NPMRDS Data & its Application in Regional Performance Monitoring

SCAG Modeling Task Force

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Topics

- MAP-21 Performance Reporting
- NPMRDS Introduction
- PM3 Performance Measures & Metrics Calculation
- SCAG PM3 Performance Metrics Maps
- SCAG 2017 PM3 Performance Measures
- Draft PM3 Statewide Targets

MAP-21 Performance Monitoring

- MAP-21 (2012) established the foundation for a national performance-based transportation planning program
- The FAST Act (2015) continued the performance monitoring requirements outlined in MAP-21
- Final FHWA rule-making was promulgated in (3) separate Performance Management (PM) packages:

  PM 1: Highway Safety (May, 2016). Statewide & regional PM 1 targets were set in May, 2017

  PM 2: National Highway System (NHS) Pavement & Bridge Condition (May, 2017)

  PM 3: NHS System Performance, Freight Movement, & CMAQ Program (May, 2017)

MAP-21 Performance Monitoring

PM 3: NHS System Performance, Freight Movement, & CMAQ Program

1) National Highway System (NHS) Performance:

- Percent of Reliable Person-Miles Traveled on the Interstate System
- Percent of Reliable Person-Miles Traveled on the Non-Interstate NHS

2) Freight Movement:

- Percent of Interstate System Mileage Providing Reliable Truck Travel Times

3) CMAQ Program:

- Total Emissions Reductions by Applicable Pollutants (VOC, CO, NOx, PM 2.5, PM 10)
- Annual Hours of Peak Hour Excessive Delay per Capita
- Percent Non-Single Occupancy Vehicle (SOV) Travel

MAP-21 Performance Reporting

- MAP-21 establishes a 4-year performance target setting & reporting cycle. Caltrans' initial 'baseline' performance period report (for most measures) is due to FHWA on October 1, 2018. The baseline report establishes existing conditions to be assessed over the first 4-year reporting period which ends on December 31, 2021.
- After 2 years, a mid-term progress evaluation is to be conducted, allowing Caltrans & SCAG to re-evaluate initial targets to ensure adequate progress is being made toward the 4-year performance goals. During the mid-term progress evaluation, Caltrans & SCAG are permitted to adjust initial 4-year targets (if necessary).
- At the conclusion of each 4-year performance period, Caltrans is required to submit a report to FHWA demonstrating that 'significant progress' has been made toward achievement of each of the statewide performance targets.

MAP-21 Performance Reporting

- Caltrans is required to set statewide performance targets, however SCAG has option to establish regional targets for most measures within 180 days of Caltrans' submittal.
- SCAG coordinated with Caltrans on establishment of the statewide targets & on specific performance targets for the SCAG region.
- MAP-21 performance reporting information will be incorporated into the SCAG 2020 RTP/SCS & FTIP.

Data Requirements for PM3 Calculation

The NPMRDS is the FHWA preferred data source for obtaining performance information for several of the NHS Performance, Freight, & CMAQ Program measures, including:

- **Percentage of Interstate system providing for reliable travel times**
- **Percentage of non-Interstate NHS providing for reliable travel times**
  - **Data Required:** Travel times for all traffic (NPMRDS), length of segments (NPMRDS), average vehicle occupancy (FHWA), & annual traffic volume (NPMRDS/HPMS conflation).
- **Truck Travel Time Reliability (TTTR) Index**
  - **Data Required:** Travel times for trucks (NPMRDS), length of segments (NPMRDS).
- **Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita**
  - **Data Required:** Travel times for all traffic (NPMRDS), length of segments (NPMRDS), vehicle classification data (NPMRDS/HPMS conflation), annual vehicle occupancy factors (FHWA), hourly volume estimation, posted speed limit, Urbanized Area population.

National Performance Management Research Data Set (NPMRDS)

- NPMRDS is a monthly archive of average travel times, reported every 5 minutes when data is available, on the National Highway System.
- Travel times are based on vehicle probe-based data.
- Separate average travel times are included for “all traffic”, freight, & passenger vehicles.
- FHWA provides access to the NPMRDS to State DOTs & MPOs to conduct their MAP-21 performance management activities.
- Average travel times have been collected monthly since July 2013.

