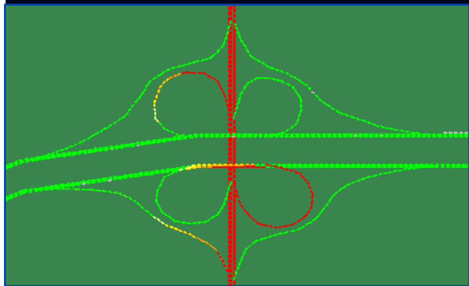
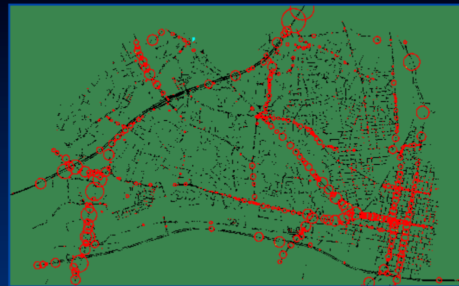
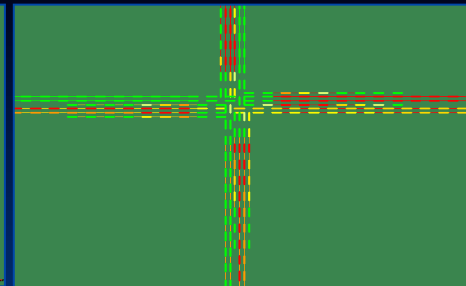





NEXTA: Simulation Data Visualizer for TRANSIMS

NEXTA: **N**etwork **EX**plorer for **T**raffic **A**nalysis

Sponsored by

Federal Highway Administration

Developed and Prepared by

Dr. Xuesong Zhou, Univ. of Utah

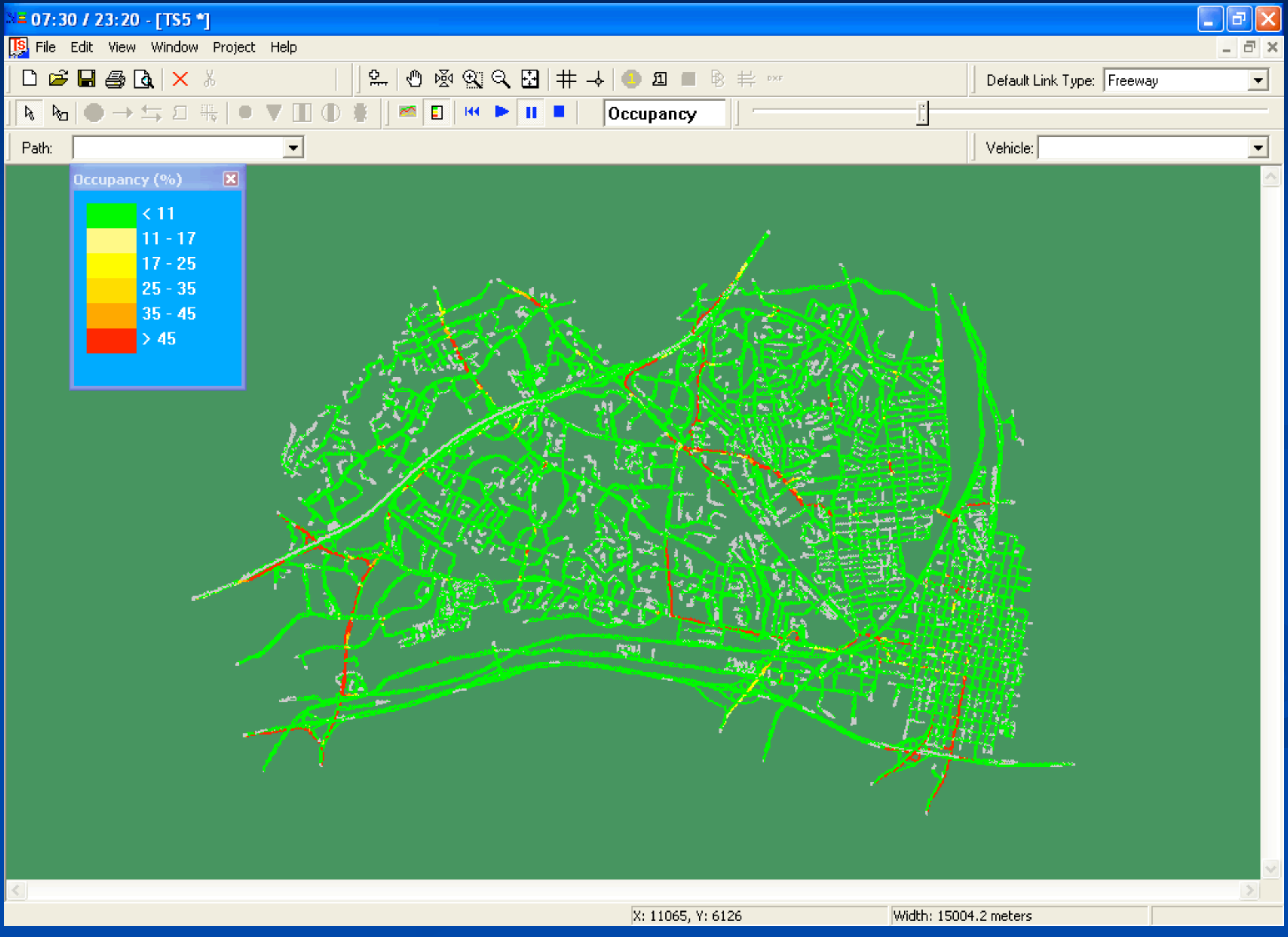
zhou@eng.utah.edu

TRANSIMS: Applications and Development Workshop
April 8–9, 2010

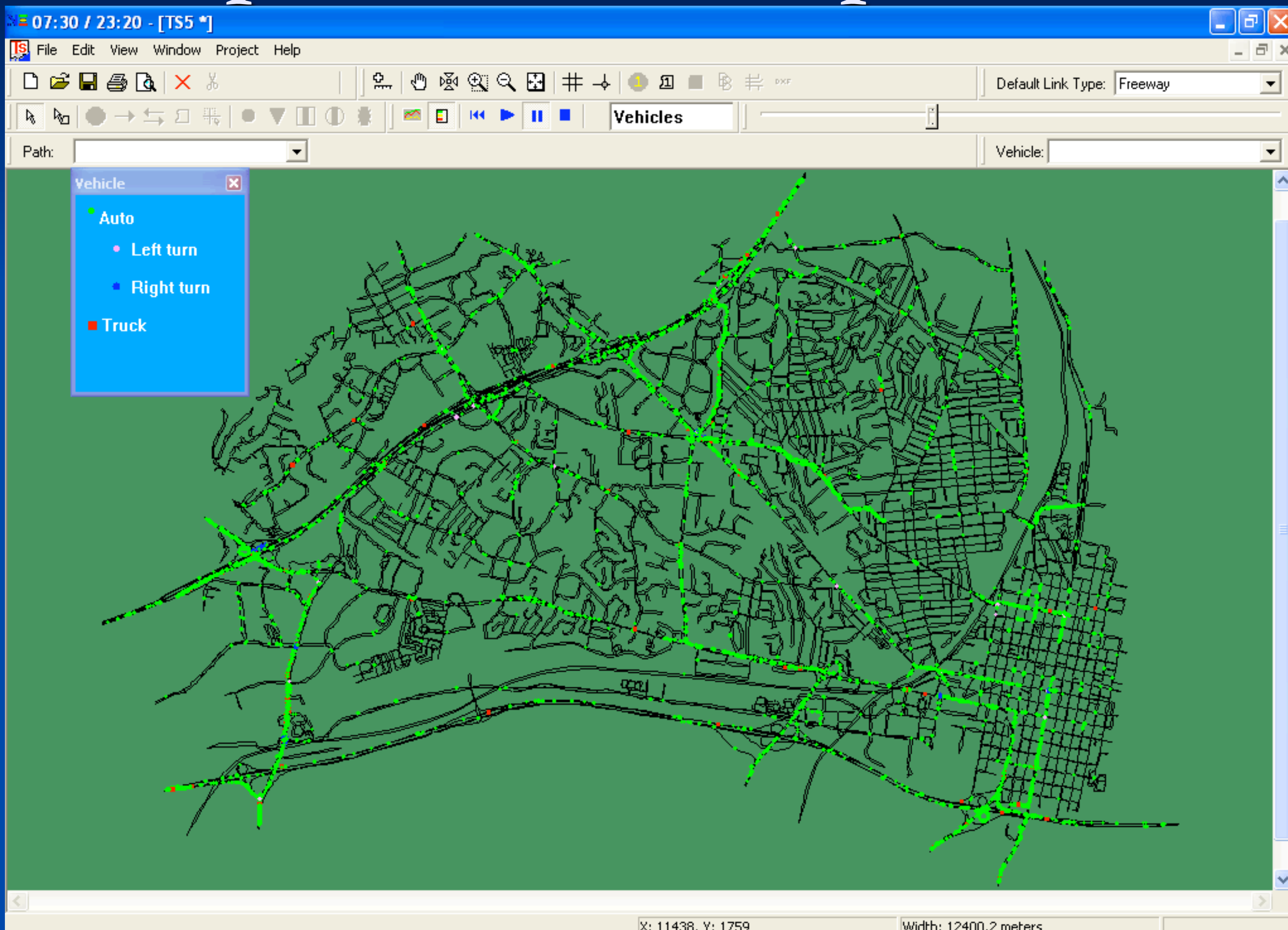
Freeware can be downloaded at

http://www.civil.utah.edu/~zhou/NEXTA_for_TRANSIMS.html

Sample Occupancy Plot



Sample Vehicle Snapshot Plot



Sample Bottleneck Snapshot Plot

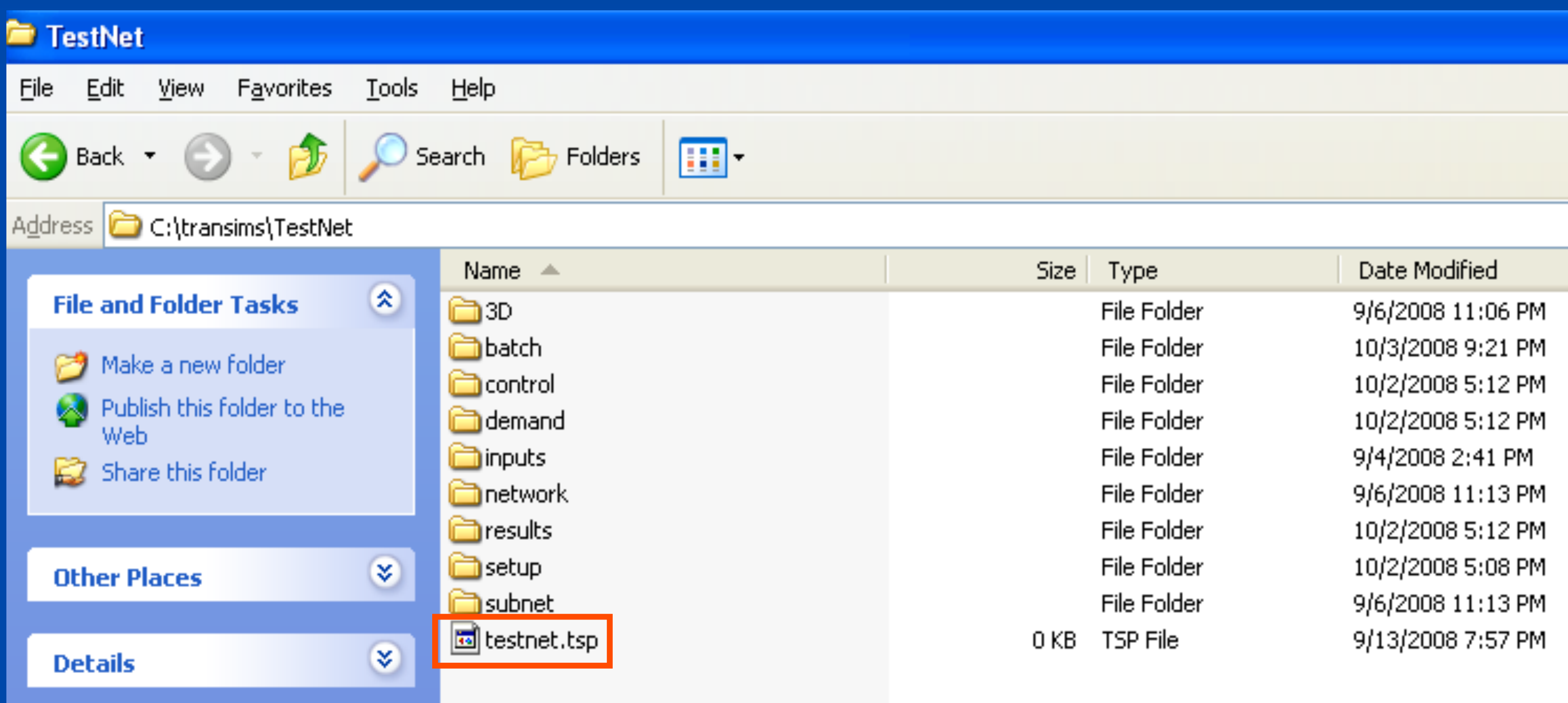
Sample Travel Time Contour (Accessibility) Snapshot Plot

Tutorial Outline

- Network and control data visualization
  - View node and link properties, lane configuration
  - Configure dynamic project menu
- Time-dependent simulation data visualization
  - View cell occupancy, speed, queue length and vehicle locations, MOE profiles
- Other tools
  - Find multiple paths
  - Create nodes and links (in development)

Step 0: Create a Project File

- Project file (*.tsp) is used by NEXTA to locate the folder of a TRANSIMS project



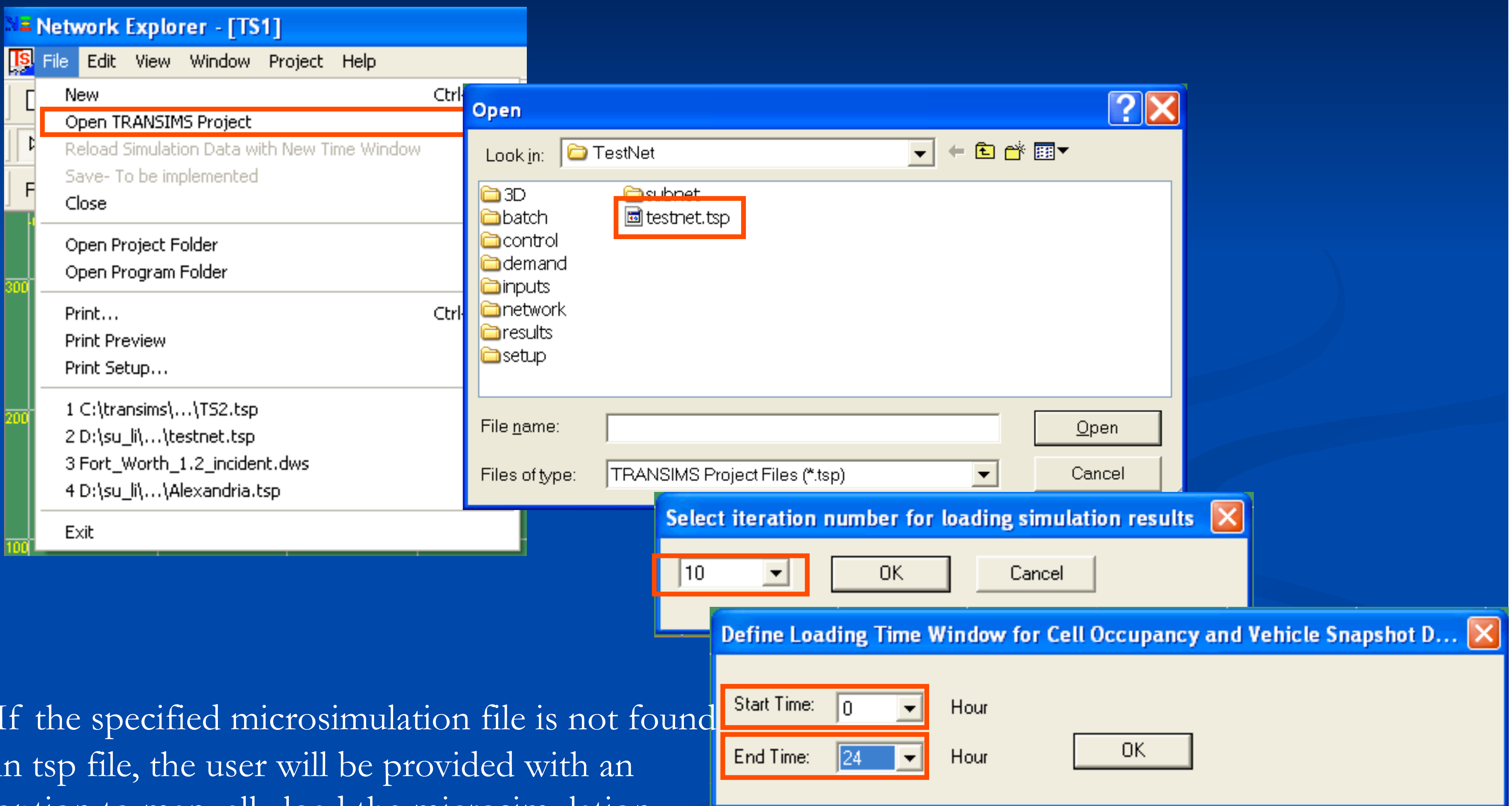
Inside a *.tsp Project File

- First line should have the relative location of the microsimulation control file

Example: TestNet data set setup
\master\Microsimulator.ctl

Example: Alexandria data set
setup\control
\Microsimulator.ctl

Step 1: Open a Project



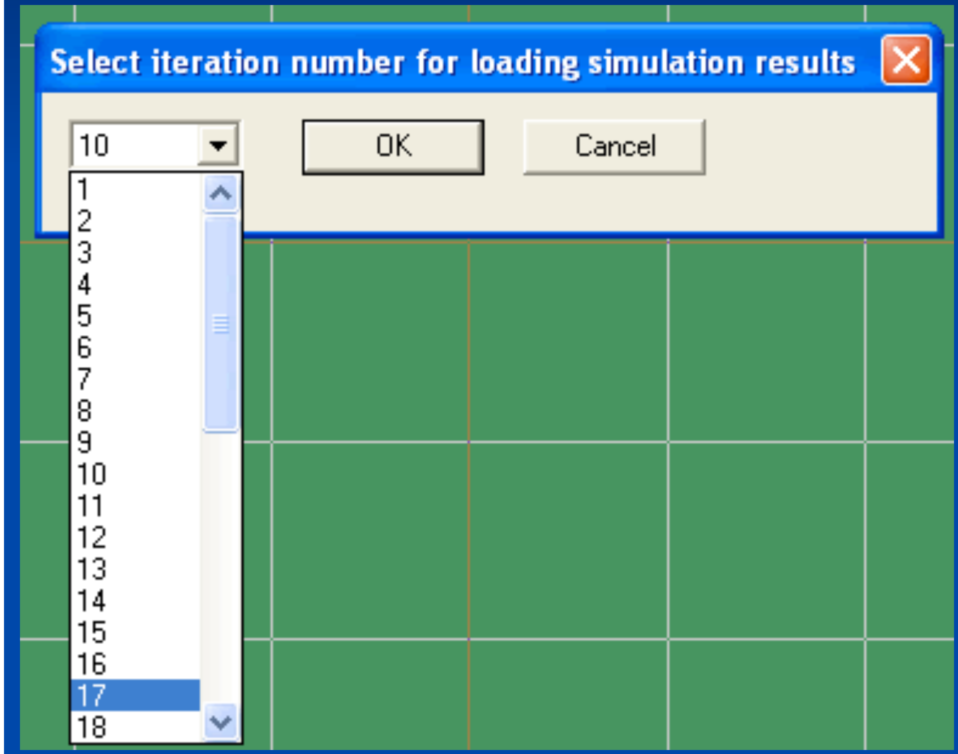
If the specified microsimulation file is not found in tsp file, the user will be provided with an option to manually load the microsimulation control file, or use the default input file locations

File Loading Status Table

Keyword	Value	Status
--Directories--		
NET_DIRECTORY	NETWORK	
--Input File Names--		
NET_NODE_TABLE	Node.txt	Loaded
NET_LINK_TABLE	Link.txt	Loaded
NET_ACTIVITY_LOCATION_TABLE	Activity_Location_3.txt	Loaded
NET_POCKET_LANE_TABLE	Pocket_Lane.txt	Loaded
NET_LANE_CONNECTIVITY_TABLE	Lane_Connectivity.txt	Loaded
NET_SHAPE_TABLE	Shape.txt	Loaded
NET_SIGNALIZED_NODE_TABLE	Signalized_Node.txt	Loaded
NET_UNSIGNALIZED_NODE_TABLE	Unsignalized_Node.txt	Loaded
NET_TIMING_PLAN_TABLE	Timing_Plan.txt	Loaded
NET_PHASING_PLAN_TABLE	Phasing_Plan.txt	Loaded
--Simulation File Names--		
Result Directory	results (parsed from OUTPUT_SNAPSHOT_FILE_1)	
OUTPUT_SNAPSHOT_FILE_1	Snapshot.txt	Loaded
OUTPUT_OCCUPANCY_FILE_1	Occupancy_Max.txt	Loaded
OUTPUT_SUMMARY_FILE_1	Performance.txt	Loaded
--NEXTA Loading Statistics--		
# of vehicle samples	487409 between 00:01 and 23:02	

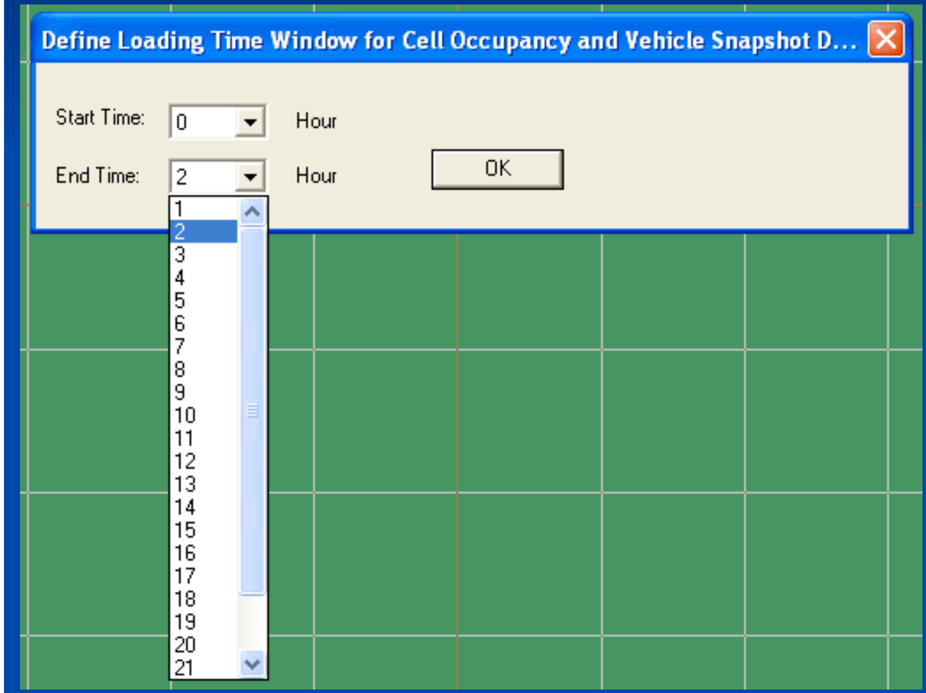
OK

Step 1: Open a Project → Select iteration number



- A user can specify an iteration number for loading average link performance, cell occupancy and vehicle snapshot data.
- By default, NEXTA automatically identifies and loads the maximum (i.e. the last) iteration number, if multiple iterations of simulation results are available from those files stored in folder “\\results”.

