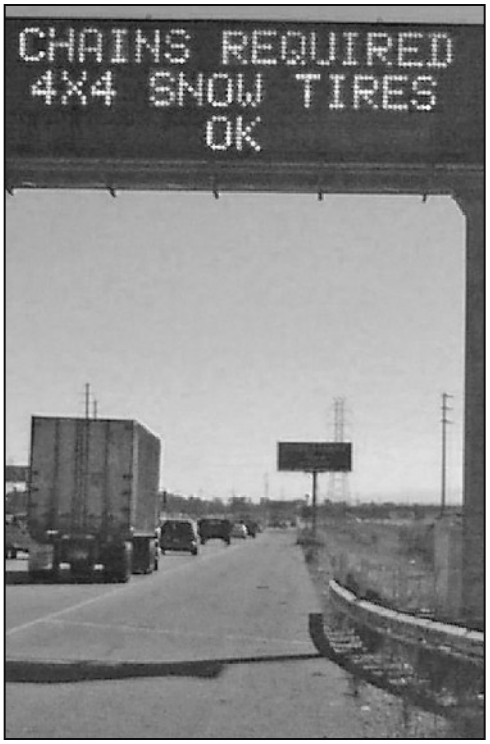
State of California
Business, Transportation and Housing Agency
Department of Transportation

CMS

Changeable Message Sign Guidelines



Prepared by the Division of Traffic Operations
April, 2006

STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION

# Guideline Change Transmittal		NO.: 06-01
TITLE: *Changeable Message Sign (CMS) Guidelines* *April 2006*	**APPROVED BY:** for John Wolf Kris Balaji, Chief Division of Traffic Operations	**DATE ISSUED:** 04/18/06 **PAGE:** 1 of 1
SUBJECT AREA: Permanent and Portable CMS	**ISSUING UNIT:** Division of Traffic Operations	
SUPERSEDES: All previous Headquarters and District guidance on CMS	**DISTRIBUTION:** Electronically via the Internet and Intranet to all guideline holders and hardcopy to all training class participants.	

The purpose of this Guideline Change Transmittal is to issue the new **Changeable Message Sign (CMS) Guidelines – April 2006.** The guidelines supersede the CMS Guidelines for Permanent Installations dated August 1995, the Portable CMS Guidelines dated April 1998, and all previous District level guidance for CMS.

The CMS Guidelines were developed by the Division of Traffic Operations in conjunction with the Districts to provide clear guidance to Department personnel and our external partners on the use of CMS on California's highways.

The authority for the use of CMS on California's highways is contained in the Federal 2003 Manual of Uniform Traffic Control Devices (MUTCD), as amended by the 2003 MUTCD California Supplement. Therefore, when these guidelines use "shall" in describing certain procedures when operating CMS it is intended to ensure consistency and compliance with the 2003 MUTCD and the 2003 MUTCD California Supplement. If there is a conflict between these guidelines and any current or future adopted version of the MUTCD, the MUTCD shall take precedence.

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PREFACE

This document provides policy and guidance for the use of Changeable Message Signs (CMS) on the State's highway system. Caltrans personnel should use this document when making decisions on when, where and how to effectively deploy CMS for providing real-time motorist information. For the purpose of this document, CMS will refer to both permanent (fixed) and Portable Changeable Message Signs (PCMS) unless otherwise noted.

These guidelines contain a compilation of national research and Caltrans current operational practices. The concepts in this document are taken from the Manual on Uniform Traffic Control Device (MUTCD) – 2003 Edition, the MUTCD 2003 California Supplement, the Federal Highway Administration (FHWA) TMC Pooled-Fund Study dated December 12, 2002 and FHWA Policy Memorandums. On May 20, 2004 Caltrans adopted the MUTCD and the California Supplement as the standard and guide for traffic control devices, including CMS. Additional information on these references are located in the Appendices.

All standards cited in these guidelines are required by the 2003 Manual on Uniform Traffic Control Devices. Exceptions or deviations from these guidelines should be discussed with Caltrans District Traffic Managers.

For additional information contact Gary Thomas at (916) 651-6130 or Zoe Bayar at (916) 654-6133.

CALTRANS CHANGEABLE MESSAGE SIGN POLICY AND SUMMARY

IT IS THE POLICY OF CALTRANS TO DISPLAY ONLY REAL-TIME INFORMATION THAT CONVEYS CURRENT TRAFFIC SAFETY, TRAFFIC GUIDANCE, TRAFFIC CONGESTION AND AMBER ALERT INFORMATION.

- A Changeable Message Sign (CMS) should display information that is associated with unexpected conditions or nonrecurrent congestion. Displaying travel times, AMBER Alert information and approved safety messages are acceptable.

- CMS messaging for other states or agencies (i.e. assisting AMBER Alerts) should adhere to Caltrans policy.

- ***A CMS shall not:***

  •Display public service messages or messages that could be considered advertising displays.
  •Flash any text within a message.
  •Display any type of graphics.
  •Scroll any part of a message horizontally or vertically.

- CMS messages should not provide information that is already obvious to the motorist.

- Districts using a CMS for purposes not described in the CMS Guidelines should consult with their District Traffic Manager. At a minimum, the sponsor or District should perform an effectiveness study when using the CMS for such activities.

- Portable CMS (PCMS) used in construction zones should also meet the specifications contained in Section 12 of the California Standard Specifications.

- A CMS should be placed 1 to 2 miles in advance of a major decision point.

- When using multiple CMS a minimum of 1000 feet separation should be provided between signs.

- A portable CMS shall be raised to a minimum height of 7 feet from the roadway in urban areas and 5 feet from the roadway in rural areas.

- A CMS should be monitored for malfunctioning disks, lamps or panels. At least 90 percent of the CMS characters should be functioning properly before displaying the message.

CALTRANS CHANGEABLE MESSAGE SIGN POLICY AND SUMMARY (Contd.)

- Whenever a PCMS is not being used it should be removed, placed or stored outside of the clear zone or behind a protective barrier.
- The minimum information that needs to be contained in a message is the traffic Problem and Location statements. The Action or Effect statement should be included if deemed relevant.
- Exit numbers should be used in the location statement whenever possible.
- Standard abbreviations should be used when creating a message, see Appendix C for a list of common abbreviations.
- Motorists should not be detoured to arbitrary routes. Prior to displaying a detour route, the CMS operator should know the current traffic conditions and route constraints.
- The CMS operator should limit the units of information displayed to a one-phase message, unless a motorist is in a queue or traveling at a low rate of speed. Multi-phase messages should be used only when it is determined that a motorist has enough time to read the entire message at prevailing speeds.
- A display time should be selected for multi-phase messages which will allow the motorist time to read the message.
- All Caltrans CMS operators should follow the same procedures on messaging as described in these guidelines.

