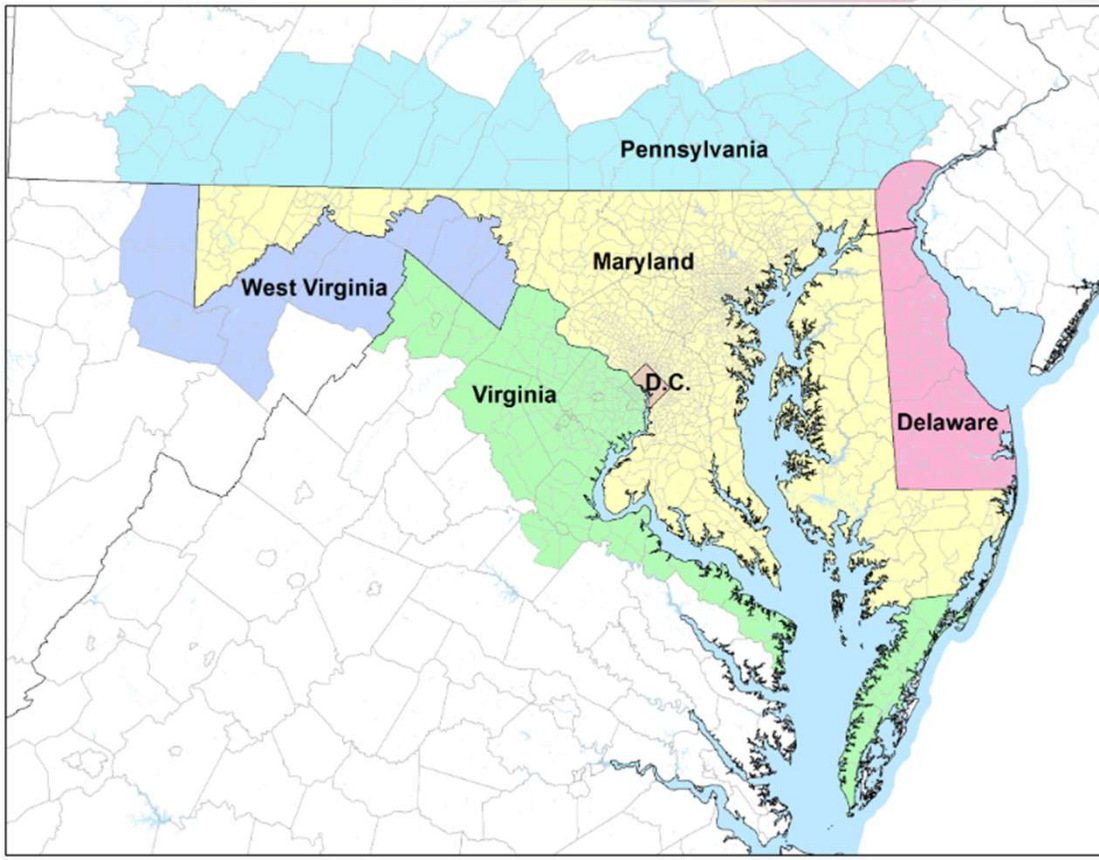
# DEVELOP A MODE CHOICE MODEL TO ESTIMATE WALK AND BIKE TRIPS IN THE MARYLAND STATEWIDE MODEL

**SEPTEMBER 2025**

MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

# MARYLAND STATEWIDE TRANSPORTATION MODEL (MSTM)

- Developed and in production for over 20 years
- Covers the whole state of Maryland
- Trip-based model with ≈1,500 level 1 zones within Maryland
- Includes a 'halo' region around the state for a total of ≈1,800 zones
- FHWA peer reviewed
- FHWA long-distance model
- Freight model
- Includes data from MPOs models in Maryland
  - Baltimore Metropolitan Council
  - Metropolitan Washington Council