Step 1: Open a Project → Define Loading Time Window



- For (memory-consuming) cell occupancy and vehicle snapshot data, a user can specify “Start Time” and “End Time” to define a data loading time window to reduce required memory for the GUI program.
- For link performance data such as density, speed and queue length, NEXTA loads 24 hours of simulation data automatically.

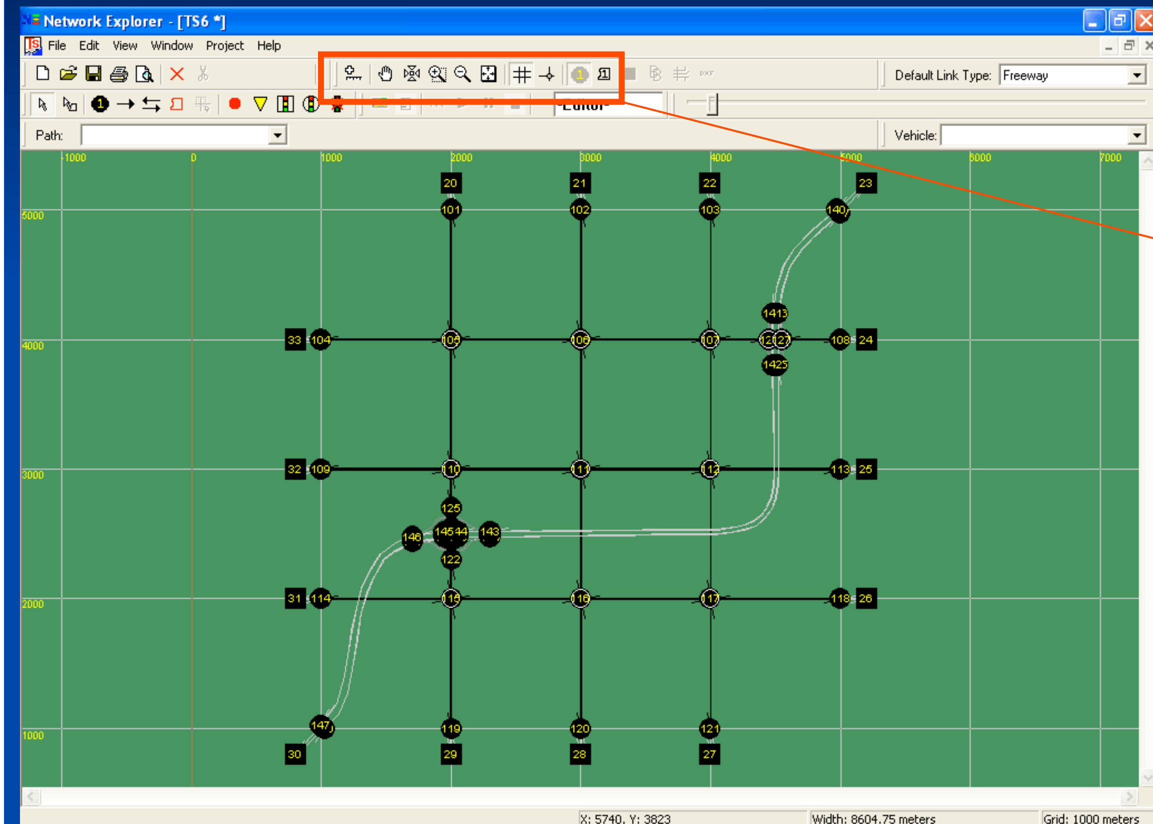
Input Files

- Folder Network
  - Node.txt, Link.txt, Pocket_Lane.txt, Shape.txt, Zone.txt
  - Signalized_Node.txt, Timing_Plan.txt, Phasing_Plan.txt

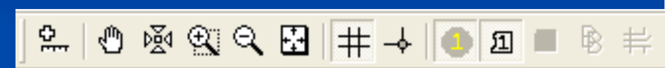
- Folder Results
  - Performance.txt (density, speed, queue)
  - Occupancy_Avg.txt (cell occupancy)
  - Snapshot.txt (vehicle locations)

Remarks: A test data set with the above files can be downloaded at
http://www.civil.utah.edu/~zhou/TestNet.zip
A user can execute */setup/runall.bat* to generate those files

First Look

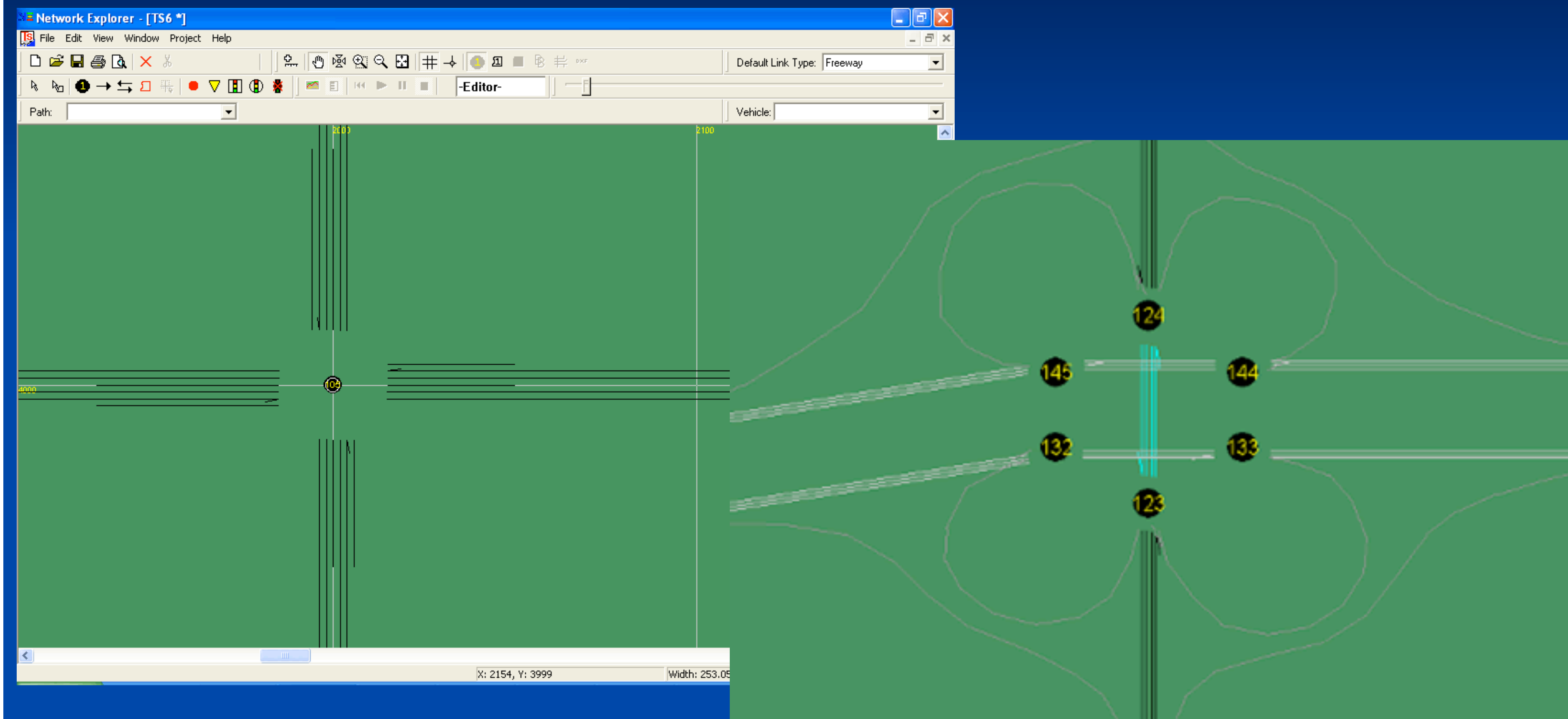


View Tools



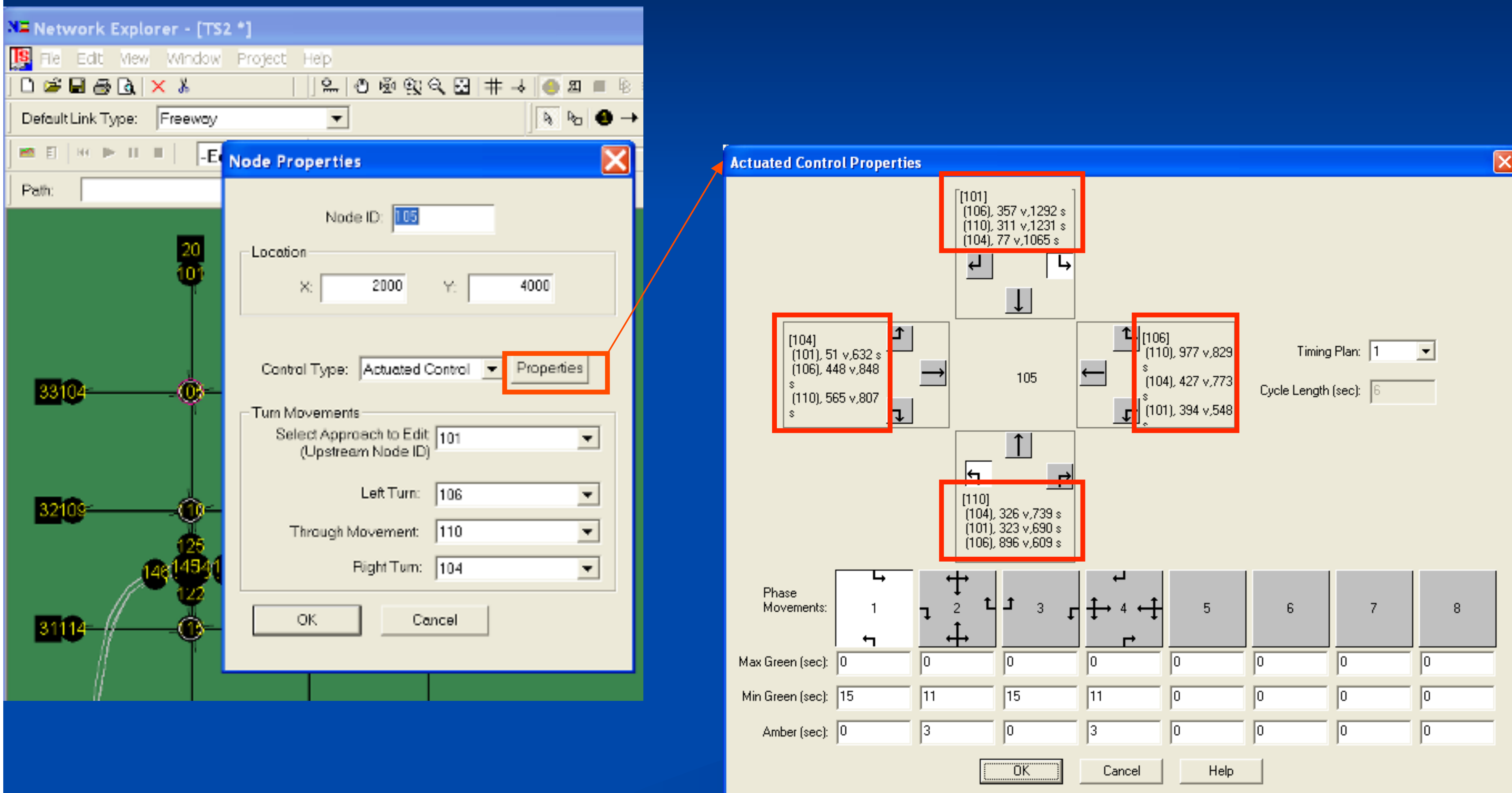
- Distance
- Move Network
- Pan
- Zoom In
- Zoom Out
- Show Entire Network
- Show/Hide Grid
- Show/Hide Node
- Show/Hide Zone

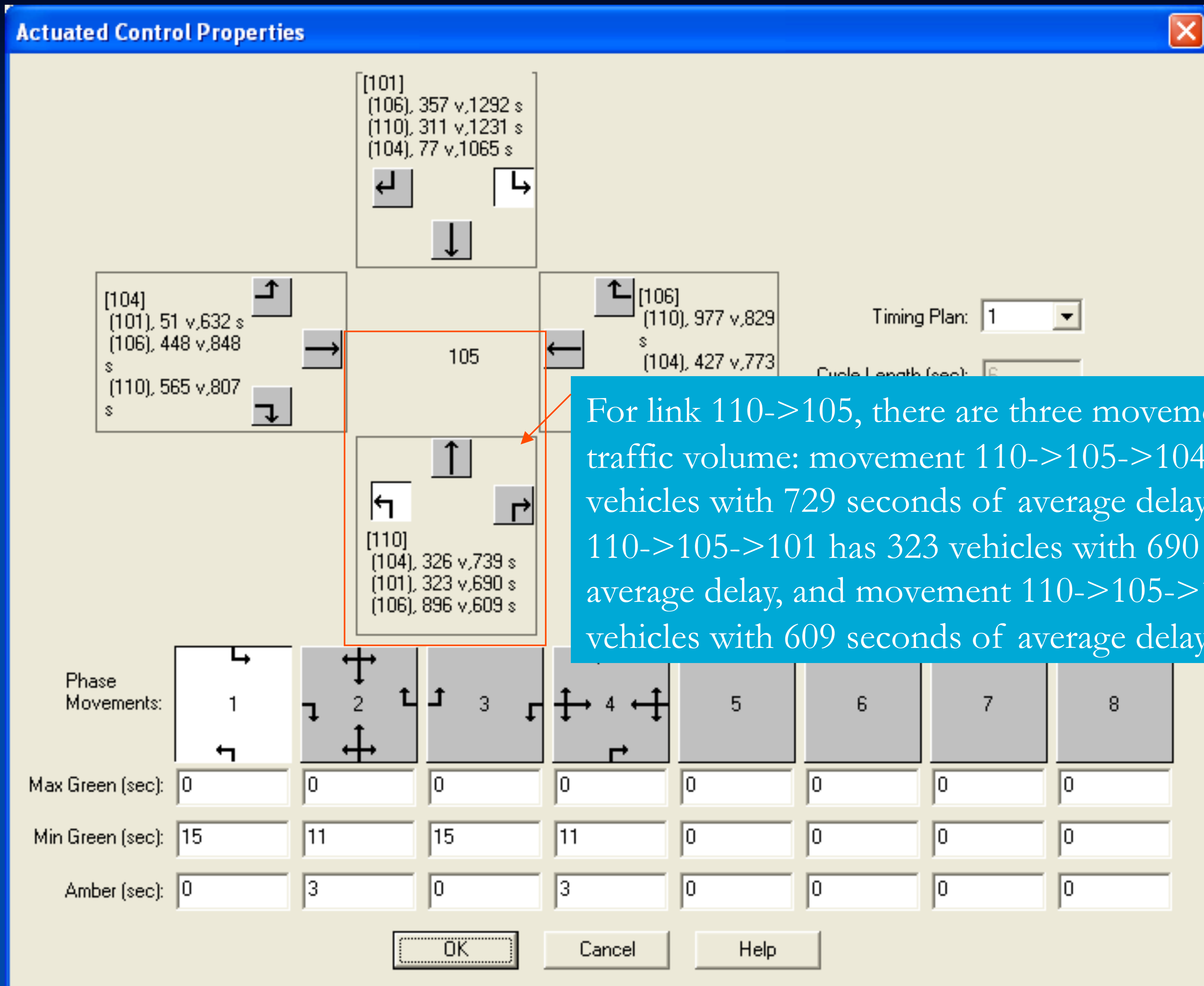
Step 2: Zoom In -> View Lane Configuration



Zooming can also be accomplished with the **Page Up** / **Page Down** keys, the **+** / **-** keys or the **mouse wheel**.

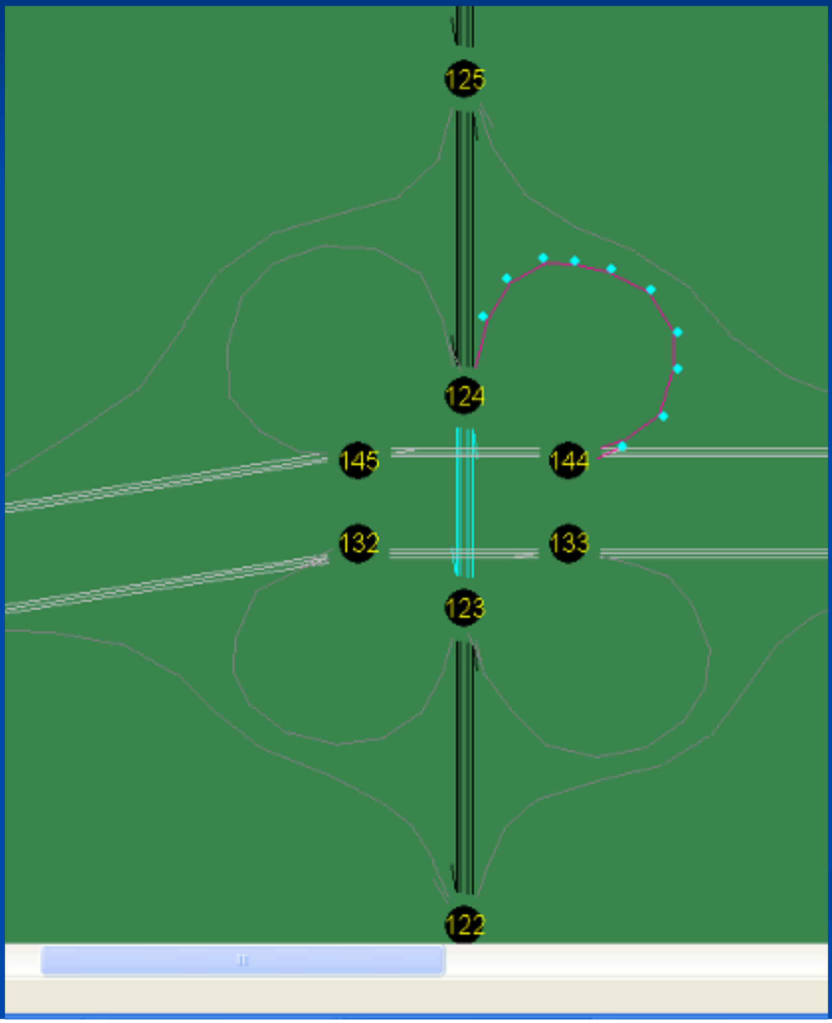
Step 3: Double-Click a Node to Show Node and Control Properties

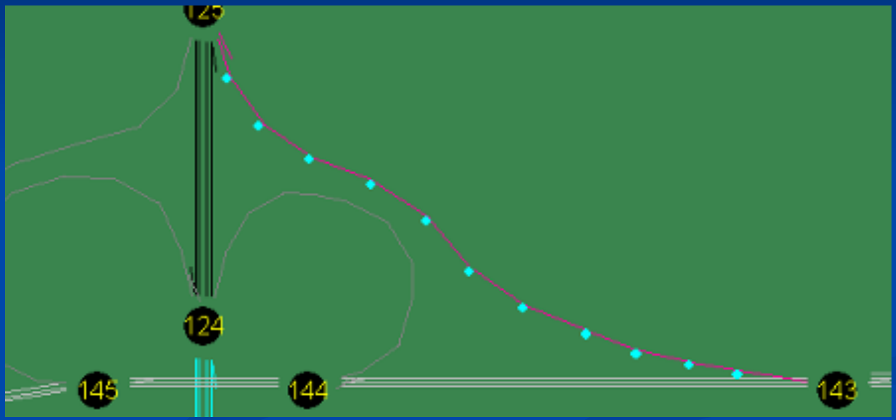


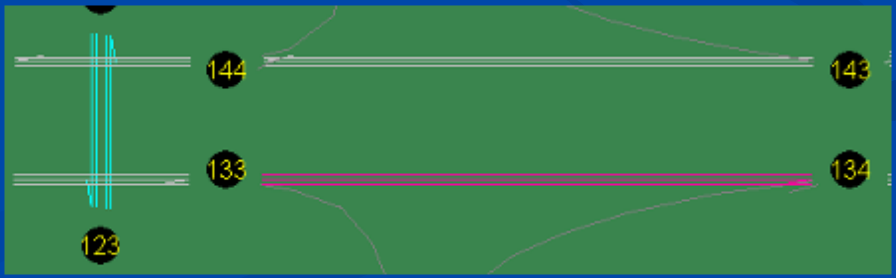


For link 110->105, there are three movements with traffic volume: movement 110->105->104 has 326 vehicles with 729 seconds of average delay, movement 110->105->101 has 323 vehicles with 690 seconds of average delay, and movement 110->105->106 has 896 vehicles with 609 seconds of average delay

