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# **Changeable Message Sign Operation and Messaging Handbook**



**Operations Office of Travel Management**  
**Federal Highway Administration**  
**400 Seventh Street, SW**  
**Washington, D.C. 20590**

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# MODULE 1. INTRODUCTION

## 1.1 BACKGROUND AND SIGNIFICANCE OF THE HANDBOOK

### OBJECTIVES OF THE HANDBOOK

CMSs are playing increasingly important roles in attempts to improve highway safety, operations, and use of existing facilities. CMSs are traffic control devices used for traffic warning, regulation, routing and management, and are intended to affect the behavior of drivers by providing real-time traffic-related information.

The real-time information not only benefits individual drivers and the responsible transportation agency, but also the general public. Motorists are interested in reaching their destinations as safely as possible without undue delays. The transportation agency is interested in utilizing the available highway capacity of the corridor or network and to improve safety and mobility. The general public desires satisfaction of its demands for safe transportation with the least possible adverse environmental impacts due to noise and air pollution.

The *Changeable Message Sign Operation and Messaging Handbook* is a consolidation of the most current and best information on the design and display of effective changeable message sign (CMS) messages for incident and roadwork events. The information was obtained from previous CMS message design and display manuals, more recent research reports, and current state CMS operations manuals, operational procedures, and best practices.

The purpose of the *Handbook* is to provide guidance to assist agencies with improving the design and display of CMS messages and improving CMS operational procedures. The *Handbook* contains the process that can be followed and the techniques that are used to develop effective messages. It was written for personnel in state, regional, and local transportation agencies that have responsibility for the operation of and/or message design for changeable message signs (CMSs) or portable CMSs. It is designed to help both new and experienced users of CMSs at various levels of the agency including a) entry level personnel, b) personnel who are very experienced with traffic operations, and c) managers. It provides very specific information for entry-level personnel, reminders for experienced personnel, and higher-level information for managers regardless whether or not they work in one of the traffic management centers (TMCs) in the state.

### PREVIOUS PUBLISHED GUIDELINES

The first comprehensive set of guidelines for designing and displaying changeable message sign (CMS) messages was documented in the *Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 1 – Design* written in 1978 (1). The *Design Guide* was written following extensive human factors laboratory, controlled field, and operational studies. The emphasis in the report was on a) the recommended content of CMS messages for various traffic situations; b) the manner in which messages should be displayed (format, coding, style, length,

load, redundancy, and the number of repetitions); and c) where messages should be displayed with respect to the situations they are explaining.

Following additional human factors laboratory, controlled field, and operational studies, the 1978 *Design Guide* was updated in 1986 report titled *Manual on Real-Time Motorist Information Displays* (2).

A 1991 report titled *Guidelines on the Use of Changeable Message Signs* (3) provided guidance on a) selection of the appropriate type of CMS display, b) the design and maintenance of CMSs to improve conspicuity (target value) and motorist reception of messages, and c) pitfalls to be avoided. CMS technology developments after 1986 were emphasized.

In 1997, the New Jersey Department of Transportation funded a multiyear research study that included human factors laboratory and controlled field studies dealing with CMS message design and operations. The research led to the development of the *Variable Message Sign Operations Manual* that was written in 2001 (4). The report includes detailed step-by-step processes for designing messages for incident and roadwork situations and includes CMS operational policies. It provides very specific information for CMS operators and entry-level personnel, reminders for experienced personnel, and higher-level information for managers.

The 2002 *Changeable Message Sign Operation and Messaging Handbook* is an update and expansion of the New Jersey *Variable Message Sign Operations Manual* written for national use with added emphasis on CMS policy and operational procedures. The design and display of messages on CMSs introduce many challenges to transportation agencies. Recommendations to meet these challenges are presented in this *Handbook*. In addition, a few operational practices are discussed with respect to conformance and nonconformance to recommended message design and display that are based on human factors studies.

Any individual in a management or supervisory position who has an interest in and/or responsibility for designing and displaying CMS messages should, as a minimum, have the following basic references in addition to this *Handbook*.

- Dudek, C.L. and R.D. Huchingson. *Manual on Real-Time Motorist Information Displays*. Report FHWA-IP-86-16. FHWA, U.S. Department of Transportation, August 1986.
- Dudek, C.L. *Guidelines on the Use of Changeable Message Signs*. Report FHWA-TS-90-043. FHWA, U.S. Department of Transportation, July 1991.
- Dudek, C.L. *Changeable Message Signs*. National Cooperative Research Highway Program, Synthesis of Highway Practice 237, TRB, National Research Council, 1997.
- Dudek, C.L. *Variable Message Sign Operations Manual*. Report FHWA-NJ-2001-10, New Jersey Department of Transportation, December 2001.

## **1.2 OVERVIEW OF HANDBOOK MODULES**

The *Changeable Message Sign Operation and Messaging Handbook* contains the following ten modules and two appendices:

- Module 1. Introduction;
- Module 2. Principles of Changeable Message Sign Operations;
- Module 3. CMS Operations Policies;
- Module 4. CMS Operating Fundamentals;
- Module 5. Principles of CMS Message Design;
- Module 6. Dealing with Long Messages;
- Module 7. Establishing the Maximum Message Length;
- Module 8. Formatting Messages;
- Module 9. Dynamic Features on CMSs;
- Module 10. CMS Operations Procedures and Guidelines;
- Appendix A. CMS Message Design Process: Incidents; and.
- Appendix B. CMS Message Design Process: Roadwork.

### **MODULE 1. INTRODUCTION**

The first module includes a discussion of the background and significance of the *Changeable Message Sign Operation and Messaging Handbook*. The importance of TMC managers and CMS operators to know how to design effective CMS messages is discussed and the message design process is summarized.

### **MODULE 2. OVERVIEW OF CMS APPLICATIONS, ISSUES, AND MESSAGE DESIGN**

The more common types of applications are summarized. An overview of issues involved with the design and display of CMS messages is given. The relationships of message design and CMS purchase and with the National Transportation Communications for ITS Protocol (NTCIP) are discussed. The importance of maintaining credibility is also presented.

### **MODULE 3. CMS OPERATIONS POLICIES**

Available CMS operations policies and guidelines at the federal level are summarized. Guidelines are presented to assist transportation agencies in developing statewide or regional policies for the operation of CMSs. As one example, Module 3 contains excerpts from the current New Jersey Department of Transportation CMS Operating Policies.

## **MODULE 4. CMS OPERATING FUNDAMENTALS**

Module 4 contains a discussion of the six basic fundamentals when operating CMSs. These are: 1) Determine the purpose for using a CMS; 2) Determine which CMS is (are) appropriate to use; 3) Determine what to display on the CMS; 4) Determine how long to display the message; 5) Resolve any message signing conflicts that exist; and 6) Display and verify message.

## **MODULE 5. PRINCIPLES OF CMS MESSAGE DESIGN**

Basic principles for designing CMS messages are presented in Module 5. It contains an overview of issues for message design, discussion of selecting the audience for the message and definitions and message design considerations. Details are given for the first step in the CMS message design process, design of the Base CMS Message. The Base CMS Message contains all of the possible information that could be effectively used to advise motorists of a crash or roadwork. Guidelines for initially reducing the length of the Base CMS Message without changing the meaning of the message are then presented. Meanings of words and phrases based on human factors research are also given. Classification, definition, and discussion of six types of diversion routes that might apply in a diversion situation are given. Suggestions for messages after an incident is removed, to support highway advisory radio, and for trucks and hazardous cargo are also presented. The use of graphics in messages is also discussed.

## **MODULE 6. DEALING WITH LONG MESSAGES**

In some cases, the Base CMS Message will exceed the amount of information that motorists can read and comprehend in the short time they have available to read the message after applying the guidelines in Module 5, or will exceed the amount of information that can physically fit on the CMS. Module 6 contains additional guidelines for several ways to reduce the message length and units of information. It includes guidelines on a) splitting messages into two phases, b) deleting “dead” words, and c) abbreviations

## **MODULE 7. ESTABLISHING THE MAXIMUM MESSAGE LENGTH**

Message length and CMS viewing distance requirements are discussed. Guidelines for the maximum CMS message length in terms of the maximum number of units of information that can be displayed are given based on CMS type, travel speed and sun position. Guidelines for reducing this maximum on light-emitting diode CMSs due to adverse vertical grades, horizontal curves, rain or fog, are also presented. A discussion and data concerning the number of motorists who may fail to read an entire CMS message because of the presence of trucks in the traffic stream are also given.

## **MODULE 8. FORMATTING MESSAGES**

In this module, message element priorities are described. Examples of correctly formatted messages using the principles discussed in the *Handbook* are presented. Examples are also

provided of messages that violate sound principles for effective design. The Module includes examples of both incident and roadwork messages.

## **MODULE 9. DYNAMIC FEATURES ON CMSs**

The following dynamic features of CMSs are discussed: a) flashing a one-phase message, b) flashing message lines, and c) alternating one line in a two-phase message. Available research results are discussed.

## **MODULE 10. DEVELOPING CMS OPERATIONS GUIDELINES**

Module 10 is devoted to a listing and items that a state DOT may want to include in a CMS operational guidelines for use at a TMC.

## **APPENDIX A - CMS MESSAGE DESIGN PROCESS: INCIDENTS**

CMS message design processes for the design of effective messages for incidents are presented in flow charts.

## **APPENDIX B - CMS MESSAGE DESIGN PROCESS: ROADWORK**

CMS message design processes for the design of effective messages for roadwork is presented in flow charts.

## **REFERENCES**

1. Dudek, C.L., R.D. Huchingson, W.R. Stockton, R.J. Koppa, S.H. Richards, T.M. Mast. *Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 1 – Design Guide*. Report FHWA-RD-78-5. FHWA, U.S. Department of Transportation, September 1978.
2. Dudek, C.L. and R.D. Huchingson. *Manual on Real-Time Motorist Information Displays*. Report FHWA-IP-86-16. FHWA, U.S. Department of Transportation, August 1986.
3. Dudek, C.L. *Guidelines on the Use of Changeable Message Signs*. Report FHWA-TS-90-043. FHWA, U.S. Department of Transportation, July 1991.
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5. Dudek, C.L. *Changeable Message Signs*. National Cooperative Research Highway Program, Synthesis of Highway Practice 237, TRB, National Research Council, 1997.



# **MODULE 2. OVERVIEW OF CMS APPLICATIONS, ISSUES, AND MESSAGE DESIGN**

## **2.1 BACKGROUND**

### **INTRODUCTION**

Road signs exist to communicate information to motorists. Static guide signs are permanent and are limited to presenting information that is largely "geographically linked." Changeable message signs (CMSs), sometimes referred to as variable message signs or dynamic message sign, can present up-to-the-moment traffic information.

CMSs are programmable traffic control devices that can usually display any combination of characters to present messages to motorists. These signs are either permanently installed above or on the side of the roadway, or portable devices attached to a trailer or mounted directly on a truck and driven to a desired location. Portable CMSs are much smaller than permanent CMSs and are oftentimes used in highway work zones, when major crashes or natural disasters occur, or for special events (e.g., sport events).

When installed, CMSs become a part of the total motorist information system. Thus the information presented on CMSs and the placement of the signs must be consistent and compatible with static signs used on the freeway.

CMSs perform a critical role on freeways. Such signs can furnish motorists with real-time information that advises them of a problem and in some cases, a suggested course of action. CMSs are also used to improve motorist safety and reduce traffic congestion and delay. CMSs can also be used to manage traffic by displaying early warning, advisory and alternative route messages.

- |   |
|---|
| <p><b>CMSs are used to manage traffic by displaying:</b></p> <ul style="list-style-type: none"><li>● <b>Early warning messages</b></li><li>● <b>Advisory messages</b></li><li>● <b>Alternative route messages</b></li></ul> |
|---|

### **EARLY WARNING MESSAGES**

Early warning messages give motorists advance notice of slow traffic and queuing ahead and are effective in reducing secondary crashes. When used in freeway work zones, early warning messages also give notice of new detours, changes in detour route, changes in lane patterns, special speed control measures, etc.

### **ADVISORY MESSAGES**

Advisory messages provide motorists with useful information about a specific problem along their route. This information allows motorists to change their speed or path in advance of the problem area, or may encourage them to voluntarily take an alternative route to their destination.

## ALTERNATIVE ROUTE MESSAGES

Alternative route messages influence motorists to travel to their chosen destination by using different routes than originally intended. The alternative route is one designated by the transportation agency. In cases when the freeway is physically closed as a result of construction, crash, or natural disaster, the motorists are notified that an alternative route must be used.

