



CENTRAL FLORIDA TSM&O CONSORTIUM MEETING SUMMARY

Meeting Date: June 5, 2025 (Thursday) **Time:** 10:00 AM – 12:00 PM

Subject: TSM&O Consortium Meeting

Meeting Location: FDOT District Five RTMC (4975 Wilson Rd., Sanford, FL 32771) and Teleconference

I. OVERVIEW

The purpose of this recurring meeting is to provide an opportunity for District Five FDOT staff and local/regional agency partners to collaborate on the state of the TSM&O Program and ongoing efforts in Central Florida. Jeremy Dilmore gave a short introduction and outlined the meeting agenda.

II. FDOT DISTRICT FIVE UPDATE

Tushar Patel provided a brief update on District Five Traffic Operations staffing.

- Jay Williams is now the District Traffic Operations Engineer (DTOE)
 - Jim Stroz, the former DTOE, is now the District's Director of Transportation Development

III. FDOT DISTRICT FIVE ITS MASTER PLAN

Dale Cody (Metric) presented on the District Five ITS Master Plan Update.

- District 5 is updating the 2016 ITS Master Plan
 - This update will be a Technical Document that is supplementary to the original ITS Master Plan. This update will NOT include a Priority List of Projects
- Lessons learned on emerging technologies from previous Master Plan
 - Wrong way driving has been a successful program, but we have many lessons learned
 - AI is the emerging technology of the Master Plan update, similar to Connected Vehicle from the last Master Plan
- Arterial Technology Rollout
 - Roadway functions (GIS Map)
 - Functional classification
 - AADT
 - Detours
 - Event Management Role
 - Safety Analysis
 - Goal is to use crash history to identify the corresponding factors that led to those crashes so that future crashes can be avoided

- Mobility Analysis to identify trouble areas
- Applications
 - EVP (rollout, agency, schedule, agreements) – replacement for traditional EVP
 - ATSPM, HMS/Shortcut, Left Turn analysis, etc.
 - Near-miss analysis (COT hardware or service)
 - Red protect minimizes severity of crashes related to red-light running
 - TMC generation
- Location Analysis
 - Identify where applications fit across FDOT and Local Agency signal systems
- Hardware needs by application
- Hardware needs by location
- Data management needs – District 5 as central warehouse with SunStore
- Freeway Technology Rollout
 - Safety analysis – use crash history to identify the corresponding factors that led to those crashes so that future crashes can be avoided
 - Freeway analysis
 - Mobility analysis to identify trouble areas
 - Applications
 - WWD
 - Full WWD, WWD Lite (OREPS), WWD mainline integration
 - Queue warning (CV to RSU)
 - Lane control signs
 - Signing needs
 - ESU
 - Predictive safety
- Connected Vehicle
 - Overall view
 - Direct and networked
 - Cellular LTE/5G/6G
 - Data management
 - Hardware-based
 - RSU/OBU
 - Hardware needs by location
- Automation / Artificial Intelligence
 - Risks and rewards – highlight FDOT AI policy
 - TMC management integration
 - Existing automation
 - QC & Report Generation
 - Next Steps
 - Decision Support System (DSS)
 - Items not to be automated
 - Control
 - Asset maintenance integration
 - Interpretation and data searches

- Serving other offices
- Supporting County and City TMCs
 - List of existing TMCs and their operations parameters
 - Needs of local TMCs
 - Implementation Plan
 - What can we do: data, workforce development, SIIA, supply sign/signal data
- Supporting MPO / TPO Efforts
 - What can we do: MPO/TPO priority projects, data, workforce development, etc.?

IV. REGIONAL TSM&O STRATEGIC PLAN

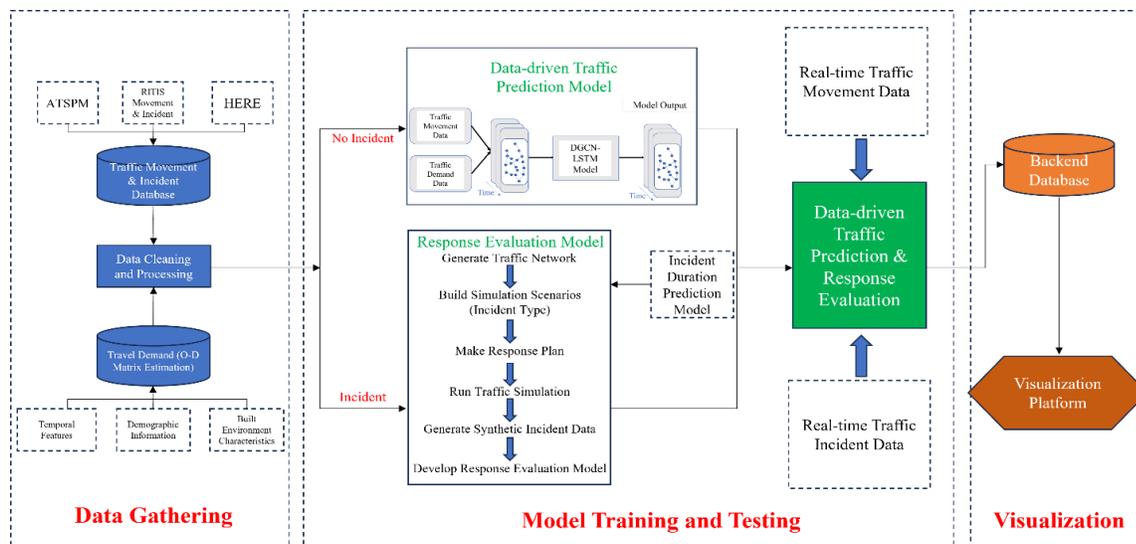
Eric Hill (MetroPlan Orlando) gave a brief update on the Regional TSM&O Strategic Plan.

- RTSM&O Strategic Plan published in February 2025
 - https://metroplanorlando.gov/wp-content/uploads/RTSMO_Strategic-Plan_FINAL_03.06.2025.pdf
- Stakeholder agencies
 - 10 Central Florida MPO/TPO agencies
 - CFX
 - THEA
 - FDOT / Florida's Turnpike Enterprise
 - USDOT
- If there's not a strong commitment for staffing and funding, it won't become a reality
- Vision – A collaborative regional partnership that leverages the individual and combined strengths of members to maximize effective TSM&O planning
- Goals and objectives
 - Align with the defined organizational purpose statement and vision
 - Reflect emerging TSM&O strategies and best practices
 - Apply to a regional TSM&O planning and decision-making organization

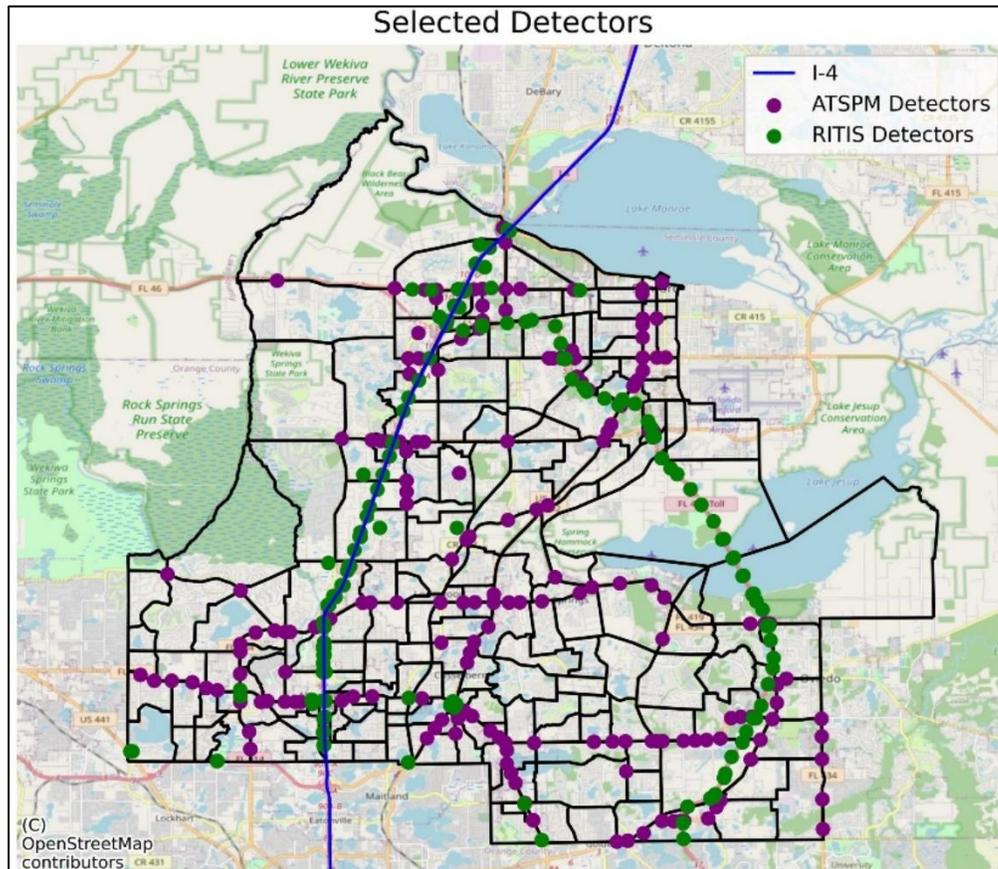
V. TRAFFIC PREDICTION MODELS FOR ICM

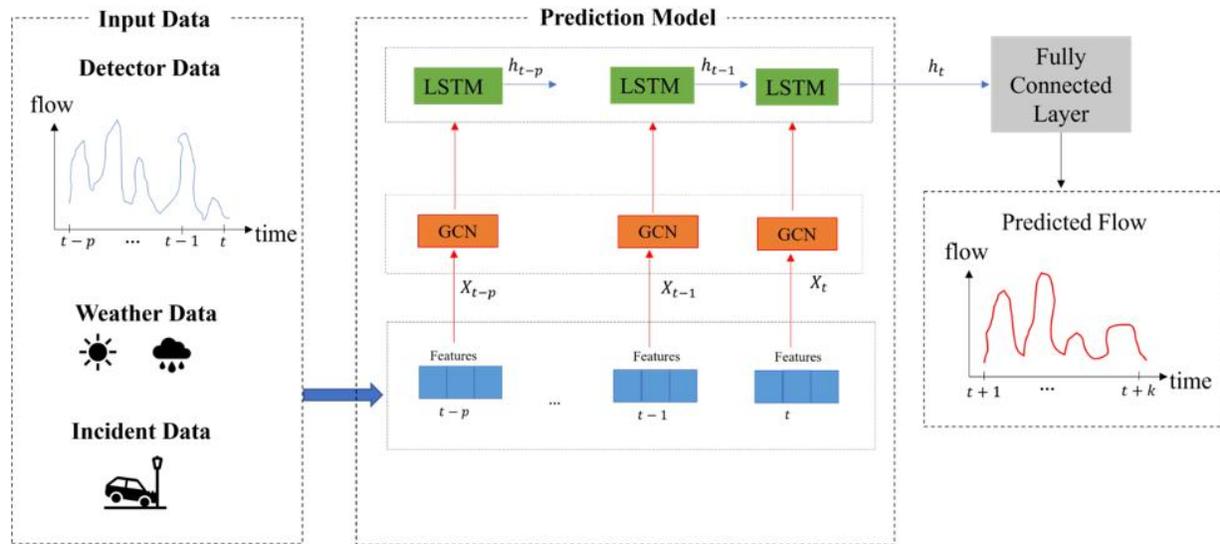
Dr. Samiul Hasan (University of Central Florida) discussed the Deep Learning-based Network-wide Traffic Prediction Models for Integrated Corridor Management Systems (ICMS).

- Simulation-based approach for traffic prediction in ICMS is costly, time consuming, and can't leverage real-time traffic data
- A deep-learning based traffic prediction system can be a better alternative considering the precision, robustness, and cost-effectiveness
- The research develops
 - Deep learning-based modeling framework for high-fidelity traffic prediction
 - Machine learning-based framework for incident duration prediction
 - Predictive strategy evaluator to assess the potential traffic management strategy impacts
- Concept Modeling Framework



- Traffic Prediction Model
 - Study area: Seminole County
 - Datasets include traffic volume, traffic speed, traffic incident, demographic characteristics, built environment, and land use data
 - Study period: 2019
 - Four prediction horizons: 15-minute, 30-minute, 45-minute, and 60-minute
 - “Given the current situation, what will the traffic look like in 15/30/45/60 minutes?”

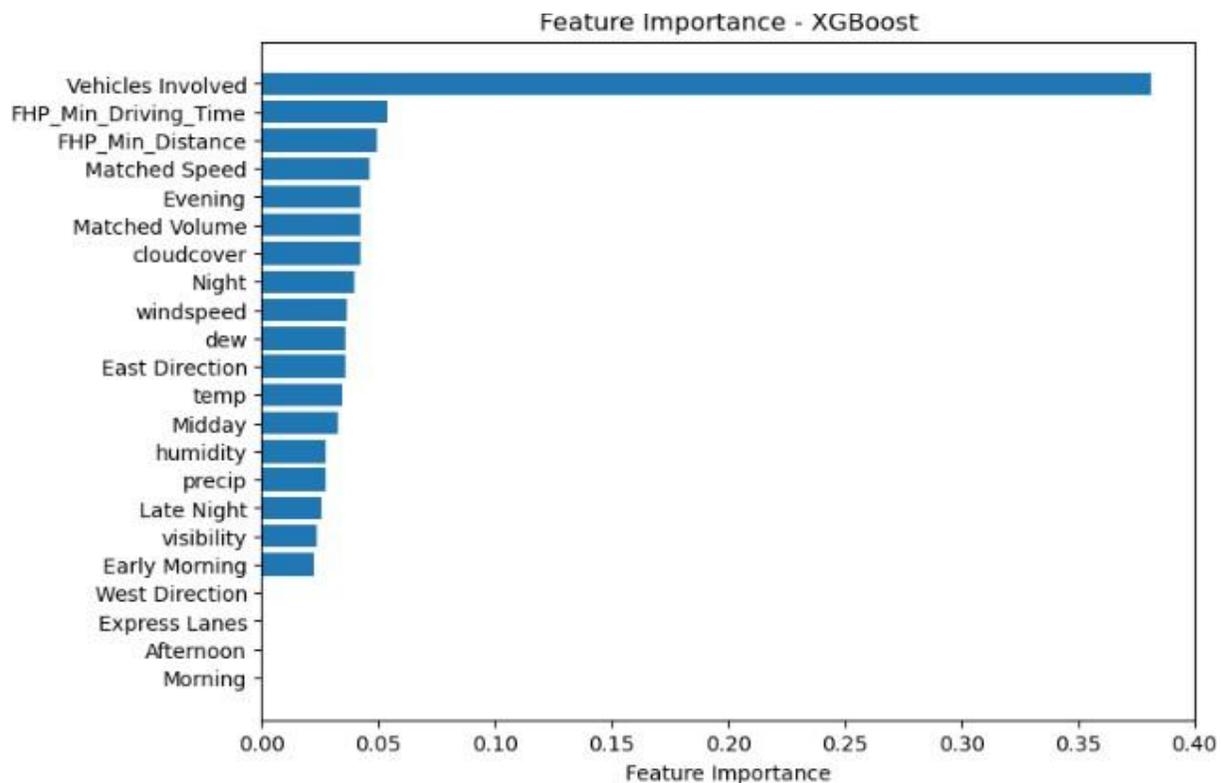




GCN – Graph Convolutional Network
 LSTM – Long Short-Term Memory Network
 CNN – Convolutional Neural Network

- Traffic Prediction Model results
 - The GCN-LSTM Model performed better than baseline LSTM and CNN-LSTM models
 - During an incident period, the model performance declined, but it remained within acceptable range for practical applications
- Incident Duration Prediction Model
 - 22,469 incidents covering a 23-mile stretch of I-4 in Seminole County and Orange County were considered during 2023 – 2024
 - Four incident duration categories were developed
 - Short duration (5-30 minutes)
 - Medium duration (30-60 minutes)
 - Long duration (60-180 minutes)
 - Very Long duration (> 180 minutes)
 - Machine Learning-based models are considered for duration prediction
 - Features included in analysis:
 - Location (EB or WB)
 - Time of day, Weekday/Weekend, and month
 - Incident-related elements such as responders, vehicles involved, maximum lanes closed, notifications sent, etc.
 - This data is not available at beginning of incident, but once available, it greatly contributes to the model's predictive capabilities
 - Traffic and geometric features
 - Temperature, dew, humidity, rain, wind, visibility, cloud cover
 - Emergency response features including minimum driving distance from FHP, minimum driving time from FHP

- The most important data feature to help model performance was the number of vehicles



- Predictive Strategy Evaluator
 - Simulated regular and incident scenarios as well as response strategies
 - Train the deep learning model with the last few time intervals simulated data and predict for the next time interval
 - In real-time operation, the deep learning model will be pre-trained and it will use real-time traffic data to predict most effective response for the next time periods
 - Case study: 9 miles of I-4 in Altamonte Springs
 - Pre-built Aimsun model is used and the chosen sub-network is calibrated with RITIS detector data before running the scenarios
- A dashboard is in development, providing a graphical user interface for:
 - Traffic Prediction
 - Incident Duration Prediction
 - Incident Strategy Evaluation
- Traffic Prediction during Hurricane Evacuation
 - Evacuation traffic is more dynamic and uncertain than regular traffic, influenced by evolving hurricane characteristics and evacuee's response toward evacuation orders
 - Sudden increase in traffic during hurricane evacuation events creates congestion on major highways, leading to delays and safety risks for evacuees
 - Predicting evacuation traffic in advance can significantly improve traffic management
 - Developed dynamic graph learning framework to capture the dynamics of detector-based network representation
 - Developed a generalized evacuation traffic prediction model using past hurricane data to

- predict future traffic flow with a lead time up to 6 hours
- The model used 11 previous hurricane events for learning; it did not include Hurricane Milton because that was the test case
- Hurricane Evacuation Prediction results (comparison of predictive model against real-world Hurricane Milton evacuation results)
 - Performed 1-hour prediction very well; can do 6-hour predictions moderately well
- Key recommendations
 - Extend study area to increase model coverage and more response strategies
 - Implementation will depend on real-time data integration through APIs, data availability, and rigorous model training/testing
 - Pilot studies for data-driven traffic prediction models and the predictive strategy evaluator for incident management
 - Pilot studies for evacuation traffic management

VI. TSM&O CONSTRUCTION PROJECT TRACKING

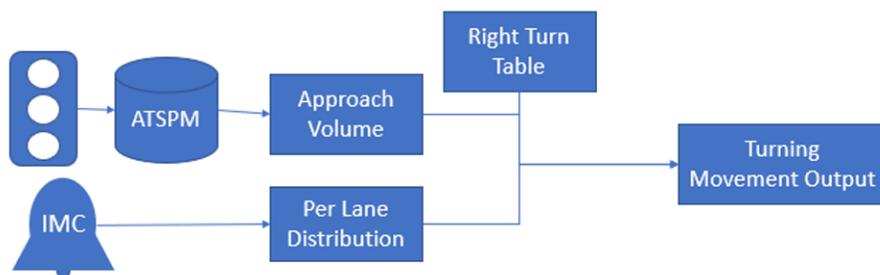
Jennifer Sardonini (FDOT) briefly discussed District Five's Construction tracking board for all projects with ITS equipment.

- Goal of this tracking system is to ensure the Traffic Operations team is aware of all Construction projects and their associated ITS equipment
- Hosted on the Jira work management platform
- District 5 is investigating how it can share a view-only API with external partners

VII. HEIDI UPDATE

Katie King (Metric) provided a brief update on the Department's High-definition Engineering Intersection Data via Integrative modeling (HEIDI) system.