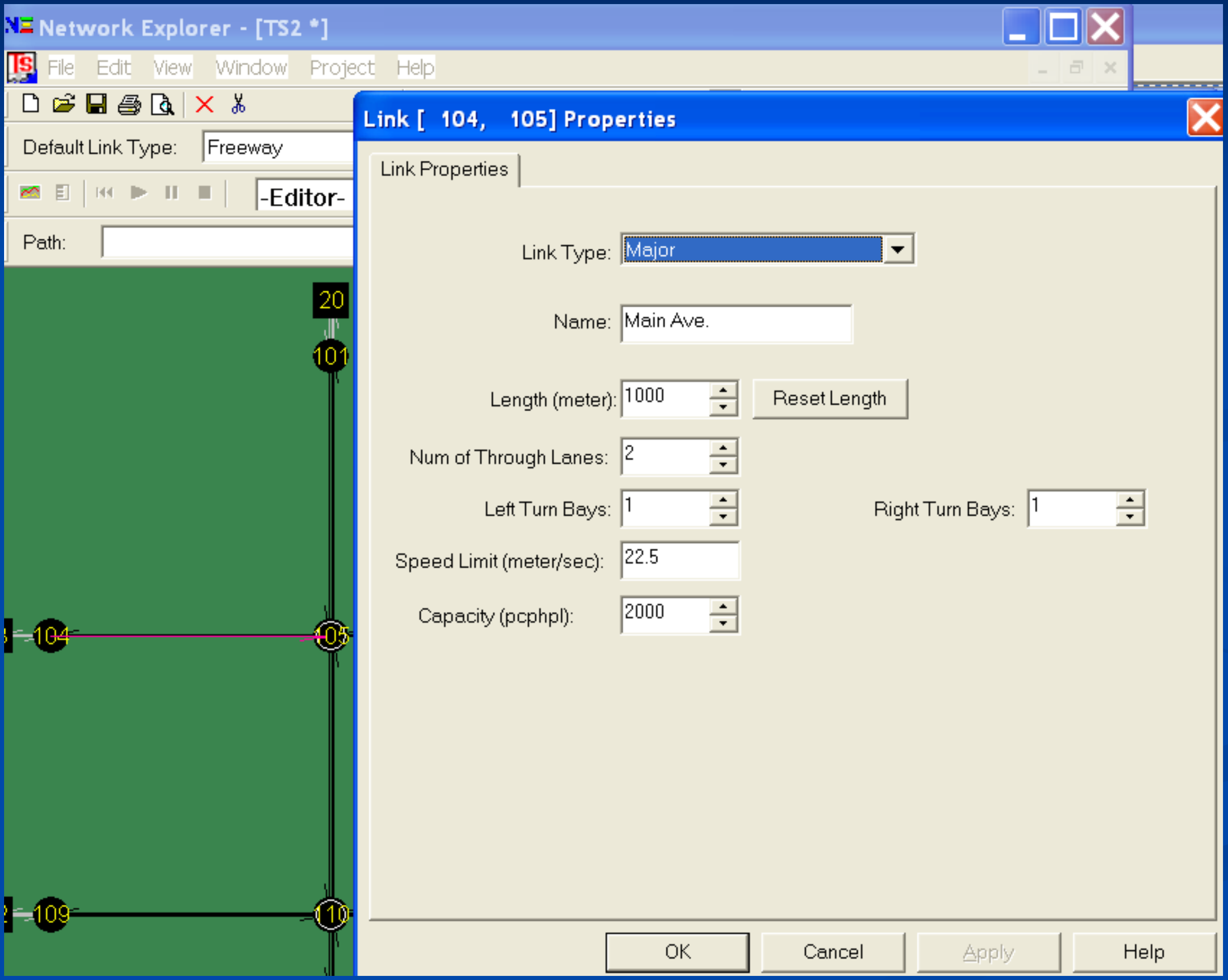
Step 4: Single-Click a Link to Show Shape Points



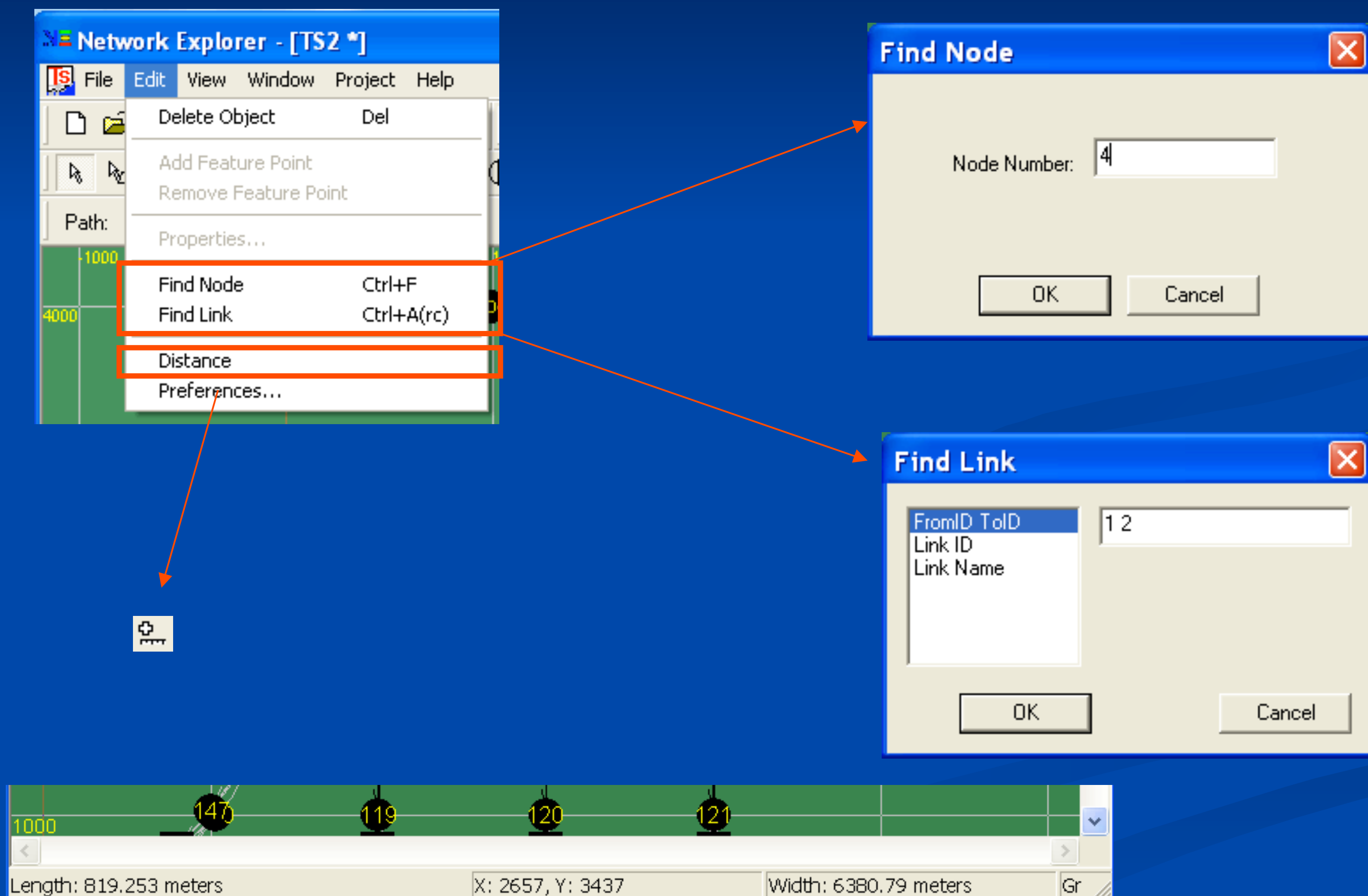




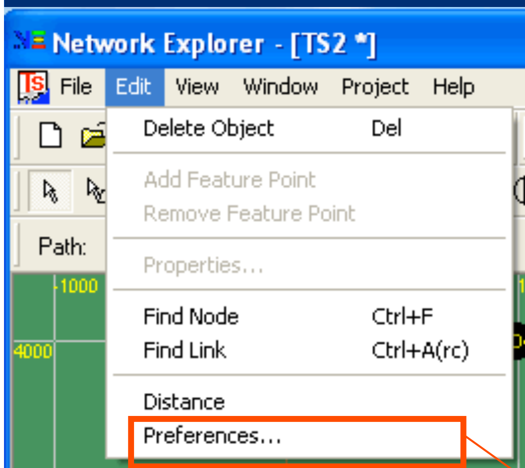
Step 5: Double-Click a Link to Show Link Property

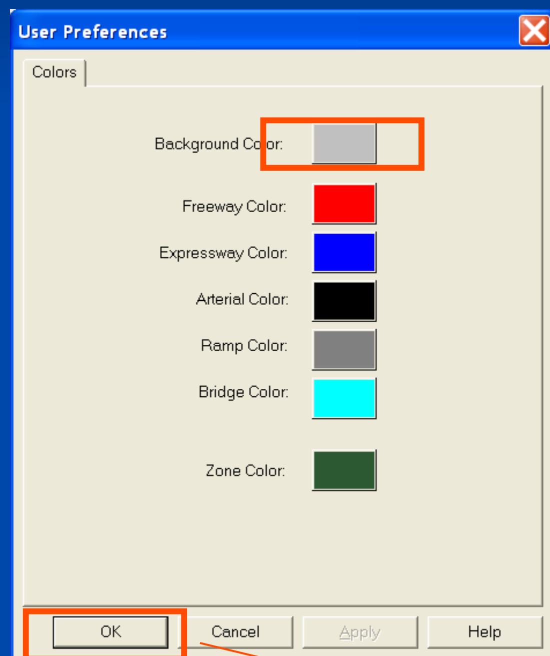


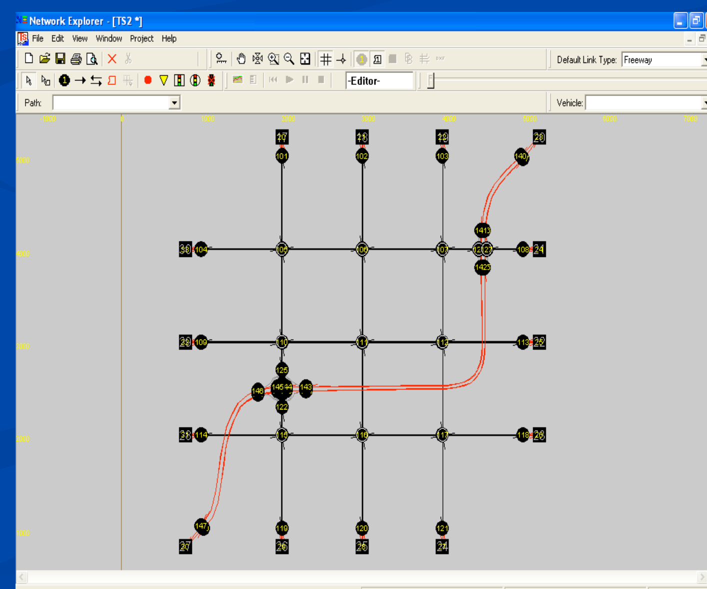
Step 6: Find Node / Find Link / Measure Distance



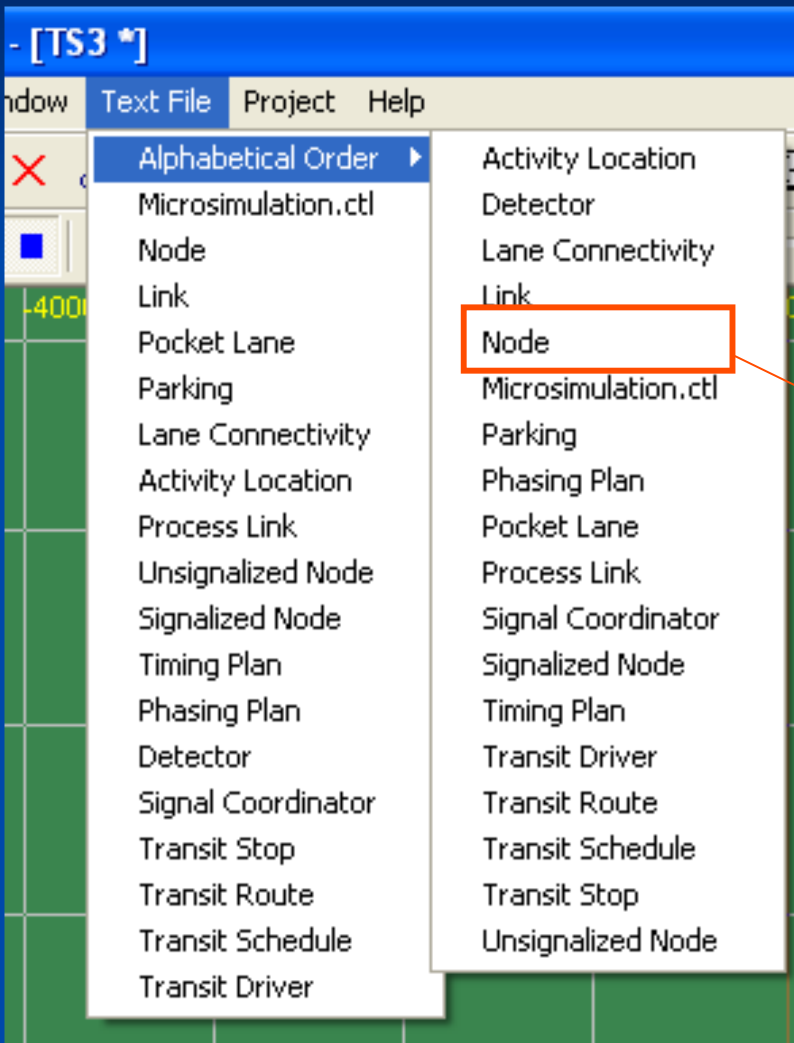
Step 7: Change Color Preferences for Background and Link Types



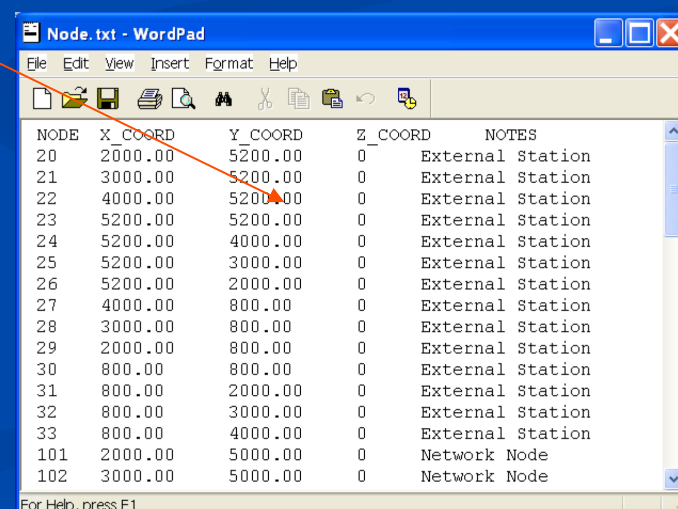




Step 8: View Text File



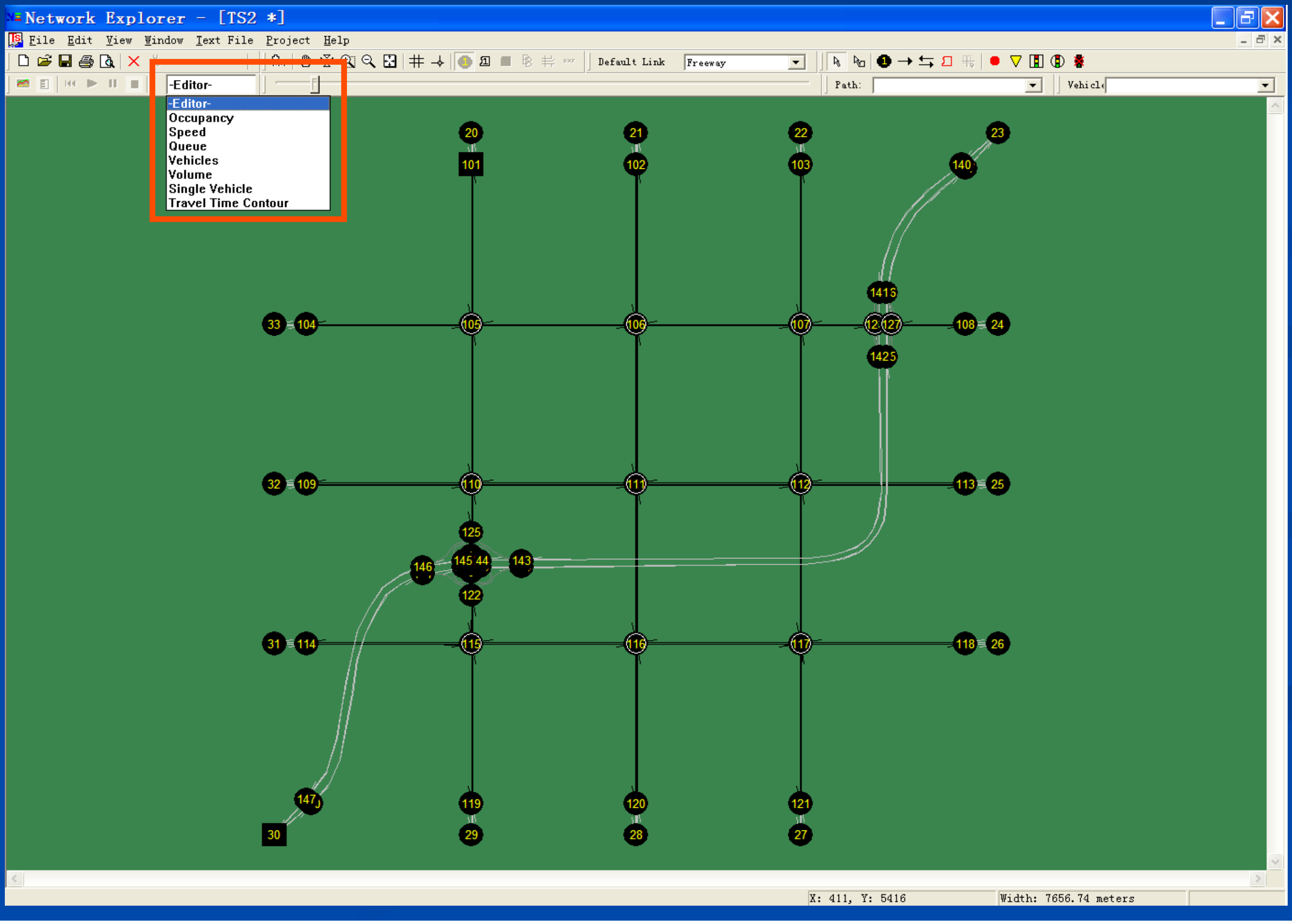
NEXTA fetches input file names directly from the microsimulator control file.



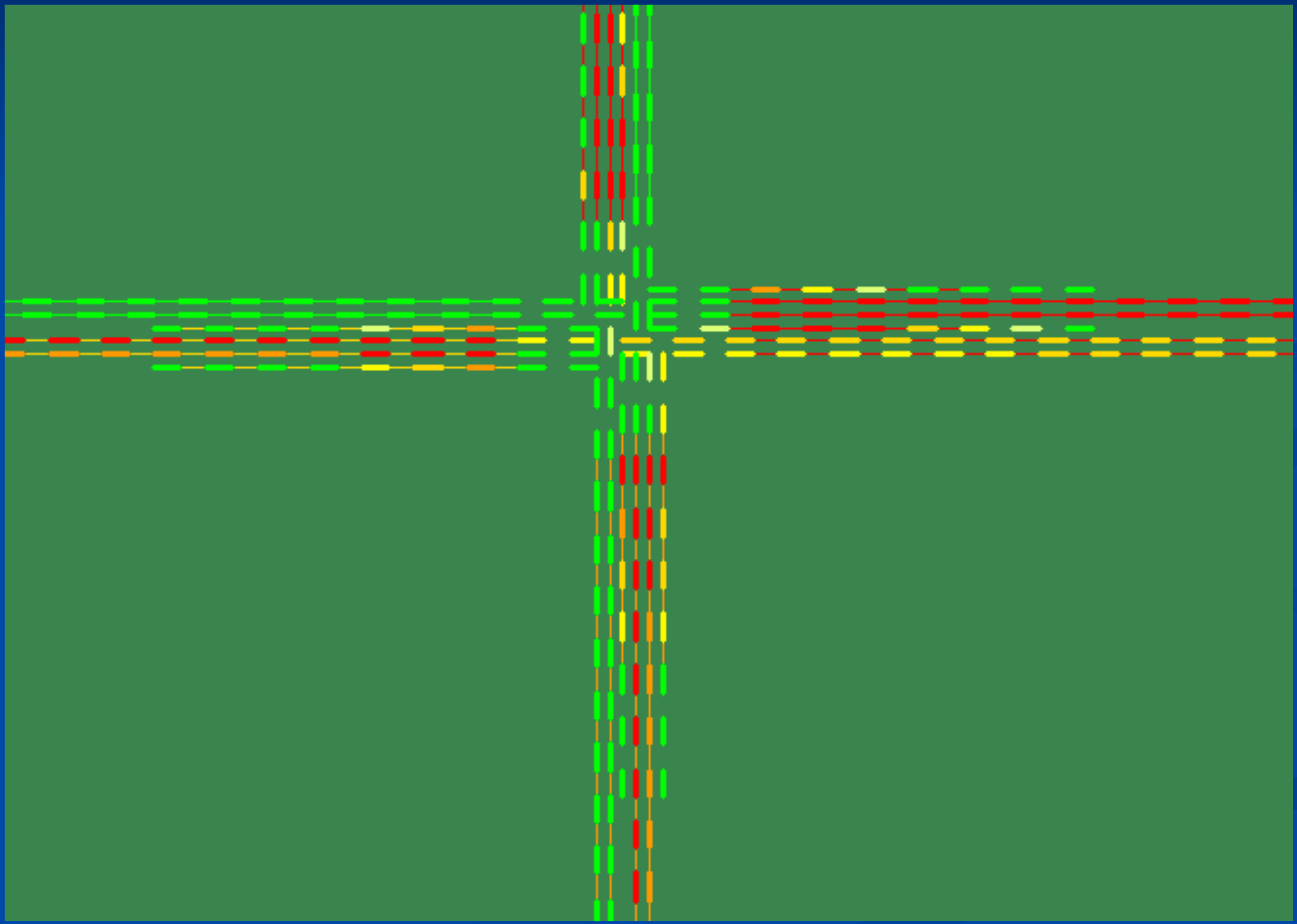
NODE	X_COORD	Y_COORD	Z_COORD	NOTES
20	2000.00	5200.00	0	External Station
21	3000.00	5200.00	0	External Station
22	4000.00	5200.00	0	External Station
23	5200.00	5200.00	0	External Station
24	5200.00	4000.00	0	External Station
25	5200.00	3000.00	0	External Station
26	5200.00	2000.00	0	External Station
27	4000.00	800.00	0	External Station
28	3000.00	800.00	0	External Station
29	2000.00	800.00	0	External Station
30	800.00	800.00	0	External Station
31	800.00	2000.00	0	External Station
32	800.00	3000.00	0	External Station
33	800.00	4000.00	0	External Station
101	2000.00	5000.00	0	Network Node
102	3000.00	5000.00	0	Network Node

