

MIDCAP

Maryland Intersection and Interchange Design & Capacity Analysis Program

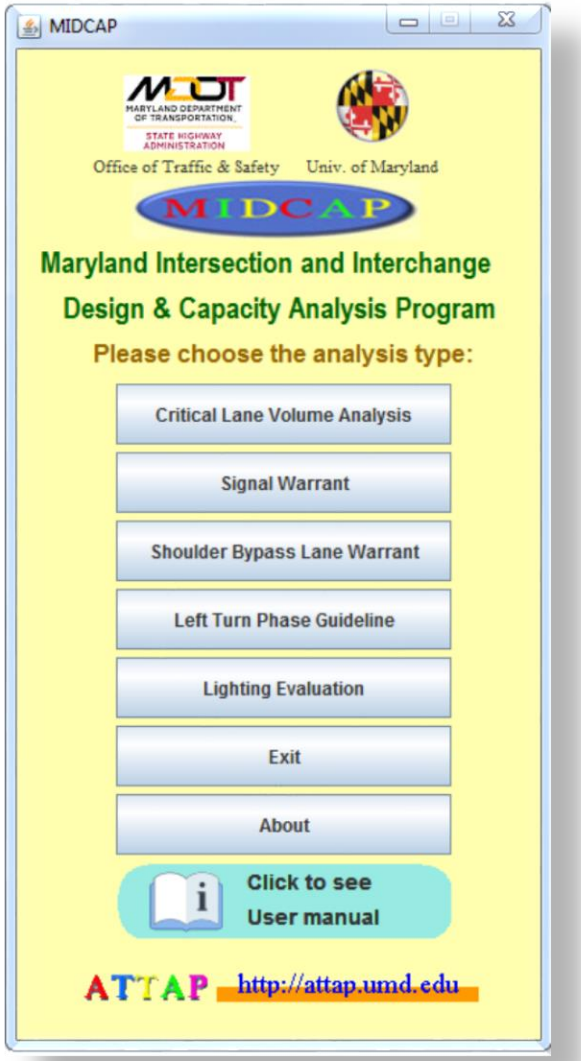
July 17, 2017

MDOT State Highway Administration
Office of Traffic & Safety
Traffic Development & Support Division

University of Maryland, College Park
Dept. of Civil & Environmental Engineering
Traffic Safety & Operations Lab

INTRODUCTION

- Software developed by **UMD**
- Sponsored by **MDOT SHA** through the Applied Technology & Traffic Analysis Program (ATTAP) funding
- **User-friendly** traffic engineering software for intersection analysis regarding
  - Capacity or queuing
  - Traffic signal warrant
  - Shoulder bypass lane warrant
  - Left turn phase selection new
  - Lighting recommendation new



MAIN MODULES

1. Critical Lane Volume (CLV) Analysis
2. Signal Warrant
3. Shoulder Bypass Lanes (SBLs) Warrant
4. Left Turn Phase Guideline
5. Lighting Evaluation

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Critical Lane Volume (CLV) analysis module conducts a **sketch-level** capacity / queuing analysis for **signalized** intersection(s) or interchange ramp terminal(s) along an arterial.

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Procedure

INPUT

- Intersection type
- Turning movement volumes
- Lane configuration
- Right-turn restriction
- Split or non-split phase

Identify non-concurrent sets of movements → Determine CLV of each sets and sum → Calculate v/c and determine LOS → Calculate Max. queue length

- Intersection CLV
- Intersection v/c and LOS
- Maximum queue length

OUTPUT

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Submodules

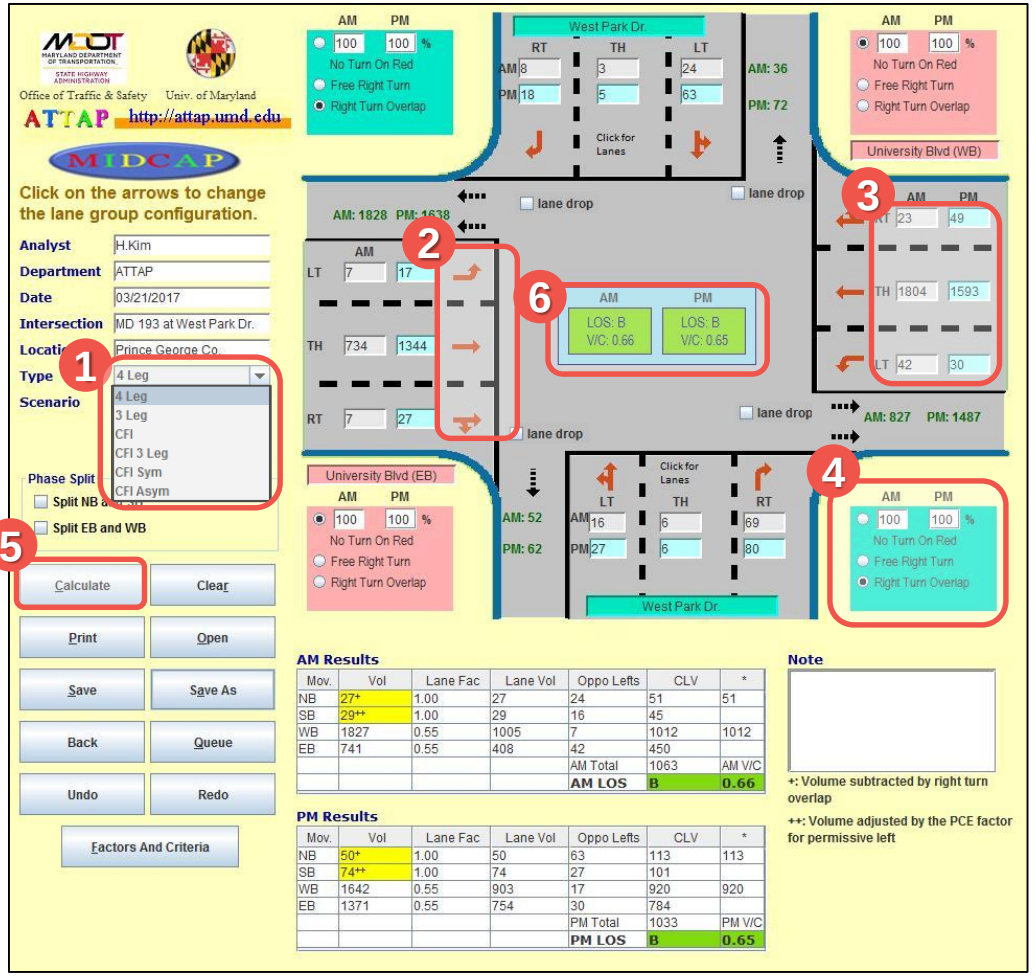
1. Intersection (**Single or Multiple** locations up to 10)
    - 3-leg
    - 4-leg
    - Continuous Flow (or Displaced Left Turn) Intersection
2. Interchange (**Single** location for alternative interchange designs analysis)
    - Regular Diamond Interchange
    - Partial Clover Leaf Interchange 

    - Single Point Urban Interchange
    - Diverging Diamond Interchange
3. **Multi-hour** calculation

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

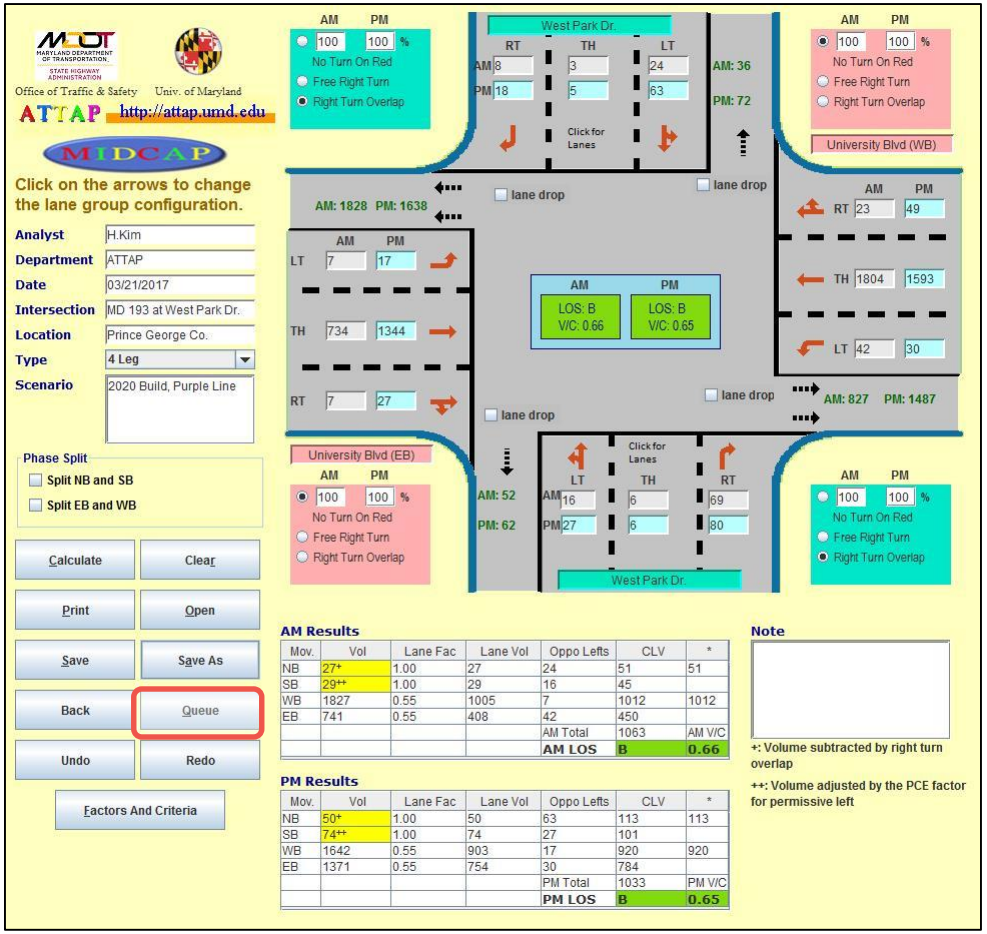
Capacity (4-Leg Intersection)

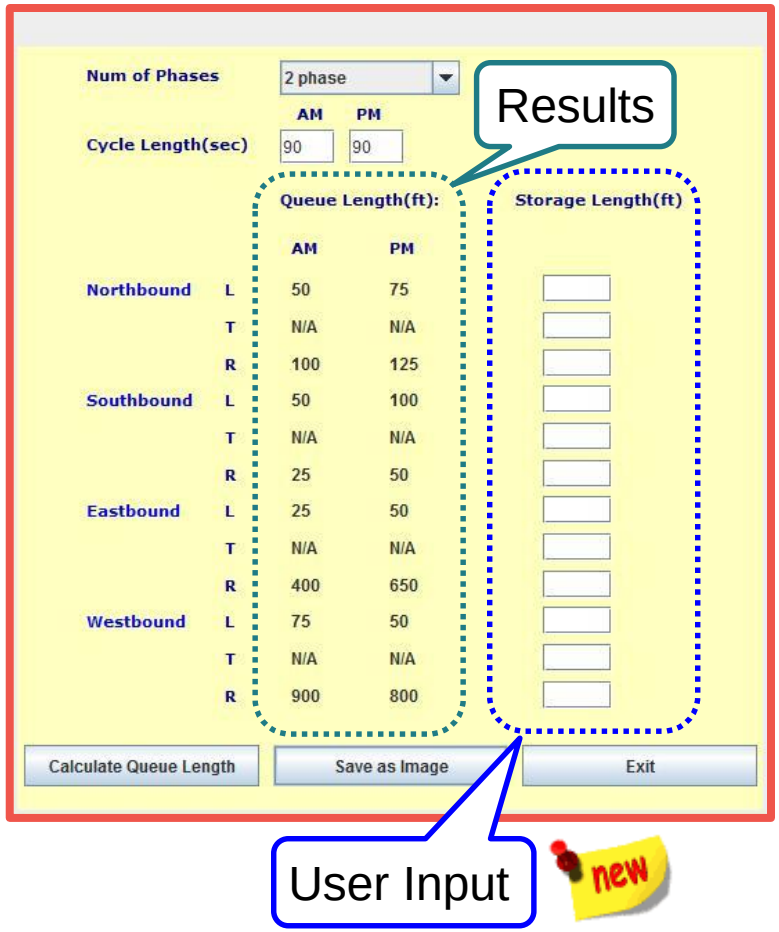
1. Choose Intersection Type
2. Set Lane Configurations
3. Input Movement Volumes
4. Choose Right Turn Control Type
5. Click Calculate
6. Obtain LOS & V/C



MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Maximum **Queue** Lengths

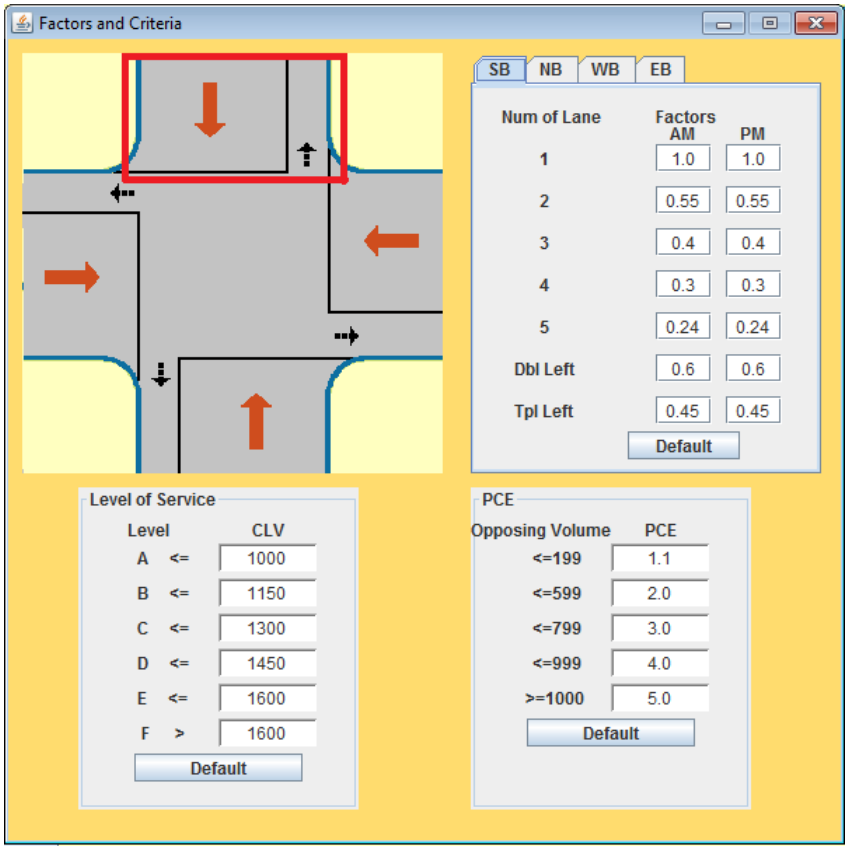




MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Factors and Criteria

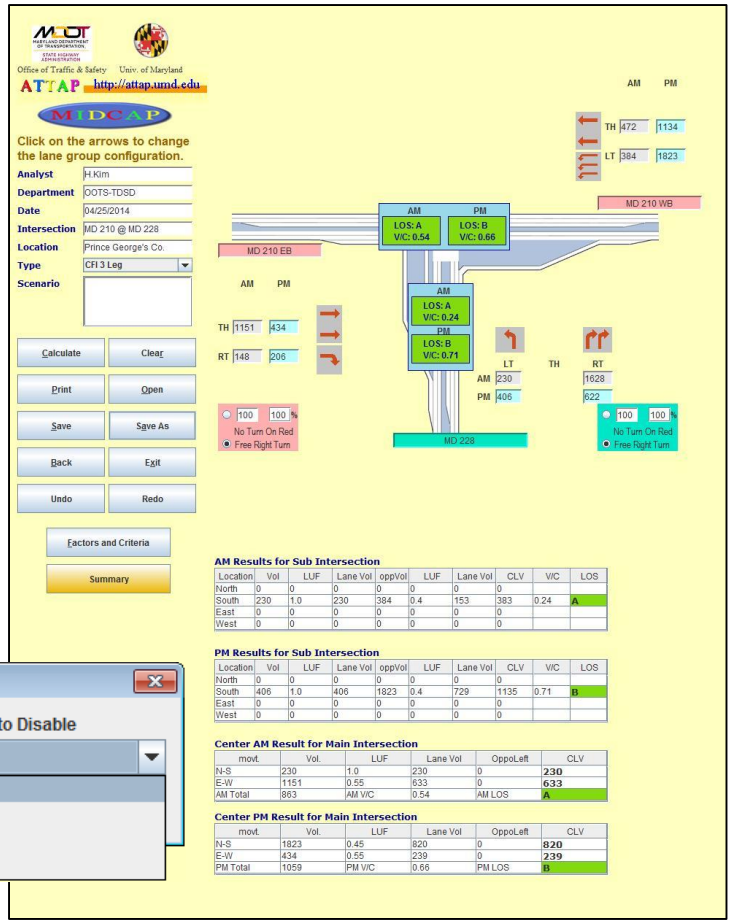
- **Editable** Lane Use Factors, LOS criteria, and Passenger Car Equivalent (PCE) values
- Applicable to each approach and AM / PM period

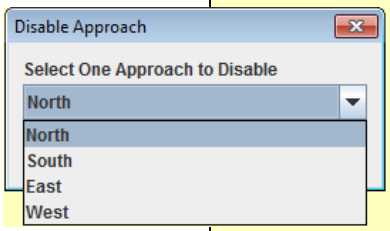


MODULE 1: CRITICAL LANE VOLUME ANALYSIS

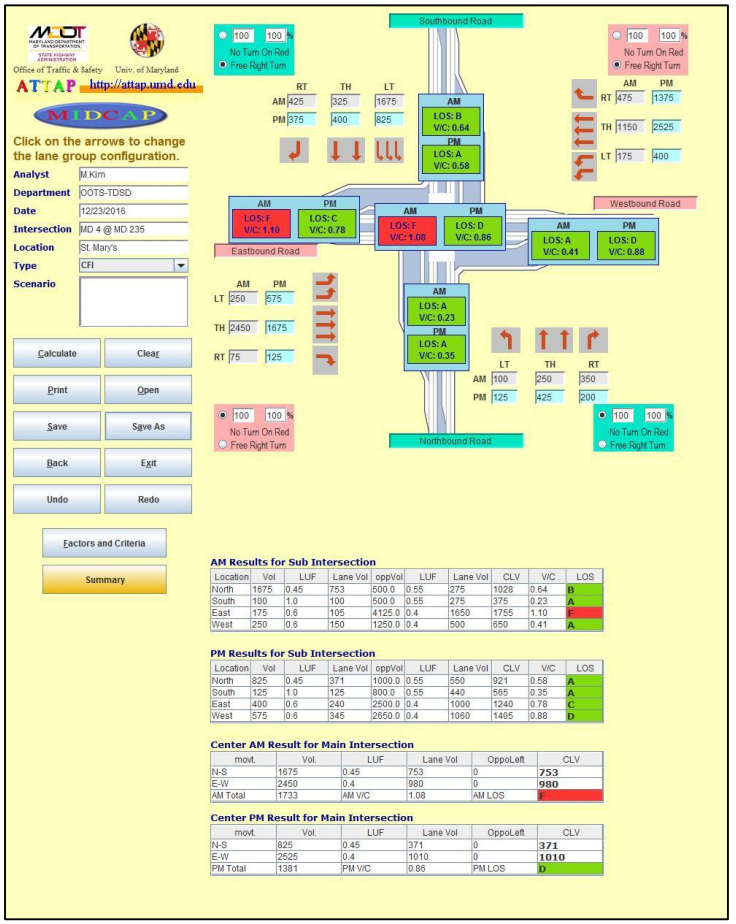
Continuous Flow (or **Displaced Left Turn**) Intersection

