

# Highway Capacity Manual Methodologies for Corridors Involving Freeways and Surface Streets

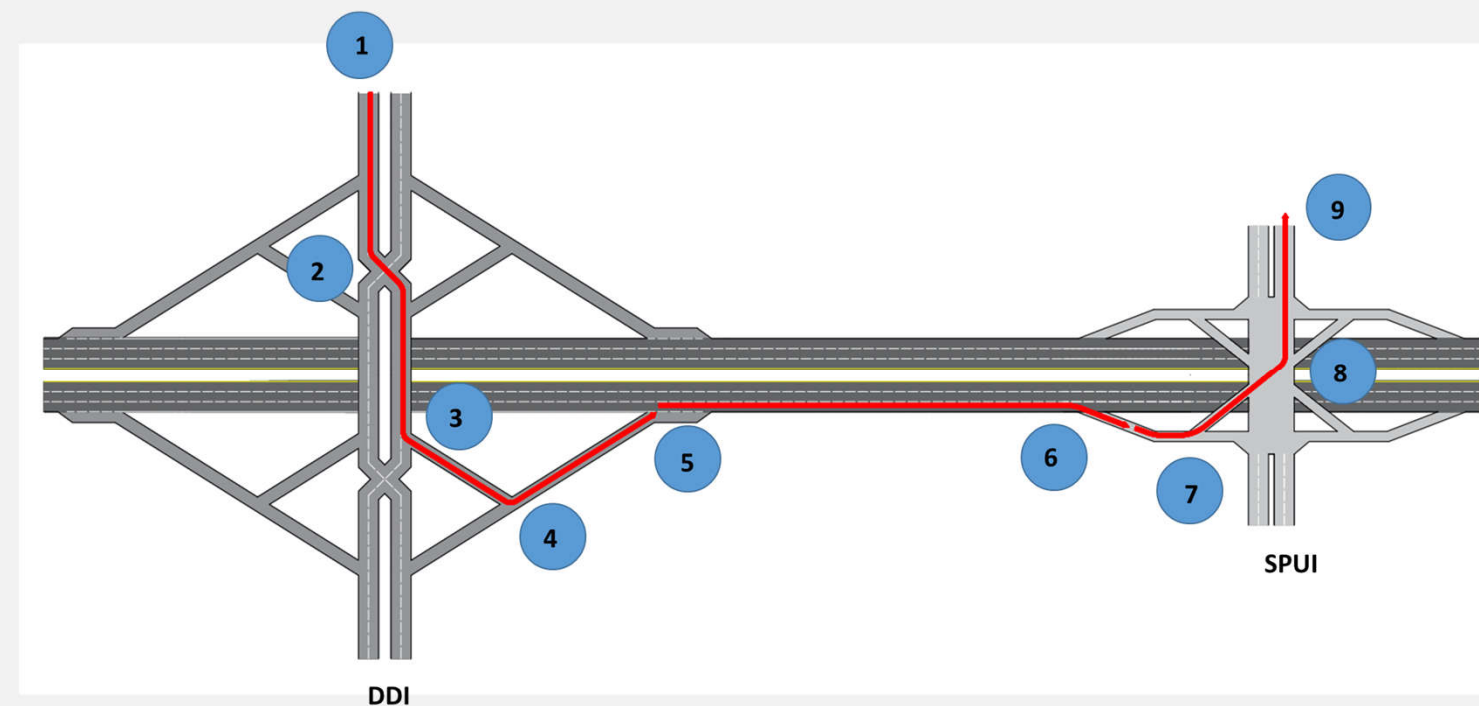
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 1. University of Florida; 2. Cambridge Systematics.

## INTRODUCTION

- HCM is a strong reference on individual analysis of freeway and urban streets (facility based), however it does not address interaction effects between these facilities;
- Increasing interest in corridor level analysis from agencies and municipalities;
- Lack of a methodology for performance of corridors with multiple adjacent facilities;
- Microsimulation is still the state-of-practice for corridor analysis, but it is time-consuming and expensive.