Step 9: Select Display Mode to View Simulation Results

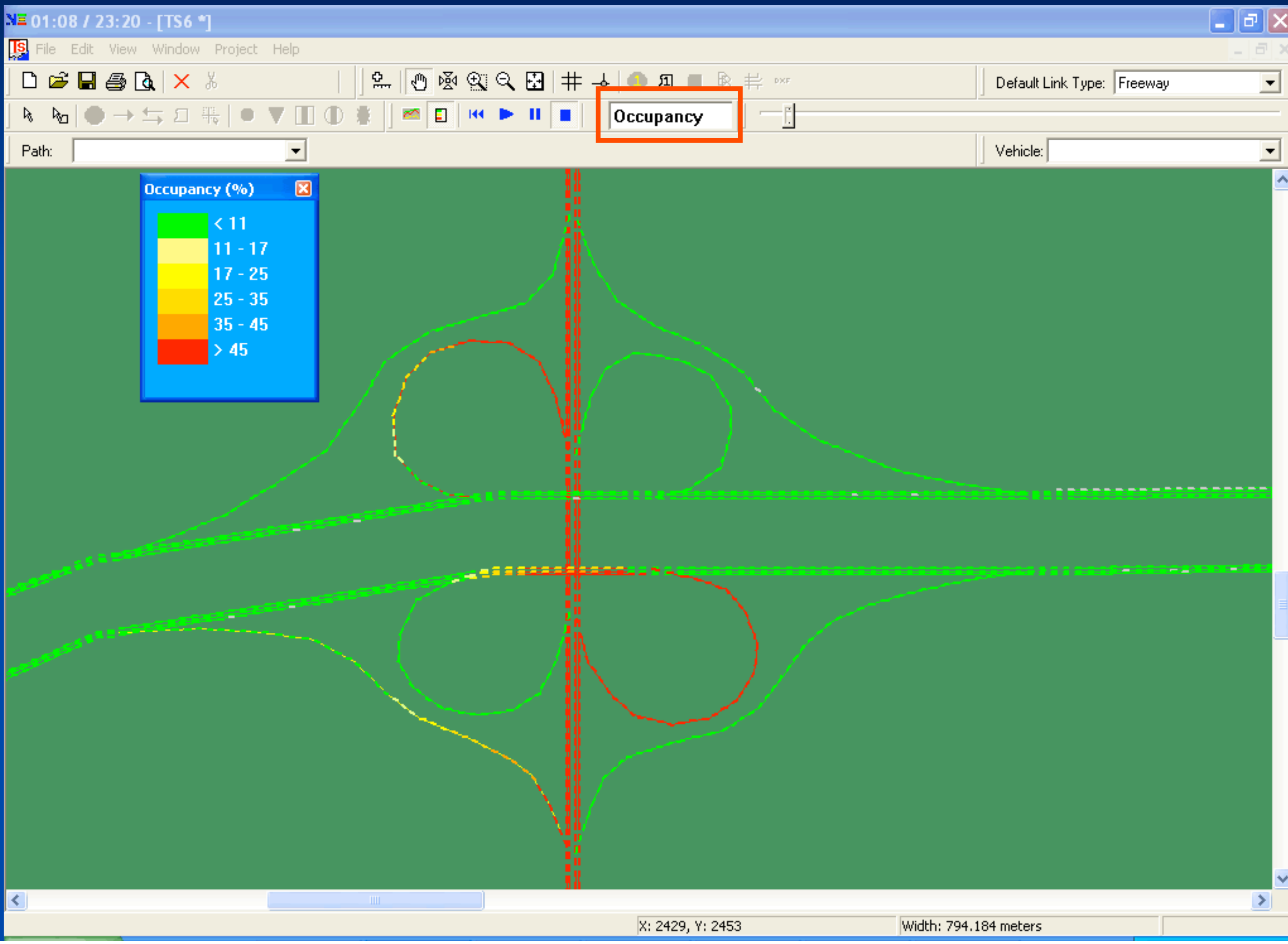
- Occupancy, Speed, Queue, Vehicles, Volume, Single Vehicle, Travel Time Contour



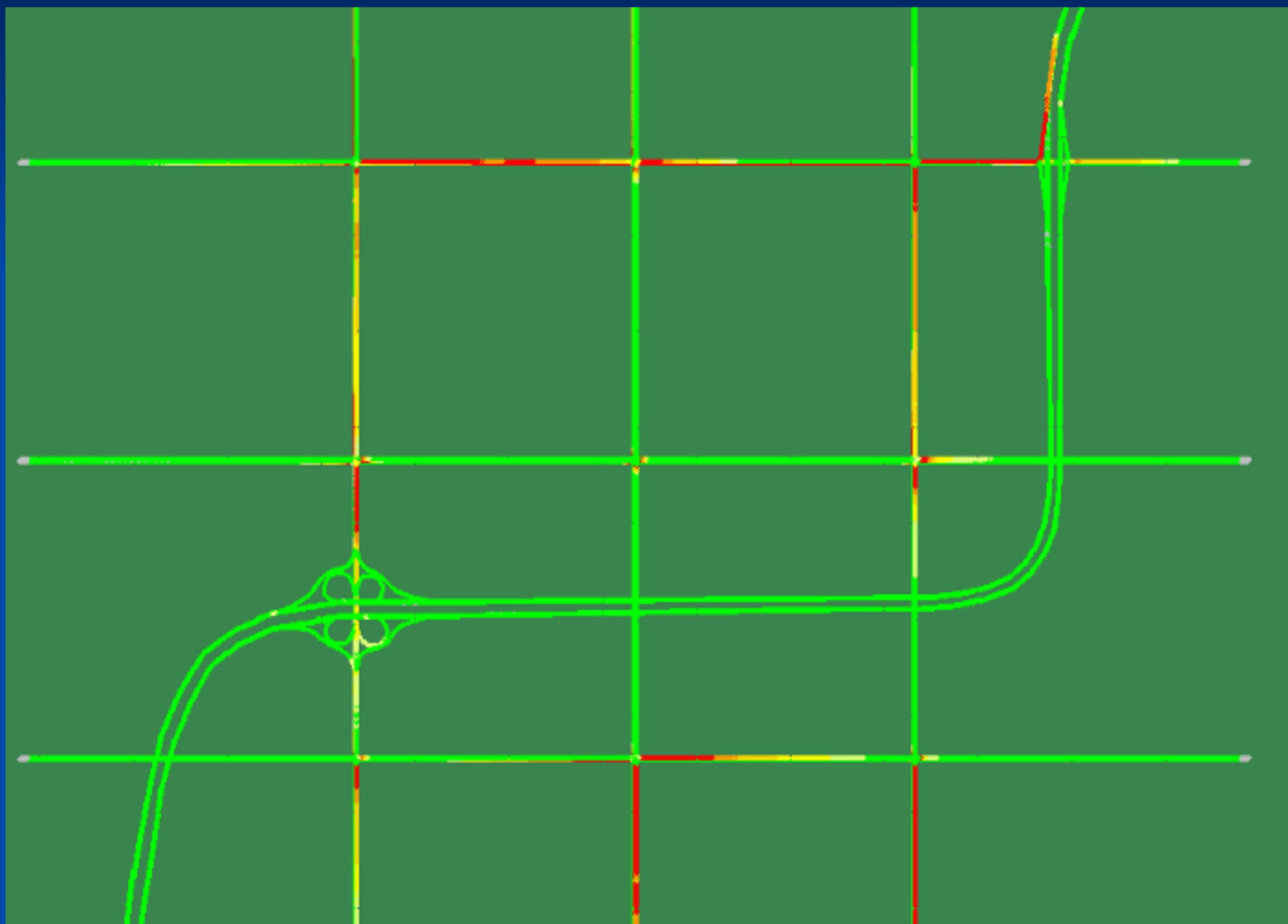
Cell-based Occupancy (I)



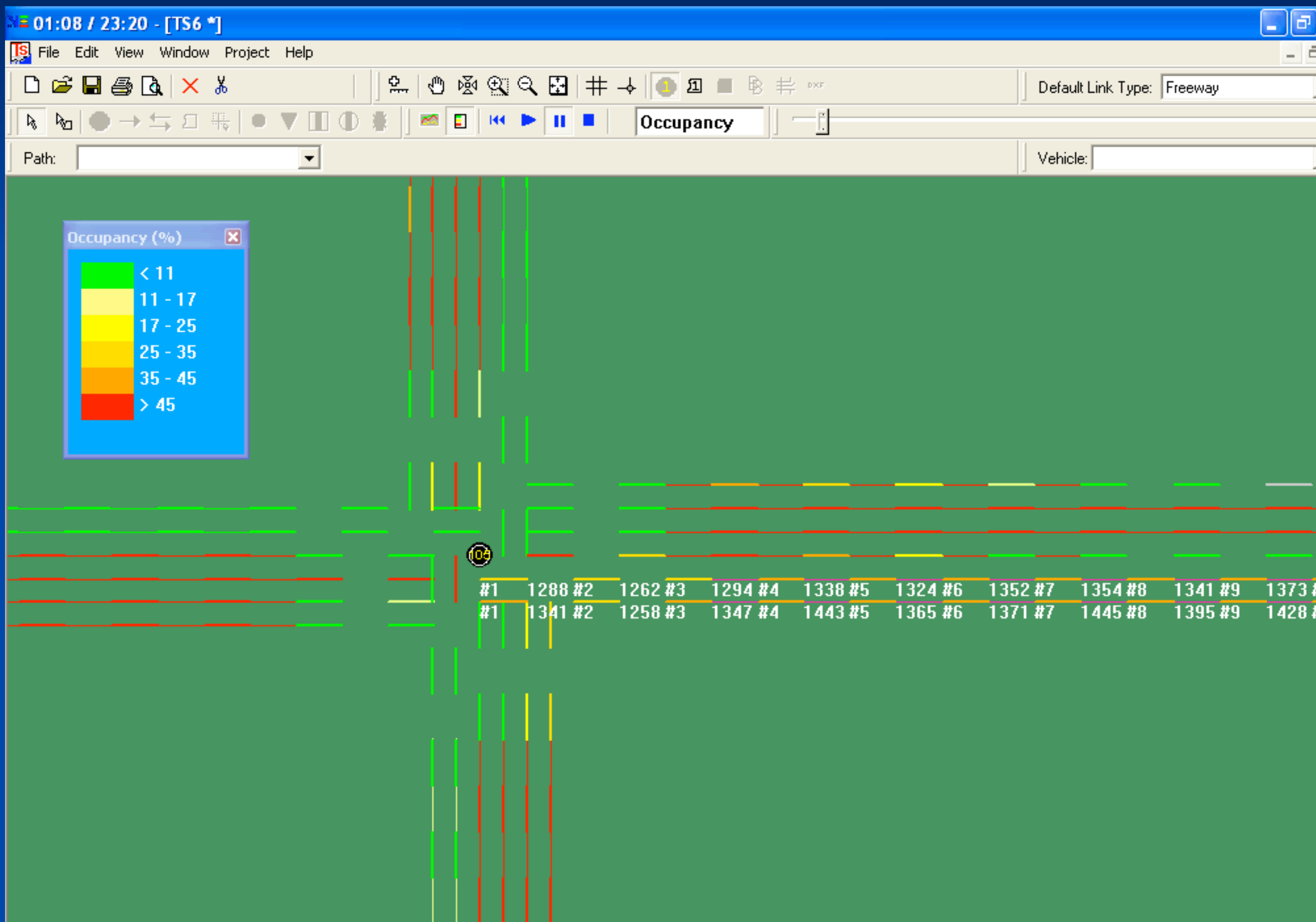
Cell-based Occupancy (II)



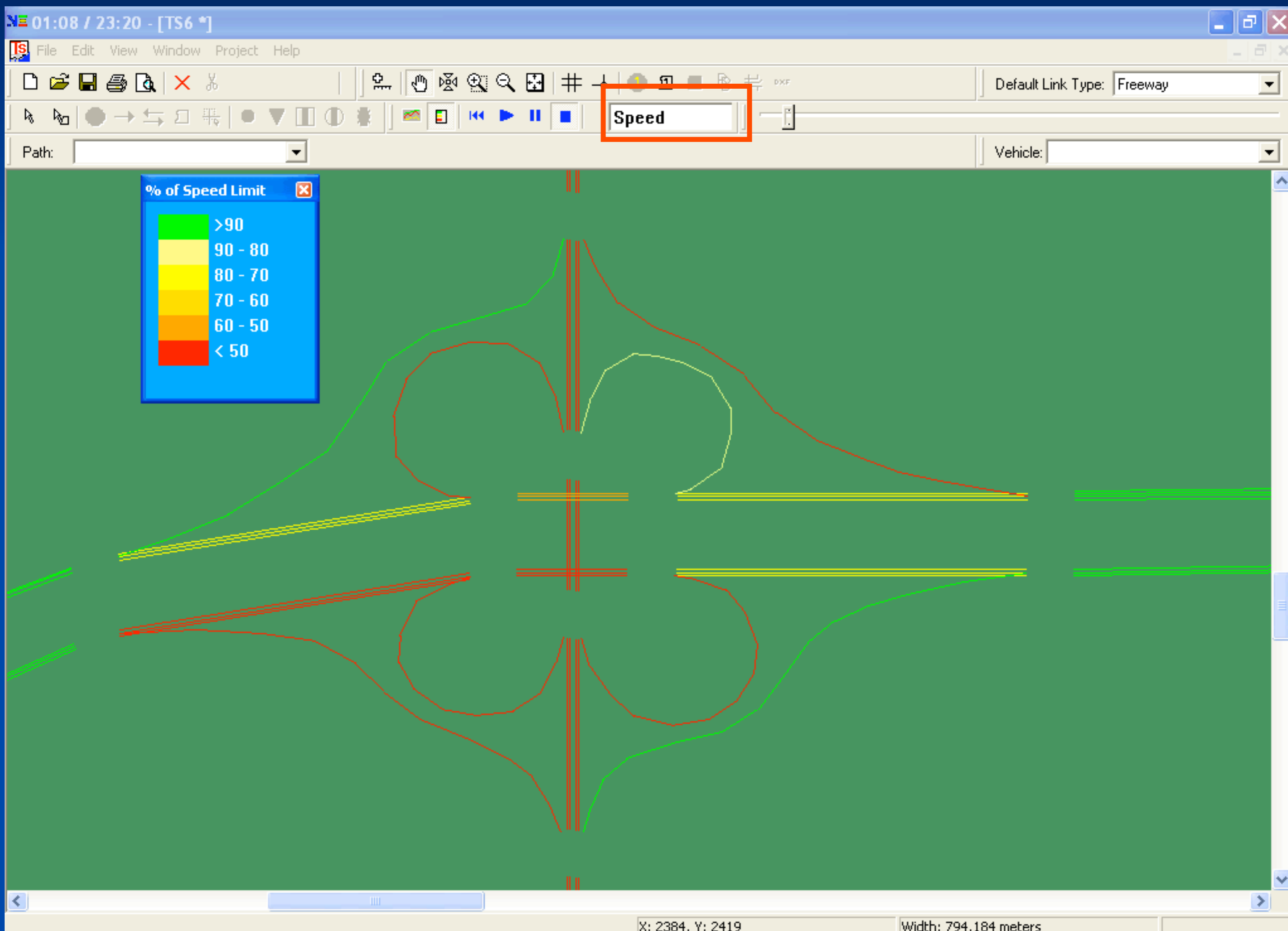
Cell-based Occupancy (III)



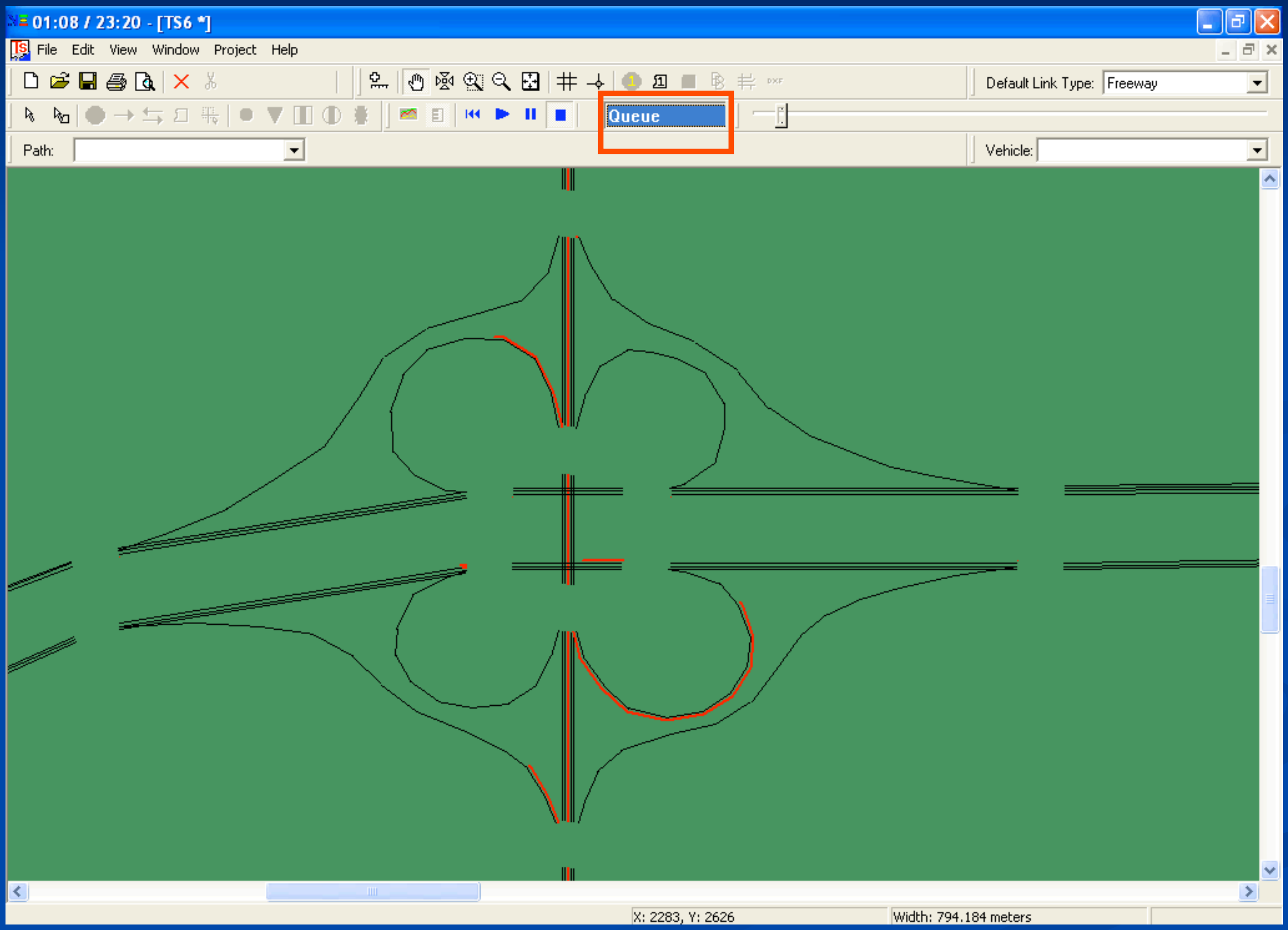
Cell-based Occupancy (IV)



Speed

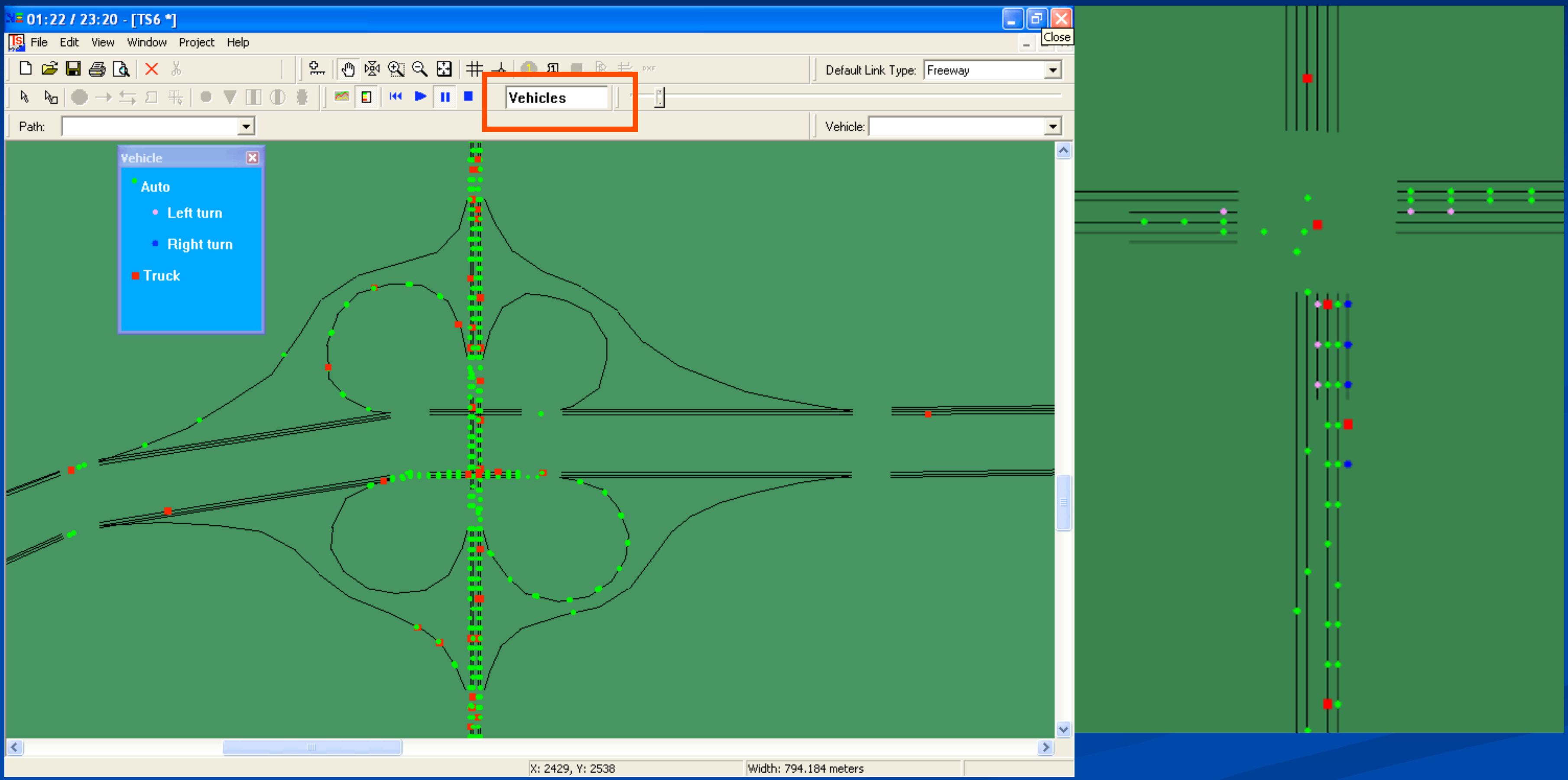

01:08 / 23:20 - [TS6 *]
File Edit View Window Project Help
Default Link Type: Freeway
Speed
Path:
Vehicle:
% of Speed Limit
>90
90 - 80
80 - 70
70 - 60
60 - 50
< 50
X: 2384, Y: 2419
Width: 794.184 meters

