I-405 EXPRESS TOLL LANES

Managing Congestion in Priced Lanes

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Washington State Department of Transportation
April 16, 2019

Agenda

- Background & History
- Goals
- Current Performance
- Issues, Solutions & Outcomes
- Future Plans

HOV Lane: What was the problem?

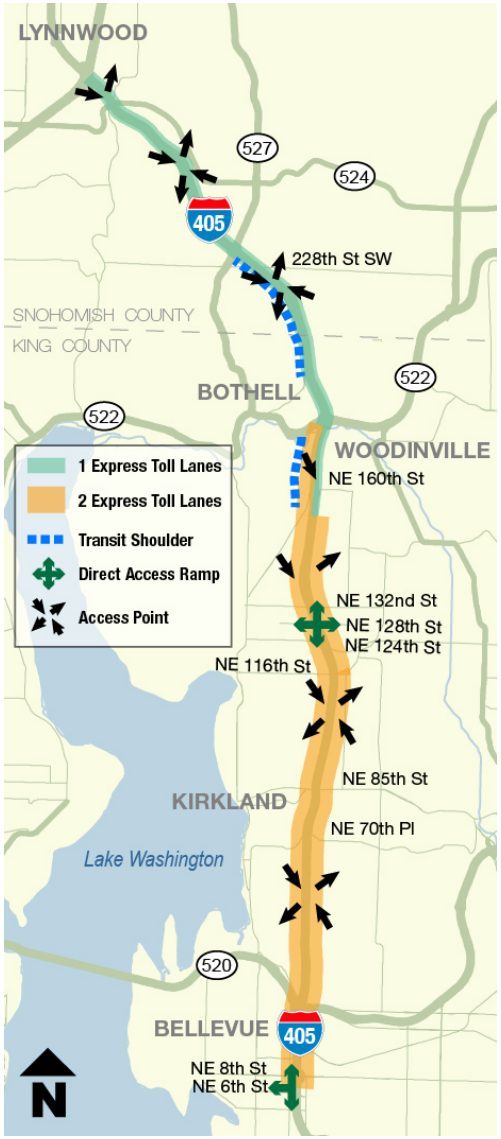
- **Bad traffic**
  - Drivers on I-405 experienced some of the worst traffic in the state and it was getting worse.
  - Before express toll lanes, the southbound I-405 HOV lane dropped below 45 mph 200 days out of the year and I-405 HOV lanes were congested 60 percent of weekdays.

- **Crowded HOV Lanes**
  - I-405 HOV lanes were not meeting state requirements to operate at 45 mph 90 percent of the time during peak hours.
  - I-405 HOV lanes were often just as congested as the regular lanes.

- **Transit Suffers**
  - Congested lanes significantly delayed transit trips and reduced reliability.

First Express Toll Lane Project – Bellevue to Lynnwood

- **15 miles of express toll lanes**
- **Toll rates**
  - Minimum toll rate $0.75
  - Maximum toll rate $10
- **Carpool policy**
  - To travel toll-free carpools must:
    - Meet new carpool occupancy requirements
      - 3+ carpools exempt at peak hours
      - 2+ carpools exempt at off-peak hours
    - Have a pre-paid *Good To Go!* account
    - Have a *Good To Go!* Flex Pass set to HOV mode



Goals for Express Toll Lanes

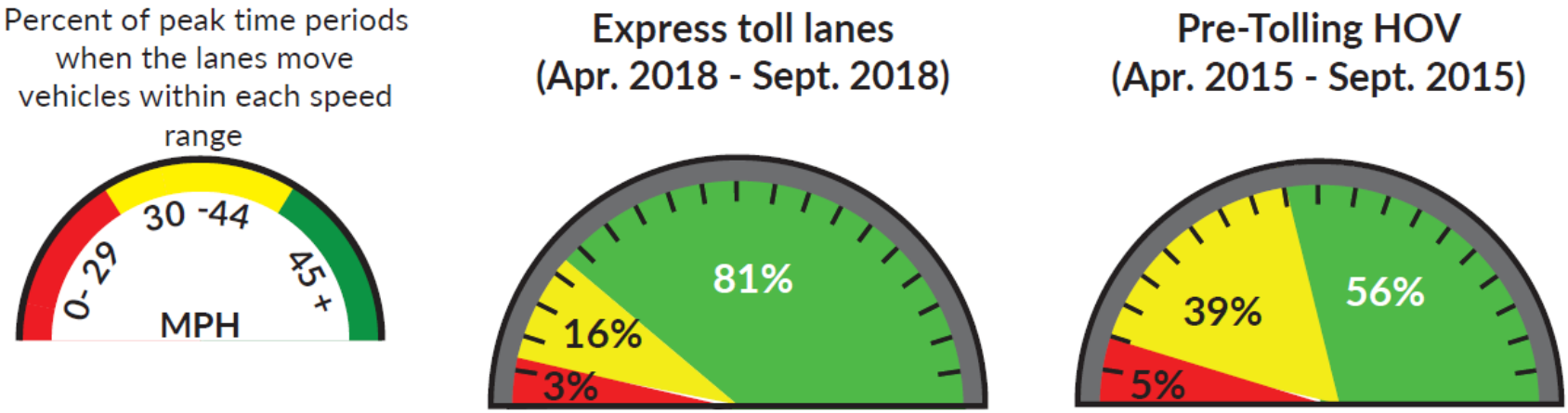
Provide a choice to drivers

Provide a faster, more predictable trip

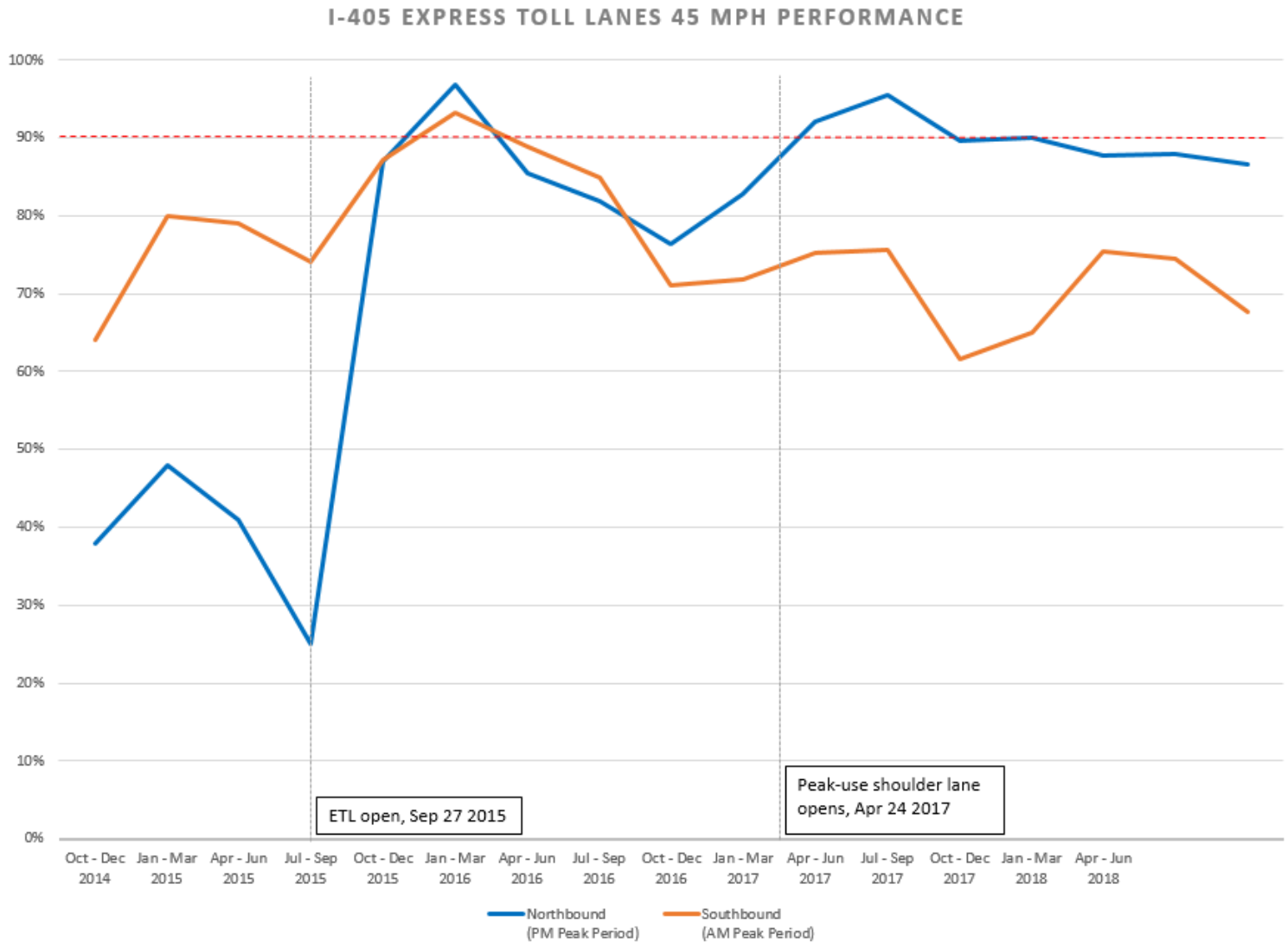
Generate revenue to reinvest in the corridor

Legislative Performance Measures

1. Whether the express toll lanes generated **sufficient revenue** to pay for all express toll lane-related operating costs.
   - $74.9 million in gross revenue with $25 million for O&M
   - $49.9 million available for reinvestment in the corridor
2. Whether the express toll lanes **maintain speeds of 45 miles per hour at least 90 percent of the time during peak periods.**



Quarterly Performance



Calculating 45mph Metric

Data

- Inductive loop speeds, spaced every ½ mile
- Weekdays Only – including incidents
- Peak-period, Peak Direction
  - SB (5 a.m. – 9 a.m.)
  - NB (3 p.m. – 7 p.m.)

15.06 miles	9/10/2018	9/11/2018	9/12/2018	9/13/2018
5:00 AM	60.0	60.0	60.0	60.0
5:05 AM	60.0	60.0	60.0	60.0
5:10 AM	60.0	60.0	60.0	60.0
5:15 AM	60.0	60.0	60.0	60.0
5:20 AM	60.0	60.0	60.0	60.0
5:25 AM	60.0	60.0	60.0	60.0
5:30 AM	60.0	60.0	60.0	60.0
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8:00 AM	58.0	43.2	26.2	48.0
8:05 AM	58.5	42.8	28.3	50.7
8:10 AM	54.6	41.6	33.5	50.0
8:15 AM	57.2	40.1	32.9	51.9
8:20 AM	56.5	40.0	37.9	49.6
8:25 AM	58.9	40.5	33.1	51.9
8:30 AM	59.9	41.9	35.3	50.6
8:35 AM	58.8	45.0	36.0	54.9
8:40 AM	59.8	46.8	38.5	57.7
8:45 AM	58.2	49.4	40.0	58.4
8:50 AM	59.7	49.3	42.1	55.8
8:55 AM	60.0	54.7	44.2	58.5
Passing	48	33	36	47
Metric (percentage):	100%	69%	75%	98%

Method

- Divide the period into 5 minute “bins”
  (48 bins per direction per day)
- Calculate the average speed for each bin
- Assign the bin a pass or fail.
  - Speed >= 45 mph = Pass
  - Speed < 45 mph = Fail
- Find the percent of passing bins
  - If the system is below 45mph for 20 minutes, we fall below 90%

Example

- On 9/12 at 8 a.m. there was a blocking incident for 10 minutes in the ETLs, dropping the speeds below the threshold for the remainder of the peak.
  - 12 bins failed, 36 bins passed – 75%

Issues

1. **Popularity** of the lanes is high and growing

2. **Violators** keep using the lanes and are immune to price

3. **Friction** from the congested GP lanes, slow the ETLs

4. **Access** to/from the ETLs impacts performance

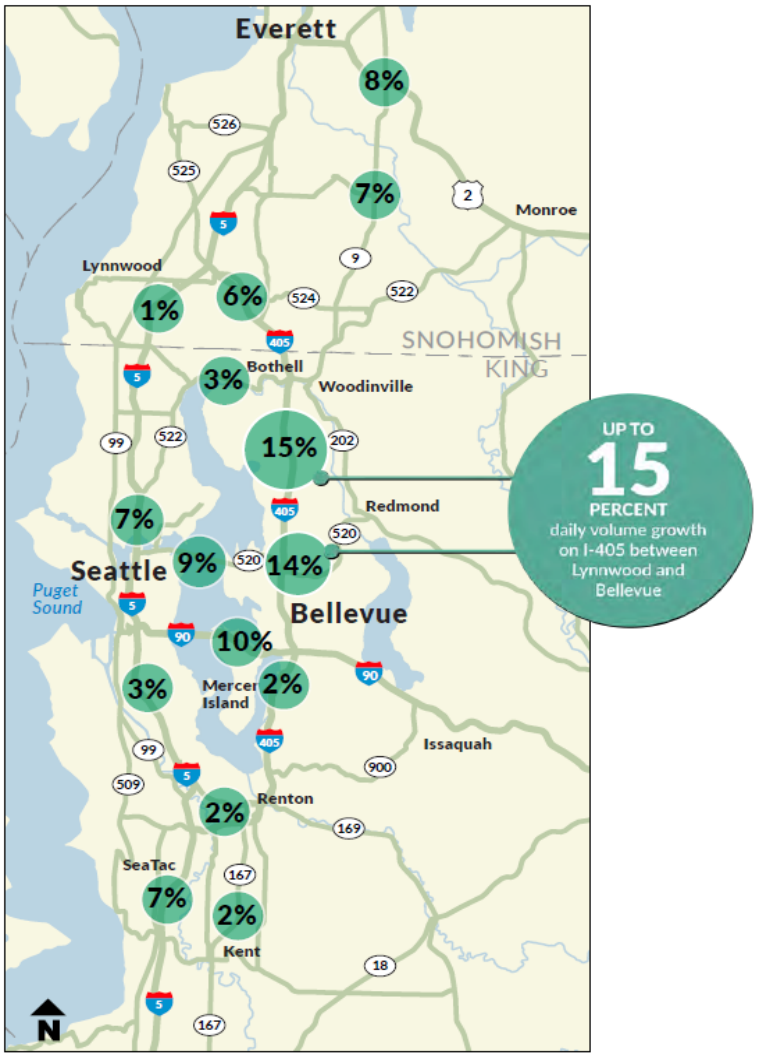
5. **Toll Rate** does not always deter usage