3-Leg CFI





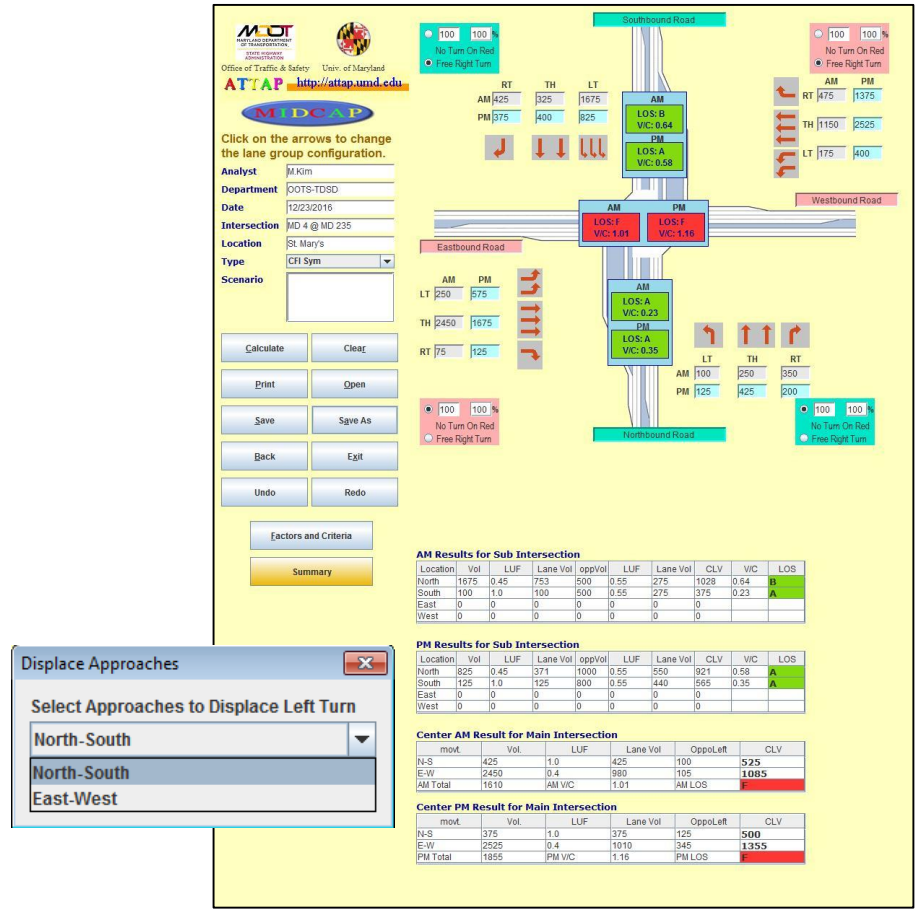
4-Leg **Full** CFI



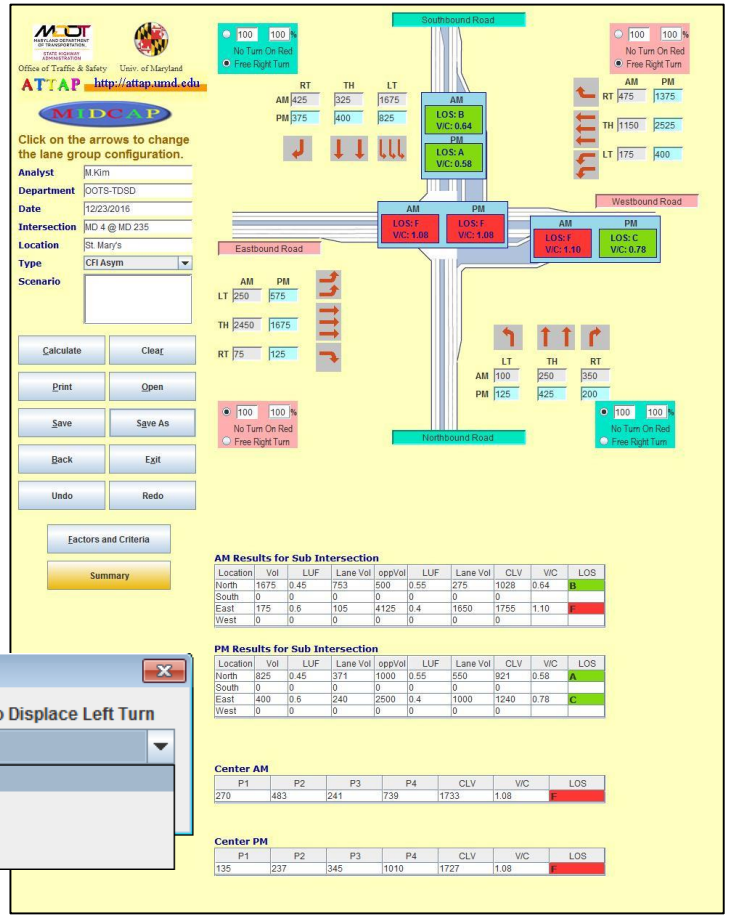
MODULE 1: CRITICAL LANE VOLUME ANALYSIS

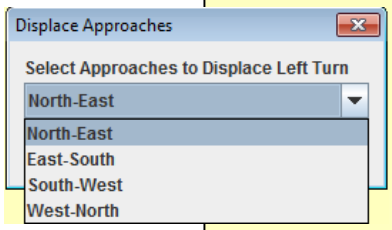
Continuous Flow (or **Displaced Left Turn**) Intersection

4-Leg Partial **Symmetric** CFI



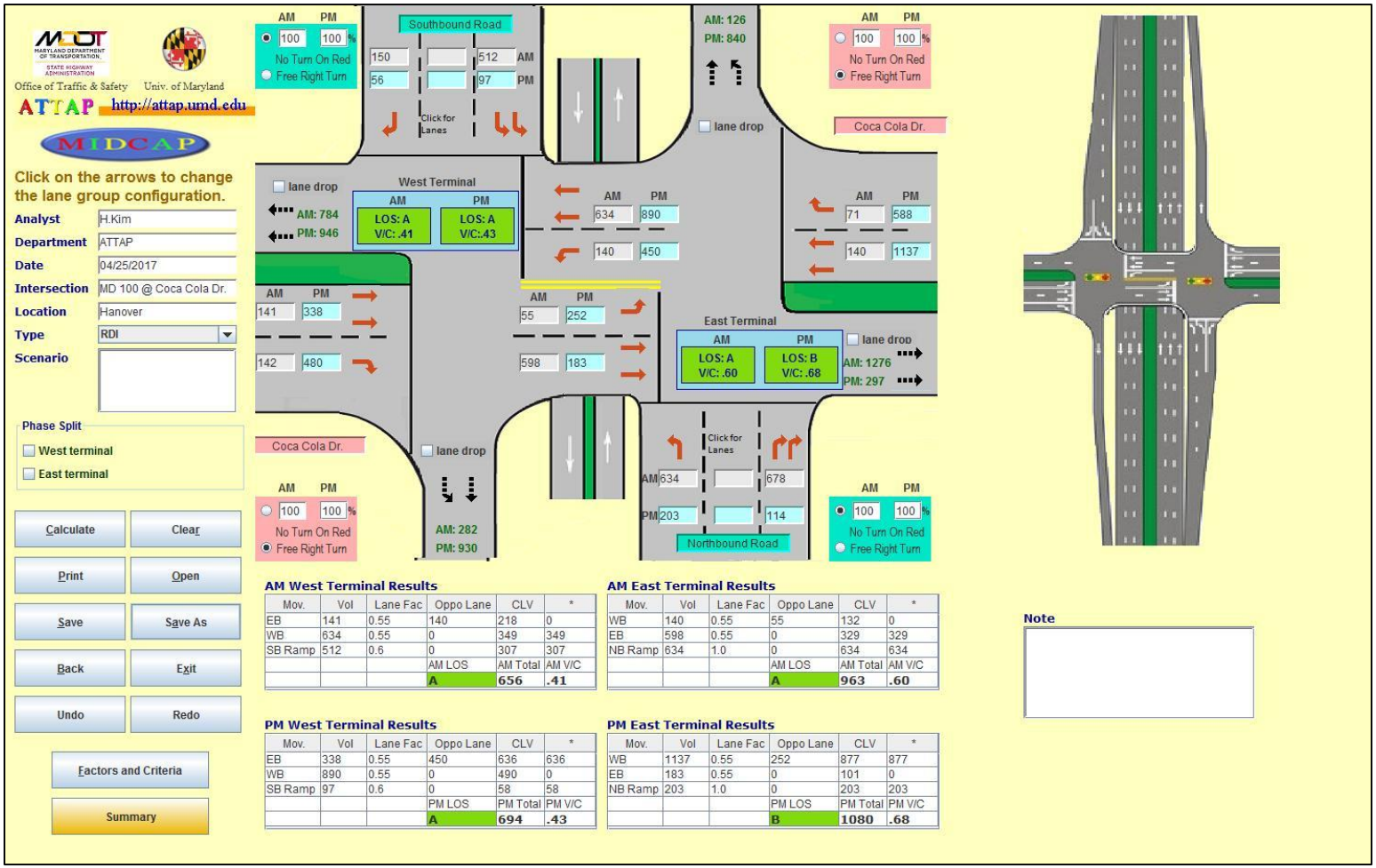
4-Leg Partial **Asymmetric** CFI





MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Interchange Ramp Terminals (Regular Diamond)



AM West Terminal Results

Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
EB	141	0.55	140	218	0
WB	634	0.55	0	349	349
SB Ramp	512	0.6	0	307	307
			AM LOS	AM Total	AM V/C
			A	656	.41

AM East Terminal Results

Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
WB	140	0.55	55	132	0
EB	598	0.55	0	329	329
NB Ramp	634	1.0	0	634	634
			AM LOS	AM Total	AM V/C
			A	963	.60

PM West Terminal Results

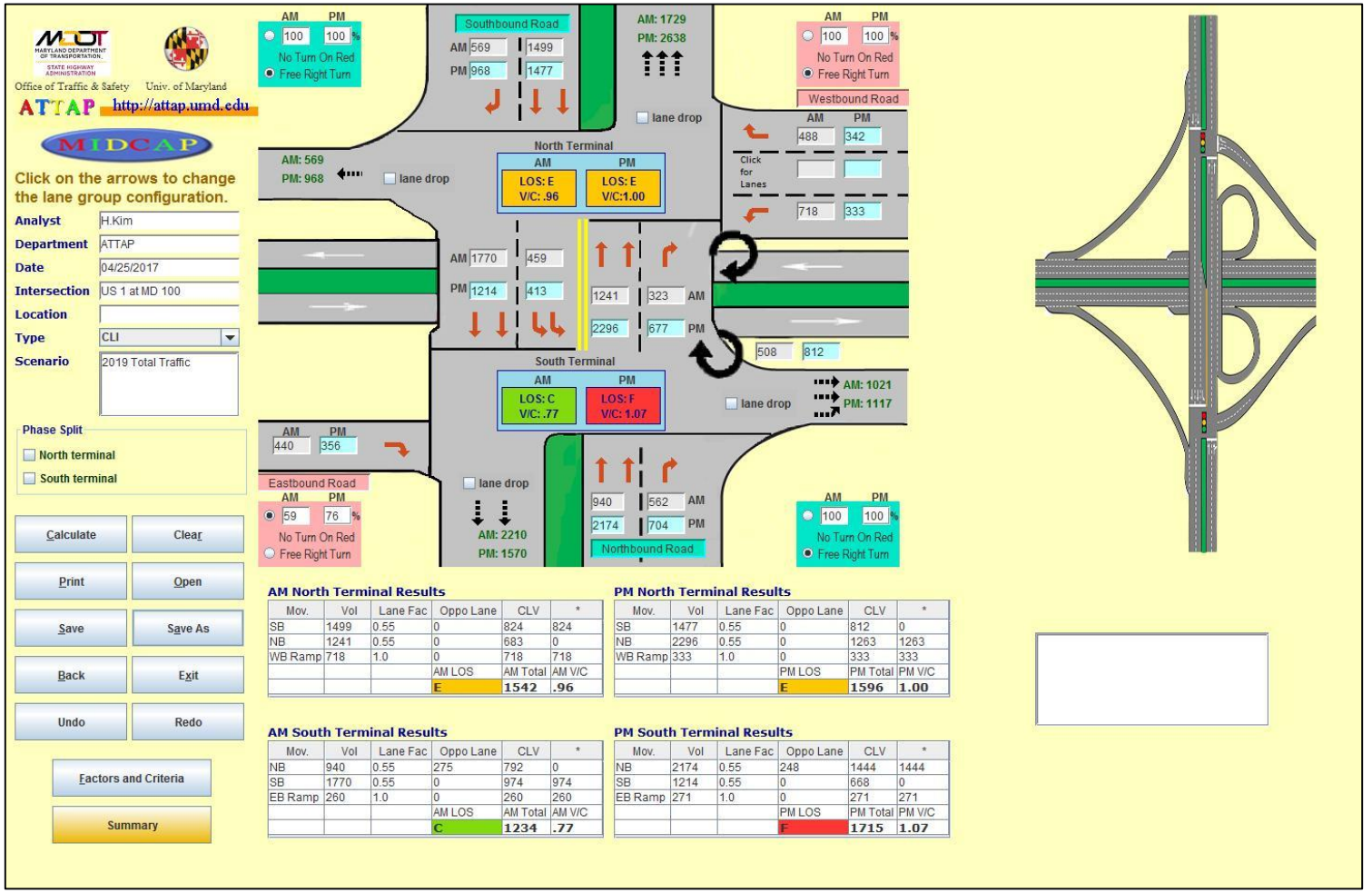
Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
EB	338	0.55	450	636	636
WB	890	0.55	0	490	0
SB Ramp	97	0.6	0	58	58
			PM LOS	PM Total	PM V/C
			A	694	.43

PM East Terminal Results

Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
WB	1137	0.55	252	877	877
EB	183	0.55	0	101	0
NB Ramp	203	1.0	0	203	203
			PM LOS	PM Total	PM V/C
			B	1080	.68

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Partial Clover Leaf Interchange



AM North Terminal Results

Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
SB	1499	0.55	0	824	824
NB	1241	0.55	0	683	0
WB Ramp	718	1.0	0	718	718
			AM LOS	AM Total	AM V/C
			E	1542	.96

PM North Terminal Results

Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
SB	1477	0.55	0	812	0
NB	2296	0.55	0	1263	1263
WB Ramp	333	1.0	0	333	333
			PM LOS	PM Total	PM V/C
			E	1596	1.00

