



Gwinnett
Transportation

Connected Vehicle Technology Master Plan

ITS Georgia Annual Meeting

October 7, 2019

Why Should We Pursue Connected Vehicle Technology?

- Safety benefits for first responders
- Automakers are planning to produce vehicles with this technology
- Safety benefits for all road users
- Potential to improve traffic flow
- GDOT is deploying this technology on state routes in metro Atlanta



Definitions

Automated Vehicles are vehicles that are capable of sensing their environment and navigating without human input.

Connected Vehicles are vehicles that use wireless communication technologies to communicate with roadside infrastructure, the driver, other cars on the road, and other devices, such as mobile phones.



Source: USDOT. Connected Vehicles Pilot Deployment Program

Vehicles to Infrastructure (V2I)

- Red Light Warning
 - Driver Alert
- Pedestrian in Crosswalk Alert
 - Driver Alert
- Restricted Lane Warning
 - Driver Alert
 - Agency Response and Safety
- Emergency Vehicle Signal Preemption
 - Agency Response, Safety, and Coordination
 - Driver Alert





Connected Vehicle Technology Master Plan

Why create this plan?

- Supplement the County's existing transportation plans by focusing on connected vehicle infrastructure
- Identify the potential safety and mobility benefits available with deployment of connected vehicle infrastructure
- Understand the current state of the technology and the plans of automakers
- Prepare for the Smart Corridor pilot located along PIB
- Provide guidance for future projects

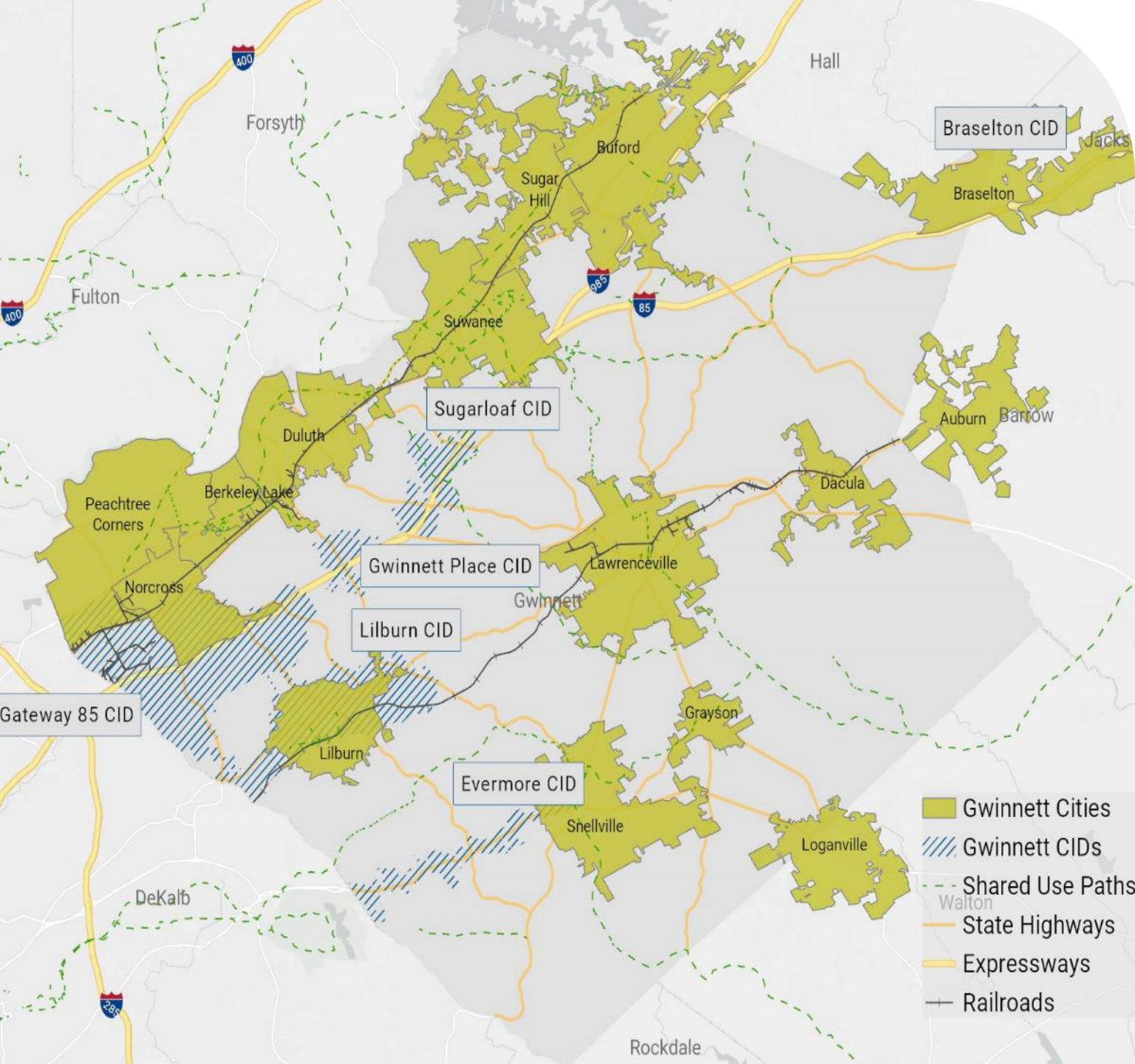
How to develop the plan?