6. **SB Single Lane** continues to under-perform

1. Popularity of ETLs

- **Happy Customers and benefit delivered**
  - 86% of customers are happy they have the option to save time by using the lanes
  - Drivers save an average of 11 minutes vs. the GP lane
  - Transit ridership is up and travel times are down
- **Demand for the ETLs continues to grow.**
  - 1,100 people move to the area every week
  - No planning is required; everyone is welcome to use the lanes
  - 1.5 Million active tags and 860,000 active accounts (FY 2018)
  - Carpool incentives
    - Given away 45,000 flex passes to eligible carpoolers

Average daily vehicle volume growth –
Oct. 1, 2014 - Sept. 30 2015 compared to Oct. 1, 2017 - Sept. 30, 2018



1. Popularity of ETLs (cont.)

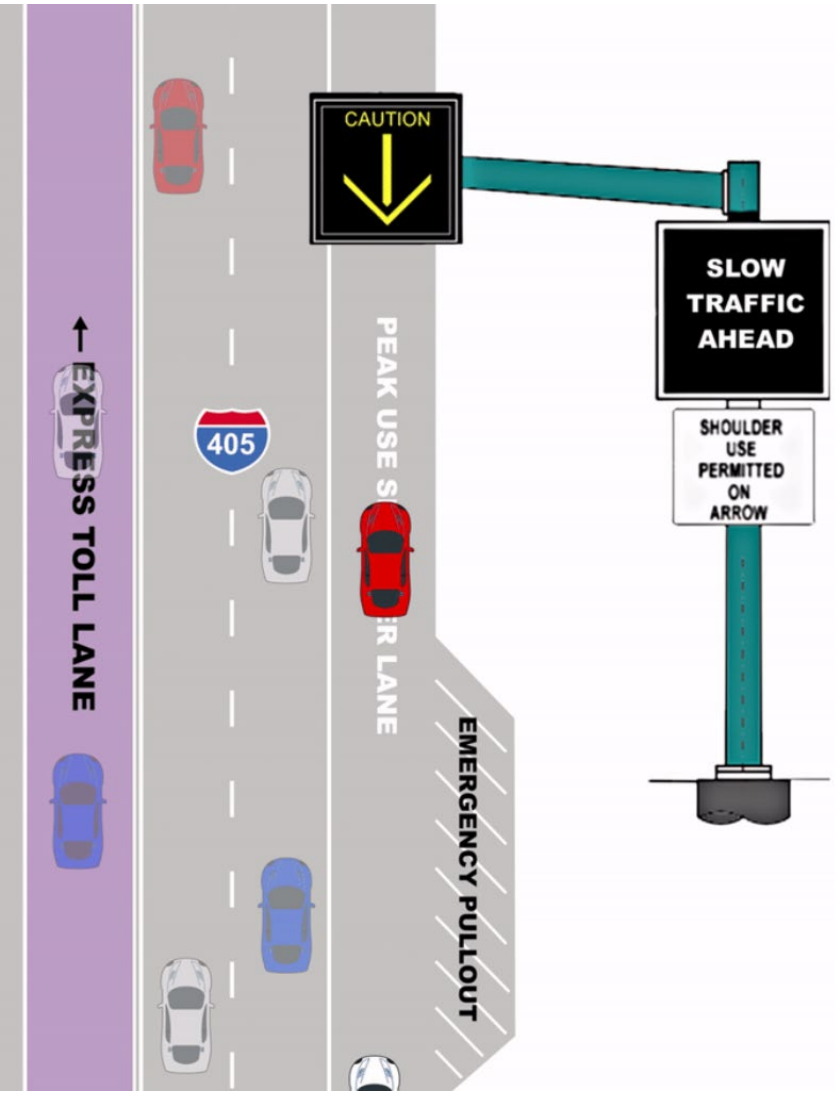
Solutions

- Expand the system with both tolled and un-tolled capacity
  - Peak Use Shoulder Lanes at NB SR 527
    - Opened in April 2017
  - Extend dual ETLs from SR 522 to I-5
- Operate as efficiently as possible
  - 50+ tweaks to the algorithm

Outcomes

- Operating the lanes as efficiently as possible
- Peak Use Shoulder Lane delivered
- Extend the ETLs – planning is underway

1. Popularity of ETLs (cont.)



Status:

- Construction fully funded by express toll lane revenue ($10 million)
- Opened to traffic April 24, 2017

Project description

- Converted 1.8-mile section of right shoulder to general purpose lane
  - Generally open during afternoon peak period
  - Four paved pull-out areas
- Built new noise wall
- Made improvements to express toll lane signage and access

2. Violators

Description

- WSDOT estimates that occupancy violations are on the rise throughout the HOV system. The ETLs are no exception.
- Officers have two ways to identify potential violators
  - Beacon flash – indicating the vehicle is not paying
  - Red square on the transponder
- Drivers do the math – it is cheaper to violate, get caught occasionally and pay the fine than it is to pay the tolls
- Insurance rates are not impacted as a result of HOV violations

2. Violators (cont.)

Solutions

- Continue to pay overtime to WSP for additional enforcement
- Employed multiple enforcement techniques
  - Roving vs. Stationary Patrols
  - Concentrated vs. Dispersed (location)
  - Emphasis Patrols vs. Spread (timing)
  - Team vs. Solo
  - Marked vs. Unmarked patrol vehicles

- HOV Emphasis Patrols region wide with signing and media
- Graduated penalties (proposed as agency request legislation)
- Researching automated occupancy detection

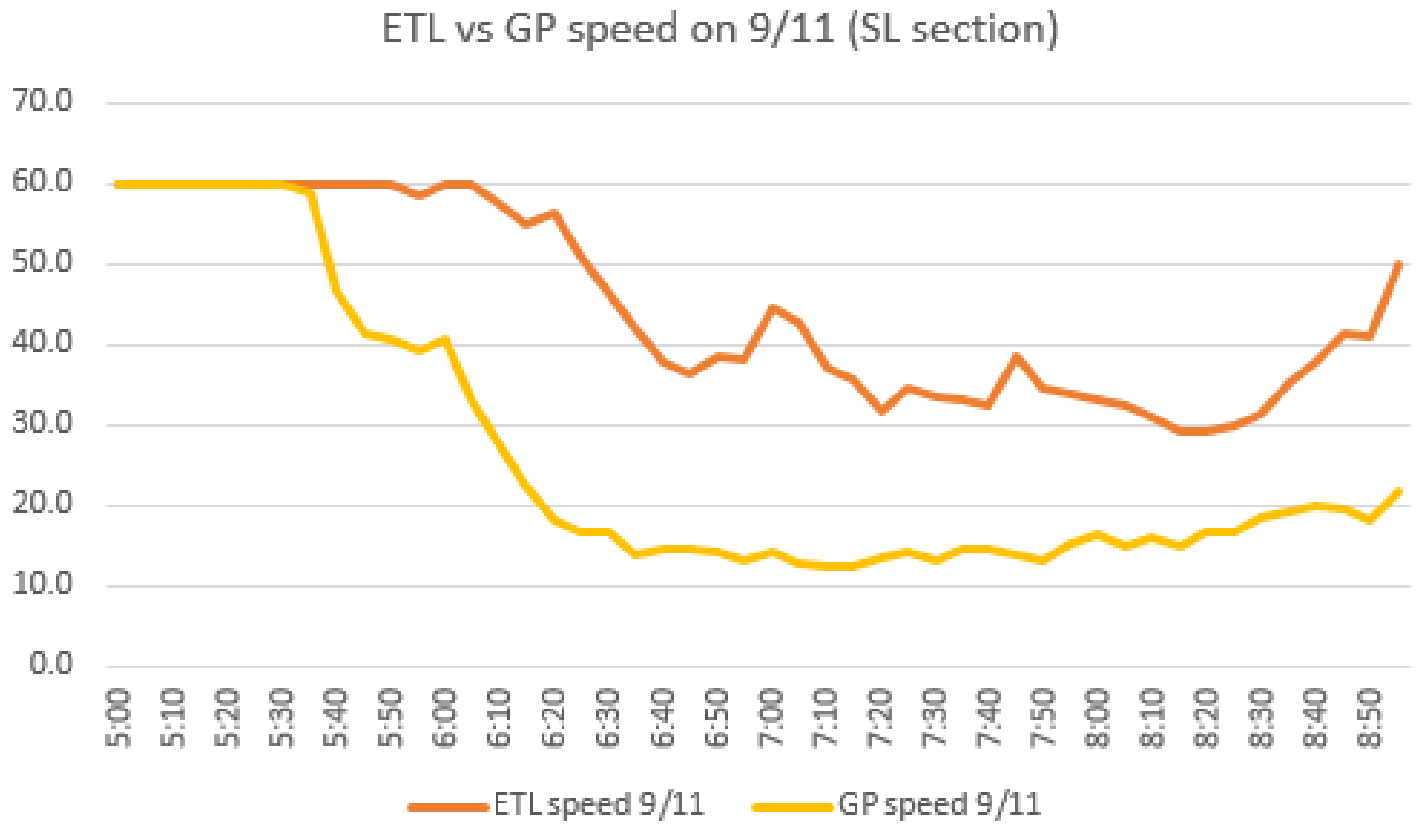
Outcome

- We continue to face challenges with violators and look for potential solutions.

3. Friction with GP Lanes

Description: “Sympathy Slowing”

- Depending on the horizontal spacing between the GP lanes and ETLs, drivers feel uncomfortable with a sizable speed differential.
- Speed differential rarely exceeds 20mph under the best conditions
- Lane buffer is 2 to 4 feet



3. Friction at SR 527 (NB)

Description

- The NB entrance ramp from SR 527 (1,000 vph) created a merging problem that slowed the GP traffic significantly. This slow-down in the GP lanes slowed the ETL traffic as well.

Solution

- Adjusted the algorithm multiple times to increase the toll rate in an attempt to decrease the number of vehicles in the lane.
- In April 2017, the **Peak Use Shoulder Lane (PUSL)** was implemented and paid for by revenue from in the ETL. (Also implemented an access improvement.)

Outcome

- The algorithm changes were successful in raising the toll rate, but were not successful at reducing the congestion in either the GP lanes or the ETLs.
- Performance improved dramatically with the opening of the PUSLs. The NB Single Lane Section went from 72% to 90% performance, comparing the quarter before and after the opening.

4. Access

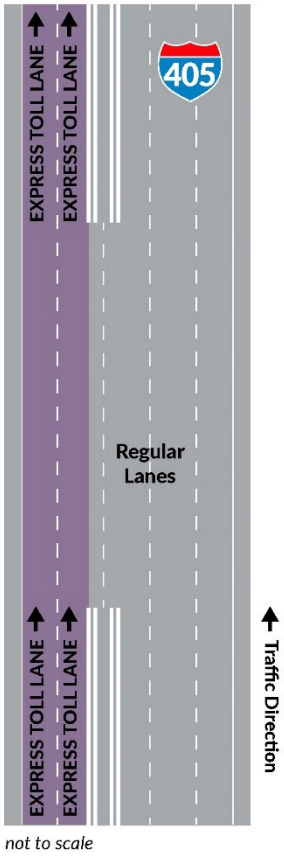
Description

- The ETL system is buffer separated with pavement markings (width 2-4')
- System implemented with 4 types of designated access points:
  - Skip Stripe (2,000' – almost 6,000' long)
  - Weave Lane
  - Channelized Ingress
  - Direct Access Ramp
- Additional congestion around access points
  - Concentrating these movements exacerbates the problem
  - Some original access areas were near minimum distance
  - ETL users wanted to get into the system sooner

*** Lesson Learned from SR 167 – an open access design increases the impact of friction with the GP lanes

4. Access (cont.)

Skip Stripe



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Weave Lane

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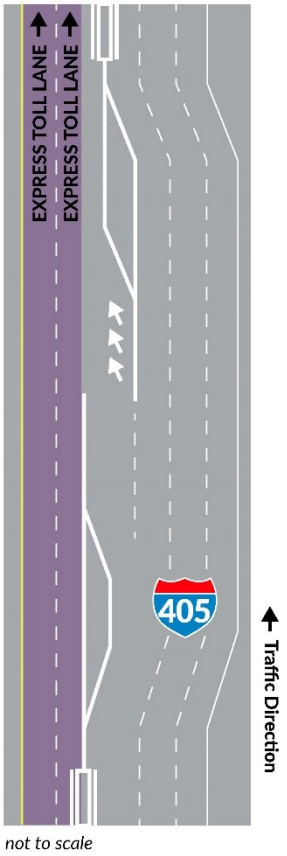
Ingress Only



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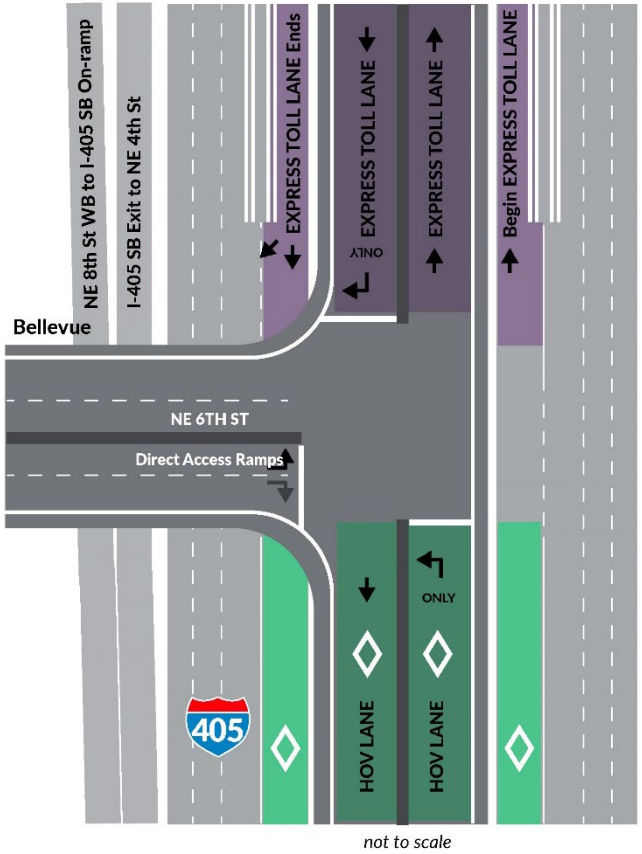
Direct Access



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4. Access (cont.)