- The HEIDI is the District's digital twin project
- Primary goal is to improve data completeness on arterials to improve our ability to operate the signals as part of the ICMS
 - "Can we fuse multiple datasets together using AI to reduce costs and scale out?"
- At the highest level, the most beneficial datasets to use to make real-time decisions are all some derivative of speed, volume, and occupancy
 - Volume data, particularly turning movement count (TMC) volume, is extremely helpful in making signal timing adjustments
 - The Smart Signal program has worked to improve data completeness deploying ATSPM capable controllers and video detection systems capable of volume counts. This is used to make informed signal timing plan change recommendations based on real-time roadway conditions.
- There are over 1,700 signalized intersections in District Five
 - 900+ signals are reporting ATSPM (2-minute frequency)
 - 200+ signals have CCTV reporting TMCs



- Timeline
 - Project kicked off in July 2023 with Flow Labs
 - Phase 1 Pilot Project – complete
 - Phase 2 Scale Up – in progress; approximately 1 more month to start seeing new locations that are currently being trained
- The pilot used two dissimilar corridors: one urban corridor in Lake Mary, one rural corridor in Sumter County
 - Primarily fuses ATSPM data with TomTom probe vehicle data
- The pilot was successful in synthesizing TMC data with 90% or higher accuracy
- Based on the pilot, moving forward with 15-minute latency and in a 15-minute bin
 - This range got the best value in accuracy. Additionally, 15-minute buckets tend to be preferred in operational analyses
- Phase 2 Scale Up
 - We will get 2,000 total signals
 - All 1,700 state road signals in the District
 - Additional 300 signals off-system
 - Chosen based on several factors: event management areas, attraction areas, Moving I-4 Forward construction, ICM diversion routes, and evacuation routes.
- Project ROI Calculator can be used to assess retiming on other implementations

	BEFORE 03/28/25 - 04/25/25	AFTER 04/28/25 - 05/23/25	CHANGE
Volume			
> Average Daily Traffic (ADT) (Entering Vehicles per Day)	70,568	71,126	+0.8%
Mobility			
Network Delay (Hour)	14,597.4hr	14,427.5hr	-1.2%
NB/EB Travel Time (median)	930.4s	901.4s	-3.1%
SB/WB Travel Time (median)	865.3s	850.7s	-1.7%
> Buffer Index	28.7%	36.8%	+28.2%
> Planning Time Index	1.78	1.86	+4.5%
> Travel Time Index	1.34	1.31	-2.2%

- Can District 5 give access to other agencies?
 - Yes!
 - After Phase 2 Scale Up, we can create an account for anyone who requests it
 - Will also host a training session to walkthrough platform. These trainings will also be available on the platform

VIII. TRAVEL-TIME TOOL

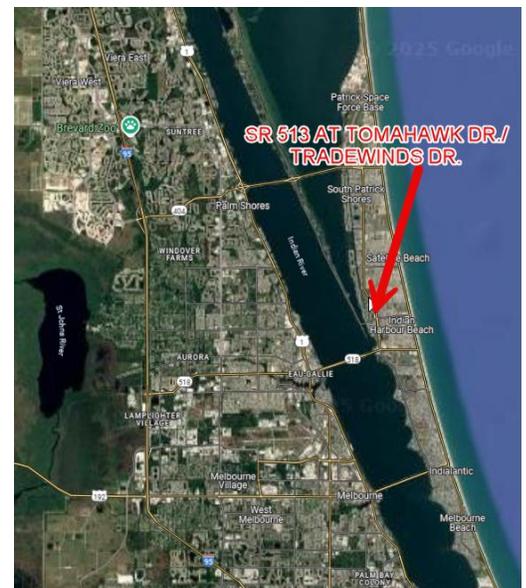
Katie King gave a brief demonstration of the Travel-Time Compare Tool.

- This travel-time tool holds a rolling 60 days of HERE data
- Suggest selecting/deselecting directional buttons to only represent the directionality you're looking for

IX. FLASH AWARD

Kevin Marquez (FDOT) presented FDOT's FLASH Award to Brevard County team members.

- SR 513 at Tomahawk Dr. / Tradewinds Dr.
- On March 18, 2025, Prompt Correction Action Advisory report was published by the SMO requesting the removal of mast arm structure due to severe corrosion and section loss at the base plate
- Emergency Response Details:
 - March 18 – Coordination began between County and District 5 to remove mast arm and use a temporary signal trailer
 - County secures contractor services for the removal work
 - County begins to secure MOT/LEO services
 - County notifies residents, businesses, and local City government of plans for construction and lane closures
 - March 25 – County received temporary traffic signal trailer, pre-positioned at the site and began preparations for use
 - March 26 – County tests and configures the trailer for use
 - March 27 – began removing mast arm at 7:30am; by 9:30am, the mast arm was removed and the signal trailer was running the approach



- Key successes
 - Experienced County personnel leading experienced contractors
 - Coordination and planning began on the same day of receiving the report
 - Split work between in-house and contracting staff to expedite results and save budget
 - Having set-aside funds for emergencies
 - Quickly determined that improvements to monitoring were needed; implemented this before switchover
 - Coordination with FDOT for equipment
- Lessons learned
 - Selection of contractor is critical to success
 - Ensure you consider heavy machinery availability part of your selection
- Future work
 - D5 TOPB working on plans to remove trailer and install temporary spans
 - Removal of additional mast arm also required but not an immediate need
 - Full intersection rebuild project also requested; scoping is underway



X. NEXT MEETING

- November 6, 2025

XI. ATTACHMENTS

- A – Presentation Slides
- B – Meeting agenda

END OF SUMMARY

This summary was prepared by David Williams and is provided as a summary (not verbatim) for use by the Consortium Members. The comments do not reflect FDOT's concurrence. Please review and send comments via e-mail to david.williams2@dot.state.fl.us so the meeting summary can be finalized.

Welcome to the TSM&O Consortium Meeting June 5, 2025



Meeting Agenda

1. FDOT District 5 Update
2. FDOT District 5 ITS Master Plan
3. Regional TSM&O Strategic Plan
4. Traffic Prediction Models for ICM
5. TSM&O Construction Project Tracking
6. HEIDI Update
7. Travel-Time Tool
8. FLASH Award – Brevard County



FDOT District Five Staffing Update

Tushar Patel, FDOT District Five

FDOT District Five Staffing Update

Recently Announced

- District Traffic Operations Engineer (DTOE)





D5 Integrated Corridor Management Project
Contract: CAG21

ITS MASTER PLAN UPDATE

A futuristic city street scene with digital overlays. A dark SUV is driving away from the viewer on a city street. The scene is overlaid with various blue and cyan digital icons and lines, including a person icon, a Wi-Fi symbol, a mail icon, and a car icon. The background shows modern buildings and green trees under a blue sky with clouds.

TSM&O Consortium Meeting
June 5, 2025

INTRODUCTION / OVERVIEW

FDOT District 5 is seeking to provide an update to the 2016 ITS Master Plan. This update will be a Technical Document that is supplementary to the original ITS Master Plan. This Update will NOT include a Priority List of Projects.





ITS MASTER PLAN

1. Lessons Learned on Emerging Technologies from Previous Master Plan

2. Arterial Technology Role Out

3. Freeway Technology Role Out

4. Connected Vehicle

5. Automation / Artificial Intelligence

6. Supporting County and City TMCs

7. Supporting MPO / TPO Efforts

LESSONS LEARNED ON EMERGING TECHNOLOGIES FROM PREVIOUS MASTER PLAN

- A. ATCMTD
- B. Automation
- C. Connected Vehicles
- D. Software Development
- E. Data





ITS MASTER PLAN

1. Lessons Learned on Emerging Technologies from Previous Master Plan

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ARTERIAL TECHNOLOGY ROLL OUT

A. Roadway Functions (GIS Map)

- Functional Classification
- AADT
- Detours – Continue evaluation of Diversion Routes Districtwide
- Event Management Role (Ingress/Egress) – Event Routing

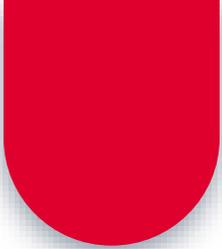
B. Safety Analysis (High level trends) -> future grants – HEAT maps => Trouble areas

- The goal is to use crash history (Injury/Fatals) to identify the corresponding factors (Congestion, Weather, etc.) that led to those crashes so that future crashes can be avoided.

B. Mobility Analysis (high level trends) – HEAT maps => Trouble areas

C. Applications

- EVP (rollout, agency, schedule, agreements) – replacement for traditional EVP



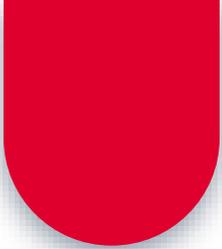
ARTERIAL TECHNOLOGY ROLL OUT

D. Applications (Cont'd)

- ATSPM (rollout and agency confirmation)
- HMS/Shortcut (IT security concern and process)
- Red Protect (define area, agency agreement, hardware, connection, TSMA hardware) – Red Light Running
- Left Turn Analysis (internal conversation between TSMO and Studies, functionality, structures signal heads, use of Flo Labs/ATSPM data for studies)
- Near Miss Analysis (COT hardware, or service)
- TMC generation (how does this data from near miss data gathering fit together)

E. Location Analysis

- Identify where applications fit across FDOT and Local Agency signal systems



ARTERIAL TECHNOLOGY ROLL OUT

F. Hardware Needs by Application – ties back to Application needs by Stakeholder

- EVP
- ATSPM
- HMS
- Red Protect/Red Light Running
- Left Turn Analysis
- Near Miss Analysis
- TMC Generation

G. Hardware Needs by location – Determine locations from operations staff and local agency

- Communications
- Camera
- Applications related hardware

H. Data Management Needs – D5 as central warehouse with SunStore. What do we do with the Depot/DEP (CV, ATSPM, etc.)



ITS MASTER PLAN

1. Lessons Learned on Emerging Technologies from Previous Master Plan

2. Arterial Technology Roll Out

3. Freeway Technology Roll Out

4. Connected Vehicle

5. Automation / Artificial Intelligence

6. Supporting County and City TMCs

7. Supporting MPO / TPO Efforts

FREEWAY TECHNOLOGY ROLL OUT

A. Safety Analysis

- The goal is to use crash history (Injury/Fatals) to identify the corresponding factors (Congestion, Weather, etc.) that led to those crashes so that future crashes can be avoided.

B. Freeway Analysis

C. Mobility Analysis (high level trends) – HEAT maps => Trouble areas

D. Applications

- WWD
 - Full WWD – Ramp systems
 - WWD lite – OREPS (Kevin)
 - WWD mainline integration – Ramp to mainline (IBI system)



FREEWAY TECHNOLOGY ROLL OUT

D. Applications (Cont'd)

- Queue Warning (CV to RSU)
- Lane Control Signs
- Signing Needs
- ESU
- Predictive Safety
 - Confirmation of functionality
 - Proactive strategy identification
 - Hardware needs for proactive safety
 - REMOVABLE SECTION – Part Time Shoulder Use





ITS MASTER PLAN

1. Lessons Learned on Emerging Technologies from Previous Master Plan

2. Arterial Technology Roll Out

3. Freeway Technology Roll Out

4. Connected Vehicle

5. Automation / Artificial Intelligence

6. Supporting County and City TMCs

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CONNECTED VEHICLE

A. Overall view

- Direct and Networked
- Cellular LTE/5G/6G
 - MEC/Low Latency
 - UWB and positional accuracy
- Data Management
 - Importance of Metadata
 - Statewide system of systems
- Hardware based
 - RSU/OBU
 - Controller requirements

B. Hardware Needs by location





ITS MASTER PLAN

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3. Freeway Technology Roll Out

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5. Automation / Artificial Intelligence

6. Supporting County and City TMCs

7. Supporting MPO / TPO Efforts



AUTOMATION / ARTIFICIAL INTELLIGENCE

A. Risks and rewards

- Highlight FDOT AI policy
- Rule based implementation vs AI

B. TMC Management Integration

- Existing Automation
 - QC
 - Report Generation
- Next Steps
 - DSS
- Items not to be automated
 - Control

C. Asset Maintenance Integration

D. Interpretation and Data Searches

E. Serving Other Offices



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6. Supporting County and City TMCs

7. Supporting MPO / TPO Efforts

SUPPORTING COUNTY AND CITY TMCs

- A. List of Existing TMCs and their operations parameters
- B. Needs of local TMCs
- C. Implementation Plan
- D. What can we do: data, workforce development, SIIA, supply sign/signal data, etc.?





ITS MASTER PLAN

1. Lessons Learned on Emerging Technologies from Previous Master Plan

2. Arterial Technology Role Out

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5. Automation / Artificial Intelligence

6. Supporting County and City TMCs

7. Supporting MPO / TPO Efforts



SUPPORTING MPO / TPO EFFORTS

A. What can we do: MPO/TPO priority projects, data, workforce development, etc.?



Regional TSM&O Strategic Plan Update

Eric Hill, MetroPlan Orlando



**Deep Learning-based Network-wide
Traffic Prediction Models for Integrated
Corridor Management Systems**

**Dr. Samiul Hasan
Urban Networks, Mobility, and Dynamics Lab
Associate Professor
University of Central Florida**

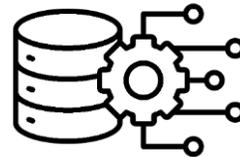
Motivation

- Simulation-based approach for traffic prediction in ICMS is costly, time consuming, and can't leverage real time traffic data.
- A deep-learning based traffic prediction system can be a better alternative considering the precision, robustness, and cost-effectiveness.
- The research develops



Deep Learning-based Modeling Framework

for high-fidelity traffic prediction



Machine Learning-based Framework

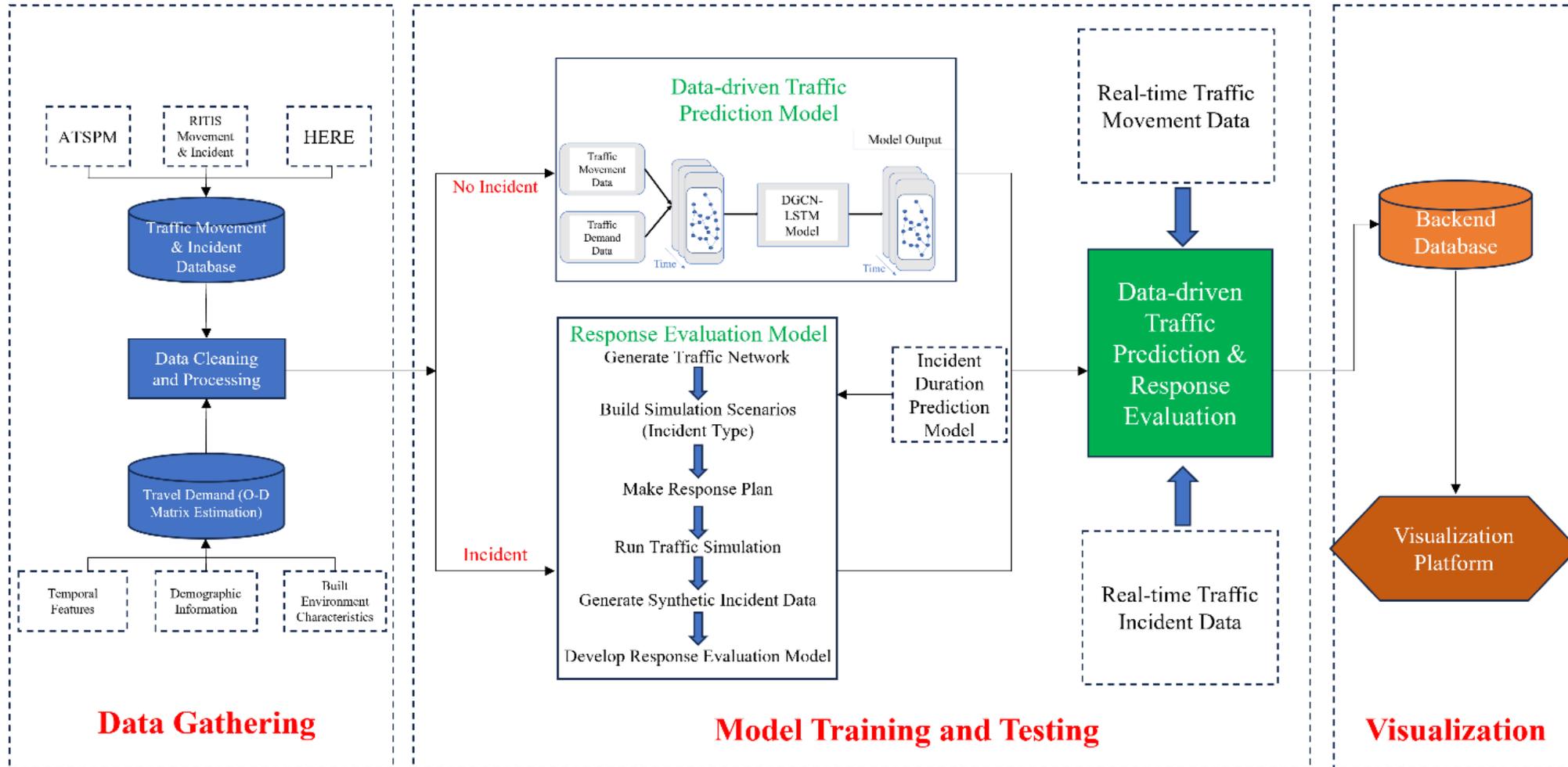
for incident duration prediction



Predictive Strategy Evaluator

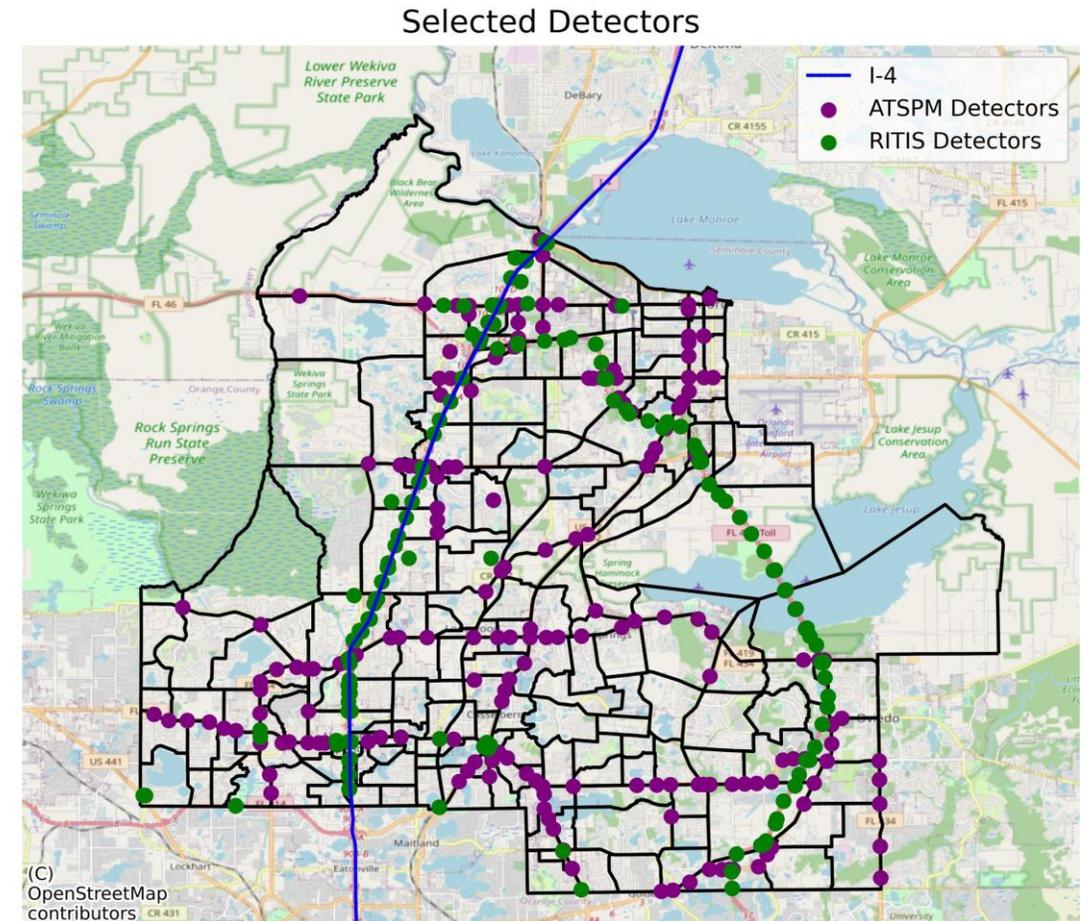
to assess the potential traffic management strategy impacts

Conceptual Modeling Framework

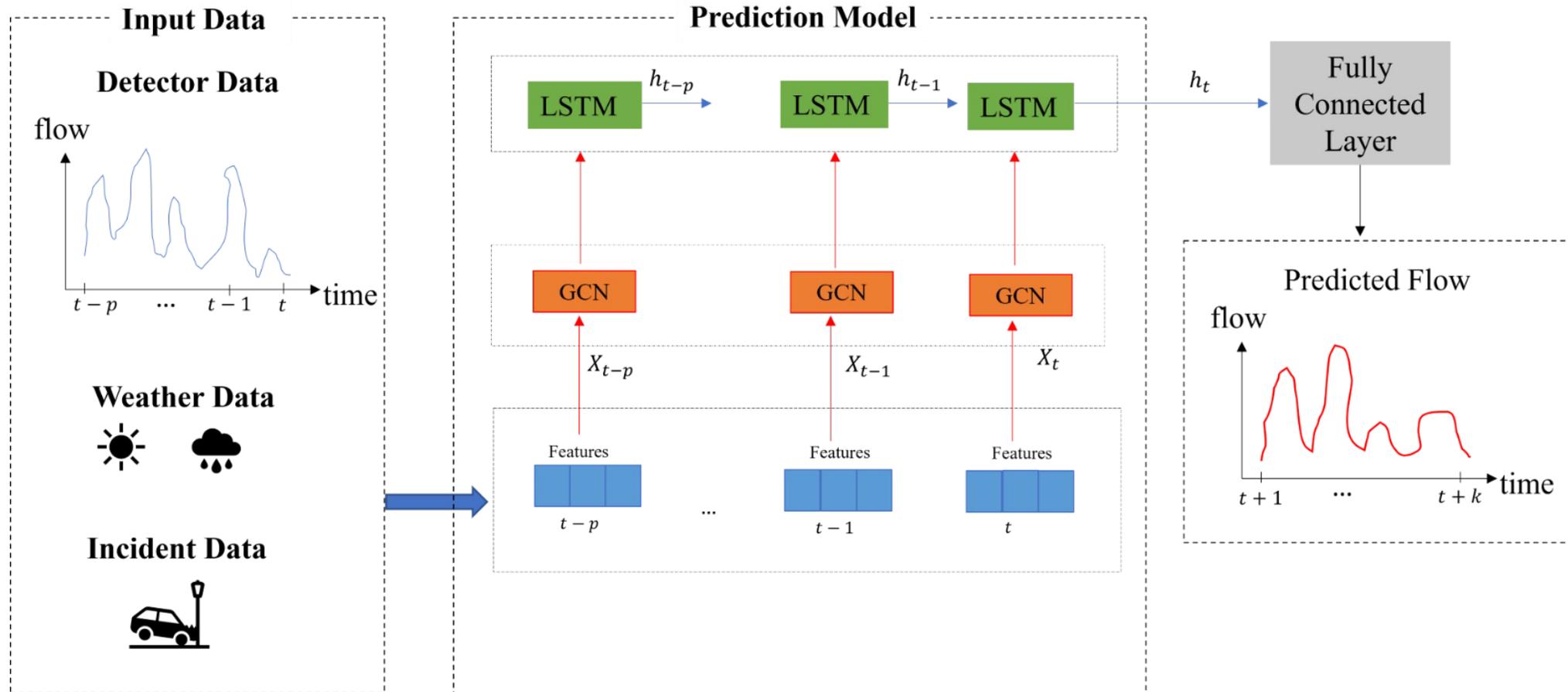


Traffic Prediction

- Study Area: Seminole County
- Traffic volume: extracted from RITIS and ATSPM detectors
- Traffic speed: extracted from HERE.
- Traffic incident: are extracted from RITIS.
- Socio-demographic characteristics, built environment, land-use data are used.
- Study period: 2019 (for data consistency)
- Four prediction horizons: 15 min, 30 min, 45 min, and 1 hr.