AM South Terminal Results

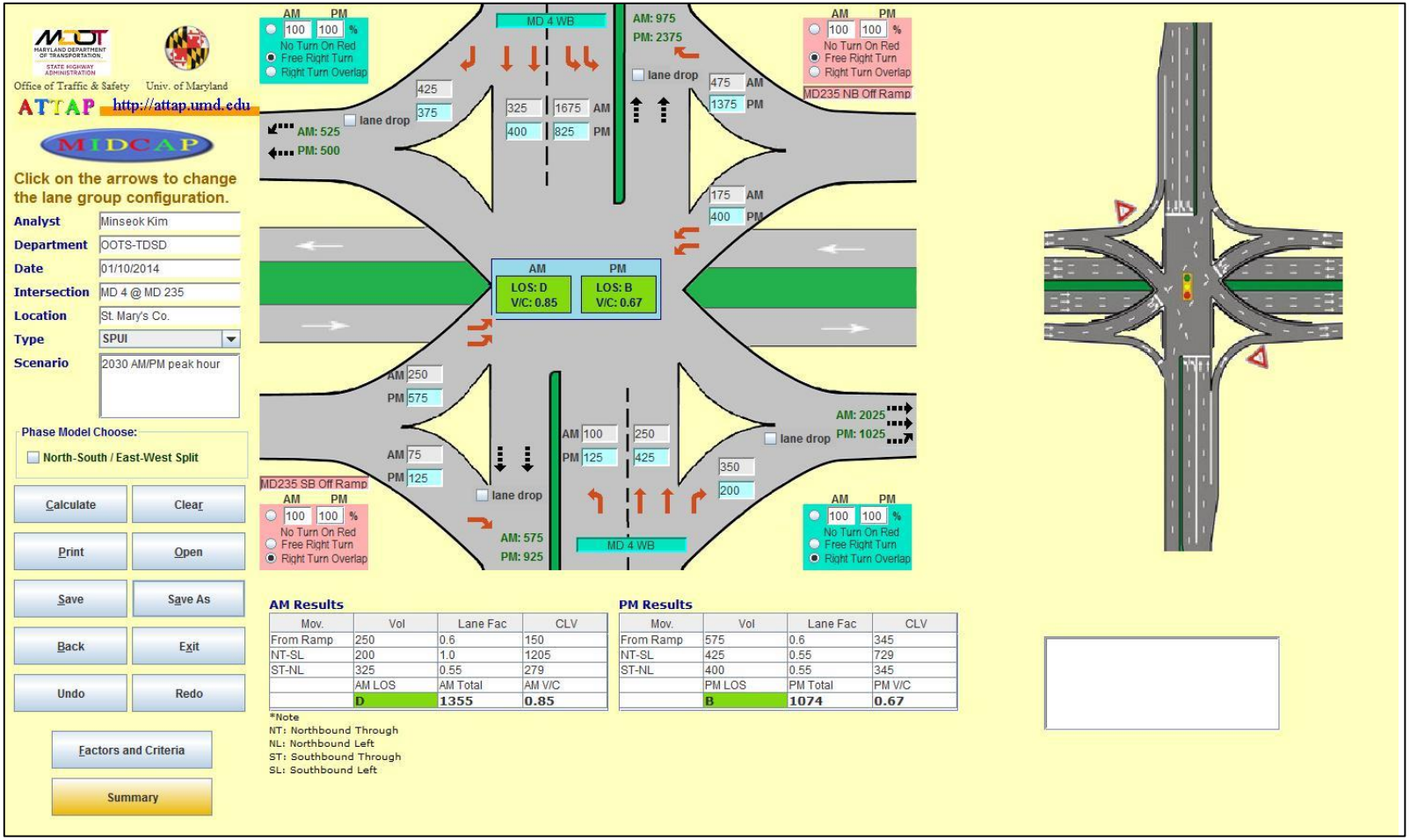
Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
NB	940	0.55	275	792	0
SB	1770	0.55	0	974	974
EB Ramp	260	1.0	0	260	260
			AM LOS	AM Total	AM V/C
			C	1234	.77

PM South Terminal Results

Mov.	Vol	Lane Fac	Oppo Lane	CLV	*
NB	2174	0.55	248	1444	1444
SB	1214	0.55	0	668	0
EB Ramp	271	1.0	0	271	271
			PM LOS	PM Total	PM V/C
			F	1715	1.07

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Single Point Urban Interchange



AM Results

Mov.	Vol	Lane Fac	CLV
From Ramp	250	0.6	150
NT-SL	200	1.0	1205
ST-NL	325	0.55	279
	AM LOS	AM Total	AM V/C
	D	1355	0.85

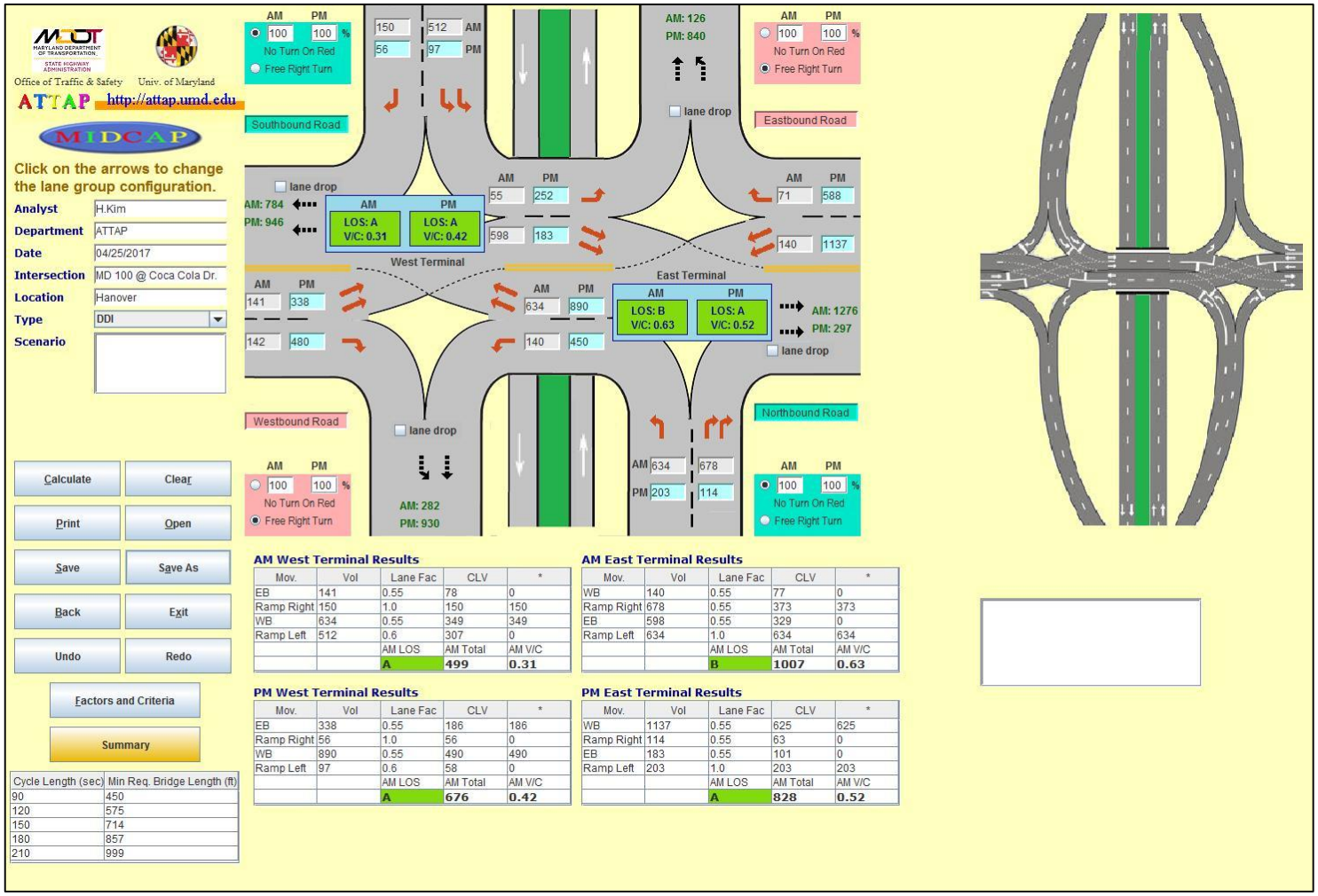
PM Results

Mov.	Vol	Lane Fac	CLV
From Ramp	575	0.6	345
NT-SL	425	0.55	729
ST-NL	400	0.55	345
	PM LOS	PM Total	PM V/C
	B	1074	0.67

*Note
NT: Northbound Through
NL: Northbound Left
ST: Southbound Through
SL: Southbound Left

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Diverging Diamond Interchange



Cycle Length (sec)	Min Req. Bridge Length (ft)
90	450
120	575
150	714
180	857
210	999

AM West Terminal Results

Mov.	Vol	Lane Fac	CLV	*
EB	141	0.55	78	0
Ramp Right	150	1.0	150	150
WB	634	0.55	349	349
Ramp Left	512	0.6	307	0
		AM LOS	AM Total	AM V/C
		A	499	0.31

AM East Terminal Results

Mov.	Vol	Lane Fac	CLV	*
WB	140	0.55	77	0
Ramp Right	678	0.55	373	373
EB	598	0.55	329	0
Ramp Left	634	1.0	634	634
		AM LOS	AM Total	AM V/C
		B	1007	0.63

PM West Terminal Results

Mov.	Vol	Lane Fac	CLV	*
EB	338	0.55	186	186
Ramp Right	56	1.0	56	0
WB	890	0.55	490	490
Ramp Left	97	0.6	58	0
		AM LOS	AM Total	AM V/C
		A	676	0.42

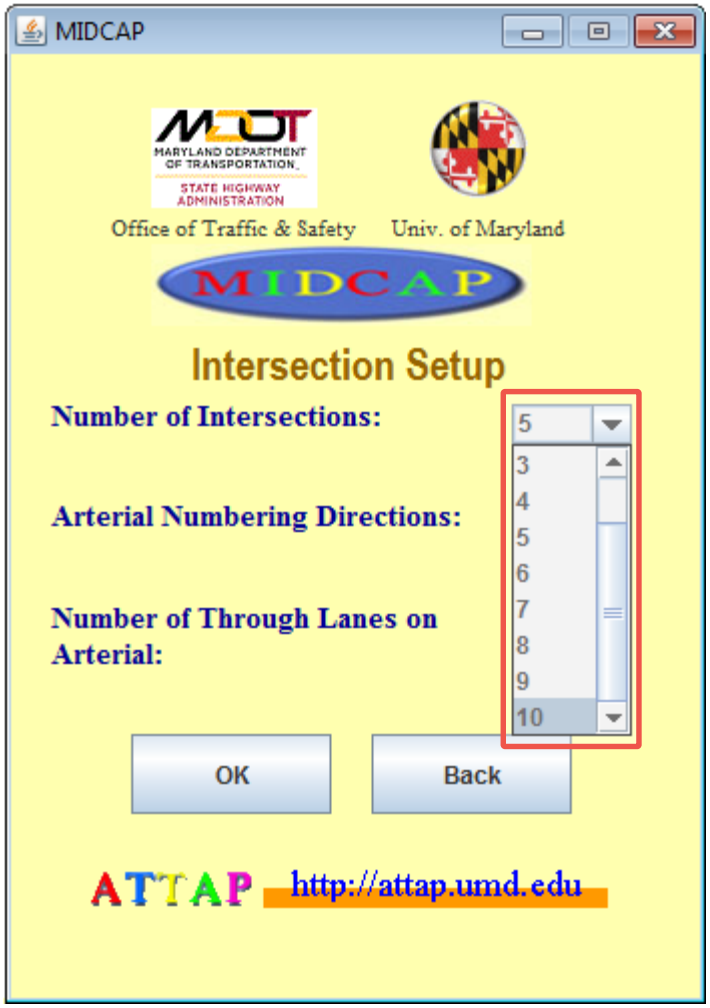
PM East Terminal Results

Mov.	Vol	Lane Fac	CLV	*
WB	1137	0.55	625	625
Ramp Right	114	0.55	63	0
EB	183	0.55	101	0
Ramp Left	203	1.0	203	203
		AM LOS	AM Total	AM V/C
		A	828	0.52

MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Arterial (Corridor) analysis

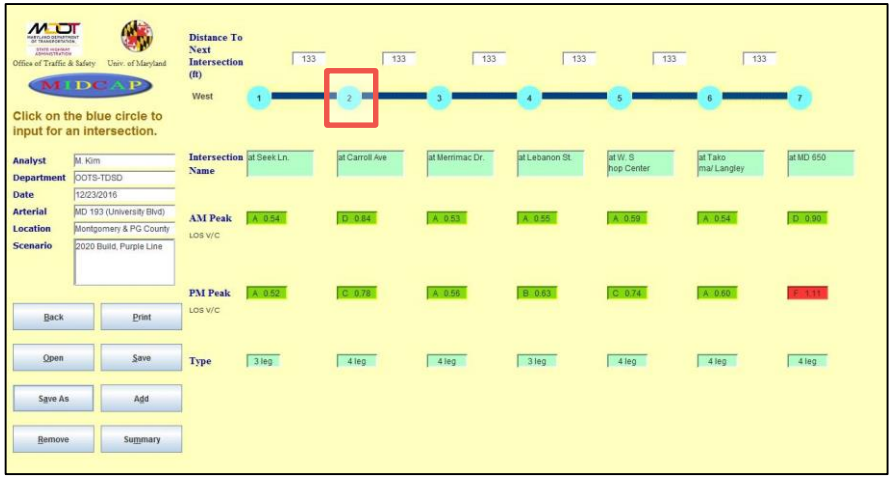
- **Multiple intersections**
- Up to 10 intersections



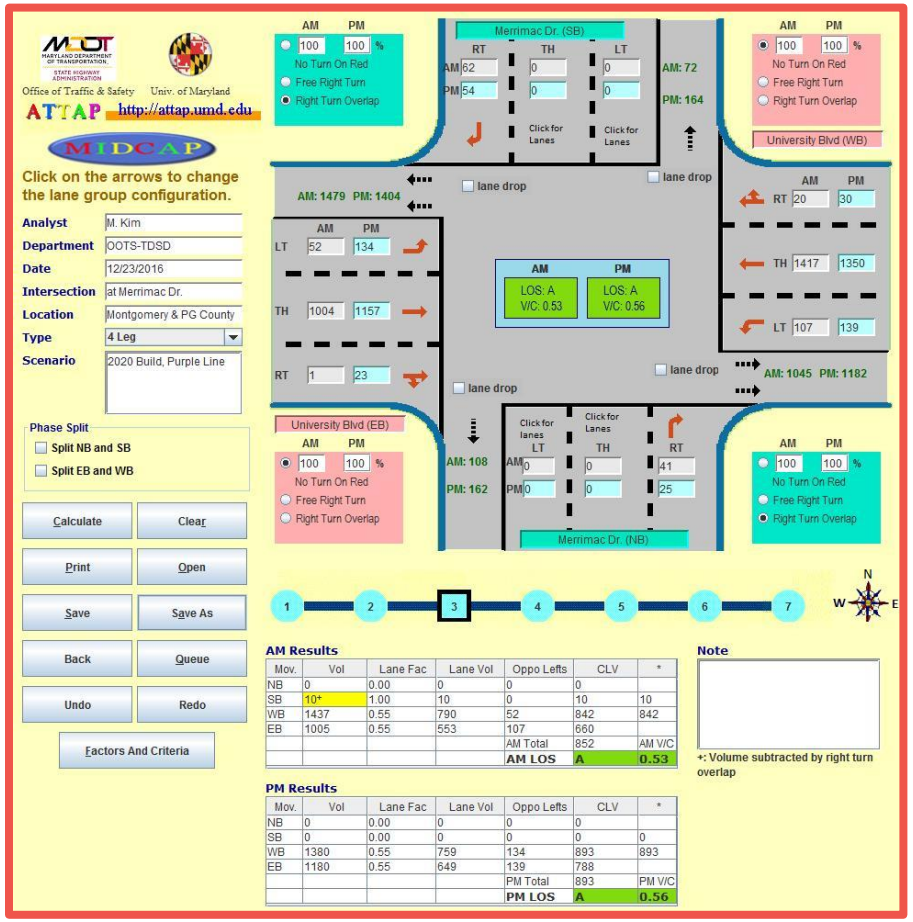
MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Arterial analysis

Arterial View



Individual Intersection View

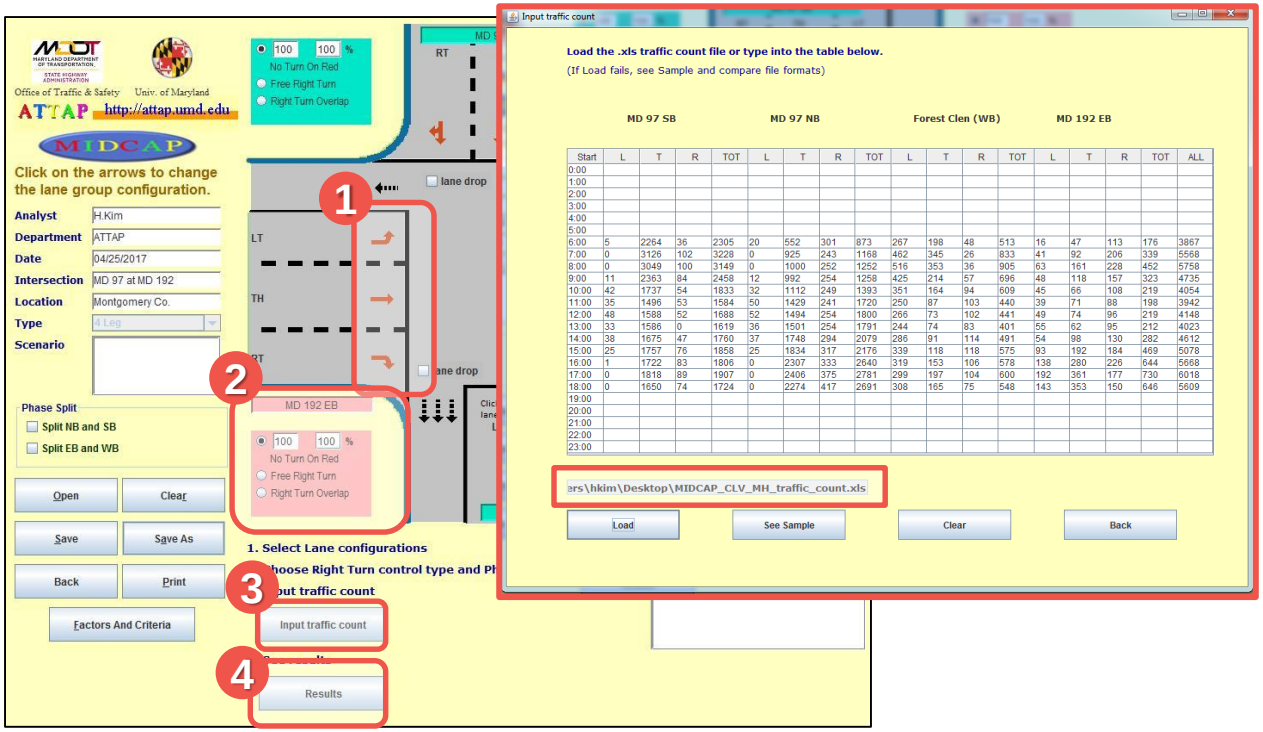


MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Multi-hour analysis

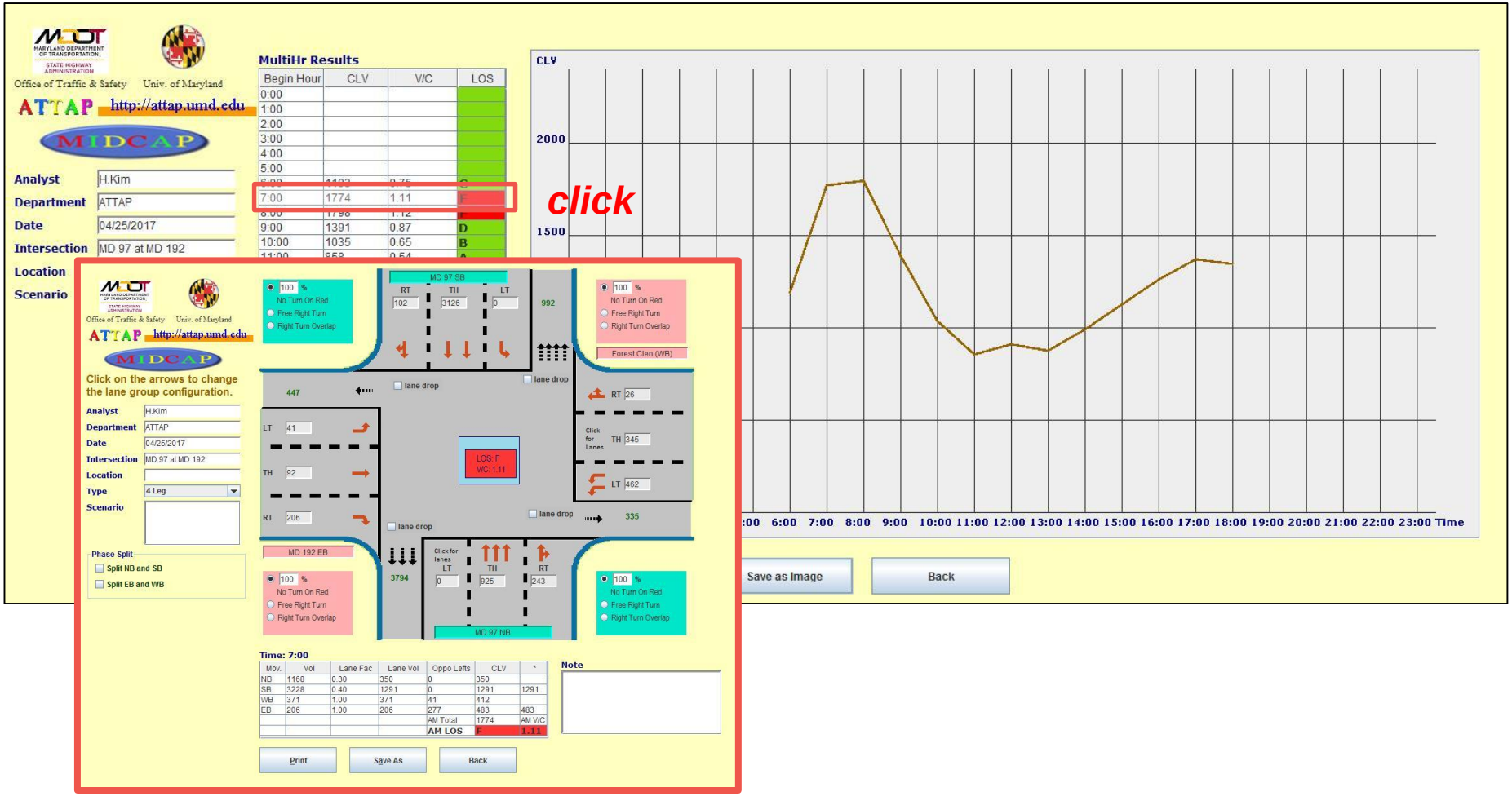
Import or copy traffic counts in Excel from MDOT SHA's Internet Traffic Monitoring System (http://maps.roads.maryland.gov/itms_public/)