## APPLICATIONS OF CMSs

Permanently mounted CMSs are used primarily for the following applications:

- ***Non-recurrent problems*** – Caused by random, unpredictable incidents such as crashes, stalled vehicles, spilled loads; or caused by temporary, preplanned activities such as construction, maintenance, or utility operations.
- ***Environmental problems*** – Caused by acts of nature such as fog, floods, ice, snow, etc.
- ***Special event traffic problems*** – Problems associated with special events (e.g., ballgames, parades, etc.).
- ***Special operational problems*** – Operational features such as high occupancy, reversible, exclusive or contraflow lanes and certain design features such as drawbridges, tunnels, ferry services.

A limited number of agencies are also using CMSs for:

- ***Recurrent problems*** – Caused by daily peak period traffic demands exceeding freeway capacities. In some cases, limits-of-congestion messages are displayed; in other cases, travel time messages are displayed.

## OVERVIEW OF ISSUES

CMSs are one of the primary links a transportation agency has to the motoring public it serves. Since the signs represent the primary concept of intelligent transportation systems (ITS) to motorists, improperly designed or operated CMS messages will have a negative impact on the perception of the public about ITS in general. The design and display of messages on CMSs introduce many challenges to transportation agencies. Some of the more relevant issues involved are briefly summarized in the following paragraphs.

***CMSs are the direct link with the motoring public***—CMSs can be an effective tool for communicating with motorists. However, displaying messages that are too long for motorists to read at prevailing highway speeds or that are too complex or inappropriately designed leading to motorist confusion, can adversely affect both traffic flow and the transportation agency's credibility.



***Efforts must be made to ensure that CMS messages are standardized and consistently applied throughout a state or region***—The messages displayed must be "transparent" to travelers in the state or region. Therefore, messages need to be presented in a consistent manner and order based on motorists' expectancies.

***Only a few seconds are available to communicate a message***—At prevailing highway speeds, the CMS message must be presented to motorists in about eight seconds or less. This translates to a message with a maximum of eight words. Uninformed transportation personnel sometimes design and display messages that are too long for motorists to read while driving at prevailing speeds.

***Available exposure time controls the maximum length of message that should be displayed***—Results of research have indicated that the reading times for CMSs are higher than for static guide signs. One distinguishing factor is that motorists can scan guide signs for relevant information; whereas, they must read the entire message displayed on CMSs in order to understand the message. Exposure time is directly related to message legibility distance and driving speed. For a specific type and design of CMS, the available message exposure time dictates the maximum length of message that can be displayed for a given highway operating speed. Another difference is that motorist view static signs regularly and are familiar with them. Additionally static signs are uniform throughout the U.S., particularly with respect to message formatting.

***In many signing situations, some of the basic information that could be useful to motorists must be omitted from the CMS message***—Key CMS objectives include maximizing information transfer to motorists; providing explicit advice; eliciting specific motorist response; and inducing motorist confidence. One major challenge is that this must be accomplished within a short time frame. CMS operators must strive to satisfy basic motorist information needs that allow more informed driving decisions to be made during incidents and roadwork. However, in most cases these basic needs exceed the number of information units that a motorist can read and comprehend at prevailing driving speeds. Therefore, some of the information in the basic message must be omitted in order to meet the maximum number of information units that can be processed by motorists. Tradeoffs must be made as to what elements of the message should be omitted.

***In many signing situations, CMS legibility distance constraints reduce the amount of information that can be communicated to motorists***—The length of message that can be displayed on a CMS at a location also depends on how far away the motorists can adequately view the message and the prevailing speed of vehicles. At some locations, geometric features sometimes obscure the visibility to the CMS. At times, trucks in the traffic stream may obscure the motorist's view to the CMS. Environmental conditions such as rain and fog deteriorate the amount of light that is coming from the CMS, thus reducing the distance at which motorists can read the message. The CMS message length must be reduced to compensate for the reduced legibility distance when and where these conditions exist.

***Steps can be taken when developing CMS messages to enhance motorist understanding of messages***—In developing messages, factors that enhance understanding of messages include the following:

- Simplicity of words,
- Brevity,
- Standardized order of words,
- Standardized order of message informational units,
- Understood abbreviations when abbreviations are needed, and
- Standardized applications of messages.

An efficient, brief, and to-the-point message is a good message. Just because there are spaces available on a CMS does not mean that all spaces should be used for a message.

***CMS messages should be displayed and changed in a timely manner***—The importance of timely display of CMS messages stems back to credibility. CMS operators do not always have all the information necessary to display messages that provide all of the details for motorists to make decisions. This is particularly true immediately after the operators are notified that an incident has occurred. Information should be displayed as quickly as it becomes available, recognizing that the CMS operator may have to change a message several times over the course of the event as new information becomes available or traffic conditions change.

Another consideration is that in some systems operators must manually type in all new messages before they are displayed. Other systems are designed with computer assisted message design and display.

***In practice, the design and display of CMS messages are not always consistent with published recommendations based on human factors laboratory, controlled field, and operational research studies***—CMS message design and display practice should be consistent with recommendations based on human factors research. The underlying reasons for the inconsistencies are not totally known. However, it is speculated that some managers and supervisors are tempted to display as much information that could fit on a CMS without recognizing that the messages exceed the capabilities of drivers to read and comprehend the messages. Results of a survey indicated that not all TMC managers have access to pertinent reports that are available to assist them in designing and operating CMS (5).

***Operating agencies should have written CMS policies and/or operational procedures***—CMS message design and display should be predicated on CMS operational policies and procedures. Although an agency is more likely to have written operational procedures, most do not have written policies. Operational policies dictate some of the requirements for operational procedures.

***CMS message objectives should be established and messages should be designed before CMSs are purchased***—Too often, agencies purchase CMSs before signing objectives and messages are determined. The consequence is disappointment in the inability of the CMS system to display the appropriate messages because the sign does not have enough lines, and/or the line length is

not long enough to display the desired messages. In addition, the CMSs have lower than expected target value and legibility for the environmental conditions present at the site.

## **2.2 RELATIONSHIP OF MESSAGE DESIGN AND DISPLAY AND CMS OPERATION TO CMS PURCHASE**

Dudek (3) emphasizes the importance of establishing signing objectives and designing the messages prior to finalizing the specifications and purchasing CMS hardware. Too often, after agencies identify locations for CMSs, hardware is purchased before signing objectives and messages are determined. The consequence is disappointment in the inability of the CMS system to display the appropriate messages because the number of lines is not enough, and/or the line length is not long enough to display the desired messages. In addition, the CMSs can have lower than expected target value and legibility for the environmental conditions present at the site.

Although the emphasis in this report is not on hardware, a recommended procedure for determining the types of CMSs that will be acceptable for a given application is given below. It should be noted that the nine steps of the procedure are interrelated and that the procedure is an iterative process. Therefore, it is likely in practice that some of the steps will be repeated. (3)

1. Clearly establish the objectives of the CMS.
2. Prepare the messages necessary to accomplish the objectives.
3. Determine legibility distance required to allow motorists ample time to read and comprehend the messages.
4. Determine locations of the CMS that allows motorists ample distance to read, comprehend, and react to the messages.
5. Identify type and extent of localized constraints that might affect the legibility of the CMS.
6. Identify the environmental conditions under which the CMS will operate.
7. Determine the target value and legibility of candidate CMSs.
8. Determine the costs of candidate CMSs.
9. Select the CMS that will allow the selected messages to be read under all environmental conditions within the cost constraints of the agency.

## **1. CLEARLY ESTABLISH THE OBJECTIVES OF THE CMS**

The importance of setting signing objectives cannot be overemphasized because the objectives directly influence message content, format, length, and redundancy, and consequently, the size and placement of the CMS. When setting objectives, the agency must first be specific in defining:

- What the problem is that is to be addressed with the CMS.

And then specify:

- Who is to be communicated with (audience);
- What type of driver response is desired;
- Where the change should take place;
- What degree of driver response is required; and
- How the CMS system will be operated.

## **2. PREPARE THE MESSAGES NECESSARY TO ACCOMPLISH THE OBJECTIVES**

Once the objectives are set, then the various CMS messages necessary to accomplish the objectives should be developed. The length of the messages will help define the character size, message line length, and number of message lines required on the CMS. It may be necessary to modify some of the messages to reduce their lengths as a result of conditions determined in steps 3 through 9.

## **3. DETERMINE REQUIRED LEGIBILITY DISTANCE**

Using guidelines presented in this report and the Basic References, the legibility distance required to allow motorists ample time to read and comprehend the messages is determined.

## **4. DETERMINE CMS LOCATIONS**

Based on the required legibility distance, the potential locations for the CMS are determined which will allow ample time for motorists to read, comprehend and then react to the messages. The CMS must be placed such that the CMS and existing static signs form an integrated and compatible system of information. Guidelines for CMS placement can be found in the *Manual on Real-Time Motorist Information Displays* (2).

## **5. IDENTIFY TYPE AND EXTENT OF LOCALIZED CONSTRAINTS**

Field inspections are advisable to ensure that there are no physical obstructions due to bridges, sign structures, geometries, etc. that would adversely affect CMS legibility. In addition, field

inspections will also help determine whether or not it is possible to actually install a CMS at the site. Obstruction problems would require that the agency either relocate the CMS or reduce the length of the messages.

## **6. IDENTIFY ENVIRONMENTAL CONDITIONS**

The environmental conditions in which the CMS must operate should be clearly identified. Weather conditions such as snow, rain, etc. and other conditions such as blowing dust, heat, cold, etc. will have an effect on the sign's operation and will, in most cases affect the legibility of the messages. These environmental conditions should be made known to the manufacturer so that the best CMS performance characteristics can be achieved. The effects of rain and fog on maximum CMS message size can be found in Reference 4.

## **7. DETERMINE TARGET VALUE AND LEGIBILITY OF CANDIDATE CMSs**

An obviously important, but unfortunately elusive, step is to determine the target value and legibility of the candidate CMSs that are being considered by the agency. An evaluation of the capabilities of the CMSs may dictate the need to reduce the message length or to require the manufacturer to modify the hardware and/or electronics to improve legibility. There are many subjective claims made concerning the legibility distance of selected types of CMSs, but it is important that objective data be used as a basis for determining target value and legibility distances. The latest objective information is presented in this report and can be found in Reference 4.

## **8. DETERMINE COSTS OF CANDIDATE CMSs**

Detailed cost analyses should be made of the candidate CMSs.

## **9. SELECT CMS TYPE**

The CMS can be selected based on satisfying the system requirements.

## **2.3 IMPORTANCE OF MAINTAINING CMS CREDIBILITY**

Paramount to the message design and display, CMSs must provide timely, reliable, accurate and relevant information and they must be operated properly to be effective. Credibility is an extremely important consideration in properly operating a CMS system. Regardless of how well a message is designed, motorists will eventually come to distrust the signing system if the messages are not changed at the correct times and updated to reflect current traffic conditions. Each time the information displayed is disproved, the credibility of the system decreases. Eventually the messages are ignored and the CMS system is in jeopardy.

There are at least eight reasons why message credibility suffers:

- Information is *inaccurate* (e.g., no crash is observed when traffic passes by the location where an incident was displayed on a CMS).
- Information is *not current* (e.g., the message is not consistent with current conditions).
- Information is *irrelevant* to essentially all motorists using that facility.
- Information is *obvious* by inspection, and hence, is redundant (e.g., displaying *HEAVY CONGESTION* when motorists are driving bumper to bumper in peak traffic).
- Information is *repetitive* (the message is the same each morning when motorists pass the sign). Displaying the same information on a CMS each day for recurrent congestion can result in many motorists ignoring the CMS after a time. When an important message is displayed that will impact their trip, the motorists may not read the message. Some agencies are even considering the use of flashing beacons on CMSs to attract the attention of motorists when important messages are displayed.
- Information is *trivial* (e.g., *DRIVE CAREFULLY, SUPPORT YOUR LOCAL RED CROSS*, time and temperature). Displaying trivial information can result in many motorists, particularly commuters, ignoring the messages that have no direct impact on their trips and consequently will begin ignoring the CMS. When an important message is displayed that will impact their trip, the motorists may not read the message.
- Information is *erroneous* and can be easily checked and disproved. Traffic speeds and time to reach a destination are examples of information that can be easily disproved. Delay time is more difficult to disprove by motorists.
- Messages are *poorly designed*. The information is poorly structured resulting in messages that are difficult to read and comprehend, or are confusing. The messages may also contain misspelled words.