Traffic Prediction Model



Traffic Prediction Results

- GCN-LSTM Model Performed better than baseline LSTM and CNN-LSTM models.
- During Incident period, the model performance declined. However, it remained within acceptable range for practical applications.

Volume (Flow) Prediction						
	Incident Scenarios			Non-incident Scenarios		
Time	RMSE	MAE	R ²	RMSE	MAE	R ²
0 - 15 min	80.38	32.26	0.94	52.51	18.54	0.92
15 - 30 min	86.56	36.07	0.93	52.86	18.92	0.91
30 - 45 min	89.09	37.12	0.92	53.49	19.01	0.91
45 - 60 min	96.16	40.13	0.91	54.40	19.44	0.91

(Flow (vph) : minimum 0, maximum 1862, mean 352)

Speed Prediction						
	Incident Scenarios			Non-incident Scenarios		
Time	RMSE	MAE	R ²	RMSE	MAE	R ²
	Westbound					
0 - 15 min	7.76	5.40	0.84	3.53	2.37	0.92
15 - 30 min	11.52	7.83	0.59	4.59	3.09	0.87
30 - 45 min	12.14	8.22	0.47	4.90	3.21	0.86
45 - 60 min	12.45	8.54	0.35	5.10	3.29	0.85
	Eastbound					
0 - 15 min	6.91	4.55	0.80	3.45	2.32	0.94
15 - 30 min	9.17	5.85	0.61	4.39	2.97	0.90
30 - 45 min	11.16	7.01	0.36	4.62	3.06	0.89
45 - 60 min	11.60	7.22	0.22	4.76	3.11	0.88

Incident Duration Prediction Model

- 22,469 incident records covering a 23 miles stretch of I-4 in Seminole County and Orange County are considered during 2023 – 24.
- Four incident duration categories:
 - Short Duration (5-30 minutes)
 - Medium Duration (30-60 minutes)
 - Long Duration (60-180 minutes)
 - Very Long Duration (> 180 minutes)
- Machine learning-based models are considered for duration prediction.

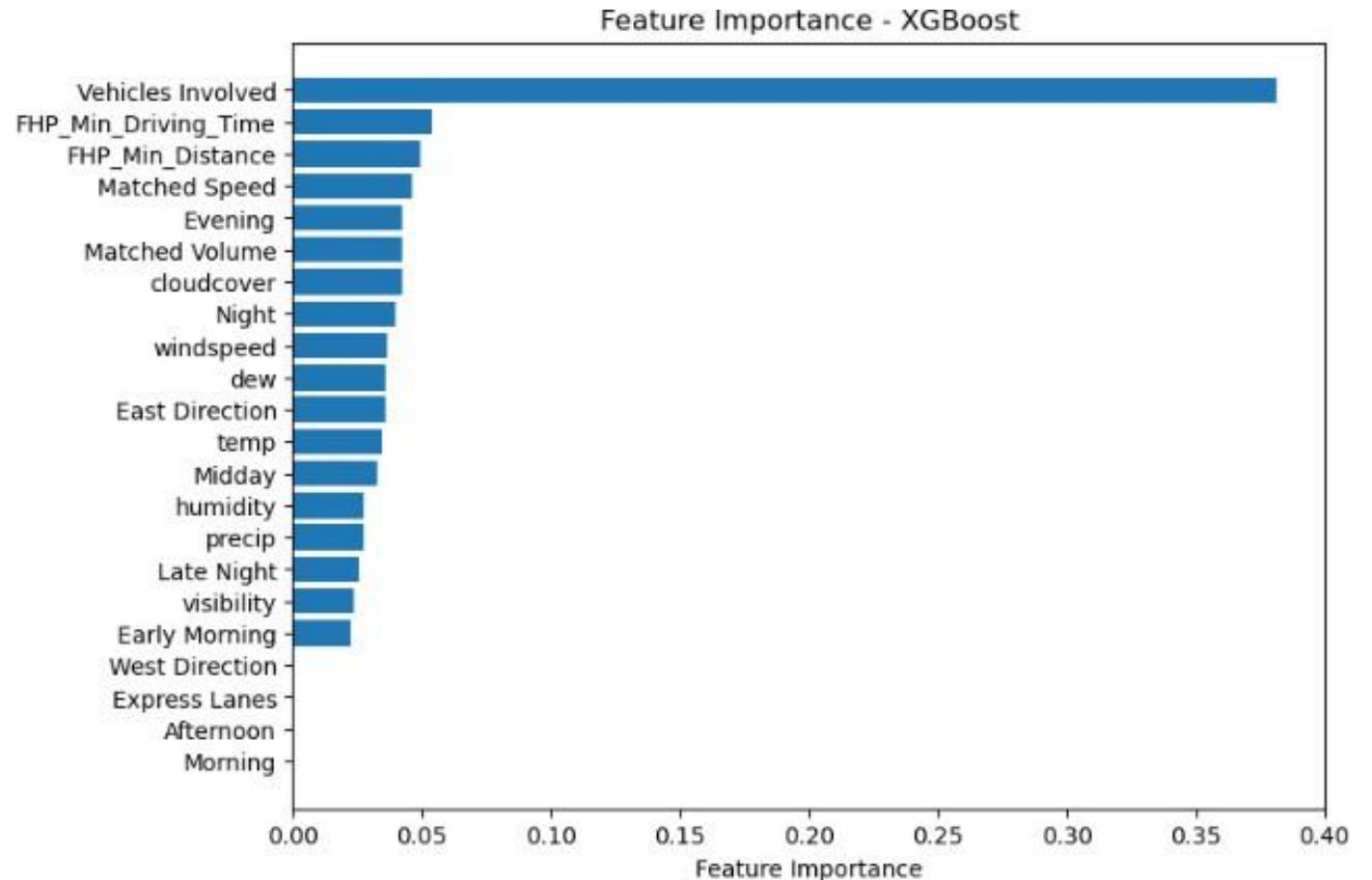
Features Used

Category	Features
Target Variable	Incident Type or Duration in minutes
Predictor Variables	
Location	East Direction, West Direction
Incident Type Features	Collision
Temporal Features	Early Morning: $5 \leq \text{hour} < 8$, Morning': $8 \leq \text{hour} < 12$, 'Midday': $12 \leq \text{hour} < 13$, 'Afternoon': $13 \leq \text{hour} < 17$, 'Evening': $17 \leq \text{hour} < 20$, 'Night': $20 \leq \text{hour} < 24$, 'Late Night': $0 \leq \text{hour} < 3$, 'Early Morning (Midnight to Dawn)': $3 \leq \text{hour} < 5$, Weekday, Weekend, January, February, March, April, May, June, July, August, September, October, November, December
Incident Related Features	Responders, Vehicles Involved, Max Lanes Closed, Notifications Sent
Traffic and Geometric Features	Matched Speed, Matched Volume, Express Lanes
Weather Features	Temperature, Dew, Humidity, Precipitation, Windspeed, Cloud Cover, Visibility
Emergency Response Features	Minimum Driving Distance from Florida Highway Patrol, Minimum Driving Time from Florida Highway Patrol

Incident Duration Prediction Results

Duration category prediction

Model	Accuracy
XGBoost	59.0%
Gradient Boosting	58.9%
Random Forest	58.7%
LightGBM	58.6%
Logistic Regression	45.8%
SVM	45.8%
MLP	45.8%
KNN	41.4%

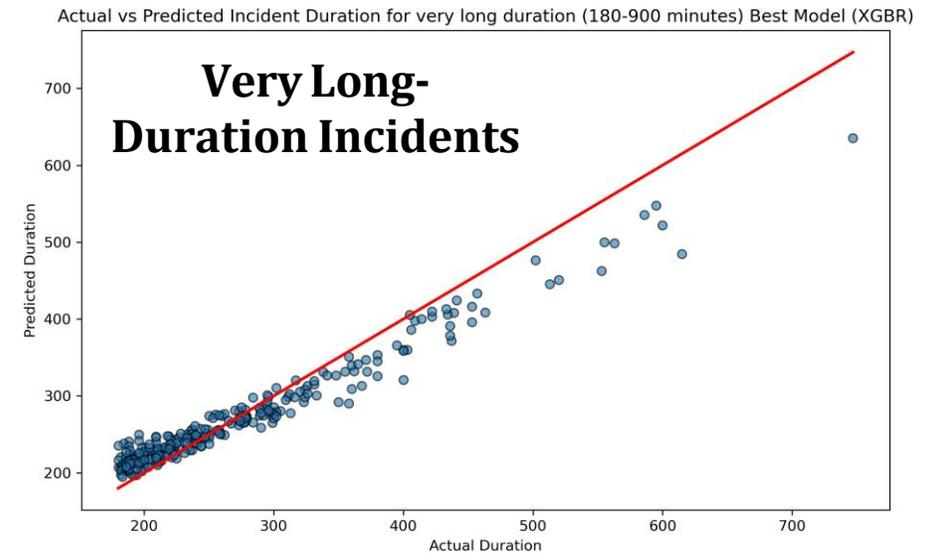
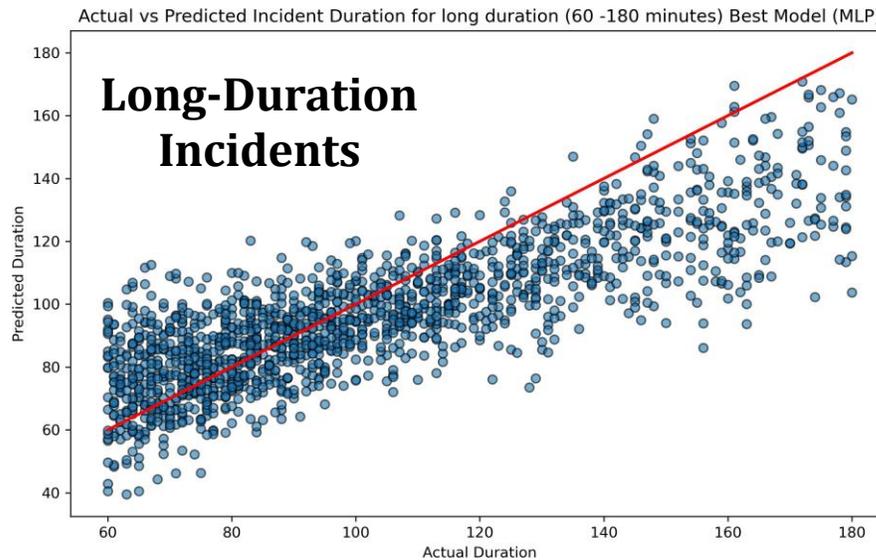
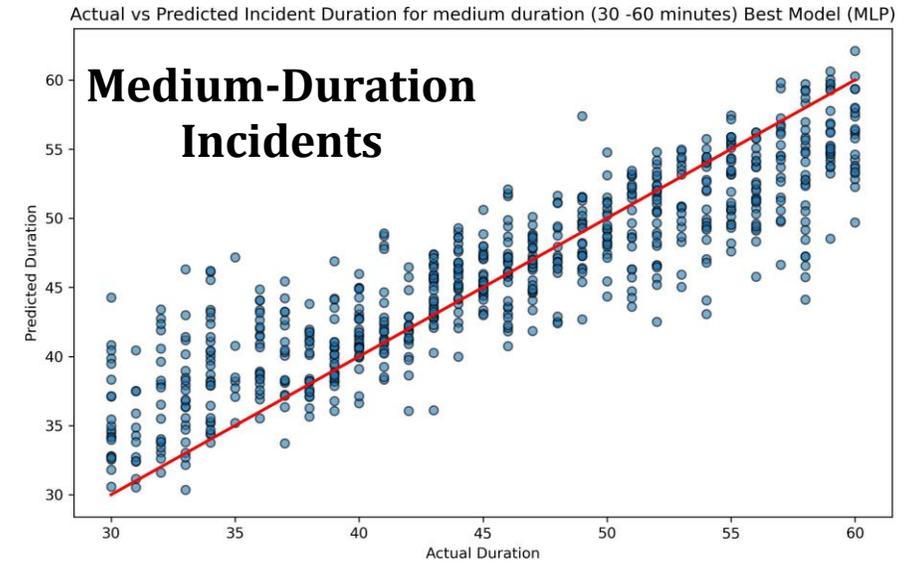
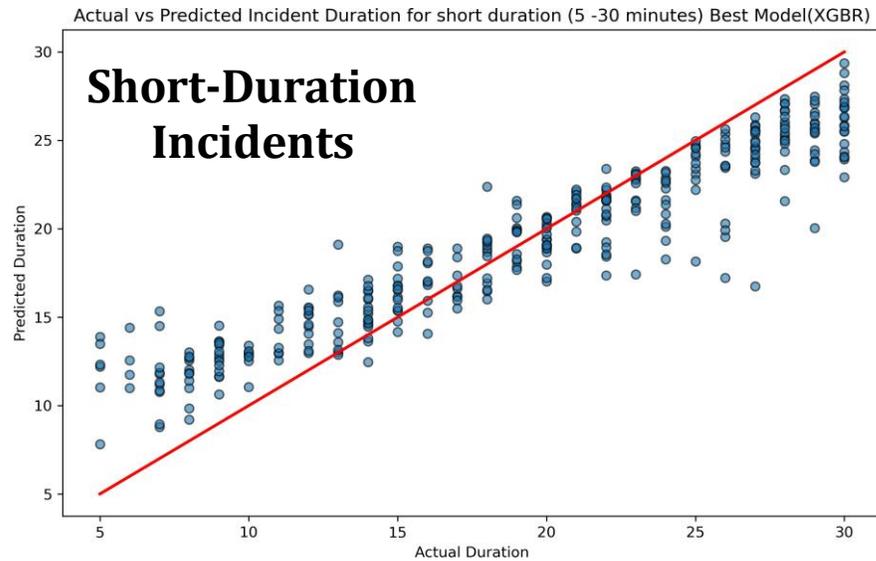


Incident Duration Prediction Results

Duration prediction for each category

Type	Best Model	RMSE	R ²	MAE	count
Short Duration	XGBR	3.08	0.82	2.42	333
Medium Duration	MLP	4.11	0.77	3.09	703
Long Duration	MLP	19.52	0.62	14.87	1517
Very Long Duration	XGBR	28.06	0.91	21.16	266

Incident Duration Prediction Results



Predictive Strategy Evaluator

- Simulated regular and incident scenarios as well as response strategies
- Train the deep learning model with the last few time intervals simulated data and predict for the next time interval.
- In real-time operation, the deep learning model will be pre-trained and it will use real-time traffic data to predict most effective response for the next time periods.
- Case study: 9 miles segment of I-4 in Altamonte Springs.
- Pre-built Aimsun model is used and the chosen sub-network is calibrated with RITIS detector data before running the scenarios.

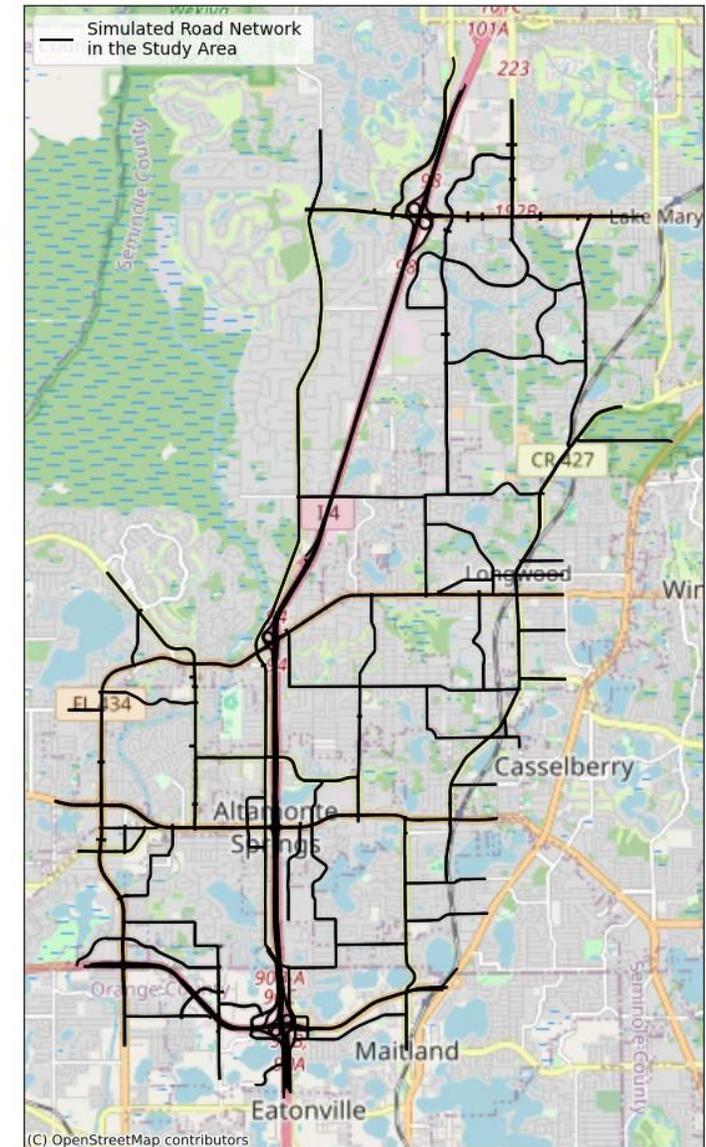


Figure: Simulation Sub-network

Scenario Descriptions

- 6 different road segments in I-4 East and West.
- 5 hour long simulation (15 minutes * 20 time steps)
- 3 incident duration options (30 min, 60 min, or 120 min)
- 2 Lane block options (1 lane block or 2 lane block)
- 2 different strategy: Rerouting and Signal Plan Change.
- 19 strategic scenarios for each incident
- Total 495 detectors (65 RITIS + 430 ATSPM)
- 10 different traffic demand variations (multiplying the original calibrated demand from factors 0.80 – 1.25)

