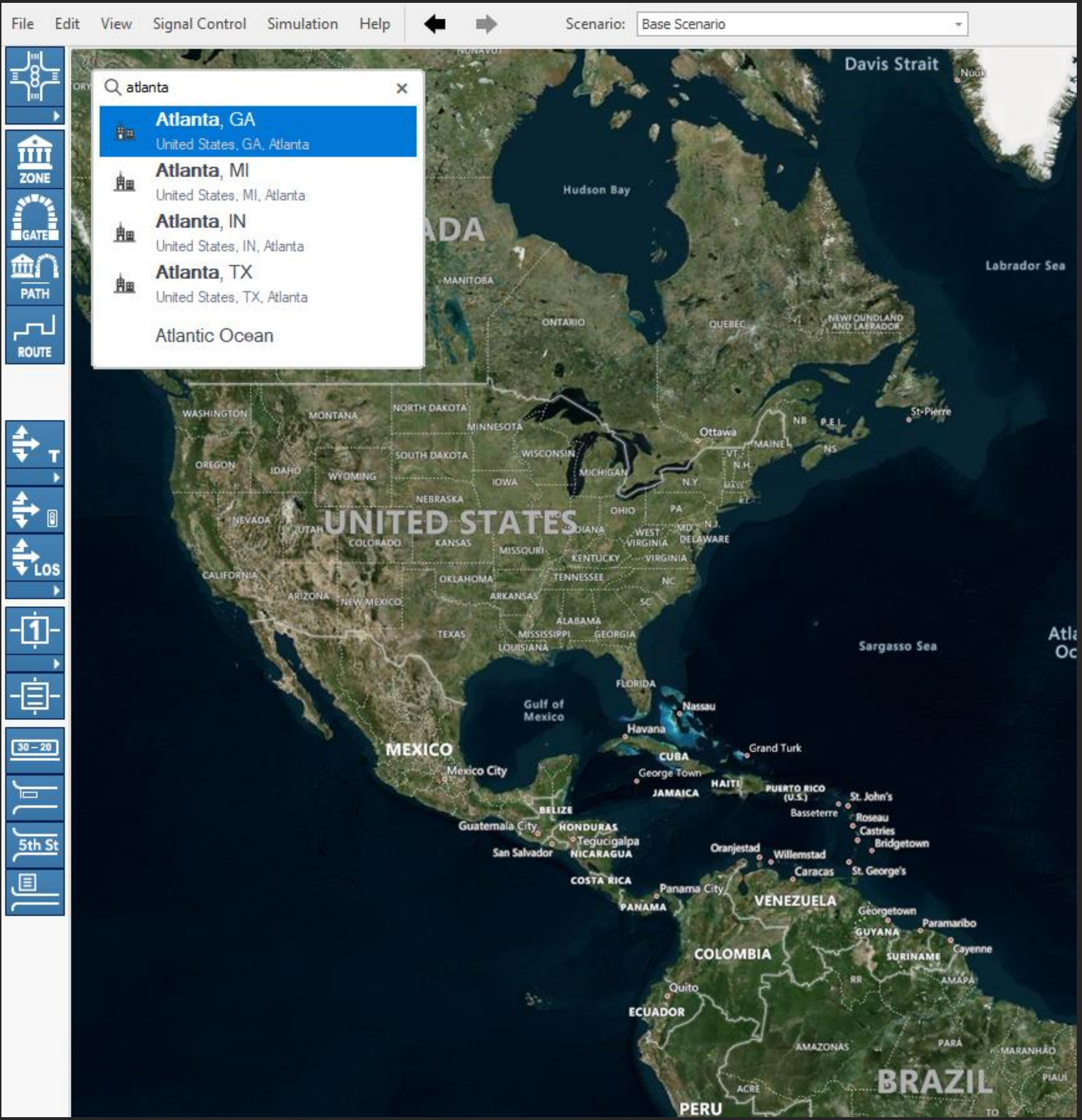


Map Search

Benefits:

- Quickly find intersections or corridors
- Find a city fast
- Find higher-level POIs.




