SFMTA

Train Control Program Update

SFMTA CAC EMSC: October 27, 2021

Current Performance

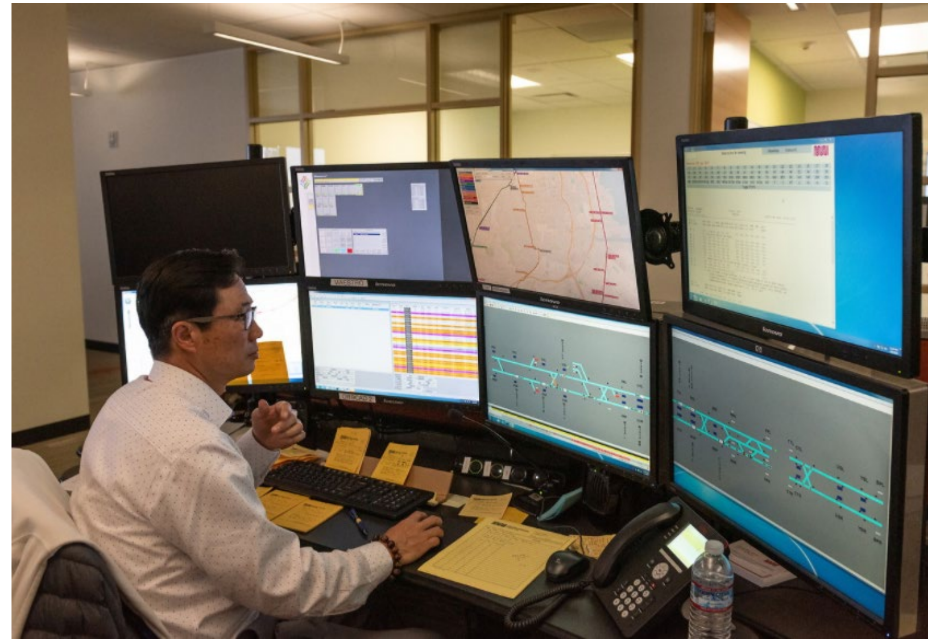
Scope

Schedule

Budget

Progress

Next Steps



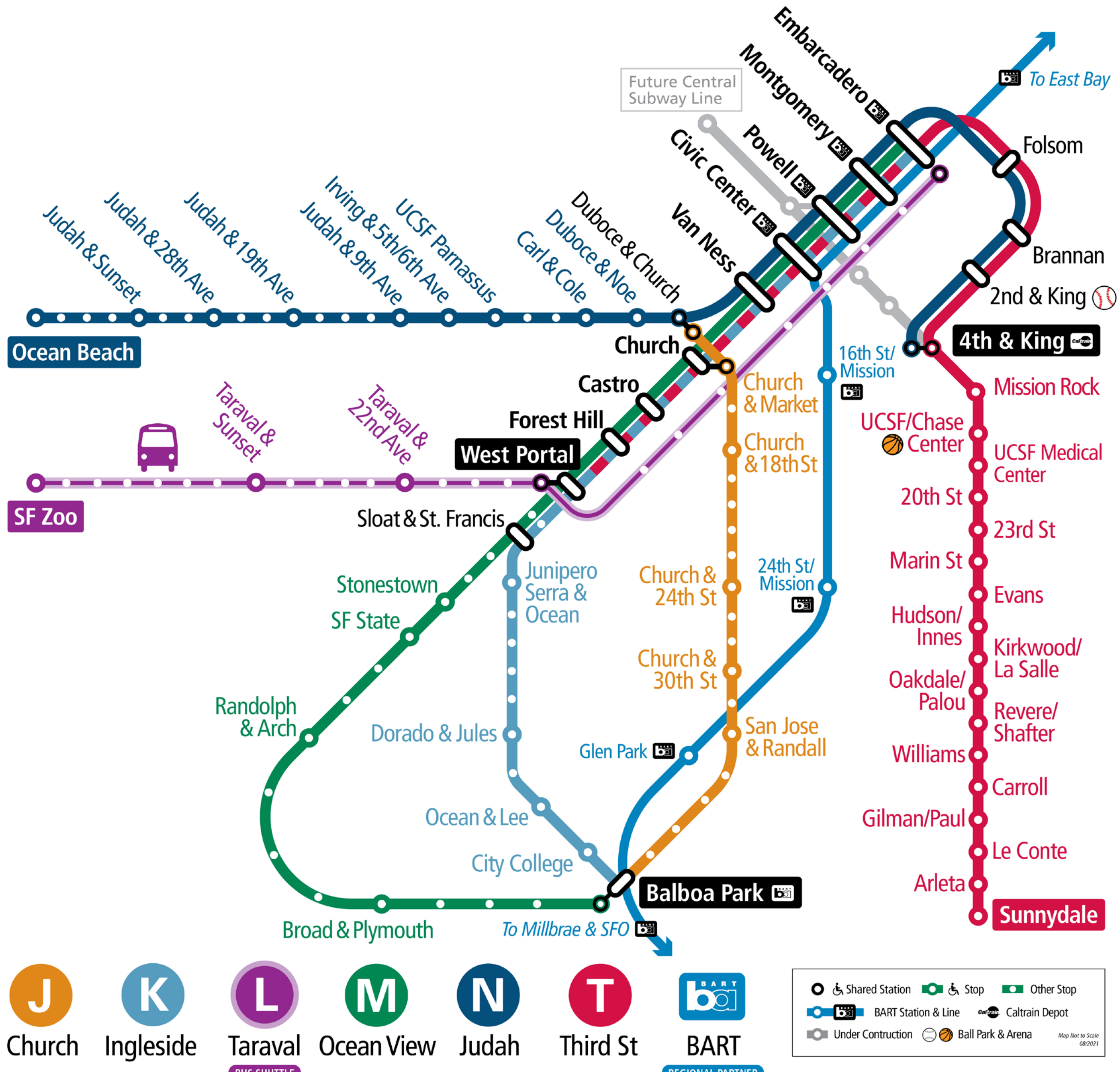
"These are astonishing numbers. No agency in the US is getting these efficiency improvements."

- Jeffrey Tumlin

"We have never seen the Market Street subway perform more reliably than today."