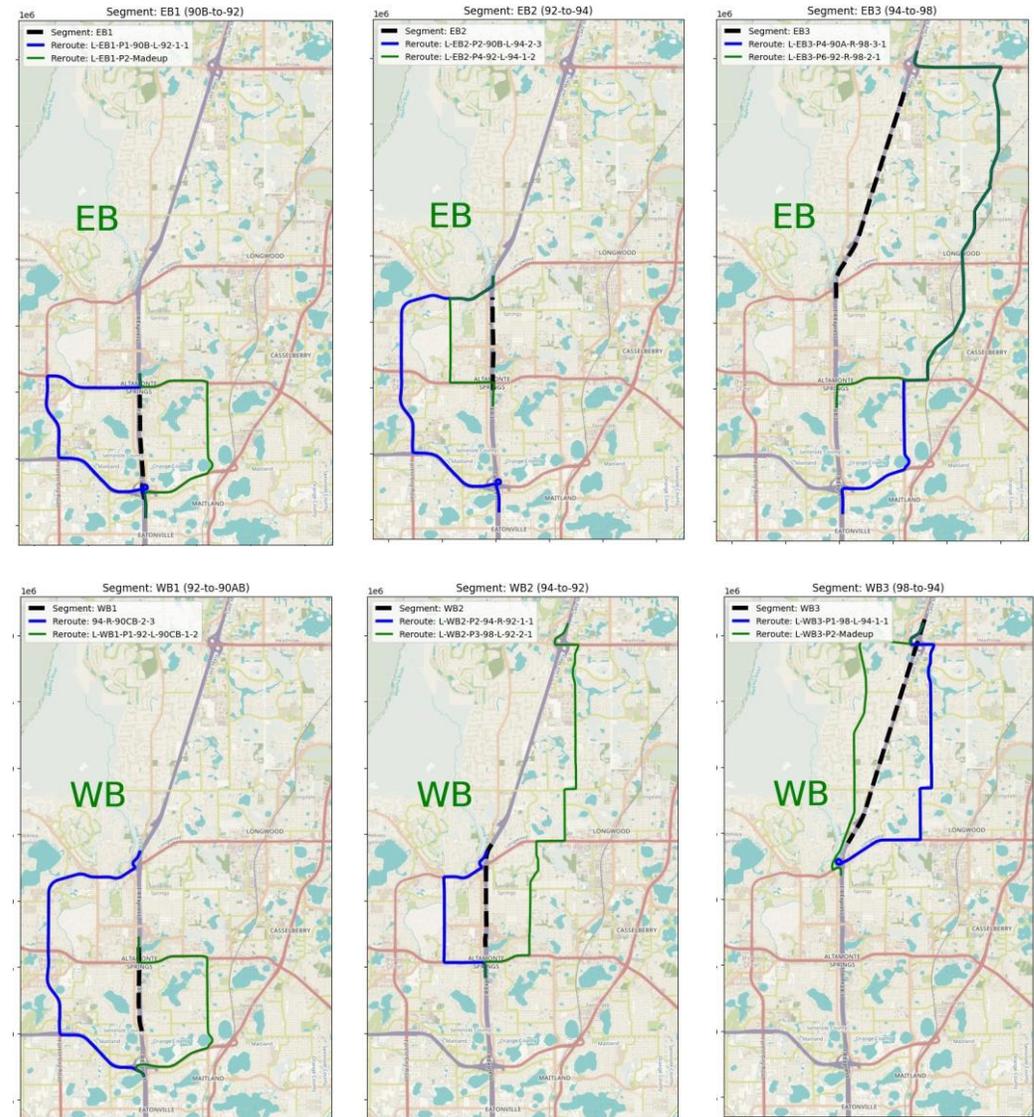
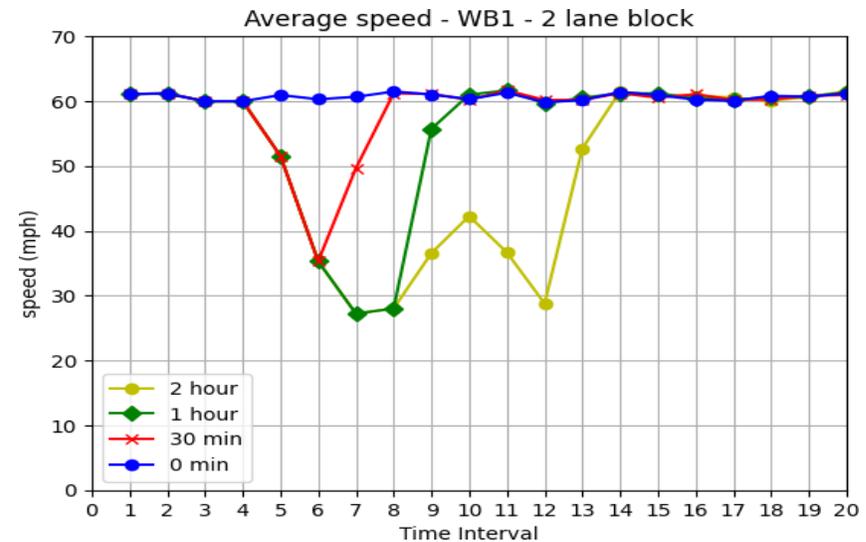
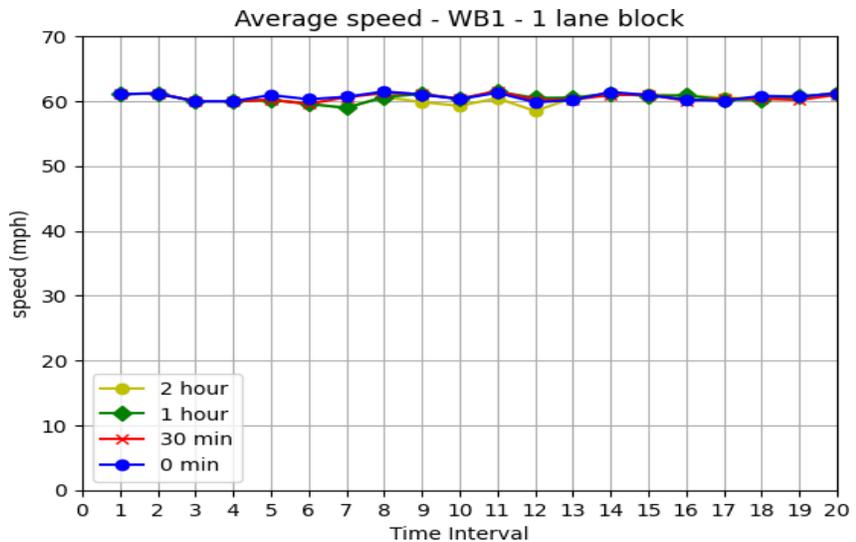
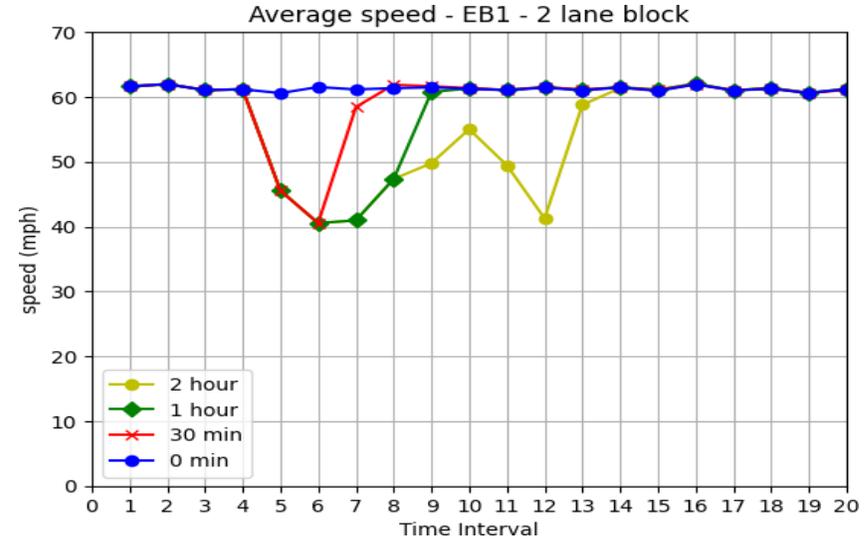
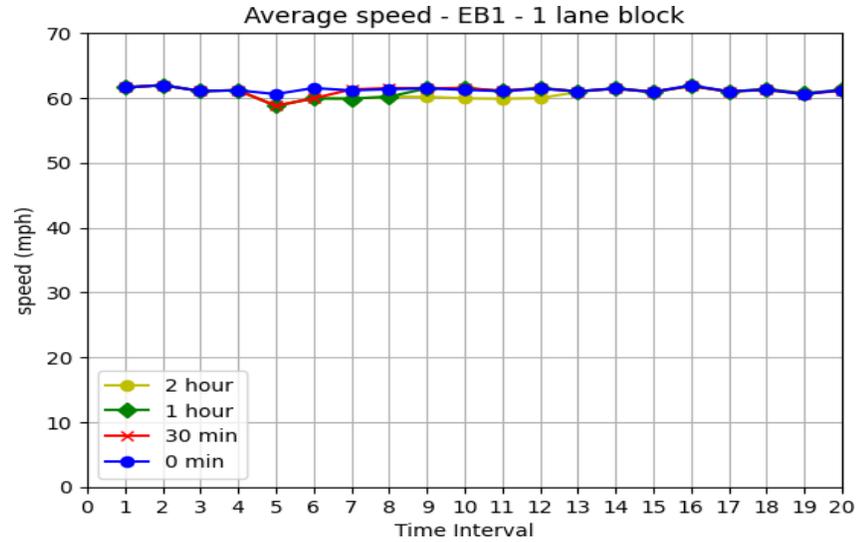
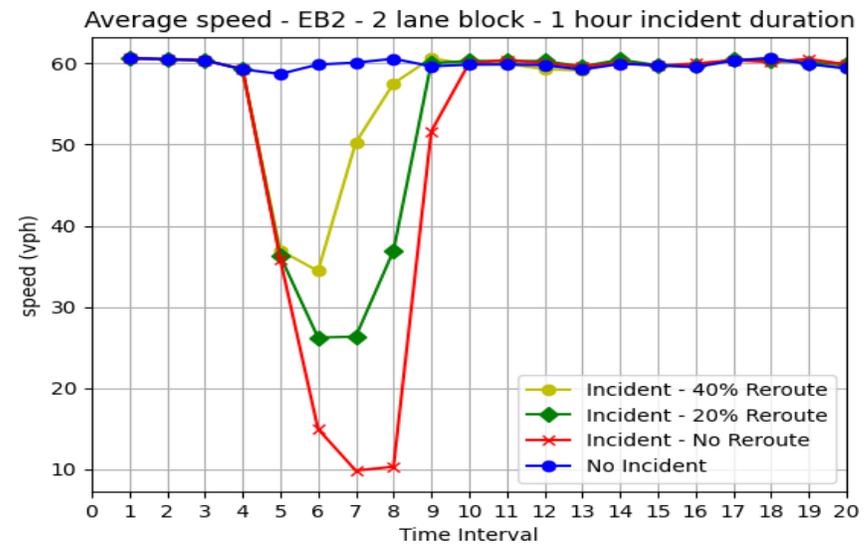
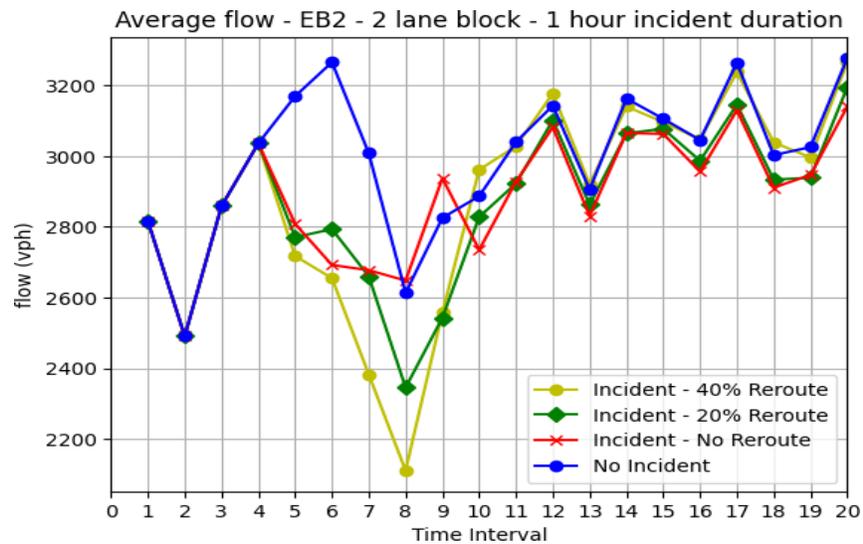
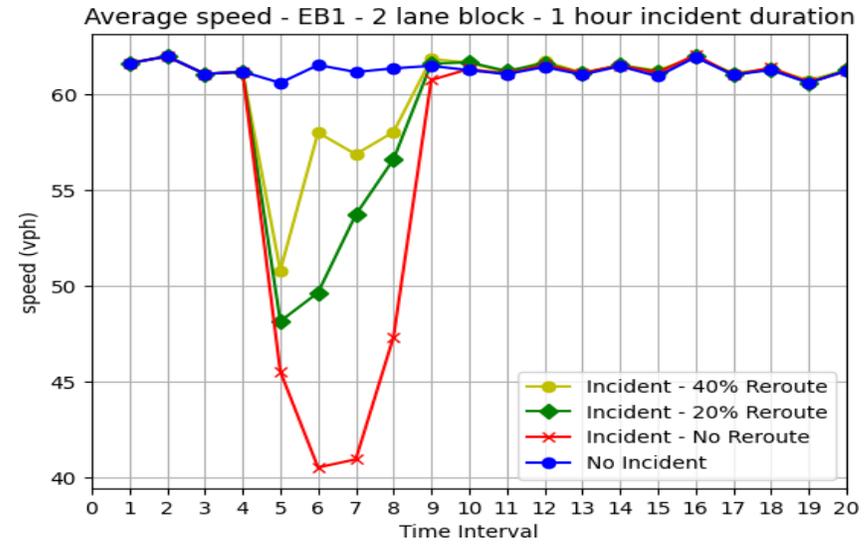
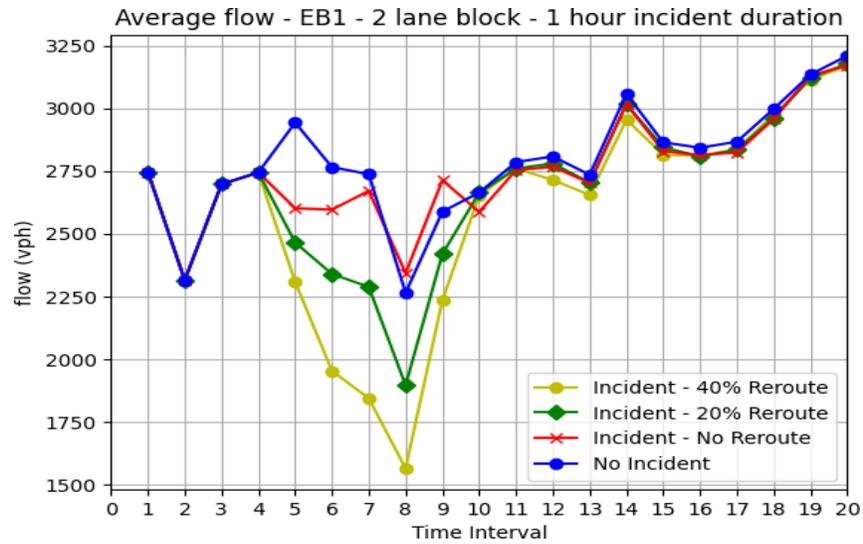


Figure: Incident Locations and Reroutes

Simulated Speed Data Visualization



Simulated Incident Strategy Visualization



Data Summary

□ Experiment-specific attributes

- ✓ Replication ID
- ✓ Interval Number

□ Network-specific attributes

- ✓ Incident location in network (0 – 6)
- ✓ Lane closed in network (0 – 2)
- ✓ Reroute strategy used in network (0 – 3)
- ✓ Reroute percent in network (0 – 2)
- ✓ Signal plan change in network (0 – 2)

□ Detector-specific attributes

- ✓ Incident location in detector (0/1)
- ✓ This detector in reroute path (0/1)
- ✓ This detector in I4 during reroute (0/1)
- ✓ Signal plan change in detector (0/1)
- ✓ RITIS or not (0/1)

✓ Flow (vph)

✓ Speed (mph)

Target Variables

On that section containing the detector

- ✓ Section Length (Miles)
- ✓ Section free-flow travel time (sec)

Deep Learning Model Results

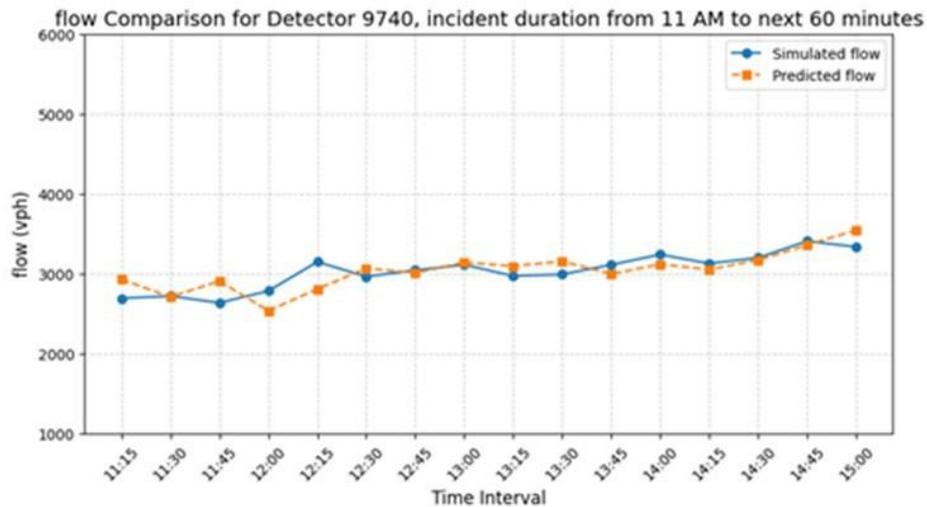
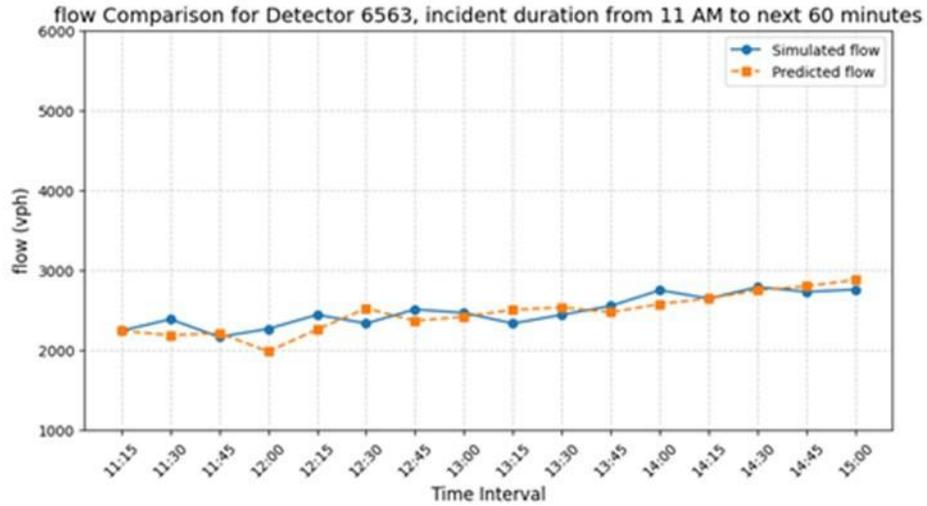
- GCN-LSTM model is used
- Test: Data generated using 2 OD demand matrix, Factors: Regular case – (0.95, 1.05), Edge case – (0.80, 1.25)
- Train: Data generated using rest 8 OD demand matrix

Flow Prediction				
Regular Case		Unit	Edge Case	
Metric	Value		Metric	Value
RMSE	99.98	vph	RMSE	104.36
MAE	46.67	vph	MAE	48.63
R ²	0.99	-	R ²	0.99
(Flow: Maximum 8392 vph, Mean 564 vph, Median 192 vph, and Minimum 1 vph)				

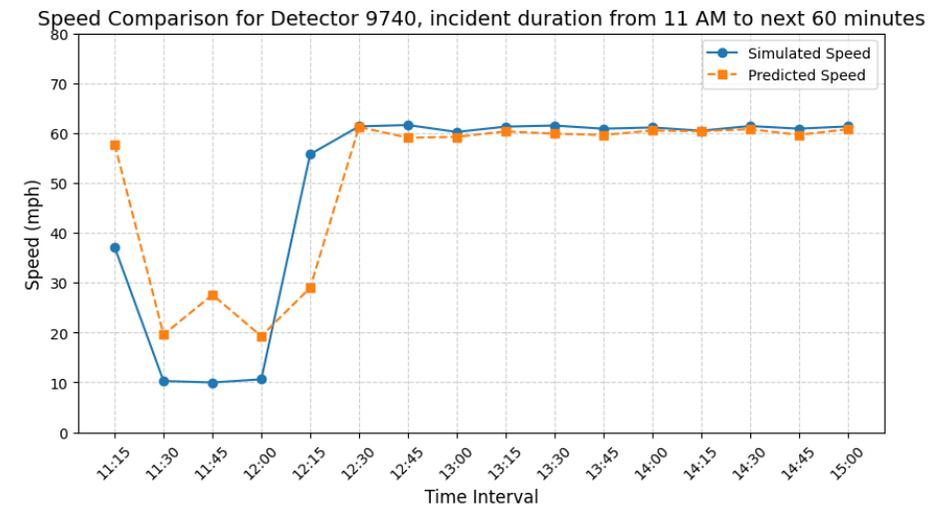
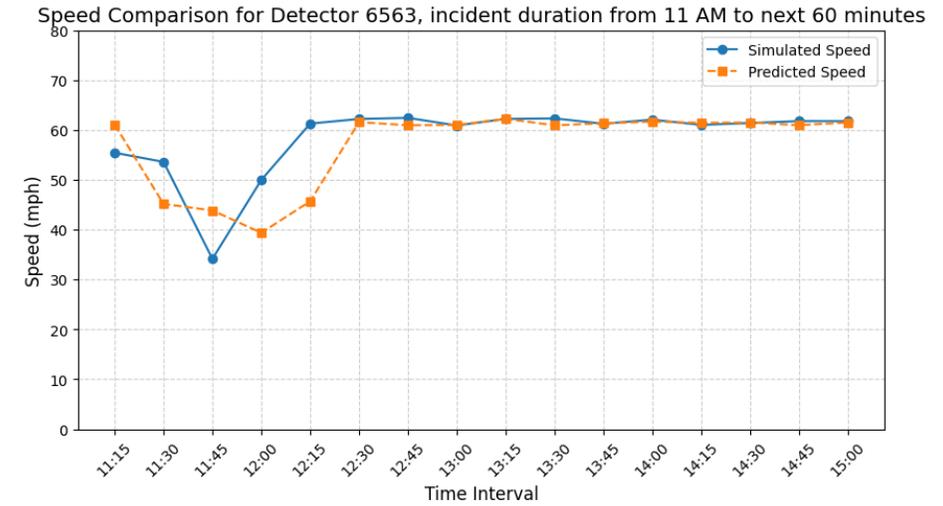
Speed Prediction				
Regular Case		Unit	Edge Case	
Metric	Value		Metric	Value
RMSE	4.12	mph	RMSE	4.34
MAE	2.40	mph	MAE	2.49
R ²	0.92	-	R ²	0.91
(Speed: Maximum 85 mph, Mean 34 mph, Median 34 mph, and Minimum 0.5 mph)				