Chapter 1 - USAGE

A CMS is primarily used to give motorists real-time traffic safety and guidance information about planned and unplanned events that significantly impact traffic on the State's highway system. At times, traffic congestion or America's Missing: Broadcast Emergency Response (AMBER) Alert information is displayed on CMS. See Tables 1.1 through 1.3 for typical applications of permanent and portable signs. Both types of sign may be used depending on the specific type and magnitude of the events. See Appendix G for Caltrans Policy regarding the use of CMS to display Amber Alert messages on State Highways. This policy is included in Chapter 2, Section 2E.21 of the MUTCD 2003 California Supplement.

A CMS may be used to display messages for advance notice of upcoming roadwork and special events that will adversely affect travel. The advance notification should not be displayed more than 7 days prior to the special event or upcoming roadwork. Calendar days (MON-FRI) should be used in lieu of Calendar dates (5/11-5/15) when displaying messages. A CMS may also be used to display safety related messages associated with approved Safety and STAR (Statewide Traffic Action Response) campaigns. Additional information regarding the use of CMS to display safety related messages on the State highway system will be disseminated to the District Traffic Managers and staff via e-mail.

Table 1.1
CMS MESSAGE TYPES AND USES

MESSAGE TYPE	USES - INFORMATION RELATED TO
Early Warning	Traffic Safety/End of Queue Protection Unexpected Traffic Slow Traffic Stopped Traffic
Advisory	Guidance Lanes Blocked (Temporary Duration) Lanes Closed (Long Duration) Freeway/Highway/Ramp/Connector Closed Adverse Roadway Conditions Post-Event Congestion Advance Notice Major Closure Major Special Event Congestion Expected Travel Times Expected Delays AMBER Alert Child Abduction Information
Alternative Route	Guidance Soft Detour (Optional Detour) Hard Detour (Required Detour)

APPROPRIATE AND INAPPROPRIATE CMS USAGE

Changeable Message Signs are also used to inform motorists of unexpected conditions and should not be used until such conditions warrant their use. Caltrans recognize the benefits of properly using a CMS to manage traffic and inform motorists. The department is also aware that improper use of a CMS can adversely affect travel on our highways. In areas where both permanent and portable signs are used, it is important that no conflicting messages are displayed. A CMS should be used as a supplement for conventional traffic control devices and not as a substitute.

An important consideration in successfully operating a CMS system is to maintain credibility with the motorist. Drivers expect the CMS to provide useful and accurate information. The CMS message should not provide information that is already obvious to the motorist (e.g. HEAVY RAIN, ROAD WET AND SLIPPERY). In general, a CMS should remain in a blank mode when conditions do not warrant the display of a message. The decision to blank a sign is determined by the operator and is based on field conditions and the message being displayed.

TABLE 1.2
CMS USAGE FOR PLANNED EVENTS

PLANNED EVENT	EXAMPLES
Construction Activity	Lane Closures, Detours, Change in Lane Pattern, Special Speed Control Measures
Maintenance Activity	Lane Closures, Moving Closures
Permits Activity	Utility Work, Encroachment Work, Special Event, Filming, Transportation Loads
Special Event	Ballgames, Concerts, Festivals, Parades
Operational Feature	High-Occupancy Vehicle, Reversible, Exclusive or Contraflow Lanes, Ramp Meters
Design Feature	Drawbridges, Tunnels, Ferry Service

TABLE 1.3
CMS USAGE FOR UNPLANNED EVENTS

UNPLANNED EVENT	EXAMPLES
Accident	Jackknife, Fatal, Overturn, Spilled Load
Hazardous Material (HAZMAT) Spill/Release	Chemical Spill, Oil Spill, Toxic Cloud, Refinery Fire
Natural Disaster	Flood, Slide, Fire, Earthquake, Tornado
Police Activity*	Bomb Threat, Terrorist Attack, Hostage/Kidnap Situation, Jumper
Severe Weather	Fog, Dust, Wind, Snow, Ice

*CMS may be used for police activity that directly impacts the motorist or travel way.

Requests to display information for other states or agencies will be determined by the appropriate district and should adhere to Caltrans policy. Requests received by Caltrans to display messages that are not consistent with these guidelines should be denied. Public service messages or advertising should not be displayed, see Table 1.4.

Districts that are planning to use a CMS for pilot programs or other purposes not described in these guidelines, should consult with their District Traffic Manager. At a minimum, the sponsor or District should perform an effectiveness evaluation of the pilot.

TABLE 1.4
INAPPROPRIATE CMS USAGE

APPLICATION	EXAMPLES
Commercial Logo Advertising	"NIKE RACE", "GOOD GUYS CAR SHOW"
Local Identifier Advertising	"RALEY FIELD", "PAC BELL PARK"
Normal Recurrent Congestion	"HEAVY CONGESTION"
Public Service Announcements	"DON'T TRASH CALIFORNIA", "SUPPORT RED CROSS"

RESPONSIBILITIES FOR USAGE

Use of the CMS for traffic management on the State highway system is the joint responsibility of Caltrans Traffic Management Center (TMC) personnel, Traffic Management Team (TMT) members and field personnel, Resident and Permit Engineers and California Highway Patrol (CHP) as designated below. Personnel should always review the message composition and location of the sign, and if needed, request assistance from Traffic Operations personnel. In addition, the CMS should be monitored to assure the sign is on or off at the correct times; there are no legibility or safety problems; and the sign is effective for traffic management.

- **TMC personnel** compose and display messages for the permanent CMS based on information gathered from field personnel, CHP Computer Aided Dispatch (CAD), and Traffic Management System (TMS) field elements such as Closed Circuit Television (CCTV) cameras and Loop Detectors.
- **TMT and field personnel** compose messages and deploy the portable CMS. Field personnel are responsible for coordinating with the TMC to request permanent CMS support. Field personnel can gather information on Estimated Time of Opening (ETO), travel times, delays and the status of the detour route.
- **DTM personnel** are responsible for providing guidance to all Caltrans personnel on when, where and how to use a CMS.
- **Resident and Permit Engineers** are responsible for providing guidance to the contractor on when, where and how to use their PCMS.

  NOTE: The PCMS used in construction zones must meet the specifications contained in Section 12 of Caltrans Standard Specifications.
- **California Highway Patrol** should refer to the Joint Operational Policy and Caltrans CMS Guidelines when requesting CMS usage.

MUTCD LIMITATIONS — USE OF CMS CAPABILITIES

The following standards should be followed:

- When a CMS is used to display a safety or transportation-related message, the display format shall not be of a type that could be considered similar to advertising displays. The display format shall not include animation, rapid flashing, or other dynamic elements that are characteristics of sports score boards or advertising displays.
- Techniques of message display such as fading, exploding, dissolving, or moving messages shall not be used.