Solution

- Extended the access length at 8 different access points by removing temporary tape used for lane markings.
  - Anticipated these potential adjustments and were able to react quickly

Outcome

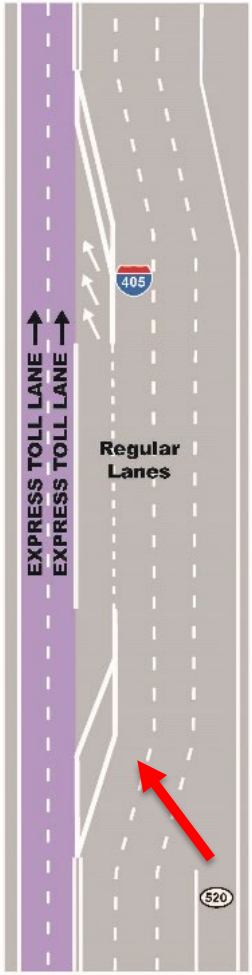
- The access adjustments successfully reduced the queueing and backups at most locations, but did not solve all of the problems. The vehicles entering the lanes at SR 520 (northbound) and those exiting at SR 527 (northbound) presented unique problems.
- Lessons learned/confirmed –
  - Vehicles exiting will stay in the ETLs as long as possible (exit late)
  - Vehicles entering the ETLs will enter as soon as possible (enter early)
  - Need to strike balance between not enough and too much access

4. Access at SR 520 (NB)

Description

- SR 520 interchange is a freeway-freeway interchange.
- The interchange with SR 520 increases the GP volume and access to the ETLs requires a merge across 3 lanes of traffic.
- The original access point north of SR 520 was a weave lane.
  - Predominately an ingress location
  - Incoming ETL traffic came from both downtown Bellevue and SR 520
  - Bottleneck existed between SR 520 on-ramp merge location and ETL weave lane access

Before



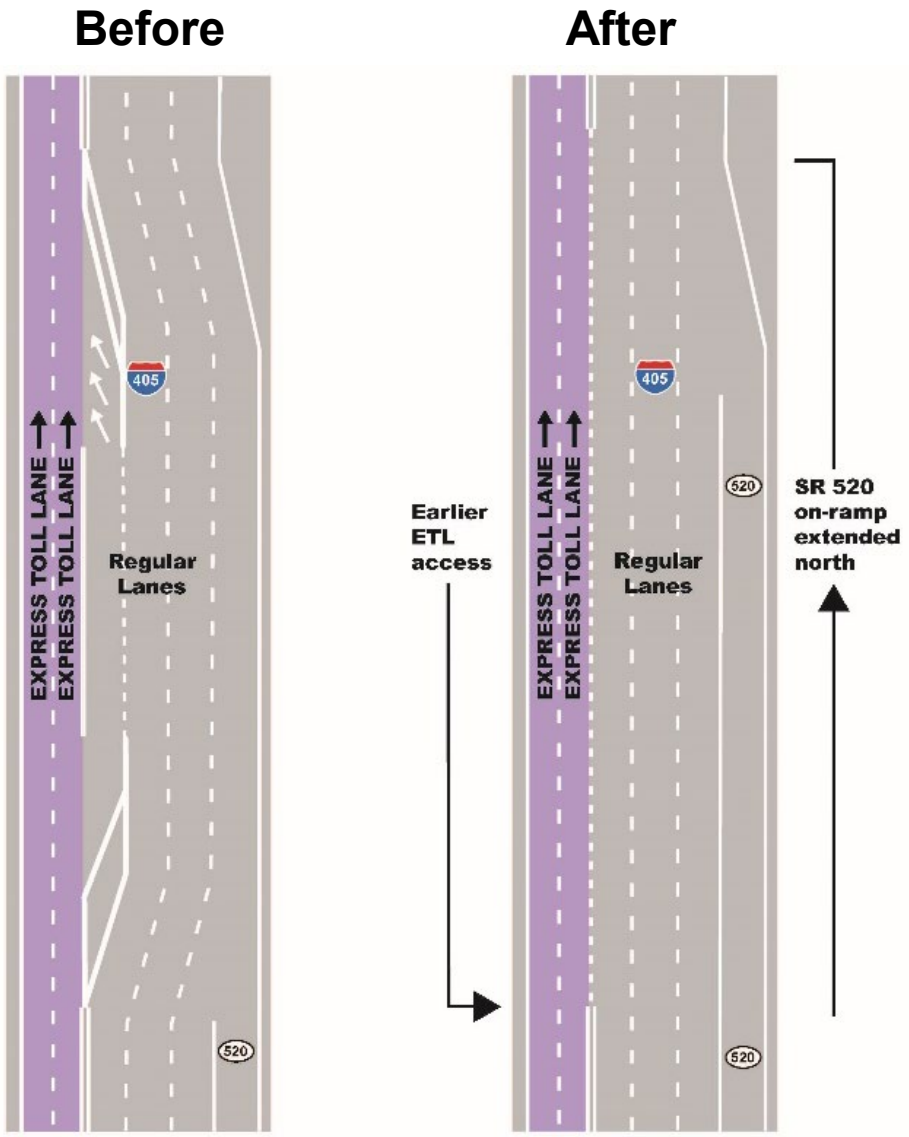
4. Access at SR 520 (NB) (cont.)

Solution

- Changed weave lane access to skip stripe access and lengthened access point to almost 6,000’
- Overlapped SR 520 on-ramp lane and access point

Outcome

- Resolved customer complains about the limited access.
- Reduced the slow down in the GP lanes
- More evenly distributed the vehicles entering the ETL



4. Access at SR 527 (NB)

Description

- Originally a skip stripe access
- Predominately an egress location
- Exiting vehicles caused a slow down in the ETLs
- Vehicles waited until the end of the access point to exit, couldn't find a gap in the GP traffic and slowed down in the ETL, impacting the speeds in the ETL

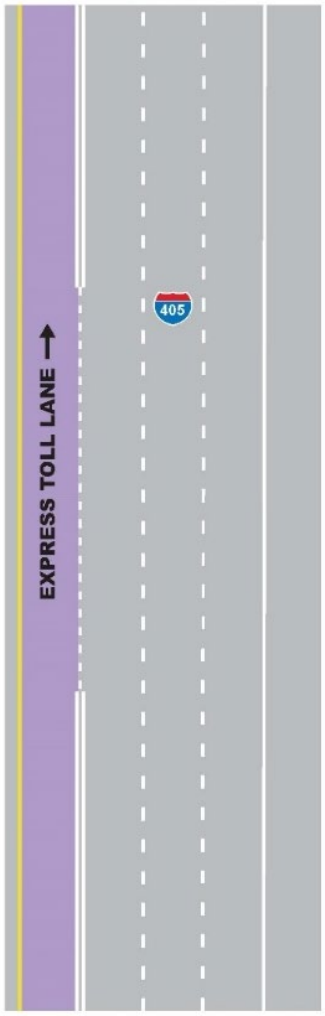
Solution

- Changed to weave lane access
- Done concurrently with PUSL

Outcome

- Exiting vehicles now looking to maximize their time in the ETL don't impact the ETL drivers

Before



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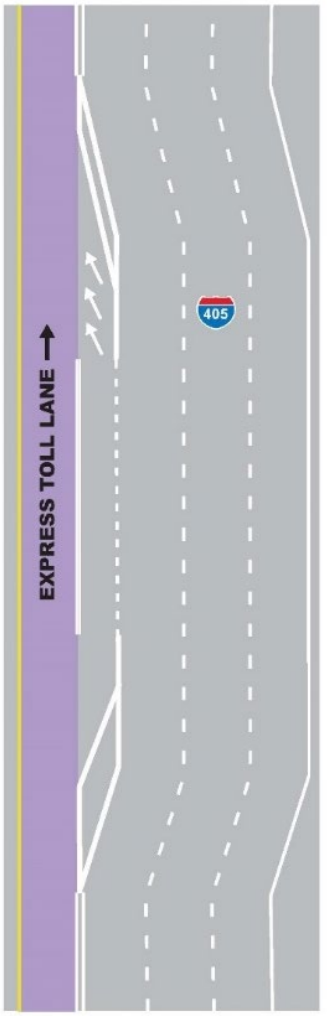
After



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4. Access – Pros and Cons of Each Access Treatment

Access Type	Pro	Con
Weave Lane (Includes Channelized Ingress)	• Better ETL operations, especially at locations with large exiting volumes and GP lane congestion	• Requires larger footprint, impacts, cost • Greater difficulty to adjust after implementation
Skip Stripe	• Better suited for locations with closely spaced interchanges and widening constraints • Easier adjustment after implementation	• If slow GP lane speeds, greater impact on ETL operations at the access point
Direct Access	• Directly serves local arterials from the ETLs • No weave across GP lanes	• Direct access on-ramps can introduce upstream congestion with merge • Over saturation of direct access off-ramps could queue back to ETLs • Cost

5. Toll Rate

Description

- Despite all the design, policy, and other issues, the toll algorithm is programmed to be able to adjust quickly enough to be able to keep the speeds at 45mph.

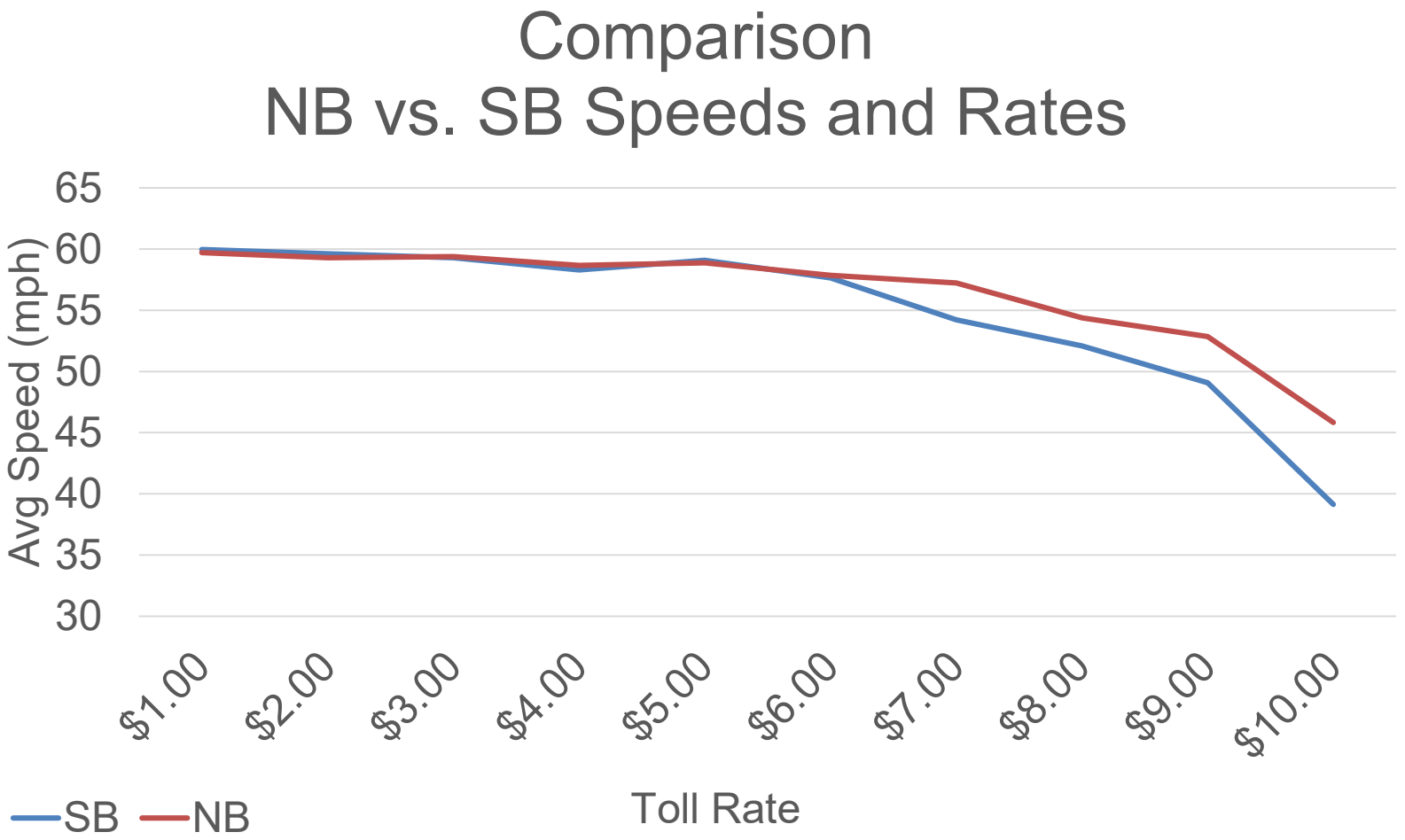
Solution

- The toll algorithm is designed, owned and operated by WSDOT
  - Uses the worst 5 segments for each trip to calculate a unique toll rate for each entrance to each zone.
  - 50+ adjustments to the algorithm

Outcome

- The max toll rate ($10) is reached on average 64% of weekday peak periods, but customers continue to buy into the lanes.
  - Once the max toll rate is reached, we lose the ability to manage demand.

5. Toll Rate (cont.)



5. Toll Rate – 128th Direct Access (SB)

Description

- Vehicles entering from 128th Direct Access create congestion as the merge onto the system.
  - The vehicles enter as a platoon and the volume has increased

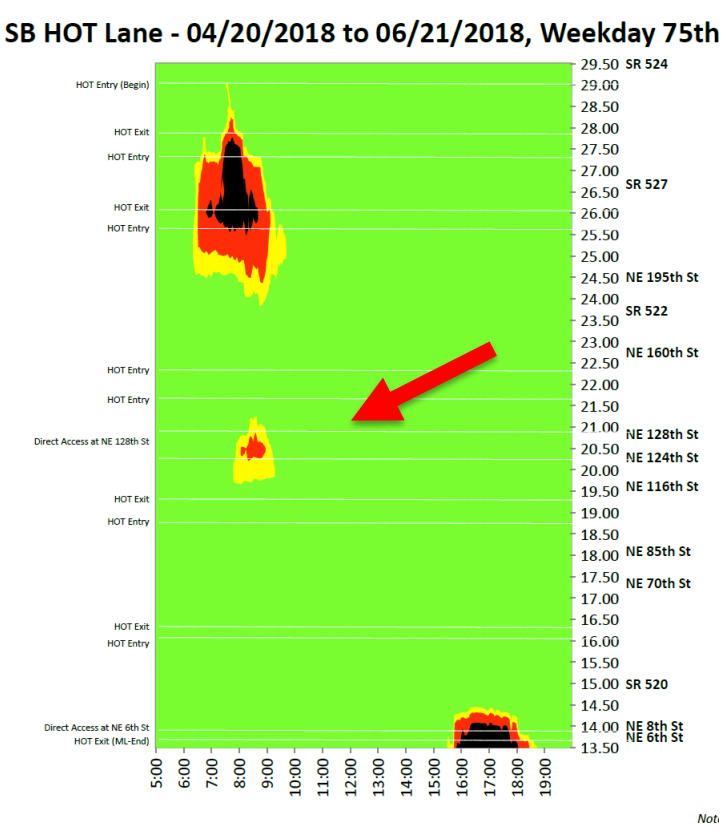
Solution

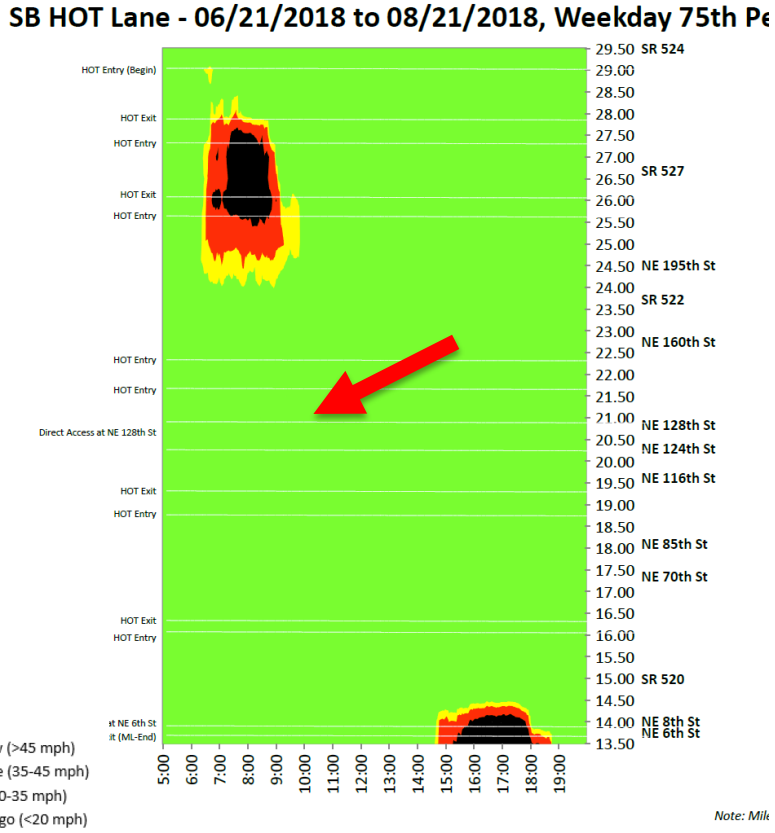
- Change business rule to allow for increased tolls (a surcharge) for vehicles entering at this unique location