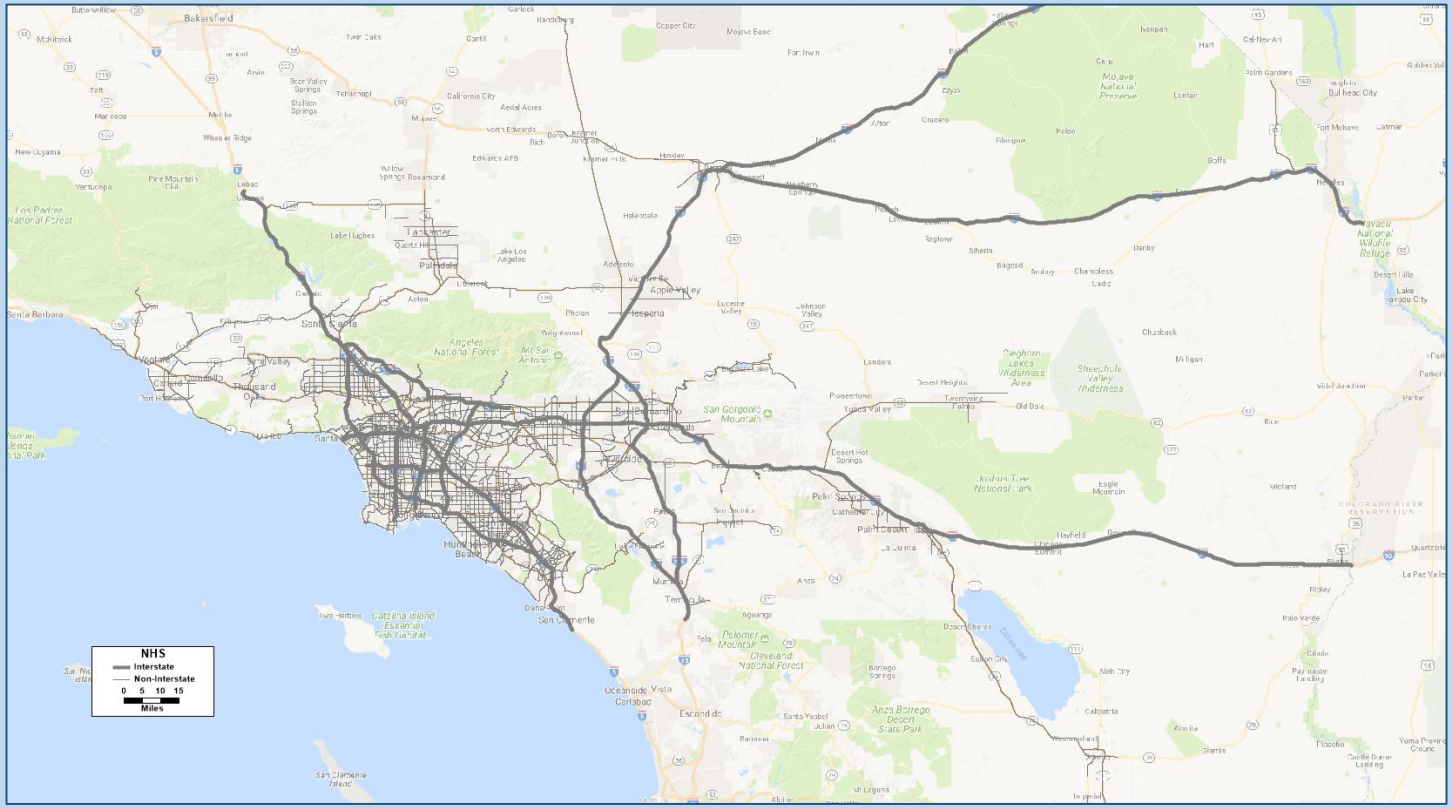
National Performance Management Research Data Set (NPMRDS)