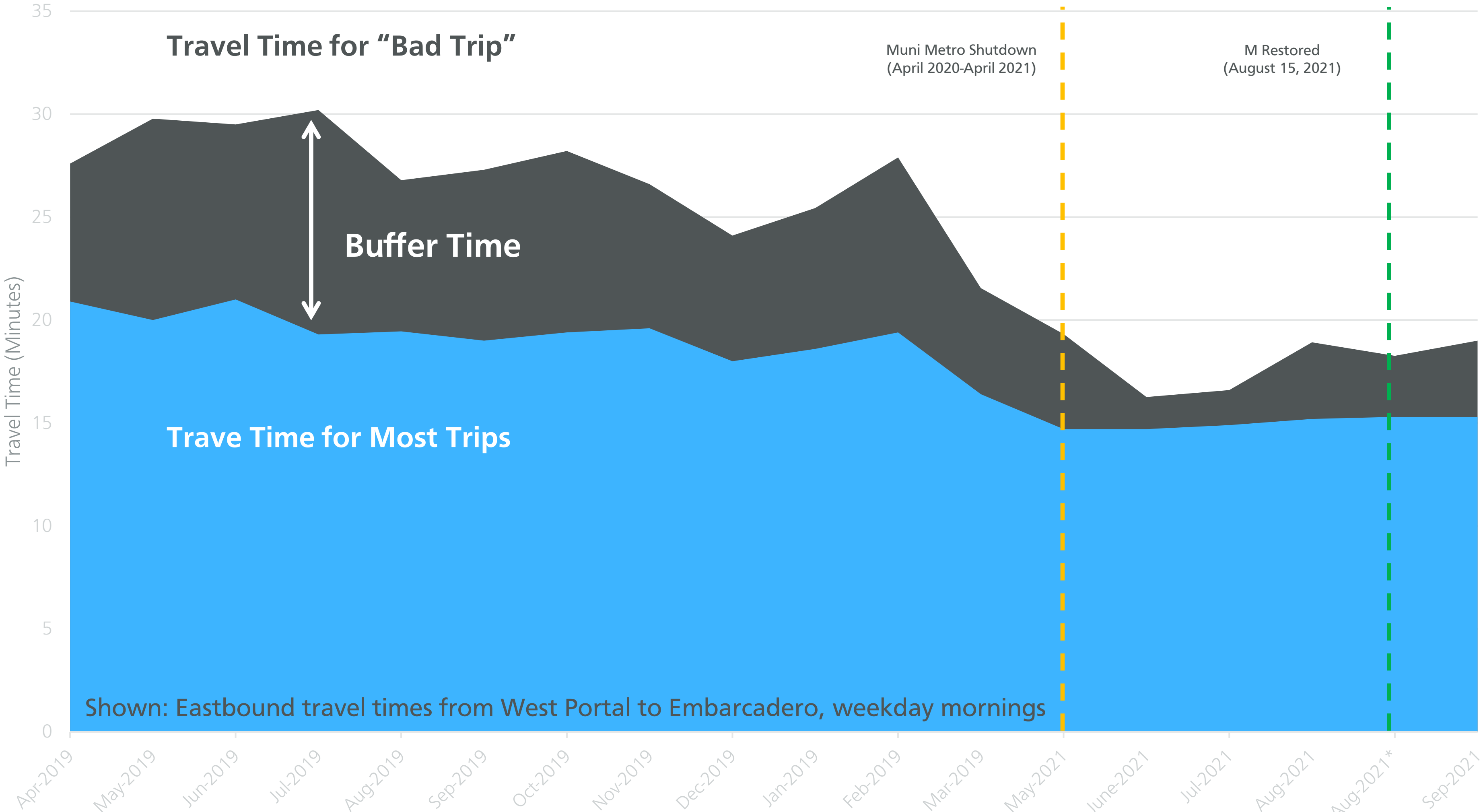
- SFMTA

Service Plan



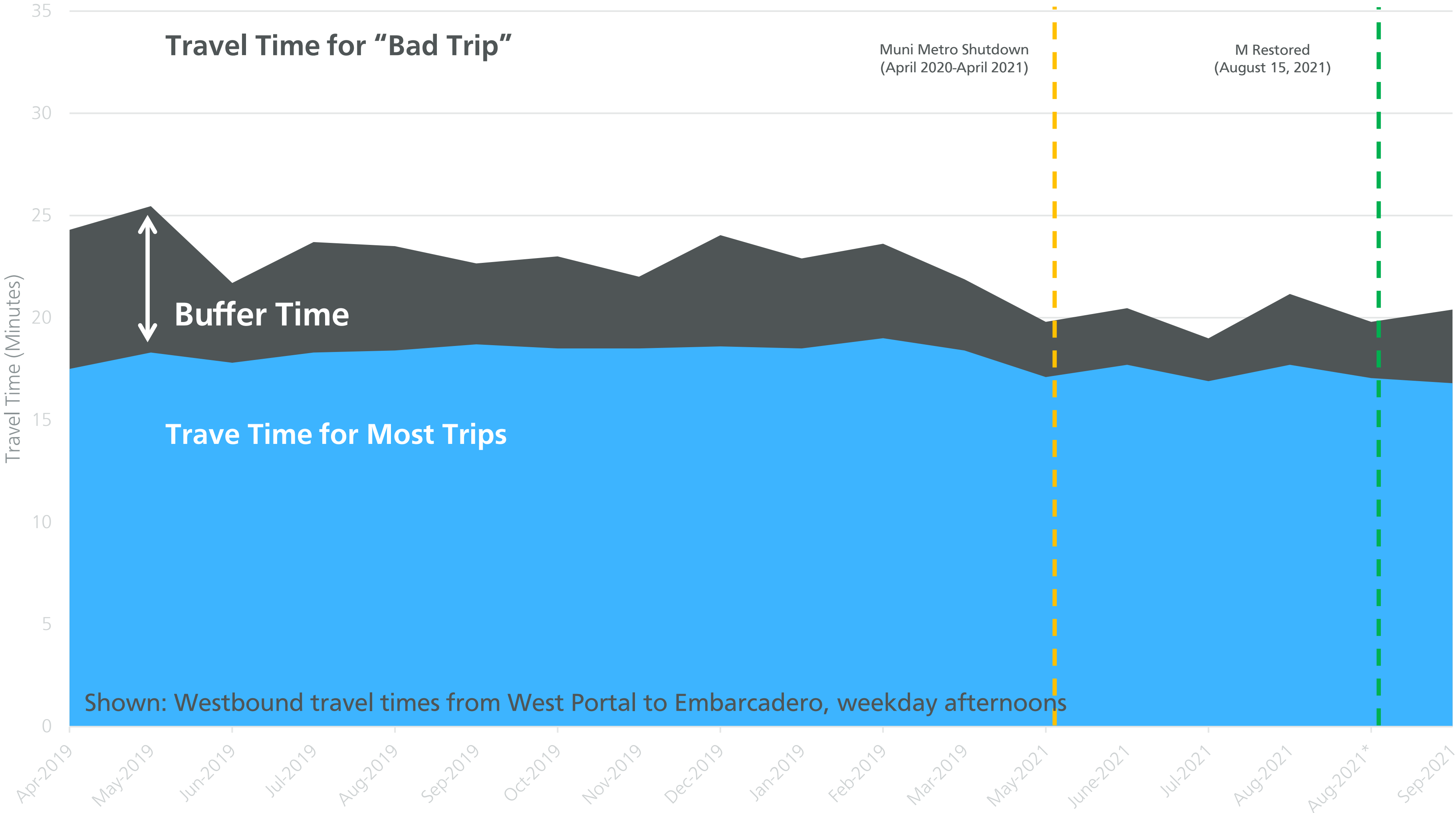
Subway End to End Travel Times

Trip times, including those “worst trips” have been reduced



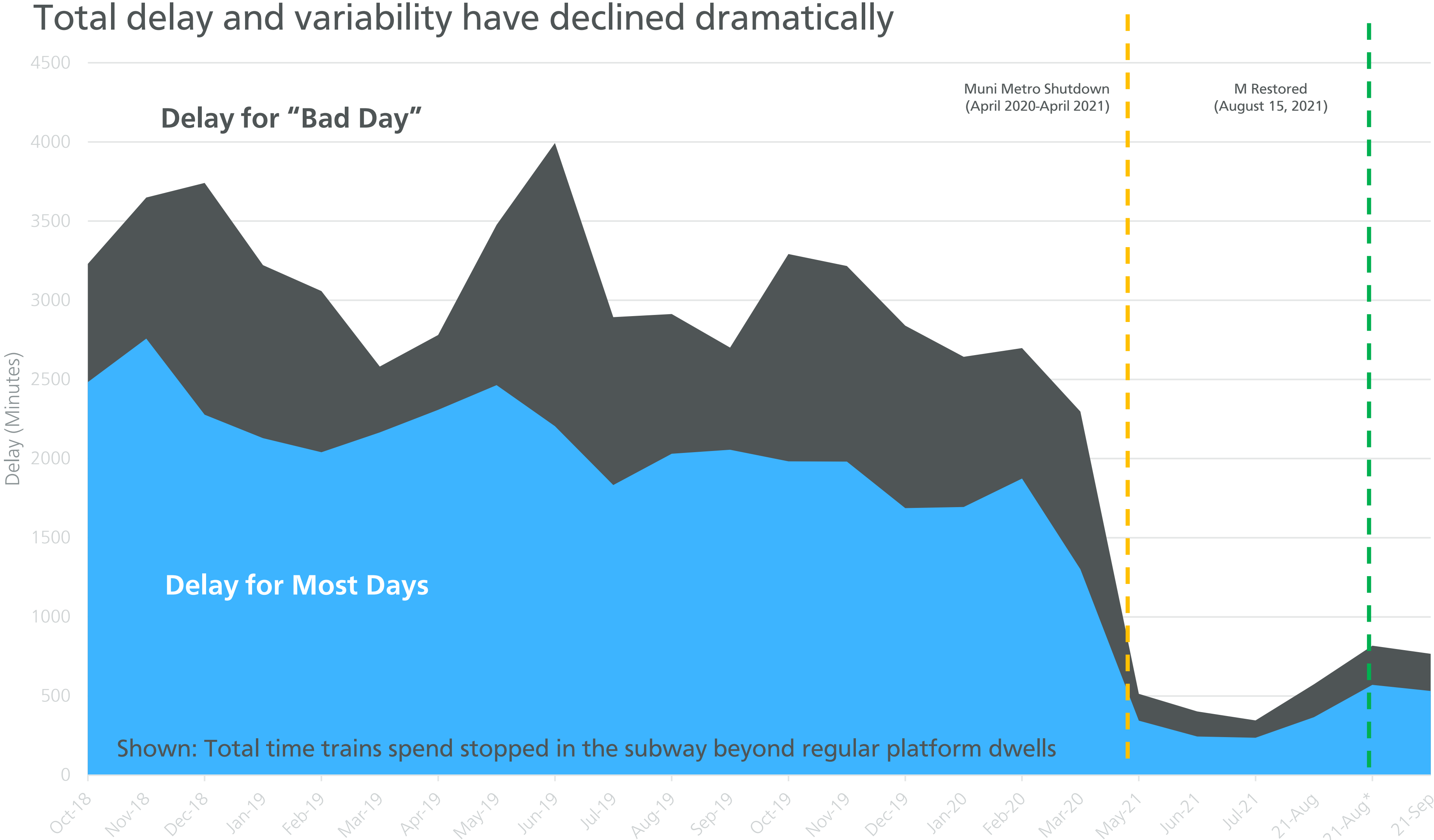
Subway End to End Travel Times

Trip times were also reduced in the westbound direction



Subway: Total Minutes of Delay

Total delay and variability have declined dramatically



Eastbound

Average daily delay*

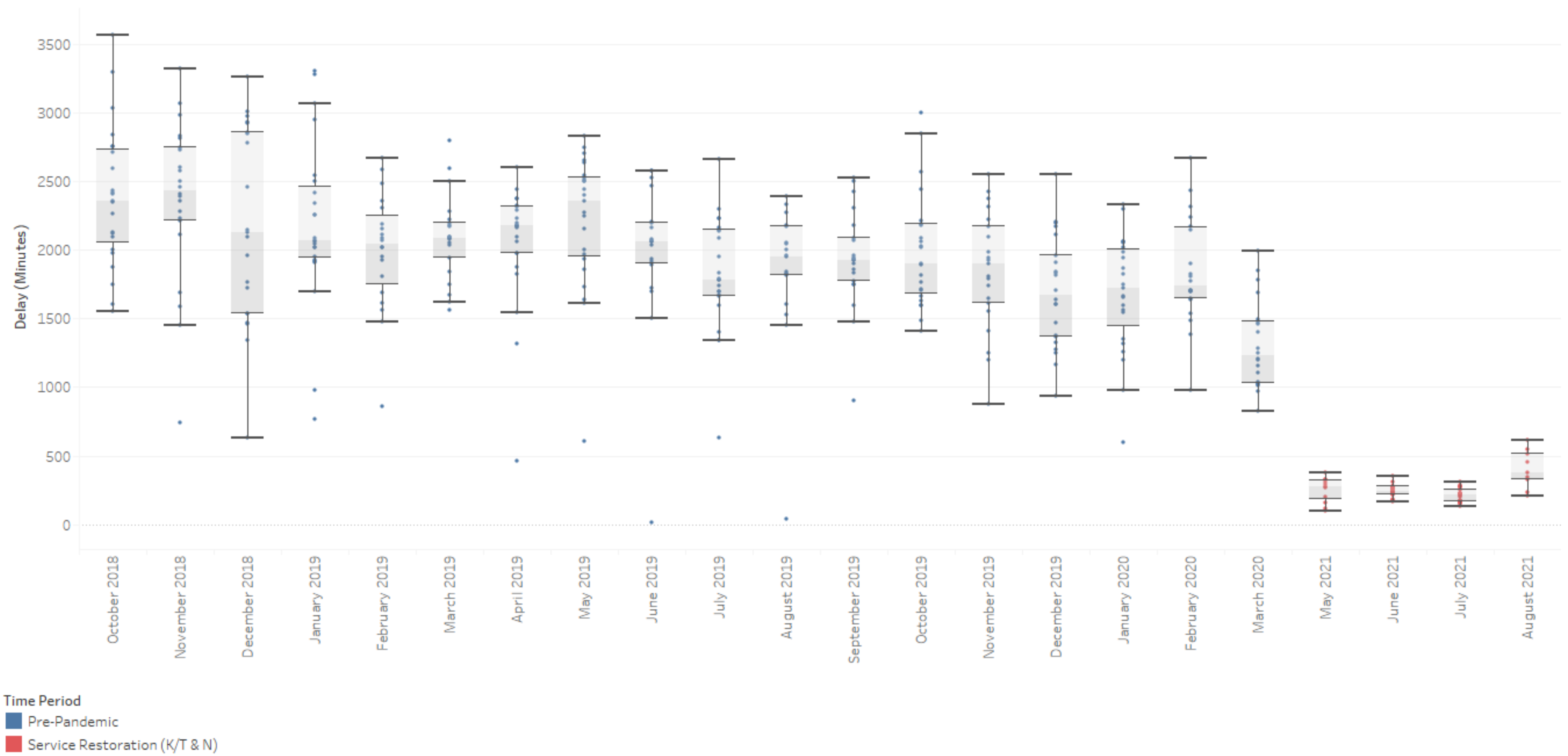
Pre-pandemic	Today
654 min	53 min

Westbound

Average daily delay*