Outcome

- (see next slide)

5. Toll Rate – 128th Direct Access (SB) (cont.)





Congestion

- Free flow (>45 mph)
- Moderate (35-45 mph)
- Heavy (20-35 mph)
- Stop and go (<20 mph)

6. SB Single Lane

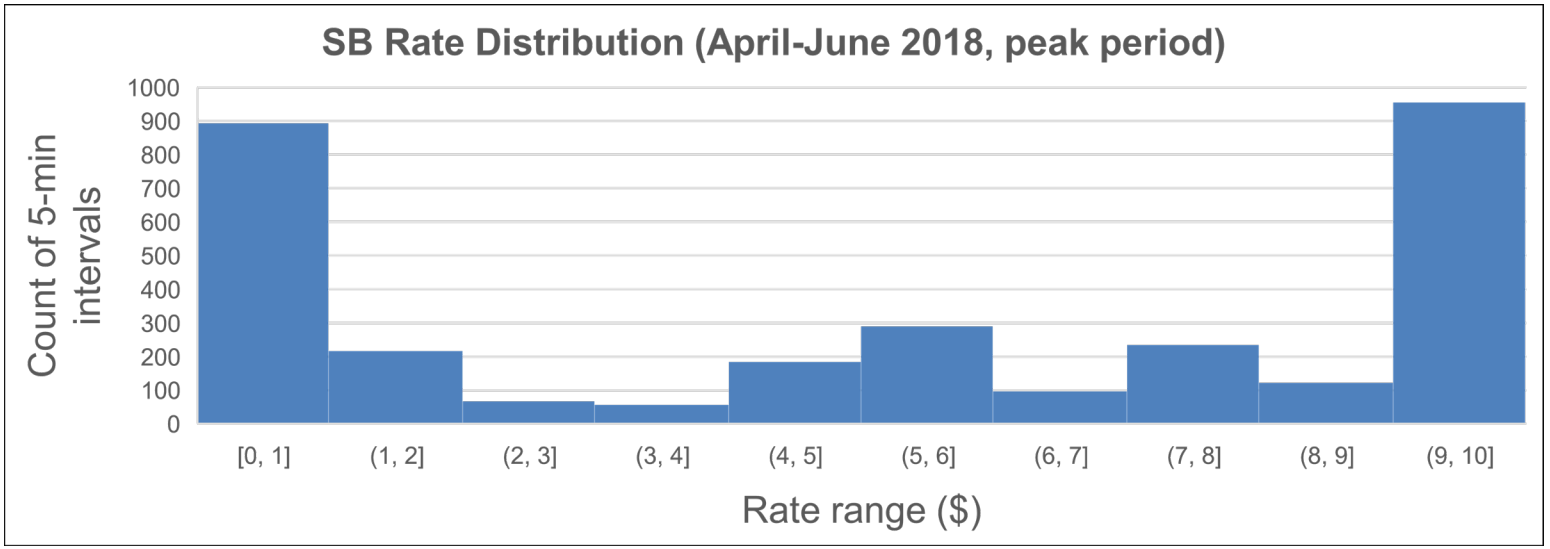
Description

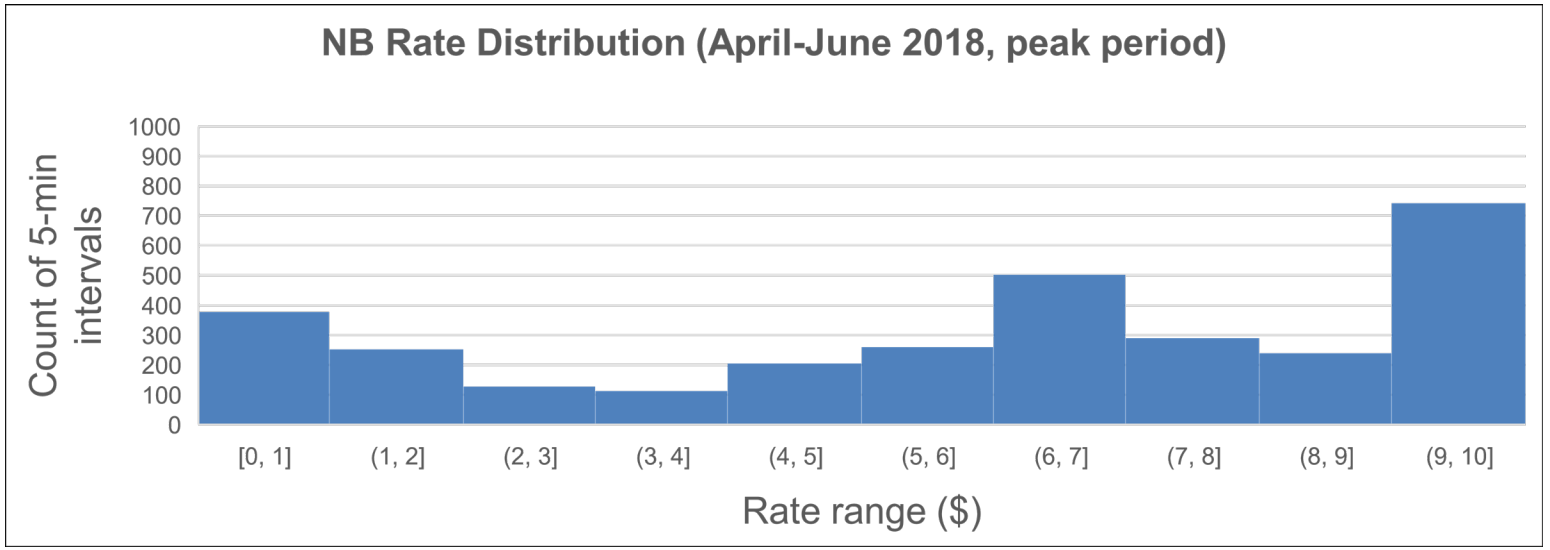
- The performance of the SB single lane section is the primary reason that the system is unable to meet the performance metrics.
- The ETL volume before the SR 522 interchange increased 42% compared to before tolling.
- The toll rates reach the maximum daily and still drivers continue to enter the system.
- The incoming vehicles from SR 527 merge across both lanes.

Solutions

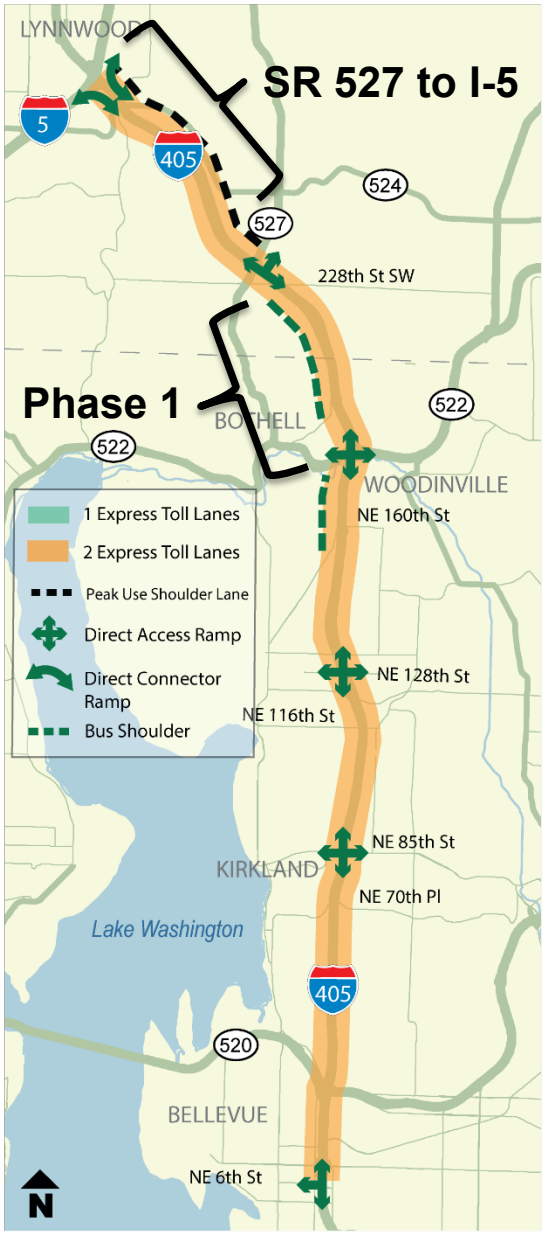
- Concentrate enforcement on the area
- Increased the sensitivity of the toll algorithm
- Changed the calculation of the pricing at SB3
- Increase the capacity

6. SB Single Lane (cont.)





Future Plans – Adding Capacity



Lanes

- Complete dual express toll lane system between SR 527 and I-5

Ramps

- Direct Connector Ramps NB & SB at I-5

Benefits

- SR 522 direct access ramps
- SR 527 inline station direct access ramp
- Improves express toll lane performance between SR 522 and I-5
- Further improves speed and reliability of BRT and transit

Phasing

- Phase 1: SR 522 to SR 527
- SR 527 to I-5
- Phase 2: Direct Connector to/from the north
- Phase 3: Direct Connector to/from the south
- Complete Lane

Future Plans – I-405 Extension

Project Overview

- Extend ETLs between existing SR 167 HOT lanes and I-405 Express Lanes in Bellevue
- Will connect a 40-mile system of express toll lanes that improves speeds and trip reliability
- Supports the new I-405 Bus Rapid Transit system

Summary

- Managing congestion and meeting performance requirements is challenging
- No ‘silver bullet’ exists to solve congestion related issues
- Taking an iterative approach to implementing solutions when funding is available, allowed for greater understanding of what works, what doesn’t and why
- Reaching out to others for new ideas and perspectives goes a long way

QUESTIONS?

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I-85 Express Lanes

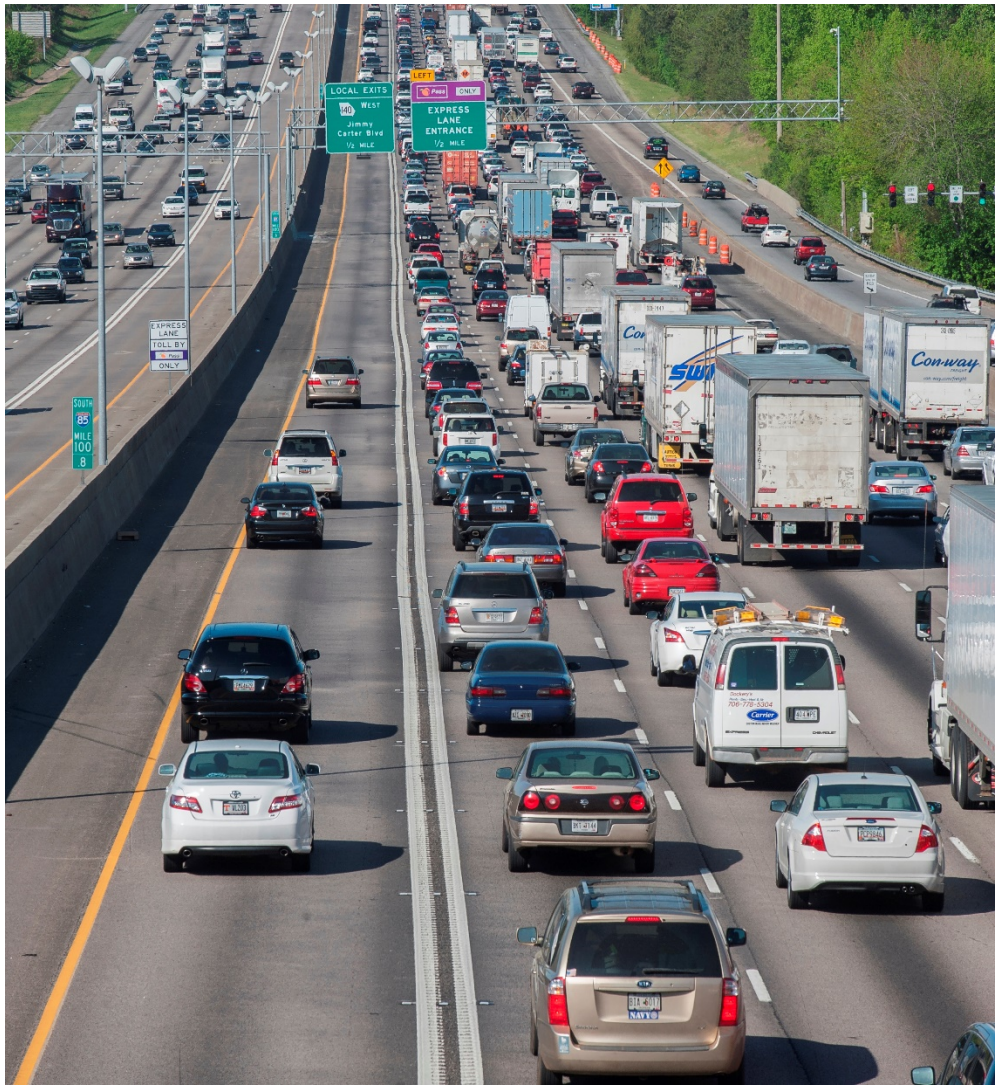
Annie Gillespie, PE
Director of Engineering