## 2.4 CMS OPERATIONS POLICIES AND PROCEDURES

Transportation agencies will have much more success in operating CMSs when they have both 1) written operations policies, and 2) written operations procedures and guidelines. *CMS operations policies* contain the guiding principles that are considered to be prudent and that influence the actions taken by the managers of TMCs in the operation of CMSs. An example is a policy on whether the CMSs should be blank when there are no incidents or roadwork on the freeway. *CMS operations procedures and guidelines* outline and describe the day-to-day operation of the CMSs (e.g., the content and format of CMS messages).

Most agencies, unfortunately, operate without statewide or regional operations policies. Consequently, when requests come to a TMC manager to display certain types of messages that are not consistent with the agency's practice, he/she does not have written documents to help justify decisions about displaying the messages. *Module 3 – CMS Operations Policies* in the

*Handbook* provides a shopping list of candidate policy statements that an agency may want to include in their own operations policies.

## **2.5 MESSAGE DESIGN PROCESS**

The *Guidelines for Changeable Message Sign Messages* is written with a focus on a) the design of effective CMS messages for incident conditions and roadwork and b) when and where to display messages. This emphasis is intentional for the following reason. CMS operations require the user to have a good understanding of not only traffic operations but also of how messages are designed. The latter is important because the CMS message design procedure in this *Handbook* helps the TMC manager to learn more about traffic operations and to understand the strengths, limitations and possible consequences of the messages that are displayed.

The CMS message design process, which was initially developed for the New Jersey DOT, begins with the development of a Base CMS Message using guidelines of acceptable words and message terms for either incident or roadwork events. The Base CMS Message is the sum total of all the information that motorists need to make fully informed driving decisions (e.g., whether to take an alternative route). In most cases, the Base CMS Message must be shortened because it will exceed the amount of information that motorists can read and comprehend in the short time they have available to read the message, or will exceed the amount of information that can physically fit on the CMS. (4)

The maximum length of message that can be displayed on a CMS depends on how far away motorists can adequately view the message and on their perception and information processing capabilities. Viewing distance will be affected by the type of sign used (light-emitting diode, fiberoptic, etc.), the sun position, geometric design of the roadway, and environmental conditions at the CMS location. Travel speed will affect the amount of information that motorists can read and comprehend.

Guidance is given in the *Handbook* in tables on the maximum number of units of information that can be displayed on a CMS based on type of CMS, travel speed, and sun position. In cases where portable CMSs are used, it may be necessary to reduce the maximum number of units of information (using tables in the *Handbook*) because of sight distance restrictions to the CMS due to vertical grades or horizontal curves. Additional guidelines are given for sight distance restrictions to the CMS because of heavy rain or fog.

After the maximum number of units of information that can be displayed on a CMS is determined, guidance is provided to shorten the Base CMS Message so that the maximum is not exceeded while keeping the most important information in the message. The process provides for consistency of information and format. Furthermore, the process assures that motorists will be able to read and understand the messages. The underlying objective is to keep messages as complete and concise as possible.

## 2.6 CMS MESSAGES VS. NTCIP MESSAGES

It is very likely that transportation agency personnel who design CMS messages and/or are responsible for the operation of CMSs in TMCs may become involved with using the National Transportation Communications for ITS Protocol (NTCIP), center-to-center standards like *Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)* (6) and other ITS standards. The NTCIP is a family of ITS standards that provides both the rules for communicating (called protocols) and the vocabulary (called objects or data elements) necessary to allow electronic traffic control equipment from different manufacturers to operate with each other as a system—a very desirable feature. (7).

It is important to recognize that NTCIP standards do not affect the design and types of messages that agencies desire to display on CMSs. The NTCIP is being developed to be responsive to the CMS message needs of the transportation agencies. And as such, the CMS messages actually “drive” the development of the NTCIP standards, and not vice-versa. Thus, transportation agency personnel do not have to know the details of the NTCIP standards in order to design CMS messages or to operate CMSs.

As one becomes involved with applying the NTCIP and other ITS standards, it will become clear that the word *message* is used with two distinct meanings—one that is common to transportation engineers and users of CMSs, and the other that is common to the electronic communications industry. Transportation agencies communicate with motorists about real-time events (crashes, roadwork, etc.) by displaying *messages* on CMSs. The *message* is the information that is displayed to the motorist. It is this definition that is used in the NTCIP standard on *Object Definitions for Dynamic Message Signs* (7).

In the communications industry, on the other hand, a *message* contains a basic set of data and includes information about how the data elements are assembled and how they are to be interpreted by the software as the information is transferred. Thus, when data are transferred between equipment (for instance between TMCs), they are transferred in the form of data *messages*. A *message set* is a group of individual *messages*. It is this definition of *message* and *message set* that is used in the center-to-center ITS standards *Traffic Management Data Dictionary (TMDD) and Message Sets for External Traffic Management Center Communications (MS/ETMCC)* (6).

## REFERENCES

1. Dudek, C.L., R.D. Huchingson, W.R. Stockton, R.J. Koppa, S.H. Richards, T.M. Mast. *Human Factors Requirements for Real-Time Motorist Information Displays, Vol. 1 – Design Guide*. Report FHWA-RD-78-5. FHWA, U.S. Department of Transportation, September 1978.
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5. Dudek, C.L. *Changeable Message Signs*. National Cooperative Research Highway Program, Synthesis of Highway Practice 237, TRB, National Research Council, 1997.
6. ITE-AASHTO TM2.01 (Draft), Message Sets for External Traffic Management Center Communication (MS/ETMCC), ITS Fact Sheet. January 2002.
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## MODULE 3. CMS OPERATIONS POLICIES

### 3.1 INTRODUCTION

This module is divided into two parts. The first part contains summaries of available CMS operations policies and guidelines at the federal level. In part two, guidelines are presented to assist transportation agencies in developing statewide and regional policies for the operation of CMSs. (*Note “region” as used in this Handbook refers to an area encompassing more than one state, in contrast to the division of state DOTs into regions within a state.*)

A distinction is made in this *Handbook* between CMS operations a) policies and b) procedures and guidelines. *CMS operations policies* contain the guiding principles that are considered to be prudent and that influence the actions taken by the managers of TMCs in the operation of CMSs. An example is a policy on whether the CMSs should be blank when there are no incidents or roadwork on the freeway. *CMS operations procedures and guidelines* outline and describe the day-to-day operation of the CMSs (e.g., the content and format of CMS messages). A list of items that an agency should consider in developing procedures and guidelines for the operation of CMSs is presented in *Module 10 CMS Operations Procedures and Guidelines*.

### 3.2 FEDERAL POLICIES

There are no written CMS operations policies at the national level. However, policies, standards, and guidance are embodied in the MUTCD (1) and in four FHWA Policy Memorandums. In addition, another Memorandum describes FHWA’s recommendation for displaying travel time on CMSs. The first Policy Memorandum “Use of Changeable Message Sign (CMS)” (<http://www.fhwa.dot.gov/legsres/directives/policy/pame.htm>) dated January 19, 2001 supports the use of CMSs as a traffic control device to safely and efficiently manage traffic by informing motorists of roadway conditions and required actions to perform. The primary sections addressing CMSs in the MUTCD are *Section 2A.07 Changeable Message Signs*, *Section 2E.21 Changeable Message Signs*, and *Section 6F.52 Portable Changeable Message Signs*. Parts of the January 19, 2001 Memorandum that relate to policies and guidelines are presented below. (2)

*“ . . . Section 2A.07 of the Manual on Uniform Traffic Control Devices (MUTCD) requires that a CMS shall conform to the principles established in the MUTCD related to the use of signs within the right-of-way of all classes of public highways, and to the extent practical, the design and applications prescribed in Sections 6F.02 and 6F.52. Section 2E.21 of the MUTCD specifies that ‘Changeable message signs shall display pertinent traffic operational and guidance information only, not advertising’. ”*

*“The 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.”*

*“ . . . 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. As per MUTCD Section 1A.01 ‘Guide and information signs are solely for the purpose of traffic control and are not an advertising medium’.”*

*“The content of a CMS message should be based on requiring the motorist to take an action. However, operational, road condition, and driver safety focused messages are acceptable to be displayed on a CMS. If driver safety focused messages are to be displayed on a CMS, they should be kept current and relate to a safety campaign. The period of time that a specific message is displayed for a safety campaign should be limited to a few weeks . . .”*

The second Memorandum “Click it or Ticket Signs” dated March 6, 2002 addresses whether the safety campaign message “CLICK IT OR TICKET” is in conformance with the MUTCD. ([http://mutcd.fhwa.dot.gov/res-memorandum\\_clickit.htm](http://mutcd.fhwa.dot.gov/res-memorandum_clickit.htm)) The following statements are contained in the Memorandum: (3)

*“The display of safety messages associated with a safety campaign is allowable under the current MUTCD, as long as it conforms to sign design, location, and spacing requirements and does not block other regulatory, guide and/or warning signs. We have determined that the “Click it or Ticket” signs meet the design requirements and are in conformance with the Manual based on the following analysis.*

*The Millennium Edition of the MUTCD does not specifically address safety message signs; however, there are provisions in Section 1A.03 and Section 2B.51 that allow an agency to develop its own regulatory and warning message signs, as long as they follow the basic guidelines on color, appearance, etc. Section 2B.51 of the Manual also includes the seat belt symbol.*

*The Federal Highway Administration (FHWA) supports the use of a Changeable Message Sign (CMS) as a traffic control device to safely and efficiently inform motorists of roadway conditions and required actions to perform. The FHWA issued a policy memorandum on CMS January 19, 2001 (copy attached). That policy gives general guidance and allows driver safety messages to be displayed on a CMS including those associated with a safety campaign. The “Click it or Ticket” sign design for a safety campaign conforms to the information in this memorandum.”*

The third Memorandum “AMBER Alert Use of Changeable Message Sign (CMS)” (<http://www.fhwa.dot.gov/legsregs/directives/policy/ambememo.htm>) dated August 16, 2002 was prepared to clarify FHWA policy on the use of CMSs to display child abduction messages as part of an AMBER (America’s Missing: Broadcast Emergency Response) Plan Program. Parts of the Memorandum that relate to policies and guidelines are presented below. (4)

*“If public agencies decide to display AMBER Alert or child abduction messages on a CMS, FHWA has determined that this application is acceptable only if (A) it is part of a well-established local AMBER Plan Program, and (B) public agencies have developed a formal policy that governs the operation and messages that are displayed on CMS.*

*(A) A local AMBER Plan Program would include written criteria for issuing and calling off an AMBER Alert, procedures on issues to coordinate with local agencies and other interests, and conforms to the recommendations of the national program. Specific criteria for issuing an Alert and the associated procedures may include:*

- 1. Confirmation that a child has been abducted,*
- 2. Belief that the circumstances surrounding the abduction indicate that the child is in danger of serious bodily harm or death, and*
- 3. Enough descriptive information about the child, abductor, and/or suspect’s vehicle to believe an immediate broadcast alert will help.*

*(B) The formal public agency policy and procedures relating to displaying AMBER Alert or child abduction messages on CMS must address the following issues:*

- 1. The criteria under which CMS will be used for AMBER Alerts.*
- 2. Clear identification of the law enforcement agency responsible for issuing the alert (e.g., State police, local police department, etc.).*
- 3. Agencies, interests, and persons to be contacted and information to be disseminated to initiate or call off an AMBER Alert.*
- 4. Specific recognition that traffic messages, such as lane closures, fog alerts, detours, etc., are the highest priority, and circumstances under which the AMBER Alert message could or could not be displayed.*
- 5. Length of time to display the message (should be of short duration, typically a few hours). (Note: 4 and 5 should be defined in cooperation with the responsible law enforcement agency based on the specific circumstances of the abduction.)*
- 6. Geographic area over which the information is to be displayed (should be limited to a reasonable search distance that is reachable within a few hours).*
- 7. Circumstances that would cause the discontinuation of use of the CMS if the AMBER Alert message creates an adverse traffic impact such as queues, markedly slowing of traffic, etc.*
- 8. Format and content of the messages to be displayed. Agencies should follow the recommended national CMS practices related to the development, use of text, manner in which messages should be displayed, and how CMS are operated.”*

The fourth Memorandum “Use of Changeable Message Sign (CMS) for Emergency Security” (<http://www.fhwa.dot.gov/legisregs/directives/policy/securmemo.htm>) dated March 21, 2003 contains a documentation of FHWA policy for use of CMSs for emergency security. The part of

the Memorandum that addresses FHWA policy should a public agency decide to display emergency or security alert messages on CMSs is presented below. (5)

*“If public agencies decide to display emergency or security alert messages on a CMS, FHWA has determined that this application is acceptable if public agencies have developed policies and procedures that govern the messages that are displayed on CMS and their operation. The public agency policy and procedures relating to displaying emergency or security alert messages on CMS must address the following issues:*

- 1. The criteria under which CMS will be used for emergency or security alert messages, including the necessary coordination with public safety or security agencies. Formal policies among critical stakeholders (such as law enforcement, security, transportation, and public safety) can be used to establish these agreed upon criteria.*
- 2. Protocols or hierarchy for prioritizing messages and determining which messages are to be displayed.*
- 3. Geographic area over which the information is to be displayed, to be determined in cooperation with public safety and security agencies.*
- 4. Identification of the circumstances under which transportation-related messages, such as lane closures, fog alerts, detours, or other messages that may be needed because of dangerous travel conditions in the immediate vicinity, would preempt emergency or security alert messages.*
- 5. The criteria that would cause the discontinuation of use of the CMS if the emergency or security alert message creates an adverse traffic impact such as queues, markedly slowing traffic, etc.*
- 6. Methodology for developing and displaying messages that are appropriate for CMS display including but not limited to standard message sets. Agencies should follow the recommended national CMS practices related to the development, use of text, manner in which messages should be displayed, human factors related to understandability of the messages, and how CMS are operated.”*

A Memorandum dated July 16, 2004 notes that FHWA strongly recommends the display of travel time information in CMSs whenever possible. A part of the Memorandum is presented below (<http://www.i95coalition.org/PDF/Calendar/travel-time-memo-ver3.pdf>) (6).

