

CHAPTER 4**ROADWAY LEVEL OF SERVICE (LOS) MONITORING****Key Topics:**

- **Legislative Requirements**
- **Legislative Intent and Application to San Francisco**
- **Technical Approach**
- **Monitoring Results**
- **Future Monitoring Approach**
- **Caltrans' Role**
- **Work Program Items – Key Milestones**

This chapter describes the methodology used to monitor the system, and compares the biennial monitoring results from 1991, through 2004.

1. Legislative Requirements

The California Government Code requires that San Francisco use LOS standards to measure the performance of the CMP roadway network, but allows CMAs a choice among the following permitted methods for measuring level of service (LOS):

- Transportation Research Board Circular 212 (TRC 212),
- Transportation Research Board's Special Report 209: *Highway Capacity Manual (HCM)*, latest version; or
- A uniform methodology adopted by the CMA that is consistent with *the Highway Capacity Manual*.

Biennially, the CMA is required to determine the City's conformance with the CMP, including attainment of LOS standards.

If actual system performance falls below the set LOS standards, (i.e. congestion worsens) actions must be taken to restore or improve LOS. Section 65089(b)(1)(B) states that "In no case shall the LOS standards established be below the

LOS E or the current level, whichever is farthest from LOS A. When the level of service on a segment or at an intersection fails to attain the established level of service standard, a deficiency plan shall be adopted pursuant so section 65089.4" In addition, Section 65089.3 establishes that "The [California] [D]epartment [of Transportation] is responsible for data collection and analysis on state highways, unless the agency designates that responsibility to another entity."

"The maintenance of LOS standards on CMP roadways in San Francisco requires a comprehensive and multimodal approach which takes into account the congestion relief potential of transit and other non-automobile based solutions, as well as operational improvements to roadways."

2. Legislative Intent in the San Francisco Context

LOS is a traffic engineering concept designed to describe the operating conditions on a roadway. LOS describes operating conditions on a scale of A to F, with "A" describing free flow, and F describing bumper-to-bumper conditions. Attributes that make up the A to F degrees of the LOS scale are a mixture of quantitative measures (such as speed and travel time), and qualitative observations, such as freedom to maneuver.

As a result, LOS is used as the main indicator of congestion and as the uniform yardstick for measurement of improvement in transportation service, as well as to gauge the congestion relief potential of proposed transportation solutions. The choice of LOS for this purpose reflects the suburban roots of the congestion management legislation: congestion relief is to be measured by the ability of the transportation system to move automobiles, because in the suburbs the single-occupant automobile is still the prevalent mode of transporta-

tion. It also reflects the fact the LOS has been used and codified more extensively and systematically than any other transportation facility performance method. Therefore, LOS is also the method that offers least potential for controversy or challenge when a CMA makes a finding of non-conformance.

Improvements on the LOS scale ensure better travel conditions for motorists, but the LOS scale does not take into account the *people throughput* potential of a roadway. Under optimum (LOS A) operating conditions, a city arterial may be carrying the maximum number of automobiles at high speed, but if each vehicle carries only the driver the people throughput of the facility is suboptimal. San Francisco faces a double challenge on this issue: on the one hand the City must comply with the LOS requirements and prevent LOS conditions from deteriorating below the set standards. On the other hand, it must strive to identify a performance measurement method that reflects San Francisco's transportation realities more appropriately than LOS. We have already begun the effort to develop multimodal performance measures appropriate to San Francisco. These are described in detail in Chapter 5 *Multimodal Performance Element*.

The Level of Service on CMP roadways in San Francisco requires a comprehensive, multimodal approach that takes into account the congestion relief potential of transit and other non-automobile based solutions, as well as operational improvements to roadways.

3. Technical Approach

The Authority monitors LOS biennially on the CMP network. The as the CMA, assesses the City's conformance with LOS standards based on the monitoring results. The CMA ensures that LOS measurement methods used by its contractors, Caltrans, or any other agencies involved in monitoring the CMP network are consistent with State law.

a. LOS Standard

The traffic LOS standard for San Francisco is consistent with CMP mandated criteria and was established at E in the initial (1991) CMP network. Facilities that were already operating at LOS F at the time of baseline monitoring, conducted to develop the first CMP in 1991, are legislatively exempt from the LOS standards. These exempt CMP facilities will be monitored periodically for planning purposes. This year, all CMP segments will be monitoring as part of the Fall 2005 LOS Monitoring.