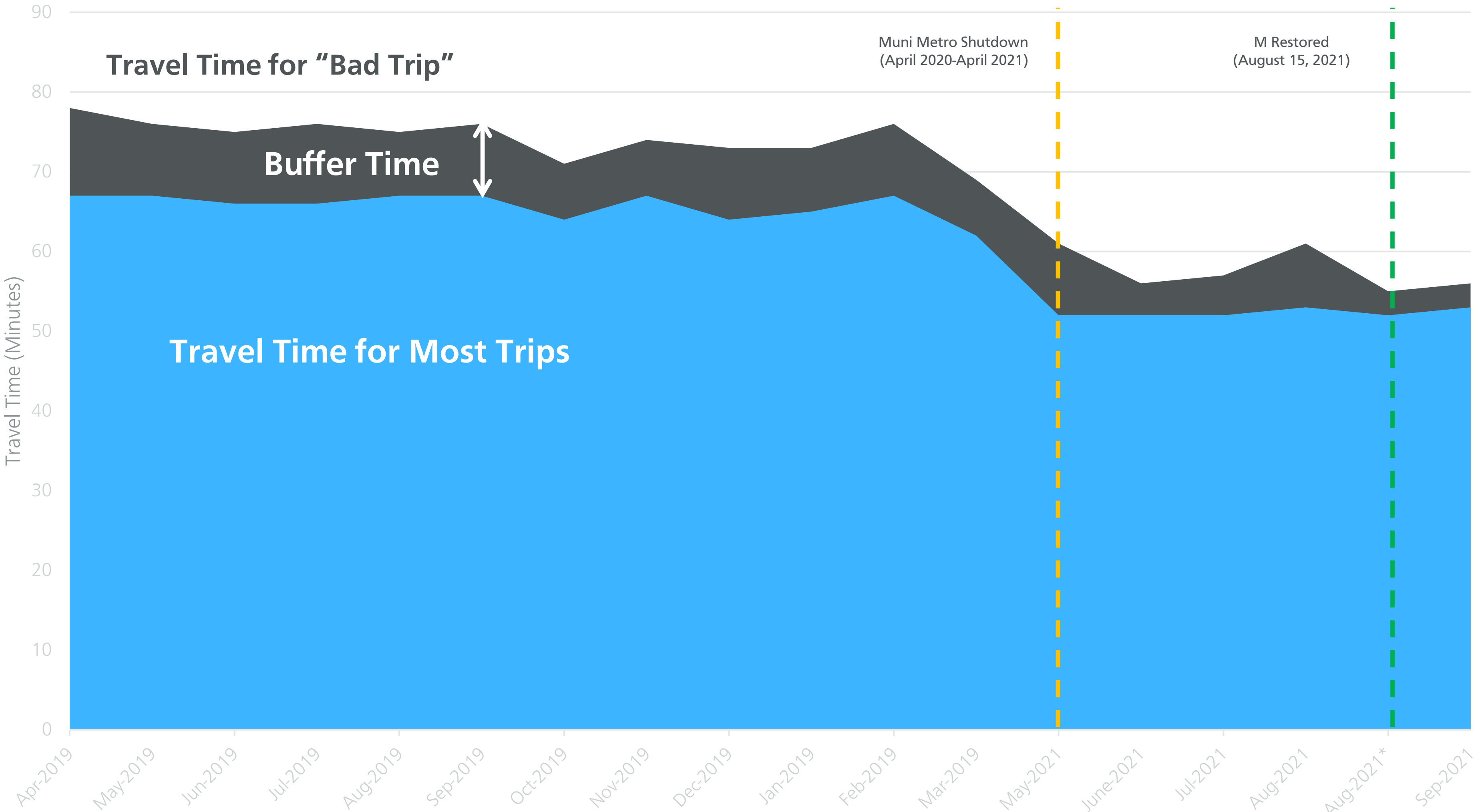
Pre-pandemic	Today
506 min	45 min

Monthly ATCS Time Stopped Box & Whisker Plot



N-Judah End-to-End Travel Times

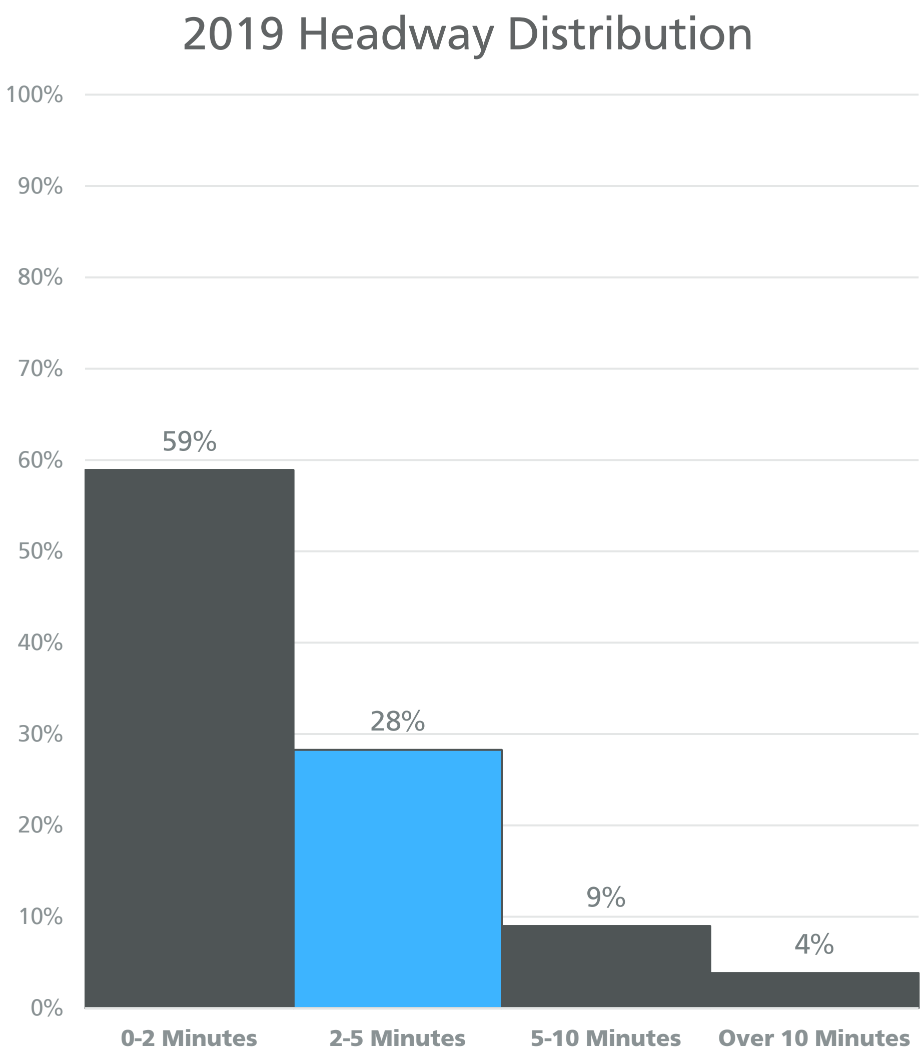
Ocean Beach → 4th & King, morning peak

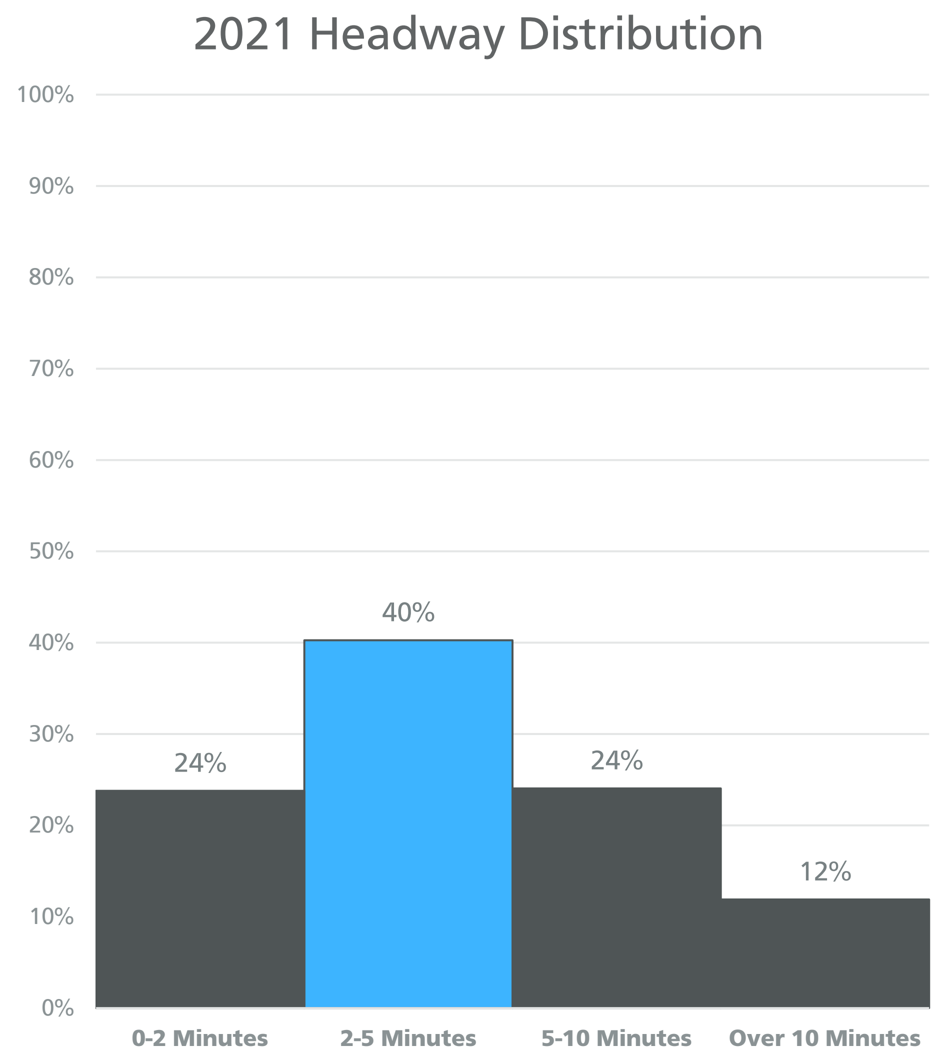


Subway Headways

Measured at Church Station, eastbound

Moving from "too close together" to "optimal" (shown in blue)

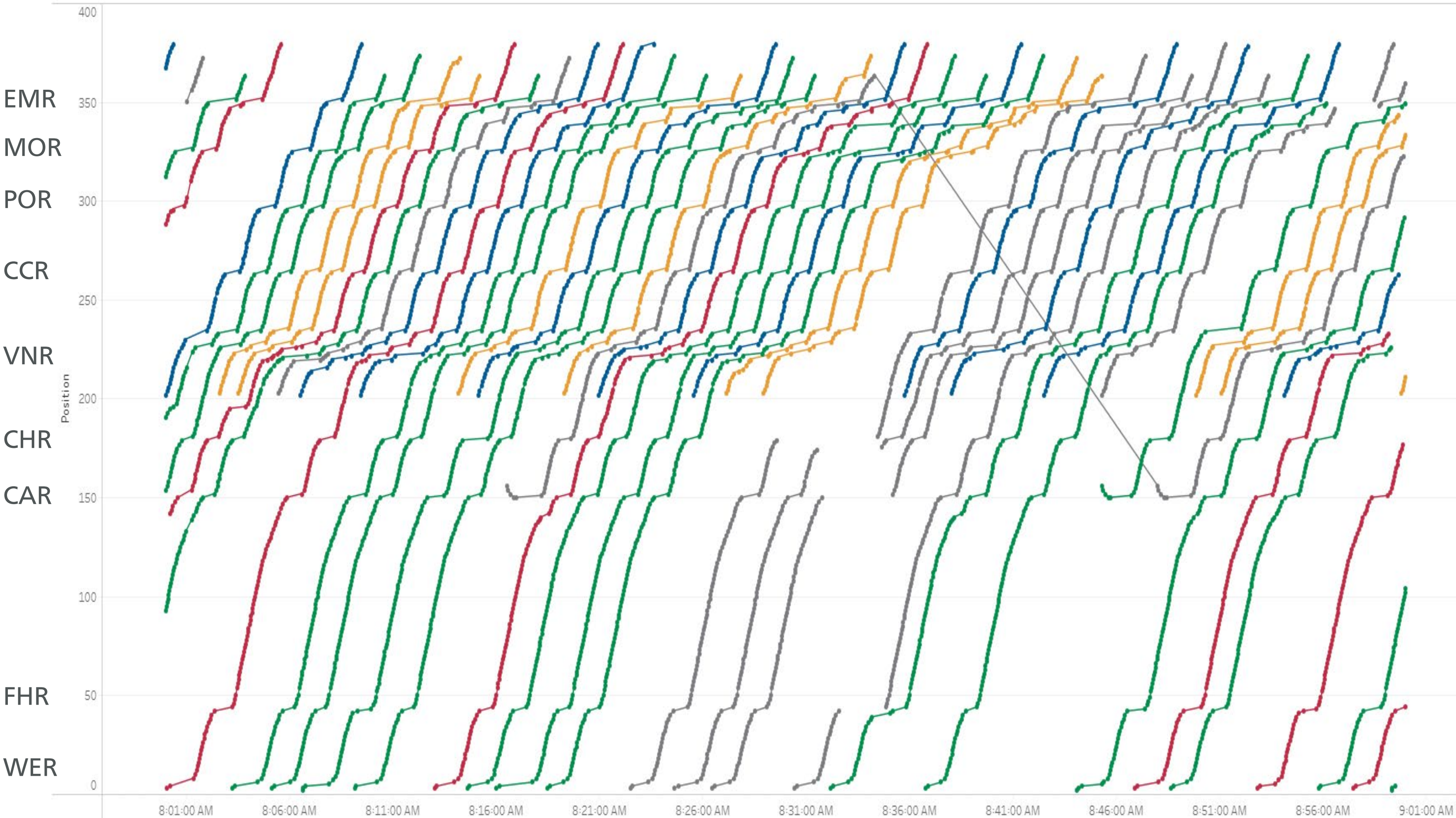




April 16, 2019, eastbound

Service Snapshot: 2019

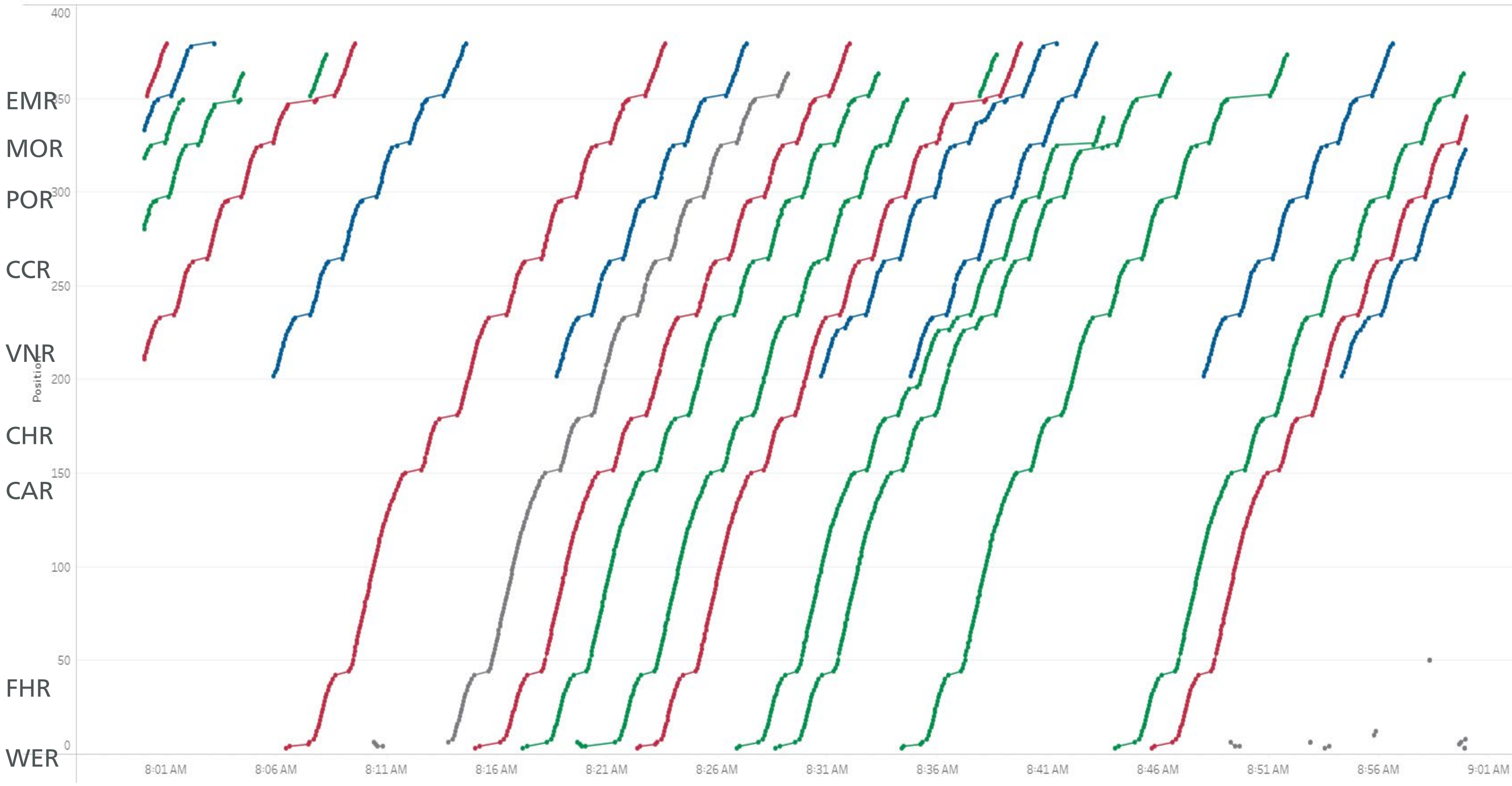
Queues form as the system has no time to recover between trains