File
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ZONE
GATE
PATH
ROUTE
LOS
5th St
Davis Strait
Hudson Bay
Labrador Sea
UNITED STATES
Sargasso Sea
Gulf of Mexico
MEXICO
Mexico City
CUBA
Havana
VENEZUELA
COLOMBIA
BRAZIL
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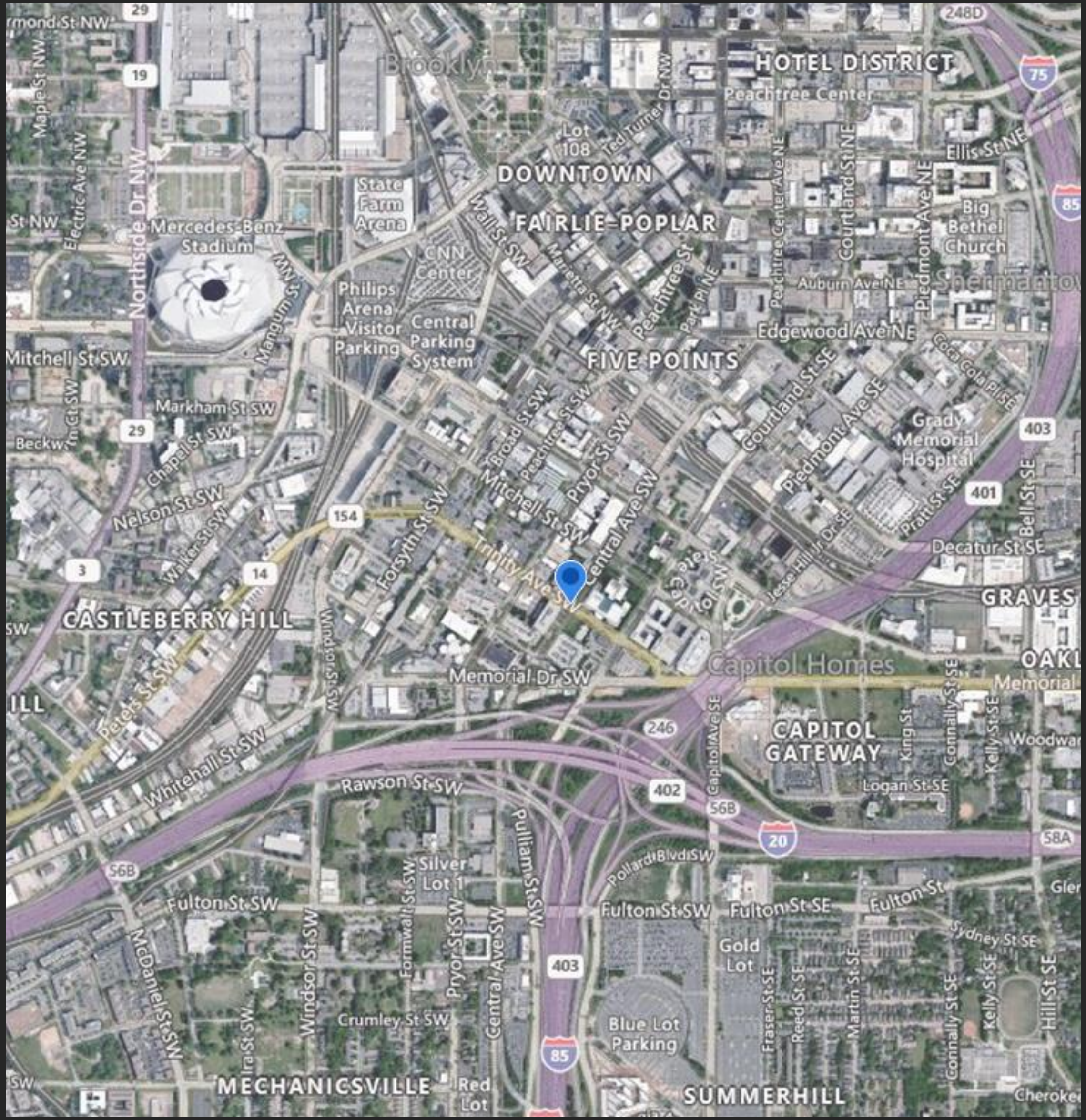

HOTEL DISTRICT
DOWNTOWN
FAIRLIE-POPLAR
Mercedes-Benz Stadium
State Farm Arena
Philips Arena Visitor Parking
Central Parking System
FIVE POINTS
CASTLEBERRY HILL
Grady Memorial Hospital
Memorial Dr SW
CAPITOL GATEWAY
Capitol Homes
MECHANICSVILLE
SUMMERHILL
Blue Lot Parking
Gold Lot
Rawson St SW
Fulton St SW
Decatur St SE
GRAVES
Trinity Ave SW

HCM 7th Edition Overview (related to Vistro)

HCM 7th Edition will be released by TRB during the TRB Annual Meeting*

Key Updates related to Vistro:

- **CAV modeling**
  - Signals
  - Roundabouts
- **TWSC updates**
- **Errata**

Lots of other updates to other methods as well

*Note: TRB is planning to release the E-pub version of the HCM 7th Edition during the TRB Annual Meeting in January 2022. The print edition is estimated to be released a couple of months afterwards.

