ARTICLE 5

Traffic Engineering Performance Assessment

General Guidance:

A. Objectives/Requirements

The responsible-charge engineer shall consult with the Functional Managers identified below in order to estimate the scope and magnitude of the Traffic Engineering studies (i.e. Travel Forecasting; Traffic Analysis; Infrastructure Evaluation; Warrant Analysis; and, Safety Review) that need to be performed during the Project Approval & Environmental Document phase.

These "studies" produce estimates of the operational and safety performance of:

- The proposed "base design" (i.e. plans for new, modified or reconstructed infrastructure)
- Specific traffic elements, devices, features and systems that may cost-effectively enhance performance; or (when added to the scope) will prevent the emergence of a safety / operational performance problem (i.e. hot spots)

These performance estimates are ultimately used to:

- Demonstrate if, and quantify how the proposed investment will meet the project Purpose and Need statement
- Produce a complete scope of work by identifying the need and value (Benefit / Cost) for including key traffic control, safety, operational, and management systems, features and devices
- Support critical engineering decisions (e.g. decisions to create or retain a nonstandard geometric design feature)

FUNCTIONAL MANAGERS (Print names; signature not required)

Division of Planning:

Travel / Traffic Forecasting Manager _____(Print Name)_____ Date _____

Division of Traffic Operations

Freeway or Highway Operations Engineer _____ Date _____
Traffic Electrical (ITS) Engineer _____ Date _____
Traffic Safety Engineer * _____ Date _____

Two consultation meetings are recommended:

1. With Travel Forecasting Manager and the appropriate District Operations Engineer
2. With the District Operations, Electrical (ITS) and Traffic Safety Engineers*

* Note: The District Traffic Safety Engineer will provide the required written assessment of performance data, infrastructure and operating conditions. This assessment will identify, or be used to identify the scope and magnitude of the formal safety analysis, which will be a component of the eventual Traffic Analysis (Report).

B. Overview:

Project-related traffic engineering studies produce findings and estimates related to the operational and safety performance of existing and proposed highway infrastructure. These performances related findings and estimates are derived from the:

- Analysis of traffic, collision and performance data *and forecasted* traffic volumes
- Evaluation of existing infrastructure to identify deficiencies and/or omissions
- Evaluation of the proposed infrastructure, including geometric design and traffic features or elements (i.e. traffic control, operational, management and safety devices, systems and features).

Performance-related findings and estimates provide the basis for project scoping and design decisions. Ultimately, formal traffic engineering studies inform and advise the PDT as to whether the project scope is complete, and whether the scope will meet the project "purpose and need."

To meet the purpose of the PSR-PDS, the preliminary traffic engineering studies should be limited to an *assessment* of readily available information and data, and macro-level analysis and evaluation. This effort will produce preliminary traffic engineering findings and estimates to inform and advise the PDT on:

- The potential scope of work and features (especially the traffic "elements" referenced above)
- Potential performance benefits and deficiencies
- The scope and magnitude of traffic engineering work (traffic forecasting, modeling, analysis and evaluation) to be performed during the Project Approval and Environmental Document phase

The traffic engineering effort performed during PA & ED will further define the scope of work and produce reliable estimates of the operational and safety impacts (benefits and dis-benefits) of the proposed highway infrastructure.

The information, questions, checklists and report template provided below are intended to guide and advise the engineer and/or traffic analyst who is responsible for the performance and documentation of the traffic engineering assessment.

A summary of the assessment and key findings and estimates should be summarized or incorporated into the PSR-PDS document (see Section F).

C. General Approach & Objective

At the PSR-PDS PID stage, the traffic forecasting activities and tasks should utilize readily available information and traffic models. At this stage of the project development process, it is not intended that effort be devoted to the generation of traffic data and to updating of traffic models. The intent is to utilize existing data, transportation reports, and performance monitoring systems describe and identify in the following sections a general description of the existing traffic and forecasted traffic. Consult with the District Local Development-Intergovernmental Review Planner for applicable local agency studies of land development proposals.

A macro-level analysis or assessment of the infrastructure, operating conditions, and traffic volume, collision and performance data should produce an estimate of performance impacts (benefits and disbenefits) on the subject highway segment, corridor or system.

The primary objective is to identify the traffic forecasting and traffic engineering studies needed to analyze, evaluate, and more accurately predict or estimate operational and safety performance of the proposed improvements. This is necessary for the preparation of the environmental determination/document; and to ensure that a complete project scope is considered and identified during the project approval phase.