- The most recent version of the NPMRDS includes information fields conflated from HPMS, including functional system, facility type, route number, & Annual Average Daily Traffic (AADT).
- Data for SCAG region:
  - Total 20,589 TMCs (about half of CA total)
  - 30~40 GB for 15 minute data for one year (60+ GB for 5 minute data)

NPMRDS Data

tmc_code	measurement_tstamp	speed	average_speed	reference_speed	travel_time_minutes	data_density
106+12381	10/1/2017 0:15	28.8	14	47	2.69	A
106+12381	10/1/2017 1:00	8.24	15	47	9.41	A
106+12381	10/1/2017 1:15	33	15	47	2.35	A
106+12381	10/1/2017 4:15	34	15	47	2.28	A

TMC	F_SYSTEM
TMCTYPE	URBAN_CODE
ROADNUMBER	FACILTYPE
ROADNAME	STRUCTYPE
ISPRIMARY	THRULANES
FIRSTNAME	ROUTE_NUMB
TMCLINEAR	ROUTE_SIGN
COUNTRY	ROUTE_QUAL
STATE	ALTRTENAME
COUNTY	**AADT**
ZIP	**AADT_SINGL**
DIRECTION	**AADT_COMBI**
STARTLAT	NHS
STARTLONG	NHS_PCT
ENDLAT	STRHNT_TYP
ENDLONG	STRHNT_PCT
MILES	TRUCK
FRC	
BORDER_SET	



Data Analysis Procedure

- Data Download: Monthly data for SCAG region
  - Monthly download to avoid data download exceed 4 GB
- Parallel Data Manipulation & Statistics with R:
  - Data split to each TMC & combine monthly into yearly data
  - For each TMC, do speed & travel time statistic for each Time of Day
  - Aggregate Statistic for all TMCs
- Join conflated 2015 HPMS & Apply PM3 assumptions for AOC & others
- Calculate Travel Time Reliability, Truck Travel Time Reliability, & PHED for each TMC
- Format metrics results in HPMS format & Summary PM3 performance measures

MAP-21 Travel Time Performance Metrics

Required fields in HPMS report:

- Conflated HPMS information
- LOTTR & 50% & 80% Travel time for all TMCs based on all vehicle travel time
- TTTR & 50% & 95% Travel time for all TMCs based on truck travel time
- PHED for all TMCs in Urbanized Area based on all vehicle travel time

Year_Record	LOTTR_AMP	TTTR_AMP
State_Code	TT_AMP50PCT	TTT_AMP50PCT
Travel_Time_Code	TT_AMP80PCT	TTT_AMP95PCT
F_System	LOTTR_MIDD	TTTR_MIDD
Urban_Code	TT_MIDD50PCT	TTT_MIDD50PCT
Facility_Type	TT_MIDD80PCT	TTT_MIDD95PCT
NHS	LOTTR_PMP	TTTR_PMP
Segment_Length	TT_PMP50PCT	TTT_PMP50PCT
Directionality	TT_PMP80PCT	TTT_PMP95PCT
DIR_AADT	LOTTR_WE	TTTR_WE
	TT_WE50PCT	TTT_WE50PCT
``LOTTR & TTTR``	TT_WE80PCT	TTT_WE95PCT
		TTTR_OVN
PHED		TTT_OVN50PCT
OCC_FAC		TTT_OVN95PCT
METRIC_SOURCE		

Starting in 2018 & annually thereafter, State DOTs must report the PM3 metrics, in accordance with HPMS Field Manual, by June 15th of each year for the previous year's measures.