b. Methodology

The Highway Capacity Manual methodology is used to monitor LOS on San Francisco's CMP network. All 130-plus miles of freeways and arterials in the network are monitored using a floating car technique, which determines LOS on the basis of average operating speed. For this purpose the network is divided into 144 segments.

i. Freeways

US Route 101, Interstate 80, and roadway facilities with designated freeway status in San Francisco. Each of these freeways also serves as a primary gateway for interregional travel between San Francisco and adjacent counties. Consistent with the law, LOS monitoring for these facilities is based on average operating speed. In addition, an alternative measure of LOS using the ratio of observed traffic volumes to freeway capacity (or V/C ratios) at selected county border screenlines is used as a test of reasonableness of LOS monitoring results. Volume data for interstate 80 at the Bay Bridge toll plaza are available through the Metropolitan Transportation Commission for this purpose. Similarly, volume data for US Route 101 at the Golden Gate Bridge toll plaza are available from the Golden Gate Bridge, Highway and Transportation District. For this facility V/C ratio is calculated for the morning peak period, inbound into San Francisco, because toll payment allows more accurate enumeration than outbound (toll free) travel.

ii. Arterials

Arterials designated in San Francisco's CMP network include the following three groups of streets:

- ✓ segments of state routes which operate on City streets;
- ✓ major thoroughfares identified in the City's General Plan;
- ✓ other major streets with significant conflicts between automobile traffic and high volumes of transit service.

These three groups of City streets constitute San Francisco's arterial network. Arterial operations are controlled by an interconnected set of signalized intersections. The overall performance of each arterial is best evaluated through analysis of segments of each roadway. The "Urban and Suburban Arterial" methodology of the 1985 Highway Capacity Manual (Chapter 11) methodology is applied to determine level of service for each arterial segment using direct field measurements of average travel speed.

c. Network Segmentation Documentation of Method and Criteria

The 1993 CMP documented the criteria used in 1991 to segment the CMP roadway network in San Francisco, including freeway facilities. The following five criteria determine segment limits for the city arterials in the CMP: predominant development patterns (e.g., number of driveways, institutional users); changes in speed limits; major cross streets; significant changes in traffic volumes; and freeway ramps. These criteria are generally recognized as significant in explaining the operating behavior of a roadway.

For freeway facilities the segmentation criteria are simpler. They include interchange on and off ramps, and points where two freeway facilities merge or bifurcate. Segment limits for freeways in the San Francisco CMP are also shown in Appendix III.

Segmentation changes

Table 2 in Appendix III lists all CMP arterials where segmentation changes were introduced as part of the 1993 CMP, including a technical justification. Changes were introduced in the segmentation of 18 arterials in the network. The new

arterial segments follow more closely the five segmentation criteria described above, and improve comparability of LOS results among similar facilities. By better reflecting local conditions, these segments increase the reliability and explanatory power of LOS measurements on the network. No segmentation changes were proposed as a result of the 2005 LOS monitoring cycle.

4. Monitoring Results

In order to determine initial (baseline) LOS conditions, the Department of Parking and Traffic monitored the CMP network during the summer of 1991. Network segments already at LOS F were legislatively exempted from conformance with the established LOS E standard but are periodically monitored and targeted for congestion management measures as appropriate.

For LOS monitoring purposes, the CMP network segments are divided into three categories:

- **Exempted** – segments which were at LOS F during the first (1991) monitoring cycle and are legislatively exempted from the LOS E standard;
- **Tier 1** – non-exempt segments which were at a LOS D, E or F during the most recent monitoring cycle; and
- **Tier 2** – non-exempt segments which were at a LOS A, B or C during the most recent monitoring cycle.

Tier 1 segments are monitored each cycle since these are the segments with the greatest potential to exceed (or fail) the LOS standard. Exempted segments and Tier 2 segments are monitored periodically. All segments are scheduled to be monitored during the fall 2005 monitoring cycle.

Tables I and II in Appendix IV show LOS monitoring results for all segments of arterials and freeways in the CMP network. The information includes segment length, direction of travel, time of day (AM and PM peak), average operating speed measured, and LOS results for 1991, 1993, 1995, 1997, 1999, and 2001, and 2004.

The previous 2004 monitoring cycle identified 12 potential LOS deficiencies.