*“...(The) goal should be to have travel time information as the default information available to motorists throughout the day. A “dark” or blank DMS is a transportation investment that is not being fully utilized. We should be asking why is it dark and what will it take to get travel time posted on an ongoing basis. Furthermore, no new DMS should be installed in a major metropolitan area or along a heavily traveled route unless the operating agency and the jurisdiction have the capability to display travel time messages.”*

### **3.3 REGIONAL POLICIES**

Some state DOTs coordinate their CMS operations with other operating agencies in a region through a variety of formal and informal mechanisms such as committees or coalitions. One of the objectives of a coalition is to coordinate across jurisdictional boundaries the display of timely and accurate information to drivers in major freeway corridors when major incidents occur or during construction. To accomplish this, the roles and responsibilities of Corridor agencies affected by incidents or construction of significant proportion are defined based on the nature of their interaction with the event. These roles and responsibilities are defined in oral or written agreements.

It is likely that agencies in a regional coalition may have different CMS operations policies. Individual states in the coalition should generally operate in accordance with the state policies, and the regional coalition should attempt to ensure, to the extent possible, that the partnership policies on CMS operations comply with key elements of the state policies.

### **3.4. STATE OPERATIONS POLICY STATEMENTS FOR PERMANENT CMSs**

#### **INTRODUCTION**

The paragraphs that follow are intended to provide guidance to agencies interested in developing statewide or regional policies for the operation of CMSs. Twenty-four candidate policy issues are presented. Table 3-1 is a summary of suggested policy issues that should be considered at state and regional levels. Certainly, not all agencies will wish to establish policy on each of these issues. Table 3-1 is intended to remind agencies of several possible policy issues that they may want to consider. The information provided in this section of the *Handbook* will be useful in deciding which policy issues should be selected and in formulating the wording for each policy issue.

To assist the agency in developing a policy, the following information is given for each of the issues listed in Table 3-1: a) an explanation of the policy, b) a policy statement example that an agency can use in developing the policy, and c) justification and/or considerations that may influence the agency's decision to elect to include the statement in its policies, along with supporting references where available. The policy issues and statements were abstracted from the New Jersey DOT *Variable Message Sign Operations Manual (7)* and from documents that the author was able to obtain from a small number of state DOTs. It should be noted that a state DOT agency may prefer to change the wording in the policy statements to fit its own specific needs.

**Table 3-1. Possible CMS Operations Policy Issues**

<b>State</b>	<b>Region<sup>A</sup></b>
1. Responsibility for operation of CMSs	1. Responsibility for operation of CMSs
2. Operation of CMSs by other state DOT personnel	2. Operation of CMSs by other state DOT personnel
3. Operation of CMSs by law enforcement personnel	3. Operation of CMSs by law enforcement personnel
4. General operations	4. General operations
5. Blank signs	5.
6. Messages during peak periods	6.
7. Display of upcoming roadwork	7.
8. Display of upcoming special events	8.
9. Display of travel times	9.
10. Traffic diversion (general)	10. Traffic diversion (general)
11. Traffic diversion to roadways not under jurisdiction of the agency	11. Traffic diversion to roadways not under jurisdiction of the agency
12. Advance notice of roadwork involving lane closures	12.
13. Special events	13. Special events
14. Regulatory speed messages	14.
15. Adverse weather, environmental, and roadway conditions	15.
16. Limits of CMS influence for incidents	16. Limits of CMS influence for incidents
17. Advertising	17.
18. Public service announcements	18.
19. Driver safety campaigns;	19.
20. Display of AMBER Alerts	20. Display of AMBER Alerts
21. Displaying information for other states	21. Displaying information for other states
22. Intermodal information	22. Intermodal information
23. Operation with lane control signals	23.
24. Test messages	24.

<sup>A</sup> The language in the Policy Statement Examples may have to be changed to accommodate cooperative interstate activities.

**1. RESPONSIBILITY FOR OPERATION OF CMSs**

**Policy**

The policy statement is to establish final responsibility for the operation of CMSs on roadways under the jurisdiction of the state DOT, and to establish responsibility for daily operations of the CMSs.

**Policy Statement Example**

*General*

[State] DOT personnel have responsibility for the operation of CMSs on roadways under the jurisdiction of the [State] DOT. The [fill in] office (or position title) has final responsibility for the operation of all CMSs on roadways under the jurisdiction of the [state] DOT. [Add the contact name(s) for general questions about the CMSs and overall responsibility.]



### ***Daily Operations With One TMC In The State***

The [Name of Center] Traffic Management Center manager has the responsibility for the daily operations of the CMSs

### ***Daily Operations With More Than One TMC In The State***

The [Name of Center] Traffic Management Center manager [telephone number] the [Name of Center] Traffic Management Center manager [telephone number], and the [Name of Center] Traffic Management Center manager [telephone number] have the responsibility for the daily operations of the CMSs in [list regions, areas, etc.] in [State], respectively.

### **Justification and/or Considerations**

It is advisable that clear lines of responsibility be established statewide and at the TMC levels.

## **2. OPERATION OF CMSs BY OTHER STATE DOT PERSONNEL**

### **Policy**

When a TMC does not operate 24 hours, 7 days a week, there may be situations that justify having other state DOT personnel operate one or more of the CMSs during off hours either from the sign site or from another TMC. The situations that might arise when the TMC is not operational include events that result in unexpected congestion or impact safety such as: a) incidents, b) emergency roadwork, c) spilled loads, d) special events, e) severe weather or pavement conditions, and f) heavy weekend/holiday traffic.

### **Policy Statement Example**

Authorized District personnel may operate CMSs located in their respective Districts during TMC off hours for emergency situations that may impact safety or traffic operations. The emergency situations may include the following: a) crashes, b) emergency roadwork, c) spilled loads, d) special events, e) severe weather or pavement conditions, and f) heavy weekend/holiday traffic. The authorized District personnel shall only display messages contained in a message library developed by the TMC manager.

### **Justification and/or Considerations**

Although it may not be practical for the state to operate the TMC 24/7, failure to display messages on CMSs when unexpected traffic congestion or events that may impact safety occur contributes to the erosion of the public's trust in the system. Therefore, it may be desirable to have authorized non-TMC personnel operate CMSs from the sign site or from a remote location during off hours.

The personnel must be trained to ensure that the proper messages are displayed for the given traffic or highway situations. In addition, it is recommended that the non-TMC personnel not be allowed to design messages. Rather, the TMC manager should provide a list of acceptable messages that are preprogrammed into the controller at the sign site or reside at the remote CMS CMS system database.

### **3. OPERATION OF CMSs BY LAW ENFORCEMENT PERSONNEL**

#### **Policy**

When the TMC does not operate 24 hours, 7 days a week, there may be situations when it is desirable to have law enforcement personnel operate one or more of the CMSs during off hours. The situations that may arise include: a) incidents, b) spilled loads, and c) severe weather or adverse pavement conditions. Operation of the CMSs may be at the sign site or from a remote location if the law enforcement agency is provided with the necessary equipment.

#### **Policy Statement Example**

Control of CMSs during TMC off hours can be arranged with the [*State, city, county, etc.*] law enforcement agency provided that appropriate agreements are developed. Authorized law enforcement personnel may operate CMSs identified by the manager of the [*Name of Center*] TMC for emergency situations during TMC off hours. Messages may be displayed for the following situations: a) incidents, b) spilled loads, and c) severe weather or pavement conditions. Law enforcement personnel shall only display messages contained in a message library developed by the TMC manager.

#### **Justification and/or Considerations**

Although it may not be practical for the state to operate the TMC 24/7, failure to display messages on CMSs when unexpected traffic congestion or events occur that may impact safety contributes to the erosion of the public's trust in the system. Therefore, it may be desirable to have authorized law enforcement personnel operate CMSs from the sign site during off hours.

The law enforcement personnel must be trained to ensure that the proper messages are displayed for the given traffic or highway situations. In addition, it is recommended that the law enforcement personnel not be allowed to design messages; but rather, the TMC manager should provide a list of acceptable preprogrammed messages.

### **4. GENERAL OPERATIONS**

#### **Policy**

A policy statement is included to emphasize the type of messages that are allowable on CMSs within the state.

## **Policy Statement Example**

Only real-time information about incidents and roadwork, and about traffic, roadway, environmental, or pavement conditions that could have an effect on driver safety and traffic efficiency shall be displayed on the CMSs, with the exception that the following may occasionally be displayed: a) advance notification of roadwork requiring lane closures as described in Policy Statement 7, and b) advance notification of special events that will adversely affect travel either because of the added traffic generated or the requirement to close streets or highways (e.g., parades, street auto races, etc) as described in Policy Statement 8. *(The following statement can be added if a state allows messages for safety campaigns.)* Occasional messages associated with driver safety campaigns and AMBER alerts as described in Policy Statements 19 and 20 are permitted. Incidents include crashes, disabled vehicles, debris, or utility line breaks.

## **Justification and/or Considerations**

It is advisable to have a policy statement that succinctly addresses the use of the CMSs.

## **5. BLANK SIGNS**

### **Policy**

The policy statement is to keep the CMS in a blank mode during the peak and off-peak periods in the absence of incidents and roadwork, and current traffic, roadway, environmental, or pavement conditions that could have an effect on driver safety and traffic efficiency.

### **Policy Statement Example**

CMSs will be in a blank mode during the peak and off-peak periods when traffic, roadway, environmental, or pavement conditions do not warrant the display of a message, or messages of advance notification of roadwork requiring lane closures (Policy Statement 7. *Display of Upcoming Roadwork*), or special events (Policy Statement 8. *Display of Upcoming Special Events*) are not being displayed. *(A phrase can be added if the state allows messages for safety campaigns and AMBER alerts.)*

### **Justification and/or Considerations**

Once a CMS system is installed, a question always arises concerning when messages should be displayed. There are two schools of thought:

1. Display messages only when unusual conditions exist on the freeway; or
2. Always display messages regardless of whether or not unusual conditions exist on the freeway. Or, as a minimum, always display a message during the peak periods and only when unusual conditions exist during the off-peak periods.

The author of this *Handbook* subscribes to the former of the two approaches because of human factors principles and because of difficulties in designing messages when incidents actually occur during the peak periods. The second approach of always displaying a message leads to violation of the following two important human factors principles for CMS operations cited by Dudek and Huchingson (8):

- Don't tell drivers something they already know; and
- For more effective systems, use the CMSs only when some response by drivers is required (i.e., change in speed, path, or route).

In the absence of incidents during the peak periods, more often than not, bottleneck locations and the subsequent locations and durations of congestion can almost be predicted. Consequently, the same congestion information will most likely be displayed almost daily. The display of repetitive information will result in many drivers failing to read the CMS even when important information is given. Some agencies are even considering the use of flashing beacons on CMSs to attract the attention of motorists when incident, roadwork, etc. messages are displayed. To circumvent any possible adverse public reaction to seeing blank signs, the public could be educated through the media that the signs will be activated only when unusual freeway conditions exist. When so advised, drivers should be alert whenever a message is displayed on a CMS because they know that it will likely affect them. Messages should be displayed when some action is required of the driver. (8)

Another consideration with respect to displaying messages for recurring congestion is that one simply runs out of descriptors for the various possible levels of congestion. For example, if descriptors such as *HEAVY CONGESTION* or *MAJOR DELAY* are used to describe recurrent congestion, then descriptors are not available for the more severe congestion when incidents occur during the peak period.