Prediction on Detectors (Incident Occurrence Location)

Flow



Speed



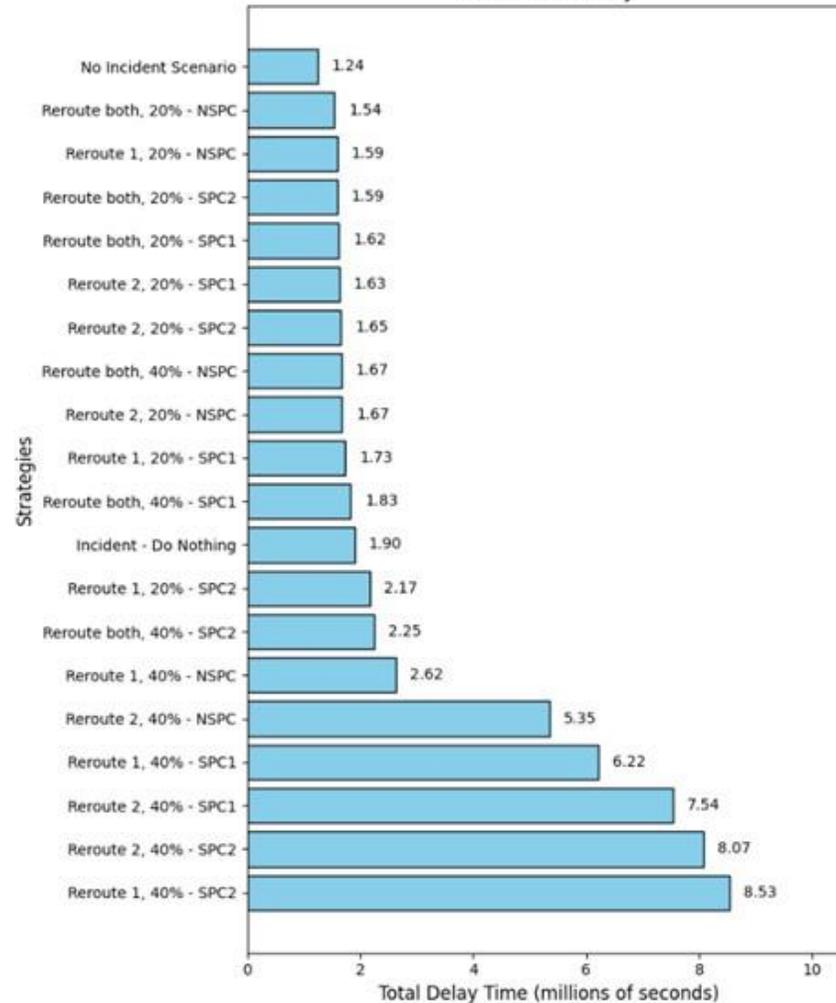
Comparative Evaluation of Strategies

- Total delay time calculated using the predictions from deep learning model are used as comparison metric.
- Checks:
 - Spearman's Ranking Correlation Coefficient
 - Presence of the most effective simulated strategy within top 3 positions of the predicted strategy ranking (then the case labeled as "Aligned")

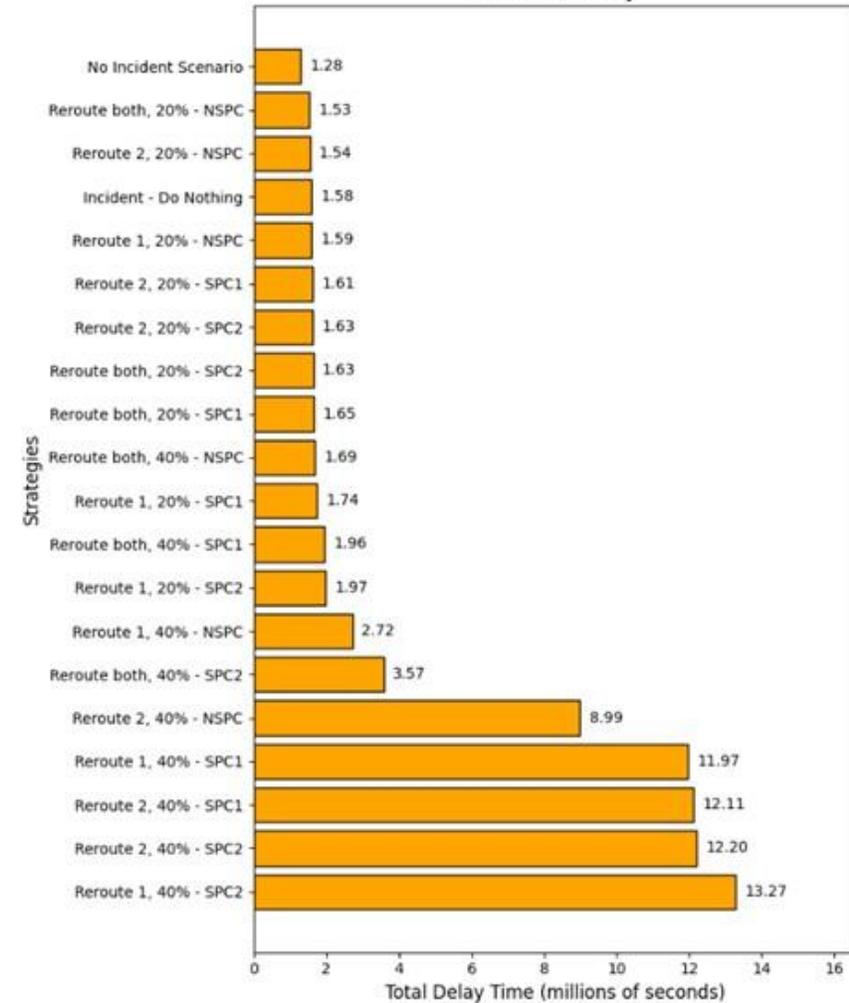
Test data	Factor	One lane block					Two lanes block				
		Mean Rank coef.	p-value < 0.05 (%)	Aligned	Not Aligned	Alignment (%)	Mean Rank coef.	p-value < 0.05 (%)	Aligned	Not Aligned	Alignment (%)
Regular Cases	0.95	0.93	100	18	0	100	0.89	100	14	4	77.8
	1.05	0.94	100	18	0	100	0.91	100	16	2	88.9
Edge Cases	0.80	0.91	100	17	1	94.4	0.92	100	17	1	94.4
	1.25	0.89	100	18	0	100	0.88	100	15	3	83.3

Evaluation Example 1 (Location: EB1)

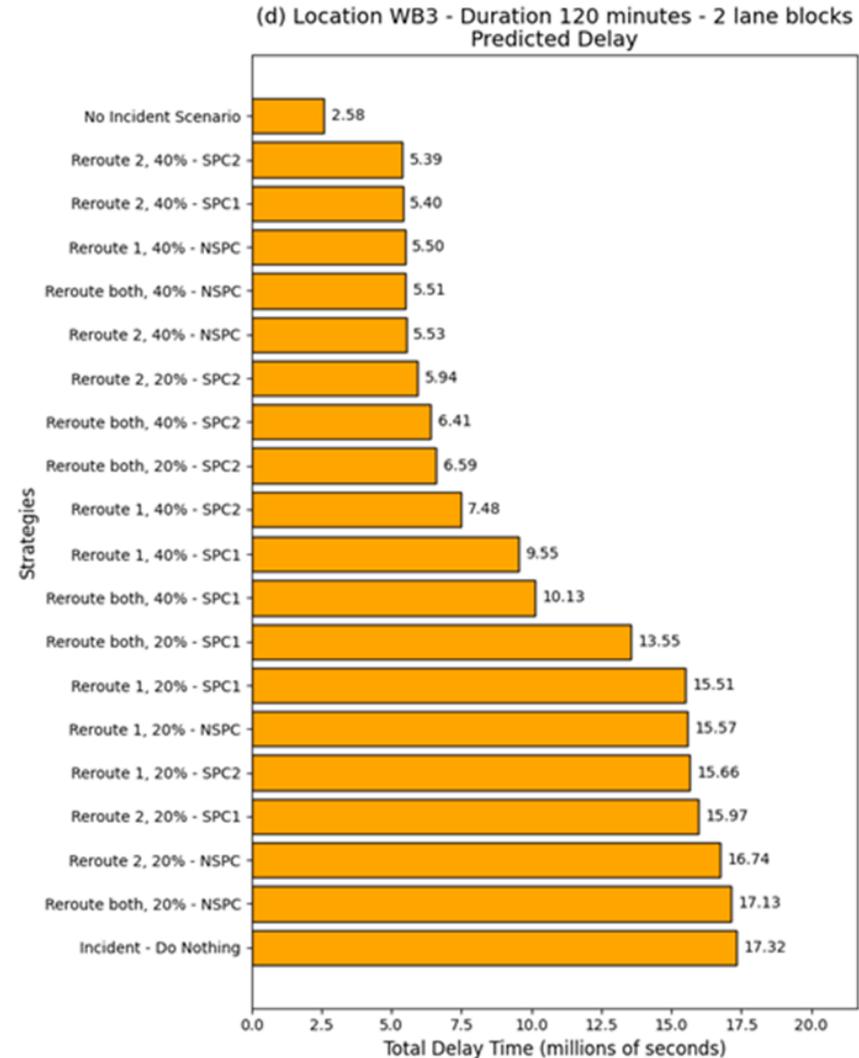
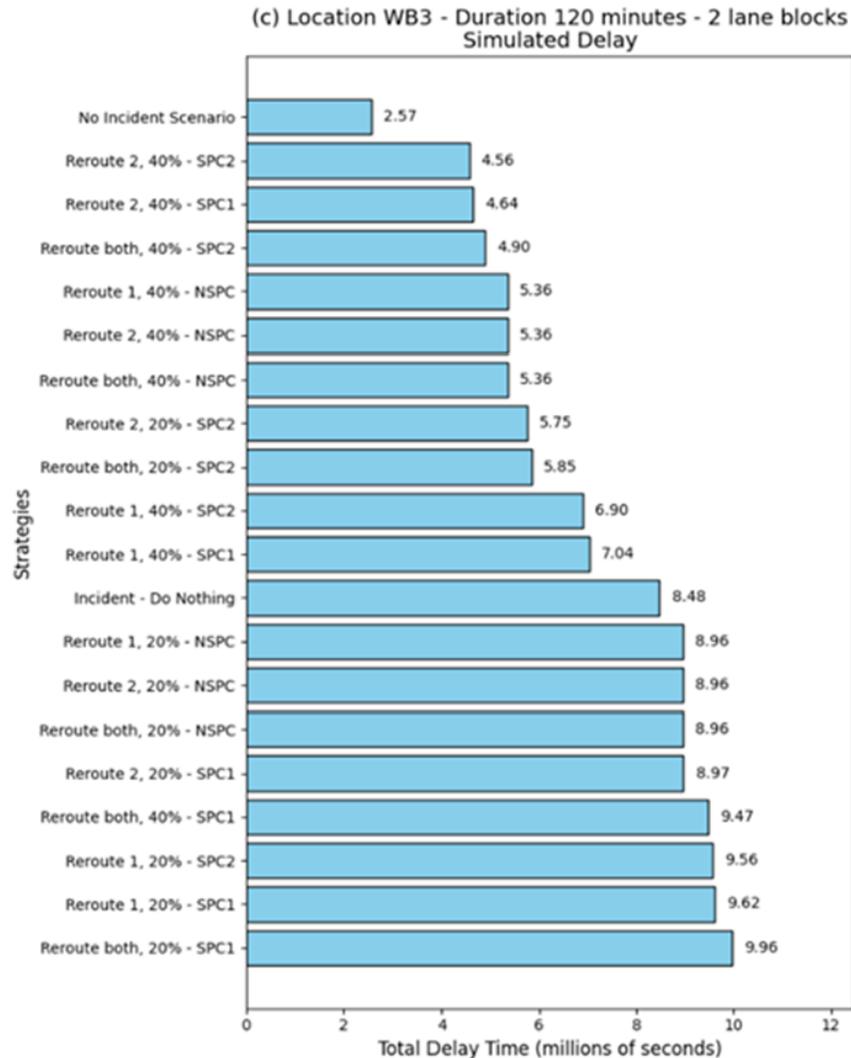
(c) Location EB1 - Duration 60 minutes - 2 lane blocks
Simulated Delay



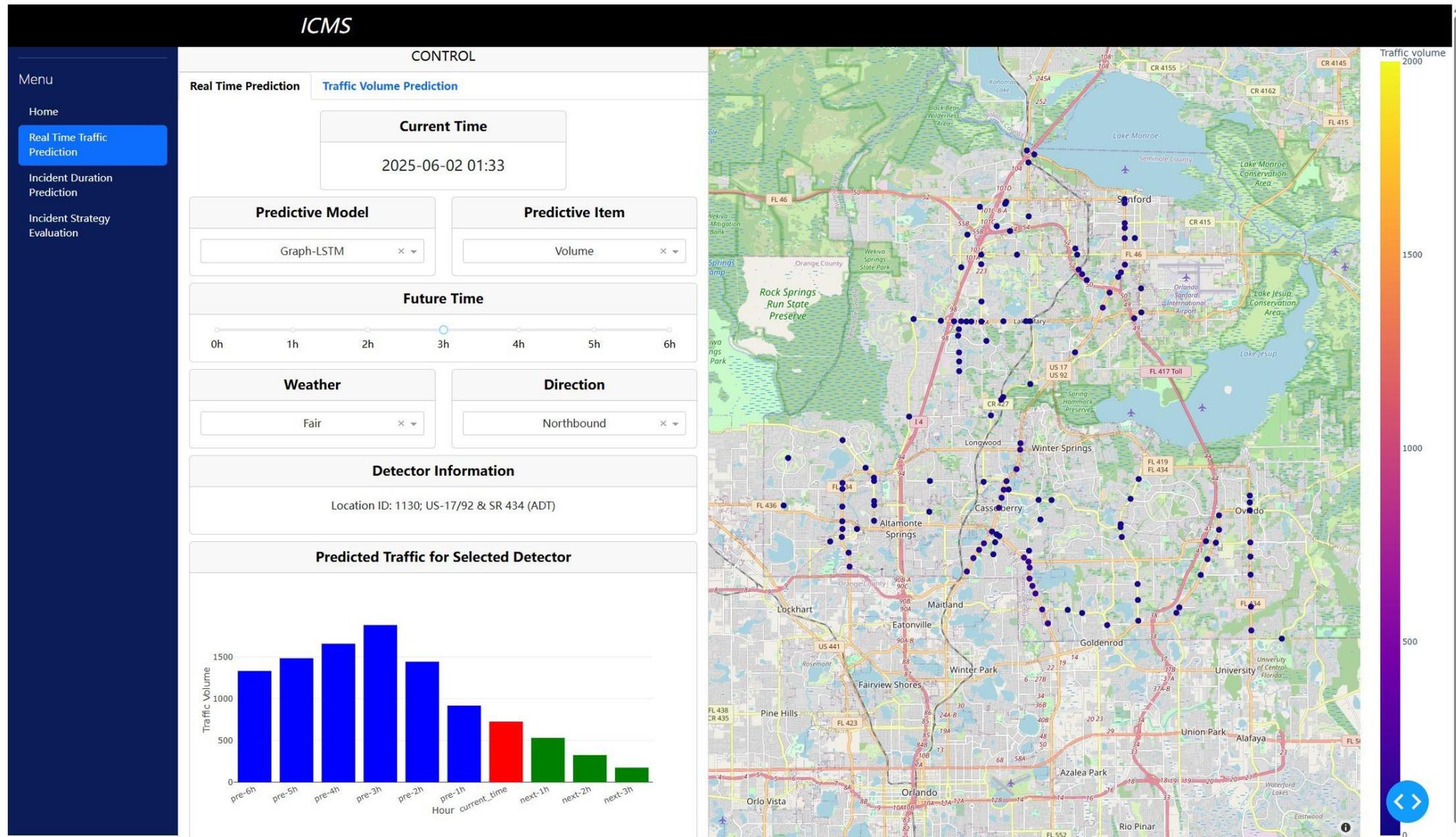
(d) Location EB1 - Duration 60 minutes - 2 lane blocks
Predicted Delay



Evaluation Example 2 (Location WB3)



Dashboard - Traffic Prediction



Dashboard – Incident Duration Prediction

ICMS

CONTROL

Input-Manually Classification Input-File Classification Input-Manually Regression Input-File Regression

Please select incident level!

Short

Vehicle Involved: 1 Time: Early Morning

Month: January Direction: East

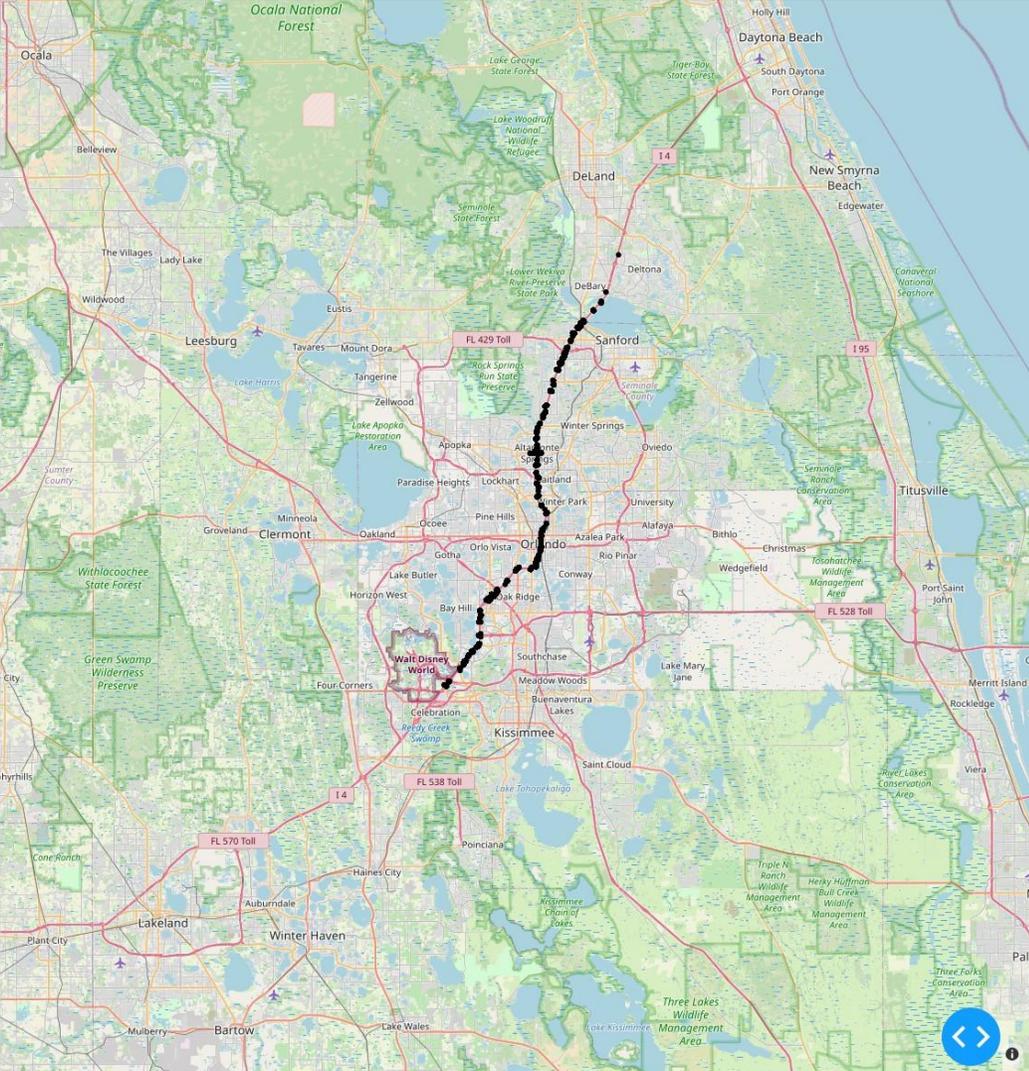
Express Lane: No

Matched Speed: 20 Matched Volume: 60

FHP_Min_Distance: 60 FHP_Min_Driving_Time: 20

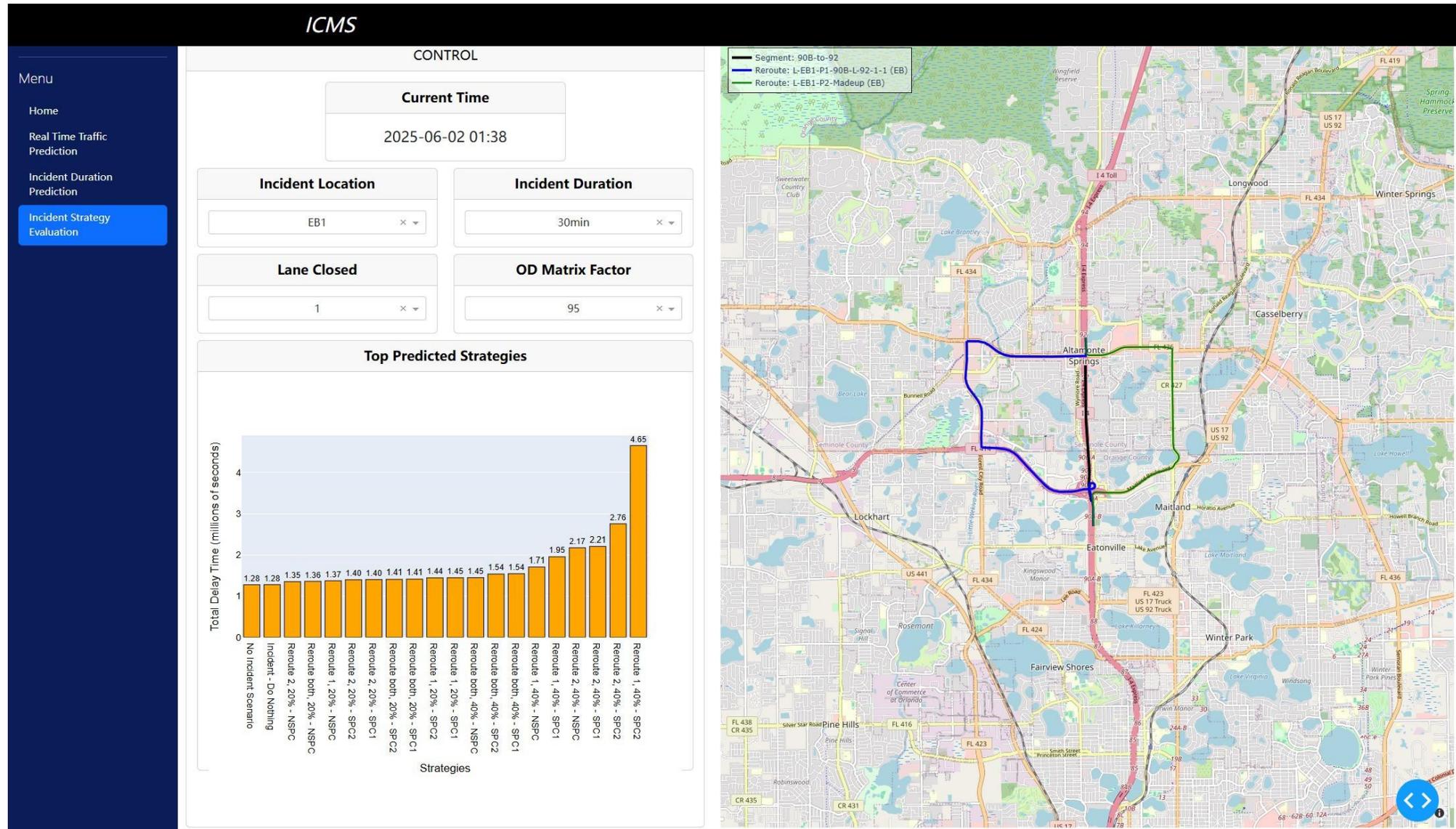
Predicted Incident Duration

The predicted incident duration: **25 min!**



The map displays a geographic area in Central Florida, centered around Orlando. A thick black line indicates the predicted incident location, running north-south through the city. Major highways like I-4, I-95, and SR 408 are visible. Landmarks such as Walt Disney World and various state parks are also shown.