## OBJECTIVES

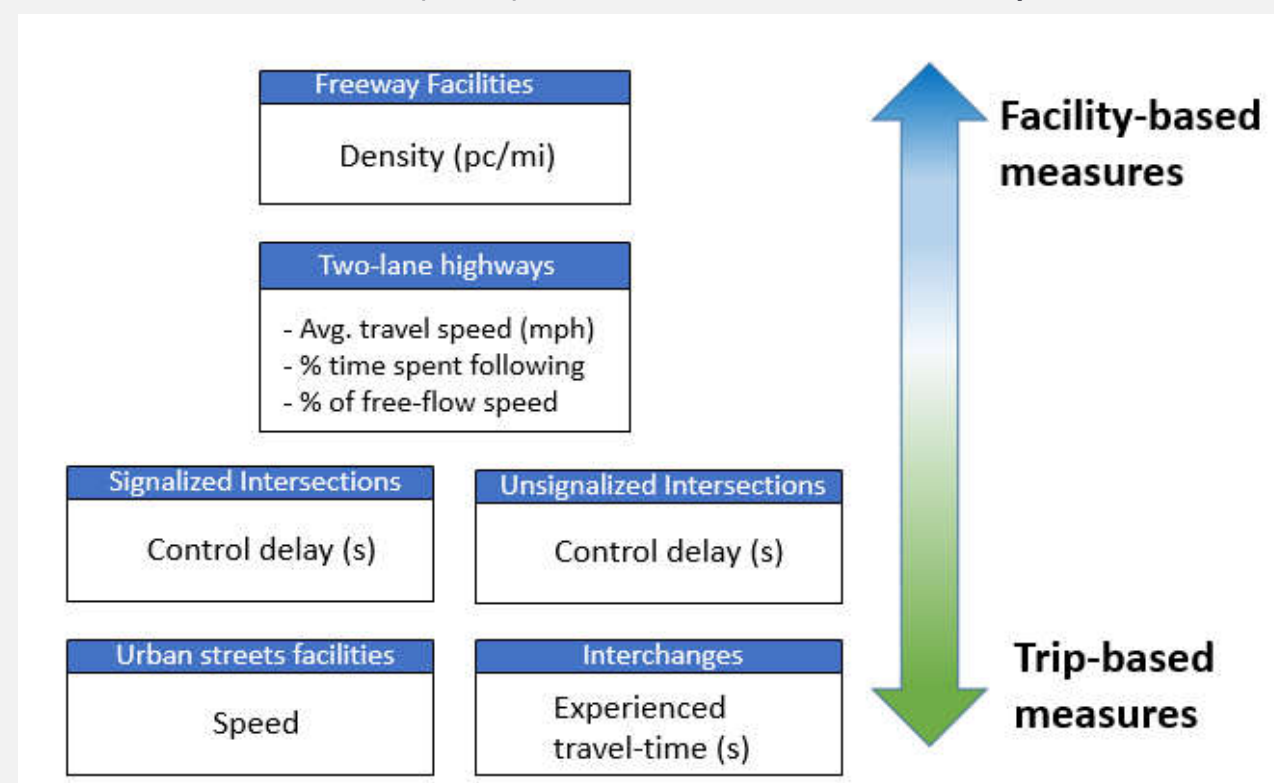
- Develop a set of common performance measures to evaluate corridors with different facilities;
- Provide methods to evaluate the quality of trip as perceived by the user;
- Integrate the existing HCM methodologies for different facilities;
- Evaluate how congestion propagates from one facility to another (queue spillback).



Sample corridor with defined origin and destination and multiple facilities

## REVIEW OF HCM METHODS

- Different Level of Service (LOS) criteria for each facility:



Representation of LOS criteria for HCM facilities

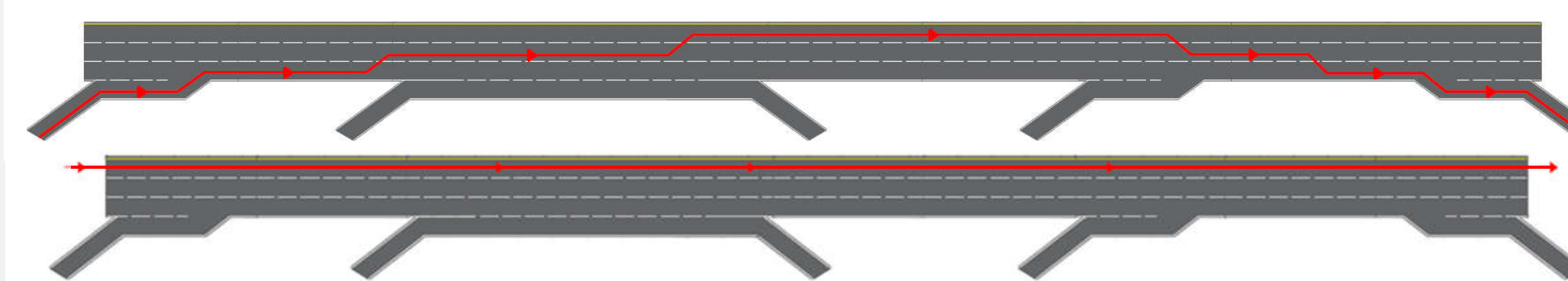
- Interface between adjacent facilities is not addressed by current method: *what are the impacts when congestion propagates from one facility to another?*
  - Queue spillback from freeways into urban streets;
  - Queue spillback from urban streets into freeways.
- Only one LOS range (F) is used to define congested conditions, which does not accurately represents how user evaluate the quality of trip.

## RECOMMENDED PERFORMANCE MEASURES

- A mix of facility-based and trip-based measures must be considered for a full system analysis
- Travel-time based measures, including Travel Time Reliability, are considered the most suitable for evaluating the quality of trips:

$$\text{Travel Time Index} = \frac{\text{Actual travel time}}{\text{Free-flow travel time}}$$

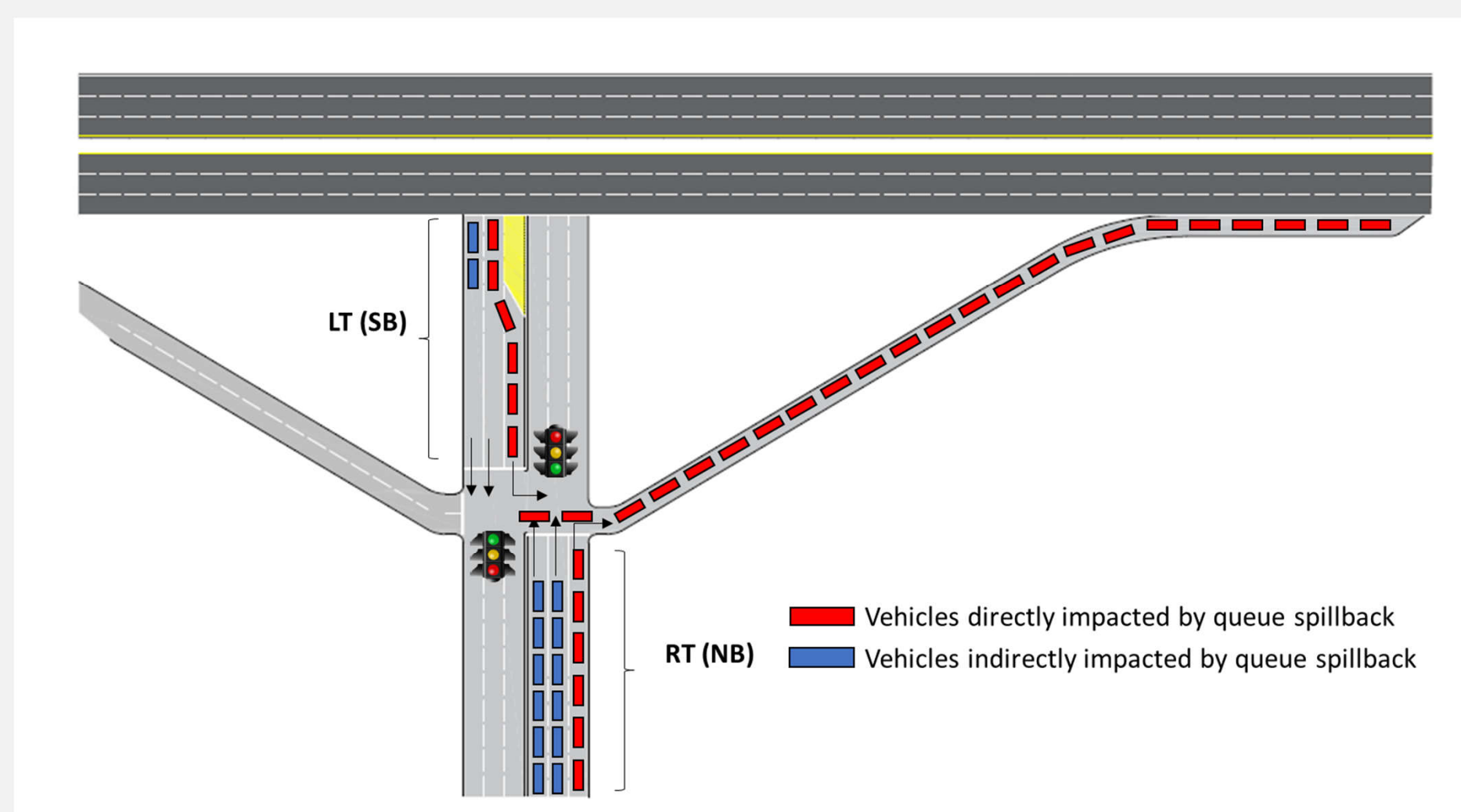
- Lane speed variability must be considered, since the set of lanes used in a trip varies according to a series of factors, to be investigated during data collection:
  - Lane speed / flow variability
  - Facility length / user distance from entry/exit points
  - Presence of a queue spillback into freeway / work zones / lane closures