Results of a survey reported by Dudek (9) in 1997 showed that 20 of 26 (77 percent) transportation agencies responding had a policy of displaying messages only when unusual conditions were present on the facility and leave the CMS blank during other times.

In contrast, because of delayed construction schedules, the CMSs were installed for the INFORM Project on Long Island more than 18 months before the system became operational. Adverse public reaction to having expensive CMSs sitting idle for several months prompted New York to adopt a policy of displaying some type of message on the freeway CMSs at all times. (10)

## **6. MESSAGES DURING PEAK PERIODS**

### **Policy**

The policy statement is to prohibit display information about recurring congestion during peak periods in absence of incidents.

## **Policy Statement Example**

During daily peak traffic periods, messages shall be used to advise motorists of unusual conditions (e.g., crashes, lane blockages, etc.) and congestion descriptors (e.g., *CONGESTION NEXT 2 MILES*) shall not be used to advise motorists of normal daily recurrent peak period traffic congestion conditions.

## **Justification and/or Considerations**

(See *Justification and/or Considerations* presented previously for 5. *Blank Signs*)

## **7. DISPLAY OF UPCOMING ROADWORK**

### **Policy**

The policy statement is to allow display of upcoming roadwork that could impact the efficiency of drivers' trips because of lane closures or other activities in the work zone. In addition, the number of days in advance of the roadwork during which a message can be displayed is established.

### **Policy Statement Example**

Traffic-related information that provides advance notice of upcoming roadwork may be displayed, but should be replaced by current information whenever applicable. The upcoming roadwork may be on a freeway that could possibly affect the drivers' trips (e.g., the same freeway as the CMS, downstream intersecting freeway, etc.). The advance notification should not be given more than 7 days prior to the roadwork. Calendar dates should not be used in the message.

### **Justification and/or Considerations**

Some state DOTs are concerned about adverse public reaction when CMSs are left in a blank mode in the absence of incidents, roadwork, or other conditions that may adversely affect the driver's safety or travel efficiency. Periodic display of relevant upcoming roadwork reduces the amount of blank time on the CMS.

Results of human factors studies in New Jersey (11) and Texas (12) indicate that the majority of drivers cannot relate calendar days (e.g., *SEP 25-SEP 28*) displayed on signs with the actual workdays. Consequently, calendar dates should not be displayed on CMSs. Days of the week (e.g., *TUES-FRI*) should be displayed instead. Therefore, advance notification of roadwork should not be displayed more than one week prior to the roadwork in order to avoid the need to display calendar days.

## **8. DISPLAY OF UPCOMING SPECIAL EVENTS THAT ADVERSELY AFFECT TRAVEL**

### **Policy**

The policy statement is to allow display of information about upcoming special events that will adversely affect travel by generating major traffic or by requiring street or highway closures (e.g., parades, street auto races, etc.). In addition, the number of days in advance of the event during which a message can be displayed is established.

### **Policy Statement Example**

Traffic-related information that provides advance notice of upcoming special events that will adversely affect travel by generating major traffic or by requiring street or highway closures (e.g., parades, street auto races, etc.) may be displayed. The advance notification should not be given more than 7 days prior to the special event. Calendar dates should not be used in the message.

### **Justification and/or Considerations**

*(See Justification and/or Considerations for 7. Upcoming Roadwork.)*

## **9. DISPLAY OF TRAVEL TIMES**

### **Policy**

Some agencies have the capability to measure or estimate travel times between sensor stations and to automatically display travel time information on CMSs. The policy is to allow travel time messages to be displayed during peak and off-peak periods in the absence of incidents, roadwork, or other conditions that may adversely affect the driver's safety or travel efficiency.

### **Policy Statement Example**

Travel time information may be displayed if travel times can be measured or calculated using the electronic sensor equipment on the freeway and in the TMC, and if the information can be displayed and updated on the CMS automatically by the system computers. *(Note: Experience with displaying travel time information indicates that manual operation, particularly when a large number of CMSs are operated, is extremely difficult for CMS operators. Displaying travel time manually introduces a tremendous amount of workload to the CMS operators, particularly when an incident occurs on the freeway. However, if an agency wishes to display travel time manually, the Policy Statement Example can be modified by deleting the second phrase of the sentence.)*

## **Justification and/or Considerations**

Display of travel time information helps to reduce the amount of time that the CMSs are blank in the absence of incidents or roadwork. Travel time is generally calculated from speed measurements taken at loop detector stations or measured directly with automated vehicle identification (AVI) sensors. .

It is important to recognize that the data available from these sources are estimated travel times of current conditions (loop detectors) or the travel times of the vehicles that recently traveled between two AVI sensor stations. In essence it is historical travel time. The process of accurately predicting the travel times of drivers viewing the CMS is not currently available. Recent human factors laboratory studies by Dudek et al. (12) suggest that the historical travel times obtained from loop or AVI sensors is acceptable to use in CMS messages. (Refer to the section on *Travel Time* beginning on page 5-17.)

## **10. TRAFFIC DIVERSION (GENERAL)**

### **Policy**

The policy statement is to ensure that positive guidance in the form of signs and/or law enforcement or traffic control personnel are placed at critical locations along the alternative route when the CMS messages direct drivers to divert to the specific alternative route.

### **Policy Statement Example**

When incidents occur that do not require the full closure of the roadway and it is desirable to divert traffic from the freeway, CMS messages shall not divert motorists to specific alternative routes unless positive guidance is available along the alternative route in the form of a) guide signs and/or trailblazers to the major destination, or b) law enforcement or traffic control personnel positioned at critical locations along the alternative route to control and guide traffic. Furthermore, both of the following conditions must be met:

- The CMS operator has current and continuously-updated knowledge of the traffic conditions on the alternative route; and
- The alternative route will result in a significant savings in time for the diverted motorists.

## **Justification and/or Considerations**

It is important that motorists are not diverted from the freeway to routes that do not provide positive guidance. Motorists are more willing to divert to an alternative route before they enter the freeway. They are less willing to divert after they are on the freeway because the average motorist enjoys the “security” of not getting lost while on the freeway, and is reluctant to drive on unfamiliar routes if he/she were to divert (13). Results of studies reported in 1979 have

shown that the average motorist at that time indicated a propensity to divert when the delay on the freeway was 20 minutes or more (14,15).

## **11. TRAFFIC DIVERSION TO ROADWAYS NOT UNDER THE JURISDICTION OF THE AGENCY**

### **Policy**

The policy statement is intended to ensure that diversion messages do not advise freeway drivers to use specific local streets that are not under the jurisdiction of the state agency without prior approvals and agreements with the local agency.

### **Policy Statement Example**

Messages giving specific alternative routes may be displayed when the route is another State route. Specific messages recommending that motorists divert to specific roadways and/or local streets that are not within the jurisdiction of the [state] DOT are not permitted unless severe conditions exist and the appropriate agencies are involved. Messages supporting preplanned diversion routes established via written agreements with the local transportation agency are permitted at all times. “Soft” diversion messages (i.e., *USE OTHER ROUTES*) may be displayed when conditions warrant.

### **Justification and/or Considerations**

It is important that institutional cooperation be maintained between the state agency and local agencies.

## **12. ADVANCE NOTICE OF ROADWORK INVOLVING LANE CLOSURES**

### **Policy**

The policy statement is to allow display of advance notice of roadwork involving lane closures that could impact the safety and efficiency of travel, and to prohibit the use of calendar days in the advance notice message.

### **Policy Statement Example**

Displaying advance notice of roadwork or other potential impacts to a roadway is acceptable. However, the advance notice should *not* be displayed more than six days before the roadwork or other event. The advance notice shall be displayed in terms of days of the week. Calendar dates shall not be displayed. Messages that impact the safety and operations of the roadway shall have priority over advance notice messages.



## **Justification and/or Considerations**

Giving advance notice of roadway activities that may impact motorists' travel helps them in planning future trips and travel paths. Results of research conducted in New Jersey (11) and Texas (12) have shown that motorists cannot translate calendar dates to specific days of the week; thus, calendar dates should not be displayed. To adequately sign using the days of the week, it is important that the motorists are not confused as to whether the message applies to the current week or the following week. Thus, the message should not be displayed more than six days before the event takes place.

Advance notice messages have much lower priority to messages that impact the safety and operations of the roadway.

## **13. SPECIAL EVENTS**

Possible applications of CMSs during special events are as follows:

- Accommodate thru drivers on the freeway when their travel is adversely affected by high impact special events; or
- Manage traffic destined to the special event.

### **Policy Alternative #1**

The policy statement is to allow messages to be displayed to advise thru drivers on the freeway when their travel is adversely affected by high impact special events.

### **Policy Statement Example**

CMS messages may be displayed to advise thru drivers on the freeway of adverse traffic conditions created as a result of special event traffic or conditions, or to reroute thru drivers.

## **Justification and/or Considerations**

Special events are traffic related events on highways that involve closing lanes (e.g., bicycle races) or occur off the freeway system but may adversely influence freeway traffic and flows. Informing thru freeway drivers of unexpected congestion, delays, lane closures, or detours resulting from the special event is a legitimate use for the CMSs and is in concert with Policy Statement 1.

### **Policy Alternative #2**

The policy statement is to allow CMSs messages to be displayed to manage traffic destined to high impact special events.

## **Policy Statement Example**

CMSs may be used to accommodate motorists traveling to special events (e.g., sporting event) when the anticipated traffic flow rates to the event exceed [number] vph. The messages may be used to direct motorists from the primary route to an alternative route that will eventually lead to a parking area. Trailblazers shall be used on the alternative route to direct motorists to the special event parking areas. Traffic conditions on the primary route and alternative route must be monitored. Messages intended to elicit diversion shall only be displayed when there is a significant savings in travel time for the motorists destined to the event, or when the motorists are being directed to parking areas with available parking spaces. The message shall be blanked alternately whenever the alternative route does not provide a significant travel time saving.

CMSs may also be used to inform drivers of intermodal facilities and transportation opportunities to accommodate visitors to the special event. (See Policy Statement 22. *Intermodal Information.*)

## **Justification and/or Considerations**

Research has shown that one of the most effective uses of CMSs is for special events (16,17). A large majority of motorists will respond to CMS messages when the information directs them to a faster route to the special event. The alternative route must provide a significant travel time saving. Also, motorists are concerned with specific directions to parking areas; therefore, trailblazers on the alternative route should guide drivers to parking areas. Signing Guidelines for special events is given in the *Manual on Real-Time Motorist Information Displays* (8).

One advantage of CMSs is that messages can be displayed when it is desirable to divert motorists to the alternative route and can be turned off whenever they no longer apply. It is essential that the state agency personnel monitor the traffic conditions on both the primary and secondary routes to ensure that the motorists are not being diverted to an alternative route that does not provide significant time saving.

For some special events, intermodal transportation travel is emphasized for a number of reasons including very limited parking or no parking at all at the special event site. CMSs are useful in informing motorists of the unavailability of parking and the need to park at facilities such as park-and-ride shuttle lots. Directions to the park-and-ride shuttle lots can be given as well.

## **14. REGULATORY SPEED MESSAGES**

### **Policy**

The policy is to ensure that CMSs are not used as an exclusive speed limit regulatory sign.

## **Policy Statement Example**

The CMS message can be displayed to supplement existing static speed limit signs. The CMS message is not enforceable and shall not be used in place of a static sign. However, the CMS can be used to display advisory speed limits without static advisory speed limit signs.

## **Justification and/or Considerations**

For certain conditions such as in freeway work zones there is a need to lower the speed limit below the normal posted speed limit. CMSs may be used to emphasize the change in speed limit that has been established using actual regulatory speed limit signs in that section.

Regulatory messages on current types of CMSs are not recognized or standardized in the MUTCD (1) nor do they have any legal status with respect to any information that they display. *(Note: FHWA is considering a change in the MUTCD that would allow a CMS sign to be used as the sole sign to post regulatory messages such as speed limits without the need for a static sign (18)).*

## **15. ADVERSE WEATHER, ENVIRONMENTAL, AND ROADWAY CONDITIONS**

### **Policy**

The policy allows display of adverse weather, environmental, roadway condition messages.

### **Policy Statement Example**

CMSs may be used to display adverse weather, environmental, or roadway conditions downstream that may impact driver visibility and safety (e.g., fog, major snow storms, sand storms, icy roadway, high cross winds, broken pavement, etc.), or advise motorists of specific regulations due to the weather or roadway conditions (e.g., tire chains required).