Future HCM 7th Edition Highlights

CAV analysis

Penetration rates, adjusted saturation flow rates and adjustment factors:

- Signalized Intersections
- Roundabouts

Two-way stop control

- Flared Lane updates
- Minor Lefts one-stage movement updates
- Shared Major-Street lane sharing updates

Connected and Autonomous

Test CAVs deterministically. Utilize scenario management and network optimize based on market penetration rates!

CAV Analysis – Signalized Intersections

Signalized Method

CAV adjustment values were derived from microsimulation using assumptions based on current knowledge; CAV adjustment values were not field validated due to the current lack of CAV market penetration in the field.

Refer to FHWA Pooled Fund Study TPF- 5(371) "*Developing Highway Capacity Manual Capacity Adjustments for Connected and Autonomous Vehicles under Varying Levels of Volume and Market Penetration*" led by Kittelson & Associates and ODOT.

Note:

The HCM methodology for CAV analysis assumes that the CAV market penetration rate is a global input for the entire intersection. These planning-level adjustment factors currently do not support varying the percentage of CAVs on a per-lane or per-approach basis.

CAV Analysis – Signalized Intersections

Signalized Method

Refresher - Saturation flow adjustment calculation:

$$s = s_o \, f_w \, f_{HVg} \, f_p \, f_{bb} \, f_a \, f_{LU} \, f_{LT} \, f_{RT} \, f_{Lpb} \, f_{Rpb} \, f_{wz} \, f_{ms} \, f_{sp}$$

Where:

s = adjusted saturation flow rate (veh/h/ln),

s_o = base saturation flow rate (pc/h/ln),

f_x = various adjustment factors (lane width, heavy vehicles and grade, parking, bus blocking, area type, lane utilization, left-turn vehicle presence, right-turn vehicle presence, ped-bike adjustment for left-turn, ped-bike adjustment for right-turn, work zone, downstream lane blockage, sustained spillback)

CAV Analysis – Signalized Intersections

Signalized Method

Base saturation flow (s_o) adjustments:

Proportion of CAVs in Traffic Stream	Base Saturation Flow Rate (pc/h/ln)
0	1,900
20	2,000
40	2,150
60	2,250
80	2,550
100	2,900

Notes: CAV = connected and automated vehicle, defined here as a vehicle with an operating cooperative adaptive cruise control system.
Assumes no interaction with non-motorized road users, no adverse weather impacts, and a facility without driveways or access points impacting saturation flow rates.
Interpolate for other CAV proportions.

Exhibit 31-64
Base Saturation Flow Rates for CAVs for Through Movements at Signalized Intersections

Additionally, the lane-width adjustment factor (f_w) should not be applied (1.0) when CAVs are present.

CAV Analysis – Signalized Intersections

Signalized Method

Protected Left Turns adjustments ($f_{CAV,prot}$) :

Proportion of CAVs in Traffic Stream	Saturation Flow Rate Adjustment for Protected Left Turns, $f_{CAV,prot}$
0	1.00
20	1.01
40	1.07
60	1.11
80	1.21
100	1.56

Notes: CAV = connected and automated vehicle, defined here as a vehicle with an operating cooperative adaptive cruise control system.
Assumptions: Average intervehicle gap within CAV platoons = 0.71 s, CAV interplatoon gap = 1.5 s, maximum CAV platoon size = 8 pc, human-driven vehicles operate with through movement saturation flow rates calibrated to 1,900, assumes no interaction with non-motorized road users, no adverse weather impacts, and a facility without driveways or access points impacting saturation flow rates.
Interpolate for other CAV proportions.

Exhibit 31-65
Saturation Flow Rate
CAV Adjustment for Protected Left Turns at Signalized Intersections

Additionally, these factors should not be used in addition to the values in Exhibit 31-64 (the s_o adjustments).

CAV Analysis – Signalized Intersections

Signalized Method

Permitted Left Turns adjustments ($f_{CAV,perm}$) :

Exhibit 31-66
Saturation Flow Rate CAV Adjustments for Permitted Left Turns at Signalized Intersections

Proportion of CAVs in Traffic Stream	Saturation Flow Rate Adjustment for Permitted Left Turns $f_{CAV,perm}$ by Opposing Through Volume Per Lane (pc/h/ln)			
	300	450	600	750
0	1.00	1.00	1.00	1.00
20	1.12	1.04	1.03	1.07
40	1.20	1.16	1.12	1.18
60	1.29	1.22	1.26	1.36
80	1.43	1.43	1.57	1.60
100	1.76	1.72	1.66	1.90

Notes: CAV = connected and automated vehicle, defined here as a vehicle with an operating cooperative adaptive cruise control system.
Assumptions: Average intervehicle gap within CAV platoons = 0.71 s, CAV interplatoon gap = 1.5 s, maximum CAV platoon size = 8 pc, human-driven vehicles operate with through movement saturation flow rates calibrated to 1,900, assumes no interaction with non-motorized road users, no adverse weather impacts, and a facility without driveways or access points impacting saturation flow rates.
Interpolate for other CAV proportions.