  NOTE: CMS that display a regulatory or warning message may use a black background with a white, yellow, orange, red or fluorescent yellow-green legend.

Chapter 2 - LOCATION

INSTALLATION AND PLACEMENT

Caltrans Division of Traffic Operations, Maintenance and Design should work closely to determine the proper location of each permanent CMS before it is designed and installed. Proper placement of a portable CMS (PCMS) should be determined in real-time by field personnel.

The most appropriate locations for installing or placing a CMS is in advance of major decision points, such as interchanges or intersections, where motorists can respond to specific information displayed on the CMS. A CMS should also be located to provide ease of access for maintenance personnel.

➢ **A CMS should be located so motorists can:**

- Detect the sign
- Read and understand the sign
- Initiate a response
- Make appropriate decisions based on the information gained from the message

A CMS too close to a decision point will not provide motorists adequate time to react to the message and will reduce the opportunity to respond. A CMS too far in advance of a decision point may reduce the overall impact or recall of the message. The recommended placement of a CMS is 1 to 2 miles in advance of a major decision point.

➢ **Permanent CMS and PCMS Locations**

Below are the recommended locations for installation or placement of the permanent and PCMS.

- Upstream of major special event facilities (stadiums and convention centers).
- Upstream of locations which may experience severe weather conditions (fog, dust, wind, ice or snow).
- Upstream of locations where information regarding travel times and delays are appropriate (i.e. construction zones and airports).

➢ **Trailer-mounted PCMS Locations**

When practical, trailer mounted CMS should be placed:

- On the right and/or left shoulder of the highway.
- Strategically upstream of bottlenecks.
- On the same side of the highway if multiple signs are needed to give additional information or for redundancy. The distance between units should be based on speed, terrain and visibility. A minimum of 1000 feet separation should be provided between signs.
- Behind an existing barrier, such as metal beam guardrail or concrete, provided the message is not obstructed.
- Before or at the crest of vertical roadway curves to maintain maximum visibility.
- Placed upstream of an event to give adequate time for motorists to react (primary function of a truck mounted CMS).

Note: Placement within or immediately after horizontal curves should be avoided.

VISIBILITY

Visibility is the distance at which a motorist can first detect a sign on the roadway. The components of visibility for a CMS sign are as follows:

- The ease in which a sign can be detected and how well it attracts the driver's attention (target value);
- The ease in which the message can be seen (brightness);
- The ease in which the message can be read (legibility); and
- The ease in which it can be read from the side (cone of visibility).

- **Target Value** is dependent on the CMS unit being more visible than the rest of the highway features. The early recognition that a sign is present, plays a key role in the motorists ability to react to the message. The proper placement of a CMS should insure that structures, curves, roadside signs and landscaping do not obscure visibility of the unit. Relocation of some highway and/or construction signs may be necessary in order to install a permanent CMS.

  Vertical and horizontal curves on freeways may have an effect on the visibility of a CMS. A CMS should be installed or placed before, or at the crest of a vertical curve and never within or immediately after a horizontal curve.

  Care should be taken to prevent objects being located too close to the PCMS since they are more likely to impact the visibility of the sign. A motorist in the lane closest to the CMS may not be able to see around the object and fully read the message.

  Obstructions such as trees, bridge abutments, overhead signs, or construction vehicles may impact the legibility of both permanent and PCMS.

  Semi-trucks in the traffic stream can be a major cause of sight obstructions to the CMS. Motorists in vehicles travelling closely behind or adjacent to a truck may have limited time to read a CMS. In cases where this is prevalent, using multiple PCMS on the same side of the highway will provide an additional opportunity for motorists to comprehend the message.

  For maximum visibility a PCMS should be raised to a minimum height of 7 feet from the roadway in urban areas and 5 feet in rural areas.

- **Brightness** or luminance of a sign is the amount of light that is coming from the CMS. Weather conditions such as fog, dust, snow or rain and other conditions such as heat or cold can affect the visibility of messages. Rain, fog and snow can scatter and block light rays from a CMS as that light travels through the atmosphere and reduce the contrast between the sign and its background. If the contrast becomes too low, motorists cannot read the message. Most signs are equipped with an automatic dimmer mechanism that will account for these conditions.

- **Legibility** is the maximum distance at which a motorist can first correctly identify letters and words on a CMS. A short message with a large font has greater legibility than a longer message with a smaller font.

  Current MUTCD Guidelines recommend the following minimum distances for visibility and legibility based on a character height of 18 inches:

  - Visibility = 2,600 feet
  - Legibility = 650 feet

  A CMS should be monitored for malfunctioning disks, lamps or panels. At least 90 percent of the CMS characters should be functioning and the message should also remain legible to motorists.

  The legibility distance of a CMS may be significantly reduced if the sun is shining directly on the sign or into the eyes of the motorist.

- **Cone of Visibility** identifies how many degrees from the sign's center axis the message remains legible. Care should be taken not to place the CMS so far off the roadway that the sign is not in the motorist's cone of vision long enough to read the message. The exposure time to read a message increases as the cone of visibility increases. The PCMS should also be slightly tilted toward the traveled way to reduce glare.

SAFETY

Along with considering the traffic management and visibility aspects of a CMS, safety of staff and the motorist should also be considered when proposing CMS locations.

- **Permanent CMS** installed to the right of the traveled way is preferred because it allows maintenance personnel to use shoulder closures during inspection or repair. Providing a parking area or pullout for maintenance should be considered in the design. If the sign is installed behind a sound wall, an access door should be provided at a safe location.

  Permanent CMS installed in a median or on an existing over-crossing provides high visibility. Unfortunately, it also poses poor accessibility and safety concerns for maintenance and may impact the vertical limits for transporting tall loads.

  The controller cabinet should be located at least 40-60 feet upstream from the sign to allow good visibility for testing. Security from vandalism should also be considered.

- **Portable CMS** should be placed as far from the travelway as reasonable, while still making the message visible to motorists. At least three traffic cones should be placed in a minimum 30 feet taper before the PCMS if it is positioned within the Clear Recovery Zone (CRZ).

  CRZ is defined in the Highway Design Manual, Section 309.1-2, 2001.

  - For freeways and expressways – 30 feet from traveled way.
  - For conventional highways (no curb) – 20 feet from traveled way.
  - For conventional highways (with curb) – 1.5 feet from face of curb.

  Whenever a PCMS is not being used, it should be removed, placed or stored outside of the CRZ or behind a protective barrier.