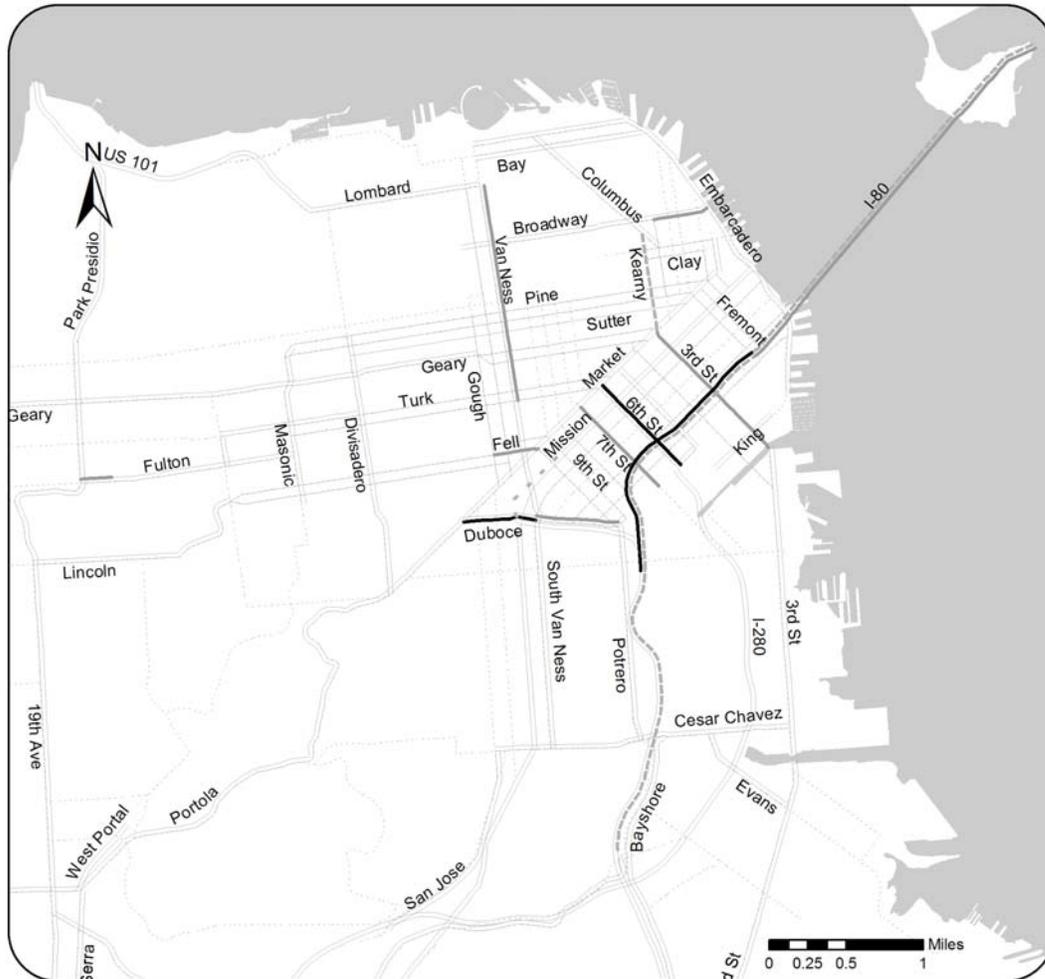
Table 4-1 lists the segments at LOS F during the 2004 monitoring. The monitoring identified 12 non-exempt LOS F segments, 3 occurred during the a.m. peak period and 9 during the p.m. peak period. Many of the LOS F segments are located in the South of Market area, which has experienced a period of rapid growth over the last several years, including the demands of the dot-com bubble of the late 1990's and early 2000s period.

Per CMP procedures, the non-exempt LOS F segments should be monitored once more to verify the LOS F findings before a deficiency plan is required.

As part of the 2004 monitoring cycle, data was collected for all Tier 1 segments and for a small subset of Tier 2 and exempted segments. The three potentially deficient segments from the 2004 monitoring cycle were monitored. The Tier 2 and exempted segments are included to provide data useful for the Authority's planning studies (such as the Geary Corridor Study).

We will determine the need to prepare a deficiency plan following the Fall 2005 LOS monitoring. If a deficiency exists, the Authority will inform the Mayor's office via written correspondence.