1. **Set Lane Configurations**
2. **Choose Right Turn Control Type**
3. **Input Movement Volumes**
4. **Click Result**



MODULE 1: CRITICAL LANE VOLUME ANALYSIS

Multi-hour analysis: CLV, V/C and LOS for **each hour**



MODUE 2: SIGNAL WARRANT

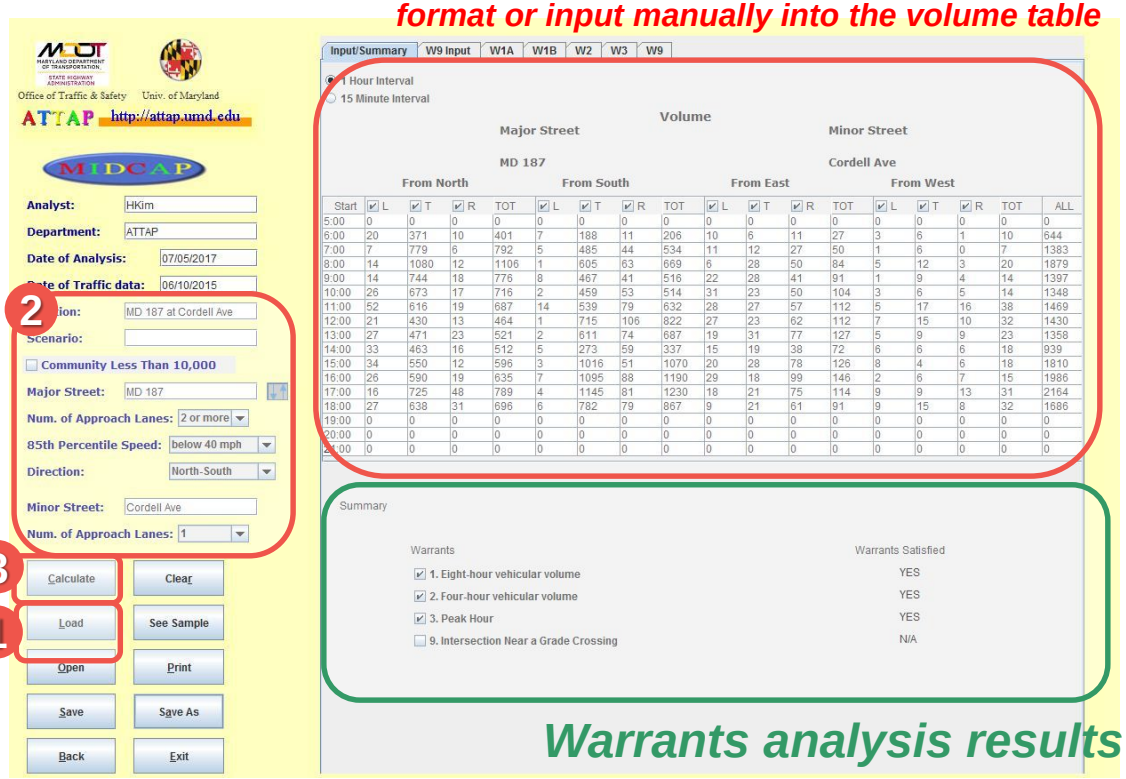
- Uses the Maryland Manual on Uniform Traffic Control Devices (**MdMUTCD**) **2011** edition
- Investigates the need for a traffic control signal by analyzing related factors such as traffic conditions and physical characteristics of the location
- Provides whether the following traffic signal warrant is satisfied at a particular location or not
  - Warrant 1. **Eight-Hour** Vehicular Volume
  - Warrant 2. **Four-Hour** Vehicular Volume
  - Warrant 3. **Peak Hour**
  - Warrant 9. Intersection **Near a Grade Crossing**

MODUE 2: SIGNAL WARRANT

Able to import or copy a traffic counts report from MDOT SHA's Internet Traffic Monitoring System (I-TMS) as input

1. **Load Traffic Volume Data**
2. **Set Location-specific Characteristics**
3. **Click Calculate**

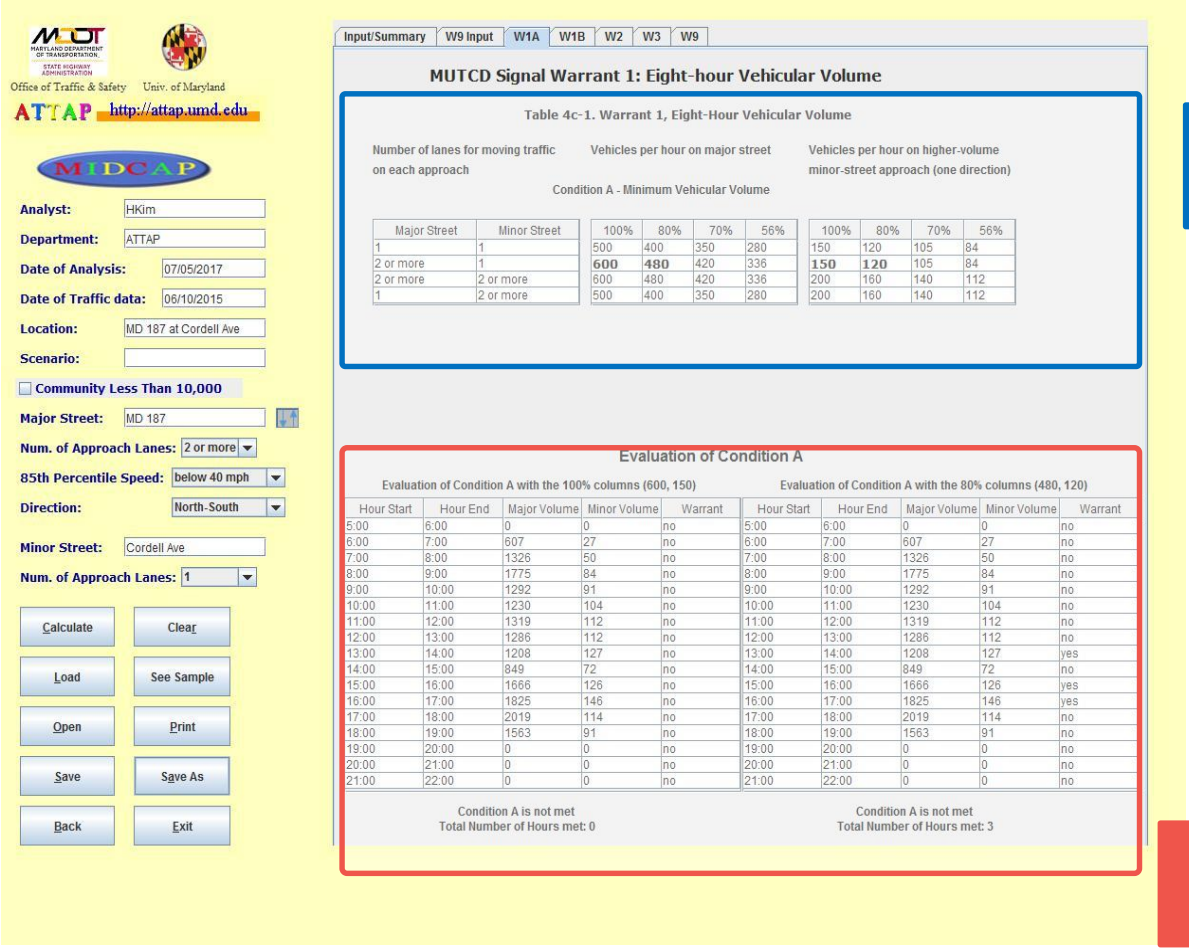
One can load the I-TMS traffic data in excel format or input manually into the volume table