Travel-Time Based Performance Measures

- **Travel Time Reliability measures for carrying out the National Highway Performance Program (NHPP) :**
  1) Percent of person-miles traveled on the Interstate system that are 'Reliable'
  2) Percent of person-miles traveled on the non-Interstate NHS that are 'Reliable'
- **One Freight Reliability measure to assess freight movement on the Interstate**
  1) Truck Travel Time Reliability (TTTR) Index
- **Two performance measures to assess traffic congestion for CMAQ program :**
  1) Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita
  2) Percent of Non-Single Occupancy Vehicle Travel

Travel Time Reliability

- 80th percentile Travel Time for all vehicles for each Time period
- 50th percentile Travel Time for all vehicles for each Time period
- LOTTR for each Time period: 80th percentile Travel Time divided by 50th percentile Travel Time
- If LOTTR for all time period is smaller than 1.5, it is considered to be reliable
- Percentage of 'reliable' person miles of travel on the interstate system & non-interstate system is calculated as:

$$\text{IS\_TT\_Reliability} = \frac{\sum_{r=1}^{RI} (SL)_r \times [\text{DIR\_AADT}]_r \times (\text{number of days in the data year}) \times [\text{OCC\_FAC}]_r}{\sum_{r=1}^{IS} (SL)_r \times [\text{DIR\_AADT}]_r \times (\text{number of days in the data year}) \times [\text{OCC\_FAC}]_r} \times 100$$

$$\text{NON\_IS\_TT\_Reliability} = \frac{\sum_{r=1}^{RN} (SL)_r \times [\text{DIR\_AADT}]_r \times (\text{number of days in the data year}) \times [\text{OCC\_FAC}]_r}{\sum_{r=1}^{NIN} (SL)_r \times [\text{DIR\_AADT}]_r \times (\text{number of days in the data year}) \times [\text{OCC\_FAC}]_r} \times 100$$

Truck Travel Time Reliability

- 95th percentile Truck Travel Time for each Time period
- 50th percentile Truck Travel Time for each Time period
- Truck Travel Time Reliability (TTTR) for each Time period is calculated by 95th percentile Travel Time divided by 50th percentile Travel Time
- Index of Truck Travel Time Reliability for a region is calculated as:

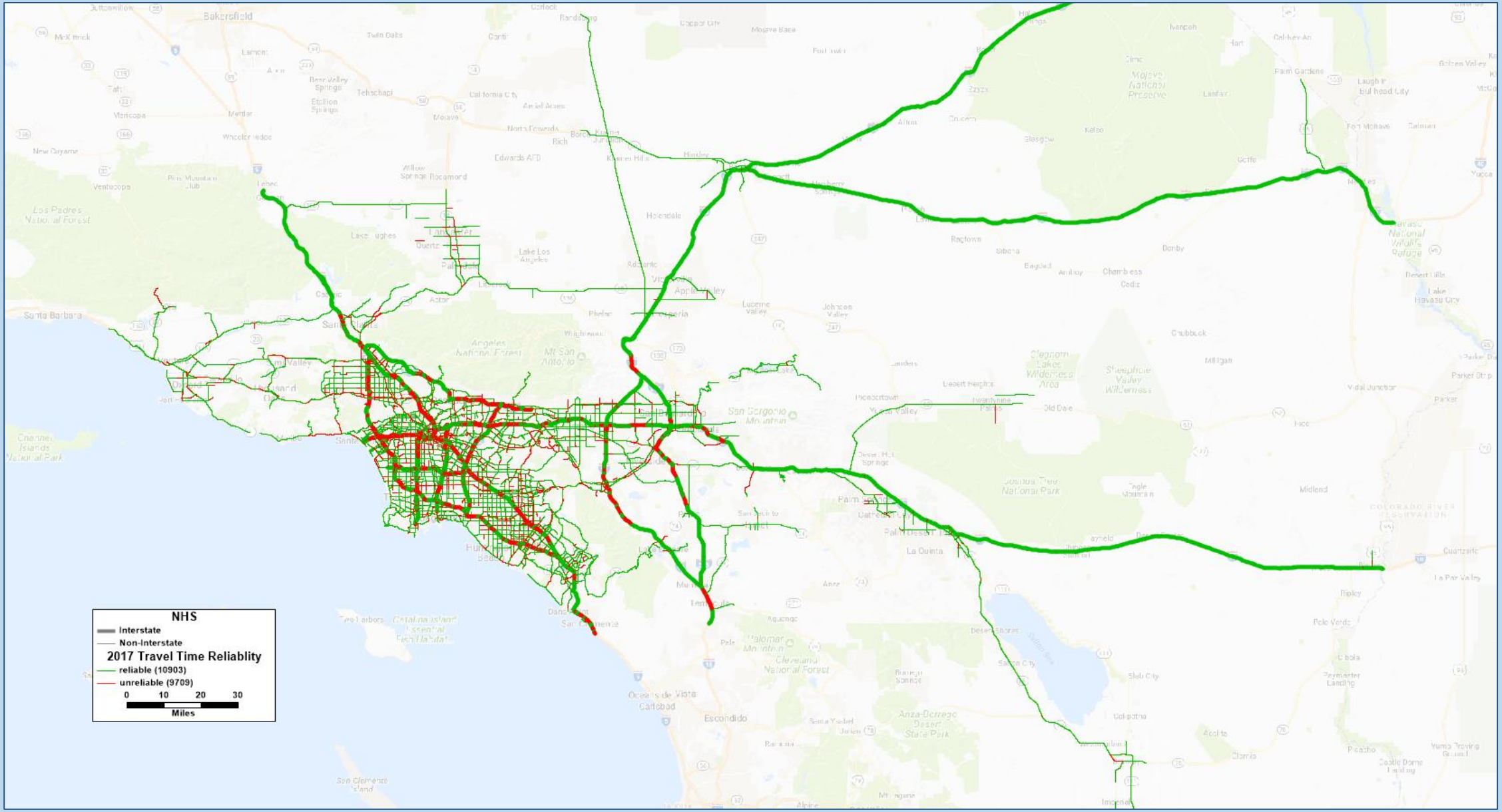
$$\text{TTTR\_Index} = \frac{\sum_{r=1}^{IS} (SL)_r \times \mathbf{max}([TTTR\_AMP]_r, [TTTR\_MIDD]_r, [TTTR\_PMP]_r, [TTTR\_OVN]_r, [TTTR\_WE]_r)}{\sum_{r=1}^{IS} (SL)_r}$$

Peak Hour Excessive Delay (PHED)