Chapter 3 - MESSAGES

Changeable Message Sign (CMS) messages inform motorists of accurate and real-time problems and in some cases, a suggested course of action.

Motorists have difficulty perceiving, processing and remembering a large amount of traffic information at one time. Consequently, the CMS and TMC operator is responsible for deciding what information is most important and how to present that information to motorists. Messages should encourage motorists to make appropriate driving decisions. This chapter will help CMS and TMC operators achieve message displays that avoid confusion on the roadway, improve traffic flow and enhance safety.

MESSAGE ANATOMY

CMS messages are divided into information components that when read separately or collectively, convey a complete thought or message to motorists, see Table 4.1.

- **Unit of Information**

  A *unit* of information is typically one to three words of text and usually occupies one line on a CMS phase. Each unit answers a question that a motorist might ask about an event. Units of information should be arranged in a logical order that effectively conveys the message to motorists. Generally this order is the Problem, Location and Effect statement.

  It is important to remember that it takes a motorist at least one second to read each unit of information. A motorist traveling at freeway speeds of 65 m.p.h. on average, has 4 - 7 seconds to read a CMS message under ideal

TABLE 4.1
MESSAGE ANATOMY

PHASE 1			
UNITS OF INFO.	INFORMATION	MOTORIST QUESTION	CMS ANSWER
1 1 1	Problem Location Effect	What happened? Where? What is the effect on traffic?	ACCIDENT AT EXIT 12 TRAFFIC JAMMED

PHASE 2			
UNITS OF INFO.	INFORMATION	MOTORIST QUESTION	CMS ANSWER
1 1	Audience Action	Who is message for? What is advised?	STOCKTON TRAFFIC USE HWY 99

conditions. Unless a motorist is in a queue or traveling at a low rate of speed, the CMS operator should limit the units of information displayed and use no more than two phases.

Location statement information should be useful whether motorists are familiar or unfamiliar with the area. If exit numbers are posted, the operator should use it in the location statement. Since exit numbers are determined by mile-based increments, they are a preferred location reference.

Note: Location Statement - If the incident is on the same freway as the CMS, there is no need to display the freeway route number or name because motorists will assume the event is on the same freeway.

- **Phase**

A *phase* is one frame of a message, which includes the units of information and the display time. Each phase of a message should be independently understood by motorists, whether it is read before or after an adjoining phase.

Single-phase messages should be used, whenever possible.

Two-phase messages should be used only when it is determined that motorists have enough time to read the **entire message** at prevailing speeds.

If more than one phase is needed, the Problem and Location units of information should appear together on one phase. An example of a two-phase message showing units of information is shown in Table 4.1. A message of this length (five units of information) should only be used in prevailing speeds less than 55 m.p.h. to assure adequate time for motorists to read and comprehend the message.

- **Message**

A *message* consists of all the text or characters being displayed on a CMS. The minimum information that needs to be contained in a message is the traffic Problem and Location. The Action or Effect statement should be included, if relevant. Messages should be brief and concise. When used, abbreviations should be easily understood.

The following are factors that enhance motorists' understanding of CMS messages.

- **Display Time**

A *display time* should be selected for multi-phase messages which will allow the motorist time to read the message at the prevailing speed.

The display time for a *permanent CMS* is generally 3 seconds per phase. However, two phases with a 3 second display time for each is not adequate for traffic moving at 60 m.p.h. Therefore, a single-phase 3 line message is preferred. Keep in mind, in order for motorists to read a two-phase message with 3 second display times, they would need to be in a queue for 12 seconds to read the full message twice.

A *PCMS* displays less text and fewer units of information per phase. Therefore, a shorter display time may be used. When a motorist can read the message twice at prevailing speeds, the operator knows the CMS has a proper display time. This should be the intended outcome for all messages, however, it may be difficult to achieve under less than ideal conditions.

Two examples of permanent and portable CMS messages for a freeway closure are shown in

Two examples of permanent and portable CMS messages for a freeway closure are shown in Diagrams 4.2 and 4.3. Diagrams 4.2A and 4.3A show two-phase messages that are used when the prevailing speeds are less than 55 m.p.h. (4 units of information). The second example, Diagrams 4.2B and 4.3B show a single-phase sign used when the prevailing speeds are greater than 55 m.p.h. (3 units of information).

➢ **Message Length**

Messages should provide motorists with enough information to make a timely driving decision. Operators should resist the urge to lengthen a message simply because there is space available on the sign. Empty spaces in a CMS message may be used for visual clarity.

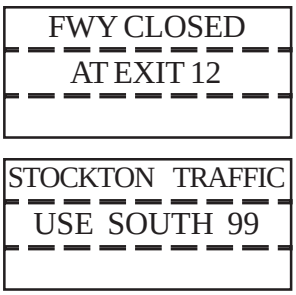
Abbreviations - May be used when creating or editing a CMS message. The example message shown in diagram 4.2 was shortened by displaying USE S-99 in lieu of USE SOUTH 99. It is important to use appropriate abbreviations, see Appendix C for a list of common abbreviations. Certain words or abbreviations are evident to the driver. For instance, the use of "Street," "Avenue" or "Boulevard" following a familiar arterial name is not required and could be omitted. There is no need to use the phrase "east bound" to describe a direction. The direction is already described in the term east or "E" if using an abbreviation. When used in conjunction with a prompt word, the motorist understands most commonly used words and abbreviations.

Standardized Messages - CMS operators statewide should follow the same messaging as described in these guidelines. Message familiarity reduces motorist reading time, thereby enhancing delivery. In general, motorists need more time to read unfamiliar messages.

DIAGRAM 4.2
PERMANENT MESSAGES

<55 MPH

A.



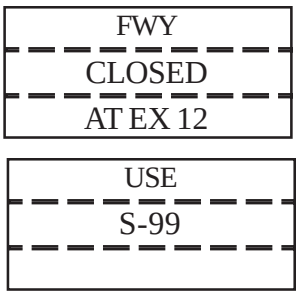
>55 MPH

B.

DIAGRAM 4.3
PORTABLE MESSAGES

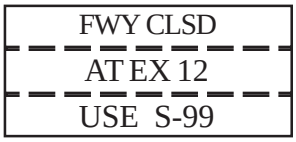
<55 MPH

A.



>55 MPH

B.



The information below should be understood before composing a CMS message.

- When referring to an off ramp, the word **EXIT** is preferred.
- The verb **USE** should be selected to indicate a route that will carry the motorist to a destination.
- The term **BLOCKED** may be used when an unexpected event is blocking lanes and no formal closure is in place.
- The term **CLOSED** is recommended after traffic control is in place.
- When using the word **AHEAD** to describe a location, the CMS should not be over one mile upstream of the incident. Also, the CMS should be on the same route as the incident.