Dashboard – Incident Strategy Evaluation



Traffic Prediction During Hurricane Evacuation

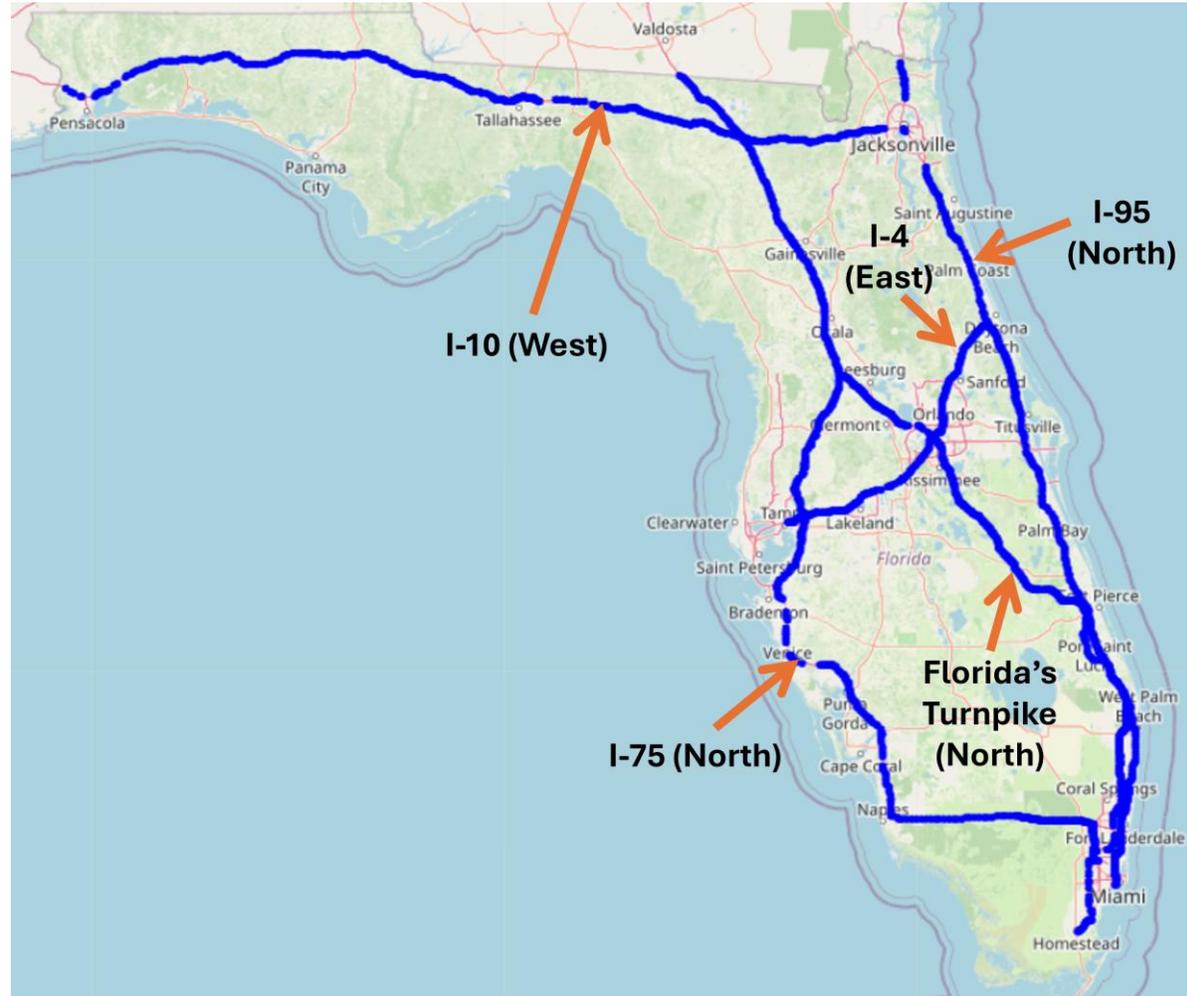


Motivation

- Evacuation traffic is more dynamic and uncertain than regular traffic as it is influenced by evolving hurricane characteristics and evacuee's response toward evacuation orders.
- The sudden increase in traffic during hurricane evacuation creates congestion on major highways, leading to delays and safety risks for evacuees.
- Predicting evacuation traffic in advance can significantly improve traffic management.
- In this research:
 - Developed dynamic graph learning framework to capture the dynamics of detector-based network representation.
 - Developed a generalized evacuation traffic prediction model using past hurricanes data to predict future traffic flow with a lead time up to 6 hours.

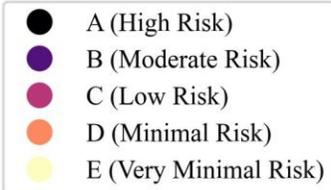
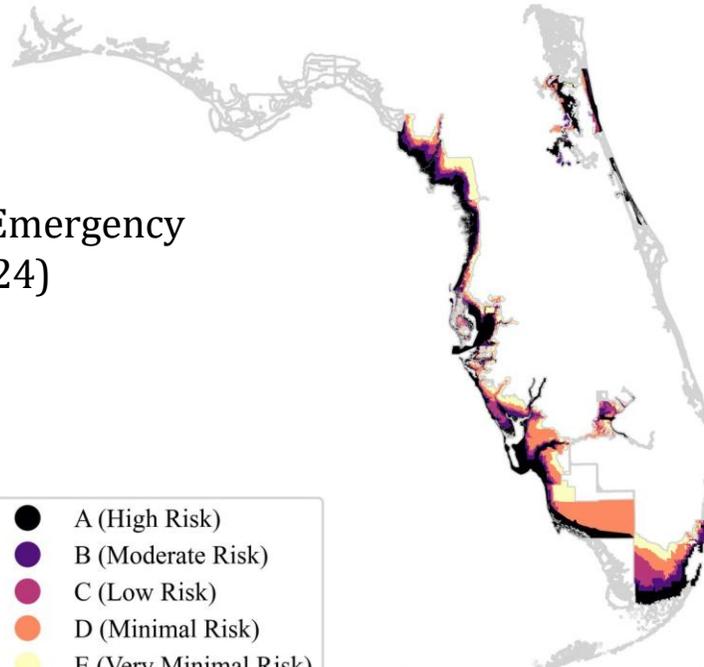
Data

Traffic Data: RITIS

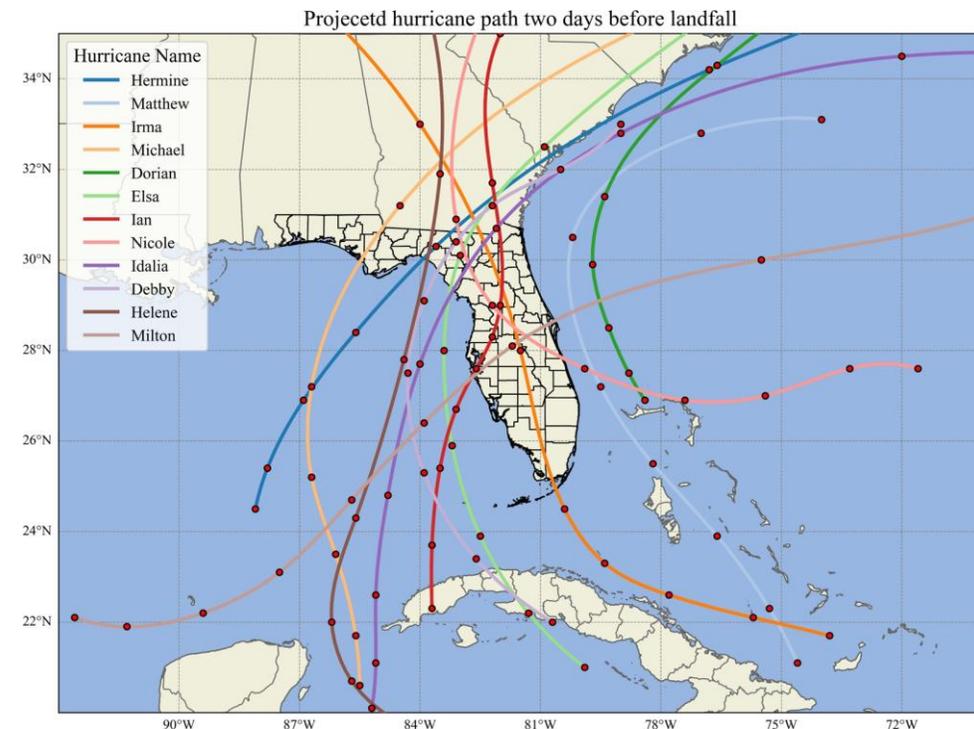


Data

Evacuation Data: Florida Division of Emergency Management, HEvOD (Anand et.al., 2024)

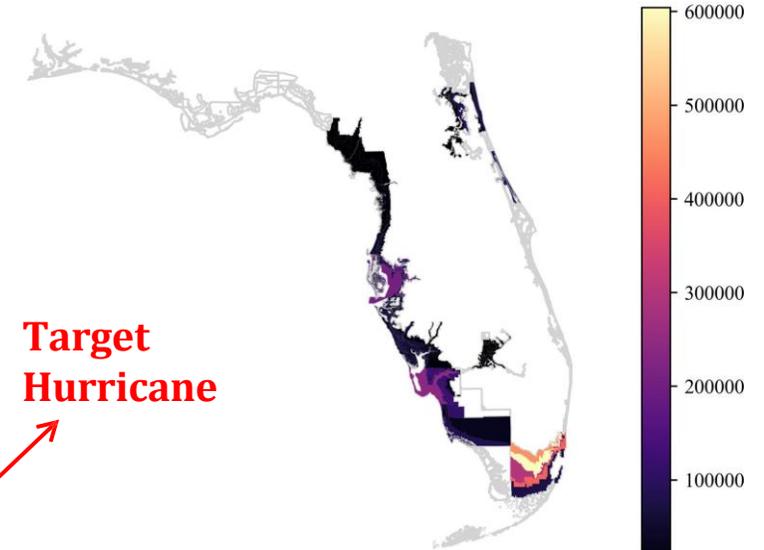


Evacuation zones during Milton



Projected hurricane paths 2 days before landfall

Hurricane Name	Landfall Date	RITIS Data Range
Hermine	September 2, 2016	08/24/2016 – 09/02/2016
Matthew	October 7, 2016	09/28/2016 – 10/07/2016
Irma	September 10, 2017	09/01/2017 – 09/10/2017
Michael	October 10, 2018	10/01/2018 – 10/10/2018
Dorian	September 4, 2019	08/26/2019 – 09/04/2019
Elsa	July 7, 2021	06/28/2021 – 07/07/2021
Ian	September 28, 2022	09/19/2022 – 09/28/2022
Nicole	November 10, 2022	11/01/2022 – 11/10/2022
Idalia	August 30, 2023	08/21/2023 – 08/30/2023
Debby	August 5, 2024	07/27/2024 – 08/05/2024
Helene	September 27, 2024	09/18/2024 – 09/27/2024
Milton	October 10, 2024	10/01/2024 – 10/10/2024



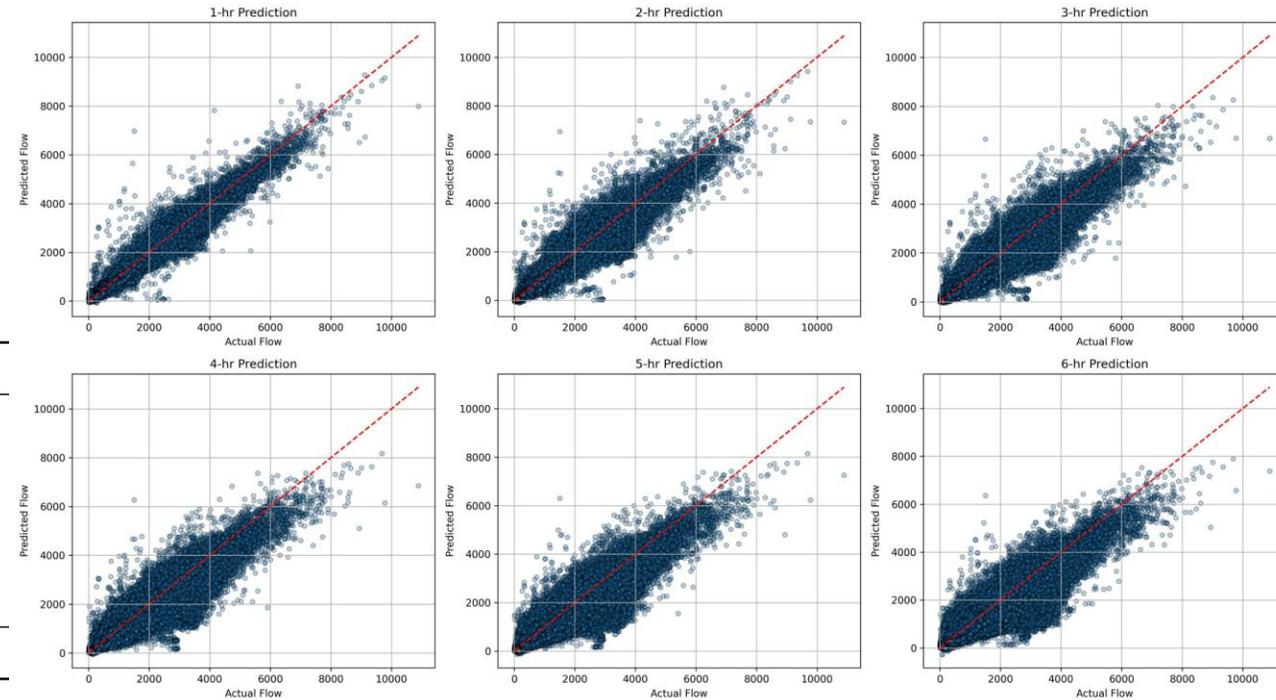
Population under evacuation order during Milton

Results

Model Performance on 2-days evacuation period of Milton

(Minimum flow = 6, Maximum flow = 10889, Mean flow = 1838, Median flow = 1503)

Prediction Horizon	RMSE	MAE	MAPE	R ²
1-hour	280.5868	179.3185	14.75	0.9586
2-hour	396.5353	256.5445	19.92	0.9169
3-hour	457.0527	299.3545	23.74	0.8881
4-hour	497.1584	329.2326	26.62	0.8657
5-hour	526.1913	353.8794	30.63	0.8478
6-hour	547.3081	370.4264	34.83	0.8335
Overall	459.7872	298.1262	25.08	0.8851



Predicted Flow vs Actual Flow for 6-hour Horizon (Milton)

Comparison with Baseline Models (Milton)

(Minimum flow = 6, Maximum flow = 10889, Mean flow = 1838, Median flow = 1503)

Model	RMSE	MAE	MAPE	R ²
LSTM	513.6687	337.0672	28.5720	0.8566
CNN-LSTM	509.2361	342.4042	29.5404	0.8591
Static GCN-LSTM	501.8664	324.5605	27.3494	0.8630
Dynamic Graph Learning	459.7872	298.1262	25.0821	0.8851

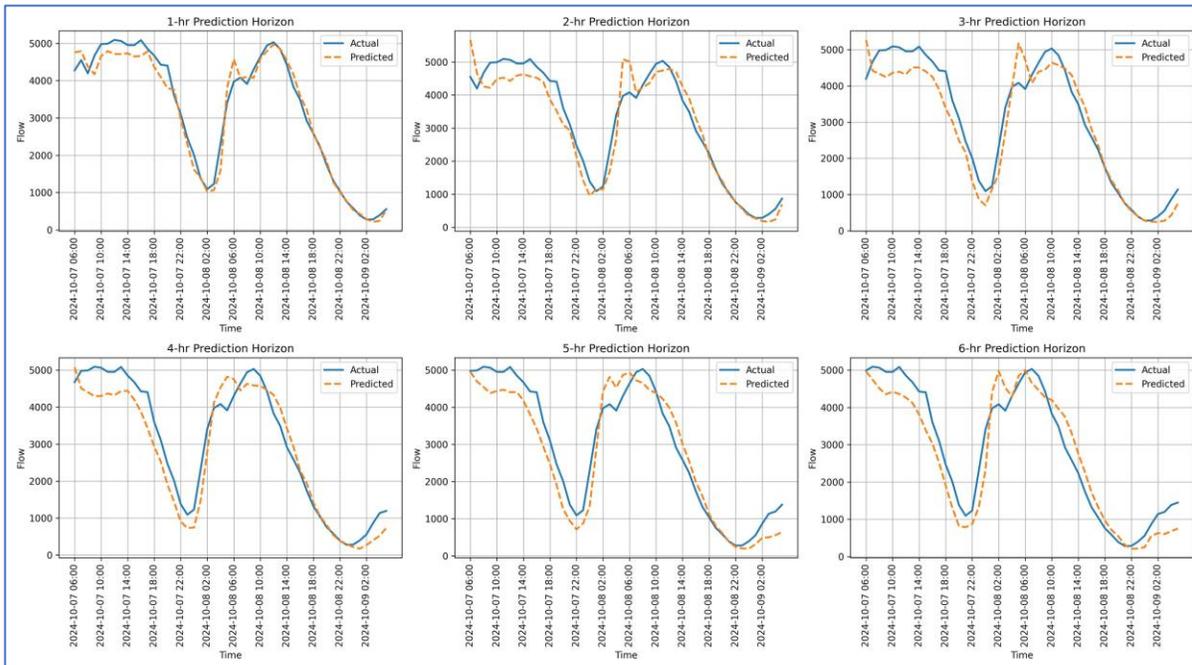
Results

Generalizable across multiple hurricanes: Robust performance for Ian

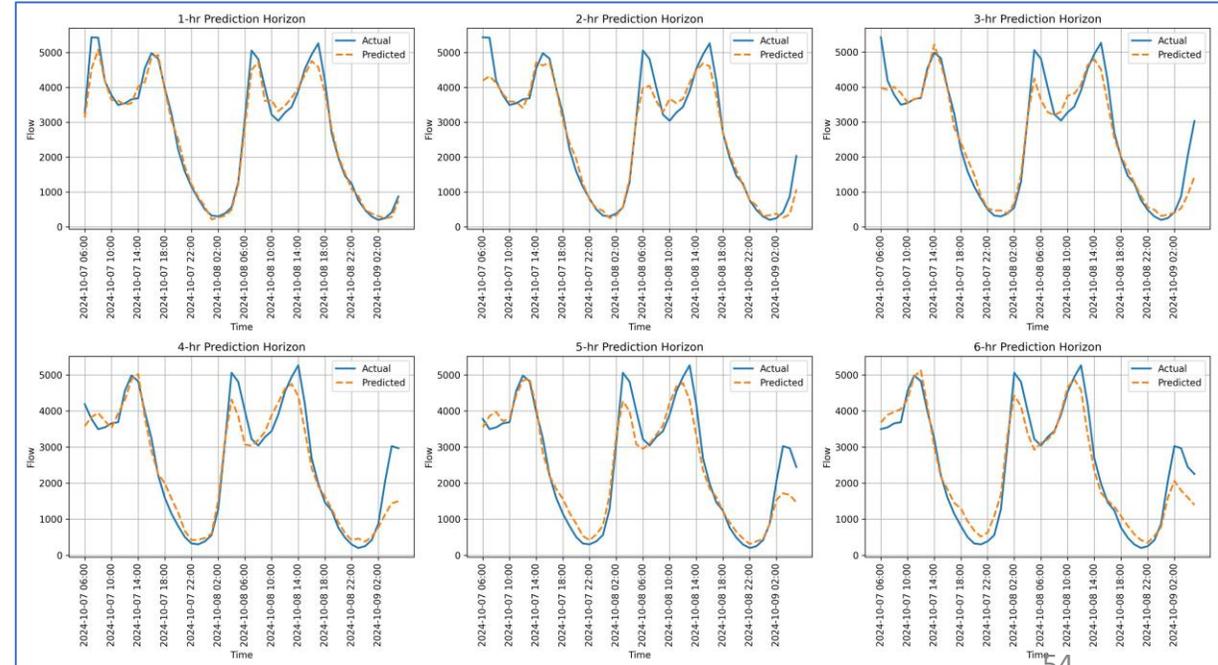
(Minimum flow = 1, Maximum flow = 10240, Mean flow = 1561, Median flow = 1161)

Prediction Horizon	RMSE	MAE	MAPE	R ²
1-hour	257.8782	159.3049	18.23	0.9610
2-hour	358.2089	229.7076	28.72	0.9242
3-hour	413.6360	271.3754	34.19	0.8964
4-hour	447.8139	296.2875	35.76	0.8757
5-hour	471.3382	315.6031	39.16	0.8600
6-hour	485.5493	333.3542	44.05	0.8486
Overall	413.1856	267.6056	33.35	0.8943

Model Performance on an I-4 detector for 6-hour Horizon (Milton)



Model Performance on an I-75 detector for 6-hour Horizon (Milton)



Results Summary

- The data-driven model achieves high accuracy in predicting evacuation traffic up to 6 hours.
- The developed model is generalized across multiple hurricanes.
- It shows robust performance for evacuation traffic prediction for any future hurricane coming from any direction in Florida.