Service Snapshot: 2021

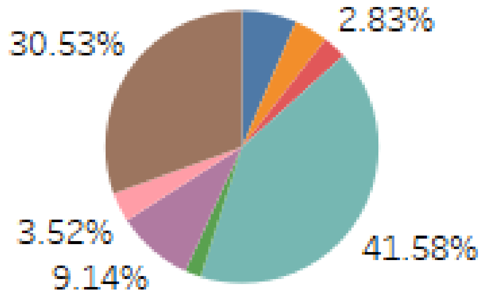
October 12, 2021, eastbound

Less closely spaced trains means system can recover from delays without cascading



Eastbound

Pre-Pandemic Stop Time Distribution



Average daily delay per train*

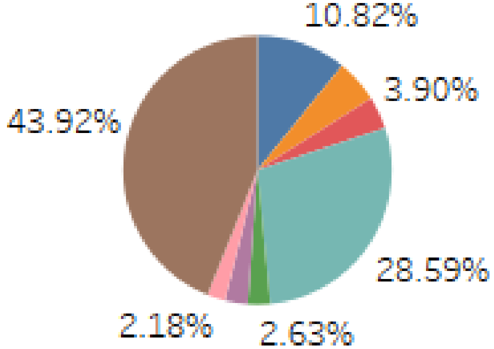
Pre-pandemic

79.2 sec / train

Service Restoration (K/T & N) Stop Time Distribution

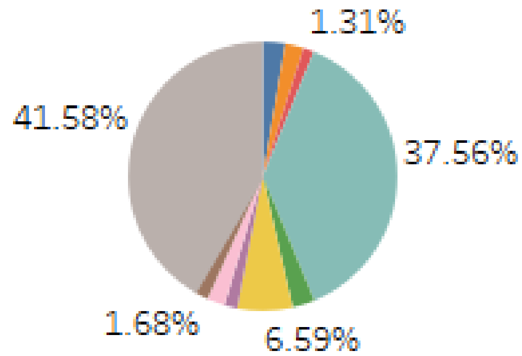
Today

18 sec / train



Westbound

Pre-Pandemic Stop Time Distribution



Average daily delay per train*

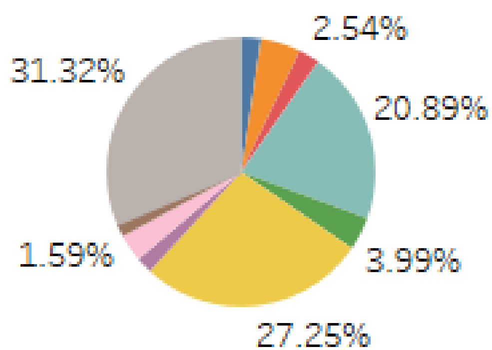
Pre-pandemic

61.2 sec / train

Service Restoration (K/T & N) Stop Time Distribution

Today

15 sec / train

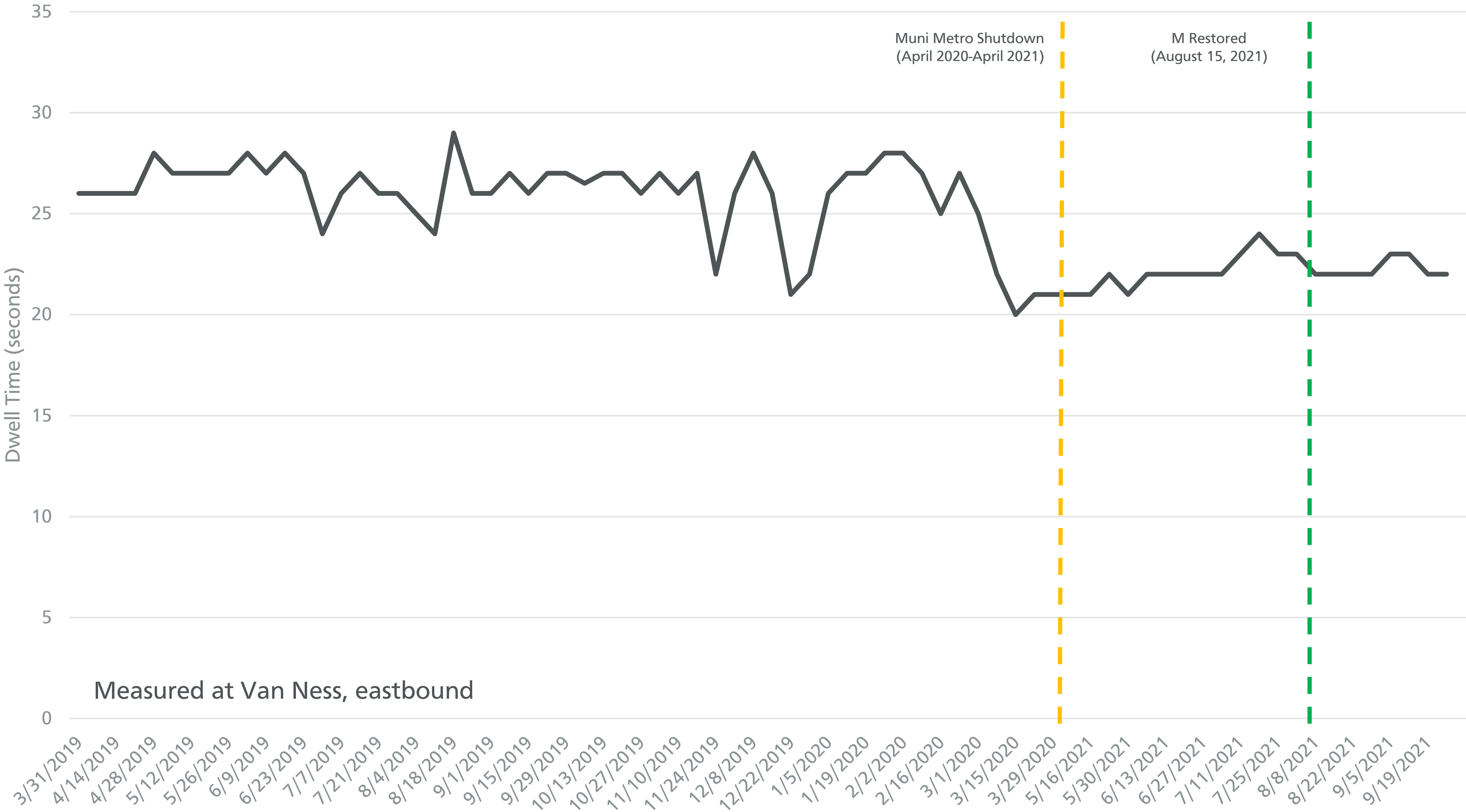


Approach

- CAL-AP
- CCL-AP
- CHL-AP
- EML-AP
- FHL-AP
- MMT-AP
- MOL-AP
- POL-AP
- VNL-AP
- WEL-AP

Subway Station Dwells

Reduced ridership in 2021 resulted in slight reduction to station dwell times
However, this reduction was not large enough to influence delays

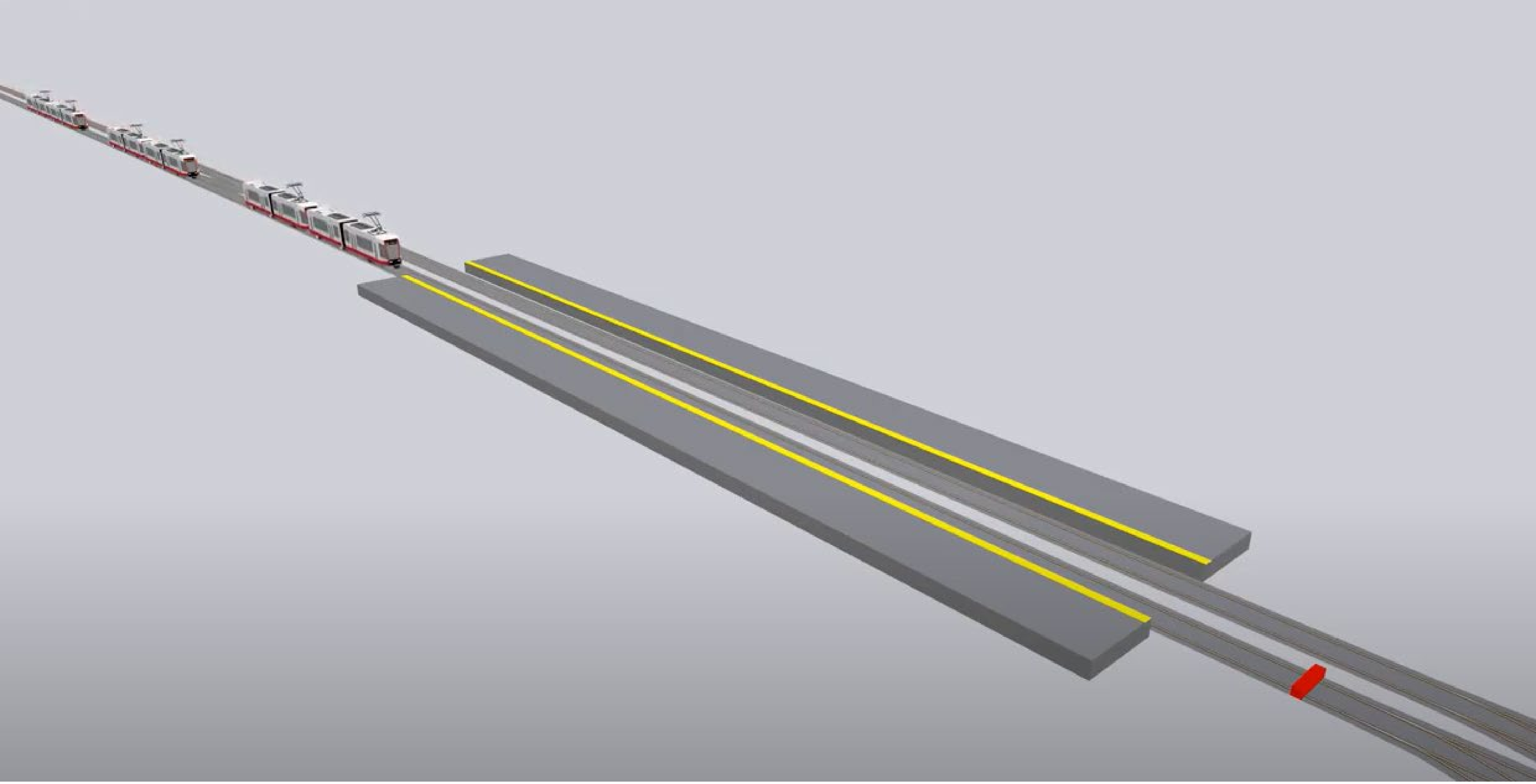


Simulation

- We know empirically that when we start to run more than about 30 trains an hour, performance suffers.
- We wanted to learn more about what causes subway congestion and delays. There are many factors including turnback times, trains arriving bunched from the surface, etc
- With a simulation we looked at the effects of just one cause, train spacing, and how that related to queuing.
- To isolate the effects, we ran a simulation of the rail system under ideal conditions, and changed the service frequency of the lines.
- This simulation helped us understand the structural disadvantage that the Muni Metro’s geographic design creates for us, independent of technical or human factors.