- Awarded one of the inaugural Georgia Smart Communities Challenge grants
- Matched with County SPLOST funds
- Included research and data analysis conducted by Georgia Tech faculty



Goals for the plan

- Have broad applicability across the County, Atlanta region, and the State of Georgia
- Understand the needs and challenges to ensure regional and statewide compatibility for road users
- Establish guidelines for deploying a new and evolving technology
- Provide guidance for ourselves and potentially other agencies for the implementation of connected vehicle technology for a local government



Project Team

- Gwinnett County:
- AECOM:
- Georgia Tech:
- Stakeholders:
 - Public Safety
 - GDOT
 - Cities
 - Community Improvement Districts

Project Timeline

- September 2018: Project initiation (Georgia Tech Workshop)
- October 2018: **Local stakeholder kick-off meeting**
- November 2018: Technology review meeting
- January 2019: CV applications identification meeting
- March 2019: CV applications completion meeting
- April 2019: **Regional CV stakeholder workshop as part of Ga Smart site visit**
- June 2019: Data collection and evaluation
- August 2019: Connected Vehicle Technology Master Plan completion
- September 2019: **Final presentation at Georgia Tech**

Project Actions

- Interviewed peer agencies that had already installed or are planning to install connected vehicle infrastructure
 - RenewATL
 - City of Marietta
 - Cobb County DOT



Project Actions

- Meetings with GDOT to coordinate on technical issues and standards
- GDOT-funded opportunities
 - Connected vehicle software
 - Roadside Unit (RSU) device testing
 - Expansion of GDOT's deployment of roadside units in Gwinnett County by 56 intersections



Source: GDOT

Benefits of the process

- Learned about transportation challenges from stakeholders
- Explained the technologies and systems at a conceptual level
- Provided overview of industry trends and opportunities
- Developed a 5 year deployment plan for connected vehicle applications and technologies
- Refined the scope of the Smart Corridor pilot project
 - Expansion from PIB signals to more roads west of I-85
 - Status of the desired connected vehicle applications

5-Year Deployment Plan

Application	2020	2021-2022	2023-2024
	Smart Corridor project	In Coordination with ARC, GDOT	In Coordination with GDOT
Signal Phase and Timing (SPaT) Information	<ul style="list-style-type: none"> Enable red light warning, phase termination/next signal phase, and green band speed applications 	<ul style="list-style-type: none"> Monitor benefits of safety applications related to fleet penetration of RSUs and cellular OBUs 	<ul style="list-style-type: none"> Monitor benefits of safety applications related to fleet penetration of DSRC/cellular OBUs
Emergency Vehicle Preemption (EVP)	<ul style="list-style-type: none"> Enable EVP Install OBUs on fire trucks 	<ul style="list-style-type: none"> State-wide; manage EVP conditional priority requirements 	<ul style="list-style-type: none"> Alerts for excessive transition time
Transit Signal Priority (TSP)	<ul style="list-style-type: none"> Enable TSP Install OBUs on transit vehicles 	<ul style="list-style-type: none"> Manage TSP conditional priority Test schedule adherence conditional priority Test bus occupancy conditional priority 	<ul style="list-style-type: none"> County-wide system development Alerts for excessive transition time