Queue Length



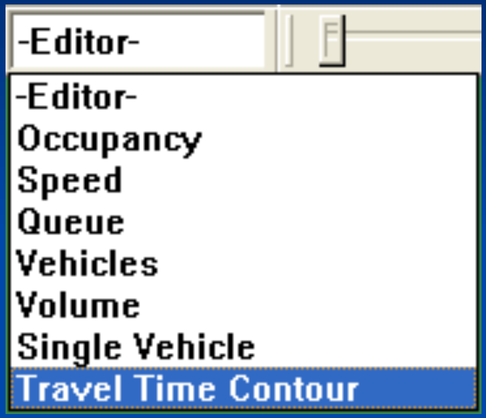
Queue length = average number of stopped vehicles per lane * 7.5 meters

Vehicle

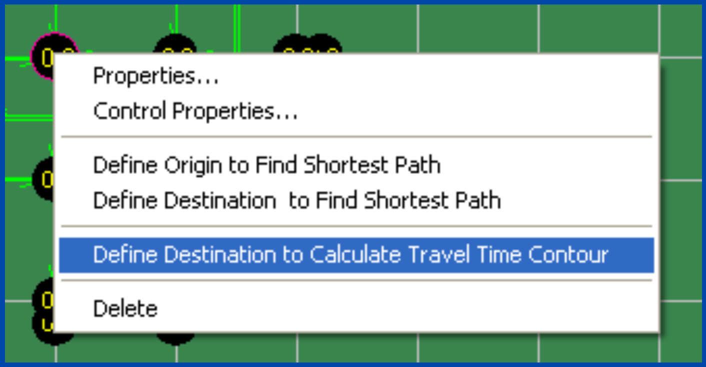


Vehicle locations are imported from snapshot file

Travel Time Contour

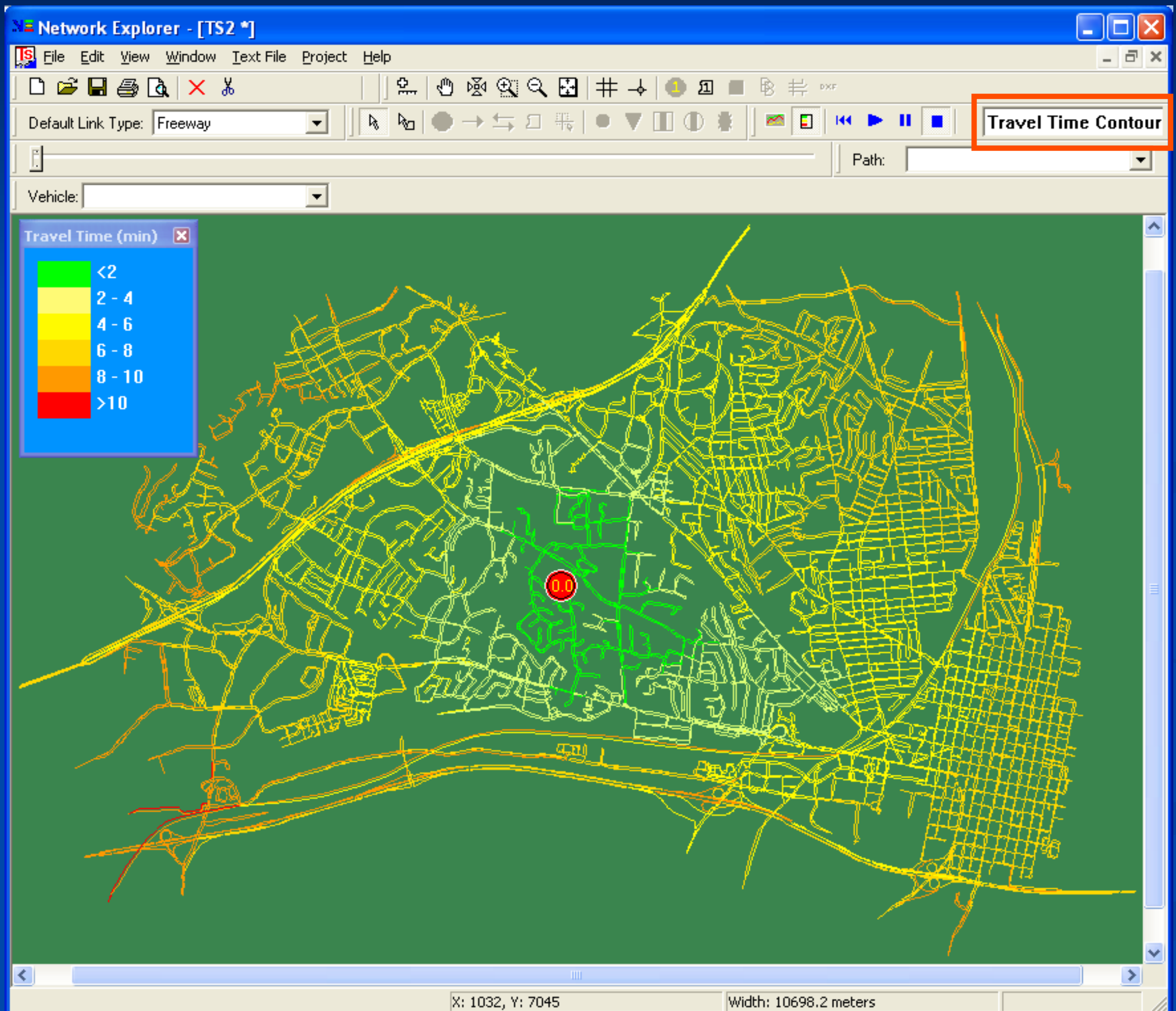


When the display mode is set to Travel Time Contour Display Mode, the minimum path travel times between a designated destination and other nodes can be plotted on the network window.



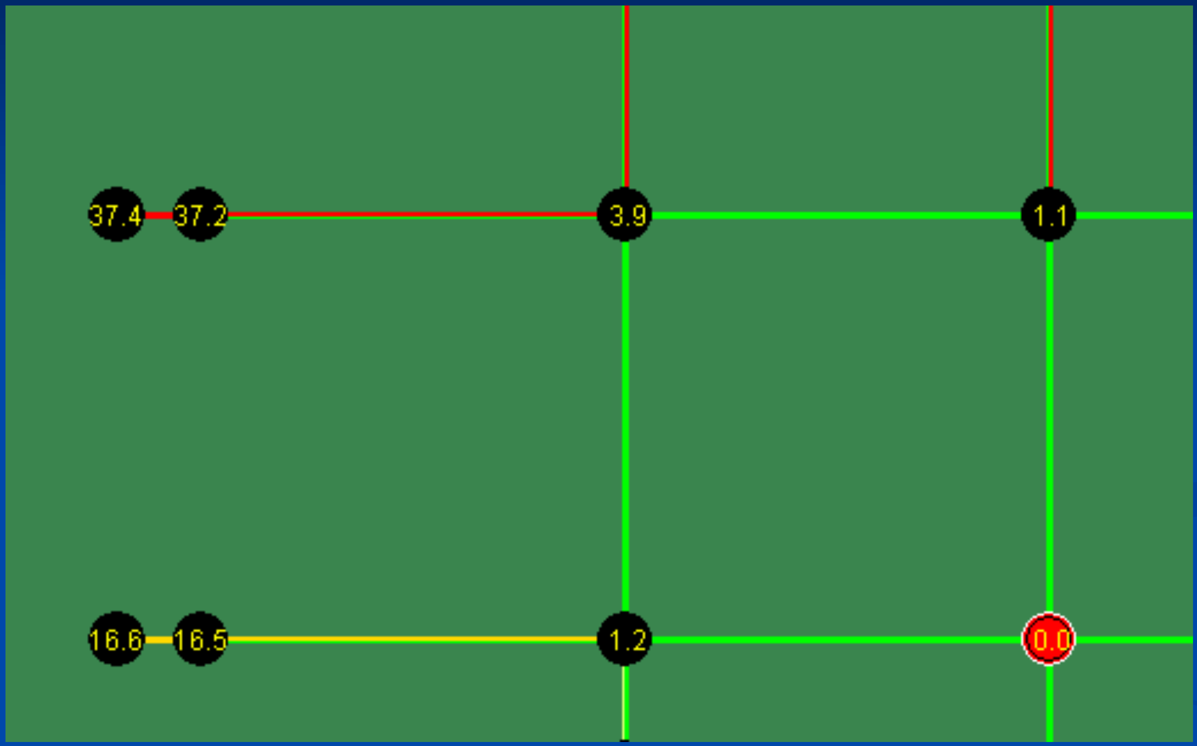
A user can right-click a node to select menu "Define Destination to Calculate Travel Time Contour".

Travel Time Contour



The minimum path travel times between a designated destination and other nodes are plotted on the network window.

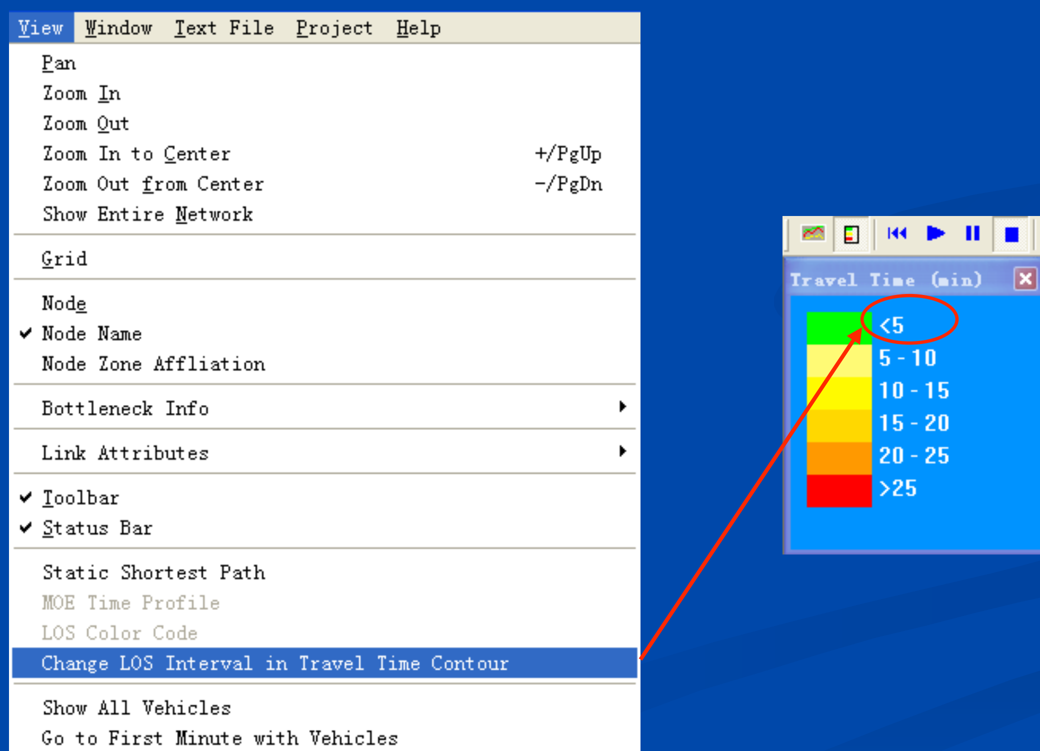
Travel Time Contour



The numbers on a node indicates the calculated minimum path travel time (in minutes) between the current node to the designated destination.

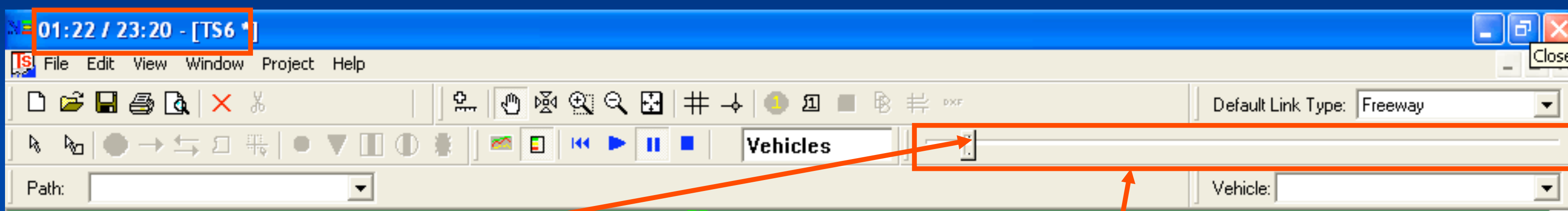
Travel Time Contour

A user can also customizes the thresholds of travel time categories displayed in travel time contour by selecting menu -> View -> Change LOS Interval in Travel Time Contour.



Step 10: Show Simulation Results at a Given Time

Simulation Time Clock: 1 hour: 33 min

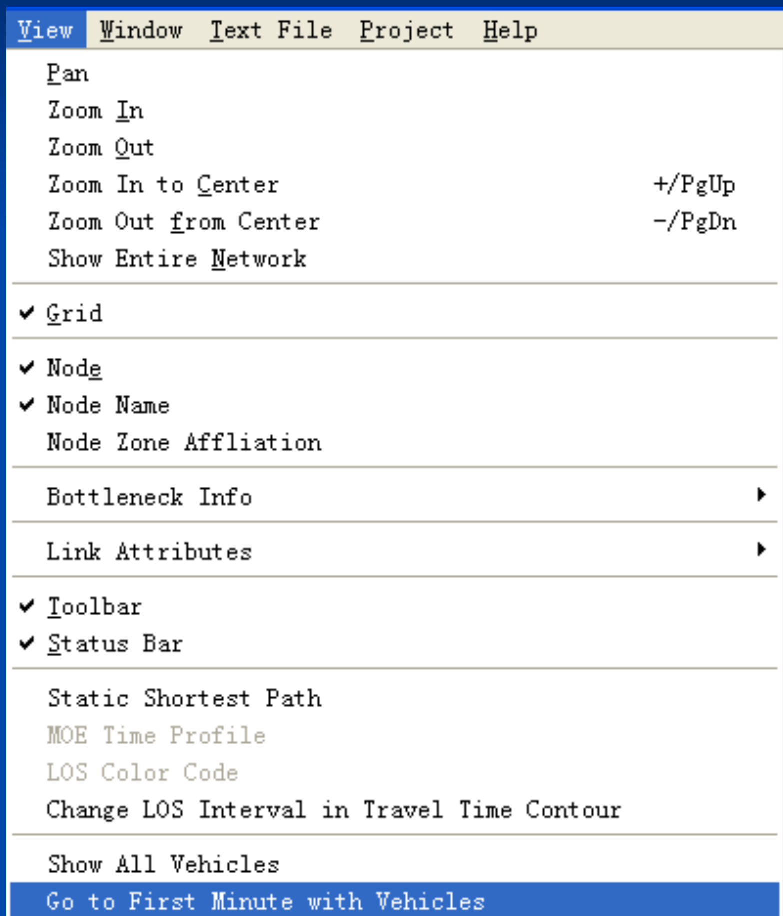


Clock Bar

Slider

Drag the slider of the clock bar to view simulation results at a given time of simulation horizon

Go to First Minute with Vehicles

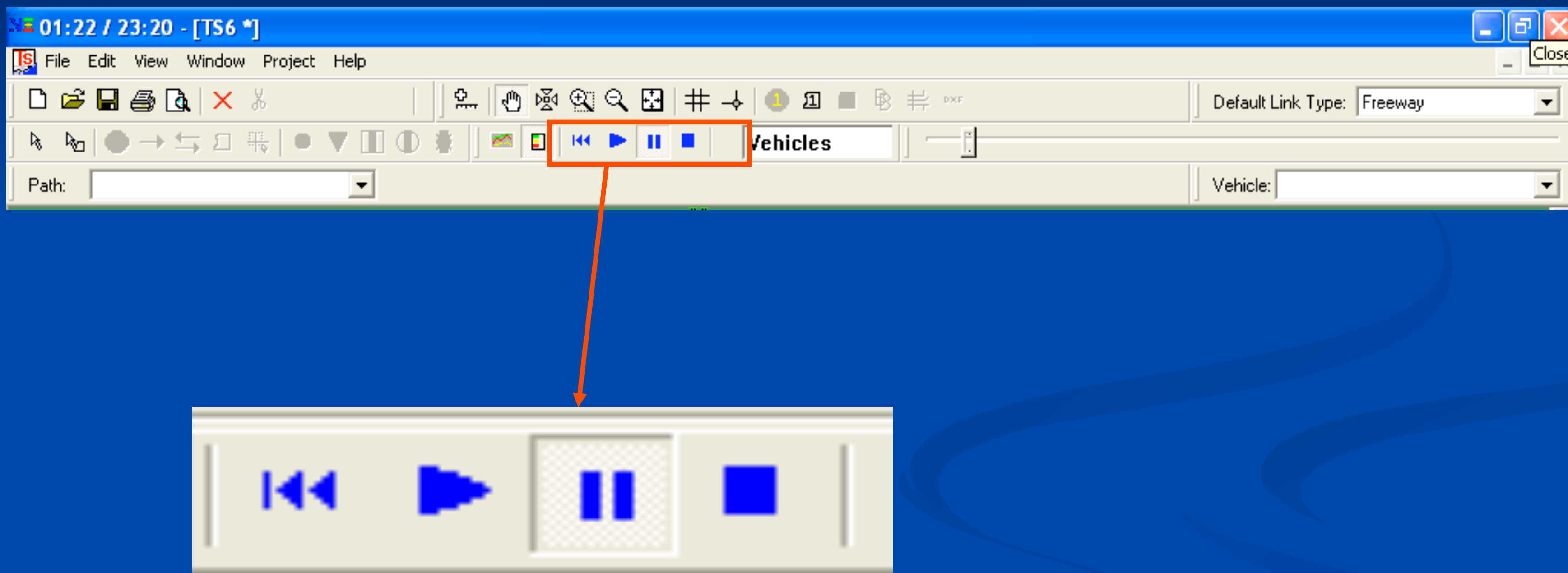


A user can set the slider of the clock bar at the first minute with vehicles.

A snapshot file might only cover a short time period of the entire simulation horizon.

After a TRANSIMS project has been loaded, a user can click on menu->View ->Go to First Minute with Vehicles to jump to the first time stamp with snapshot data.