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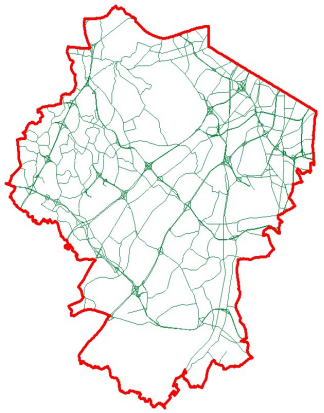
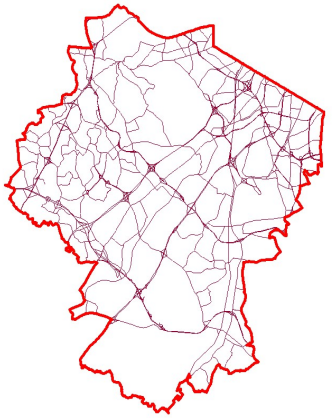
# MARYLAND STATEWIDE TRANSPORTATION MODEL (MSTM)

- Highway network
  - Based on MDOT-SHA roadway centerline data
  - Linkage with other asset data (Counts, ADT Segments, etc.)
  - Single point intersection coding
  - Multi-resolution database allows for greater flexibility and scalability
- Zone Structure
  1. SMZs
  2. TAZs
  3. Census blocks

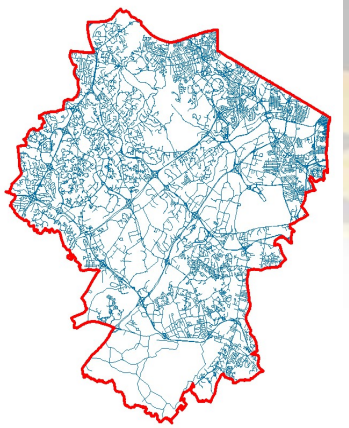
Level 1
MSTM Network



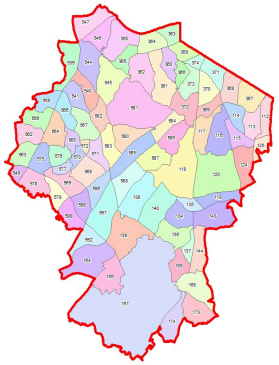
Level 2
MPO Network



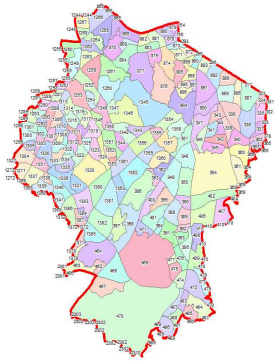
Level 3
SHA Centerline Network



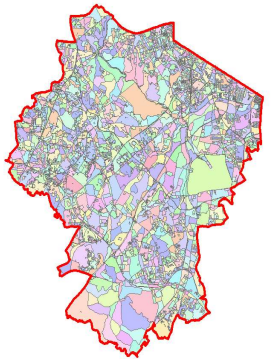
Level 1
MSTM Zones



Level 2
MPO Zones



Level 3
Census Block Zones



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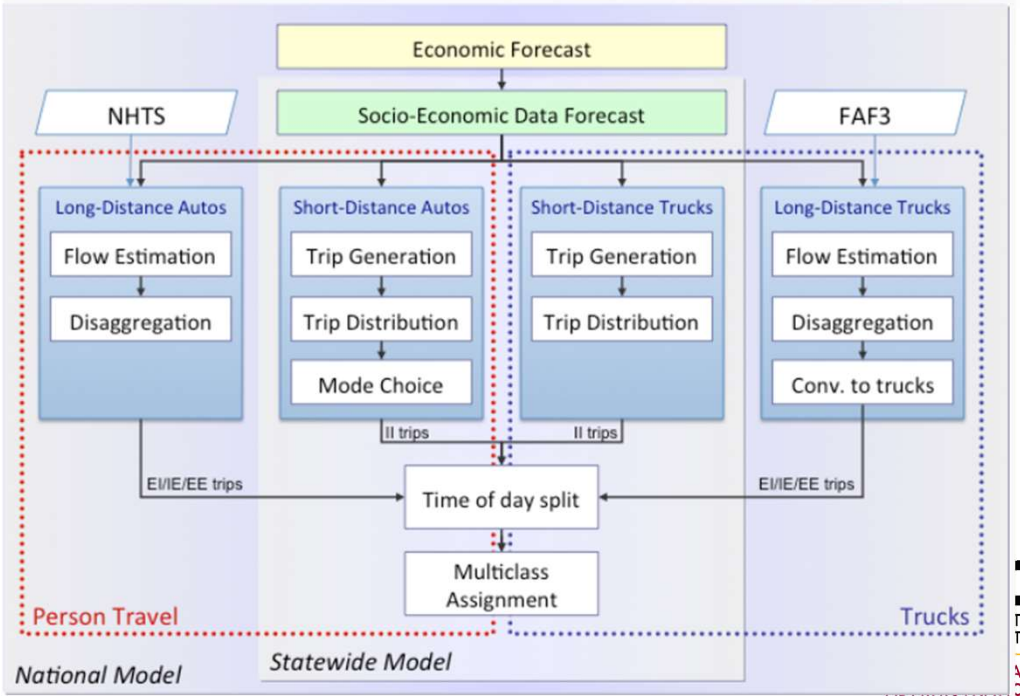
# MARYLAND STATEWIDE TRANSPORTATION MODEL (MSTM)