- Identification of connected vehicle applications that could be deployed in pilot project
- Understanding of which applications would need support from other parties and more development

Connected Vehicle Applications for Smart Corridor Pilot Project



- Emergency vehicle preemption
- Transit signal priority
- Pedestrian presence notification
- Railroad crossing status
- Construction and maintenance activity notification
- Signal timing and phasing information

Project Recommendations

- Solve real problems
- Coordinate with GDOT, since connected vehicle functions should be boundary-less
- Recognize that plan flexibility is necessary due to the speed of technology evolution
- Budget time and finances for system field testing, O&M, and security certification





Georgia Tech Research Actions & Results

Research Focus

- Evaluate the potential for improvements in safety and response time with emergency vehicle preemption
- Focus on fire apparatus at stations within the pilot project area
- Develop strategies for maximizing benefits and minimizing impacts

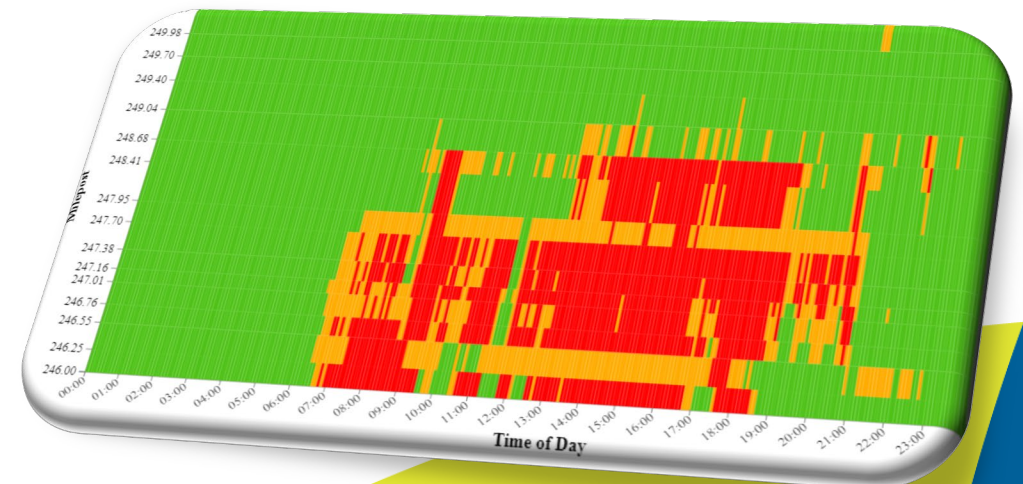


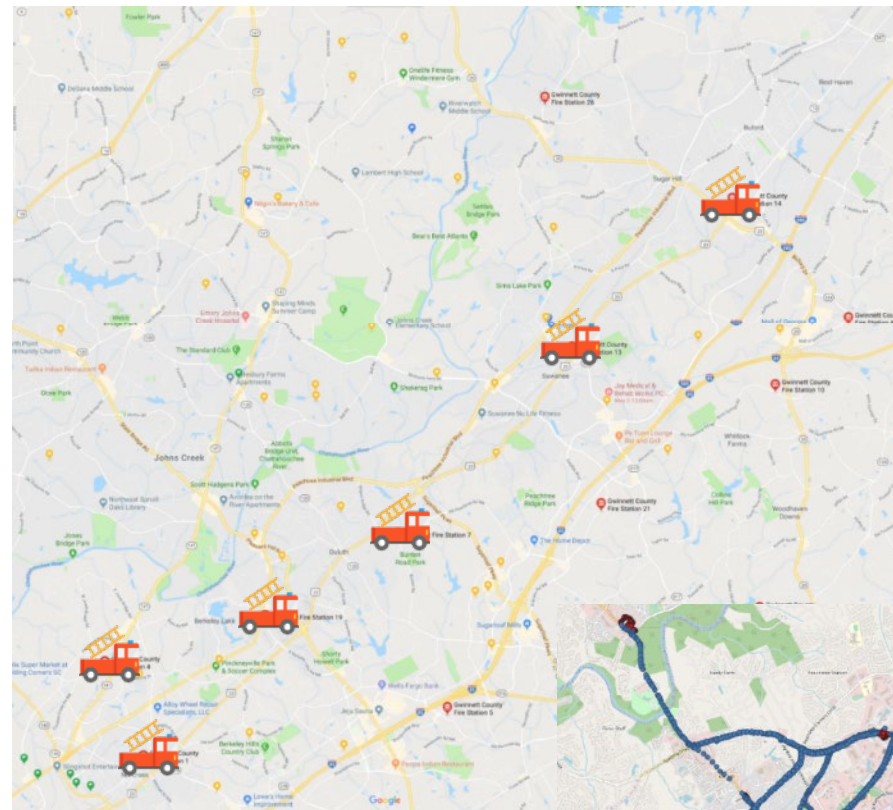
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<https://www.cnn.com/2013/04/10/us/georgia-firefighters-hostage/index.html>