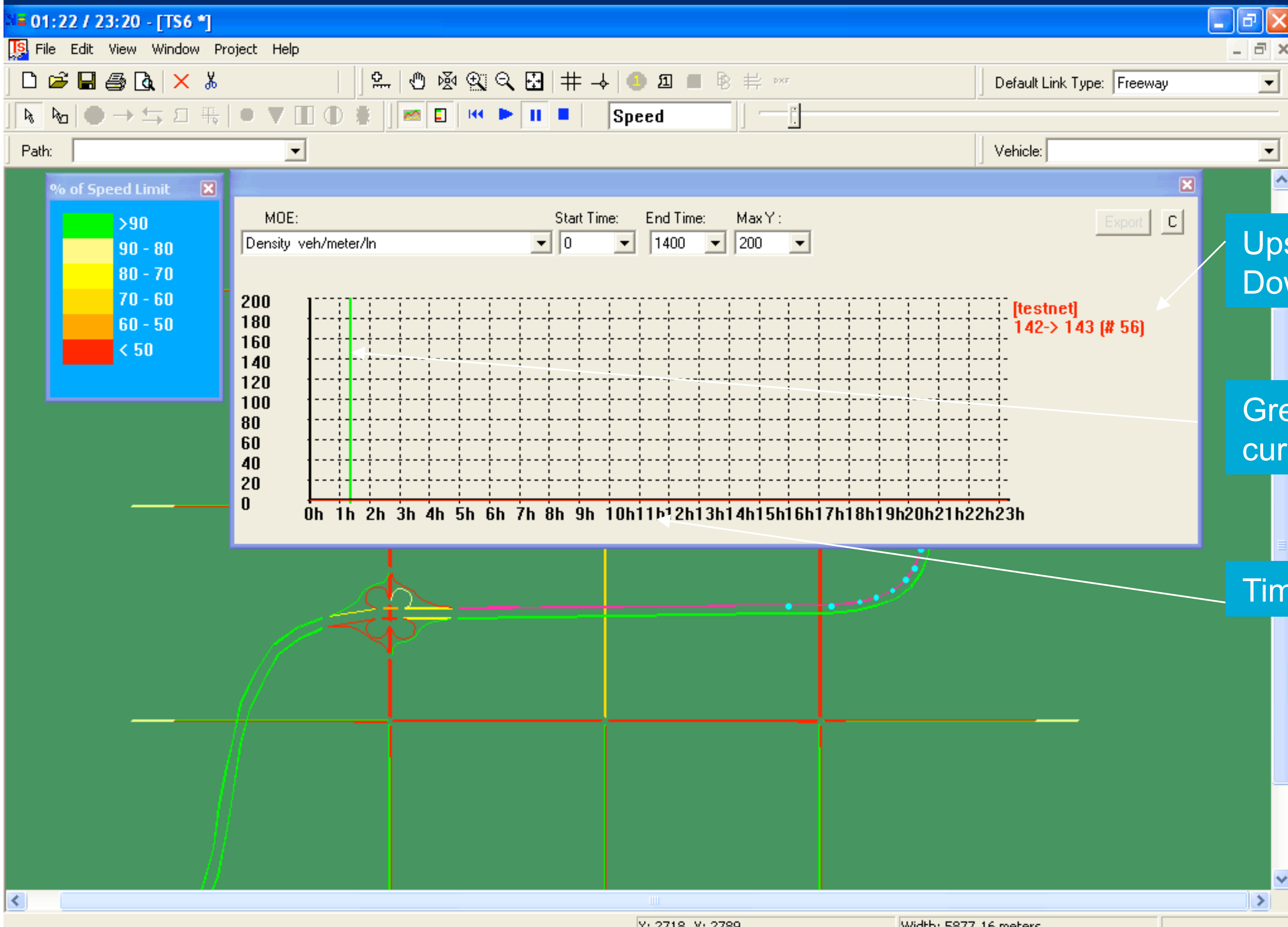
Step 11: Play Animation



Rewind, play, pause, stop

Remarks: Simulation clock is advanced at 1-min interval

Step 12: Double-Click a Link to Show MOE Profile



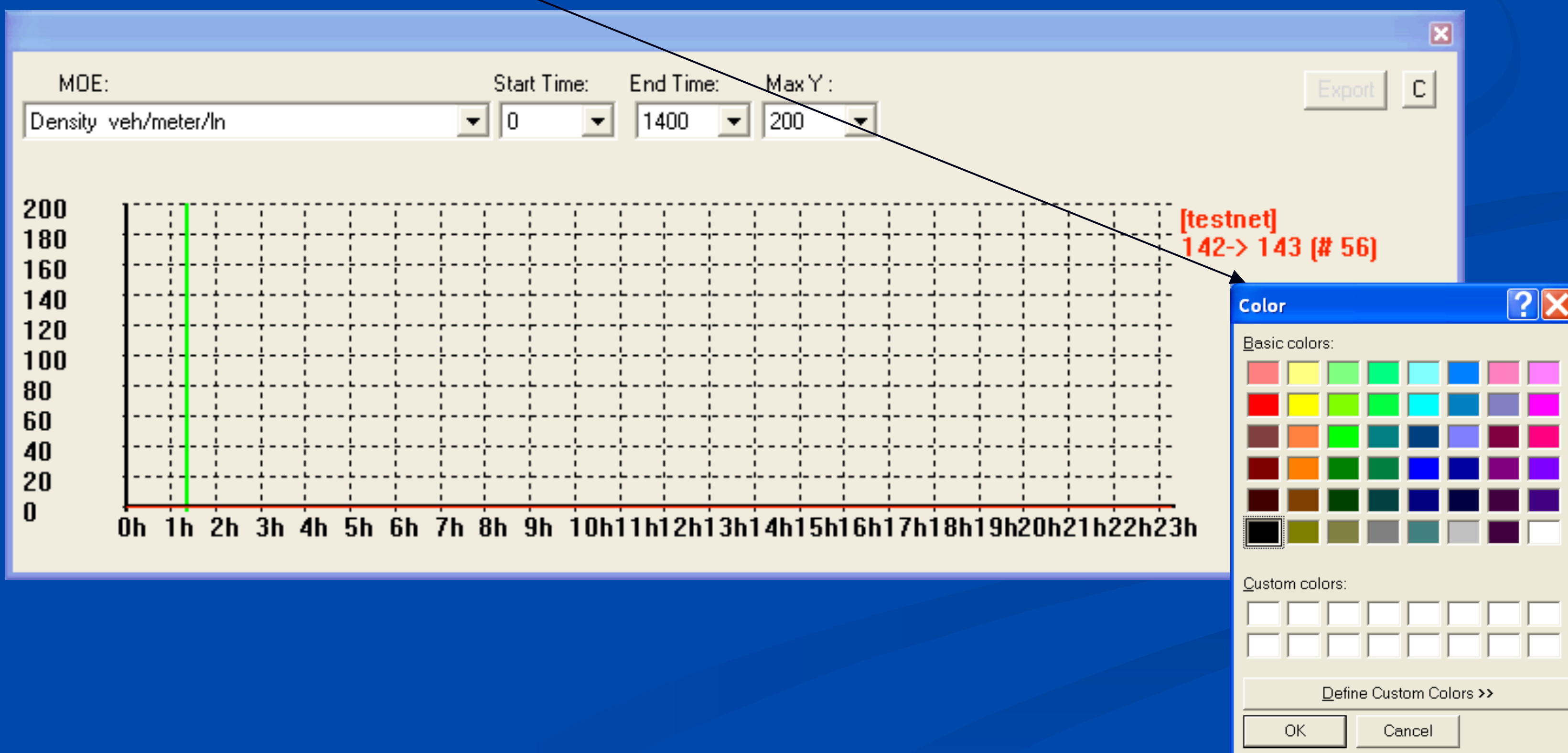
Upstream node -> Downstream node (# link ID)

Green line indicates the current simulation time

Time axis (unit: min)

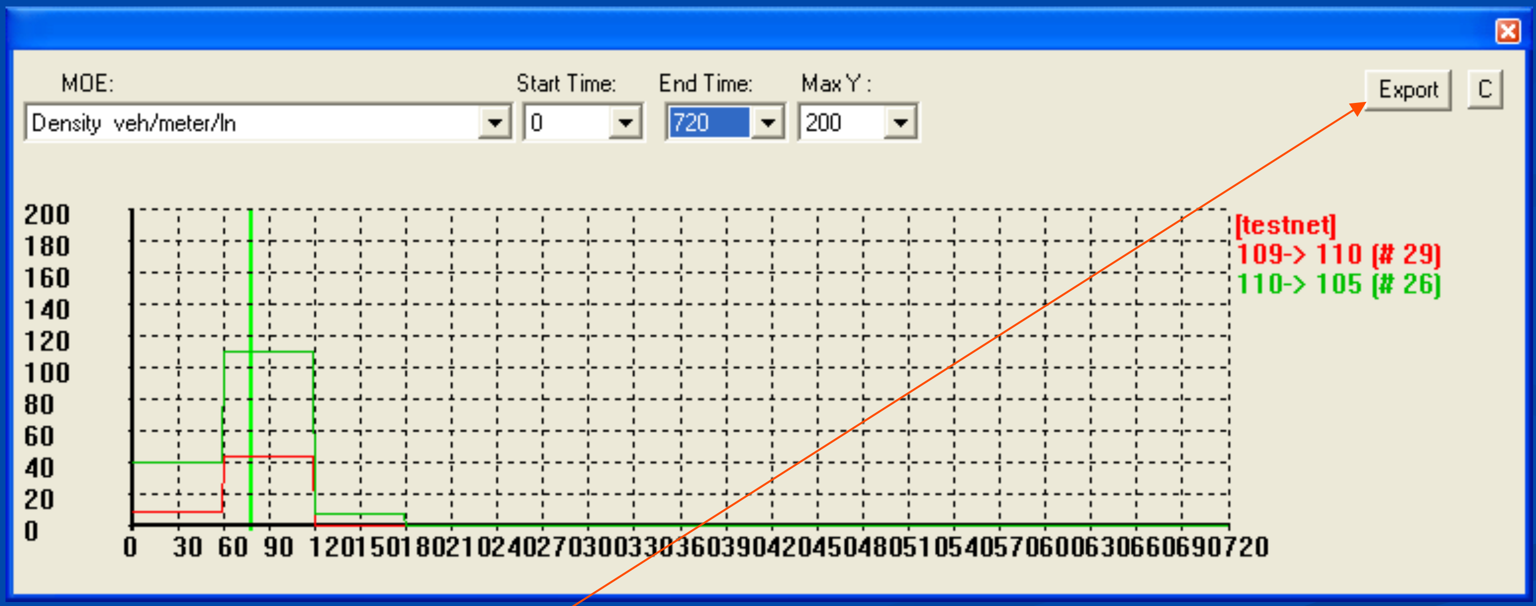
Step 13: Configure MOE Display Dialog

- •MOE: Density, Speed, Queue Length, Volume
- •Start Time, End Time, Max Y
- •Background color



Step 14: Multi-link Comparison

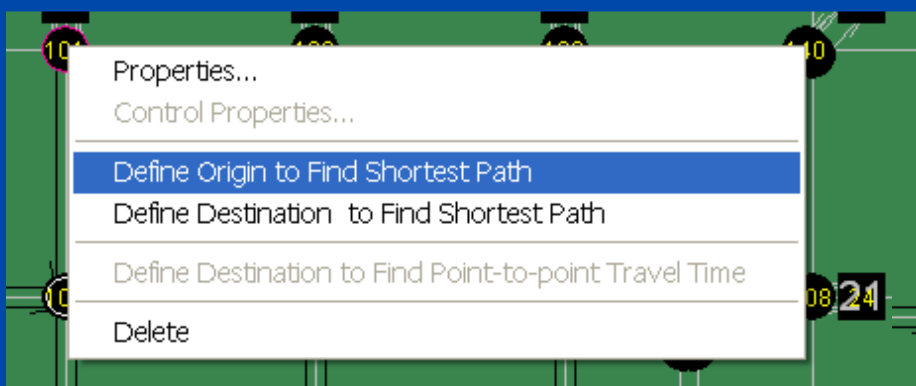
- Select multiple links (by using Ctrl+ mouse click) to display MOE time profiles simultaneously for multiple selected links, in the same or different projects.

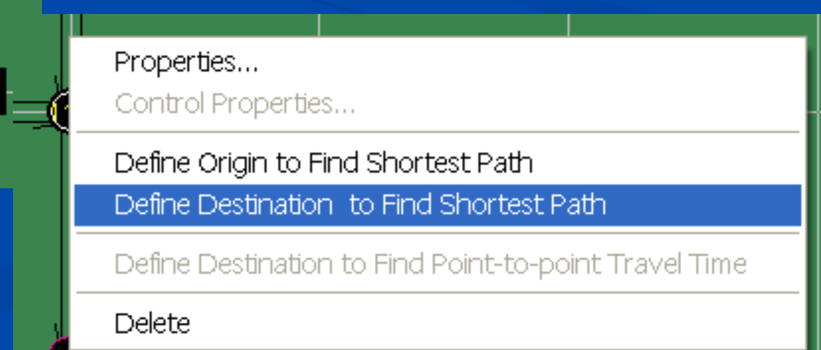


- Data can be exported to a CSV file

Step 15: Find Paths

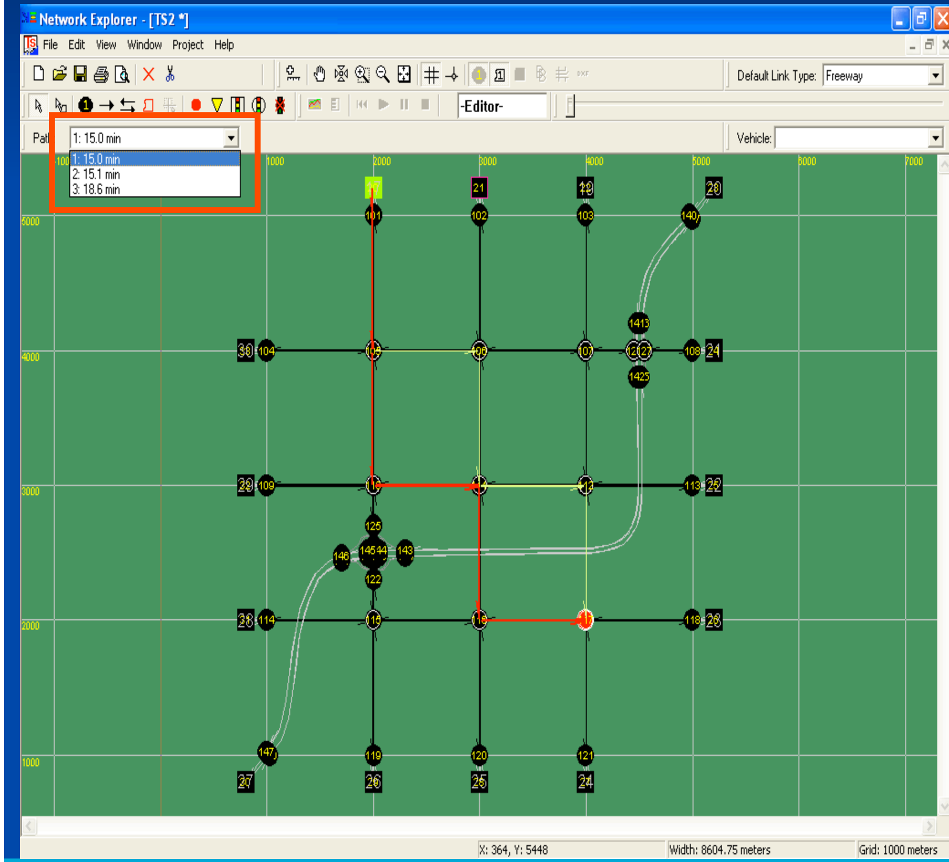
- Select an origin node,
- Right-click to select menu “Define Origin to Find Shortest Path”,
- Select a destination node,
- Right-click to select menu “Define Destination to Find Shortest Path”.

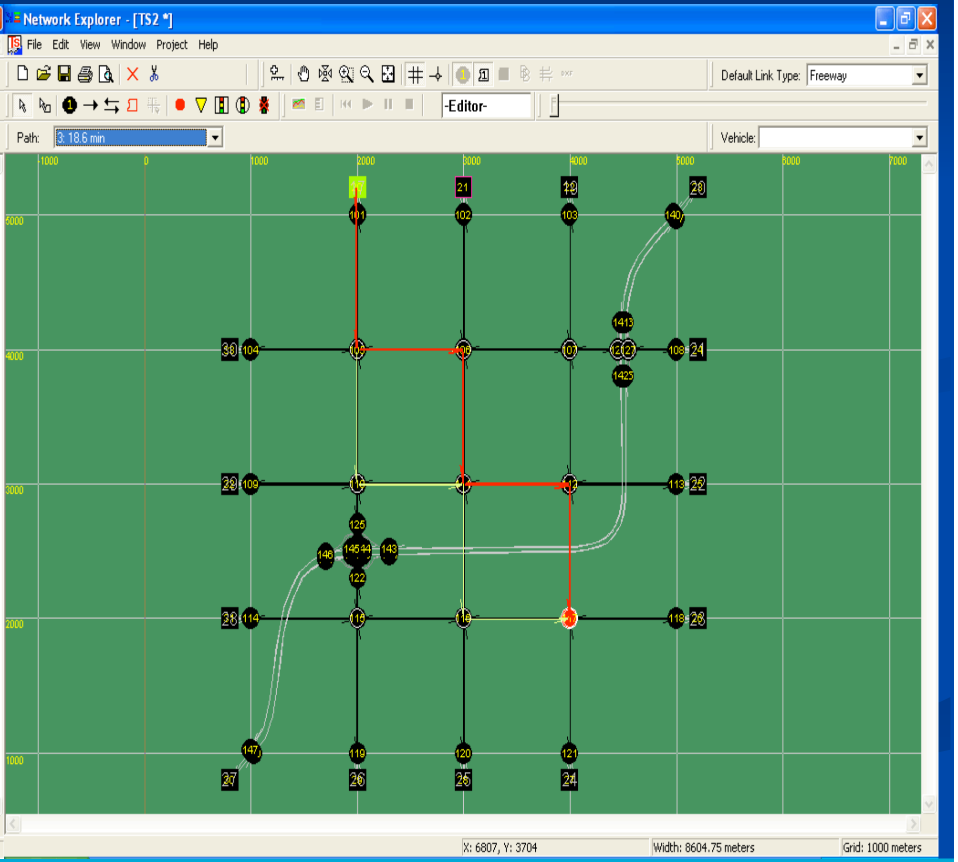




Step 16: Show Multiple Paths

- Path 1: 15 min Path 3: 18.6 min



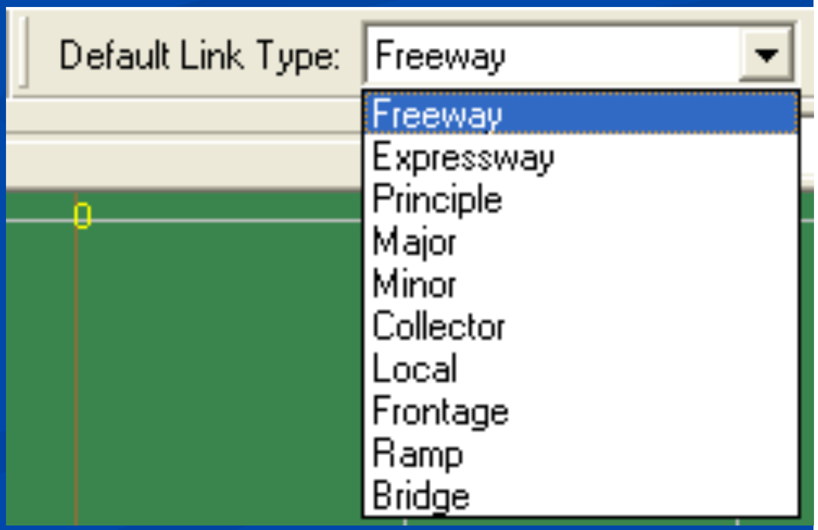


The path finding algorithm uses dynamic travel time calculated from simulated link speed at a given time.

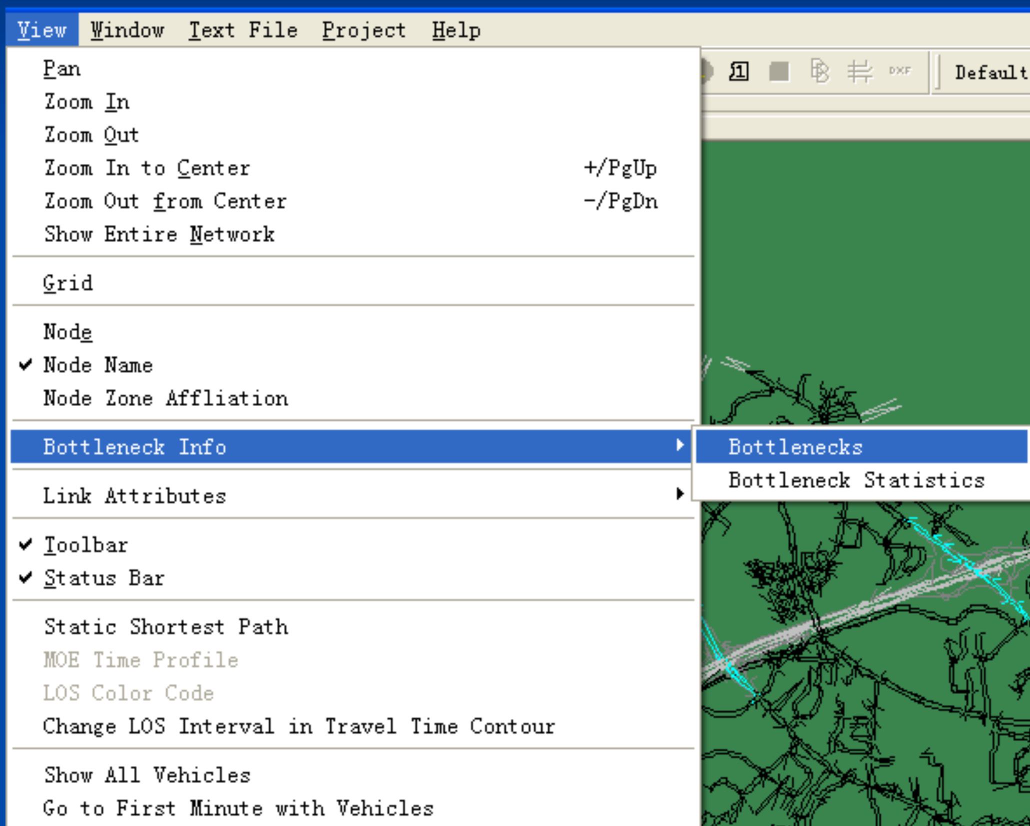
Step 17: Create Nodes/Links

- Insert node (in the middle of a link)
- Add one-way link
- Add two-way link
- Add zone
- Add stop sign
- Add yield sign
- Add pre-timed controller
- Add actuated controller

Select link type



Step 18: Show Bottleneck Information

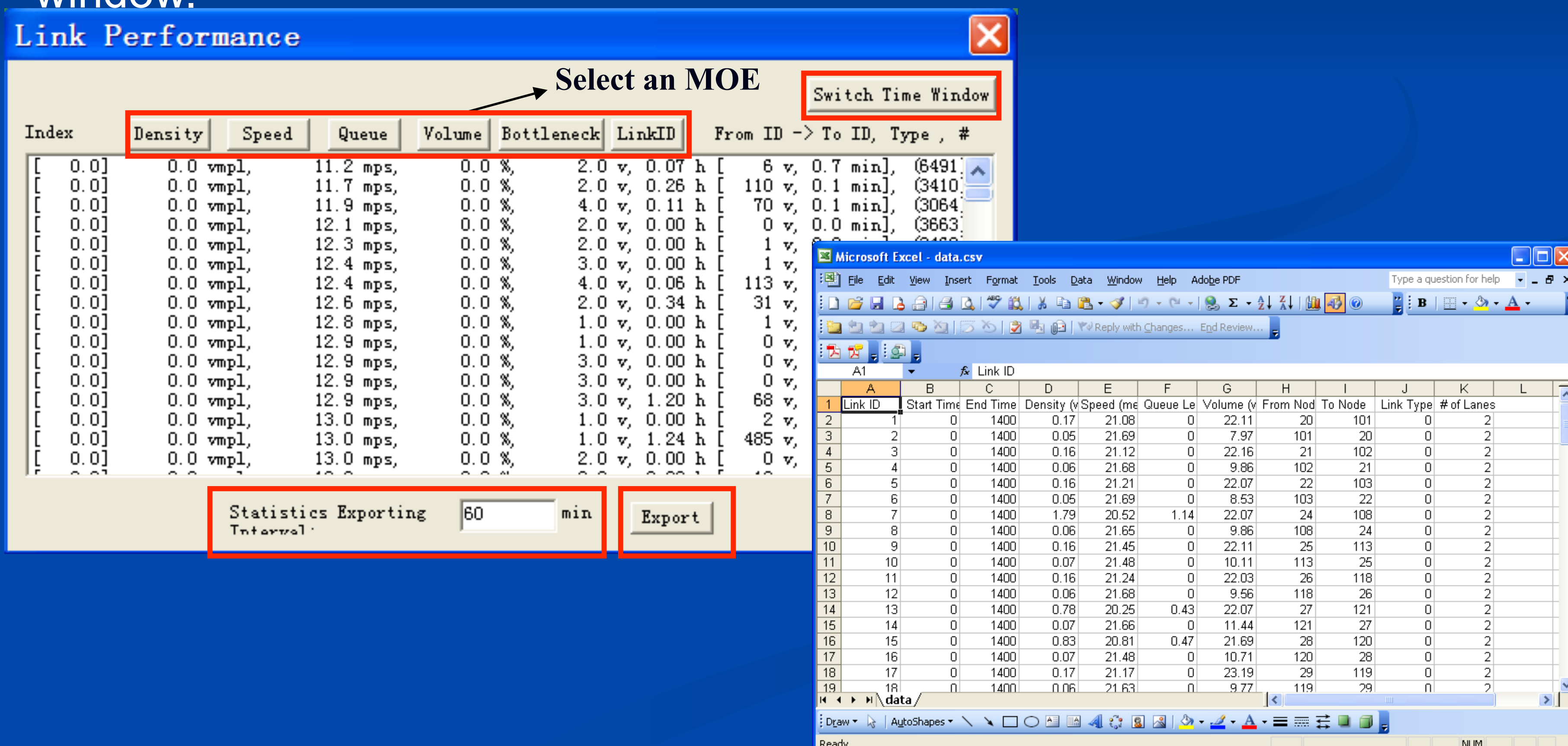


A user can click on menu View->Bottleneck Info-> Bottlenecks to display bottleneck information on different links.