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San Francisco County CMP

Spring 2004 LOS F Segments: AM Peak Period

Level of Service (LOS)

- 1st Cycle LOS F
 - 2nd Cycle LOS F
 - Exempt
 - - - Under Construction
 - Other Segments (LOS A - E)
 - Other arterials
- Two-way street segments are represented by two parallel lines.





San Francisco County CMP

Segments Exempt from Mitigation Requirements: AM period

Level of Service (LOS)

— Exempt

— Not exempt

Two-way street segments are represented by two parallel lines.

..... Other arterials

Segments which were at LOS F during the first (1991) monitoring cycle are exempted from CMP legislation mitigation requirements.





San Francisco County CMP

Spring 2004 LOS F Segments: PM Peak Period

Level of Service (LOS)

- 1st Cycle LOS F
 - 2nd Cycle LOS F
 - Exempt
 - Other Segments (LOS A - E)
- Two-way street segments are represented by two parallel lines.
- Other arterials





San Francisco County CMP

Segments Exempt from Mitigation Requirements: PM period

Level of Service (LOS)

— Exempt

— Not exempt

Two-way street segments are represented by two parallel lines.

..... Other arterials

Segments which were at LOS F during the first (1991) monitoring cycle are exempt from CMP legislation mitigation requirements.



Table 4-1
2004 Roadway Level of Service (LOS) Monitoring Results – LOS F Segments

A.M. Peak Period – Arterials

CMP Route	Limits	1999 Study Results	2001 Study Results	2004 Study Results	Comments
3 rd Street	China Basin to Market	Avg Speed = 10.8 mph LOS = D	Avg Speed = 9.2 mph LOS = D	Avg Speed = 6.2 LOS = F	Requires follow-up monitoring.
6 th Street	Brannan to Market	Not Monitored	Avg Speed = 4.7 mph LOS = F	Avg Speed = 5.5 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
7 th Street	Brannan to Market	Avg Speed = 14.2 mph LOS = C	Not Monitored	Avg Speed = 6.8 mph LOS = F	Requires follow-up monitoring.
Broadway	Montgomery to Embarcadero	Avg Speed = 12.2 mph LOS = E	Avg Speed = 11.6 mph LOS = D	Avg Speed = 8.8 mph LOS = F	Requires follow-up monitoring.
Duboce/Division	Market to Mission	Avg Speed = 8.8 mph LOS = E	Avg Speed = 5.5 mph LOS = F	Avg Speed = 5.8 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
Duboce/Division	Potrero to Mission	Not Monitored	Avg Speed = 11.3 mph LOS = D	Avg Speed = 5.8 mph LOS = F	Requires follow-up monitoring
Fell	Gough to Market	Avg Speed = 8.1 mph LOS = E	Avg Speed = 7.6 mph LOS = E	Avg Speed = 6.1 mph LOS = F	Requires follow-up monitoring
Fulton	10 th Ave to Park Presidio	Not Monitored	Avg Speed = 10.4 mph LOS = D	Avg Speed = 6.4 mph LOS = F	Requires follow-up monitoring
Kearny	Market to Columbus	Avg Speed = 8.8 mph LOS = E	Avg Speed = 12.9 mph LOS = D	Avg Speed = 5.4 mph LOS = F	Requires follow-up monitoring
Mission/Otis	9 th St to 14 St	Avg Speed = 11.7 mph LOS = D	Avg Speed = 8.7 mph LOS = E	Avg Speed = 5.8 mph LOS = F	Construction impacted 2004 monitoring
Van Ness	Washington to Lombard	Avg Speed = 9.4 mph LOS = D	Avg Speed = 12.6 mph LOS = D	Avg Speed = 6.9 mph LOS = F	Requires follow-up monitoring
Van Ness	Golden Gate to Washington	Avg Speed = 10.4 mph LOS = D	Avg Speed = 10.4 mph LOS = D	Avg Speed = 6.9 mph LOS = F	Requires follow-up monitoring

A.M. Peak Period – Freeways

CMP Route	Limits	1999 Study Results	2001 Study Results	2004 Study Results	Comments
US 101 Northbound	I-280 to I-80	Not Monitored	Avg Speed = 28.1 mph LOS = F	Avg Speed = 27.8 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
I-80 Southbound	Treasure Island to Fremont	Not Monitored	Avg Speed = 28.8 mph LOS = F	Avg Speed = 22.3 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
I-80 South-west	Fremont to US 101	Avg Speed = 40.4 mph LOS = E	Avg Speed = 25.9 mph LOS = F	Avg Speed = 24.0 mph LOS = F	Possible Deficiency. Requires follow-up monitoring
I-80 Northbound	US 101 to Fremont	Avg Speed = 28.8 mph LOS = F	Avg Speed = 16.3 mph LOS = F	Avg Speed = 24.9 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
I-80 North-east	Fremont Exit to Treasure Island	Avg Speed = 30.5 mph LOS = F	Avg Speed = 36.5 mph LOS = E	Avg Speed = 20.2 mph LOS = F	Requires follow-up monitoring