Messages, when used, are restricted to a specific location and a specific CMS. The roadway condition must be in the vicinity of the sign in use. General weather, environmental, or roadway condition information (*ICY ROAD CONDITIONS AHEAD*) is not permitted.

### **Justification and/or Considerations**

Informing motorists of adverse conditions helps to prepare them to take action (e.g., reduce speed).

## 16. LIMITS OF CMS INFLUENCE FOR INCIDENTS

### Policy

This policy statement establishes the limits of the message influence with respect to distance downstream of the CMS.

### Policy Statement Example

The following constitutes the policy for displaying incident messages on CMSs.

- Messages should be displayed for all verified major incidents (e.g., multi-vehicle crash affected several lanes, truck overturn, etc.) that occur on the freeway up to [number] miles downstream of the CMS. The message should include the location of the incident (or closure) and the number of lanes closed.
- Information concerning verified minor incidents and lane closures should be displayed for incidents occurring up to [number] miles from the CMS, provided that information about the location and the number of lanes closed can also be given.
- Information concerning verified lane-blocking incidents that occur on an intersecting freeway may be displayed on CMSs that are located upstream of the interchange with that freeway depending on the location, severity and duration of the incident.
- CMSs located on freeways leading to other states may display messages concerning verified major incidents (e.g., all lanes closed, truck overturn, etc.) on connecting freeways within the following states [names of states] depending on the location, severity and duration of the incident.

### Justification and/or Considerations

There is sometimes uncertainty by TMC supervisors concerning whether a CMS should be activated to display a message when an incident occurs that in the supervisor's opinion may not be close to the CMS. If there are more than one TMC in the state, then it is essential that practices are the same among the TMCs.

## 17. ADVERTISING

### Policy

The policy prohibits the display of advertisements or advertisement type messages.

## **Policy Statement Example**

Messages advertising any product, service, campaign or political party are prohibited. Messages for special events should be designed such that advertising is not embedded in the messages (e.g., *GARTH BROOKS CONCERT*).

## **Justification and/or Considerations**

Commercial advertisements on CMSs are prohibited by Federal regulations (see Section 2E.21 in MUTCD). The illegality is also emphasized in two memoranda—one written in 1995 by Jerry L. Malone, Chief Counsel, FHWA (19) and the other written in 2001 by Christine M. Johnson, Program Manager, Operations and Director, ITS Joint Program Office, FHWA (<http://www.fhwa.dot.gov/legsres/directives/policy/pame.htm>) (2).

Oftentimes, special events will have a significant impact on motorists--those attending the special event and those using the same primary freeway to pass by the special event location. Messages for special events can be well designed without including the private company or person sponsoring or performing at the event. For example, if Garth Brooks was performing at the Meadowlands, rather than displaying *GARTH BROOKS CONCERT*, the facility at which the concert will be performed *MEADOWLANDS* can be used.

## **18. PUBLIC SERVICE ANNOUNCEMENTS**

### **Policy Alternative #1**

The policy prohibits display of public service announcements.

### **Policy Statement Example**

Messages designed to relay a public service announcement (ridesharing, enforcement actions, telephone hotlines, potential transit strike notices, etc.) are not permitted on CMSs, nor are messages designed to increase public awareness of a specific topic not associated with traffic or transportation.

### **Justification and/or Considerations**

Public service announcements do not provide drivers with real-time safety or travel efficiency information. Public service announcements provide motorists with information that can be more effectively given through other methods such as media campaigns or pamphlets. These and other methods would benefit a greater majority of the motoring public since it would not be limited to only those that travel on freeways with CMSs.

One argument in support of this policy is the concern that motorists who continually travel a specific route will become accustomed to the public service sign message and then begin to ignore the CMSs. Subsequent messages indicating lane closures, detours, etc., that directly affect the motorists' travels may then tend to be unnoticed. Since CMSs are provided for the

purpose of informing the motorists of unexpected conditions, the signs should be left blank and not be used until such conditions warrant their use. When the use of the signs for real-time information is infrequent, it may be desirable to display other information that may affect the motorists' travel (e.g., existing or planned roadwork on the specific facility or on other intersecting freeways, expressways or toll roads, or travel time information).

A second argument is the potential negative response by the public when public service announcements are displayed. In the past, Caltrans personnel in the TMC in Los Angeles displayed public service messages on freeway CMSs. Although these messages were transportation in nature (e.g., *NEXT TIME TRY AMTRAK TO LAS VEGAS*; *RELIEVE CONGESTION-RIDESHARE*; etc.) they did not relate to the operation of the freeway system. Public reaction to the use of the CMSs in the manner was quite negative. There was a belief among the traffic operations professionals that such use led to a public disregard of messages on the CMSs, thus making the signs less effective when traffic operational messages were displayed. The practice has been discontinued; CMSs are now used only for messages pertaining to unusual real-time traffic flow conditions (20).

## **Policy Alternative #2**

The policy allows display of public service announcements.

## **Policy Statement Example**

Public service announcements (PSAs) may be displayed on a limited and short-term basis. The CMSs should only be used randomly and sparingly for PSAs so that the primary purpose of the signs will not be degraded. PSAs shall not be displayed in urban areas during the peak periods, and the total duration of the display should not exceed [number] hours per day or more than [number] days per month at any permanent CMS location.

PSAs shall not be displayed prior to the approval of the [title]. The text for PSA messages must be approved by the [title].

## **Justification and/or Considerations**

Normally, the CMSs will only be used for PSAs that are directly related to transportation (e.g., carpool information, transit information, etc.). If the CMSs are used on a regular basis for non-critical messages and public service announcements, motorists may begin ignoring the signs and miss urgent messages. The concept is that the signs are blank unless there is something urgent to relay to motorists.

## **19. DRIVER SAFETY CAMPAIGNS**

Although a safety campaign message is a form of public service announcement, it is addressed separately because some states permit safety campaign messages and not other types of public service announcements.

## Policy

The policy allows display of traffic safety messages associated with safety campaigns.

## Policy Statement Example

Public service announcements related to traffic/driver safety issues shall be displayed only as a supplement to local or statewide traffic/driver safety media campaigns on the same topic. The PSAs shall not be displayed in urban areas during the peak periods, and the total duration of the display should not exceed [number] hours per day or more than [number] days per month at any permanent CMS location.

## Justification and/or Considerations

(See Justification and/or Considerations for 17. Public Service Announcements above.)

## 20. DISPLAY OF AMBER ALERTS

### Policy

The policy allows messages to be displayed for child abduction (AMBER) alerts. The policy statement below is an interim policy established by Caltrans (21).

### Policy Statement Example

CMS messages may be displayed 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 meet 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 [name of law enforcement agency] will consult with the investigating agency prior to requesting any CMS sign activations. [State DOT Agency] will only respond to AMBER alert requests from the [name of law enforcement agency]. The TMC staff and local [name of law enforcement agency] staff shall jointly agree upon the most appropriate CMS message content(s). TMC staff shall also consult with [name of law enforcement agency] 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) - 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.

### **Justification and/or Considerations**

The AMBER Plan Program is a voluntary program through which emergency alerts are issued to notify the public about abductions of children. The FHWA has determined that the use of CMSs for this application is acceptable only if the criteria presented in the FHWA Memorandum “AMBER Alert Use of Changeable Message Sign (CMS)” dated August 16, 2002 are satisfied. (<http://www.fhwa.dot.gov/legsregs/directives/policy/ambermemo.htm>) A summary of the criteria was presented earlier in this *Handbook* starting on page 3-2.

The AMBER Plan Program encourages the most effective methods to communicate with the public on behalf of abducted children. The FHWA notes that CMSs are not always the most effective or safest method to disseminate information related to child abductions. Only a limited amount of information can be conveyed on a CMS. When there is a need to provide extensive information to motorists, FHWA states that it is critical that other types of traveler information media (e.g., 511, HAR, web sites, commercial radio) be used, or that the messages on a CMS supplement these other media.

## **21. DISPLAYING MESSAGES FOR OTHER STATES**

### **Policy**

The policy allows messages to be displayed on CMSs when major incidents or roadwork occur in an adjoining state.

### **Policy Statement Example**

CMSs may be used to display messages relating to major incidents and major construction for other agencies. The priority for displaying messages shall remain in the control of [state] DOT. If another agency’s message is preempted by [state] DOT for higher priority needs, [state] DOT shall notify the other agency.

### **Justification and/or Considerations**

Many states in high volume corridors have recognized the importance of providing motorists who travel from one state to another state or through several states with information about major



incidents in the adjacent state. The I-95 Corridor Coalition and the Gary-Chicago-Milwaukee ITS Priority Corridor are examples of multi-state cooperative agreements to apply ITS technologies toward the solutions of regional problems. Also, agreements are sometimes reached between two adjacent states that are not in a high volume corridor.

## **22. INTERMODAL INFORMATION**

### **Policy**

The policy is designed to allow CMS messages to be displayed for inter-modal travel.

### **Policy Statement Example**

CMSs may be used to display messages to inform motorists of conditions to assist them with inter-modal travel. For example, CMSs may display messages to inform motorists a) of the availability of parking at Park-and-Ride facilities, b) of the availability of parking at the [name] Airport, c) whether AMTRAK trains are running on schedule, or d) about delays in departures of the [name] Ferry System. This information is of a lower priority than information concerning roadway incidents and other situations that affect motorist safety. The priority for displaying messages shall remain in the control of [state] DOT.

### **Justification and/or Considerations**

In high-density corridors, travel options are highly interrelated. Information about parking lot availability, ferry system departure delays, etc. can affect freeway driver real-time decisions about which exit ramps to use and so are appropriate information units to present in CMS messages.

## **23. OPERATION WITH LANE CONTROL SIGNALS**

### **Policy**

The policy requires that a message should be displayed on the relevant CMS whenever lane-use control signals (LCS) display red or yellow symbols.

### **Policy Statement Example**

CMS should always be used whenever lane-use control signals are activated to display either red or yellow symbols.

## **Justification and/or Considerations**

At least one state DOT has a similar written policy.

Truly effective freeway LCS symbols should convey a clear message and elicit a consistent response from all motorists if they are to be useful tools for managing traffic during incidents. This should be true whether drivers have been educated about their use, or if they are seeing them for the first time. Results of studies in the late 1950s by Forbes et al. (22) in the late 1970s by Dudek et al. (13) and more recently in the 1990s by Ullman (23) and Wohlschlaeger et al. (24) indicated that the majority of drivers tested understand the meaning of the green arrow and red X. However, the interpretations indicate that the yellow X is ambiguous, particularly when it is displayed with a red X in an adjacent lane. Wohlschlaeger et al. found that a higher percentage of drivers understood the downward slanted yellow arrow than the yellow X and produced the least variation and confusion.

Results of studies by Dudek et al. (12) reported in 2000 showed that only 36 percent of the motorists tested responded that they did not need any additional information beyond what was provided by the LCS and an *ACCIDENT AHEAD* message displayed on a CMS. Fourteen percent stated that they would like to see which lanes were closed (which would be redundant with the LCS). Meanwhile 50 percent of the drivers stated that other information would be useful. Information about the approximate distance to the crash was cited as needed information by 14 percent of the drivers. Finally, smaller proportions of drivers indicated a preference for expected travel times, magnitudes of delays, average speeds downstream, or general caution information. The results suggest that it is possible to rely on the LCS to indicate which lanes are blocked or closed, and to utilize the CMS to provide other key information (what is the problem, how far downstream the problem is located, etc.).

## **24. TEST MESSAGES**

### **Policy**

The policy establishes the appropriate messages that can be displayed during system testing or for special studies.

### **Policy Statement Example**

It is sometimes necessary to display messages on a CMS to assure correct operations, to “burn-in” a new sign, or for special studies. Acceptable test messages should either state *TEST-MESSAGE*, display a portion of the alphabet, a sequence of numbers, or a non-message test pattern such as moving columns or rows, etc. (*Note: SIGN UNDER TEST may be a suitable option to TEST-MESSAGE.*) Other test messages shall be reviewed and approved by [*name of office or title of person*] before they are displayed.

## Justification and/or Considerations

It is vital that drivers are not misinformed with typical traffic control messages displayed for the purposes of system testing.

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# MODULE 4. CMS OPERATING FUNDAMENTALS

## 4.1 BASIC CONSIDERATIONS FOR OPERATING CMSs

### INTRODUCTION

It is important to remember that CMSs are tools to help manage traffic on a roadway system. Just as a carpenter carefully selects a tool and then uses that tool to accomplish a particular construction task, one must determine when and how to use CMSs to best accomplish traffic management tasks.