- Traditional 4-step model
  1. Trip Generation
  2. Trip Distribution
  3. **Mode-Choice**
  4. Assignment

Currently in MSTM

- Mode choice accounts only for motorized modes
- Non-motorized shares are static and identified from old survey data, and thus removed from model stream

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# RESEARCH PROJECT BACKGROUND

- In summer of 2023, MDOT SHA funded a research project to develop a mode choice model.
- Morgan State and Carnegie Mellon University were awarded research funding.
- Both universities jointly collaborated to conduct the research.

# RESEARCH GAPS

Current mode choice model limitations:

- Limited data available on alternative travel modes for walk/bike trips
- Survey data restricts accurate OD location detail due to privacy constraints
- Few models incorporate Level of Traffic Stress (LTS) or other bike/ped related network measures

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# RESEARCH GOALS

- Model walk and bike modes in the statewide model
- Expand MSTM capabilities to support MDOT policy & program initiatives related to active transportation
- Improve representation of short distance, non-motorized trips in the statewide model

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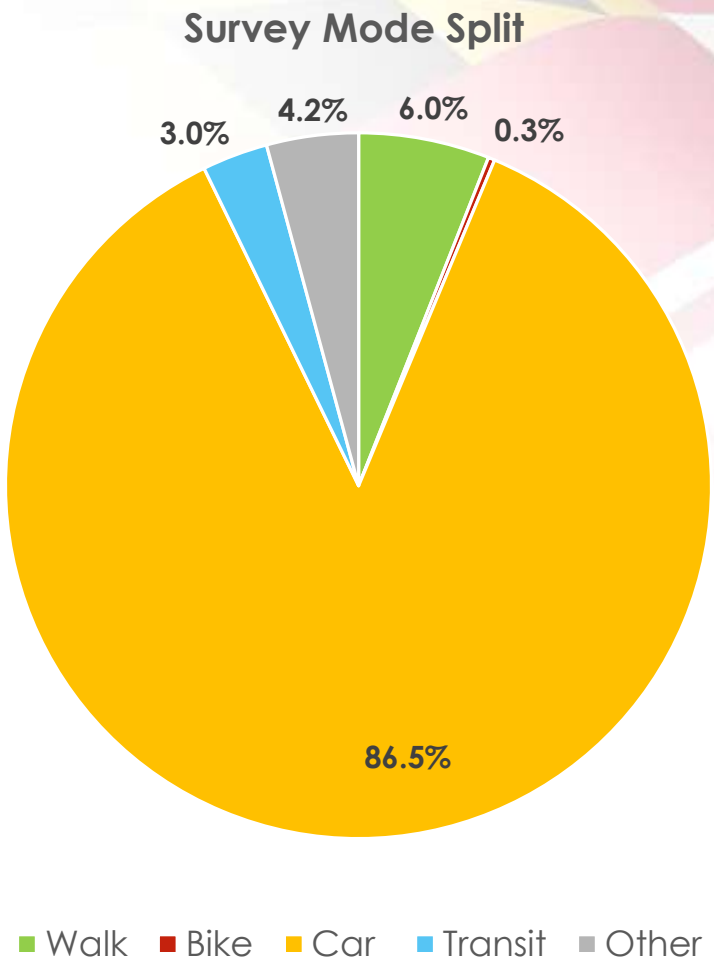
# Data