West Portal Queuing Simulation

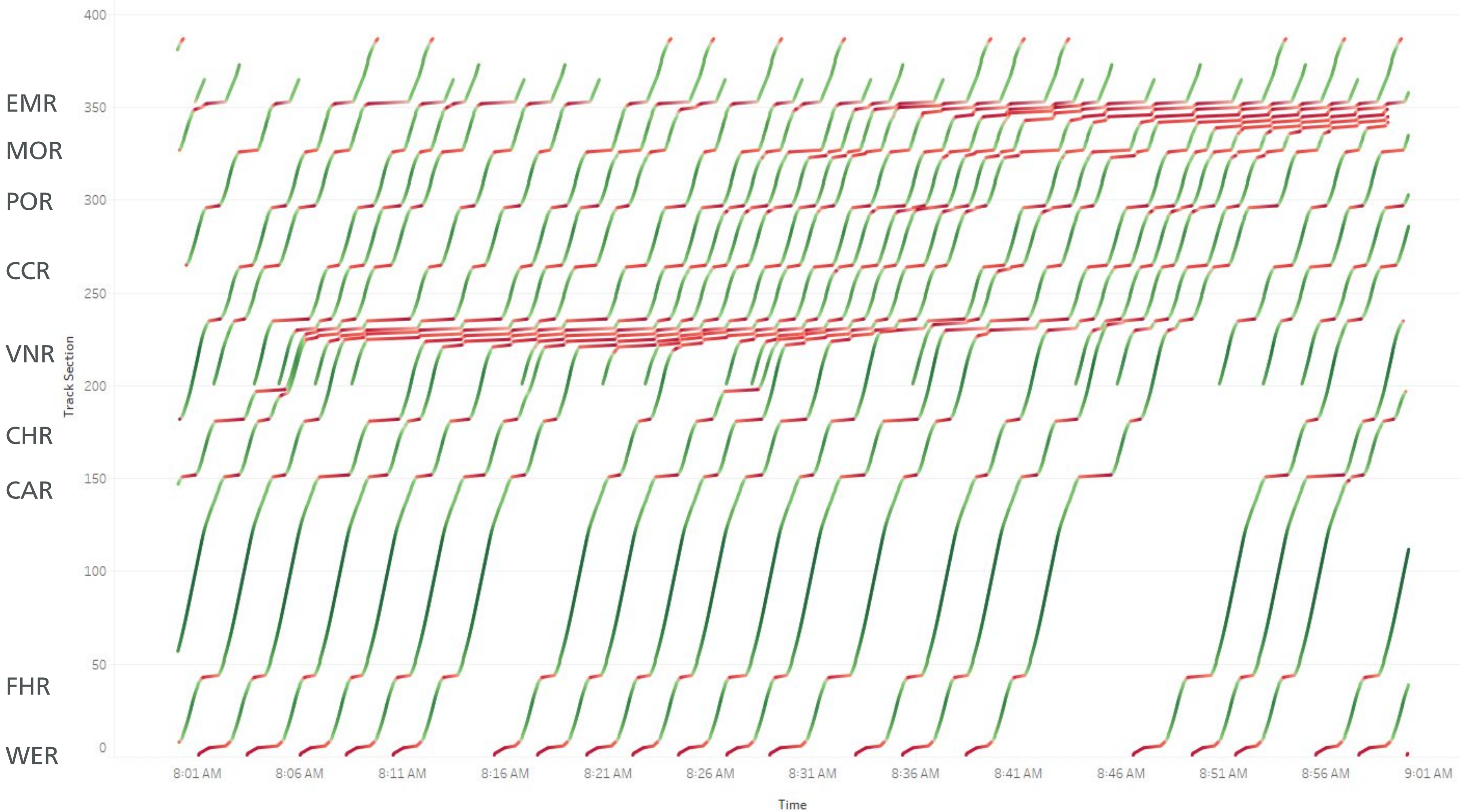
Embarcadero Queuing Simulation



April 16, 2019, eastbound

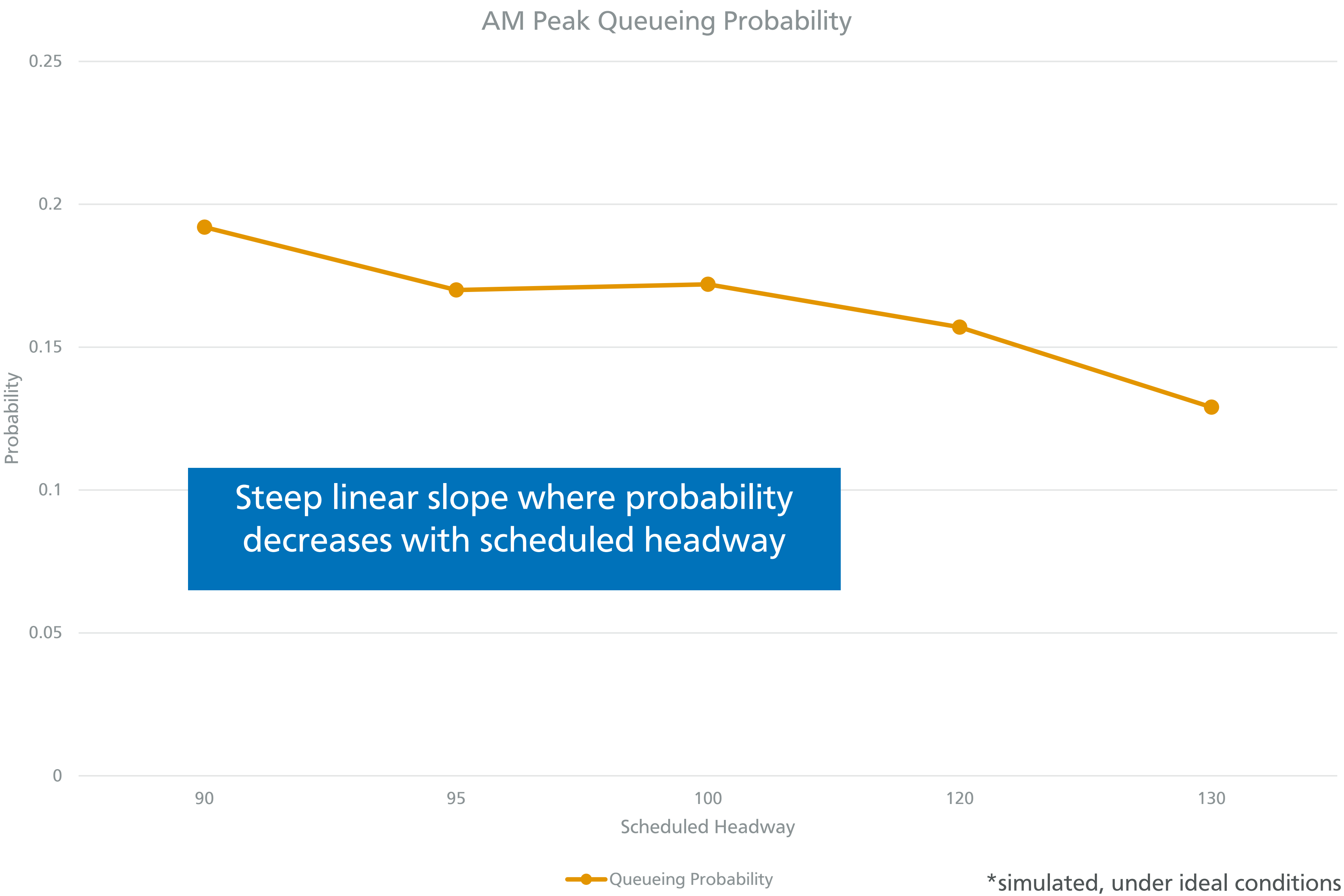
Simulation Snapshot

Queues form at the bottlenecks at Van Ness and Embarcadero

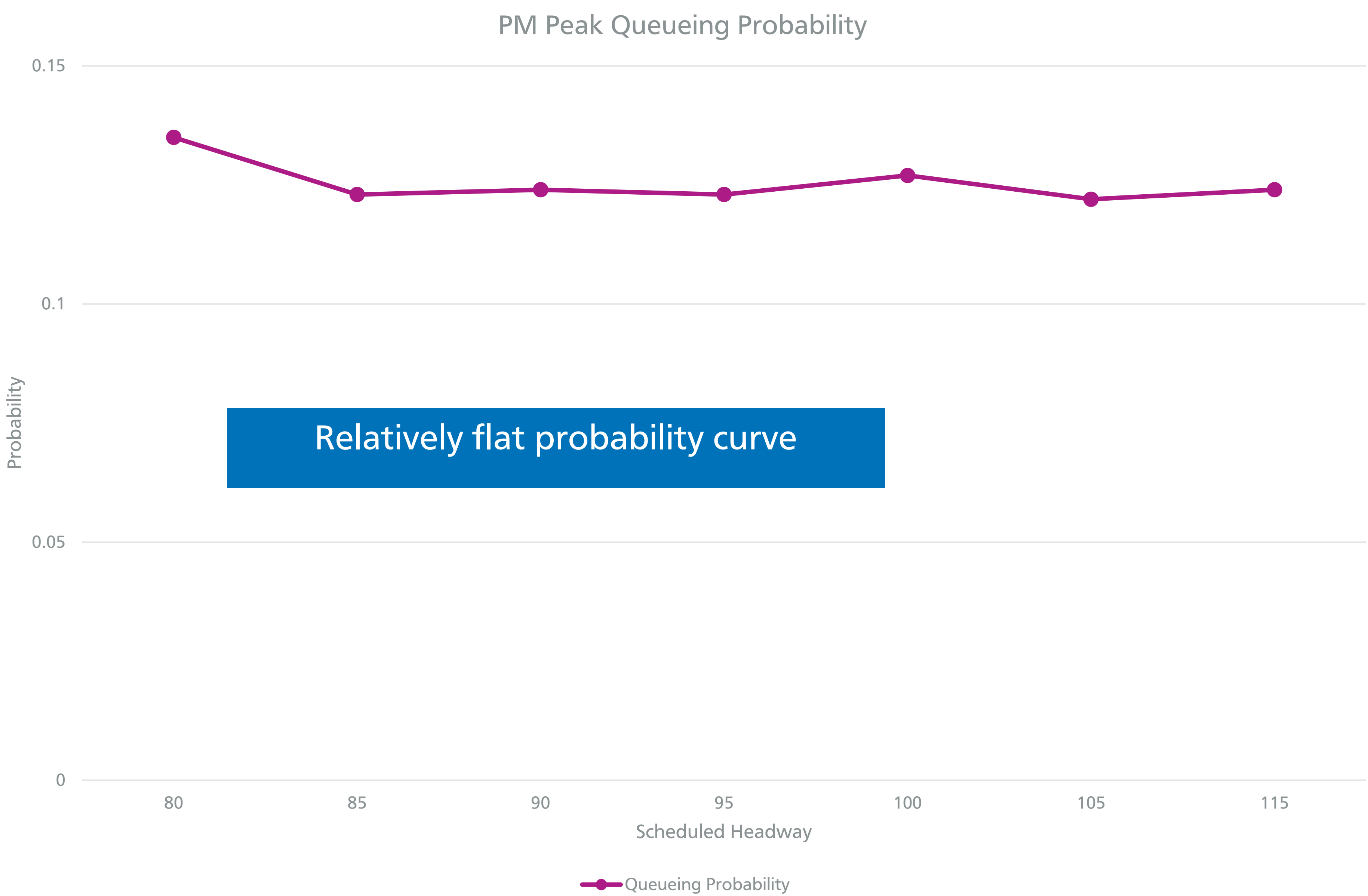


Importance of the Relationship between Queueing and Headways

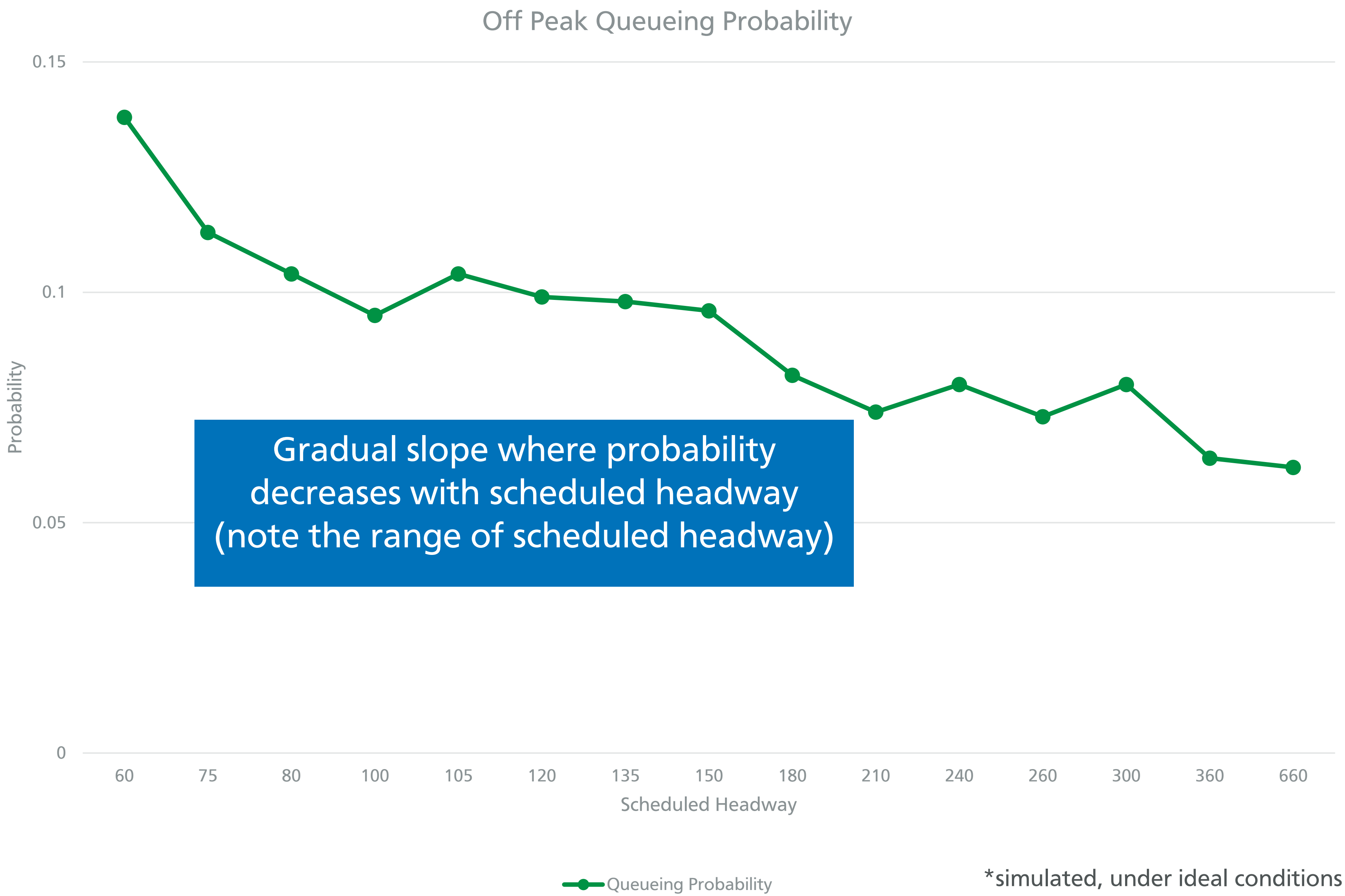
- Queueing occurs when the processing rate of a station (dwell + clearance time) is greater than the arrival rate (headway)
- Delay as a result of queueing can be broken up into two parts
  - Time Stopped – Time a train spends stopped in a queue
  - Start Up Lost Time – Time a train spends to accelerate to speed from a complete stop
  - Total Delay = Time Stopped + Start-Up Lost Time
- Delay from being in a queue can compound as more trains arrive and the queue gets longer
  - Train at the end of the queue needs to wait for all preceding trains to dwell at platform