Step 18: Show Bottleneck Information

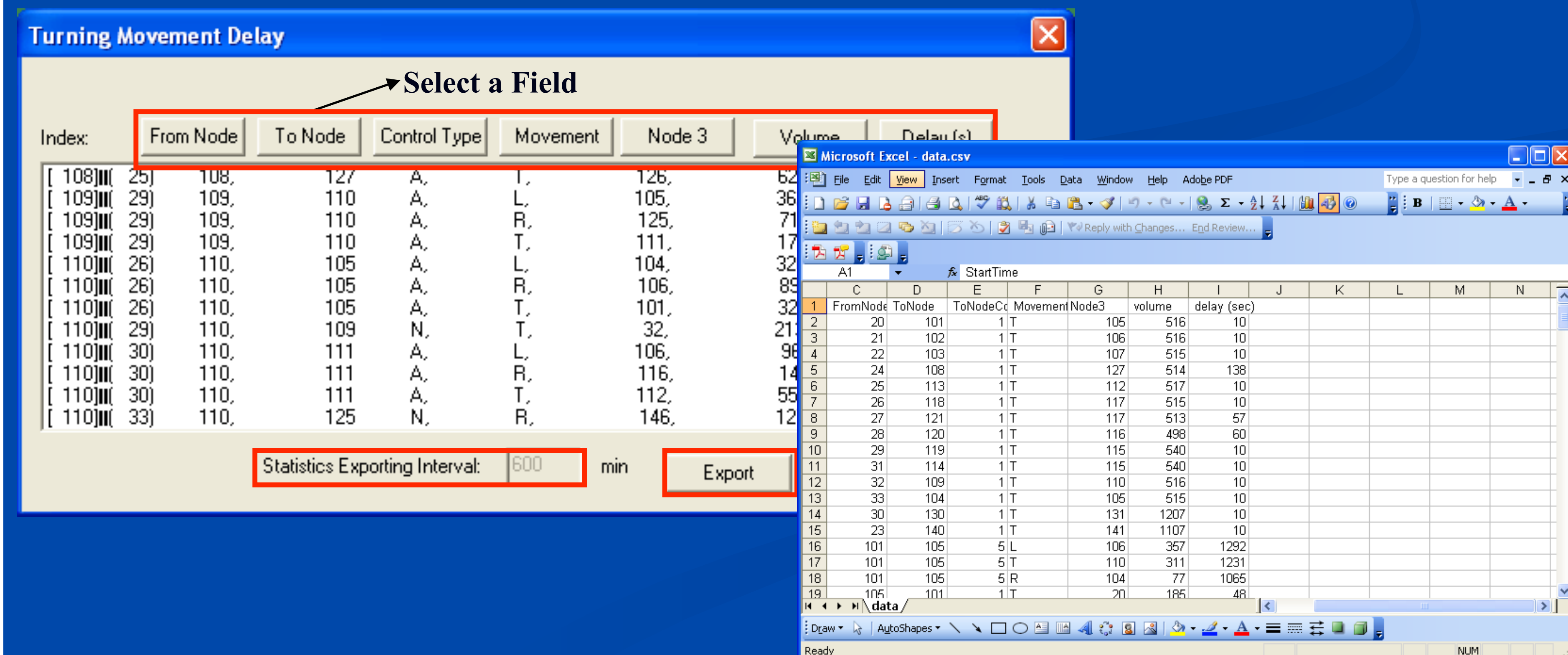
Step 19: Sort Link Performance Data

A user can click on menu Project->Sort Link Performance Data to sort, display and export the link performance data in a designated time window.



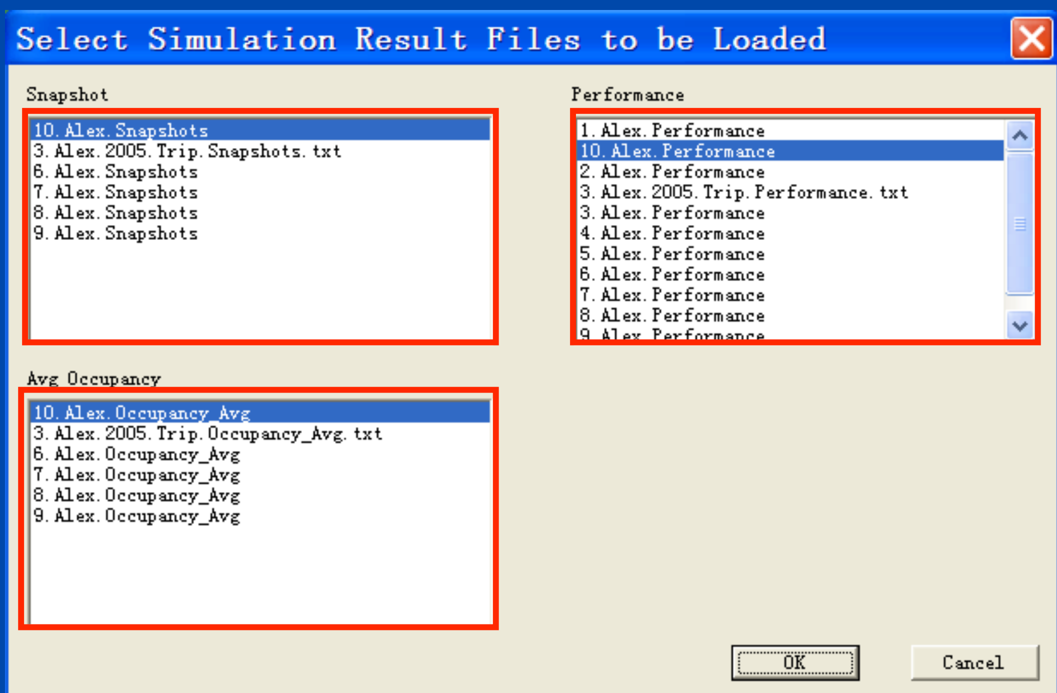
Step 20: Sort Movement Performance Data

A user can click on menu Project->**Sort Movement Performance Data** to sort, display and export the intersection movement performance data in a designated time window.



Step 21: Reload Simulation Data with Selected Files

As there might be multiple snapshot files for the same simulation run, a user can click on menu ->File->Reload Simulation Data with Selected Files to reselect the simulation files to be loaded.



A user can select the snapshot, performance, and average occupancy files of a designated simulation run individually.

Future Development

- Save network data
- Run simulation directly
- Configure simulation scenarios
- Use vehicle trajectory information
  - Enable travel time reliability analysis
  - Enable impacted vehicle analysis
  - Identify traffic bottlenecks through vehicle trajectory file

Vehicle Trajectory-based Traffic Analysis and Visualization

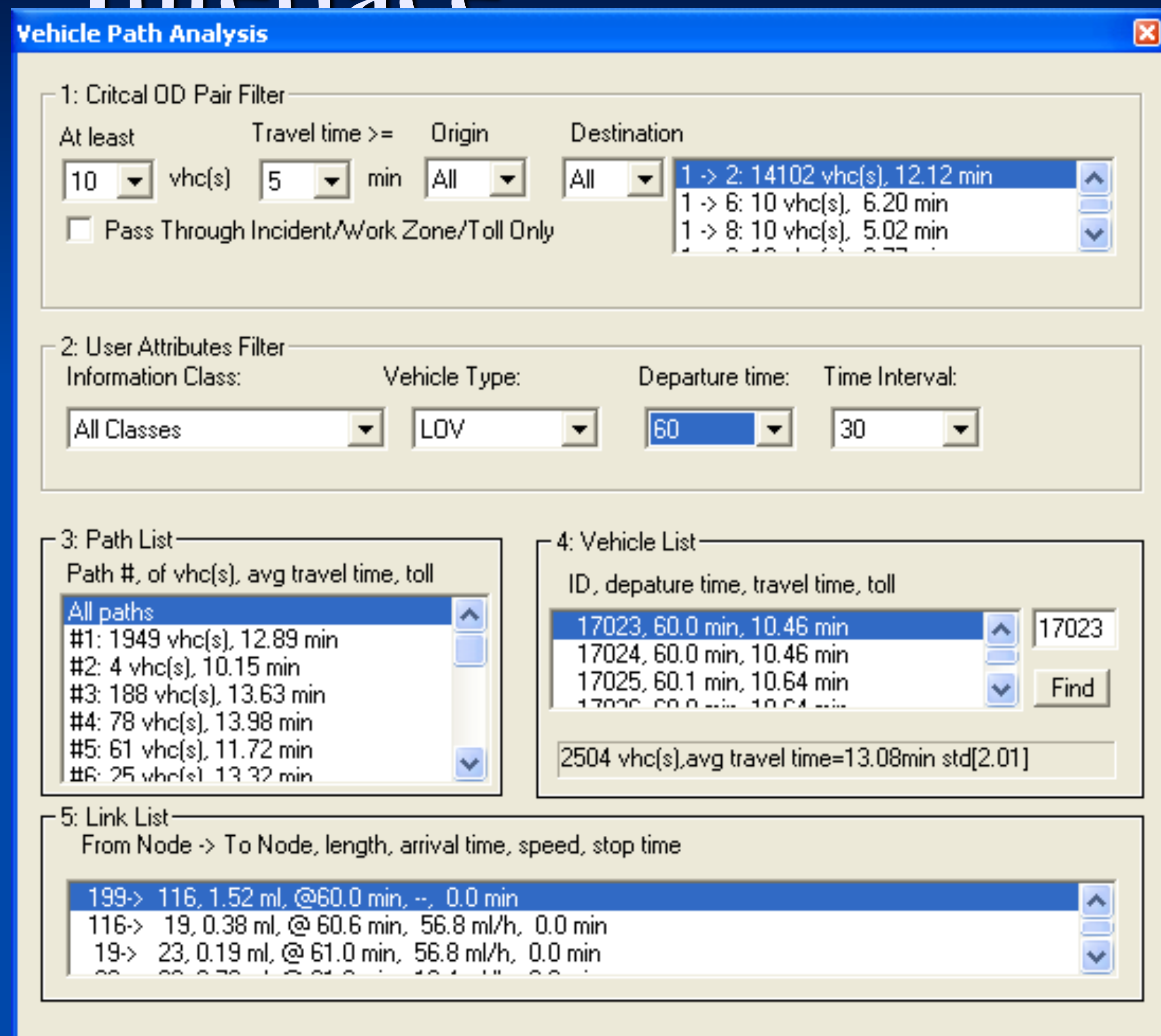
Potential GUI enhancement for TRANSIMS

1. Gap Analysis for Quantifying Traffic User Equilibrium

- Step 1: Read vehicle trajectory file
- Step 2: Group vehicles by
  - OD pair od, departure time τ, path p
- Step 3: Output experienced mean travel time $c^{\tau}_{odp}(r)$ and least travel time π^{τ}_{od}
- Step 4: Calculate the gap function

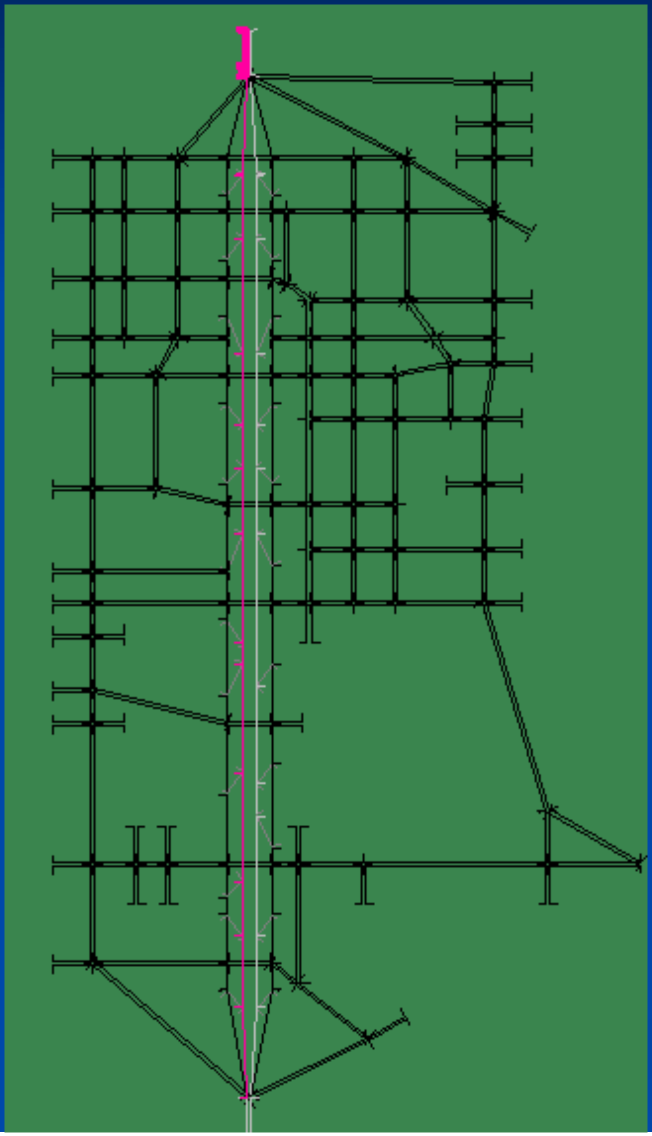
$$Gap(r,\pi) = \sum_{o \in O} \sum_{d \in D} \sum_{\tau \in T} \sum_{p \in P(o,d,\tau)} r^{\tau}_{odp} [c^{\tau}_{odp}(r) - \pi^{\tau}_{od}]$$

Interface

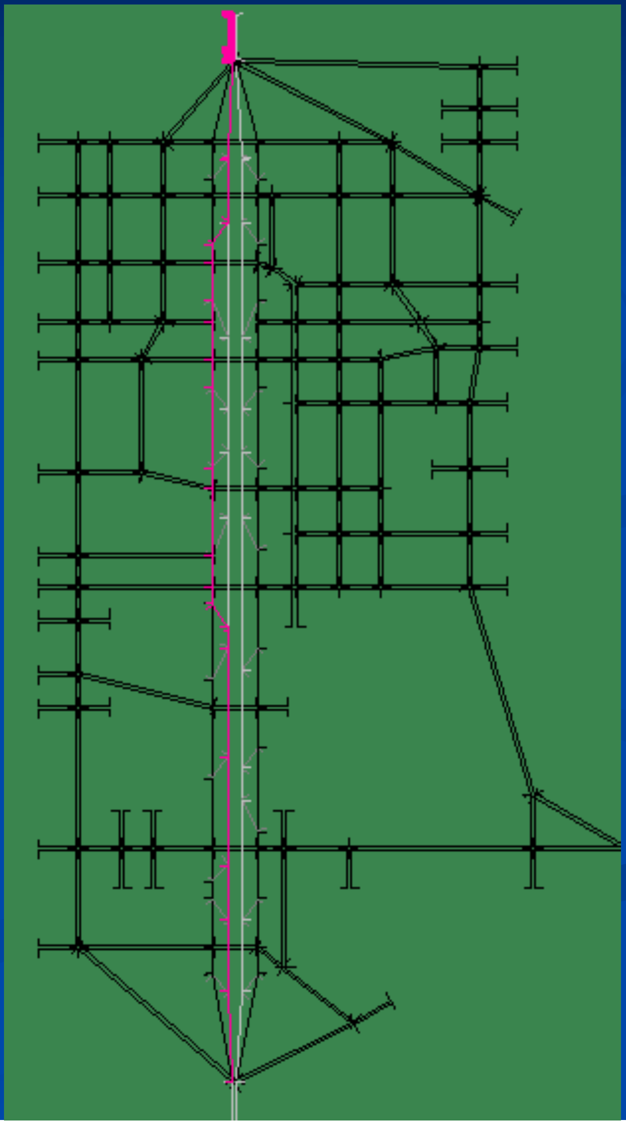


Vehicle Path Analysis
1: Critcal OD Pair Filter
At least
Travel time >=
Origin
Destination
10
vhc(s)
5
min
All
All
1 -> 2: 14102 vhc(s), 12.12 min
1 -> 6: 10 vhc(s), 6.20 min
1 -> 8: 10 vhc(s), 5.02 min
Pass Through Incident/Work Zone/Toll Only
2: User Attributes Filter
Information Class:
Vehicle Type:
Departure time:
Time Interval:
All Classes
LOV
60
30
3: Path List
Path #, of vhc(s), avg travel time, toll
All paths
#1: 1949 vhc(s), 12.89 min
#2: 4 vhc(s), 10.15 min
#3: 188 vhc(s), 13.63 min
#4: 78 vhc(s), 13.98 min
#5: 61 vhc(s), 11.72 min
4: Vehicle List
ID, depature time, travel time, toll
17023, 60.0 min, 10.46 min
17024, 60.0 min, 10.46 min
17025, 60.1 min, 10.64 min
17023
Find
2504 vhc(s),avg travel time=13.08min std[2.01]
5: Link List
From Node -> To Node, length, arrival time, speed, stop time
199-> 116, 1.52 ml, @60.0 min, --, 0.0 min
116-> 19, 0.38 ml, @ 60.6 min, 56.8 ml/h, 0.0 min
19-> 23, 0.19 ml, @ 61.0 min, 56.8 ml/h, 0.0 min