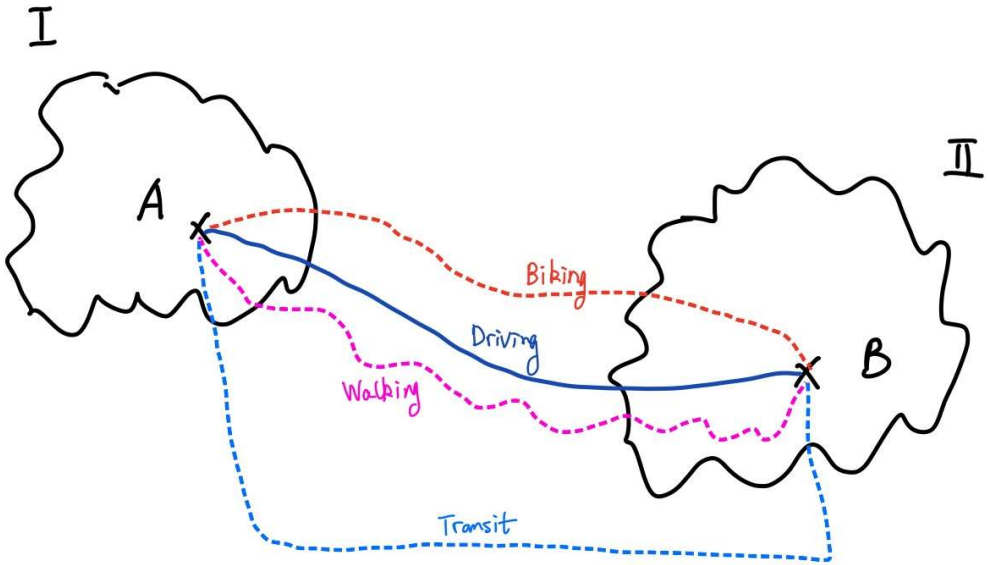
**Maryland Statewide Household Travel Survey**

- April 2018 to August 2019
- 59,913 trips on weekdays
- Demographics, selected travel mode, distance, duration, and OD at CBG level



# Data

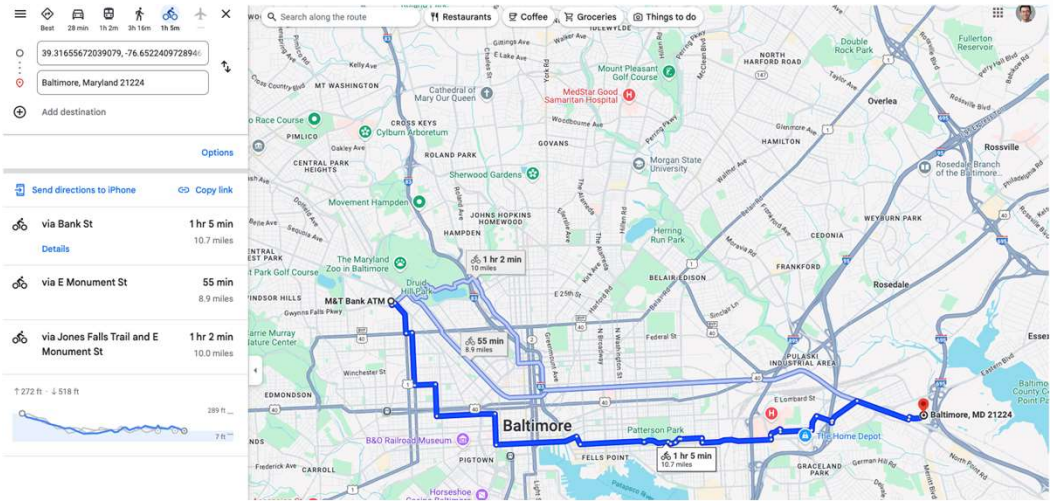
- Use Google Maps API to request travel cost information
- Modes included: Car, walk, bike, and transit (+walk)