<https://www.semanticscholar.org/paper/GPS-and-ZigBee-based-traffic-signal-preemption-Kodire-Bhaskaran/b1d0e1034d5c147b44f6fcb51ab06d722b30acaa>

Data

- GPS data collection on 17 trucks/engines/med-units from 6 Fire Stations
- GT equipment deployed on Gwinnett county fire vehicles
- 1 month of second by second location data



Georgia Tech Student Engagement



Smart Community Corps student

- On-site placement at the Gwinnett County DOT Traffic Control Center
- Streamlined the process for data transfer for high resolution (massive volume) traffic signal data from Gwinnett to GT on a regular basis
- Developed data fusion API for GPS and Signal status data



Civic Data Science team

- Performed Bottleneck Analysis using GPS and Signal data
 - Developed data quality checks
 - Developed data transformation protocols for GPS data
- Identified Intersections contribution to maximum delay for Emergency Vehicles



Data Processing

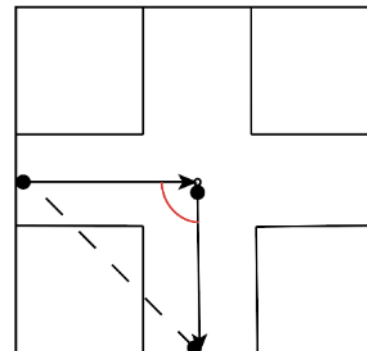
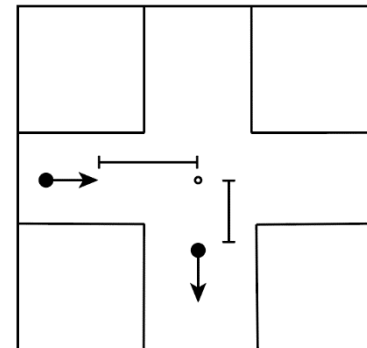
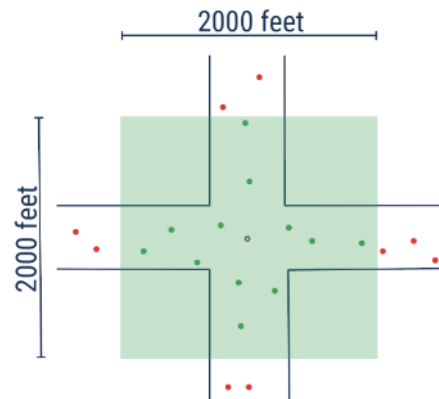
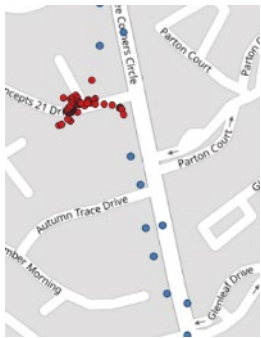
Off-route filter