How different would travel times be between the two routes through the same facility?

## METHODOLOGY ADJUSTMENTS

### IMPACT OF QUEUE SPILLBACK FROM FREEWAYS INTO URBAN STREETS



Impact of an onramp queue spillback into a typical diamond intersection

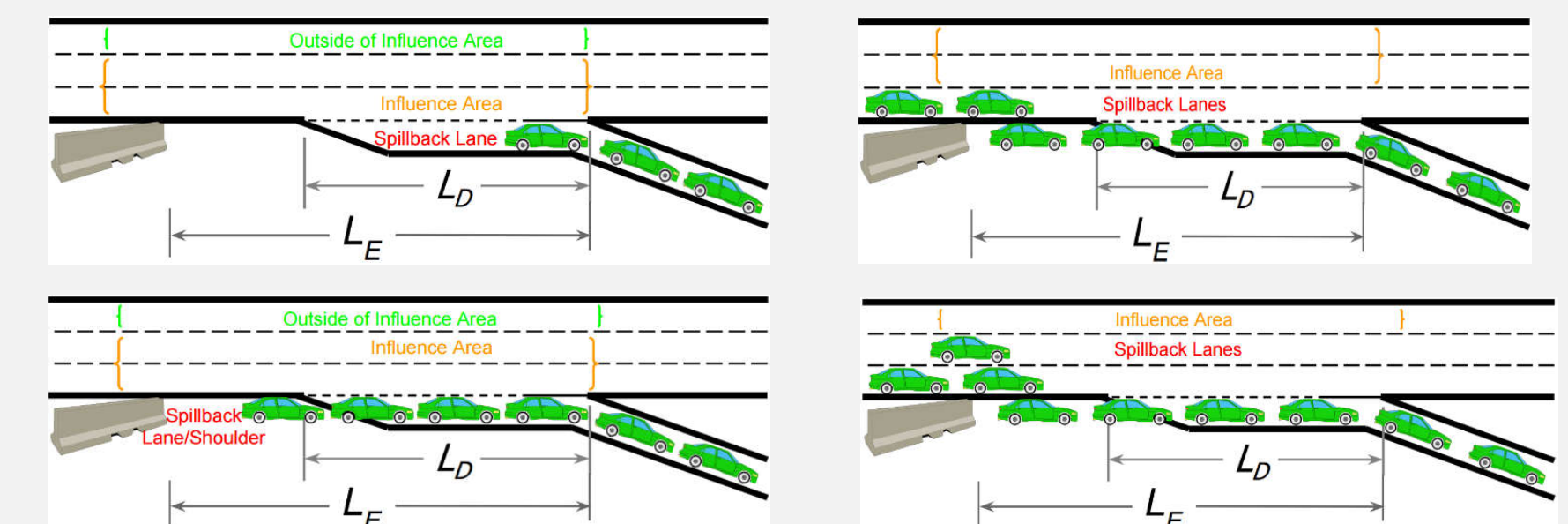
Adjustment of effective green time ( $g'$ ) on upstream intersection, as function of:

- Number of affected lane groups
- Cycle phasing
- Discharge rate at freeway x arrival rate at the intersection movements
- Possibility of intersection blockage
- Turn bay overflow

## METHODOLOGY ADJUSTMENTS

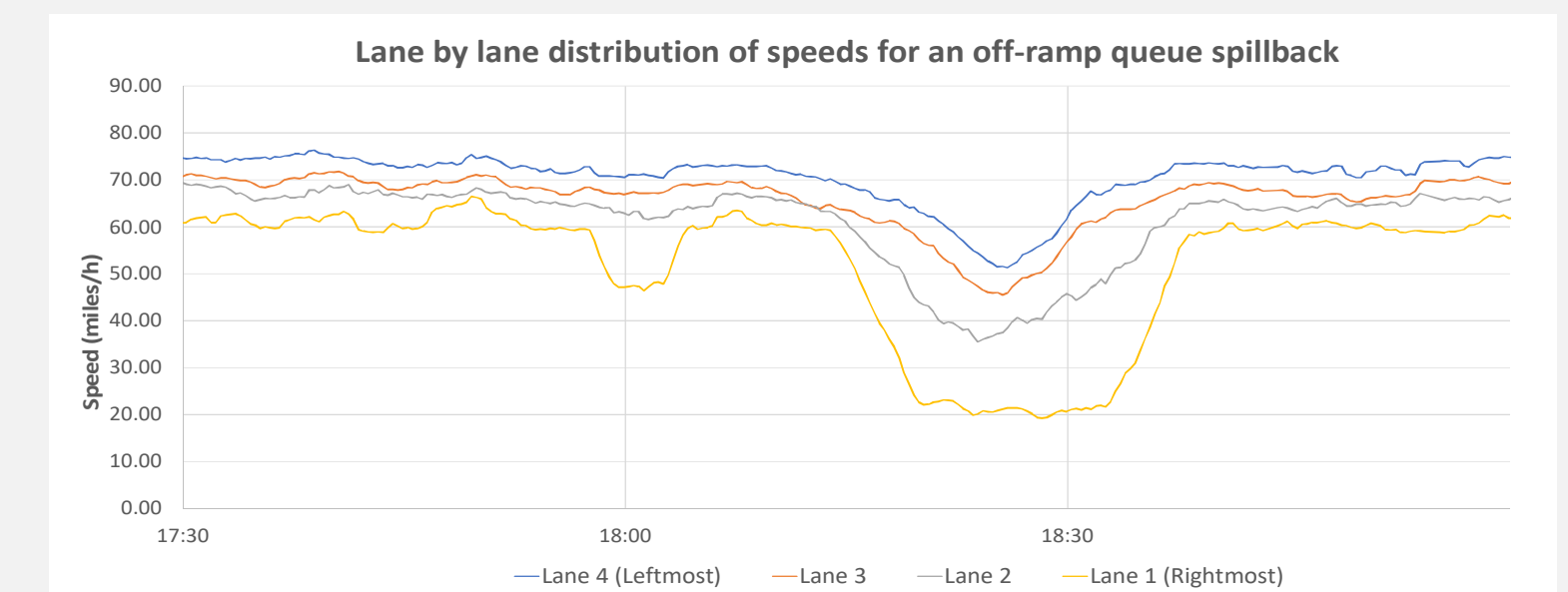
### IMPACT OF QUEUE SPILLBACK FROM URBAN STREETS INTO FREEWAYS

- Capacity on diverge segments is reduced, as function of:
  - Number of lanes outside influence area
  - Queue length
  - Driver aggressiveness



Proposed spillback regimes for queue spillback into freeways (source: ARMSTRONG)

- Impacts of queue spillback are different for each freeway lane



Sample observation of speeds during off-ramp congestion (I-295, Jacksonville/FL)

## CONCLUSIONS

- Trip-based measures are a logical step in evolution of HCM, and its relevance tends to grow rapidly as more data becomes accessible from new technologies (GPS data, connected/autonomous vehicles, etc);
- An appropriate evaluation of how congestion propagates between adjacent facilities is essential for an effective corridor performance evaluation;
- Data will be collected to validate and calibrate the proposed adjustment to the methodology.

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## CONTACT INFORMATION

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