*simulated, under ideal conditions

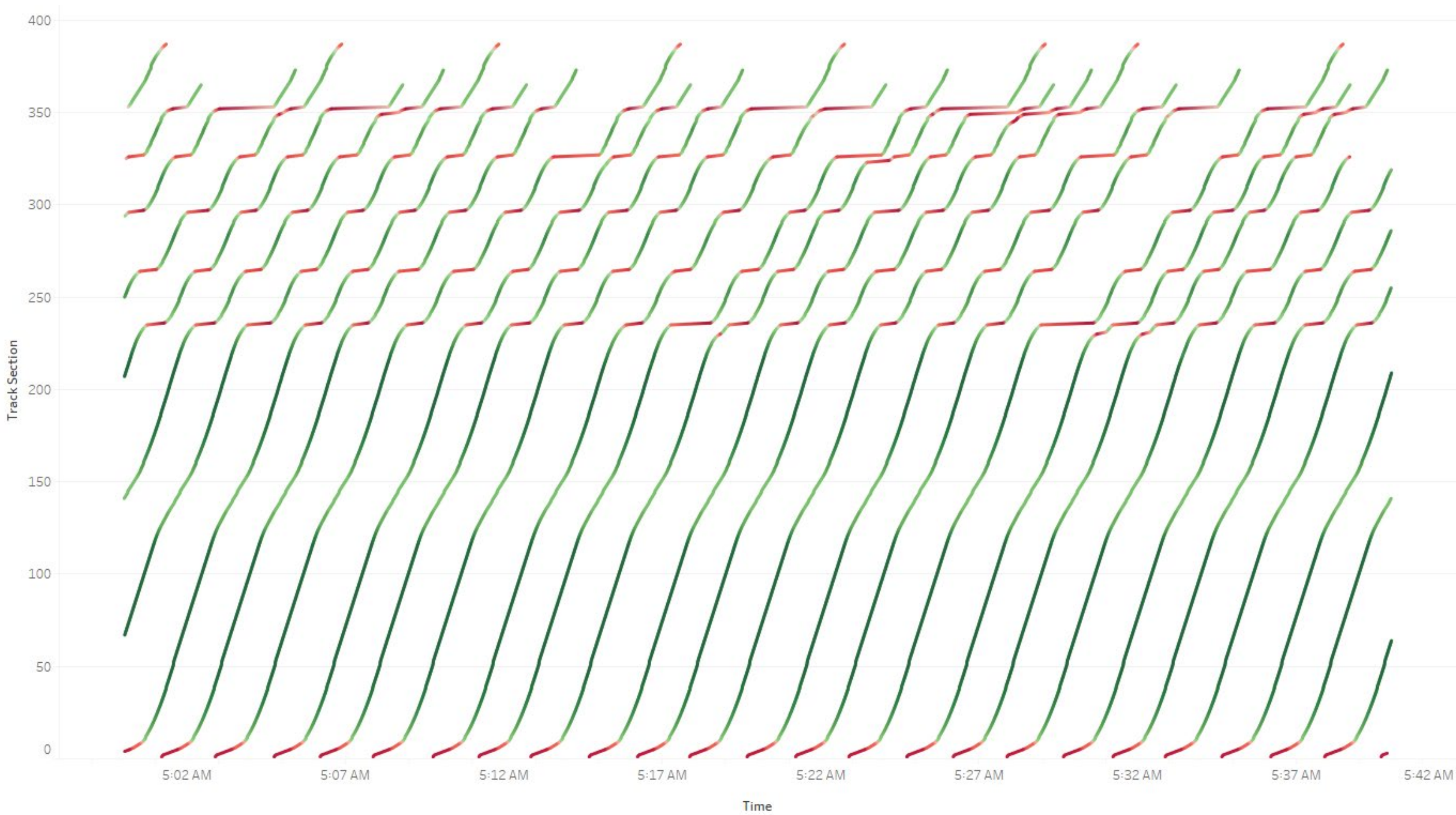


*simulated, under ideal conditions



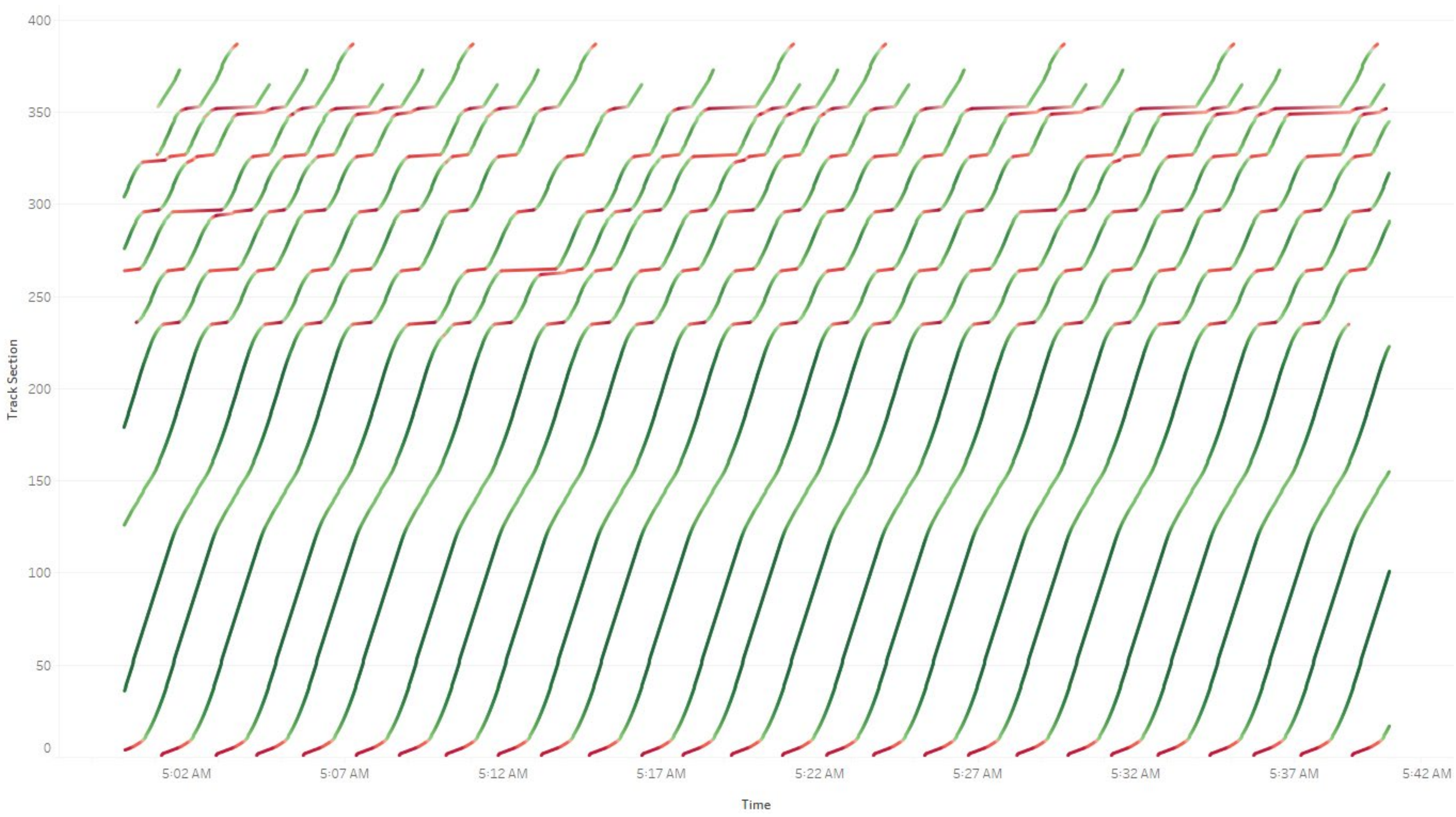
*simulated, under ideal conditions

100 second headway (simulated)



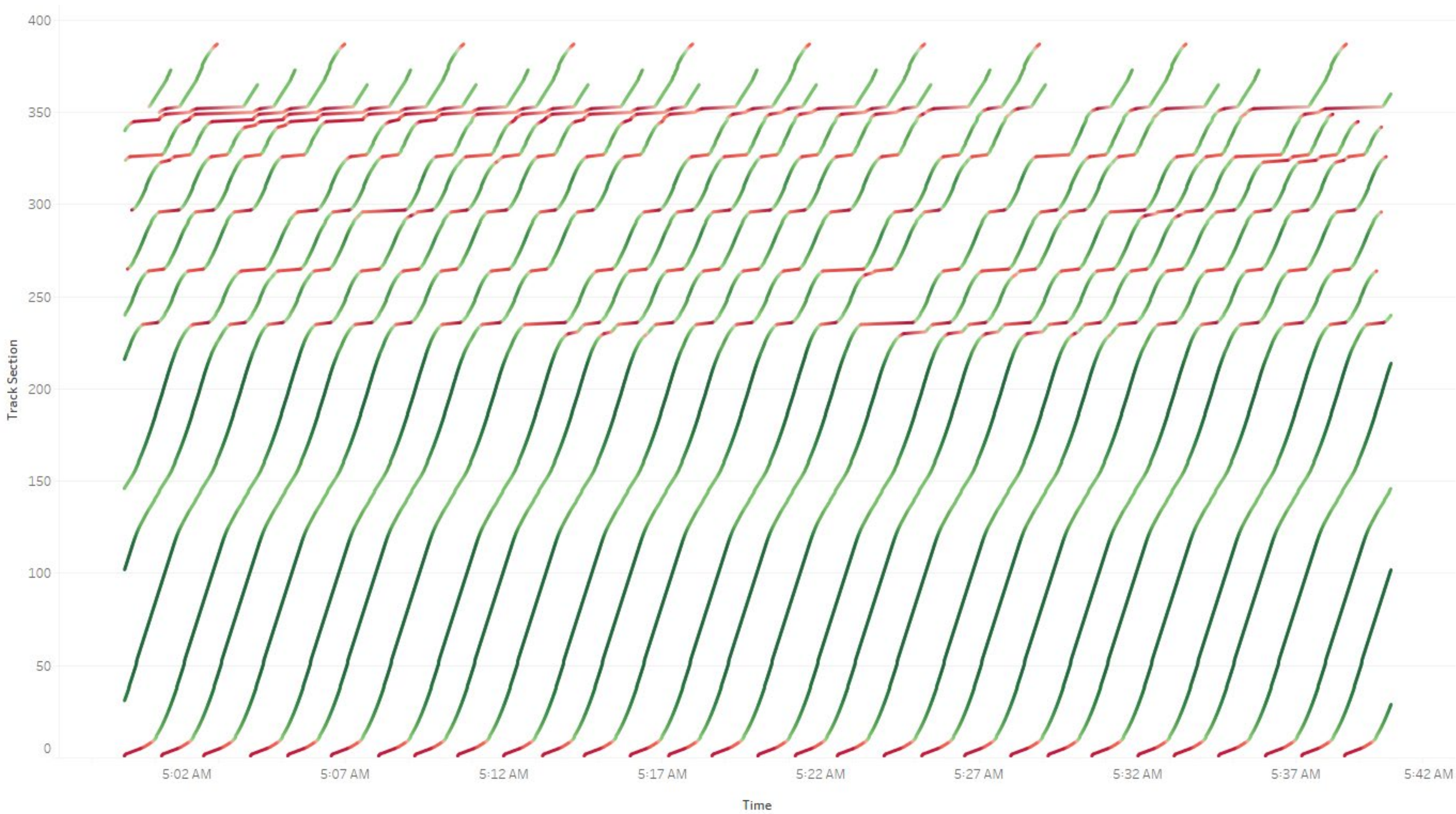
*simulated, under ideal conditions

90 second headway (simulated)