The operation of CMSs involves six basic considerations presented in logical order:

1. Determine the purpose for using a CMS;
2. Determine which CMS(s) is (are) appropriate to use;
3. Determine what to display on the CMS;
4. Determine how long to display the message (s);
5. Resolve any message signing conflicts that exist; and
6. Display and verify CMS message.

Within each of these, several factors and issues need to be addressed. It is important to realize that these factors often change over the duration of an incident or other event. These changes require the operator to revisit the situation and possibly modify how the CMS is being used. This process can be illustrated as shown in Figure 4-1.

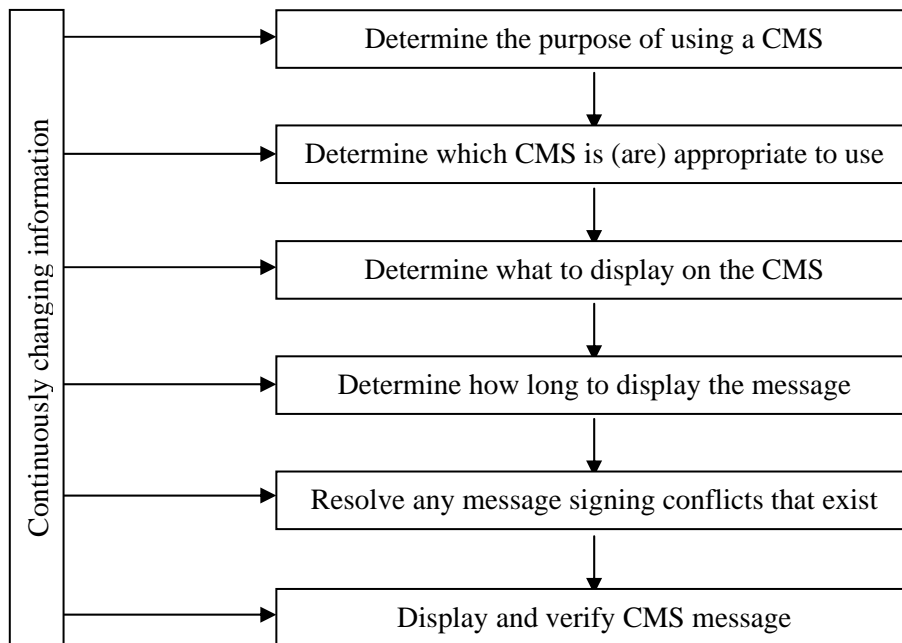


Figure 4-1. CMS Operating Process

## **DETERMINE THE PURPOSE FOR USING A CMS**

CMSs should always be used with a specific purpose or objective in mind. To determine this purpose, the CMS operator must fully understand six things:

1. What is the problem I am trying to address?
2. What verified information do I have?
3. Who is the audience that I am trying to reach with the CMS message?
4. What type of motorist response is required?
5. Where should the response take place?
6. What degree of response is required?

### **What Is the Problem I Am Trying to Address?**

The CMS operator must consider not only the basic type of problem (i.e., crash, work zone lane closure, etc.) that exists, but also the following:

- Location of problem (position within the roadway right-of-way as well as its relation to other freeways and major traffic generators);
- Scope (number and types of agencies that will likely need to be involved, whether police officers will be required to direct traffic at the scene or on a detour, whether a major incident response team will be activated);
- Potential duration of the situation; and
- Extent of impacts (number of lanes affected, location where lanes are affected, nearby ramps that are blocked or constrained by the traffic queue, etc.).

### **What Verified Information Do I Have?**

Credibility is very important in CMS operations; therefore, an CMS operator must determine the information that is available about the:

- Incident,
- Conditions on the primary route, and
- Conditions on the diversion route.

Although it is desirable to design and select messages based on complete and perfect information, situations often occur where an operator receives only limited information about a problem (particularly early on in the timeline of an event). Furthermore, the information that is available may be from an unknown or untrained source (e.g., a motorist), or may conflict with other information that has been received. As a result, a CMS operator must decide what information can be used, and how it can be best used to operate the CMS.

**Verified** information is that which is obtained directly by the CMS operator via closed circuit television or other visual means, or is provided by approved personnel of selected agencies. Law enforcement officers, emergency response personnel, or transportation agency courtesy patrol personnel are examples of individuals who can generally provide verified information.

**Unverified** information, on the other hand, is not obtained directly by the CMS operator or received from the sources above. Most common examples of unverified information are calls received from motorists about incidents that they have encountered. Unconfirmed commercial radio reports are another source of unverified information.

CMS operators should only use verified information to operate CMSs. Motorists and other sources of unverified information will often provide inaccuracies about locations and effects that, if presented to the public and found to be false, degrade the credibility of the CMS system and the operating agency. *However, unverified information can be useful to the operator in identifying information items that may need to be explored further.* For example, calls from one or more motorists that an incident has cleared may prompt the CMS operator to check a closed circuit television (CCTV) camera or contact the appropriate enforcement agency to verify that the incident has indeed cleared.

If recommendations are to be made about a specific diversion route to use around a problem, the CMS operator must also have information about current conditions on that route. If the operator cannot obtain such information, the CMS should not recommend a specific route. The only exception to this is when the freeway has been completely closed and police officers or traffic control personnel are directing traffic along a designated detour route.

### **Who Is the Audience for the CMS Message?**

A component of establishing an objective for a CMS message is to decide who the audience will be for the message. The audience is the group of motorists that the CMS operator wants to respond to the message in some manner. In some cases, this may be all of the motorists who pass by the CMS. In other cases, the message is intended for only some of the motorists (e.g., those who are travelling all the way into downtown). Depending on the situation, it may be necessary to identify the intended audience as part of the CMS message itself. In other situations, the intended audience is implied.

### **What Type of Motorist Response Is Required?**

The operator of a CMS must first decide what he or she wants motorists to do in response to the message to be placed on a sign or group of signs. Messages will be most effective when they encourage some type of response from the motorist, such as to:

- Reduce speed;
- Move out of a blocked or closed lane; or
- Take an alternative route.

## Where Should the Response Take Place?

The location where responses are desired will depend on:

- Type of response desired,
- Layout of the roadway system,
- Type and severity of problem being addressed, and
- Availability of existing guide signs or those installed by the DOT in response to a major incident.

It is important to realize that the desired motorist response to a particular problem may differ depending on where in the roadway system the motorists are at that particular time. For example, the desired response for a motorist traveling immediately upstream of a full freeway closure might be to follow the designated traffic control devices to leave the freeway, travel along the designated alternative route, and return back to the freeway. For motorists approaching an intersecting freeway farther upstream of the closure, however, the desired response might simply be to not exit onto the closed freeway, and find their own alternative route to their ultimate destination. In general, the more severe the problem and the longer it is expected to last, the farther upstream messages should be displayed on CMSs.

## What Degree of Motorist Response Is Required?

The CMS operator must monitor traffic conditions and motorist response to the CMS messages. Suggested alternative routes must provide improved travel to motorists as compared to remaining on the freeway. Remember, the messages on the CMSs can be changed or turned off when conditions on the alternative route(s) no longer are better than the freeway.

- |   |
|---|
| <ul style="list-style-type: none"><li>• <b>Keep message displayed to continue driver response</b></li><li>• <b>Change message or turn message off to reduce driver response</b></li></ul> |
|---|

## DETERMINE WHICH CMS(S) IS (ARE) APPROPRIATE TO USE

### Proximity of CMSs to Problem

Next, the operator must determine which CMS or CMS group within the overall CMS system should be used to address a particular situation or problem. CMS operators should have a fairly good idea of current locations of permanent CMSs or quickly be able to determine their location from maps or computerized databases. These signs should be located where it is most advantageous to provide information to motorists. When signing for a current incident or work zone lane closure, the CMS operator must be careful to make sure that the CMSs selected will reach the appropriate audience for the message to be displayed. Three simple questions should be asked when determining which CMS should be activated:

- Is the incident close enough to the CMS so that the distance does not exceed the written CMS operations policy?



- Is the expected duration of the incident or lane closure longer than the expected travel time from that CMS to the incident or lane closure?
- Are there a significant number of motorists traveling past the CMS who are destined for the incident or lane closure location?

If the answer to any of these questions is “no,” the CMS is not appropriate to activate for that situation. For advance warning of future lane closures and special events, the messages being displayed are typically of a general warning nature and so can be displayed on CMSs over a fairly wide area.

### **Characteristics of the CMS Hardware**

The maximum length of CMS message that should be displayed will be dictated by the characteristics of the sign. These include the type of sign (LED, fiberoptic, etc.), the number of lines available, and the number of characters on each line. Each of these characteristics can have an effect on how far away the CMS can be read and, consequently, how much information can be presented to motorists. It should be the responsibility of the TMC manager/supervisor to assess the CMS characteristics and determine the maximum length of message to display.

In locations where permanent CMS have not been installed or in situations where the amount of information that needs to be presented exceeds the motorists’ processing capabilities from a single sign, it may be necessary to deploy portable CMSs to provide the necessary information to motorists. The time needed to deploy these devices must be considered in determining whether they are appropriate for a given situation. These CMSs should also be deployed far enough away from other CMSs, existing static signing, and complex roadway geometrics such as weaving areas. The agency must ensure that motorists are not overloaded with information when choosing where to place the portable CMS.

### **Roadway, Traffic, and Environmental Characteristics in the Vicinity of the CMS**

The CMS operator needs to also know about the actual site characteristics in the vicinity of the CMS. These characteristics dictate the amount of information that can be displayed. Among the items of interest are the following:

- The operating speed of traffic on the roadway;
- The presence and design characteristics of any vertical curves affecting sight distance;
- The presence of horizontal curves and obstructions such as trees, bridge abutments, or construction vehicles that constrain sight distance to the CMS around the curve;
- The location of the CMS relative to the position of the sun (for daytime conditions);
- The presence, number, and information on static guide signs in the vicinity; and
- Whether or not rain or fog is present to degrade visibility to the sign.

## **DETERMINE WHAT TO DISPLAY ON THE CMS**

### **Basic Information Needs and CMS Message**

CMSs are a transportation agency's direct link to the motoring public. Displaying well-designed messages on CMSs is key to effectively managing traffic and to maintaining credibility with motorists. The majority of this *Handbook* is devoted to proper design of CMS messages.

Proper design begins with understanding the basic information needs of motorists. Motorists want several different types of information in order to make their driving decisions. For lane closure incidents and roadwork, these elements include the following:

- The type of problem (incident or road work descriptor);
- Location of the problem;
- The lanes that are affected (closure description);
- Location of the lane closure;
- The effect on travel;
- The audience for the message;
- Proper response or driving action by motorists; and
- A reason to follow the recommended driving action.

Unfortunately, motorists are not equipped to perceive, process, and remember a large amount of information at one time. Consequently, the job of the CMS operator is to decide what information is most important, and how to present that information on a CMS in a way that maximizes motorist understanding and encourages them to take appropriate actions. Guidelines for accomplishing this are presented in other modules in this *Handbook*.

### **Diversion Routes**

Motorists must not be diverted to arbitrary routes. It is important that the suggested diversion route result in a significant time savings in comparison to remaining on the primary freeway. In addition, it must be a route that contains adequate static guide signs so that motorists can travel without getting lost. It must be an acceptable pre-established alternative route according to the CMS operations policy. Before a recommended diversion route is displayed on a CMS, the CMS operator must know the following about the route given that it is acceptable according to policy:

- Current traffic capacity constraints; and
- Current traffic conditions.

When motorists are advised by the CMS message to divert and take a specific highway or route, it is essential that the destination names and routes used in the message are the same as those displayed on the existing guide signs. Inconsistency between the CMS message and the existing guide signs will lead to motorist confusion and cause some to take incorrect routes. Therefore, if the CMS operator is composing new messages, he/she must have full knowledge of the wording

and route markers on the existing guide signs before diversion messages directing motorists to a specific highway or route are used in a CMS message.

## **CMS Operator Message Options**

The design of a safe, effective CMS message requires consideration of a number of different factors and the interactions between factors. This design process is complex, as is shown in the following modules, and can take a significant amount of time to utilize properly. Fortunately, many situations require a message or group of messages that are identical to those used in other past situations or that have been developed in advance for a particular event. In other situations, a CMS message or message group can utilize a general template and modify an item or two prior to display on the CMS(s). Finally, an extremely complicated or unusual situation may necessitate following the complete design process in order to determine the best CMS message to display. Basic considerations under each of these approaches are discussed below.