D. The Project Approval and Environmental Document (PA&ED) Traffic Engineering Study

Objectives:

Ultimately, traffic forecasting and traffic analysis identifies operational and safety performance deficiencies and impacts (needs), and a reliable estimate of how the improved highway infrastructure will perform. This allows for a determination as to whether the scope is adequate, whether the project "purpose and need" will be met, and the cost-effectiveness of the investment. Specifically, the function of the formal traffic study is to:

1. Identify performance deficiencies - both existing and potential - based on the review, evaluation and analysis of:
   - Infrastructure (current and proposed)
   - Operating conditions
   - Traffic, collision and performance data

2. Predict and/or estimate the operational and safety performance of proposed highway geometric designs (for new infrastructure)

3. Predict and/or estimate the operational and safety performance impacts (i.e. benefits and disbenefits) of specific modifications to existing highway infrastructure or a base design; for example:
   - The performance of an intersection should improve when a left turn lane is added to the base design
   - The performance of a freeway entrance ramp merging operation during periods of heavy demand should improve when metering is employed

4. Quantify the impact (benefits and disbenefits) of proposed infrastructure reconstruction, expansion, modification, etc. on the operational and safety performance of a highway segment, corridor or system

Content:

A formal traffic engineering study requires and/or is comprised of the following major components:

- Traffic Forecasting / Modeling
- Traffic Analysis

- Operational Analysis (includes capacity analysis)
- Safety Analysis

- Evaluation of highway infrastructure and operating conditions (e.g. the impact of queuing and unstable flow on adjacent segments, traffic movements, access points and safety)

E. Screening

To help estimate the scope and magnitude of the (future) traffic engineering study, the project engineer responsible for the PSR-PDS and key Functional Managers should jointly review the following "checklists" to discuss /decide their applicability to the specific PSR-PDS.

1. Forecasting / Modeling Requirements, Considerations and Assumptions

- Use Local Model?
- Update Model
- New Model
- Existing Traffic Counts
- New Traffic Counts
- Historical Growth
- General Plan (GP) Buildout
- Pro-Rate GP Growth
- Existing Year ( )
- Design Year ( )
- Interim Year ( )

2. Preliminary Scope of Work (Traffic Elements / Features / Systems / Plans)

Based on a review and evaluation of performance data, and the existing and future Infrastructure and operating conditions, the project engineer and appropriate functional managers should meet to review the following list of traffic operational, control, management and safety systems, devices, features and strategies (i.e. *traffic elements*).

The preliminary scope of work should reflect the need to include ***traffic elements*** as they relate to the Purpose & Need, or compliance with traffic engineering policy or system performance requirements.

The preliminary list of ***traffic elements*** will facilitate the development of a ballpark estimate for construction, right of way, and Maintenance & Operation costs. More importantly, the preliminary list will identify ***elements*** for which traffic analysis or some other traffic engineering support activity is required to determine the engineering need for their inclusion in the scope based on *warrant* analysis, *benefit/cost* analysis, and *safety* analysis.

a. Major Traffic Control Devices

- Overhead sign structures
- Changeable Message Signs (especially overhead)
- Sign Gantries (for Active Traffic Management)

b. Operational Features / Treatments / Systems

- Auxiliary Lanes
  - Channelization lanes
  - Speed change lanes
- Acceleration lanes
- Deceleration lanes
- Slow moving vehicle lanes
- Ramp "braiding"
- Median and Traffic Islands / Channelizers
- Intersection Control Strategies / Systems
  - Yield Control / roundabouts
  - Signalization
  - All Way Stop Control
  - Pedestrian Crossing Devices / Systems

c. Traffic Management Strategies and Systems

- Managed Lanes (Express or HOV lanes)
- Ramp Metering Systems
- Changeable Message Signs
- Detection Systems
- Communication Networks / Hardware
- Highway Advisory Radio
- Closed-Circuit TV cameras
- Park & Ride Lots

d. Safety Systems / Devices / Strategies

- Roadside / Roadway Departure Systems and Treatments
  - Median Barrier Systems
  - Guardrail Systems
  - Clear Zone Enhancements (e.g. slope flattening, tree removal, etc)
- Glare Screen
- Lighting
- Truck Escape Ramps
- Fencing
- Intersection Traffic Control Systems
  - Roundabouts (yield control)
  - Signalization
  - All Way Stop Control
  - Beacons
- Real-Time (Intelligent) Warning Sign Systems
- Left-turn and right-turn channelization
- Acceleration and Deceleration Lane extensions (via auxiliary lanes)
- Pavement Surface Treatments (OGAC, grooving, etc.)
- Drainage System Enhancements
- Severe Weather Detection & Warning Systems for Ice /Fog / Wind

e. Transportation Management Planning (related to construction phase)

- Construction Staging
- Full Closure (review Checklist or consult with Dist Traffic Manager)
- Strategies (analysis needed to determine which to employ)

f. EXAMPLES: (how to use checklist to identify scope of work and Traffic Analysis):

- The decision to provide a freeway auxiliary lane to extend the acceleration lane and improve the ability of drivers to find a suitable gap into which they can merge shall be based on Traffic Analysis findings related to the operational and safety benefits during peak periods and peak "shoulders." The analysis shall consider the density of mainline lanes, the percentage of trucks, ramp volumes, the presence of ramp metering and if it can be effectively operated during peak periods, etc. Therefore, this type of Traffic Analysis needs to be planned for project proposals which intend to add a new interchange, expand the capacity of an existing interchange, or simply allow more vehicles to enter the mainline during critical periods of operation.