Intersection filters

Intersection association

Approaching / receding determination

Signal light association



Approach Direction + Turn

Traffic Signal status

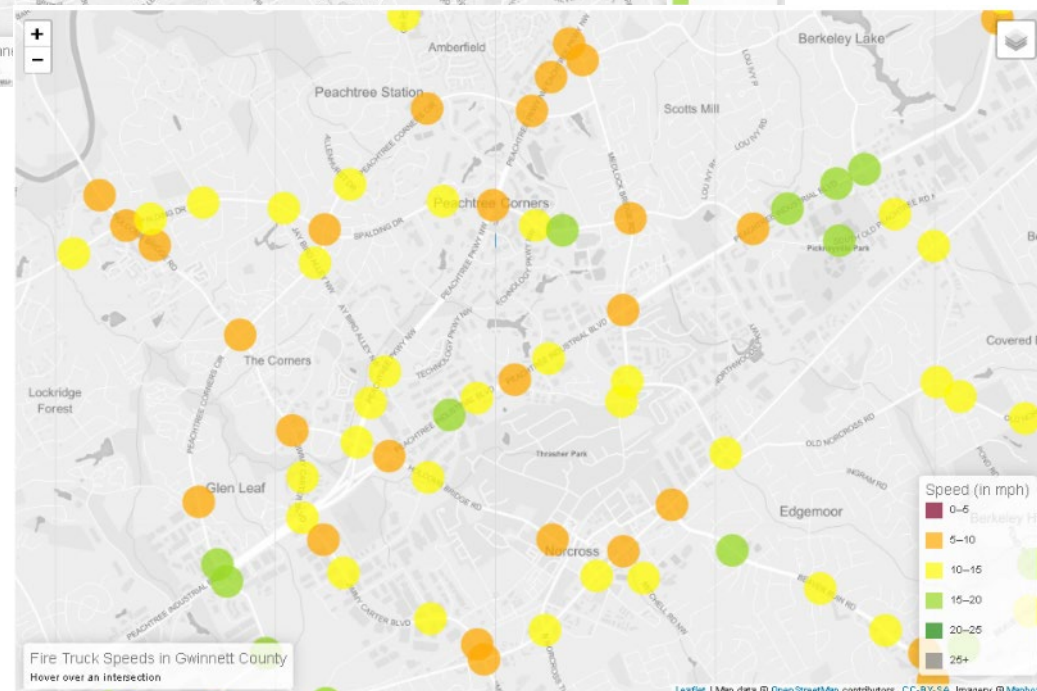
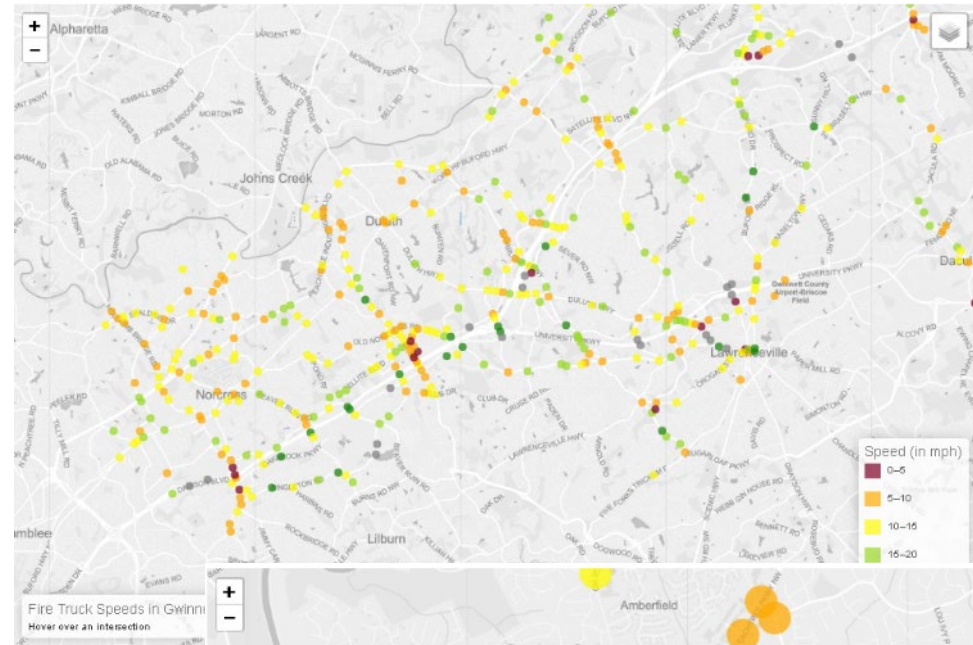


Preliminary Results

Average Speed Near Intersections

Top 10 intersections

Intersection	Speed
PLEASANT HILL RD	7
HOWELL FERRY RD	8
MCGINNIS FERRY RD	8
NORTH BERKELEY LAKE RD	8
PEACHTREE HILL S/C / DUNKIN DONUTS	8
ALTON TUCKER BLVD / FIRST AVE	9
SUWANEE DAM RD	9
MEDLOCK BRIDGE RD	9
SR 20 / NELSON BROGDON BLVD	9
REPS MILLER RD	10