April 16, 2019

I-85 HOT Lanes

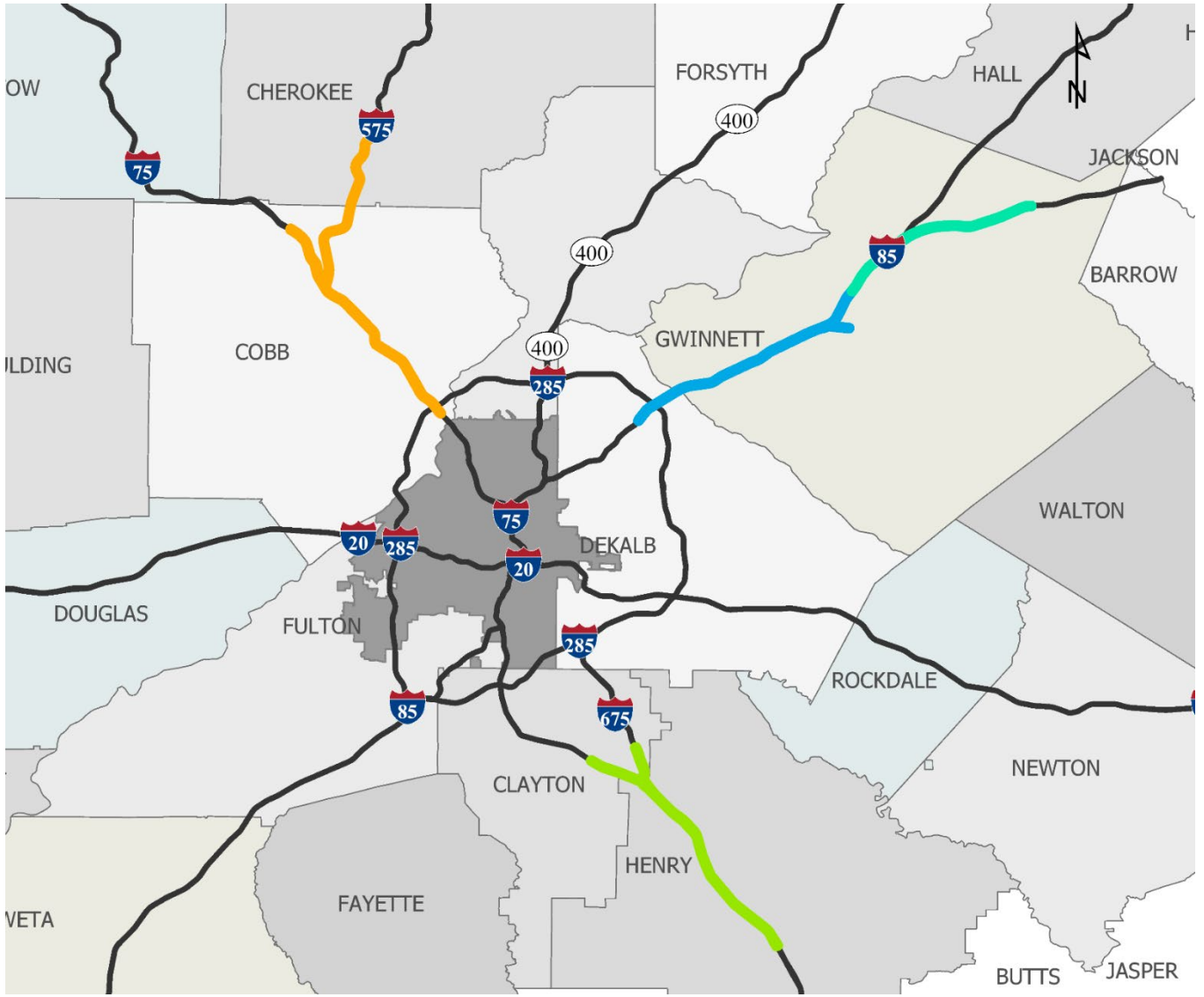
Agenda

- Background
- Performance
- Rate History
- Takeaways



STATE ROAD & TOLLWAY AUTHORITY
SRTA

Express Lanes in Georgia



I-85 HOT Lane

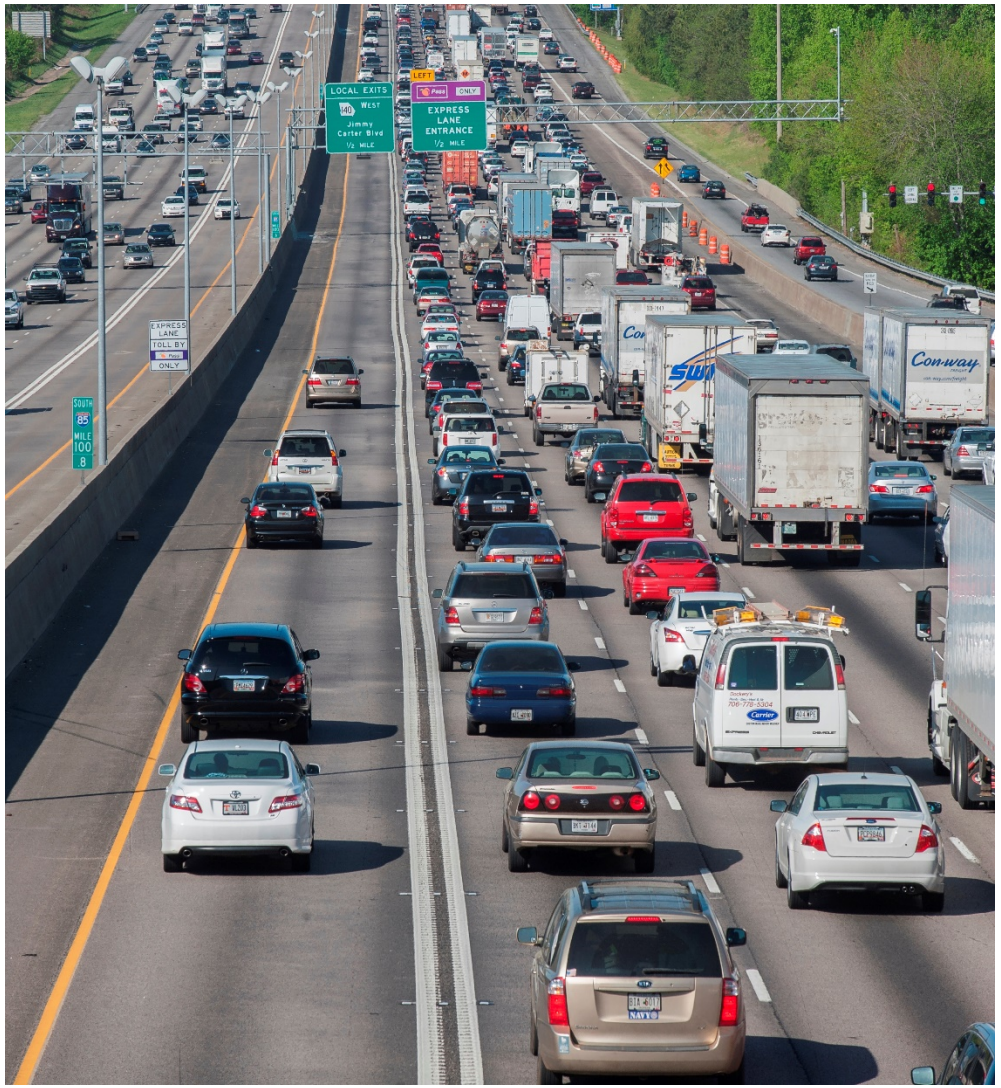
I-75 South Express Lane

Northwest Corridor

I-85 HOT Extension

I-85 HOT Lanes

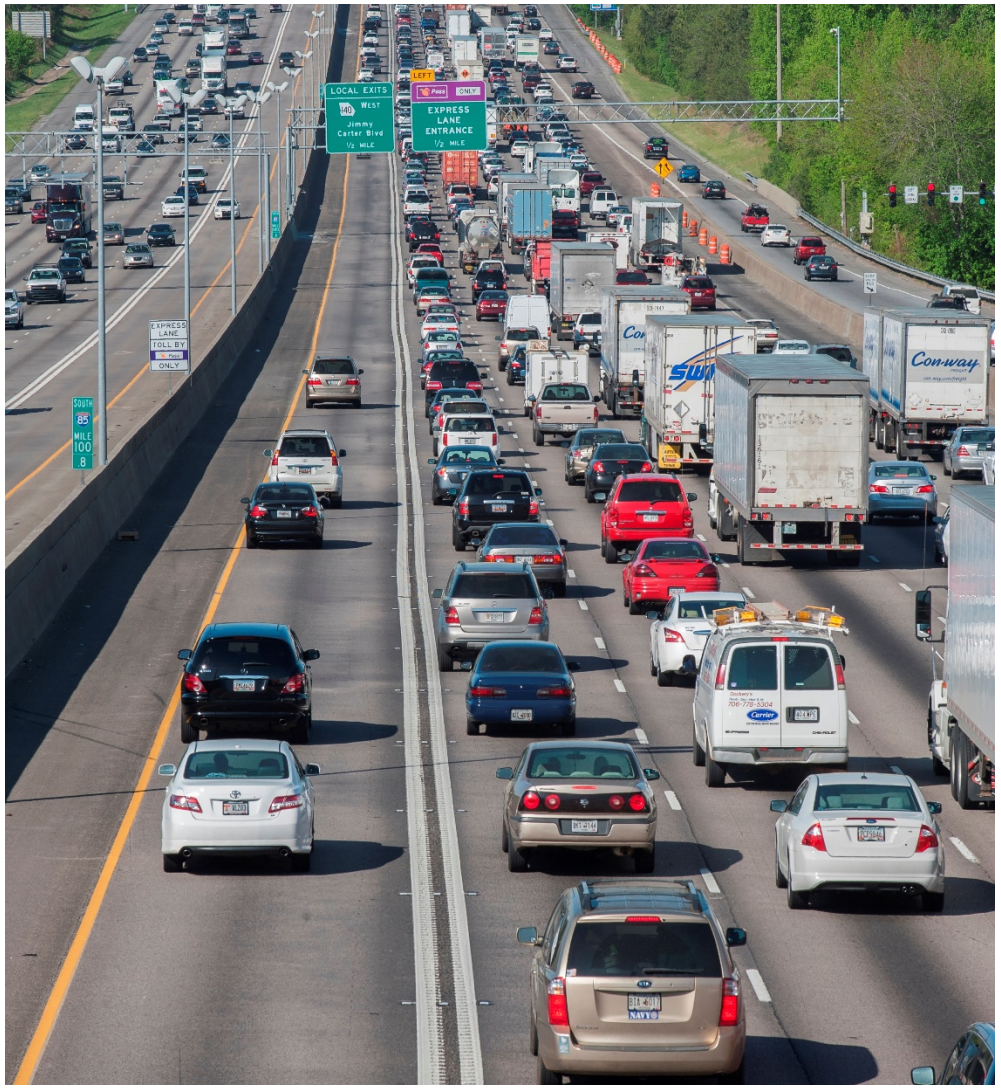
- Opened October 1, 2011
- Conversion from HOV2+ to HOT3+
- 15 miles
- 1 bidirectional, buffer-separated lane
- Operates 24/7



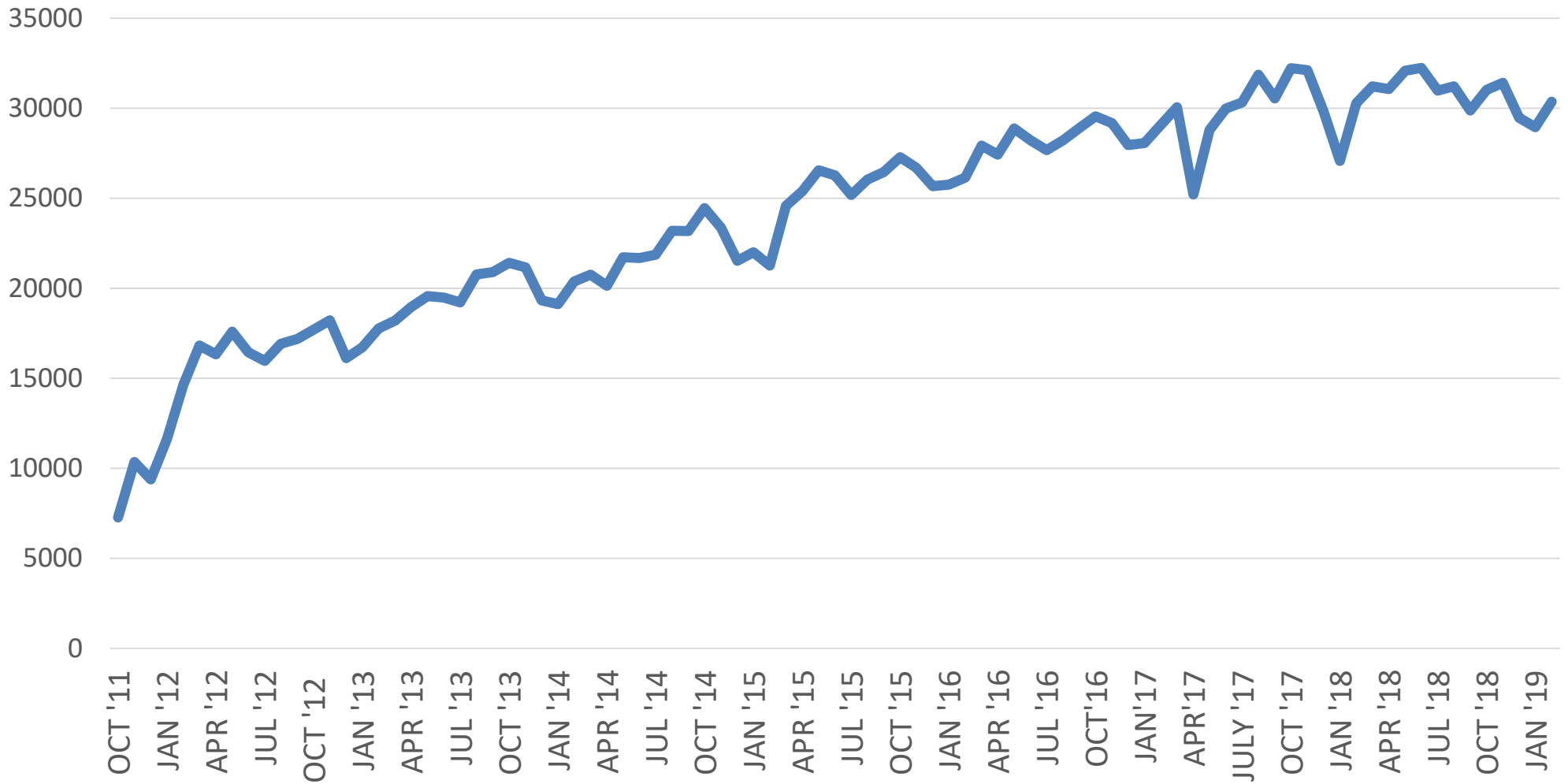
I-85 HOT Lanes

- Exempt from tolls:
  - HOV3+
  - Transit Vehicles
  - Alternative Fuel Vehicles
  - Motorcycles