Path 1: 1,949 vehicles
12.89 min



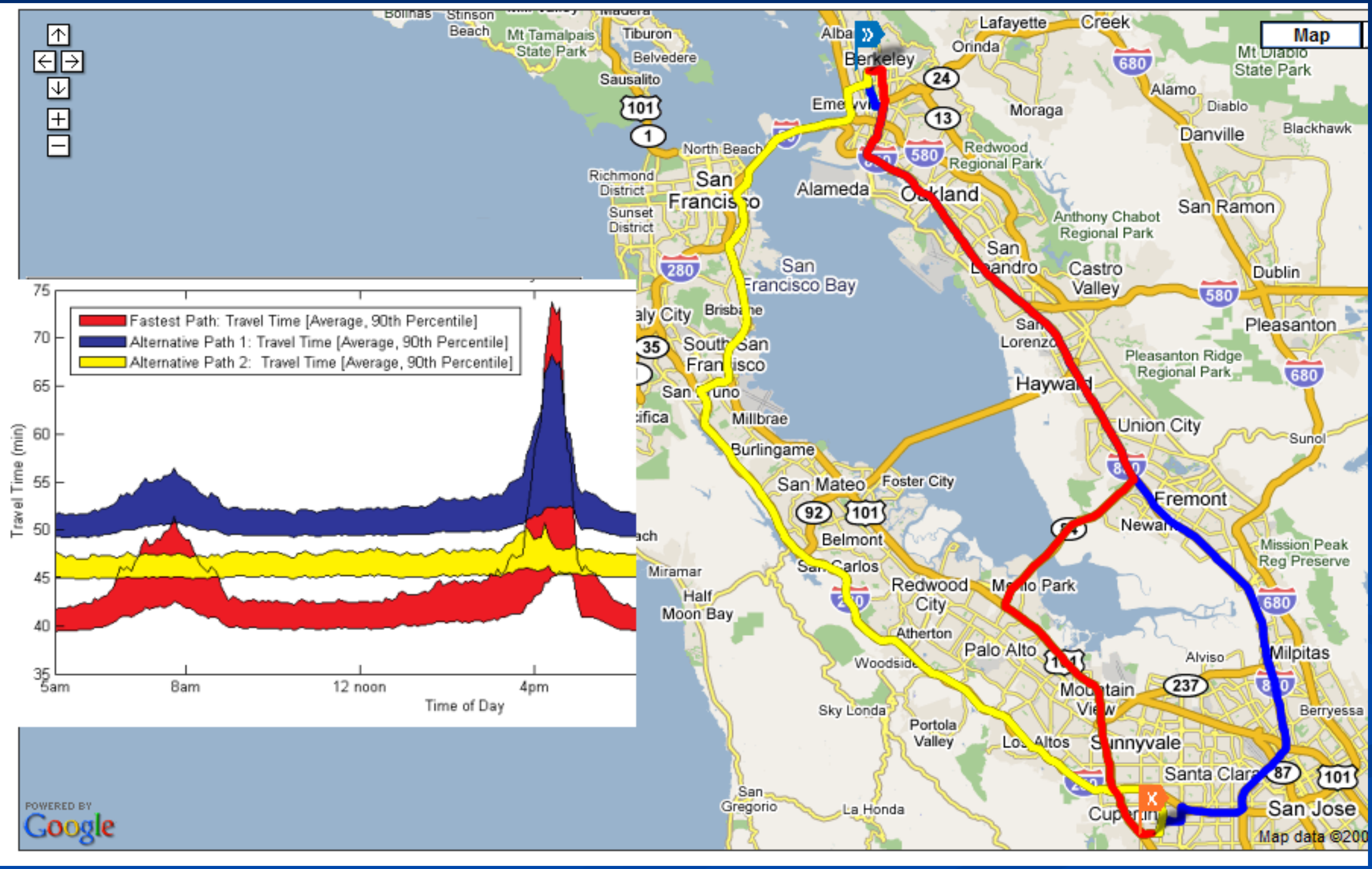
Path 5: 61 vehicles
11.72 min



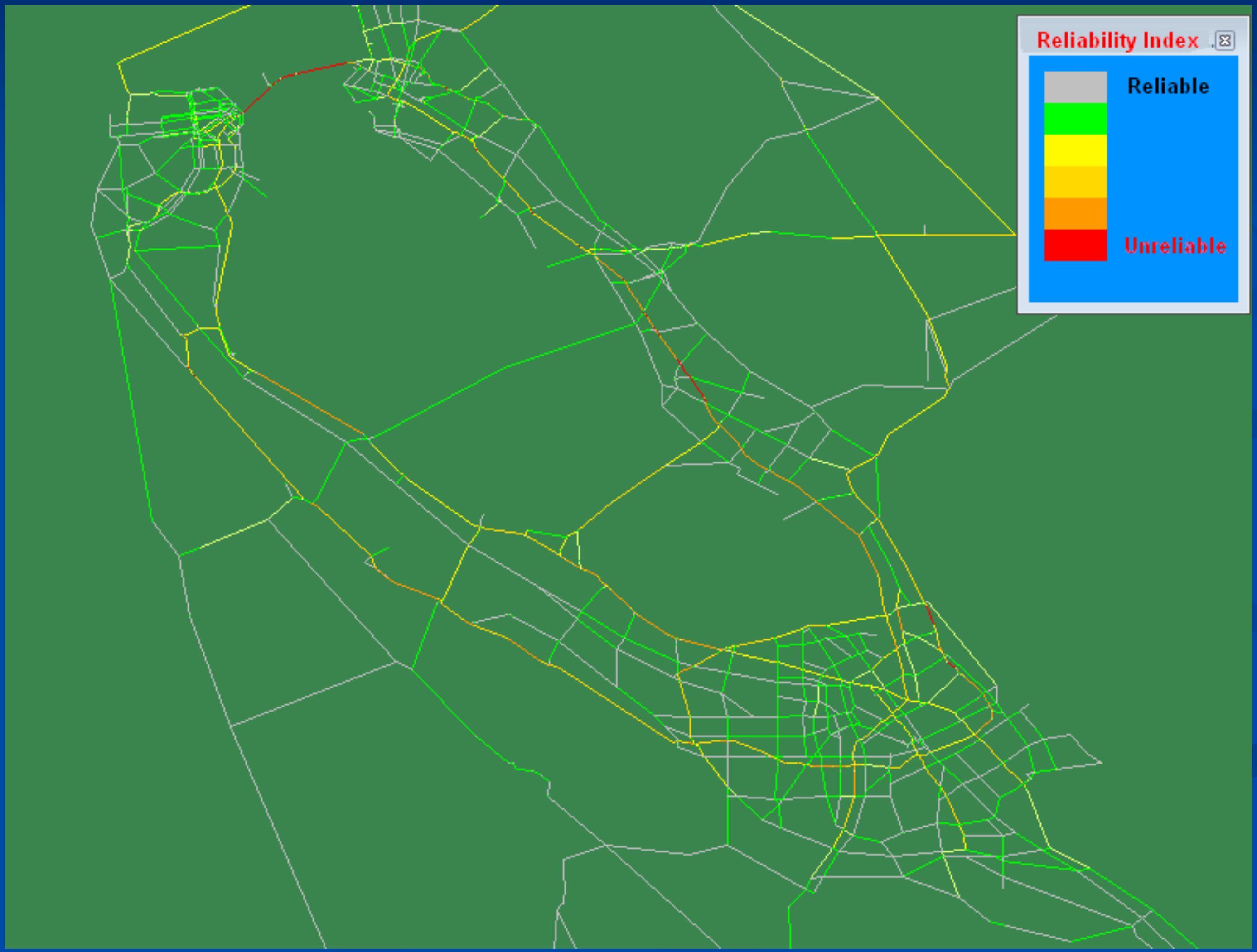
2. Travel Time Reliability Analysis

- Step 1: Read vehicle trajectory file
- Step 2: Group vehicles by
  - OD pair od, departure time τ, path p
- Step 3: Reliability Statistics Output:
  - Mean, median, variance, standard deviation, range, skewness, percentiles, buffer time and index

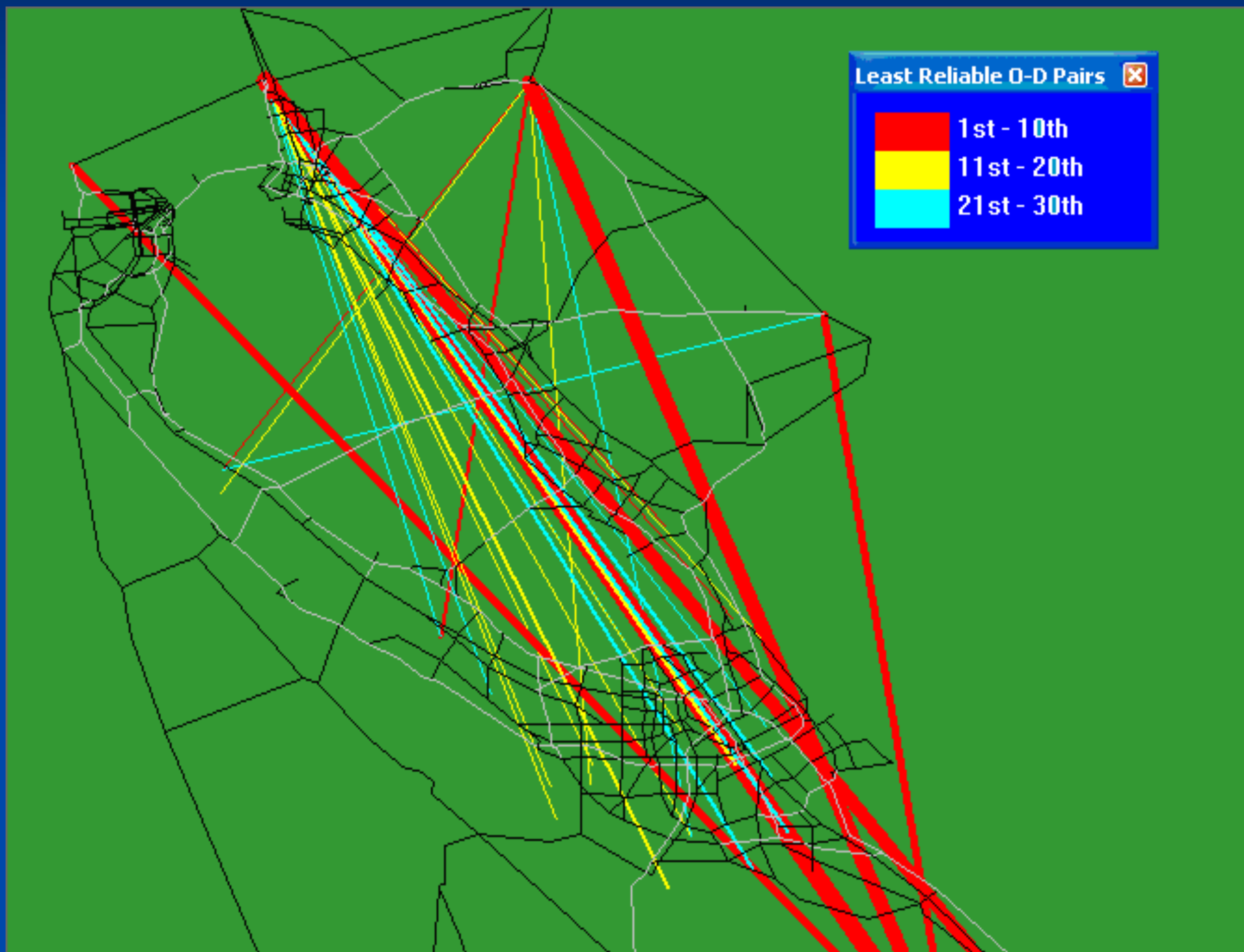
Path-level Travel Time Reliability Visualization



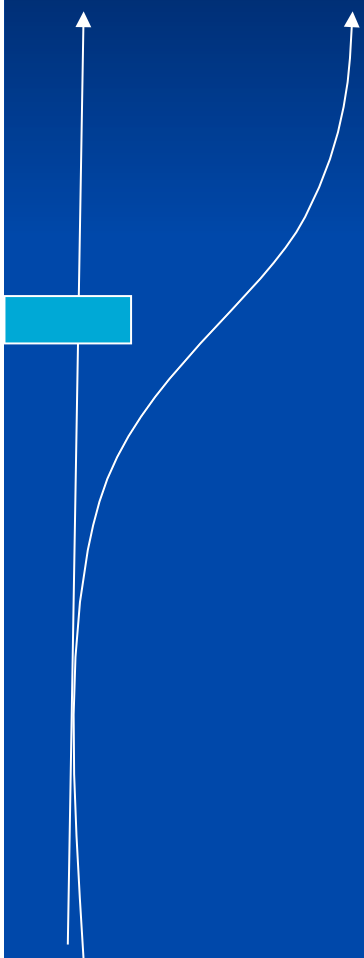
Link-level Traffic Reliability Visualization



Network-level Traffic Reliability Visualization

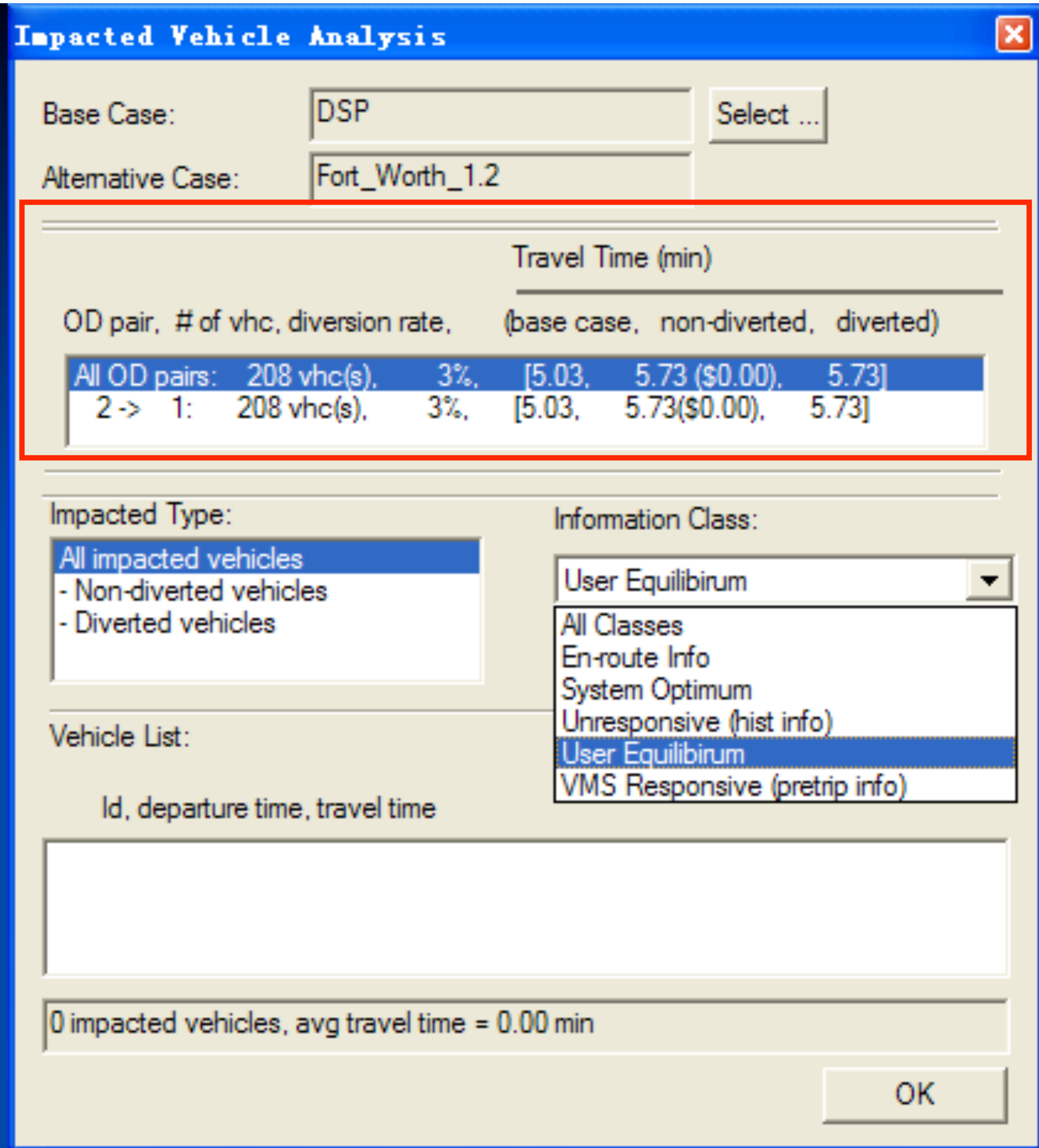


3. Impacted Vehicle Analysis



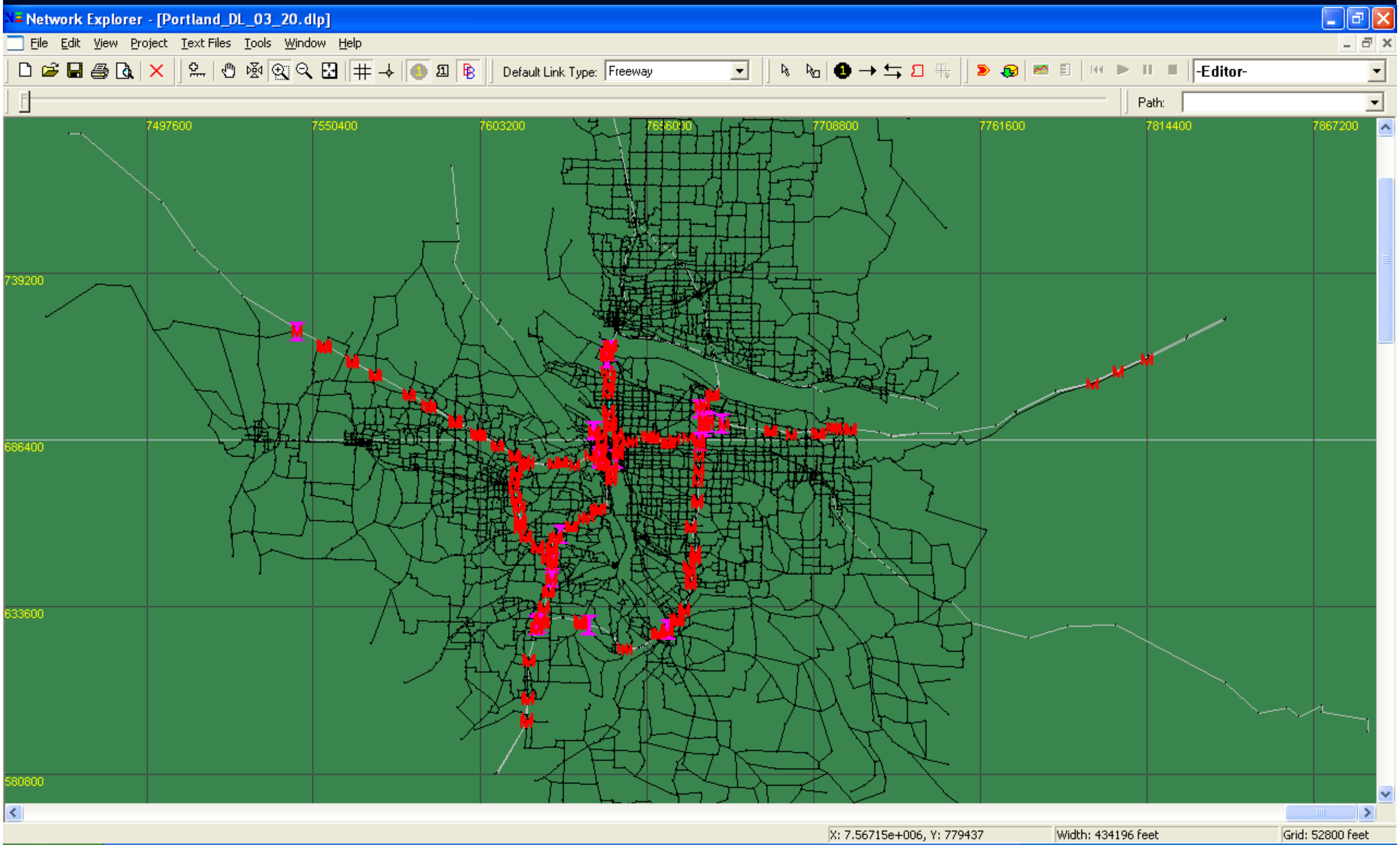
- Fully utilize vehicle trajectory data at different cases to evaluate the system-wide impacts of incident, work zone, toll link, and/or VMS

- **Do nothing** vs. **alternative** cases
- **Impacted vehicles** are vehicles passing through the link of interest in the base case
- **Diverted** vs. **non-diverted** vehicles in alternative case


Impacted Vehicle Analysis
Base Case:
DSP
Select ...
Alternative Case:
Fort_Worth_1.2
Travel Time (min)
OD pair, # of vhc, diversion rate, (base case, non-diverted, diverted)
All OD pairs: 208 vhc(s), 3%, [5.03, 5.73 ($0.00), 5.73]
2 -> 1: 208 vhc(s), 3%, [5.03, 5.73($0.00), 5.73]
Impacted Type:
All impacted vehicles
- Non-diverted vehicles
- Diverted vehicles
Information Class:
User Equilibirum
All Classes
En-route Info
System Optimum
Unresponsive (hist info)
User Equilibirum
VMS Responsive (pretrip info)
Vehicle List:
Id, departure time, travel time
0 impacted vehicles, avg travel time = 0.00 min
OK

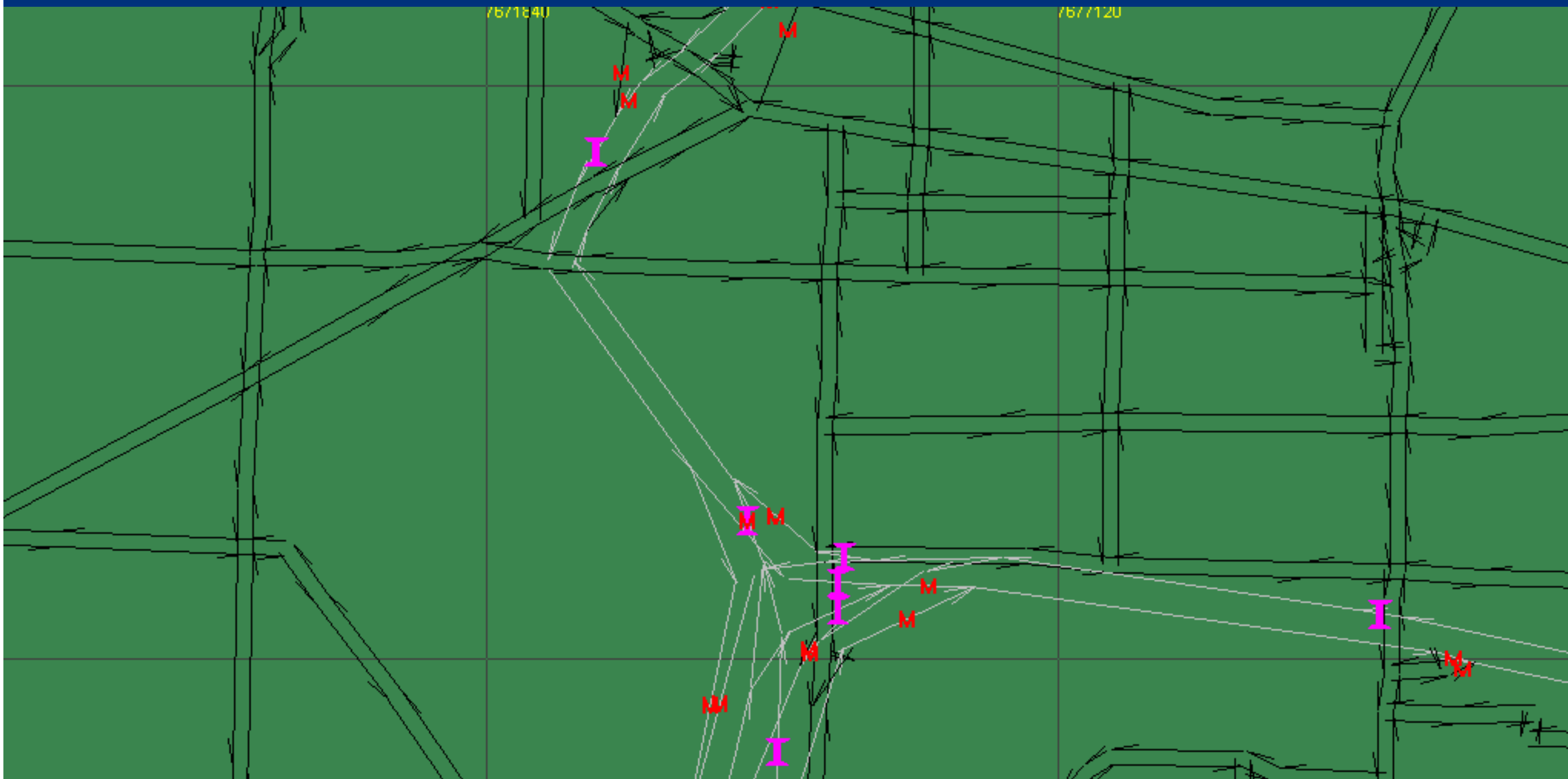
4. Bottleneck Identification

- Geometric Bottleneck
  - Lane drop
  - Weaving
  - Merge
- Use vehicle trajectory to detect speed transition points along vehicle paths
- Identify the head and tail of congestion/ bottleneck
- Use multi-day vehicle samples to distinguish recurring and non- recurring bottlenecks (under stochastic capacity)



Network Explorer - [Portland_DL_03_20.dlp]
File Edit View Project Text Files Tools Window Help
Default Link Type: Freeway
-Editor-
Path:
7497600
7550400
7603200
7708800
7761600
7814400
7867200
739200
686400
633600
580800
X: 7.56715e+006, Y: 779437
Width: 434196 feet
Grid: 52800 feet

Merge/Lane Drop Bottleneck



I see congestion everywhere, but where is the active bottleneck?