P.M. Peak Period – Arterials

CMP Route	Limits	1999 Study Results	2001 Study Results	2004 Study Results	Comments
1 st Street Southbound	Market to Harrison	Not Monitored	Avg Speed = 2.1 mph LOS = F	Avg Speed = 2.6 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
5 th Street Southbound	Market to Brannan	Not Monitored	Avg Speed = 5.2 mph LOS = F	Avg Speed = 6.3 mph LOS = F	Possible Deficiency. Requires follow-up monitoring
6 th Street Southbound	Market to Brannan	Avg Speed = 6.8 mph LOS = D	Avg Speed = 6.8 mph LOS = F	Avg Speed = 4.4 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
6 th Street Northbound	Brannan to Market	Avg Speed = 9.0 mph LOS = D	Avg Speed = 6.4 mph LOS = F	Avg Speed = 6.6 mph LOS = F	Possible Deficiency. Requires follow-up monitoring
Brannan Eastbound	Division to 9 th Street	Not Monitored	Avg Speed = 4.5 mph LOS = F	Avg Speed = 5.4 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
Brannan Westbound	9 th Street to Division	Not Monitored	Avg Speed = 1.8 mph LOS = F	Avg Speed = 5.0 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
Broadway Eastbound	Larkin to Powell	Avg Speed = 25.5 mph LOS = C	Avg Speed = 11.0 mph LOS = F	Avg Speed = 12.7 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
Broadway Westbound	Powell to Larkin	Avg Speed = 25.3 mph LOS = C	Avg Speed = 11.0 mph LOS = F	Avg Speed = 10.6 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
Broadway Westbound	Embarcadero to Montgomery	Avg Speed = 9.6 mph LOS = D	Avg Speed = 4.4 mph LOS = F	Avg Speed = 6.9 mph LOS = F	Possible Deficiency. Requires follow-up monitoring.
Clay	Kearny to Davis	Avg Speed 10.4 mph LOS = D	Avg Speed = 9.4 mph LOS = D	Avg Speed = 6.5 mph LOS = F	Requires follow-up monitoring.
Duboce/Division	Market to Mission	Not Monitored	Avg Speed = 7.5 mph LOS = E	Avg Speed = 6.3 mph LOS = F	Requires follow-up monitoring.
Duboce/Division	Mission to Market	Not Monitored	Avg Speed = 7.4 mph LOS = E	Avg Speed = 6.0 mph LOS = F	Requires follow-up monitoring.

CMP Route	Limits	1999 Study Results	2001 Study Results	2004 Study Results	Comments
Fremont Northbound	Harrison to Market	Not Monitored	Avg Speed = 3.2 mph LOS = F	Avg Speed = 5.2 mph LOS = F	Possible Deficiency. Requires follow-up monitoring
Gough Southbound	Pine to Geary	Not Monitored	Avg Speed = 6.5 mph LOS = F	Avg Speed = 6.3 mph LOS = F	Possible Deficiency. Requires follow-up monitoring
Gough Southbound	Golden Gate to Market	Not Monitored	Avg Speed = 7.6 mph LOS = E	Avg Speed = 6.4 mph LOS = F	Requires follow-up monitoring.
O'Farrell Eastbound	Mason to Market	Not Monitored	Avg Speed = 4.2 mph LOS = F	Avg Speed = 6.7 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
Pine	Market to Kearny	Avg Speed = 6.7 mph LOS = F	Avg Speed = 8.0 mph LOS = E	Avg Speed = 4.3 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
Pine	Leavenworth to Franklin	Not Monitored	Avg Speed = 9.4 mph LOS = D	Avg Speed = 6.5 mph LOS = F	Requires follow-up monitoring.
Van Ness	Golden Gate to 13 th	Avg Speed = 23.1 mph LOS = B	Not Monitored	Avg Speed = 5.0 mph LOS = F	Requires follow-up monitoring
Van Ness	13 th to Golden Gate	Avg Speed = 18.3 mph LOS = C	Not Monitored	Avg Speed = 6.6 mph LOS = F	Requires follow-up monitoring.