The verb FOLLOW carries the inferred meaning that motorists will be guided by other signs along the route. FOLLOW should not be used unless detour signs are in place.

In areas where both permanent and PCMS signs are used, it is important that no conflicting messages are displayed simultaneously.

➢ **Message Type**

Early Warning messages give motorists advance notice of unexpected, slow or stopped traffic and queuing due to a planned or unplanned event.

Early warning messages are effective in reducing secondary crashes. Examples of early warning messages are shown on the opposite side of this page:

PERMANENT

EXAMPLE 1: Problem: Location:

ACCIDENT
2 MILES
AHEAD

EXAMPLE 2: Problem: Location: Action:

ACCIDENT
2 MILES AHEAD
PREPARE TO STOP

EXAMPLE 3: Problem: Location: Effect:

ACCIDENT
AHEAD
EXPECT DELAY

PERMANENT

ONE LANE AHEAD
PREPARE TO STOP

PORTABLE

SLOW

PREPARE
TO STOP

Advisory Messages provide motorists with real-time information about a specific problem along their route. The message should use days of the week and not dates (i.e. Mon, Tues. not 12/15 to 12/17).

An example of Advisory Messages for a ramp closure are shown below:

PERMANENT

GRAND ST EXIT
TO BE CLOSED
MON-FRI 10PM-2AM

PORTABLE

RAMP
CLOSURE

MON-FRI
10PM - 2AM

Additional Usage of Advisory Messages - At times, Traffic Congestion (travel time) or AMBER Alert information is displayed on permanent CMS. The traffic congestion messages may give expected travel times or expected delays from one location to another. AMBER Alert messages are typically a one-phase, 3 line message that provides information

AMBER ALERT MESSAGE

CHILD ABDUCTION
BLUE FORD VAN
CA LIC 1ABC123

TRAVEL TIME MESSAGE

TRAVEL TIME
TO MARKET ST
35 MINUTES

to motorists on the abduction of a child. The message should display a vehicle description and license plate number (or partial number).

Alternative Route/Detour messages are used when an incident blocks or closes an exit or freeway interchange. This event requires motorists to use or take another route than originally intended. Motorists should not be detoured to arbitrary routes. The suggested detour route should be a route that contains adequate road signs so motorists can travel without getting lost. Before a recommended detour route is displayed on a CMS, the operator should know the current traffic conditions and current route constraints. The operator should also consult with the Caltrans District Traffic Manager's (DTM) office.

A simple message is needed which will allow motorists a quick return to their original route. An example of Alternate Route messages are shown, below:

PERMANENT

ACCIDENT AT
HARBOR BL
USE E-91 TO S-57

PORTABLE

ACCIDENT
AT
HARBOR

USE
E-91 TO
S-57

Alternate route messages are divided into two categories: Soft Detours and Hard Detours. A Soft Detour is an optional detour, i.e. USE OTHER ROUTES. A Hard Detour is a required detour, i.e. USE NEXT EXIT / USE HIGHWAY 99. If no detour is needed, or available, an advisory message, PREPARE TO STOP /REDUCE SPEED should be used.

Chapter 4 - EQUIPMENT

When installed or placed, the CMS becomes a part of the total motorist information system, acting in partnership with existing roadway signs. Roadway signs display an unchanging message to motorists; therefore, the need for a CMS is prevalent for situations requiring time sensitive information. For this reason, both permanent and Portable Changeable Message Signs (PCMS) are utilized. Permanent signs are placed in the median, shoulder or on existing over-crossings. Portable truck or trailer mounted signs can be temporarily placed in desired locations.

PERMANENT AND PCMS MODELS

A number of design options for both permanent and portable devices exists. Detailed equipment and option descriptions can be found on the Caltrans internetwebsite.

PermanentCMS
www.dot.ca.gov/hq/esc/ttsb/electrical/cms.htm

PCMS
www.dot.ca.gov/hq/eqsc/

➢ **Permanent CMS Model 500**

- 25’ x 6.5’
- Fixed Location
- 3 lines of text
- 16 characters per line
- 18” characters
- Full Matrix Display
- Installed on freeways and expressways

➢ **Permanent CMS Model 510**

- 14.5’ x 4.5’
- Fixed Location
- 3 lines of text
- 16 characters per line
- 12” characters
- Full Matrix Display
- Installed on freeways, expressways, and conventional highways

➢ **Permanent CMS Model 520**

- 8’ x 4.5’
- Fixed Location
- 3 lines of text
- 8 characters per line
- 12” characters
- Full Matrix Display
- Installed on conventional and rural highways

- **Portable CMS Trailer -**
  Characteristics vary
  - Sizes (80”w x 56”h & 115”w x 80”h)
  - Movable Location
  - 3 lines (based on 12” characters)
  - 8 characters per line
  - Can be left at location for duration of event

- **Portable CMS Truck-Mounted-**
  Characteristics vary
  - Size (80”w x 56”h)
  - Movable Location
  - 2-3 lines
  - 8 characters per line
  - Can be constantly repositioned

SIGN TECHNOLOGY

There are several types of sign technology currently available for CMS. Listed below is the technology Caltrans Maintenance and Operations use:

- **Light-Emitting Diode (LED) Signs** use a cluster of LED lamps instead of incandescent bulbs to produce light. A bright amber LED currently produces the highest light output. The key advantage is the advertised theoretical 100,000-hour life and solid state design. Disadvantages include inconsistency of color, need for adequate ventilation and requires screening from the sun. Currently, the entire fleet of PCMS are LED. Caltrans has also introduced a few permanent LED signs in selected locations around the state.

- **Xenon Bulb Signs** have replaced Incandescent Bulb Signs on the permanent CMS Models because of their proven energy efficiency. Xenon bulbs are noted for their extended bulb-life, cool light and low wattage requirement.

CMS COORDINATION WITH OTHER FIELD ELEMENTS

A CMS can convey only a limited amount of information; therefore, when there is a need to provide extensive information to motorists, a CMS can be used in conjunction with other traveler information devices. These devices include the entire Traffic Operations System (TOS) network. The TOS network includes but is not limited to the following:

- **Highway Advisory Radio (HAR)**

  HAR units are used when there is a need to provide extensive roadway information to motorists, such as chain control or adverse weather conditions.

- **Extinguishable Message Sign (EMS)**

  An EMS is used to display a fixed message such as TUNE RADIO TO 1610 AM or ALL TRUCKS EXIT AT SCALES. Another type of EMS is a roadside sign which display fixed messages with flashing beacons to draw attention to the activated sign.

- **Flashing Beacon**

  Beacons can be used in conjunction with the CMS/EMS to draw attention to the sign and its message.