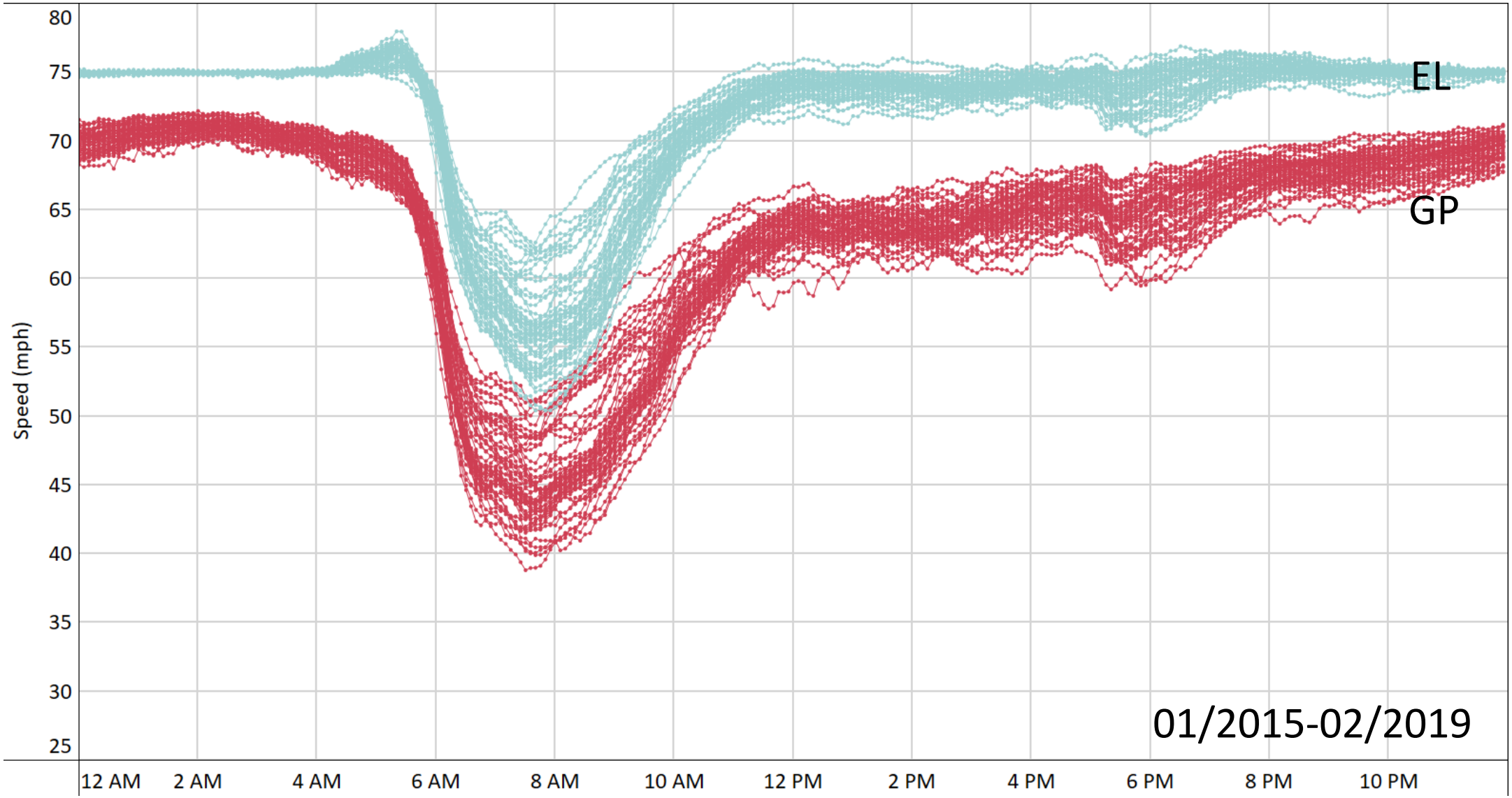
- Dynamically priced between $0.10/mile and $1.30/mile
  - Lowest Toll = $0.20
  - Highest Toll = $15.50



Weekday Average Trips



Southbound Average EL vs GP Speed (M-F)



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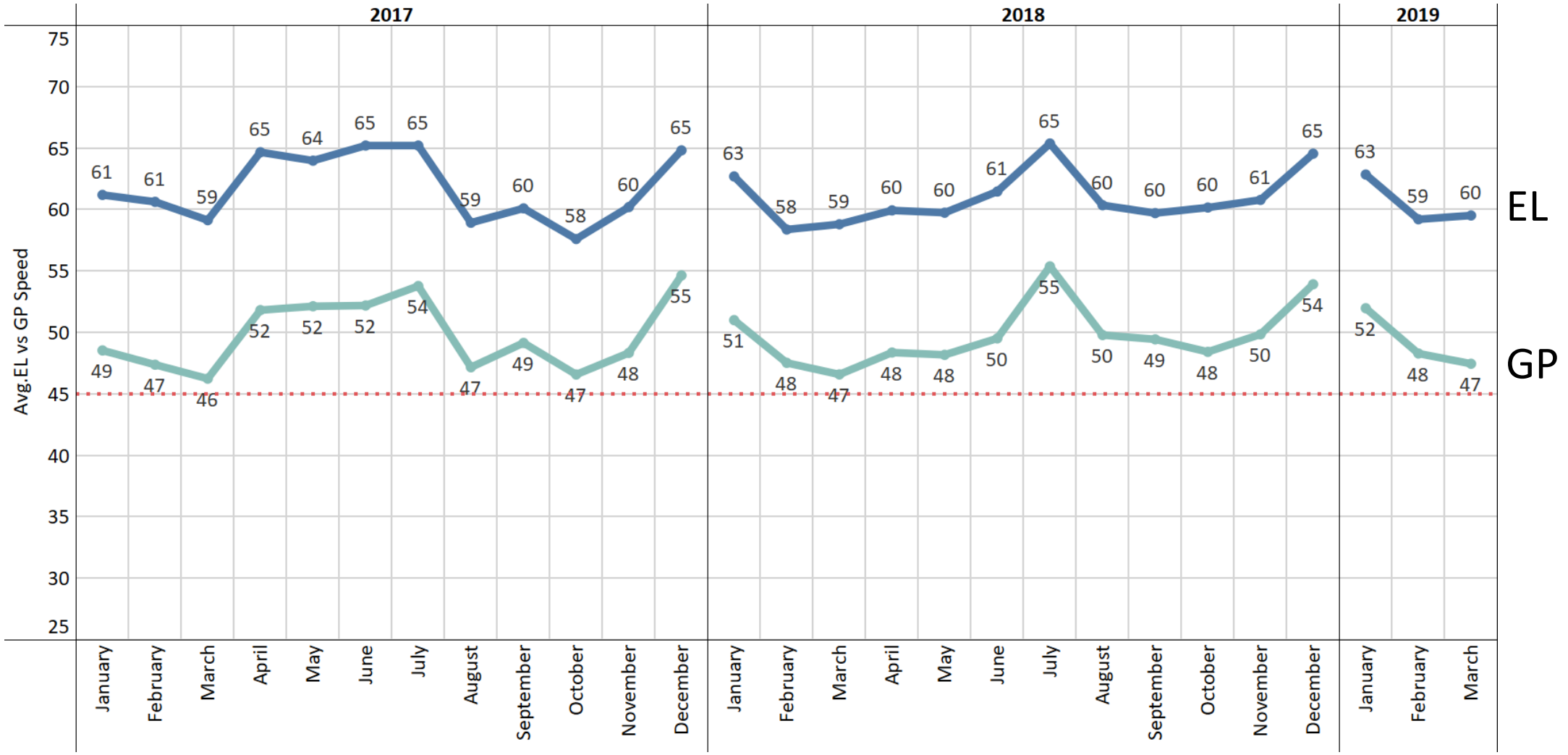
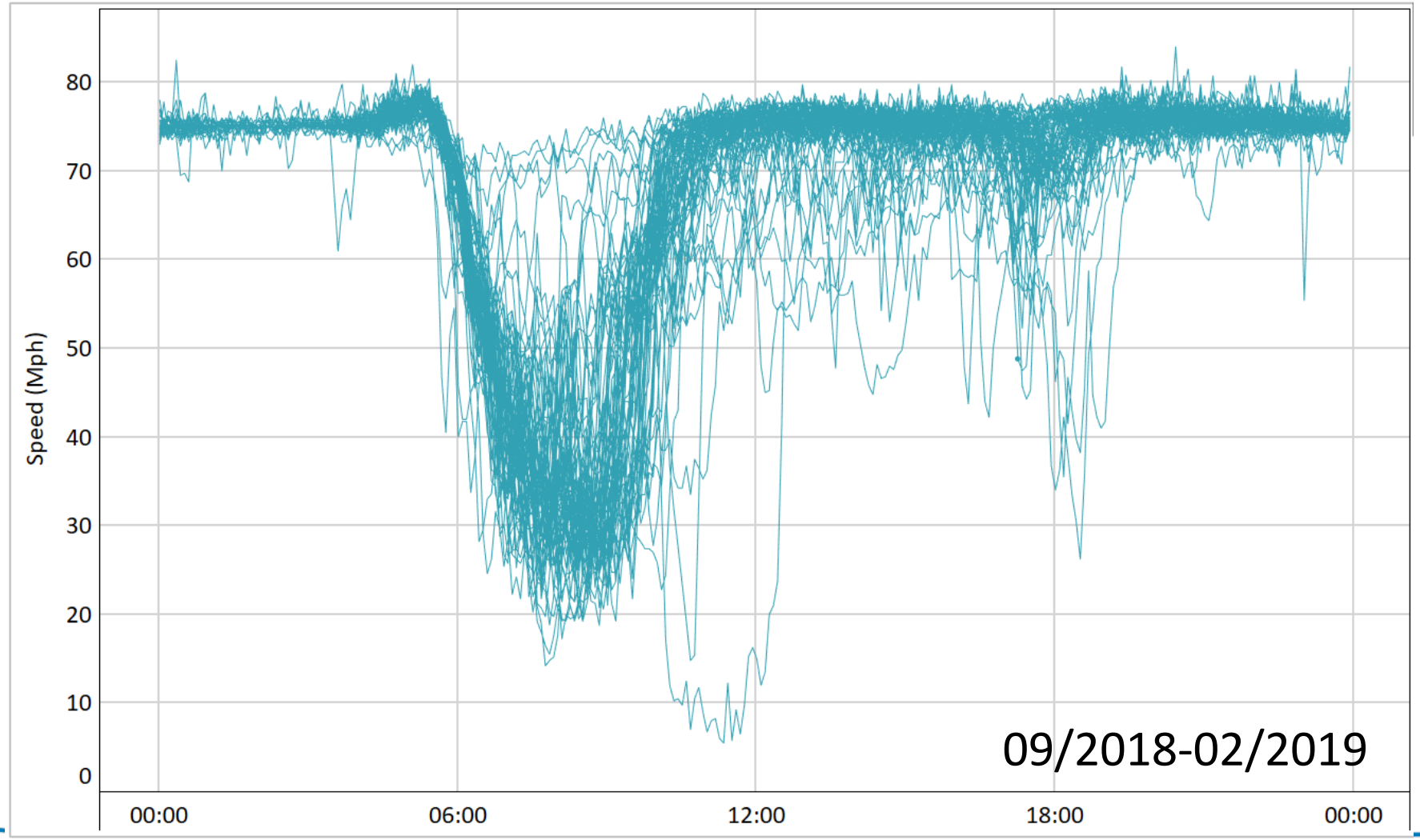
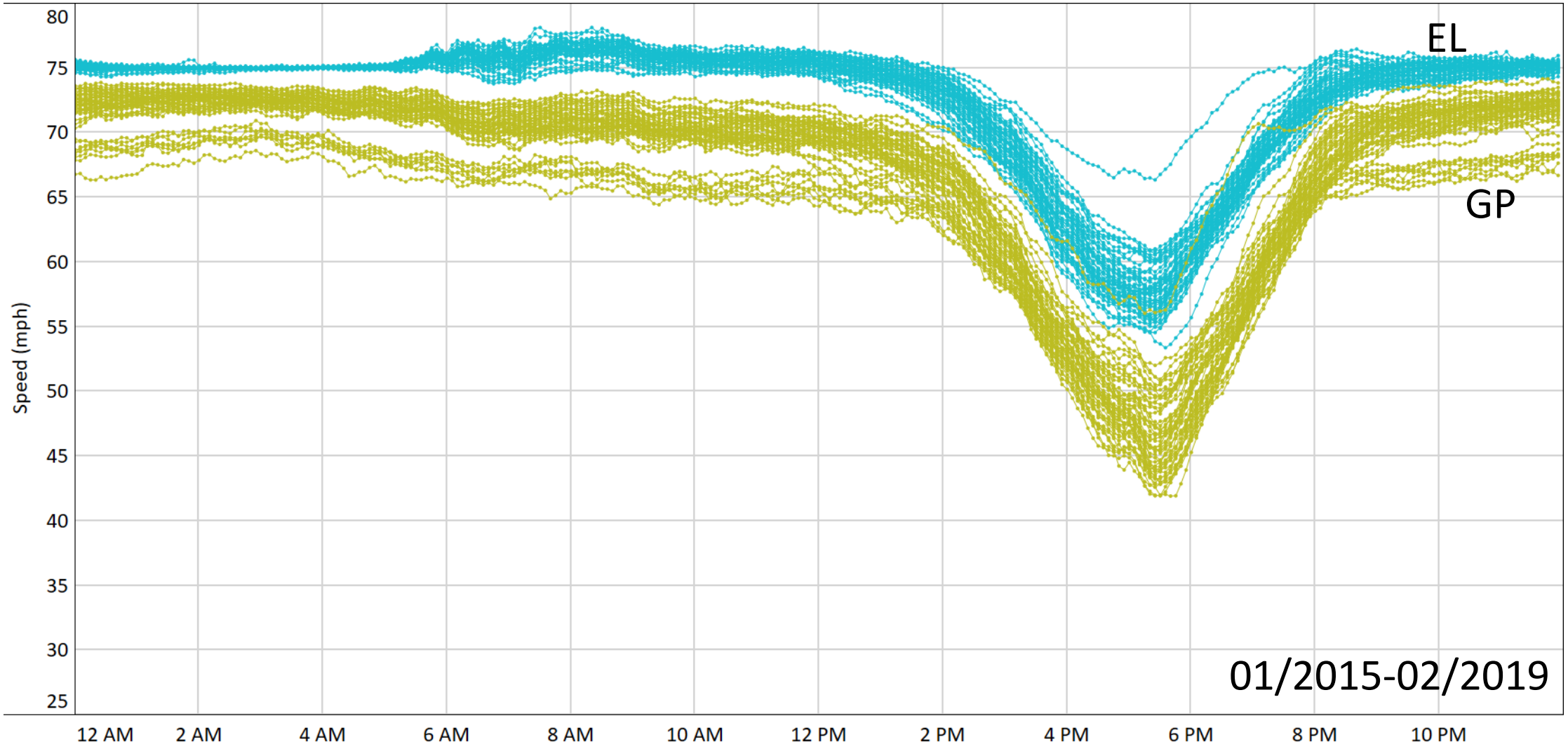