P.M. Peak Period – Freeways

CMP Route	Limits	1999 Study Results	2001 Study Results	2004 Study Results	Comments
US 101 Northbound	I-280 to I-80	Avg Speed = 6.2 mph LOS = F	Avg Speed = 24.0 mph LOS = F	Avg Speed = 17.8 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
US 101 Northwest	I-80 to Mission Exit	Not Monitored	Not Monitored	Avg Speed = 21.7 mph LOS = F	Same as Above

CMP Route	Limits	1999 Study Results	2001 Study Results	2004 Study Results	Comments
I-80 Southbound	Treasure Island to Fremont Exit	Not Monitored	Avg Speed = 31.6 mph LOS = E	Avg Speed = 21.7 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
I-80 South-west	Fremont to US 101	Not Monitored	Avg Speed = 24.9 mph LOS = F	Avg Speed = 13.8 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
I-280 East-bound	6 th /Brannan to US 101	Not Monitored	Avg Speed = 30.9 mph LOS = E	Avg Speed = 28.5 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1993). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
US 101	Van Ness to I-80	Not Monitored	Not Monitored	Avg Speed = 14.9 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
US 101	I-80 to I-280	Avg Speed = 32.4 mph LOS = E	Avg Speed = 44.4 mph LOS = E	Avg Speed = 21.4 mph LOS = F	Requires follow-up monitoring.
I-80 Northbound	US 101 to Fremont	Not Monitored	Avg Speed = 14.8 mph LOS = F	Avg Speed = 10.0 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.
I-80 North-east	Fremont to Treasure Island	Avg Speed = 23.1 mph LOS = F	Avg Speed = 21.6 mph LOS = F	Avg Speed = 14.6 mph LOS = F	This segment was at LOS F during the initial monitoring cycle (1991). Per state law, this segment is exempted from the LOS E standard and does not constitute a deficiency.

5. Future Monitoring Approach

In years past, the Authority has discussed with the Department of Parking and Traffic the possibility of using mechanical tube counts of arterial traffic volumes for CMP purposes. These counters would also provide additional data for DPT at regular intervals. Traffic counting loop detectors could be installed at permanent counter stations, as well as locations designed to collect cordon counts of downtown (the last one was in 1983). These discussions should be revived. We will also explore the idea of conducting monitoring using a corridor-level approach, and expanding the trips monitored to include other modes.

Consideration may also be given to evaluating LOS based on the newer HCM2000 arterial standard. Currently, the Authority uses the 1985 HCM standard that was current at the time of the original CMP legislation. The 2000 HCM standard calls for five arterial designations, rather than three. This may be more appropriate for San Francisco as many of the City's arterials do not fit the suburban stereotype that the 1985 HCM assumes.

6. Caltrans' Role

Although Section 65089.3 establishes that Caltrans is responsible for LOS monitoring on the State highway system, the department has not been able to fully address this obligation due to budget constraints. The Authority continues to work with Caltrans District 4, MTC and the other Bay Area CMAAs to ensure that freeway operations data still being collected by Caltrans is put to the best possible use to help satisfy CMP monitoring requirements. Until a budget solution is found, the Authority will continue to include state highways in its periodic LOS monitoring efforts to ensure that the information is available to satisfy CMP conformance determination requirements.

In September 2002 the Governor signed AB 2535 (Diaz). This legislation, called Transportation Congestion Data Collection, requires Caltrans to, within existing resources, collect, analyze and summarize highway congestion data for District 4 (Bay Area) and provide it to Congestion Manage-

ment Agencies for LOS monitoring on state routes and highways. This bill would put the burden to do the monitoring on state routes back on Caltrans. Ideally, this reform will ensure uniform measurements and save the Authority this ongoing expense.

In light of the current state budget crisis, it is unlikely that Caltrans will find the necessary resources to comply with the requirement to provide LOS data on state routes to the CMAAs on a biennial basis. The Authority expects this will change as the state-wide economy improves.

7. Work Program Items – Key Milestones

- Monitor LOS for eligible segments in October/November 2005, as well as follow up monitoring for the three potentially deficient segments remaining from the 2003/4 cycle to determine whether there is a deficiency. Report results to the Plans & Programs Committee by April 2006.