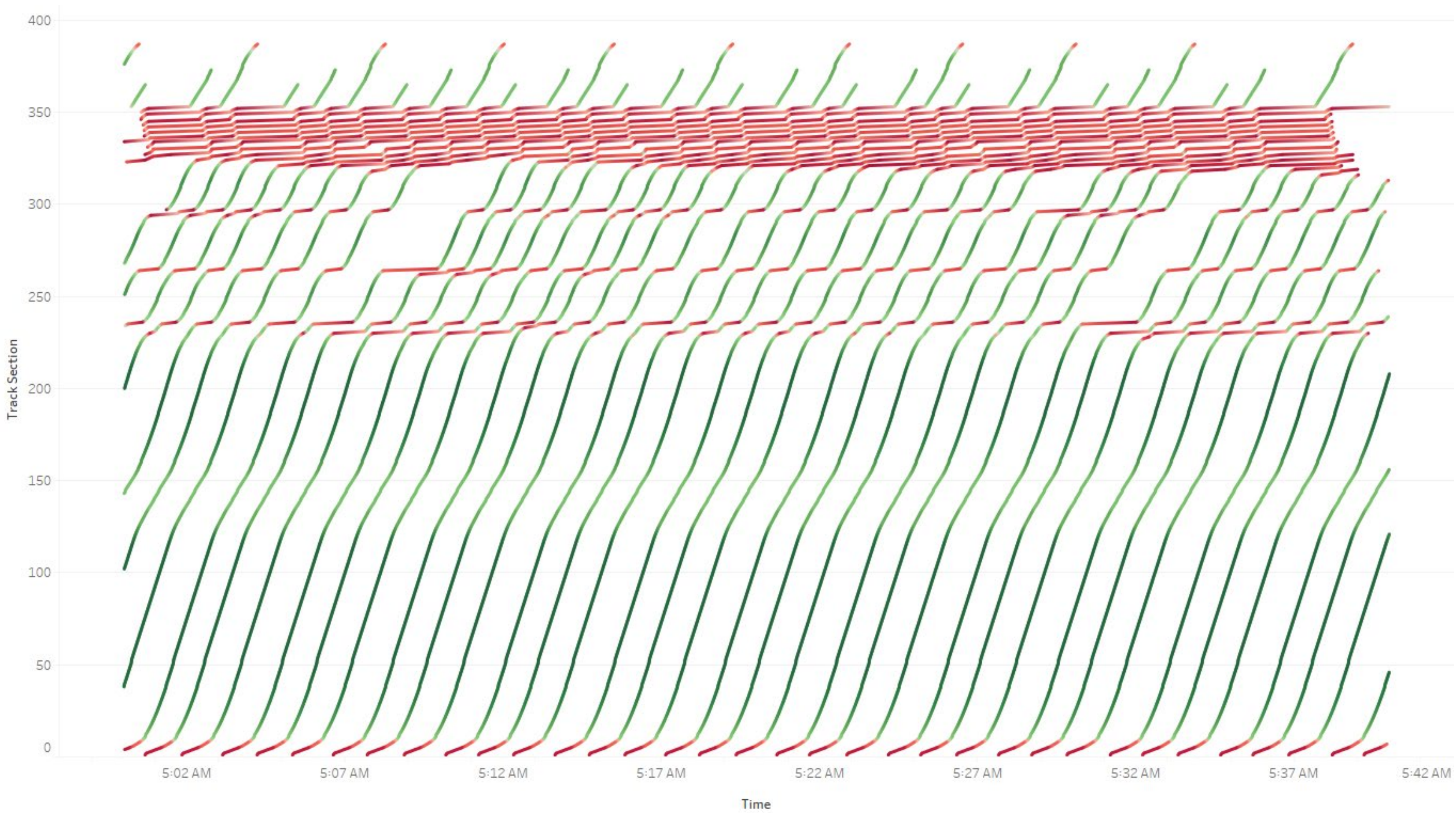
*simulated, under ideal conditions

80 second headway (simulated)



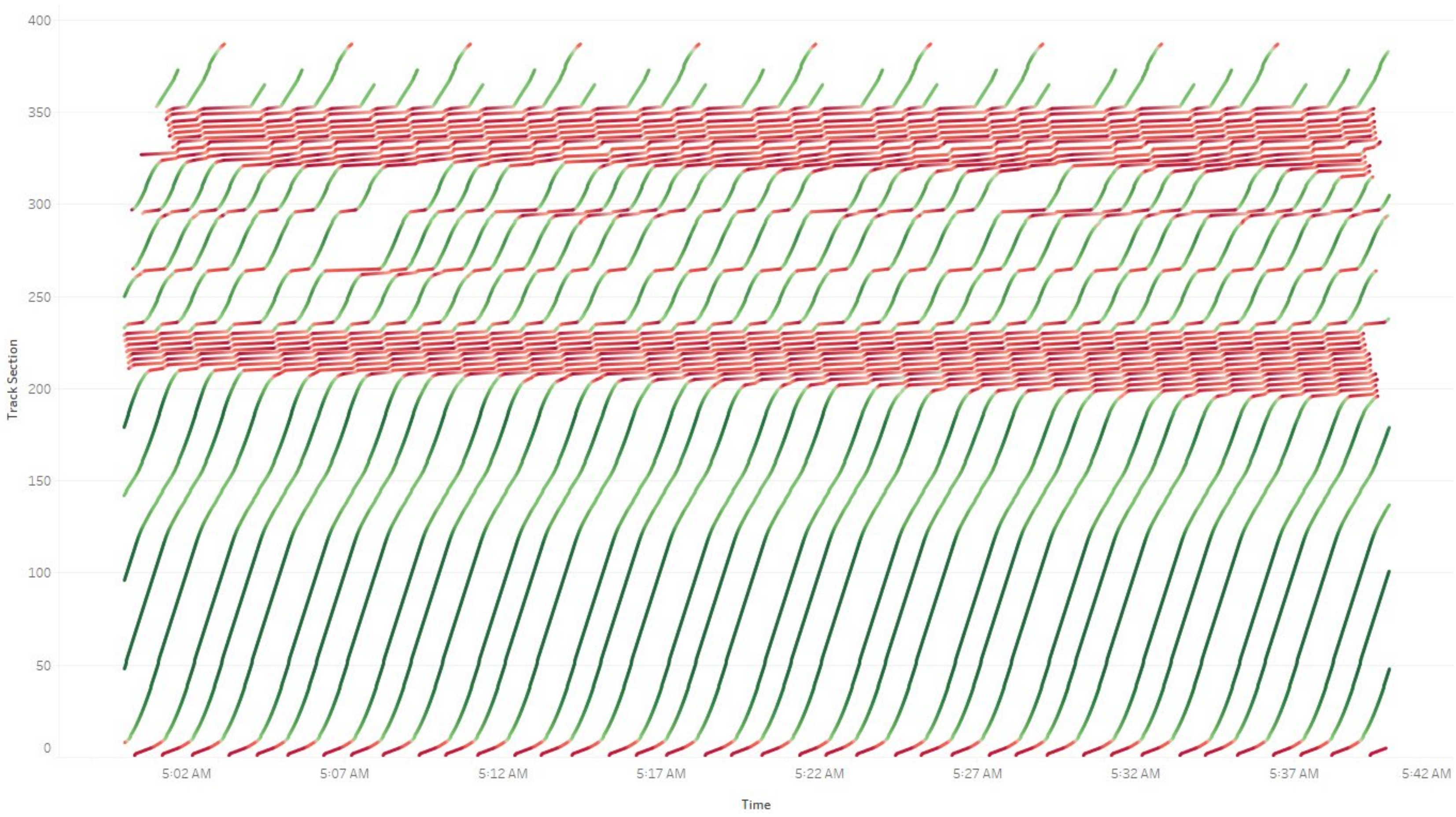
*simulated, under ideal conditions

70 second headway (simulated)



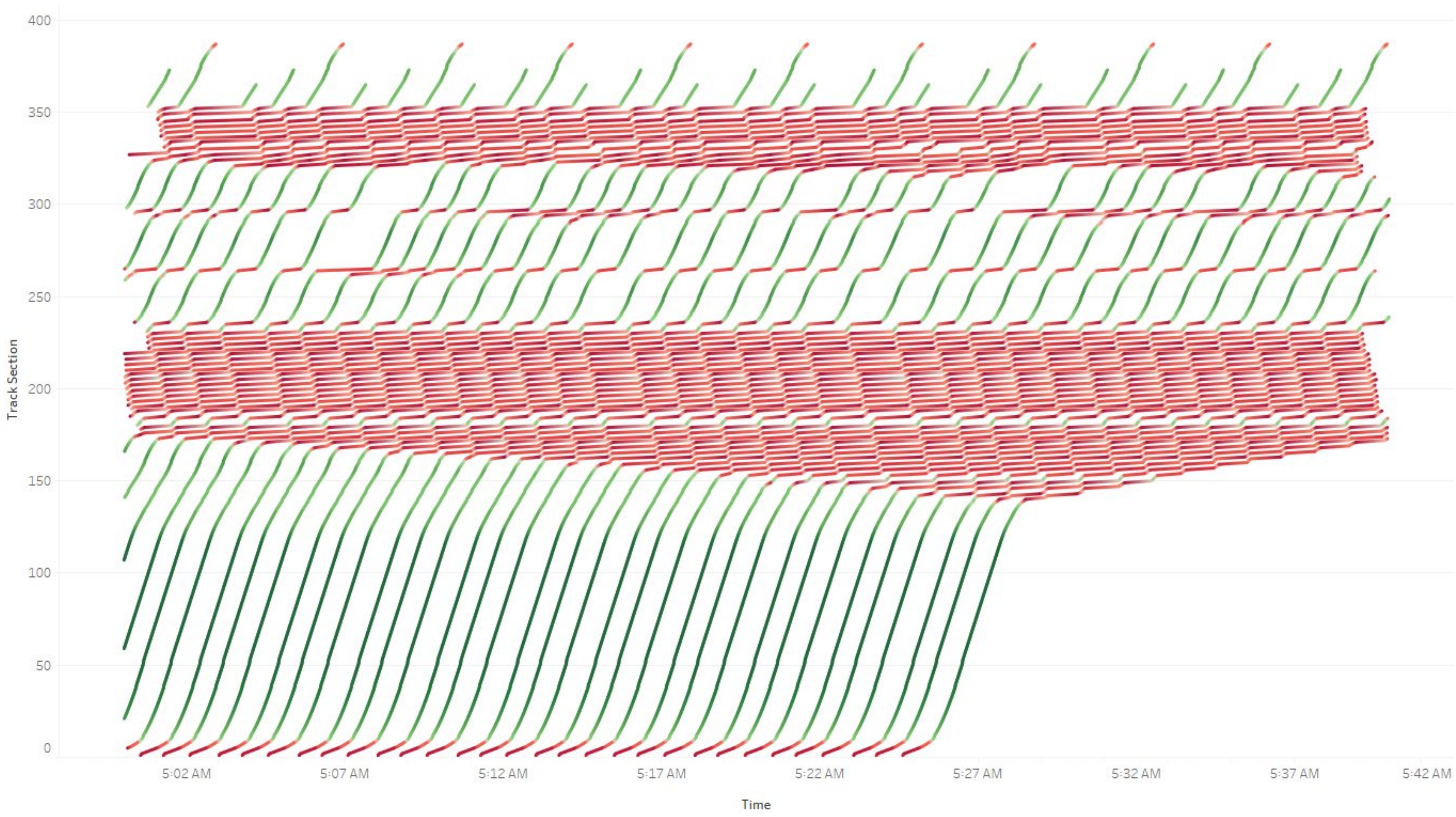
*simulated, under ideal conditions

60 second headway (simulated)



*simulated, under ideal conditions

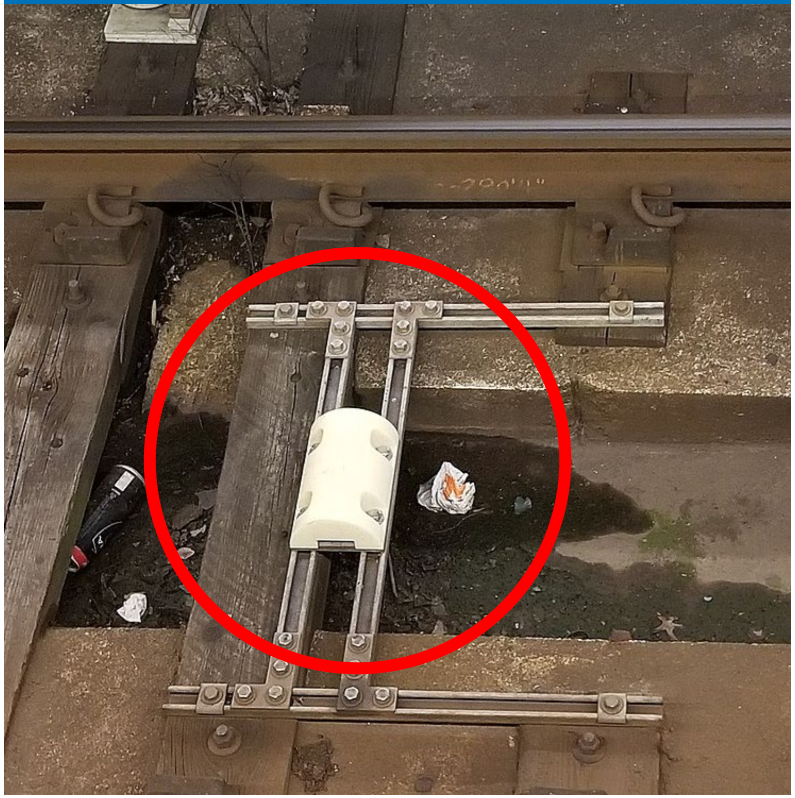
50 second headway (simulated)