# Data

## Google Maps API

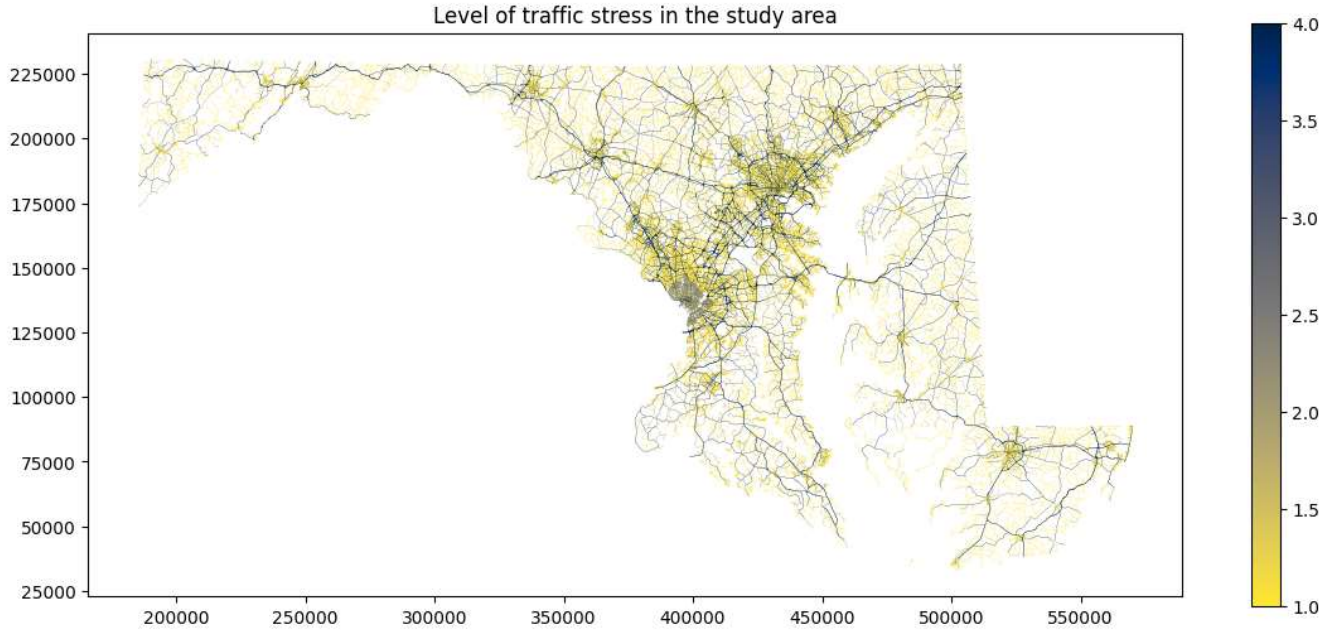
- Largest navigation platform
- Provide multiple routes for each OD pair
- Distance, duration, and polyline of each route
- Recommends routes based on aggregated travel behavior from users



# Data

## MDOT Level of Traffic Stress (LTS)

- Level of traffic stress experienced by the road users
- MDOT methodology scores based on factors: speed, volume, number of lanes, bike lane width, etc.
- Scale: 1–4, with higher values = greater stress



# Methodology

- Model people's active travel mode choice for the entire Maryland state
- Randomly sample locations within the census block group (CBG) level
- Apply a unique dataset containing the LTS for over 140,000 roads in Maryland and DC
- Request travel time/cost information of the routes of alternative travel modes from Google Maps API

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# Methodology

**Multinomial logit model**

- **Alternatives:** Car, walk, bike, and transit

$$Mode\ choice = f(Network\ attributes, Trip\ attributes, Accessibility, Sociodemographic\ variables)$$

- **Network Attributes:** Level of traffic Stress (LTS)
- **Accessibility (**from Accessibility Observatory)
- **Trip Attributes:** Travel Time, Distance (Google API)
- **Sociodemographic:** Employment status, income, age, gender, household size, etc.