Warrants analysis results

MODUE 2: SIGNAL WARRANT

Evaluation results for Warrant 1

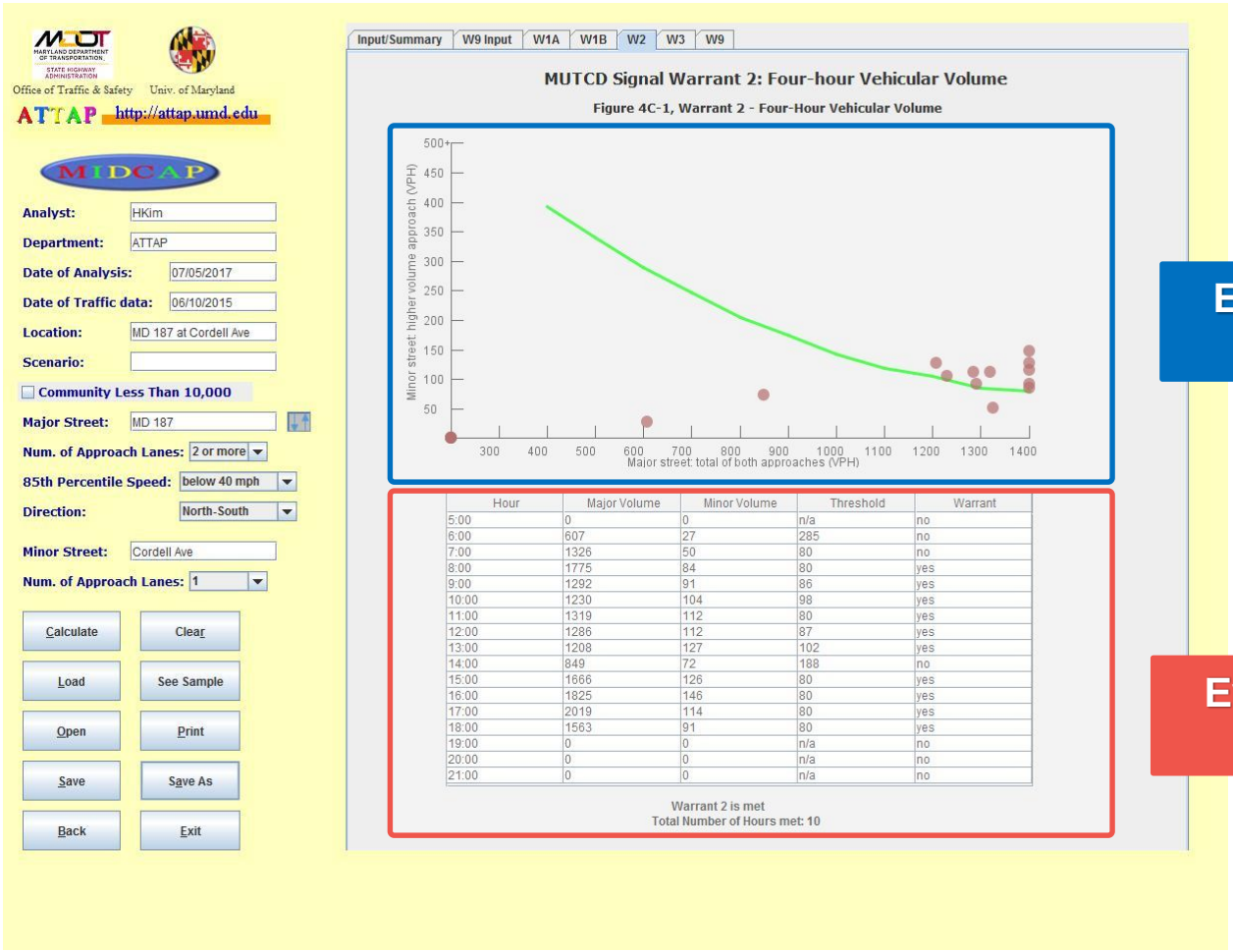


Evaluation criteria

Evaluation results

MODUE 2: SIGNAL WARRANT

Evaluation results for Warrant 2

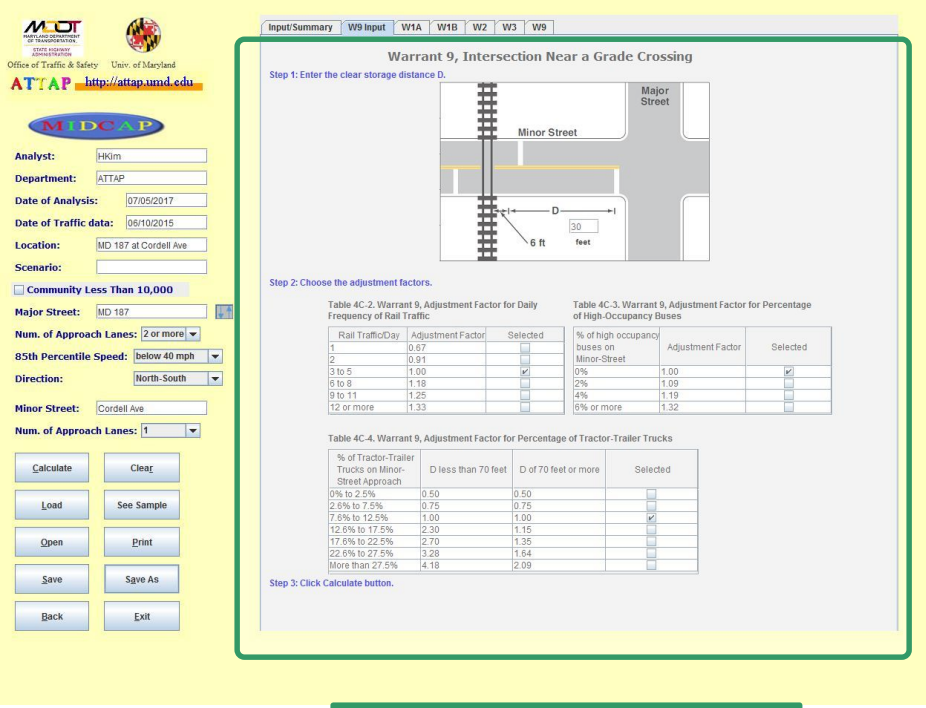


Evaluation criteria

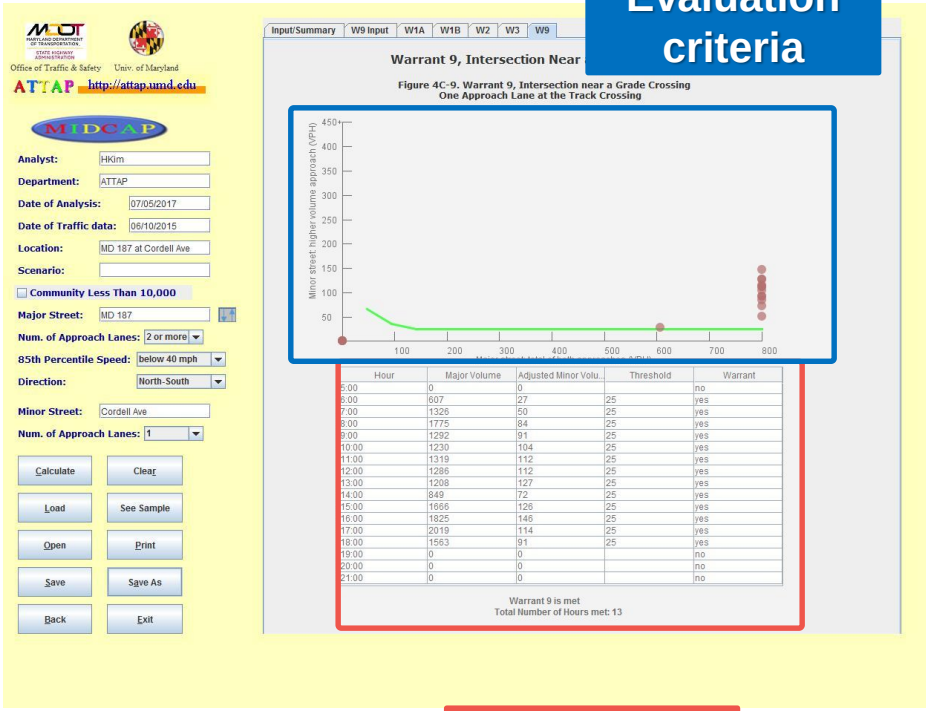
Evaluation results

MODUE 2: SIGNAL WARRANT

Evaluation results for Warrant 9



Additional input for W9



Evaluation results

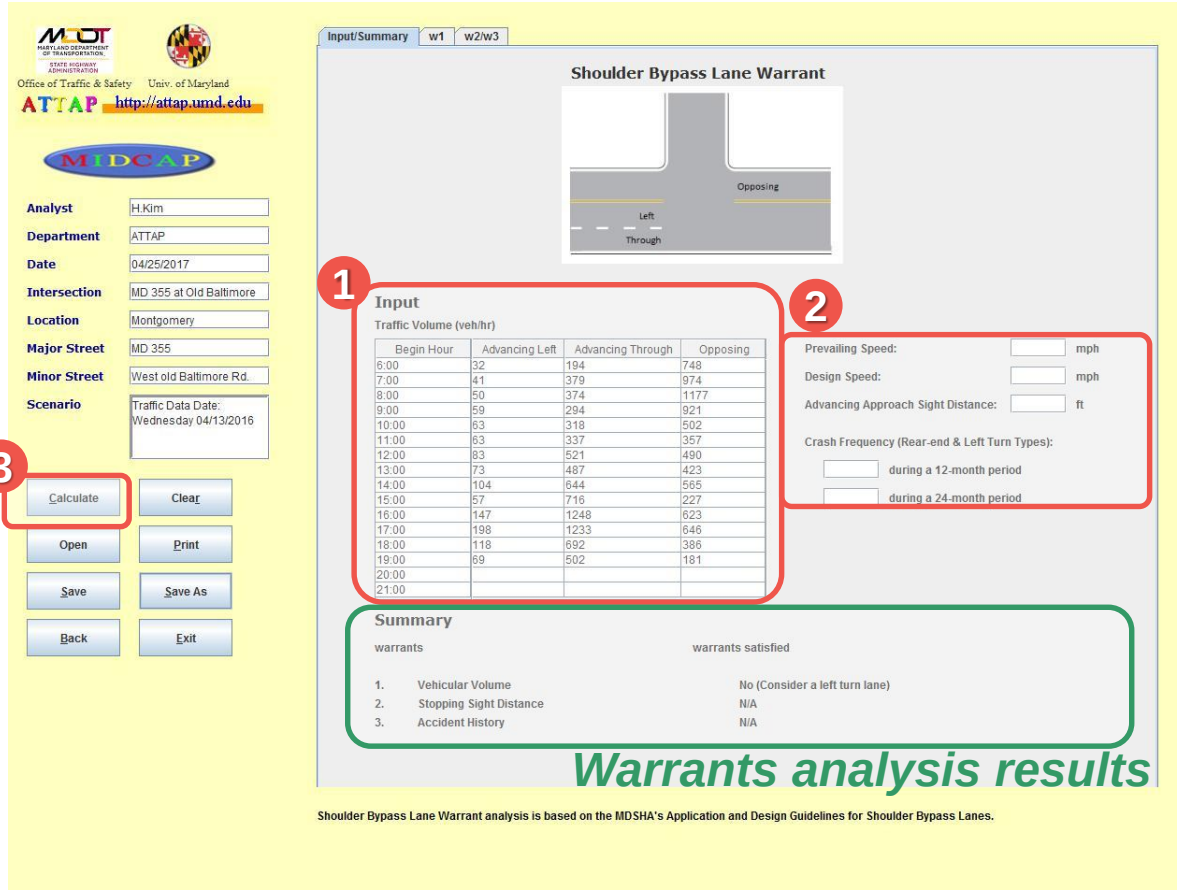
MODULE 3: SHOULDER BYPASS LANE WARRANT

- Uses the MDOT SHA's **Application and Design Guidelines for Shoulder Bypass Lanes** (SBLs)
- Investigates the need for shoulder bypass lanes versus left-turn lanes by analyzing related factors such as traffic conditions and physical characteristics of the location
- Provides whether the following shoulder bypass lane warrant is satisfied at **a two-lane, two-way unsignalized T-intersection** or not
  - Warrant 1. Vehicular **Volumes**
  - Warrant 2. Stopping **Sight Distance**
  - Warrant 3. **Accident** History

MODULE 3: SHOULDER BYPASS LANE WARRANT

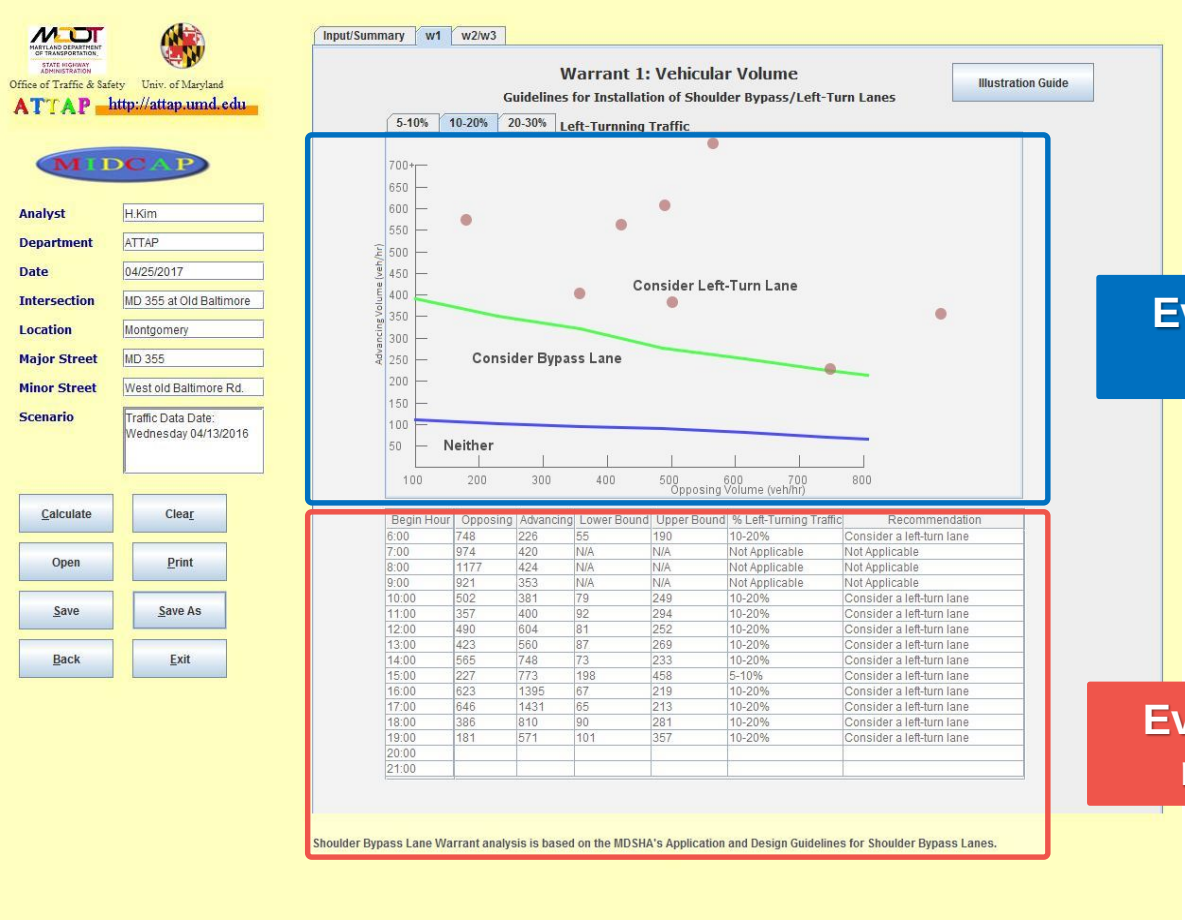
How to Use

1. **Input Traffic Volume Data**
2. **Set Location-specific Characteristics**
3. **Click Calculate**