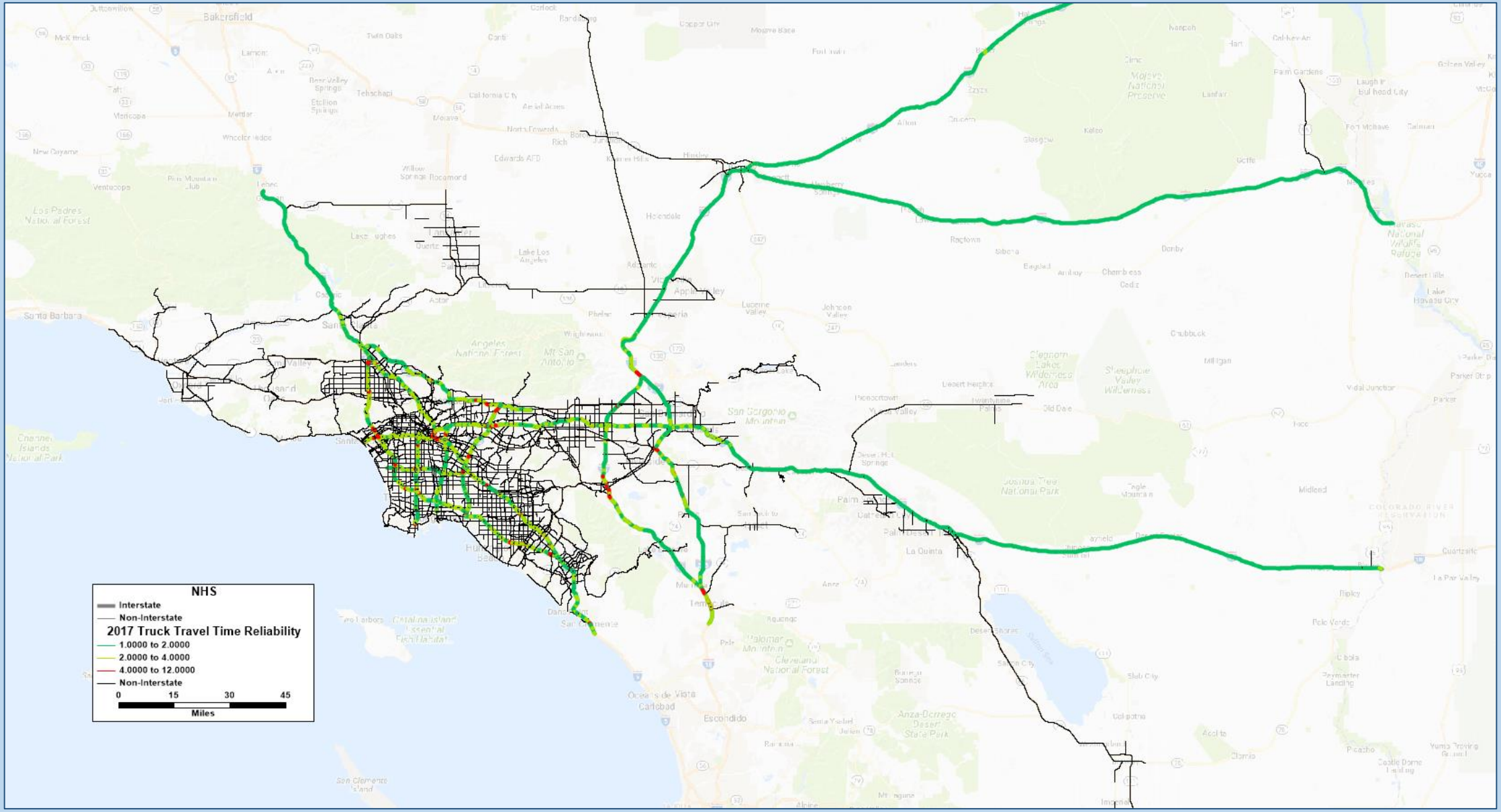
- PHED is calculated for segments within designated 'Urbanized Areas' for weekdays between 6-10am & 3-7pm
- Annual total person hours of travel time in excess of the threshold travel time determined by the larger of 20 mph or 60% of posted speed limit
- Annual Hours of Excessive Delay per Capita:

$$\text{PHED\_Measure} = \frac{\sum_{r=1}^{U} [\text{PHED}]_r}{\text{UZA\_Population}}$$