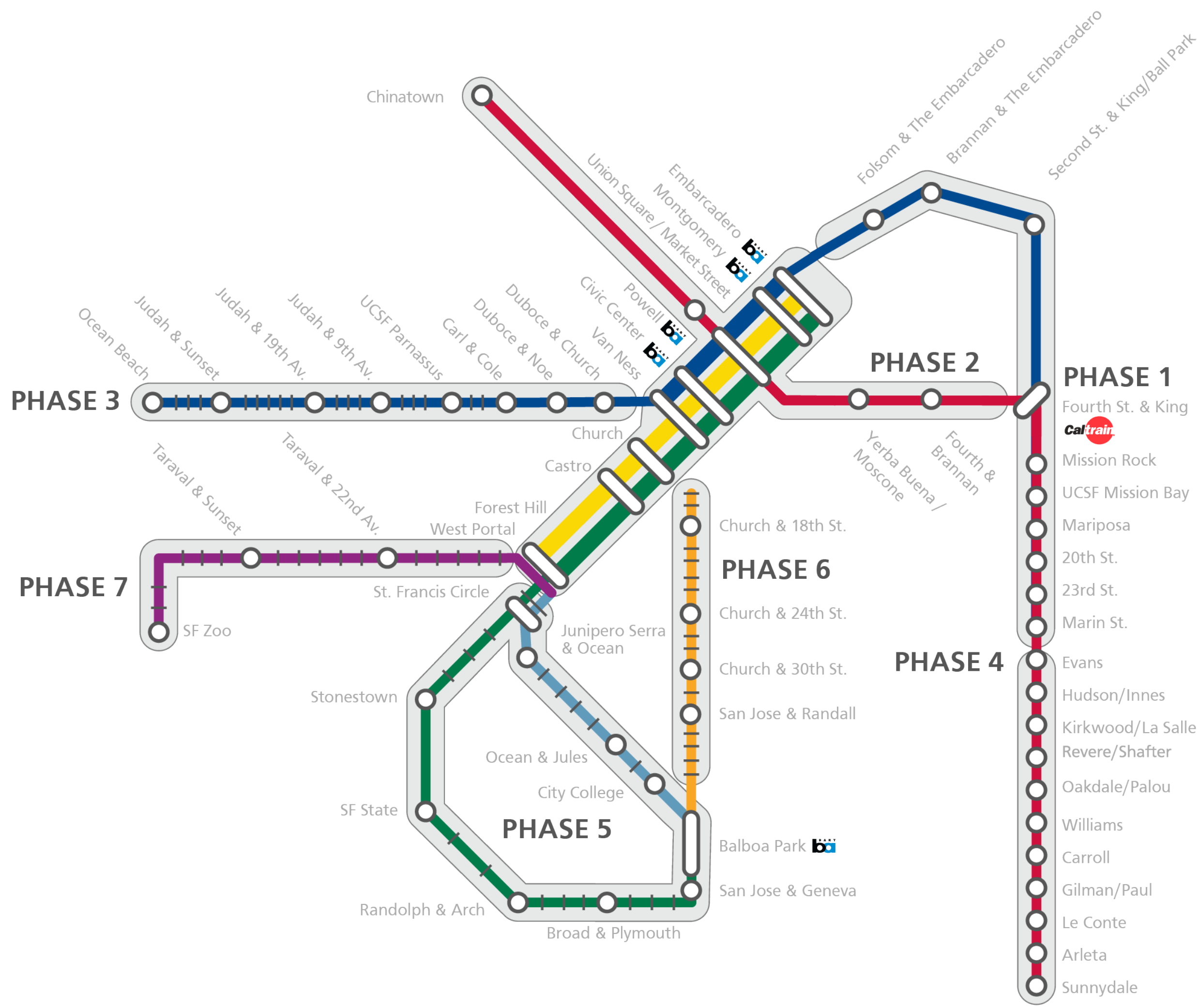
*simulated, under ideal conditions

SFMTA ATCS Loop Cable

NYC MTA CBTC Transponder



10-year upgrade and expansion of communications-based train control (CBTC) to improve Muni light rail service.



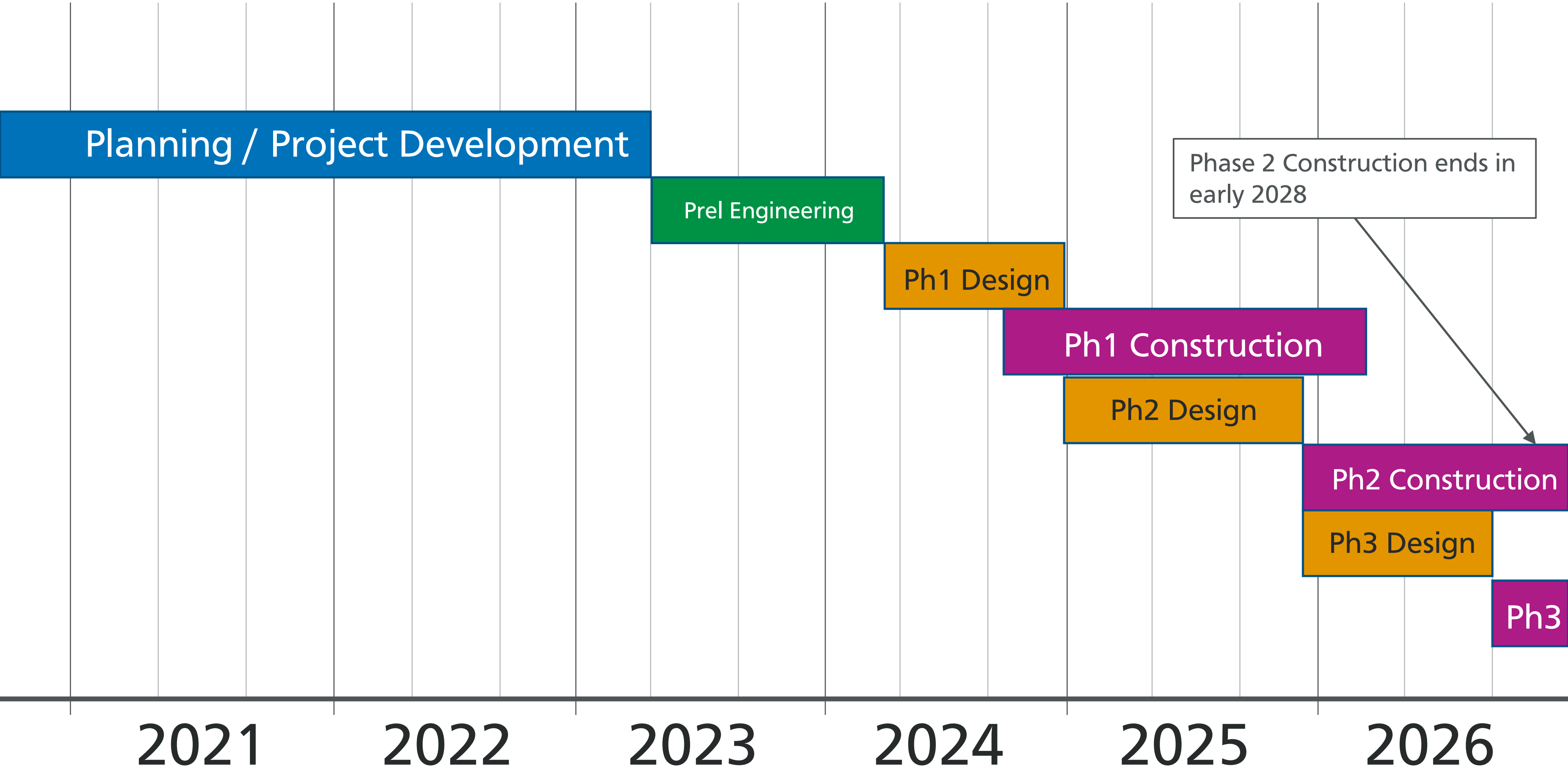
Upgrading to CBTC and expanding to the surface will provide these benefits to Muni light rail service:

Reduced Delays	Subway delays reduced by 20-25% through reduced train control failures and reduced congestion
Improved Maintainability	System monitors redundant components for faults so preventative action can be taken before service is affected
Consistent trip times	Expanding system to surface and integrating with traffic signals means trip times are less variable
Greater capacity	System enables better supervision and management of trains, addressing bottlenecks and increasing capacity

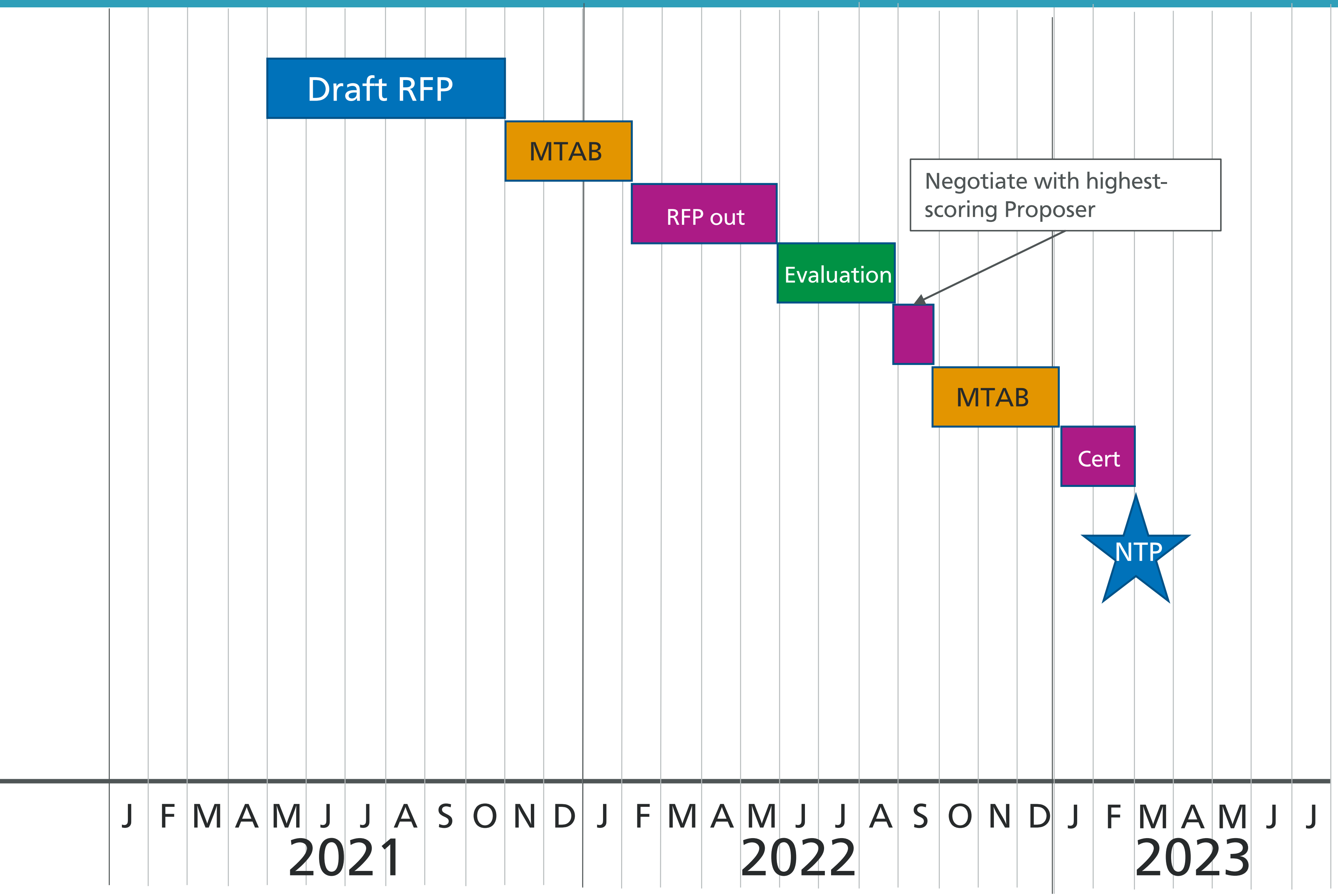
Project Scope | Key Improvements

- Upgrades loop-cable based system in subway to redundant, reliable wireless communications
- Expands train control system supervision as well as automatic speed and signal enforcement to the surface
- Replaces central computers, local computers, and onboard equipment with the latest technology
- Connects to traffic signals to provide better train priority (trains will be less likely to encounter a red traffic signal)
- Provides the TMC with greater flexibility and better tools to manage service; including adjustments to speed and dwell times to maintain trains on-headway or on-schedule
- Improved information to train operator, including positions of upcoming switches, distance to next speed restriction / stop, current speed limit
- Better tracking of work crews, non-revenue and historic vehicles for enhanced safety and monitoring from TMC
- Greater reliability and maintainability of train control system as well as monitoring of LRV and wayside equipment status
- Provides for the long term support and upgrade of the system; holds supplier accountable for failures or issues affecting service

Phase 1: Third St (to MME) and Embarcadero
Phase 2: Subways
Phase 3: N Judah



Project Schedule | Planning Phase



Project Budget: Approx $400 - 500 million

Budget is under review and will be presented in January

Currently in Planning / Project Development Phase

- Hired project planning & admin staff
- Determined contracting structure
- Hired technical consultants (WSP/Parsons)

Next Steps

Working on technical and commercial requirements	Early 2022
Working on project safety plan	Jan 2022

Supplier

- System Procurement — 2022
- System Support — 2022

Consultant

- Professional Svcs — 2022

Installer

- 2024 — Installation

Other Svcs

- 2024 — Technology & Facilities

This scenario uses the Ch 21 procurement process for the supplier and then a separate Chapter 6 RFP for the installer

Questions?