M-F (6-10AM)

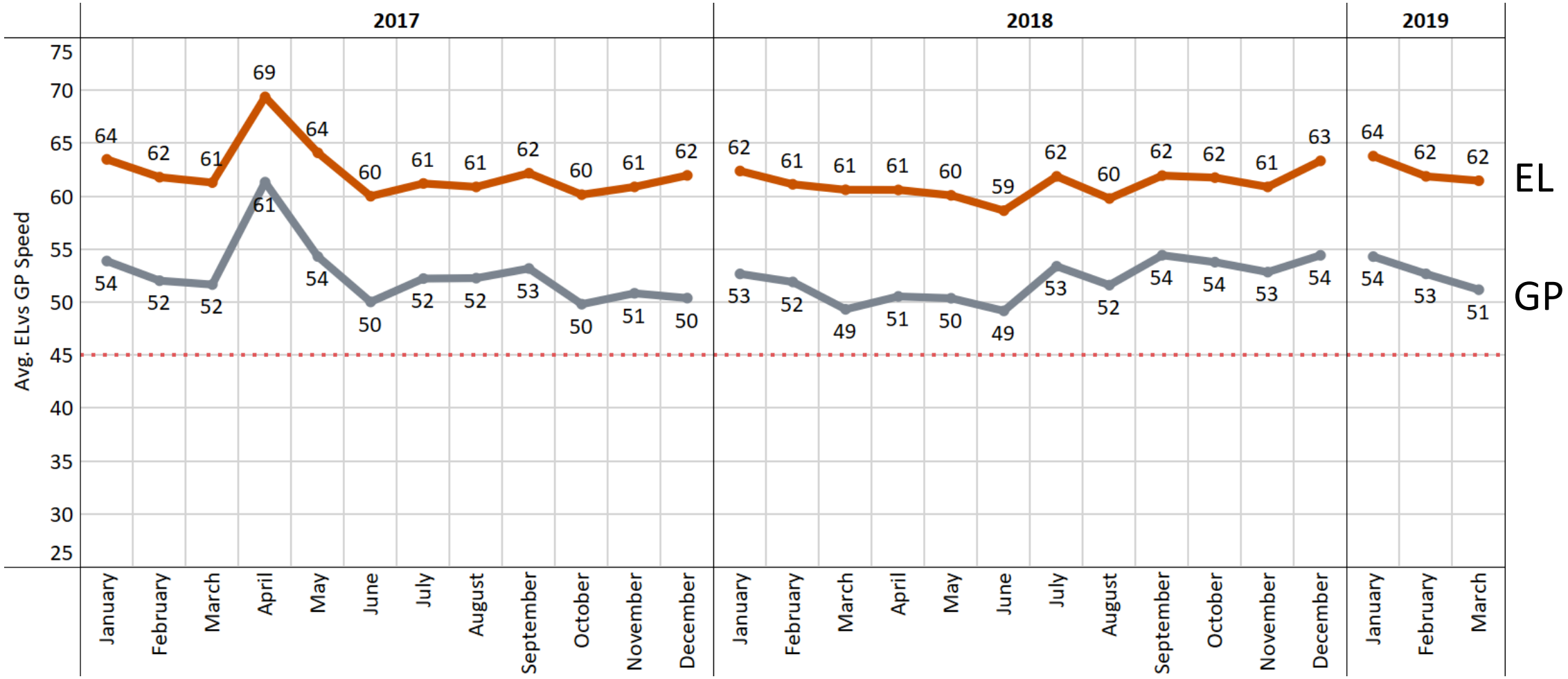
Southbound Average EL Speed
Most Congested Segment M-F (6-10AM)



Northbound Average EL vs GP Speed (M-F)

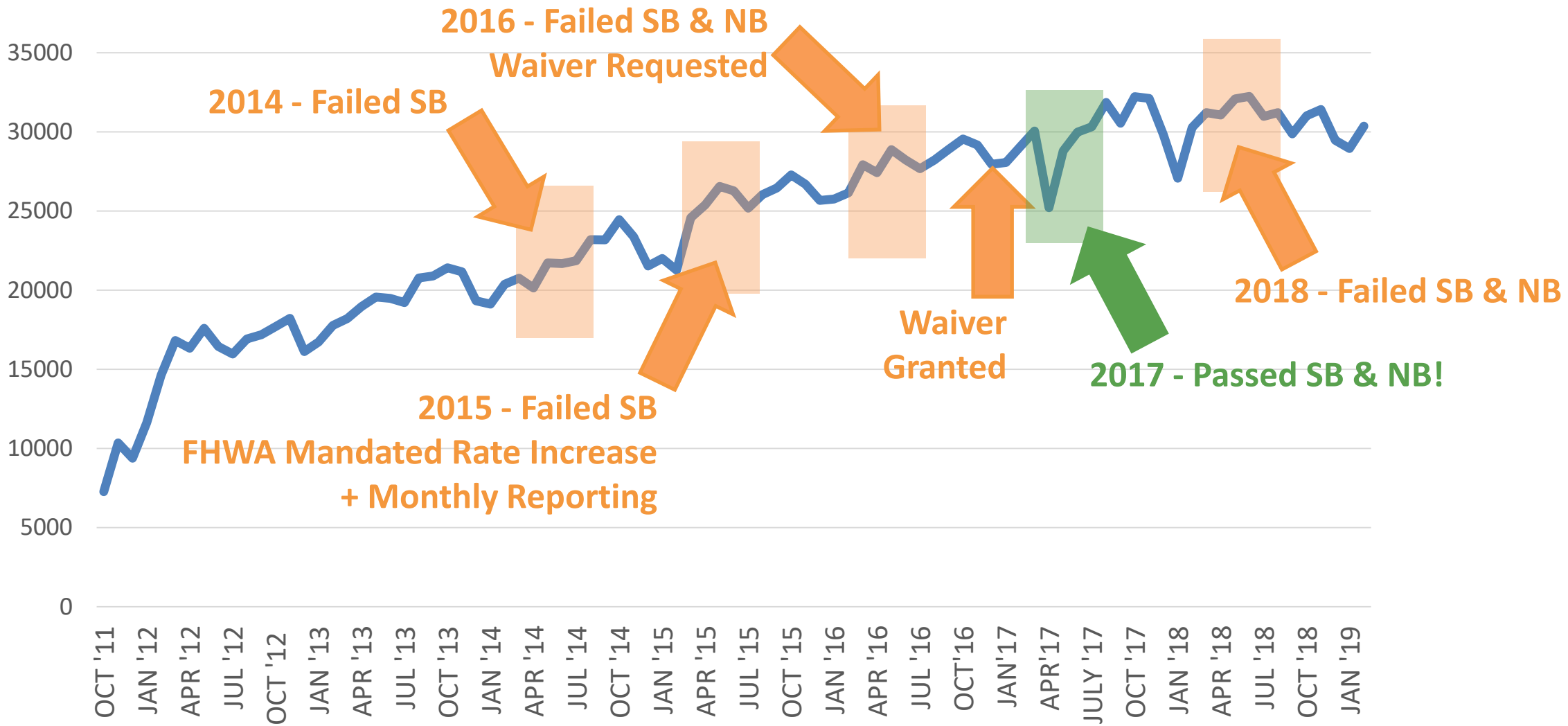


Northbound Average EL vs GP Speed



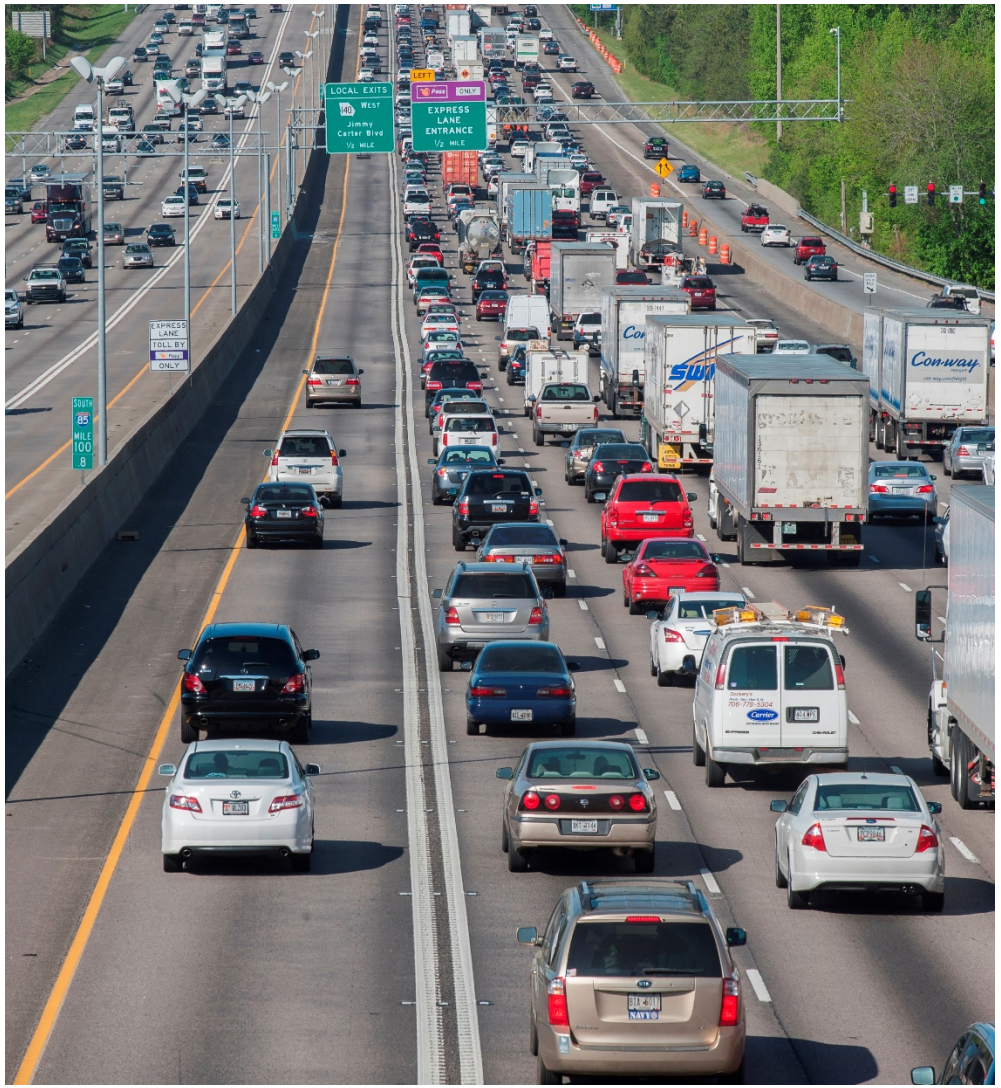
M-F (3-7PM)