MODULE 3: SHOULDER BYPASS LANE WARRANT

Evaluation results for Warrant 1



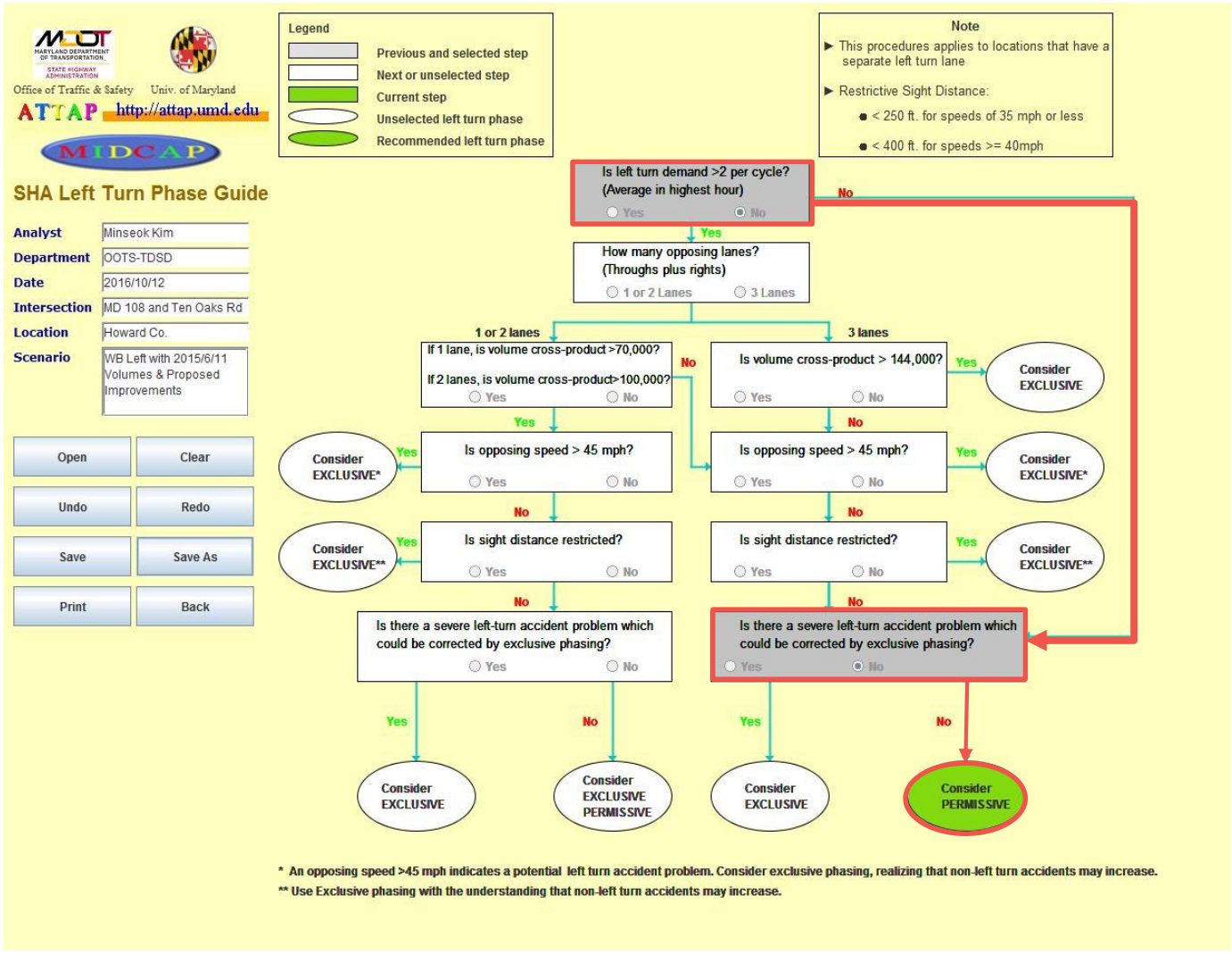
Evaluation criteria

Evaluation results

MODULE 4: LEFT TURN PHASE GUIDELINE

- Uses the **Left Turn Phase Guideline** from the MDOT SHA's Traffic Engineering & Safety Manual
- Provides a recommended type of left turn phase among exclusive, permissive and exclusive/permissive at a particular location

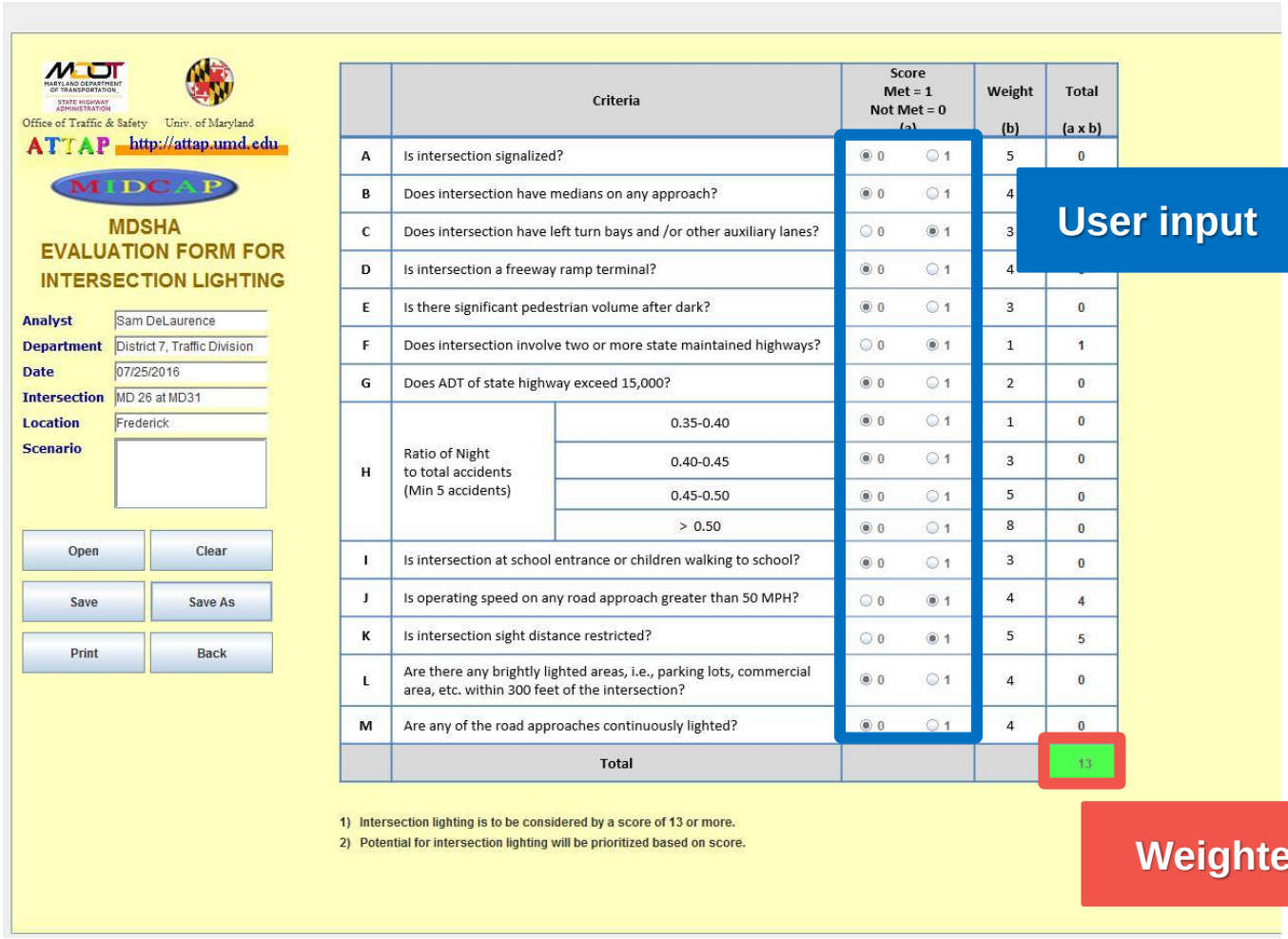
MODULE 4: LEFT TURN PHASE GUIDELINE



MODULE 5: LIGHTING EVALUATION

- Uses the MDOT SHA's **evaluation form for intersection lighting**.
- Provides whether or not the intersection lighting is to be considered based on the weighted sum of scores (13 or more) for criteria, such as signalization, the existence of medians, the existence of left turn bays and/or other auxiliary lanes, etc.

MODULE 5: LIGHTING EVALUATION



Office of Traffic & Safety Univ. of Maryland

ATTAP http://attap.umd.edu

MIDCAP

MDSHA EVALUATION FORM FOR INTERSECTION LIGHTING

Analyst	Sam DeLaurence
Department	District 7, Traffic Division
Date	07/25/2016
Intersection	MD 26 at MD31
Location	Frederick
Scenario	

Open | Clear | Save | Save As | Print | Back

	Criteria		Score Met = 1 Not Met = 0 (a)	Weight (b)	Total (a x b)
A	Is intersection signalized?		0 / 1	5	0
B	Does intersection have medians on any approach?		0 / 1	4	
C	Does intersection have left turn bays and /or other auxiliary lanes?		0 / 1	3	
D	Is intersection a freeway ramp terminal?		0 / 1	4	
E	Is there significant pedestrian volume after dark?		0 / 1	3	0
F	Does intersection involve two or more state maintained highways?		0 / 1	1	1
G	Does ADT of state highway exceed 15,000?		0 / 1	2	0
H	Ratio of Night to total accidents (Min 5 accidents)	0.35-0.40	0 / 1	1	0
		0.40-0.45	0 / 1	3	0
		0.45-0.50	0 / 1	5	0
		> 0.50	0 / 1	8	0
I	Is intersection at school entrance or children walking to school?		0 / 1	3	0
J	Is operating speed on any road approach greater than 50 MPH?		0 / 1	4	4
K	Is intersection sight distance restricted?		0 / 1	5	5
L	Are there any brightly lighted areas, i.e., parking lots, commercial area, etc. within 300 feet of the intersection?		0 / 1	4	0
M	Are any of the road approaches continuously lighted?		0 / 1	4	0
	Total				13

1) Intersection lighting is to be considered by a score of 13 or more.
2) Potential for intersection lighting will be prioritized based on score.

User input

Weighted sum



THANK YOU!

For questions or technical support, contact us at MIDCAP@umd.edu.

ATTAP
http://attap.umd.edu