- Similarly, Traffic Analysis must be planned to determine the need for, and selection of the optimum form of intersection traffic control at each new or affected interchange ramp termini. In most cases: the interchange configuration, the width of overcrossing or undercrossing structures, and right of way requirements will be based directly on the form of intersection control and the cross-section of approach roadways. Therefore, the Traffic Analysis performed to support the selection of a traffic signal or a roundabout (yield control) will have a significant impact on the scope, cost, right of way, and environmental impacts.

- RE: Freeway widening proposals -- The need for, and selection of the treatment to mitigate the affect of headlight glare on the operational and safety performance of drivers during the hours of darkness will be based on Traffic Analysis findings regarding impacts and benefits produced by the installation of glare screen or lighting (especially through horizontal curves at which Stopping Sight Distance can be impacted by the installation of glare screen)

3. Traffic Analysis

The following list identifies specific performance measures, infrastructure components (operational, safety and management features, systems and devices), traffic movements, conflicts, etc. for which Traffic Analysis is typically performed or required.

Most traffic analysis relates directly to the operational and safety performance of access points and highway segments that are directly affected by the location, spacing and type of access opening. The capacity and performance of any highway corridor is affected and often limited by the capacity of access points, such as: conventional at-grade intersections, freeway merges and diverges, HOV lane access openings, and the weaving that occurs between adjacent access points.

a. Operational & Capacity Analysis

- Mainline LOS (capacity analysis)
- Ramp Merge and Diverge LOS
- Weaving analysis
- Ramp terminal intersection LOS
    - Exit Ramp storage / queue analysis
- Interchange / Local System network analysis
- Ramp Metering System analysis
    - Interchange specific
    - Corridor-wide
- Managed Lane (HOV Lanes, Express Lanes, Transit Only Lanes, etc.) analysis
- Intersection Control Alternatives Analysis
    - Signal warrant analysis
    - Yield Control / Roundabout performance analysis
    - All-Way Stop Control
- Conventional Intersection Analysis
    - Capacity analysis (to determine number of through lanes and channelization)
    - Delay studies
    - Queuing and channelization storage analysis
    - Network analysis

b. Safety Study / Analysis

Based on a review and assessment of collision data, rates, trends and safety performance management and monitoring reports; and an evaluation of existing and proposed (future) infrastructure and operating conditions (and other relevant technical data and information), the District Safety Engineer will estimate the scope and magnitude of the formal (future) safety study / analysis.

This assessment will quantify the safety "need" within the highway segment or corridor, upon which a specific form of engineering analysis and evaluation will be recommended and estimated (e.g. Safety Audit, Safety Analysis and/or Safety Review).

- The future safety study will be performed by, or under the direction of the District Traffic Safety Engineer.
- Safety Analysis shall be focused on the evaluation of off-peak and "shoulders" of the peak period when speeds are highest and environmental factors (darkness and glare) affect driver performance.

c. Other Analysis

- Project & Construction Staging (mostly during design phase)
- Traffic Management Planning
    - Lane Closures
    - Full Closure Traffic Studies (consult with District Traffic Manager)
- Special Truck Studies

F. TEMPLATE - Documentation of the Traffic Engineering Performance Assessment

PROJECT PROPOSAL IDENTIFICATION (required if this document will **not** be attached to PSR-PDS)

1. District – County –Route – Limits:
2. Facility Type:
3. Project Type (new facility, increase capacity, increase access, expand access, congestion management, safety):
4. Targeted System User (motor vehicles, transit, bicyclists, pedestrians):
5. Key Transportation Agencies (MPO, RTPA, County, Cities):
6. Context (rural, urban, suburban):
7. Project Manager:

SUMMARY OF PRELIMINARY FINDINGS & RECOMMENDATIONS

Assessment Approach, Data Sources & Major Assumptions

- Forecasted Traffic Volumes & Conditions
- Modeling Tools / Methodologies
- Traffic Analysis
  - Operational / Capacity
  - Safety

Preliminary Assessment Findings (regarding operational and safety performance)

- Operational Deficiencies
- Infrastructure Deficiencies
- Infrastructure Omissions
- Assessment of Safety Performance / Needs
- Project Scope: Recommended or Required Features, Systems, Devices
  - Operational Features
  - Safety Systems
  - Traffic Control Systems
  - Traffic Management Systems

Include a general description of the operational performance deficiencies and needs for which operational features should be required (e.g. auxiliary lanes, overhead signs, intersection control strategies etc.). Also discuss traffic management systems and elements (e.g. ramp metering, CMS, HOV lanes, etc.) to be incorporated. Discuss any strategies or components of the traffic management system that may be controversial during development of the environmental determination/document (e.g. the addition of tolling to an existing HOV lane).

SCOPE OF FUTURE TRAFFIC ENGINEERING STUDIES, ACTIVITIES, AND TASKS (based on "Findings"):

- Forecasting
- Operational / Capacity Analysis & Evaluation
- Safety Analysis & Evaluation
- Electrical Systems (type, service, hardware, software)
- Traffic Management Planning (for work zone)