- **Flashing Arrow Sign (FAS)**

  An FAS is also known as an arrow board; it is sometimes used to supplement a CMS. The electronic FAS typically directs traffic away from a downstream lane closure. At times, a portable CMS may be used to simulate an arrow panel display.

Chapter 5 - DOCUMENTATION

Chapter 5 provides guidance on the information necessary for consistent documentation of CMS usage. This documentation is used to evaluate the Caltrans CMS system and its benefits to the motoring public and to determine the workload for budget purposes.

The following information should be recorded whenever a CMS is operated within the State right-of-way:

- Location
- Messages displayed
- Date of usage
- Time on and off
- Reason for use
- Name of operator

APPENDIX A – ACRONYMS

ACRONYM	MEANING
AMBER	America's Missing Broadcast Emergency Response
CAD	Computer Aided Dispatch
CHP	California Highway Patrol
CMS	Changeable Message Sign
CRZ	Clear Recovery Zone
DOT	Department of Transportation
DTM	District Traffic Manager
EMS	Extinguishable Message Sign
ETO	Estimated Time of Opening
FAS	Flashing Arrow Sign
FHWA	Federal Highway Administration
JOP	Joint Operational Policy
HAR	Highway Advisory Radio
HAZMAT	Hazardous Material
LED	Light Emitting Diode
MUTCD	Manual on Uniform Traffic Control Devices
RE	Resident Engineer
TMC	Transportation Management Center
TMP	Transportation Management Plan
TMS	Traffic Management System
TMT	Traffic Management Team

APPENDIX B – GLOSSARY

AMBER Alert: The America's Missing Broadcast Emergency Response Alert is a Plan through which emergency alerts are issued to notify the public about abductions of children

Bottleneck: A location where traffic demand wanting to use a section of roadway is greater than that section's capacity

Clear Recovery Zone: The unobstructed, relatively flat area beyond the edge of the traveled way which affords the drivers of errant vehicles the opportunity to regain control

Cone of Visibility: The area inside which a CMS sign is visible, which is narrow near the sign and gradually increases in width as the distance from the sign increases, effectively creating a "cone" shaped foot print on the pavement

Congestion: A condition where a breakdown of traffic flow has occurred and a queue begins to form because the amount of traffic approaching a section of highway exceeds the amount of traffic passing through it

Credibility: Believability (credit, belief or trust; confidence)

Cycle: For multi-phase messages, the complete series of phases for a given message; the time within which a set of phases is complete

Decision Point: An interchange or intersection where a motorist must decide on a route

Display Time: For multi-phase messages, the time in seconds that each phase will appear

Downstream: Beyond a certain location, in the same direction of traffic

End of Queue: The last cars to arrive in a queue; the upstream end of congestion

Extended Message: Multi-phase message

Frame: A set of text displayed as one phase of an extended message

Full Matrix Sign: A sign with a bulb or LED array capable of displaying graphics, animation, and various sizes of text

Gawk: Slowing down to look at some incident or distraction

Head of Queue: The downstream most area of congestion, usually used during dissipation

LED: A type of technology used for CMS luminance; light emitting diode

APPENDIX B – GLOSSARY (Contd.)

Legibility: ..... The ease in which a sign can be read or deciphered

Luminance: ..... A measure of the brightness of a luminous surface

Message: ..... All the text or characters being displayed, including all panels in multi-phase operation

Panel: ..... The physical part of a sign which displays the message; also used to reference a part of a message that is held by one panel, as in a multi-phase message

Phase: ..... One panel of a multi-panel message, and the display time of that panel

Queue: ..... A waiting line (of vehicles); the area of congested traffic upstream of a bottleneck or incident scene

Recurrent: ..... Appearing or occurring again, or typically

Secondary Collision: ..... Collisions which occur in the queue of an initial collision

Skew: ..... To turn aside, or to one side; slanting; oblique

Special Event: ..... A sporting event, concert, or other event likely to attract large numbers of attendees, potentially causing heavy traffic or congestion

Taper: ..... A section of cones laid out to divert vehicles out of a lane, shoulder, or away from an obstruction

Target Value: ..... How well a CMS attracts the motorists' attention

Traveled Way: ..... The portion of the roadway for the movement of vehicles, excluding shoulders

Upstream: ..... Against, or in the same direction of traffic, but ahead or in advance of a certain location

APPENDIX C – ABBREVIATIONS

Acceptable Abbreviations

WORD	ABBREVIATION
Afternoon/Evening	PM
Alternate	ALT
Avenue	AVE, AV
Bicycle	BIKE
Boulevard	BLVD, BL
Center	CNTR
Circle	CIR
Closed	CLSD
Crossing (other than highway-rail)	XING
Do Not	DONT
Drive	DR
Emergency	EMER
Entrance, Enter	ENT
Expressway	EXPWY
Feet	FT
FM Radio	FM
Freeway	FWY, FRWY
Friday	FRI
Hazardous Material	HAZMAT
Highway	HWY
Hour(s)	HR
Information	INFO
Junction/Intersection	JCT
Lane	LN
Left	LFT
Maintenance	MAINT
Mile	MI
Miles Per Hour	MPH
Monday	MON

APPENDIX C – ABBREVIATIONS (Contd.)

Acceptable Abbreviations

WORD	ABBREVIATION
Morning/Late Night	AM
Normal	NORM
North	N
Parking	PRKING
Parkway	PKWY
Pedestrian	PED
Road	RD
Right	RHT
Saturday	SAT
Service	SERV
Shoulder	SHLDR
South	S
Street	ST
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Thursday	THURS
Traffic	TRAF
Tuesday	TUES
Two-Way Intersection	2-WAY
Two-Wheeled Vehicles	CYCLES
US Numbered Route	US
Vehicle(s)	VEH
Warning	WARN
Wednesday	WED
West	W
Will Not	Wont

APPENDIX C – ABBREVIATIONS (Contd.)

Acceptable Abbreviations - Only With A Prompt Word

WORD	ABBREVIATION	PROMPT WORD
Access	ACCS	Road
Blocked	BLKD	Lane*
Bridge	BRDG	(Name)*
Chemical	CHEM	Spill
Condition	COND	Traffic*
Congested	CONG	Traffic*
Construction	CONST	Ahead
Downtown	DWNTN	Traffic
Exit	EX, EXT	Next*
Express	EXP	Lane
Frontage	FRNTG	Road
Interstate	I	(Number)
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Minute	MIN	Ahead
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Roadwork	RDWK	Ahead (Distance)
Upper	UPR	Level

*These prompt words should precede the abbreviation

APPENDIX C – ABBREVIATIONS (Contd.)