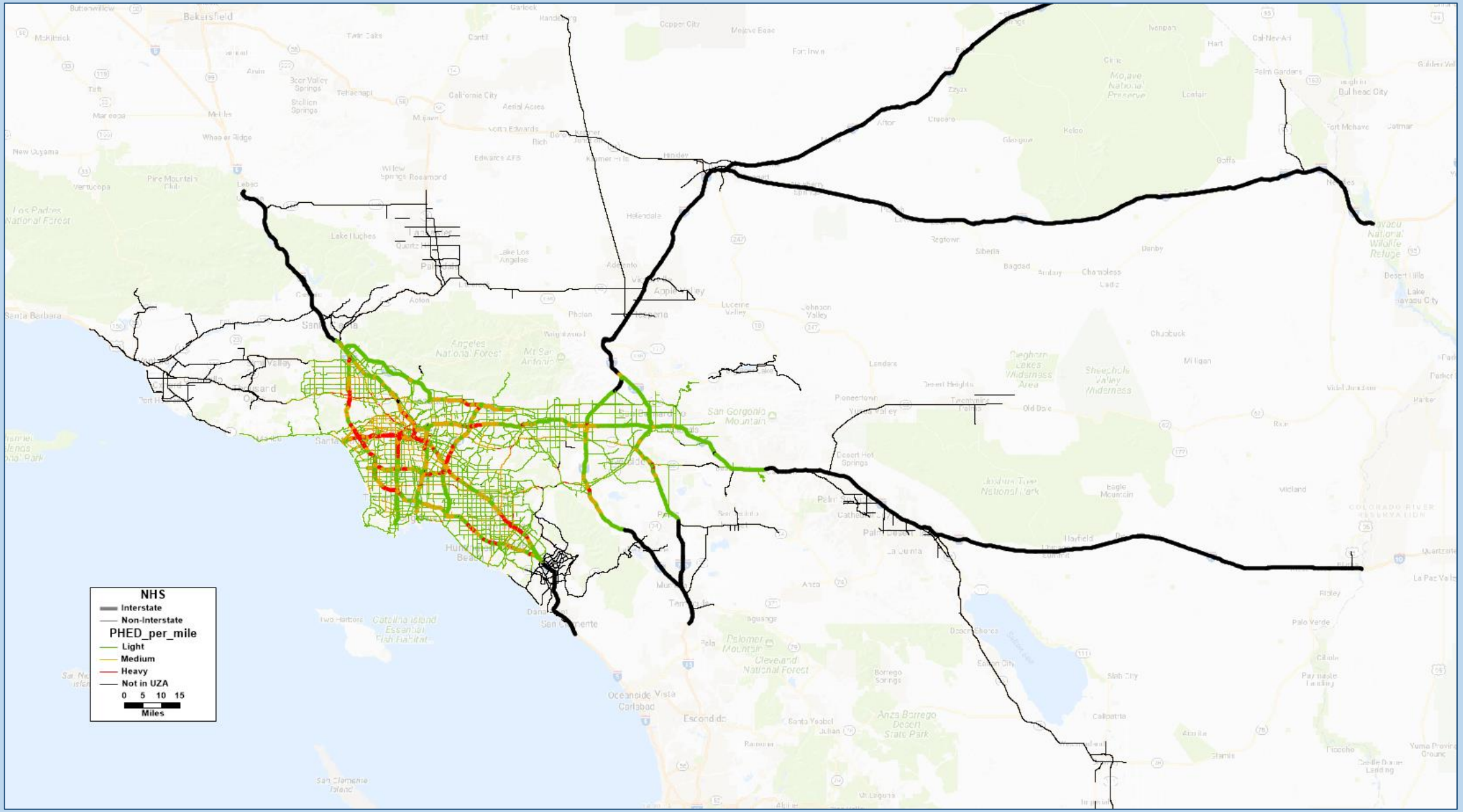
Travel Time Reliability: 2017



Freight Reliability: 2017



Peak Hour Excessive Delay: 2017



SCAG PM3 Performance Measures

Performance Measure	2017 Baseline
Percent of person-miles traveled on the Interstate system that are 'Reliable'	59.3%
Percent of person-miles traveled on the non-Interstate NHS that are 'Reliable'	68.7%
Truck Travel Time Reliability (TTTR) Index	1.71
Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita (Los Angeles/Long Beach/Anaheim)	51.7 Hours
Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita (Riverside/San Bernardino)	16.3 Hours

Draft Statewide PM3 Targets

Performance Measure	2017 Baseline	2-Year Target	4-Year Target
Percent of the person-miles traveled on the Interstate that are Reliable	64.6%	65.1% (+0.5%)	65.6% (+1.0%)
Percent of person-miles traveled on the non-Interstate NHS that are Reliable	73.0%	N/A	74.0% (+1.0%)
Truck Travel Time Reliability (TTTR) Index	1.69	1.68 (-0.01)	1.67 (-0.02)
Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita (Los Angeles/Long Beach/ Anaheim)	51.7 Hours	N/A	51.2 (-1.0%)
Annual Hours of Peak Hour Excessive Delay (PHED) Per Capita (Riverside/San Bernardino)	16.3 Hours	N/A	16.1 (-1.0%)

Thank You!

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