Weekday Average Trips

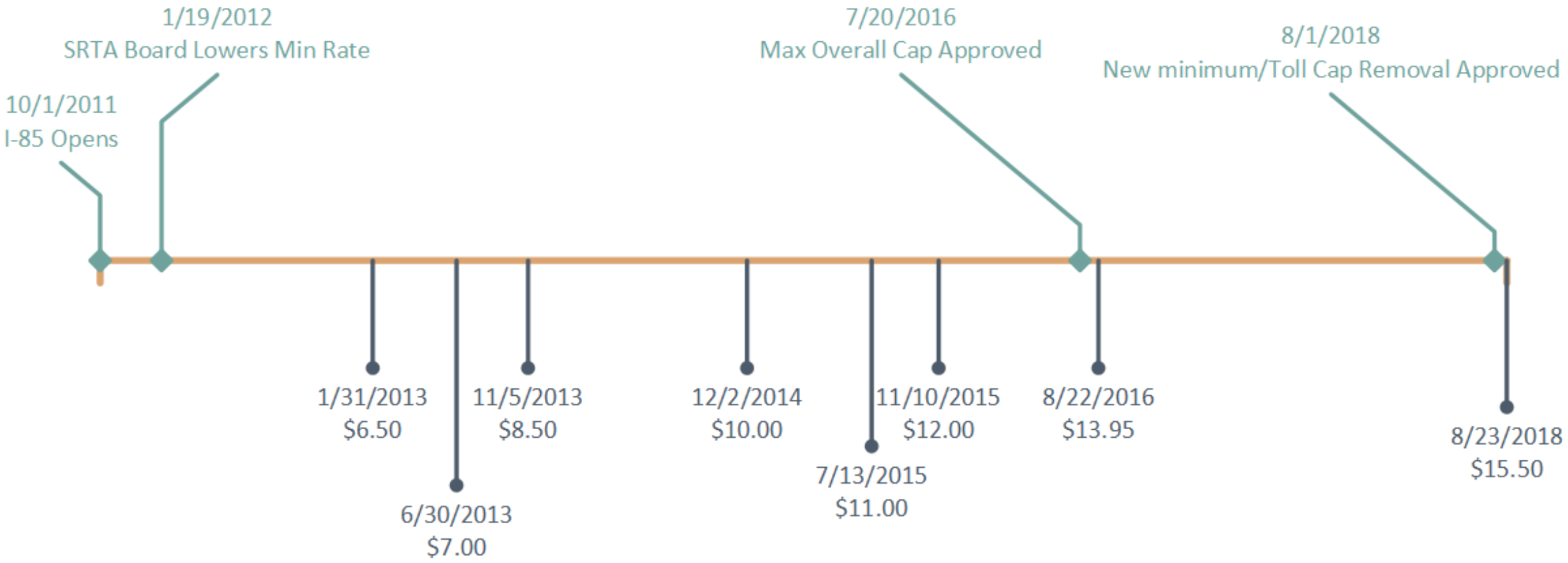


FHWA Waiver

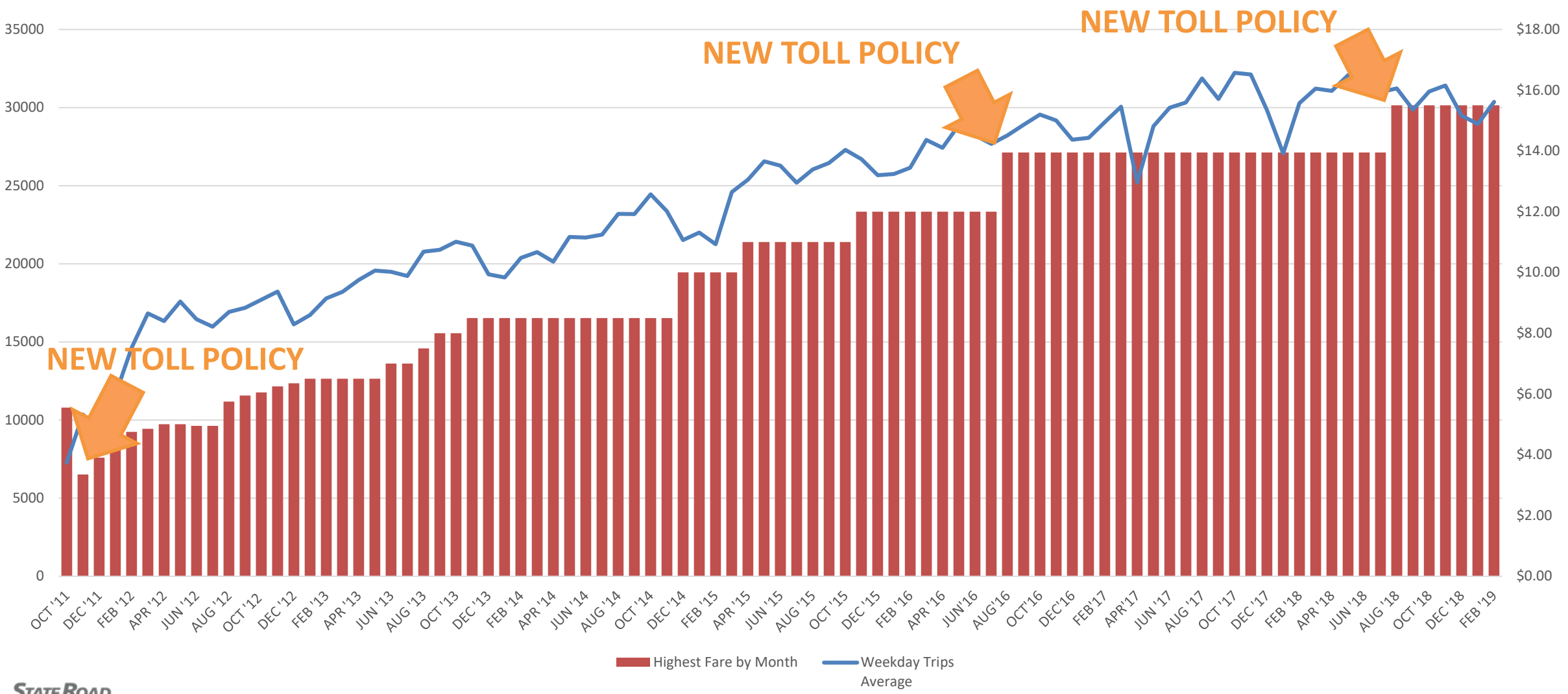
- Demonstrated improvements and toll increases
- Case for “best interest of the traveling public”
  - Rates and Trips have been going up
  - Friction with adjacent lanes impacts possible speed
  - Maintaining better reliability and average speeds than GP
- Looking for other ways than price to improve performance



I-85 Pricing Milestones



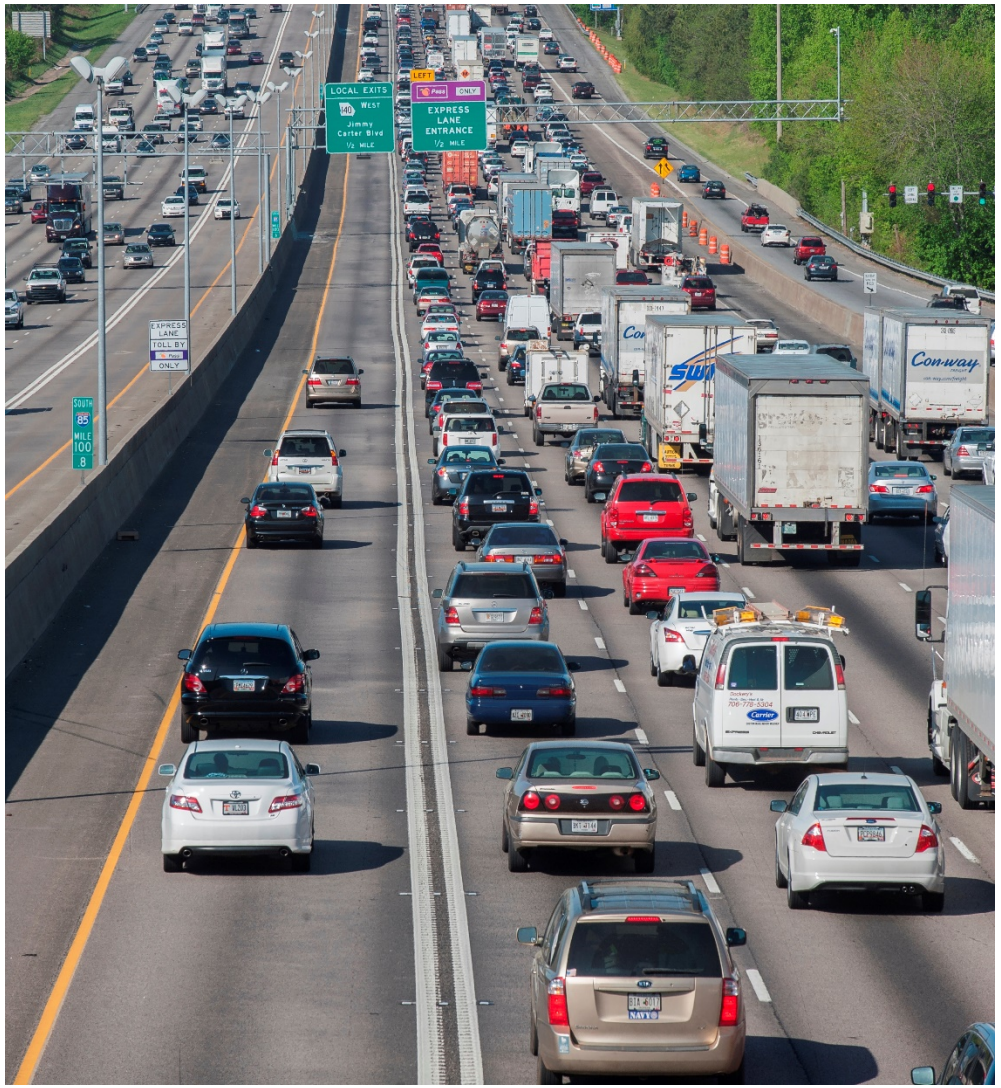
Highest Fare by Month



I-85 HOT Lanes - Takeaways

- Increasing Peak Tolls
  - Increased duration of peak (moved users to shoulders)
  - Very little immediate reaction
  - Peak volumes have not decreased
  - Increasing users in “non-toll mode”

- Increasing Off-Peak Tolls
  - Higher Violation Rate
  - Largest trip increases



Thank you

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METRO EXPRESSLANES

I-10 HOV 5+ Pilot

Managing Congestion in Priced Lanes
FHWA Webinar, April 16, 2019

Presented by Robert Campbell, LA Metro

Metro

Board Motion and Response

- I-10 ExpressLanes Pilot that increases the toll-free occupancy requirements to vanpools and transit vehicles only, as a means of preserving the ExpressLanes as a fast, reliable travel option for transit users and all corridor travelers.
- Motion by Director Fasana, amended by Director Solis, from April 2018.
- Board authorized development of an implementation plan for this pilot in January 2019.

Metro

Current and Proposed HOV Policy

In the I-10 ExpressLanes, the following vehicles travel toll-free:

CURRENT	PROPOSED
HOV 3+ DURING PEAK PERIODS HOV 2+ DURING OFF-PEAK PERIODS	HOV 5+ AT ALL TIMES

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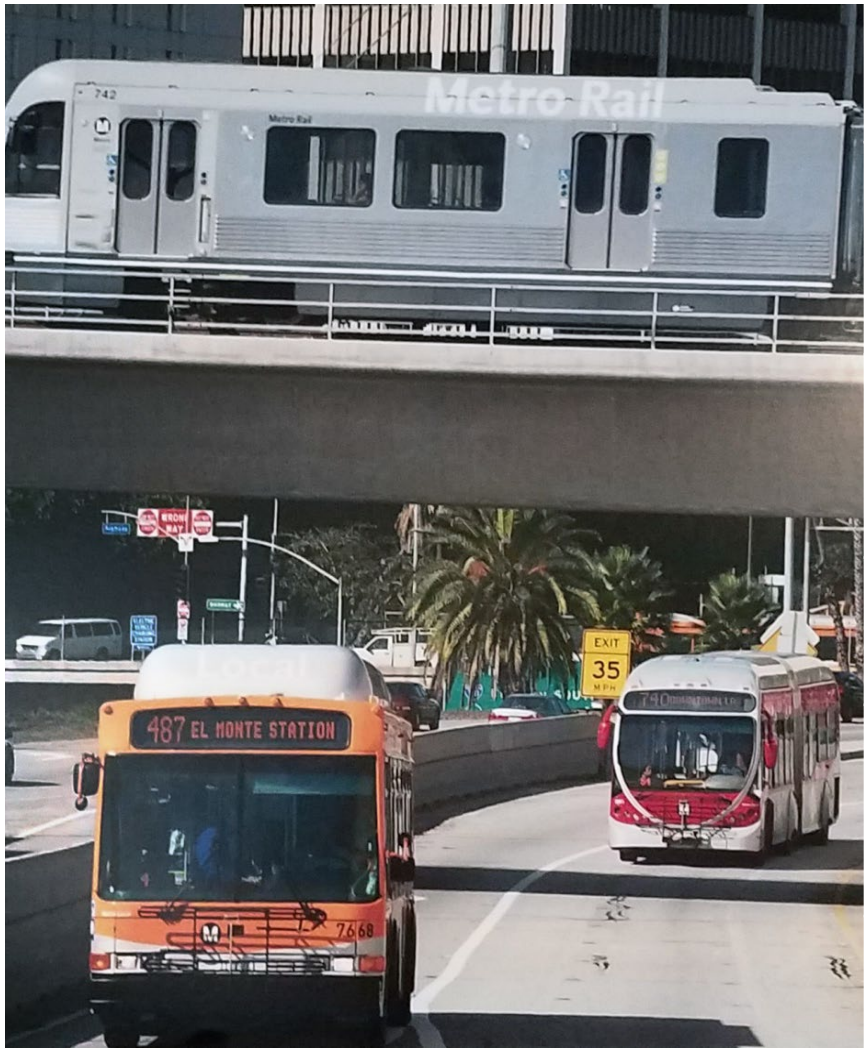
Historical Context



1973: Facility initially opens as a busway.

1974: HOV3+ vehicles temporarily allowed in busway during a 3-month transit strike.

1976: HOV3+ vehicles allowed to use busway during peak periods.

1981: HOV3+ vehicles allowed to use busway at all times.

2000: HOV2 vehicles allowed to use busway during non-peak periods.

2013: Busway converted to ExpressLanes.

I-10 ExpressLanes Performance Challenges

58%

increase in ExpressLanes trips

from 10,093,413 in FY14 to 15,924,317 in FY18

201%

increase in HOV-Only minutes

from 1,101 in FY14 to 3,314 in FY18

12.5%

decrease in AM Peak ExpressLanes speeds

from 60.8 mph in FY14 to 53.2 mph in FY18

- Additional I-10 travel time has been added to the Metro Silver Line schedule to keep buses on time.
- Up to 19% of Foothill Transit Silver Streak buses operate behind schedule.
- Significant proportion of traffic mis-representing vehicle occupancy to improperly obtain toll-free travel.

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Potential Impacts of Implementing Pilot

- Overall mobility benefit of approximately $3.7 million per day in time/delay cost savings corridor-wide.
- Increase in ExpressLanes person-throughput by 600 persons/day (a 4% increase for ExpressLanes throughput)
- Increase in end-to-end travel times in the general-purpose lanes by 4 minutes on average.
- Increase in congestion of the eastbound I-10 ExpressLanes at the end of the facility due to forced merging into the general-purpose lanes.
- Improvements in transit travel time reliability, based on qualitative evaluation by subject area experts.
- Provision of a more long-term sustainable toll strategy that is less susceptible to congestion—especially congestion caused by vehicles that mis-represent occupancy.

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Impacts to Low-Income Commuters

Survey findings from 479 low-income commuters on I-10

- Very few (3%) have ever used a vanpool on the I-10 ExpressLanes.
- Approximately 50% currently use the I-10 ExpressLanes.
- Under the proposed pilot, respondents indicated they would do the following:

	Would use the ExpressLanes			Would use the General Purpose Lanes
	As SOV/HOV	As transit	As vanpool	
Current ExpressLanes Users	41%	13%	21%	23%
Current General Purpose Lane Users	18%	5%	17%	56%

*Rows will not sum to 100% due to some respondents indicating "another form of transportation" which could include active transportation.

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Vanpool Program

- Vanpool programs generally require participants to lease vehicles with seating capacity of at least 7 persons. This is a potentially significant barrier to participation.
- To facilitate vanpool participation, staff recommended that the occupancy threshold for toll-free passage be set to 5 persons per vehicle.
- Staff is exploring strategies to further incentivize vanpooling for commuters.

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Timeframe Considerations

Integration will be required with the new Back Office System, expected to come online by early 2020.

Comprehensive outreach strategy to all customers and corridor users requires substantial time to complete.

Significant lead time required to engage a third-party contractor to verify vanpools & handle toll exemptions.

Before-and-after study requires a considerable data collection period before go-live.

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Key Decision Points and Milestones

- Obtained concurrence from Caltrans and FHWA
  - As a condition of concurrence, FHWA requires a before-and-after study and significant public outreach.
- Collect and analyze additional data on
  - Effects on transit operations
  - Barriers to ExpressLanes, transit, and vanpool usage
  - More detailed assessment of low-income impacts
- Develop a formal implementation plan and return to the Board with recommendations in 12–15 months.
  - Optimal method of verifying vanpools and handling toll exemptions through integration with Back Office
  - Determine cost associated with implementation

$1.4 M

total anticipated cost

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