Unacceptable Abbreviations

ABBREVIATION	INTENDED WORD	MISINTERPRETATIONS
ACC	Accident	Access (Road)
CLRS	Clears	Colors
DLY	Delay	Daily
FDR	Feeder	Federal
L	Left	Lane (Merge)
LT	Light (Traffic)	Left
PARK	Parking	Park
POLL	Pollution (Index)	Poll
RED	Reduce	Red
STAD	Stadium	Standard
WRNG	Warning	Wrong

APPENDIX D – PERMANENT CMS SAMPLE MESSAGES

EVENT/SCENARIO	PREFERRED	AVOID	COMMENTS
"Accident"	ACCIDENT AHEAD		< Use the word "ACCIDENT" when signing for an accident - Only use the word "AHEAD" if the sign is less than a mile from the queue.
N, S, E, W Dashes or Slashes	E-60 AT AZUSA 2 RT LANES CLSD	2 RT LNS CLOSED EAST 60 AT AZUSA EB 60 2 RT LANES CLSD AT AZUSA E/60 2 RT LANES CLSD AT AZUSA	< Use the letter designating direction (N, S, E, W) - state the location first if possible - always put a dash between the direction and route number - avoid using slashes. < Don't use the abbreviation "EB" - this is an internal abbreviation and not familiar to all motorists.
Closed vs. Blocked	ACCIDENT AHEAD LEFT LANES BLKD ACCIDENT AHEAD LEFT LANES CLSD		< The term "BLOCKED" would be preferred for an accident, unless Maintenance had arrived and closed the lane.
Use Numbers	ACCIDENT AT 17TH ST	ACCIDENT AT SEVENTEENTH ST	< Use numbers whenever possible.

APPENDIX D – PERMANENT CMS SAMPLE MESSAGES (Contd.)

EVENT/SCENARIO	PREFERRED	AVOID	COMMENTS
"HWY" vs. "RTE," "I" or "SR"	ACCIDENT AT HWY-5	ACCIDENT AT RTE-5	< The Caltrans standard is "HWY" to address the subject route - "SR" is not considered a common abbreviation to the public - "I" is still used to indicate "Interstate," especially when space is limited.
	ACCIDENT AT I-5	ACCIDENT AT SR-55	
Single phase messages are preferred	3 RT LANES CLSD AT ROSEMEAD BL TRAFFIC JAMMED	3 RT LANES CLSD AT ROSEMEAD BL	< This information can be displayed on a single phase 3 line message, rather than a 2 phase message.
	3 RT LANES CLSD AT ROSEMEAD BL TRAFFIC JAMMED	3 RIGHT LANES CLSD ROSEMEAD TO BALDWIN AVE	< Lane closure limits are not useful to motorists, only the location of the beginning of closure.
Congestion after incident is cleared	TRAFFIC JAMMED CITRUS TO GRAND		< Providing congestion limits is very effective. <A dash can be used to replace the word "TO," especially when pressed for space. <Use "TO instead of "AT" if the CMS is located in the traffic queue.
	HEAVY TRAFFIC ROSEMEAD - GRAND		
	TRAFFIC JAMMED TO ROSEMEAD		
CMS is on the same route as the incident	2 LFT LANES BLKD AT LAKE AVE	2 LEFT LANES AT LAKE BLOCKED	< Problem stated on one line, location stated on another.

APPENDIX D – PERMANENT CMS SAMPLE MESSAGES (Contd.)

EVENT/SCENARIO	PREFERRED	AVOID	COMMENTS
Only one lane is open	E-60 AT PECK RD SINGLE LANE ONLY SINGLE LANE ONLY E-60 AT PECK RD	E60 AT PECK 3 RT LNS BLCKD	< "Single Lane Only" has a great impact, and provides a good description of the conditions to the motorists.
Off ramp closed	FAIRFAX EXIT CLOSED	FAIRFAX OFF-RAMP CLOSED	
Off ramp partially blocked	ACCIDENT FAIRFAX EXIT BLOCKED		
Freeway Connector closed with recommended detour	W-10 EXIT CLOSED DETOUR AT VALLEY	W-10 CONNECTOR CLOSED	< If a detour is in place
Freeway Connectors (both directions) blocked	ACCIDENT HWY-10 EXIT BLOCKED ACCIDENT HWY-10 EXIT BLKD		

APPENDIX D – PERMANENT CMS SAMPLE MESSAGES (Contd.)

EVENT/SCENARIO	PREFERRED	AVOID	COMMENTS
Freeway connector closed on another route	N-710 TO W-105 EXIT CLOSED		

Standard Messages

PREFERRED
TRAFFIC INFO TUNE TO 1620 AM
-SLOW- DENSE FOG AHEAD
TOLL LANES CLOSED
ANAHEIM POND EXIT BALL RD
-CAUTION- FLOODING AHEAD

ADDITIONAL INFORMATION

- √ The only desirable punctuation is a dash - avoid periods, commas, quotes, etc.
- √ Make sure reference is a major cross street with signing on freeway
- √ Always use the word accident if accident involved
- √ For off route incidents, use affected route and direction after the word "ACCIDENT"
- √ Only use the word "AHEAD" on signs one mile or less from an accident scene or event
- √ Limit messages to two lines when possible

APPENDIX E – PORTABLE CMS EXAMPLES

EVENT/SCENARIO	PHASE 1	PHASE 2	COMMENTS
"Accident"	ACCIDENT AHEAD	PREPARE TO STOP	< Maybe the most common portable message used to manage the end of queue. This message is generally used on TMT trucks.
N, S, E, W	S-133 EXPECT DELAYS	MON - FRI 9 AM - 3 PM	< Use the letter designating direction - use a dash between the direction designation and the route number - avoid using "NB," "SB," etc.
Advance Closure Notice	N-405 RAMP CLOSURE	FRI - 9 PM THRU MON-5 AM	< If a major ramp closure will have a significant impact on traffic, this advance notice is effective - avoid using calendar dates (i.e., 3/14 - 3/17).
Special Traffic Handling	ALL VEHICLES	CARPOOL LANE OK	
End Mixed HOV Lane	CARPOOL LANE	2 OR MORE PER VEHICLE	
Route Guidance	N - 5 DETOUR >>>>>>>		

APPENDIX E – PORTABLE CMS EXAMPLES (Contd.)

EVENT/SCENARIO	PHASE 1	PHASE 2	COMMENTS
Advance notice	RAMP TO BE CLOSED	MON-FRI 9 AM - 3 PM	
Advance notice	TRAFFIC INFO	TUNE TO 1620 AM	
Advance notice	CHAINS REQUIRED	SNOW TIRES 4 X 4 OK	
Advance notice	DENSE FOG AHEAD		
Advance notice	ACCIDENT EXIT 123 CLOSED		
Advance notice	TRAFFIC JAMMED	CITRUS TO GRAND	

APPENDIX E – PORTABLE CMS EXAMPLES (Contd.)