Preliminary Results

Percentage for Red light on Approach

Top 10 intersections

Intersection	Speed	%Red
PLEASANT HILL RD	7	57%
MCGINNIS FERRY RD	7	63%
HOWELL FERRY RD	8	90%
NORTH BERKELEY LAKE RD	8	86%
PEACHTREE HILL S/C / DUNKIN DONUTS	8	81%
SUWANEE DAM RD	8	74%
ROGERS BRIDGE RD	9	33%
MEDLOCK BRIDGE RD	9	46%
REPS MILLER RD	9	40%
ALTON TUCKER BLVD / FIRST AVE	9	84%



FS 19 Driveway
~1,100 feet
From PIB



Preliminary Results

Average Queue Length Top 10 intersections

Intersection	Queue Length	Occurrences
SUWANEE WALK AVE (~670 FEET SOUTH OF MCGINNIS FERRY RD)	734	13
RIVERGREEN PKWY (NORTH)	622	19
SUMMITT RIDGE PKWY / SWEETWATER CENTER	378	113
PEACHTREE HILL S/C / DUNKIN DONUTS	364	36
ALTON TUCKER BLVD / FIRST AVE	344	36
REPS MILLER RD	331	71
SUWANEE DAM RD	319	87
PLEASANT HILL RD	299	118
SR 20 / NELSON BROGDON BLVD	299	190
WEST PRICE RD	289	12

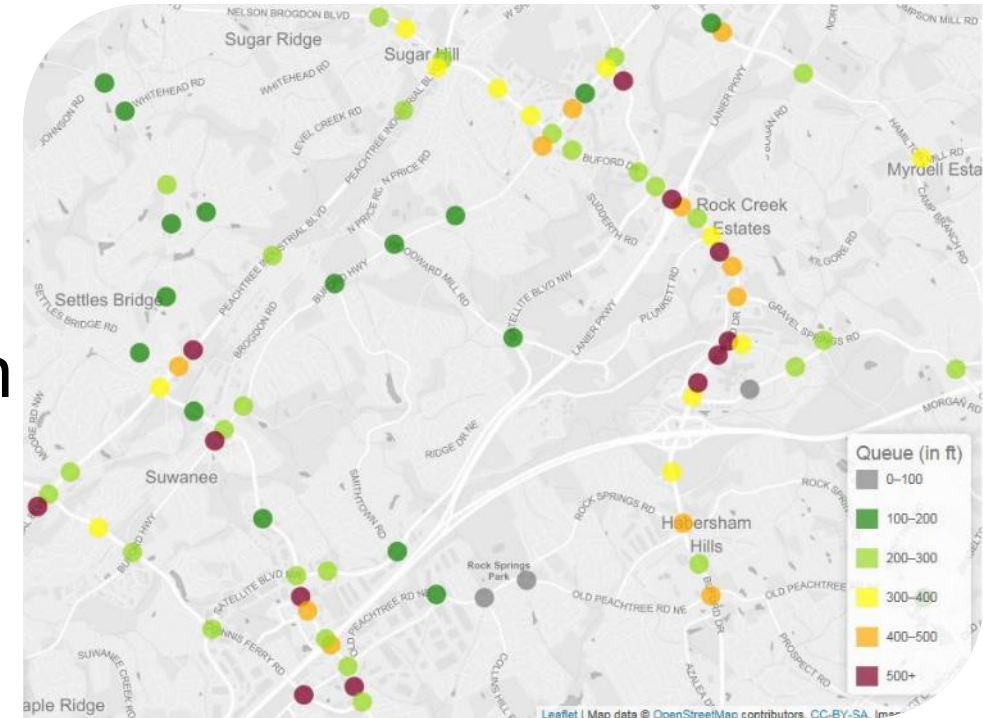
Suwanee Walk Ave

Rivergreen Pkwy



Next Steps in Analysis

- Deeper analysis of data
- Quantify total observed delay
- Identify critical signal phases for emergency vehicles at each intersection
- Evaluate forward looking preemption feasibility
- Collect more before-deployment data in Fall 2019
- Post-CV deployment analysis (2020-2021)



Project Team Contact Information

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