Key Takeaways

- Data-driven models can capture well the spatio-temporal dynamics of traffic during *normal*, *incident*, and *evacuation* periods showing high predictive performance.
- Data-driven models can accurately predict the duration of a collision incident.
- Data-driven strategy evaluator produces ranking of the incident response plans similar to the simulation model.

Key Recommendations

- Extend study area to increase model coverage and more response strategies.
- Implementation will depend on real-time data integration through APIs, data availability, and rigorous model training/testing.
- Pilot studies for data-driven traffic prediction models and the predictive strategy evaluator for incident management.
- Pilot studies for evacuation traffic management (e.g., ESU decisions).

Acknowledgments

- Florida DOT for data access and supporting the project “A Deep Learning-based Network-wide Traffic Prediction Model for Integrated Corridor Management Systems”.
- Jeremy Dilmore, FDOT District 5.
- Ryan Casburn, Kittelson & Associates, Inc.

Thank You

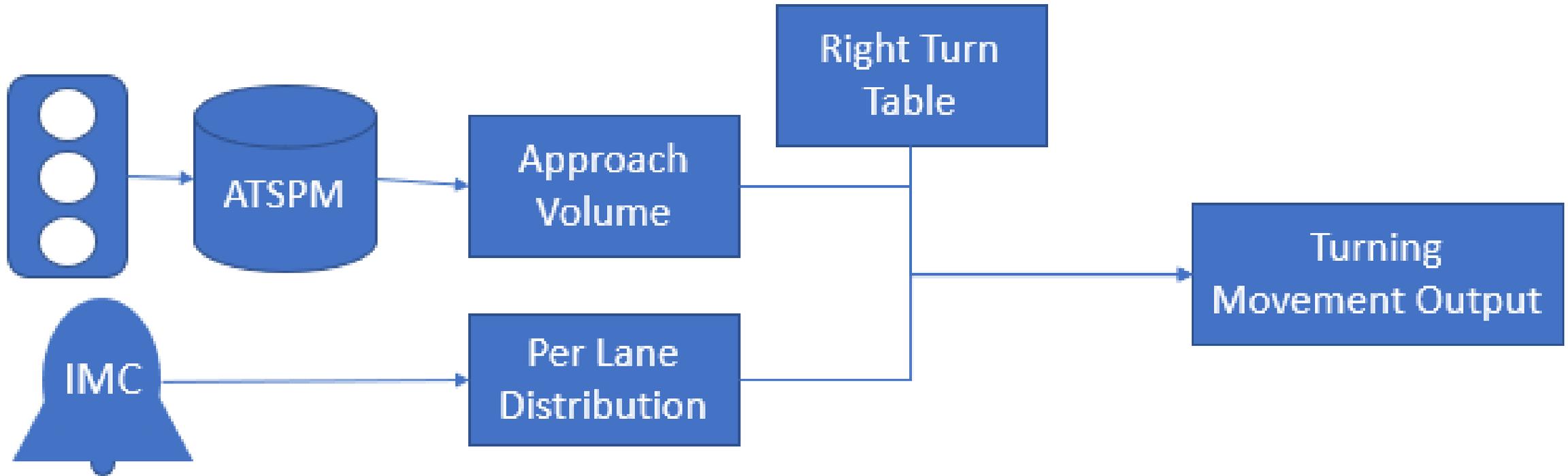


FDOT TSM&O Construction Project Tracking

Jennifer Sardonini, FDOT District Five

AI Use within FDOT

High-definition
Engineering
Intersection Data
via Integrative
modeling (HEIDI)



HEIDI - BACKGROUND

- Arterial Roadways D5 has over 1,700 signalized intersections
 - 900+ reporting ATSPM (2-minute frequency)
 - 200+ have CCTV reporting Turning Movement Counts
- Crowd Sourced Data
 - GPS based subset of instrumented vehicles reporting probe data values on the roadways.

HEIDI - RESEARCH TO REAL LIFE APPLICATION

Research by UCF and UF looked at AI for fill in gaps for Turning Movement Counts

Both concluded feasible, Offered models, but desire for enterprise product

Crowd Sourced Data fills in both gaps uninstrumented and when maintenance occurs



Applications for Traffic Operations Improvement

Realtime arterial analysis

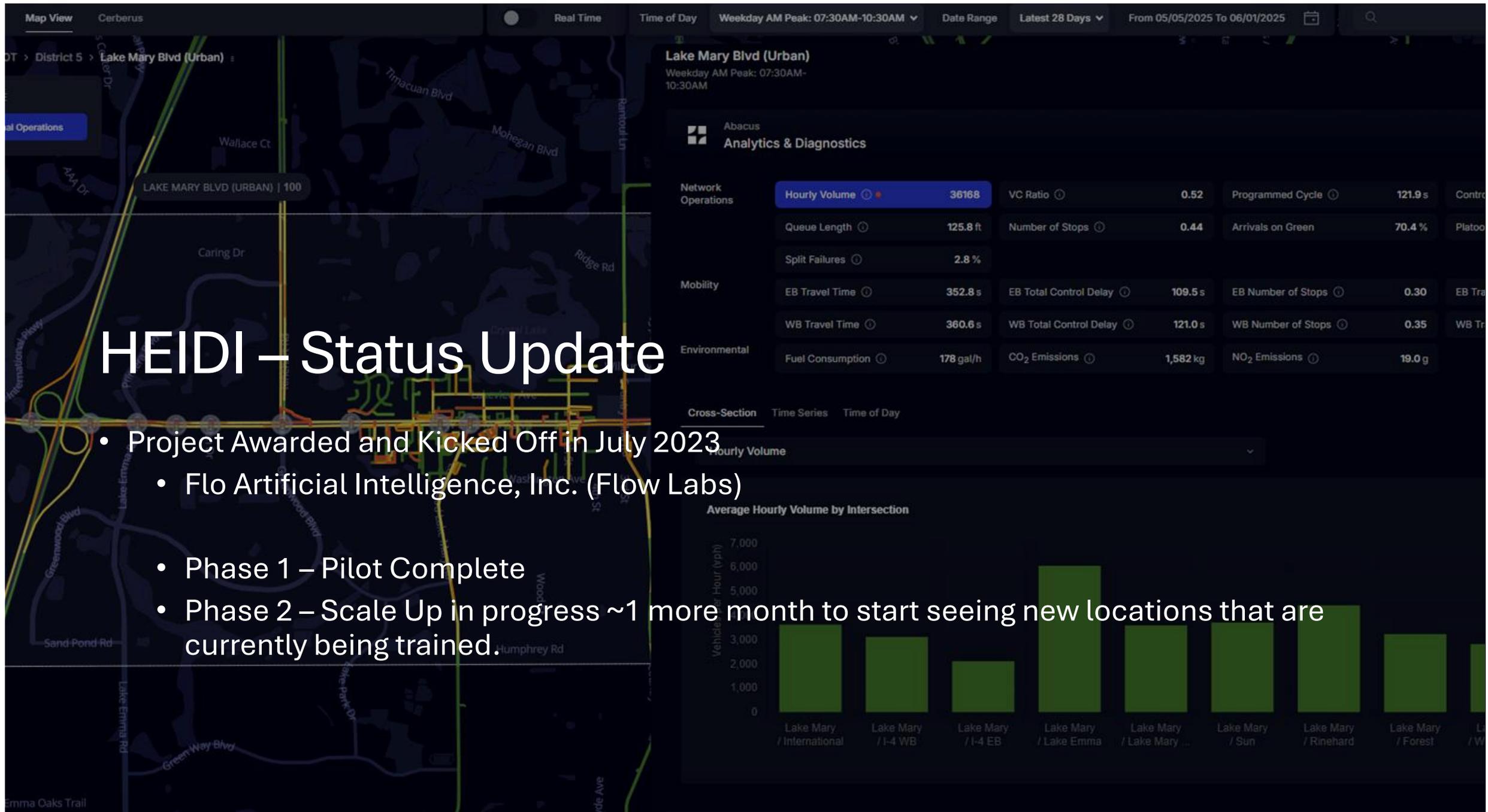
Offline clustering and pattern development



The HEIDI project

HEIDI – Status Update

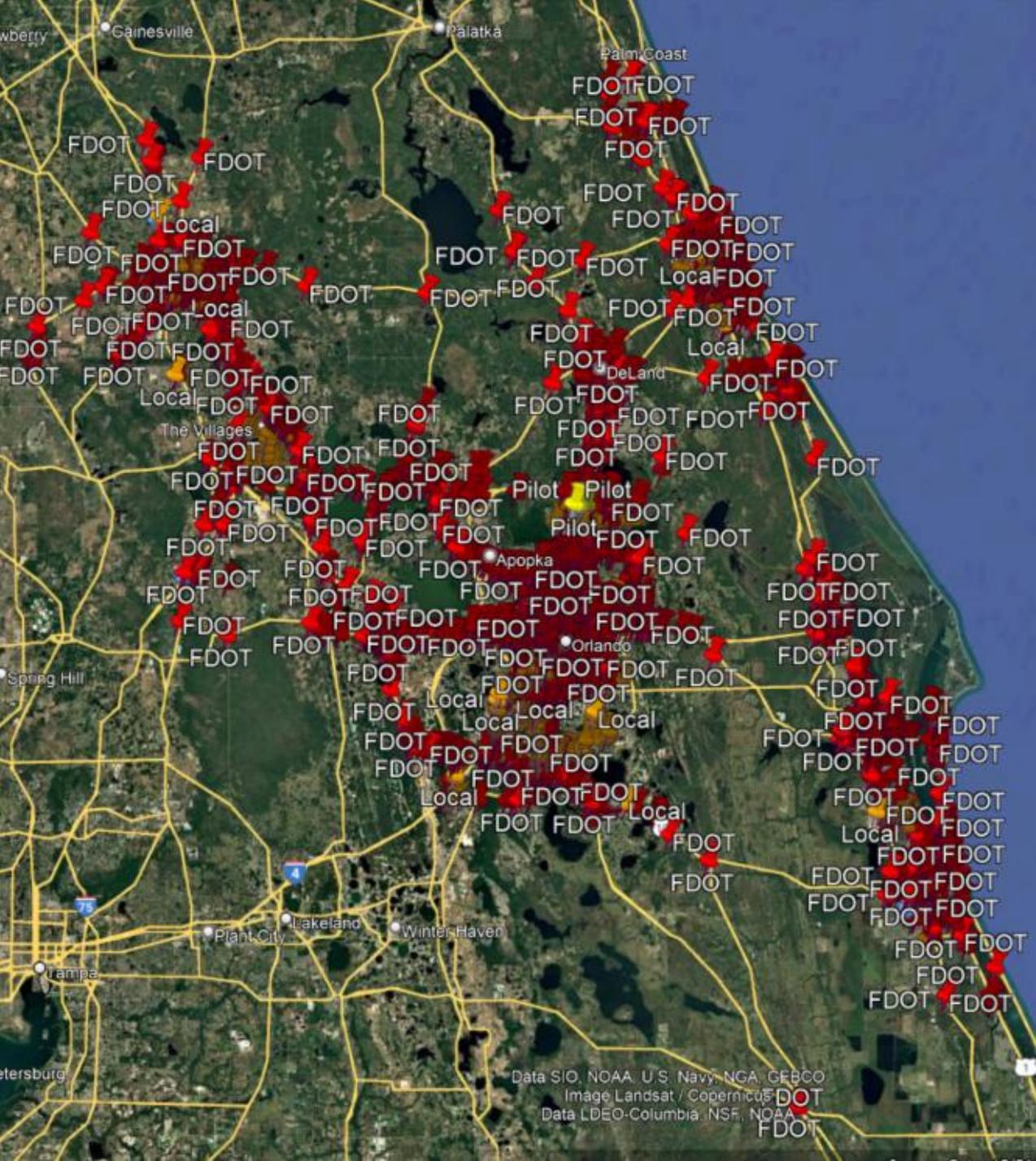
- Project Awarded and Kicked Off in July 2023
 - Flo Artificial Intelligence, Inc. (Flow Labs)
- Phase 1 – Pilot Complete
- Phase 2 – Scale Up in progress ~1 more month to start seeing new locations that are currently being trained.



HEIDI – Status Update

		Time Interval (minutes)					
		1	3	5	15	30	60
Latency (minutes)	1	35.09%	16.61%	13.82%	9.84%	7.71%	5.80%
	3	35.09%	16.61%	13.81%	9.57%	7.52%	5.95%
	5	35.09%	16.59%	13.62%	9.35%	7.08%	5.87%
	10	35.04%	16.48%	13.48%	8.53%	5.88%	6.14%
	15	34.07%	15.61%	11.93%	7.83%	6.07%	6.36%
	30	34.08%	15.54%	11.94%	7.90%	5.96%	6.27%
	60	34.08%	15.54%	11.95%	7.90%	5.97%	6.28%

- Turning Movement Count Pilot Results



HEIDI – Status Update

- Phase 2 Scale Up
 - We will get 2,000 total signals.
 - All 1,700 state road signals in the District
 - Additional 300 signals Off-System
 - We chose the additional off system signals based on several factors: Event Management Areas, Attractions Area, Moving I-4 Forward construction, ICM diversion routes, and evacuation routes.

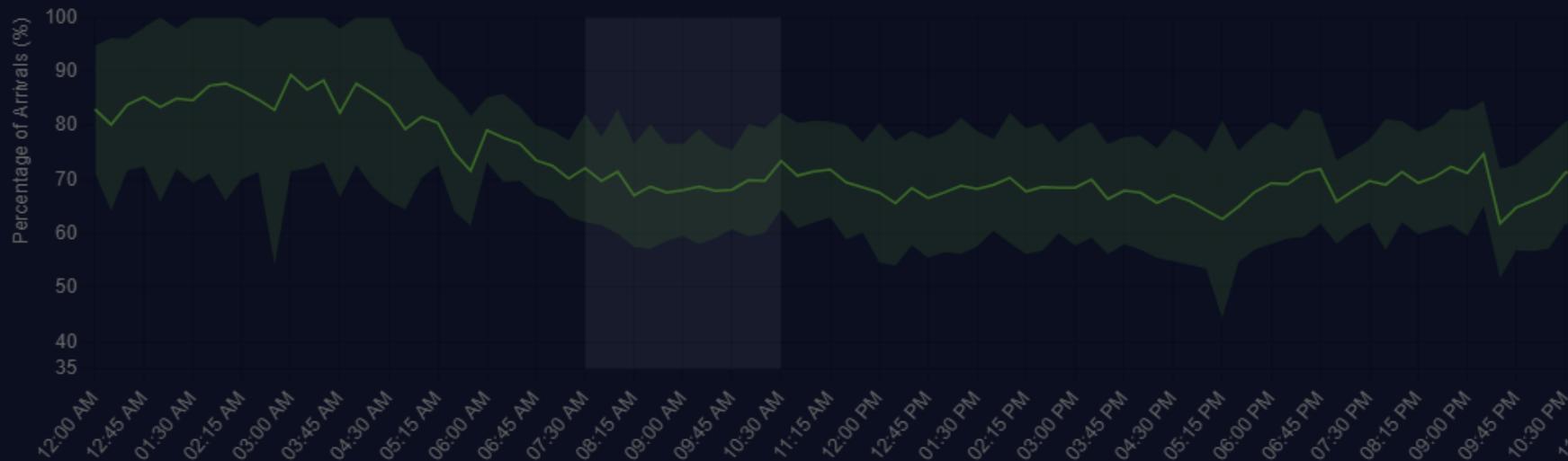
HEIDI – Additional Features besides Volumes

Lake Mary Blvd (Urban)
Weekday AM Peak: 07:30AM-10:30AM

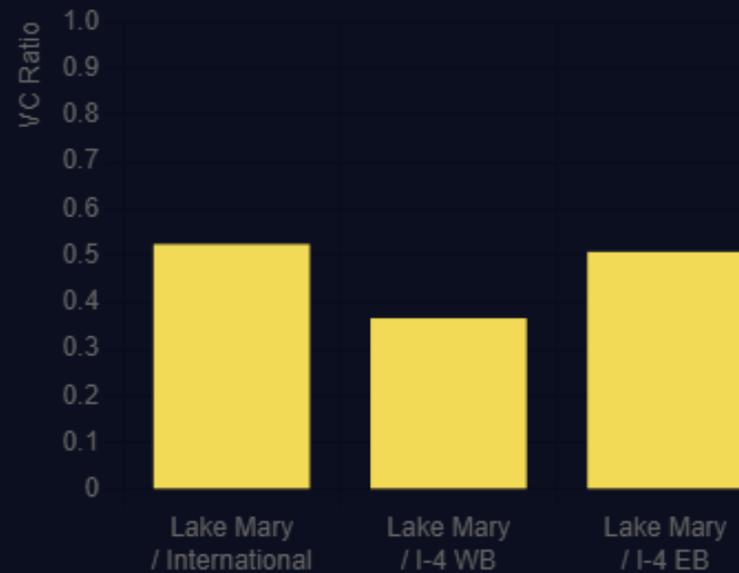
 **Abacus Analytics & Diagnostics**

Network Operations	Hourly Volume ⓘ ●	36168	VC Ratio ⓘ	0.52	Programmed Cycle ⓘ	121.9 s	Control Delay Mean ⓘ	26.1 s
	Queue Length ⓘ	125.8 ft	Number of Stops ⓘ	0.44	Arrivals on Green	70.4 %	Platoon Ratio	1.23
	Split Failures ⓘ	2.8 %						
Mobility	EB Travel Time ⓘ	352.8 s	EB Total Control Delay ⓘ	109.5 s	EB Number of Stops ⓘ	0.30	EB Travel Time Index ⓘ	1.42
	WB Travel Time ⓘ	360.6 s	WB Total Control Delay ⓘ	121.0 s	WB Number of Stops ⓘ	0.35	WB Travel Time Index ⓘ	1.44
Environmental	Fuel Consumption ⓘ	178 gal/h	CO ₂ Emissions ⓘ	1,582 kg	NO ₂ Emissions ⓘ	19.0 g		