EVENT/SCENARIO	PHASE 1	PHASE 2	COMMENTS
Advance notice	E - 60 AT PECK RD	SINGLE LANE ONLY	
Advance notice	LOCAL TRAFFIC ONLY		
Advance notice	HWY - 123 CLSD AT LINCOLN	UNTIL 5 AM MONDAY	
Advance notice	HWY - 123 TO BE CLOSED	NIGHTLY 8 PM - 5 AM	

APPENDIX F – FHWA POLICY MEMORANDA

The first FHWA Policy Memorandum, "Information: Use of Changeable Message Sign (CMS)" dated January 19, 2001, states that "FHWA supports the use of a CMS as a traffic control device to safely and efficiently manage traffic by informing motorists of roadway conditions and required actions to perform. The appropriate use of a CMS and other types of real-time displays should be limited to managing travel, controlling and diverting traffic, identifying current and anticipated roadway conditions, or regulating access to specific lanes or the entire roadway. A national survey of 26 transportation agencies in 1997, indicated that 77 percent had a policy of displaying messages only when unusual roadway conditions are present, leaving the CMS blank during other times. The use of a CMS for the display of general public information or other nonessential messages is discouraged. Only essential messages should be displayed on a CMS."

The FHWA Policy Memorandum "Information: AMBER Alert Use of Changeable Message Sign (CMS)" dated August 16, 2002, was prepared to clarify FHWA policy on the use of CMS to display child abduction messages as part of the AMBER Plan Program.

These memoranda can be accessed at: **www.fhwa.dot.gov/legregs/directives/policy/**

APPENDIX G – CALTRANS AMBER ALERT POLICY

Caltrans Policy regarding the use of CMS signs for child abductions (AMBER) alert messages

A primary mission of the department is the safe and orderly movement of traffic. It is the policy of Caltrans to display only real-time information that conveys current traffic safety and congestion information on Highway Changeable Message Signs (CMS).

An exception to Caltrans policy on the use of CMS signs will be made only for AMBER Alerts. Only credible real-time information, where it is crucial to the safety of the victim to disseminate the information to the public in the near term, will be displayed on these CMS signs. Law enforcement activates an Amber Alert when circumstances meets the following criteria: the missing child is of a pre-determined age; the law enforcement agency believes the child has been kidnapped; the agency believes the missing child is under threat of serious bodily harm or death.

The CHP will consult with the investigating agency prior to requesting any CMS sign activation. Caltrans will only respond to AMBER alert requests from the CHP. District TMC staff and local CHP staff shall jointly agree upon the most appropriate CMS sign message content(s). TMC staff shall also consult with CHP staff regarding the length of time to display messages (initially 2-3 hours), and extent of roadway system to display the messages (i.e. radius and/or directions and specific routes).

TMC personnel should discuss with the requester the limitations on message content, the number of signs that can be deployed within a given time period, conflicts with other necessary sign messages etc. There is a concern that messages that are too general in describing vehicles might result in inappropriate vigilantism. The preferred response is to display a radio frequency (thus referring the public elsewhere for details) - Caltrans Highway Advisory Radios (HAR) or appropriate commercial radio. Alternatively, a license plate number (or partial number) might be displayed along with a vehicle description. The display of any contact phone number is discouraged.

Nothing in this policy suggests a requirement to pre-empt true motorists safety messages, e.g. unexpected "end of queue" motorist alerts, severe weather advisories (fog, smoke), road closure and detour information etc. It may be necessary to turn off an AMBER alert sign that creates a traffic hazard.

This Policy primarily applies to the use of permanently installed overhead CMS signs. Should the use of mobile CMS signs be necessary and appropriate at a specific location(s); Caltrans can expect CHP assistance with mobile sign deployment as needed.

TMCs should notify the Caltrans HQ Communications Center when responding to an AMBER alert request. TMCs should monitor and save traffic data in order to determine if unintended consequences of displaying such a message occurred on the highway. A joint debriefing of Caltrans and CHP personnel shall follow every event.

In all cases, messages shall maintain the credibility of the CMS system.

AMBER Alert Policy 2003

APPENDIX H – BIBLIOGRAPHY

Portable Changeable Message Sign guidelines. California: California Department of Transportation; Division of Traffic Operations, April 1998.

Permanent Changeable Message Sign Guidelines. California: California Department of Transportation; Division of Traffic Operations, August 1995.

Manual on Uniform Traffic Control Devices (MUTCD) 2003 Edition., Washington, DC: Federal Highway Administration, 2003.

Federal Highway Administration TMC Pooled-Fund Study.

http://tmepfs.ops.fhwa.dot.gov/efprojects/new detail.cfm?id=25&new=2

Federal Highway Administration Policy Memorandums.

"INFORMATION: Use of Changeable Message Signs (CMS)." March 21, 2003, August 16, 2002, March 6, 2002, January 19, 2001.

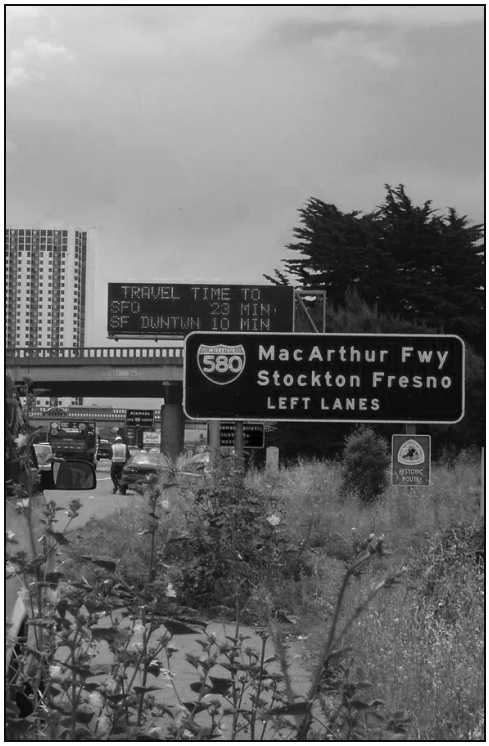
New Jersey Department of Transportation, Transportation Research Record #1692.

Numerous Studies conducted by noted researcher, Dr. Conrad L. Dudek, Texas A&M University.

Virginia Department of Transportation, CMS Procedure Manual, February 2004.

Note: *Every attempt was made to cite reference sources used for this document. Please accept our apology if we overlooked any sources. For questions, please contact Gary Thomas, HQ Traffic Operations, 916-651-6130.*

NOTES:



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