Additionally, these factors should not be used in addition to the values in Exhibit 31-64 (the s_0 adjustments).

CAV Analysis – Roundabouts

Roundabout Method

CAV adjustment values were derived from microsimulation using assumptions based on current knowledge; CAV adjustment values were not field validated due to the current lack of CAV market penetration in the field.

Refer to FHWA Pooled Fund Study TPF- 5(371) "*Developing Highway Capacity Manual Capacity Adjustments for Connected and Autonomous Vehicles under Varying Levels of Volume and Market Penetration*" led by Kittelson & Associates and ODOT.

Note:

The HCM methodology for CAV analysis assumes that the CAV market penetration rate is a global input for the entire intersection. These planning-level adjustment factors currently do not support varying the percentage of CAVs on a per-lane or per-approach basis.

CAV Analysis – Roundabouts

Roundabouts Method

Capacity Adjustment Factors

$$c_{e,pce} = Ae^{-Bv_{c,pce}}$$ **Equation 33-1**

$$c_{e,adj,pce} = f_A Ae^{-f_B Bv_{c,pce}}$$ **Equation 33-2**

where

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

A = intercept parameter, from Exhibit 33-12;

B = slope parameter, from Exhibit 33-12;

$v_{c,pce}$ = conflicting flow rate (pc/h);

$c_{e,adj,pce}$ = entry lane capacity, adjusted for CAVs and heavy vehicles (pc/h);

f_A = adjustment factor for the intercept parameter, from Exhibit 33-13; and

f_B = adjustment factor for the intercept parameter, from Exhibit 33-13.

CAV Analysis – Roundabouts

Roundabouts Method

To determine the CAV-adjusted capacity, first identify the values of A and B from Exhibit 33-12 for the appropriate combination of number of entry lanes and number of conflicting circulating lanes.

Entry Lane Type	*A*	*B*
One-lane entry conflicted by one circulating lane	1,380	1.02×10^{-3}
Two-lane entry conflicted by one circulating lane (both entry lanes)	1,420	0.91×10^{-3}
One-lane entry conflicted by two circulating lanes	1,420	0.85×10^{-3}
Two-lane entry conflicting by two circulating lanes (right entry lane)	1,420	0.85×10^{-3}
Two-lane entry conflicting by two circulating lanes (left entry lane)	1,350	0.92×10^{-3}

Source: Equations 22-1 through 22-5.

Exhibit 33-12
Roundabout Entry Lane Capacity Model Parameters (without CAVs)

CAV Analysis – Roundabouts

Roundabouts Method

Next, identify the values of f_A and f_B from Exhibit 33-13 for the combination of subject entry lane type and proportion of CAVs in the traffic stream.

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.

Exhibit 33-13
Capacity Adjustment Factors for CAVs for Roundabouts

CAV Analysis – Roundabouts

Roundabouts Method

Finally, apply these values in Equation 33-2 to determine the subject entry lane's adjusted capacity.

$$c_{e,pce} = Ae^{-Bv_{c,pce}}$$

Equation 33-1

$$c_{e,adj,pce} = f_A Ae^{-f_B Bv_{c,pce}}$$

Equation 33-2

where

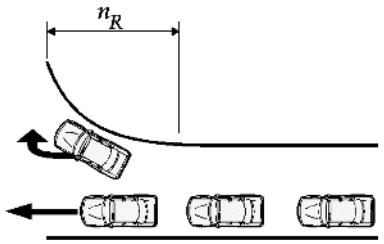
$c_{e,pce}$ = entry lane capacity, adjusted for heavy vehicles (pc/h);
A = intercept parameter, from Exhibit 33-12;
B = slope parameter, from Exhibit 33-12;
$v_{c,pce}$ = conflicting flow rate (pc/h);

$c_{e,adj,pce}$ = entry lane capacity, adjusted for CAVs and heavy vehicles (pc/h);
f_A = adjustment factor for the intercept parameter, from Exhibit 33-13; and
f_B = adjustment factor for the intercept parameter, from Exhibit 33-13.

Two-Way Stop Control Updates

TWSC Method Updates

Updated calculation of Rank 4 capacity (Step 9a, Section 20-3)
Rank 4 = left-turns from minor street at 4-leg intersection
Updated to correct an overestimation of capacity for minor-street left-turn movements for one-stage movements.



Updated calculation of flared minor-street lane effects (Step 10b, Section 20-3)
Updated to simplify and improve the accuracy of the calculations.

Adjusted calculation of shared major-street lane effects (Step 7d, Section 20-3).