# Model Results

- Coefficients and statistical significance levels were estimated across all attribute categories, including sociodemographic variables, trip characteristics, and network-related attributes.
- Some attributes with high significance are shown below:

Table. Model result

| Variable | Estimate | Significance level |
|---|---|---|
| LTS | -0.58 | *** |
| Duration | -4.10E-04 | *** |

Table. Model results

| Variable | | Estimate | Significance level |
|---|---|---|---|
| Number of vehicles | Walk | -0.45 | *** |
| | Bike | -0.53 | *** |
| | Transit | -1.34 | *** |
| Parking cost at destination | Walk | 0.02 | *** |
| | Bike | 0.02 | ** |
| | Transit | 0.01 | *** |
| License | Walk | -1.79 | *** |
| | Bike | -1.24 | *** |
| | Transit | -2.40 | *** |
| Gender | Walk | 0.23 | ** |
| | Bike | 2.12 | *** |
| | Transit | 0.00 | |
| Age | Walk | -0.21 | *** |
| | Bike | -0.69 | *** |
| | Transit | -0.15 | ** |
| Household income | Walk | 0.38 | *** |
| | Bike | 0.09 | |
| | Transit | 0.19 | |
| Household size | Walk | 0.01 | |
| | Bike | -0.28 | ** |
| | Transit | 0.13 | *** |

# CASE STUDY

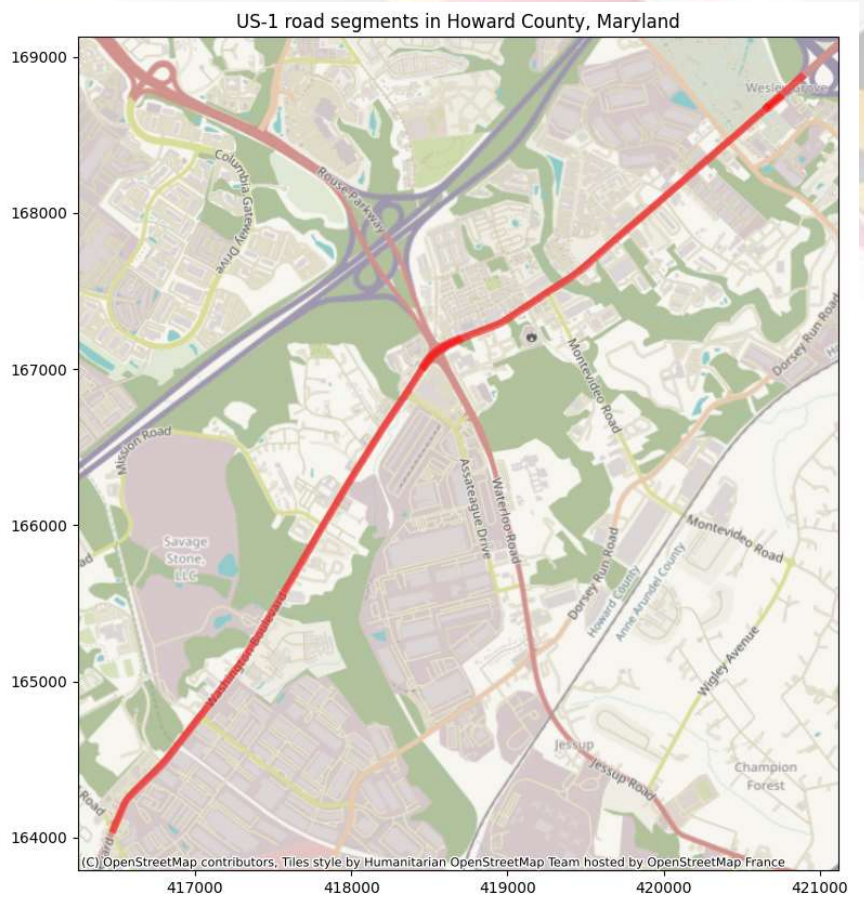
**US 1 in Howard County, MD** (in red)

- Four-lane highway
- Suburban area
- Medium density mixed use
- Current LTS level 4

**Improvements**

- Accessible pedestrian signal with countdown (APS/CPS)
- Americans with Disabilities ACT (ADA) improvements
- Lighting enhancements

| Travel Mode | Before (%) | After (%) | Change (%) |
|---|---|---|---|
| Bike | 0.11 | 2.83 | 2.72 |
| Walk | 0.21 | 3.41 | 3.2 |
| Transit | 1.44 | 3.22 | 1.78 |
| Car | 98.2 | 90.54 | -7.66 |



## NEXT STEPS

- Integrate MDOT LTS methodology to MSTM network system
- Integrate the updated mode choice model to MSTM
- Validate results using examples of Complete Street project across the state

# Thank You!