Arrivals on Green



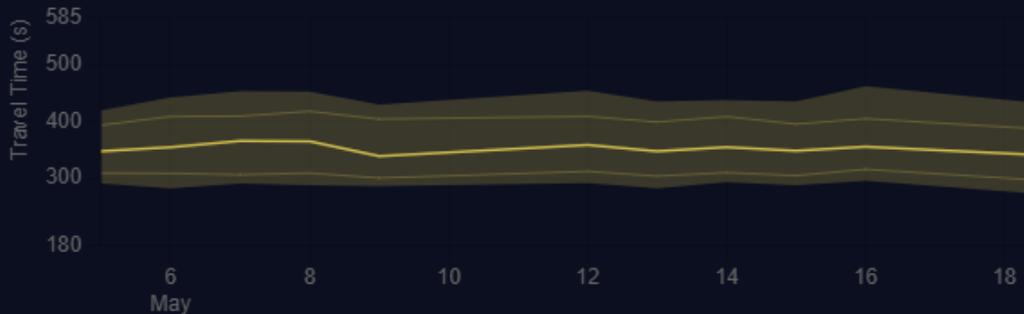
VC Ratio by Intersection



Diagnostic **Time Series** Time of Day

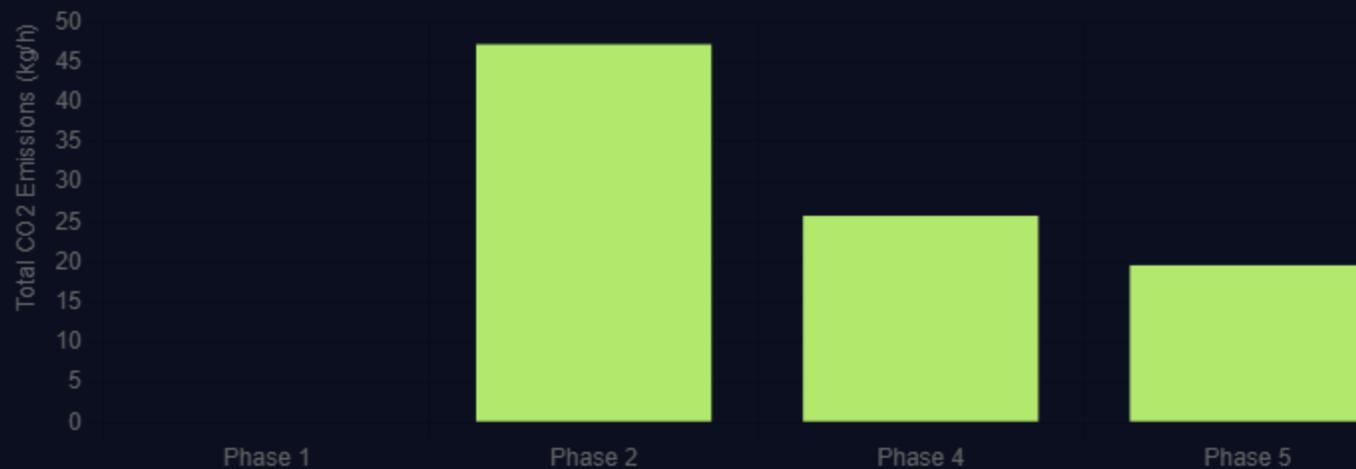
Travel Time Median

Mainline Travel Time



Cross-Section Time Series Time of Day

Total CO2 Emissions By Phase





Create

Project ROI Calculator

Signals • 28 Days ending on 04/25/2025 • 28 Days starting on 04/26/2025 • M, Tu, W, Th, F • 7:30 AM - 10:30 AM EDT [Clear](#) ✕

	BEFORE 03/29/25 - 04/25/25	AFTER 04/26/25 - 05/23/25	CHANGE
Volume			
> Average Daily Traffic (ADT) (Entering Vehicles per Day)	70,568	71,126	▲ +0.8%
Mobility			
Network Delay (Hour)	14,597.4 hr	14,427.5 hr	▼ -1.2%
NB/EB Travel Time (median)	930.4 s	901.4 s	▼ -3.1%
SB/WB Travel Time (median)	865.3 s	850.7 s	▼ -1.7%
> Buffer Index	28.7%	36.8%	▲ +28.2%
> Planning Time Index	1.78	1.86	▲ +4.5%
> Travel Time Index	1.34	1.31	▼ -2.2%

Signal Operations

> Split Failures (% of cycles)	12.4 %	12.0 %	▼	-3.2%
> Split Failures (% of vehicles)	10.6 %	9.9 %	▼	-6.6%
> Queue Length (Mean queue length in feet)	277.7ft	252.5ft	▼	-9.1%
> Number of Stops (Mean number of stops)	0.74	0.69	▼	-6.8%
> Arrivals on Green (% of arrivals)	52.3 %	59.4 %	▲	+13.6%
> Platoon Ratio	1.09	1.09	▲	+0.0%
> Mean Control Delay (seconds)	37.2 s	36.5 s	▼	-1.9%
Mainline Delay (Median) (seconds)	18.0 s	16.0 s	▼	-11.1%
Side Street Delay (Median) (seconds)	34.0 s	41.2 s	▲	+21.2%

HEIDI – Can I give everyone access? Yes

Next Steps after scale up –

Create accounts for anyone who requests it 😊

Host a training

- All trainings provided by the vendor save in our instance of the platform so they are always there to rewatch.

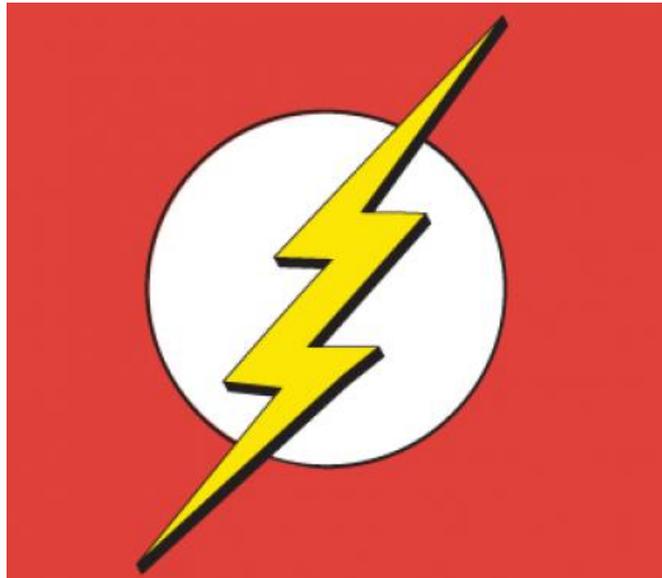


Travel-Time Tool

Katie King, Metric Engineering

FLASH AWARD

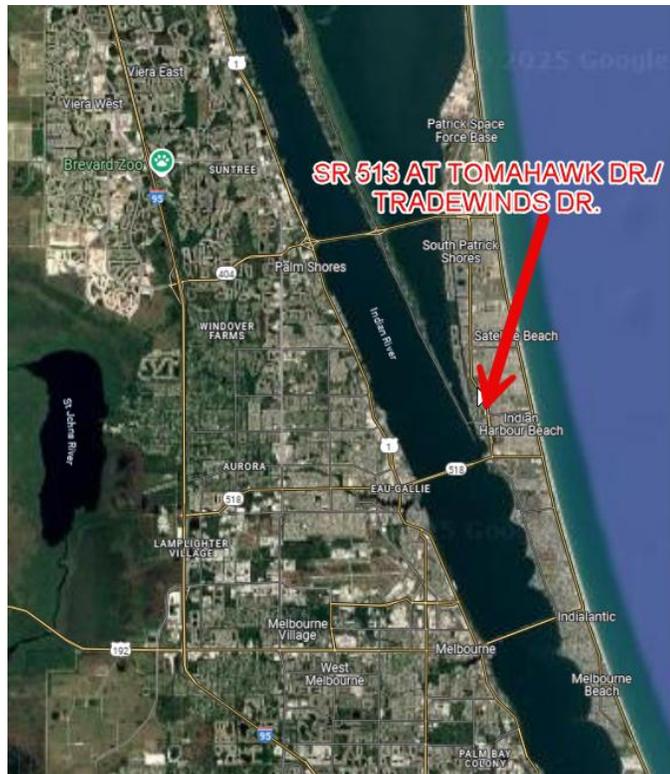
- D5 TSM&O's recognition program for outstanding maintaining agency response for traffic signal emergencies
- Focuses on showcasing specific efforts throughout D5
- Discuss processes, best practices, lessons learned, etc.



SR 513 at Tomahawk Dr. / Tradewinds Dr. Brevard County



- March 18th, 2025: Prompt Correction Action Advisory report is published by the SMO requesting the removal of mast arm structure due to several corrosion and section loss at the base plate.



March 18, 2025



To: Mr. Bobby McQuarrie
Florida Department of Transportation - District 5
1650 North Kepler Road
DeLand, FL 32724

From: Michael Scherer, P.E.
QA Engineer
8875 Hidden River Parkway, Suite 200
Tampa, Florida 33637

Project: FDOT District 5 Traffic Signal Mast Arm Inspection
Contract No. CAT71

Subject: Prompt Corrective Action Advisory - V3 Severe Corrosion
Interim T3MA Inspection
T3MA No. 704054 - SR-513 at Tomahawk Drive / Tradewinds Drive
Brevard County

Copy to: Doug Shockley, Mario Bizzio, Jonathan Jastrensky, Rick Maslyn, Tricia Ballard, Jim Stroz, Kevin Marquez

Content: An Ayres Associates inspection team has recently inspected the above referenced intersection and observed the following deficiency noted below. The Prompt Corrective Action (PCA) box has been marked in the report.

Summary: During the March 2025 interim inspection, vertical V3 was observed to have severe corrosion at the base. The notes are as follows:

V3: Based on ultrasonic testing (D-meter) readings the bottom 1 in. of the vertical has nearly 50% section loss around the full circumference and a new corrosion hole 1 ¼ in. L x 1 in. H to go along with the existing hole 3 ½ in. L x 1 ½ in. H. Refer to Photos 1 through 3.

Thickness measurements were taken just above base plate weld and 4 in. above the base plate between each anchor bolt:

Original thickness = 0.180 in.

Between ABs #1 and #2
BP = 0.140 in.; 4 in. = 0.180 in.

Between ABs #2 and #3
BP = 0.100 in.; 4 in. = 0.180 in.

Between ABs #3 and #4
BP = 0.080 in.; 4 in. = 0.165 in.

Between ABs #4 and #5
BP = 0.085 in.; 4 in. = 0.180 in.

SR 513 at Tomahawk Dr. / Tradewinds Dr. Brevard County



T SMA No 70M054



Photo 1: V3 - Hole due to corrosion at base of vertical



Photo 2: V3 - Hole due to corrosion at base of vertical



28.16044, -80.60419, -28.0m, 50°
2025-03-20 10:04:35 AM

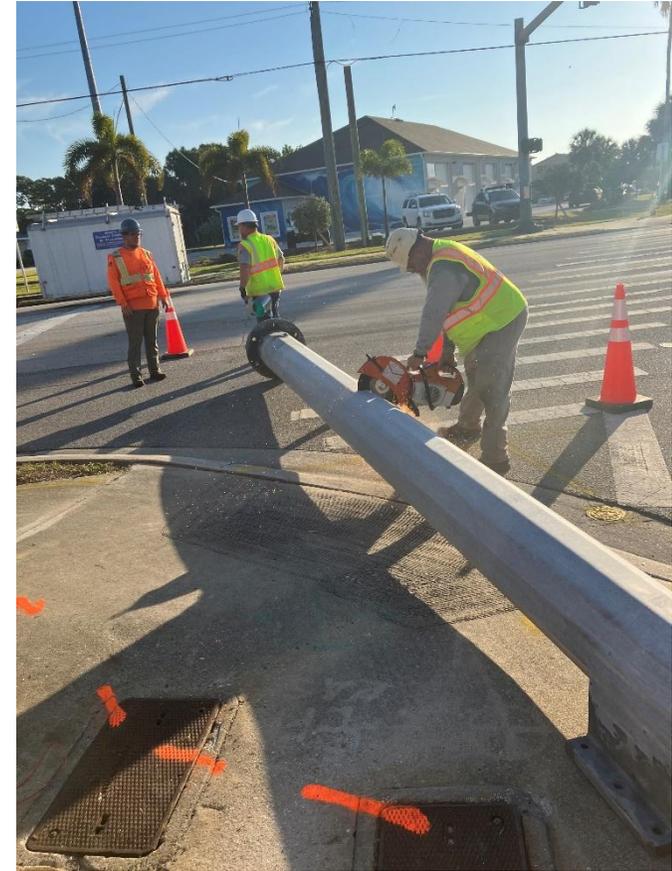
SR 513 at Tomahawk Dr. / Tradewinds Dr. Brevard County



- **Emergency Response Details**

- March 18th: Brevard County received notice of the report findings from D5
 - Coordination began between County and D5 to plan for the removal of the mast arm and use of a temporary signal trailer
 - County prepares to bring the intersection online via installation of Pepwave and CCTV
 - County begins to secure contractor services for the removal work with availability for cranes
 - County begins to secure MOT and LEO services
 - County begins to notify nearby residents, businesses, and local City Government of issue and plans for construction and lane closures
- March 25th : County took delivery of the temporary signal trailer, pre-positioned at the site and begins to prep for use
- March 26th: County configures tests and configures the trailer for use
- March 27th:
 - 7:30am begins removal of mast arm
 - By 9:30am mast arm is removed, and signal trailer is running the approach.

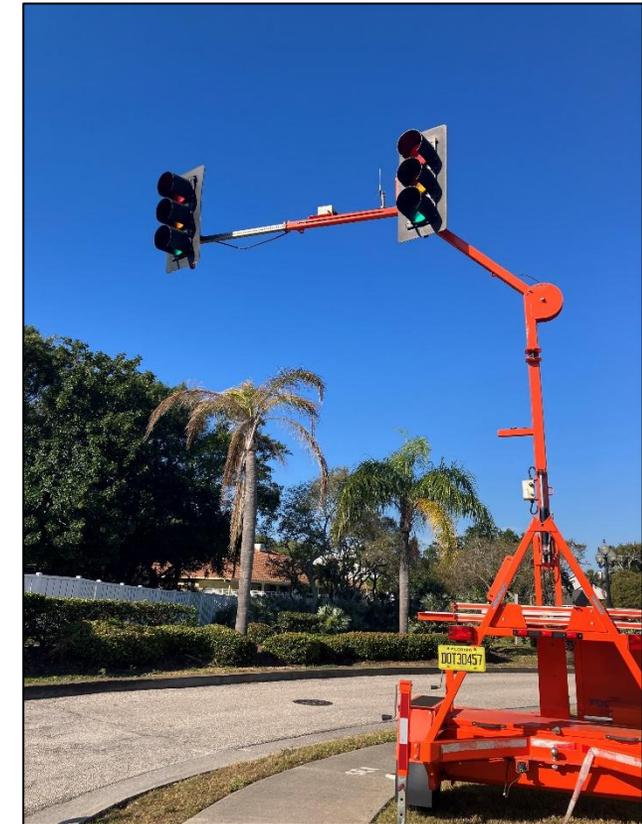
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SR 513 at Tomahawk Dr. / Tradewinds Dr. Brevard County



- **Key Successes**

- Experienced County personnel leading a experienced contractors (ACS and Straight Line Loops)
- Coordination and planning began on the same day of receiving the report findings
- Split work between in-house and contracting staff to expedite results and save budget
- Having set-aside funds for emergencies
- Quickly determined that improvements to monitoring were needed; implemented this before switchover
- Coordination with FDOT for equipment

- **Lessons Learned**

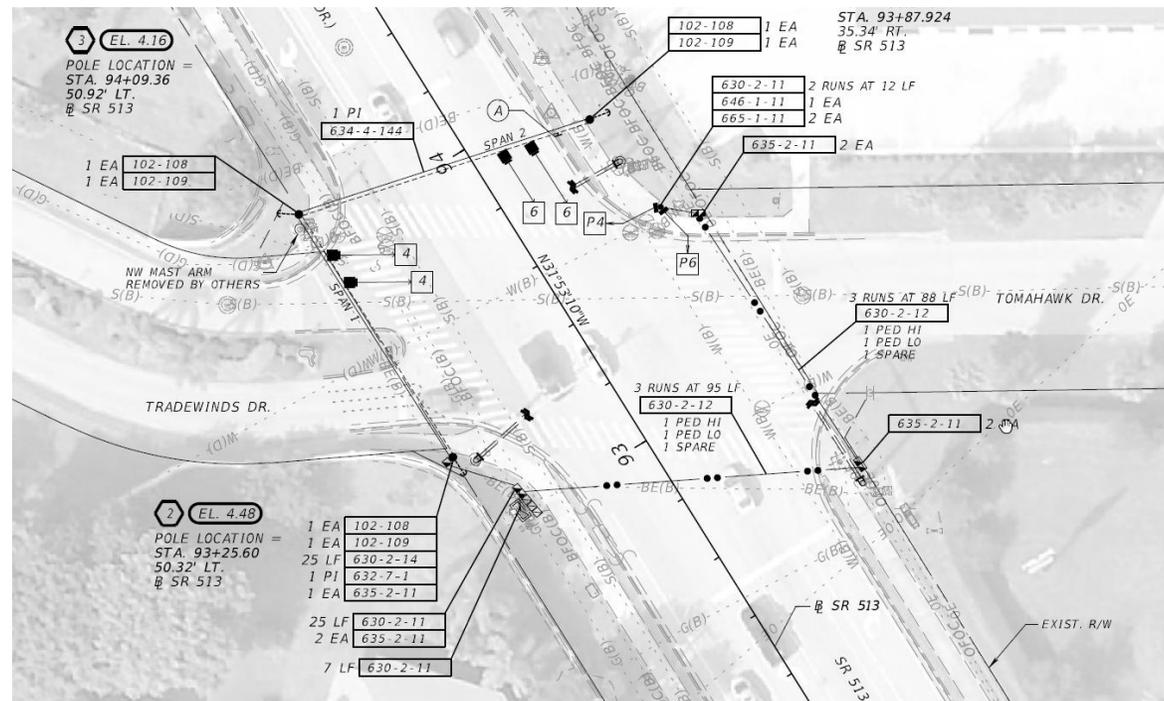
- Selection of contractor is critical to success
 - Make sure you consider heavy machinery availability as part of your selection



SR 513 at Tomahawk Dr. / Tradewinds Dr. Brevard County



- Future work
 - D5 TOPB working on plans to remove trailer and install temporary spans
 - Removal of additional mast arm also required but not an immediate need
 - Full intersection rebuild project also requested, scoping is underway

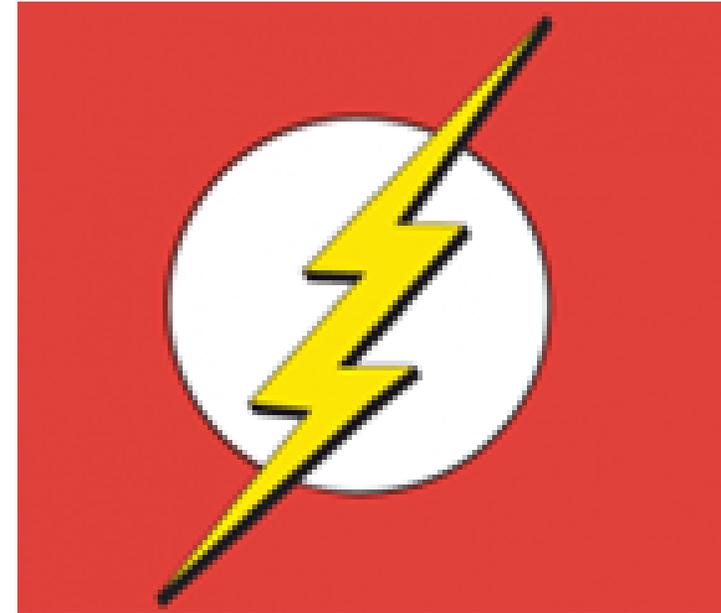




SR 513 at Tomahawk Dr. / Tradewinds Dr. Brevard County

Key Staff Involved – Brevard County:

- Rich Ataman: Planning, coordination and supervision
- Jaharie Scarborough: Pepwave, and CCTV installation and controller set up
- Anthony Mercado: Pepwave, antenna and CCTV installation
- Andrew Martinez: MOT and portable traffic trailer set up and programming
- Robbie Newton: MOT and portable traffic trailer set up





Current Initiatives

David Williams, VHB

Current Initiatives

- I-4 Express Lanes
- I-4 FRAME
- OBU Deployment

Current Initiatives

- Hurricane App
- DANIEL (Digital Analytics Notification for Incident and Event Localization)
- HEIDI (High-Definition Engineering Intersection Data via Integrative Modeling)



THANK YOU!

Next Consortium – August 7, 2025



TSM&O Consortium Meeting

MEETING AGENDA

Teleconference or
FDOT District 5 RTMC (4975 Wilson Rd, Sanford, FL 32771)

June 5, 2025

10:00 AM-12:00 PM

- 1) FDOT DISTRICT FIVE ITS MASTER PLAN UPDATE
 - Dale Cody, Metric Engineering
- 2) REGIONAL TSM&O STRATEGIC PLAN
 - Eric Hill, MetroPlan Orlando
- 3) TSM&O CONSTRUCTION PROJECT TRACKING
 - Jennifer Sardonini, FDOT District Five Traffic Operations
- 4) INCIDENT DURATION AND TRAFFIC FLOW PREDICTION – UCF RESEARCH UPDATES
 - Dr. Samiul Hasan, CECE University of Central Florida
- 5) HEIDI – UPDATE
 - Katie King, Metric Engineering
- 6) FLASH AWARD FOR EMERGENCY REPAIRS – BREVARD COUNTY
 - Kevin Marquez, FDOT District Five Traffic Operations
- 7) CURRENT INITIATIVES
 - David Williams, VHB