### ***Selecting a Message From a Message Library***

In the simplest case, a CMS operator may be able to select a proper message from an existing message library on the CMS operating system. The agency would have a predefined scenario prepared (following the proper message design process) for a given type of problem, location, severity (such as how many and which lanes are blocked or closed), and time of day. If a problem develops that fits the scenario, the CMS operator can simply call up a message from the library and display it on the appropriate sign(s). This approach only requires that the CMS operator be able to verify that all of the information to be displayed on the CMS is correct (which lane or lanes are blocked, the location of the problem, etc.).

### ***Modifying a Message From a Message Library***

Another type of CMS message that may be included in message libraries is one that requires some modification by the operator prior to displaying it on a sign. The modification may be needed to display the correct location of a problem to motorists, the lane(s) that are affected, the action that should be taken, etc.

Modified messages present special challenges in CMS operations. They require CMS operators to make sometimes complex decisions about message elements that need to be changed, whether a change in overall message format is required (e.g., if the location name is fairly long), the proper term to use for a location, etc. Consequently, the potential for errors to creep into modified messages can increase during periods of high operator workload. CMS operators need to pay special attention to ensure that they review such messages prior to posting on a CMS.

### ***Creating a New Message***

If a message in the library does not properly address the particular situation of interest or cannot be modified to address the situation, a new message must be created. Principles and procedures illustrated elsewhere in this *Handbook* should be followed to formulate the message. This requires the highest level of reasoning and decision making from the CMS operator. Those operators who have responsibility for creating new messages must have adequate training of the message design process.

## **DETERMINE HOW LONG TO DISPLAY THE MESSAGE(S)**

After messages have been selected and conflicts resolved, the CMS operator must decide how long to display the message on the sign. For advance warning of upcoming work activity or special events, the message can be shown for several hours or even days prior to the event. However, it is more difficult to determine an appropriate duration for incidents. If the CMS operator has responsibility for only a limited number of CMSs and the incident occurs during off-peak periods when demand for attention is lower, it may be acceptable to set an extremely long duration on the message and simply change the message or turn the message off when the incident clears. This means that the operator must constantly monitor the incident and then remember to deactivate the signs at its conclusion.

During periods of high operator workload or if the operator has a large number of CMS to operate, it may be necessary to estimate the expected duration of the incident and set the message display time to that duration. This may require the operator to periodically adjust the time setting if the expected duration changes as more information about the incident is obtained. The advantage of such a procedure is that it ensures against an operator forgetting that an incident message is being displayed long after the incident is cleared. Failure to change or deactivate messages that are no longer relevant can degrade the agency's credibility with the motoring public.

## **RESOLVE ANY MESSAGE SIGNING CONFLICTS THAT EXIST**

There are two levels of message display priorities that must be established in a TMC. These are

- Priorities of message types, and
- Priorities when two or more events occur on the freeway.

### **Priorities of Message Types**

There are a variety of message types (incident, construction, weather, test messages, etc.) that an agency may consider displaying on CMSs. The priorities of message types should be based on the criticality of the message (e.g., motorist safety, mobility, and information).

A review of the information that TTI received from the states indicate that a) not all states have established a list of message type display priority, b) there are differences in terminology used among the states, c) there are differences in the number of message types used by the states, and d) there are sometimes differences in priorities between TMCs within a state. A summary of message type priorities from four states from which information was available to the researcher is shown in Table 10-1.

**Table 4-1. Examples of State DOT Message Type Priorities**

State DOT 1		State DOT 2	State DOT 3 (Draft)	State DOT 4*
Region 1 (Draft)	Region 2 (Draft)			
1. Dedicated lane control and regulatory CMS – (lane control near entrance to express lanes, variable speed limits)	1. Safety related	1. Drawbridge operations, road or ramp closures, emergency situations	1. Safety related – message that is directly related to specific safety incident (emergency closures of a tunnel or highway).	1. Emergencies – Unplanned events where extreme traffic diversions are required (hurricanes, closure of facility, etc).
2. Safety related – (emergency tunnel or highway closure, flammable restrictions for tunnels, etc.)	2. Information impacting the route a driver would take	2. Incident or accident	2. Roadway closures – message related to an active road or ramp closure (accident, construction).	2. Hazardous conditions – (Extreme weather, unusual roadway conditions, accident or emergency vehicles on shoulder, severe congestion causing reduced speeds.)
3. Roadway or ramp closures	3. Incidents of minor traffic impacts (construction and delay information)	3. Construction or maintenance operations	3. Minor traffic impacts – blocking incidents, (construction, lane closures, delay, etc.)	3. Short-term detour – detours lasting less than one week (overnight ramp closure, temporary weight restriction.
4. Minor traffic impacts – (construction lane closures, blocking incidents, delay information, etc.)		4. Adverse weather or environmental conditions	4. Pre-Warners – planned, major highway closures.	4. Traveler information and suggested alternative routes (expected delay, suggested alternative route, suggested routes to large generator, availability of alternative modes).
5. Public service announcements		5. Traffic information associated with special events	5. Test messages	5. Advance notice for scheduled incidents (lane closures, road closures, special events).
6. Test messages		6. Travel related information directed at individual vehicles		6. Other public information that assists the Department in improving highway safety and reducing congestion. The message must require motorists to alter their driving.
		7. Travel time information		
		8. Public service announcements		

(Safety messages do not include those associated with safety campaigns such as suggestions for safer driving or seatbelt usage).

\* Portable CMSs

## **Priorities When Two or More Events Occur on the Freeway**

Sometimes the CMS operator is faced with competing message needs when two or more events take place on the freeway at the same time. For example, the CMS may contain a message about a downstream crash when a second crash occurs on the freeway. The CMS operator must decide which of the two crashes should be presented on the CMS because it is neither possible nor advisable to display information about two crashes on the CMS.

### ***Basic Message Priorities***

There are a number of different combinations of events that can take place on the primary freeway, on intersecting freeways, and on freeways in an adjoining state. In general the following priority principles should apply:

- Messages about downstream lane closures (blockages) or full closures (blockages) on the primary freeway should receive priority over events on downstream intersecting freeways or on freeways in other states; and
- Messages about lane closures (blockages) or full closures (blockages) on downstream intersecting freeways should receive priority over events on freeways in other states.

### ***Common Types of Competing Message Needs***

Competing CMS message needs for incidents that occur downstream of the CMS can be classified according to whether:

- Two events occur concurrently on the same freeway;
- One event occurs on the primary freeway and the second occurs concurrently on an intersecting freeway;
- One event occurs on the primary freeway and the second occurs concurrently on a connecting freeway in an adjoining state;
- Two events occur concurrently on an intersecting freeway; or
- One event occurs on an intersecting freeway and the second occurs concurrently on a connecting freeway in an adjoining state.

Tables 4-2 and 4-3 are examples of message display priorities when a major crash occurs upstream and downstream of another freeway event that was established by the New Jersey DOT. Similar priority lists when other types of events occur can be found in the New Jersey DOT *Variable Message Sign Operations Manual (1)*. Note that when a major crash occurs upstream of any of the other events shown in the list in Table 4-2, the CMSs will display messages for the upstream major crash. However, when a major crash occurs downstream, it does not always receive priority as shown in Table 4-3.

In establishing the priorities, New Jersey DOT assumed that incidents that occur on the freeways have a good chance of adversely affecting a large percentage of motorists on the freeways. For example, a major incident on an intersecting freeway may possibly have an adverse affect on motorists who will turn off the primary freeway onto the intersecting freeway. However, if the major incident is far downstream (e.g., 10 miles) of the interchange, then the likelihood that the incident would affect motorists turning onto the intersecting freeway would greatly diminish. Typical procedures would require the CMS operator to consult with the TMC manager when the operator is uncertain about possible adverse affects to motorists on the primary freeway.

**THE CMS MESSAGE PRIORITIES ASSUME:**

- **Motorists who travel past the CMS will be adversely affected by the incidents; and**
- **A high majority of motorists normally remain on the primary freeway rather than turning onto an intersecting freeway.**

**Table 4-2. Example of Message Priority for Major Crashes that Occur UPSTREAM of Another Event (Ref 1)**

<b>Major Crash Occurs Upstream of:</b>	<b>Give Message Priority to:</b>
● Crash (Major)	Upstream major crash
● Crash (Minor)	Upstream major crash
● Construction project	Upstream major crash
● Construction project with temporary lane closure(s)	Upstream major crash
● Disabled vehicle blocking a lane	Upstream major crash
● Incident (Load spill, debris, etc.) requiring lane closure	Upstream major crash
● Incident (Load spill, debris, etc.) requiring total freeway closure	Upstream major crash
● Maintenance operations with lane closure(s)	Upstream major crash
● Maintenance operations requiring total freeway closure	Upstream major crash
● Special event exit	Upstream major crash
● Adjoining state crash (Major)	Upstream major crash
● Adjoining state maintenance operations requiring total freeway closure	Upstream major crash
● Adjoining state incident (Load spill, debris, etc.) requiring total freeway closure	Upstream major crash

**Table 4-3. Example of Message Priority for Major Crashes that Occur DOWNSTREAM of Another Event (Ref 1)**

<b>Major Crash Occurs Downstream of:</b>	<b>Give Message Priority to:</b>
● Crash (Major)	Upstream major crash
● Crash (Minor)	Upstream minor crash
● Construction project	Downstream major crash
● Construction project with temporary lane closure(s)	Downstream major crash
● Disabled vehicle blocking a lane	Downstream major crash
● Incident (Load spill, debris, etc.) requiring lane closure	Downstream major crash
● Incident (Load spill, debris, etc.) requiring total freeway closure	Upstream incident
● Maintenance operations with lane closure(s)	Downstream major crash
● Maintenance operations requiring total freeway closure	Upstream maintenance
● Special event exit	Downstream major crash

## **DISPLAY AND VERIFY CMS MESSAGE**

Once the operator is satisfied with the accuracy of the information available, the information in the message and the message format, the selected message can be displayed. After the CMS message is activated, it is important that the operator validate that the correct message is displayed on the CMSs. Validation can be accomplished by viewing the messages via the CCTV. The operator should not rely solely upon electronic validation from the software/computer system.

## **4.2 CMS OPERATIONAL MODES**

There are two basic modes for displaying messages on CMSs from a TMC:

- Manual signing, and
- Automated signing.

### **MANUAL SIGNING**

Manual signing is a process where all messages are typed in and displayed by the operators. Although well-trained and experienced CMS operators can perform effectively, there are many disadvantages to manual signing including the following:

- Difficulty in changing messages in a timely manner, particularly when there are several CMSs in the system or when more than one incident occurs;
- Increased chance of displaying inconsistent messages among the CMS operators and by individual operators;
- Inability to automatically display and update travel time information; and
- Increased chance of incorrect messages being displayed, particularly when the operators are inexperienced.

### **AUTOMATED SIGNING**

Automated signing helps to circumvent the problems of manual signing. Important features include automatic sign message generation, display, update and removal. However, it is important that the software produces efficient and accurate results. A good deal of operational testing is needed to arrive at proper message display levels. The INFORM system experience reported by Smith (2) revealed that initially, only about one third of the automated sign messages generated were accurate compared to human sign message generation based on the same data. The accuracy level increased following software improvements and further operational testing. Automated signing involves a multilevel process. For example, the INFORM system operates under four levels of automated signing (2):

- Intervention,
- Semi-automatic,



- Use, and
- Automatic.

### **Intervention**

In this mode, the operator receives an audible and visual prompt that the system has detected a need to place a message for a specific sign on the system. The system will display the proposed sign message. The operator may then accept or reject the prompt. If the prompt is accepted, the message is sent out to the sign, after which all updates then occur automatically. This mode is frequently used for mainline signs in areas where delays are complex and difficult to analyze, and the system is less likely to generate an accurate message. The mode can be specified for any of the signs on the system.

### **Semi-Automatic**

In this mode, the system automatically sends the problem statement line and the problem location line. Updates are automatic. No diversion statements are processed.

### **Use**

In this mode, lines one and two are handled identically as in Semi-Automatic, however diversions are processed and prompted for line three as in an intervention mode.

### **Automatic**

In this mode, all sign messages are sent and updated automatically for all lines with no prompting.

## **REFERENCES**

1. Dudek, C.L. *Variable Message Sign Operations Manual*. Report FHWA-NJ-2001-10, New Jersey Department of Transportation, December 2001.
2. Smith, S.A. *INFORM Evaluation, Volume 1: Technical Report*. Report FHWA-RD-91-075 FHWA, U.S. Department of Transportation, January 1992.



# MODULE 5. PRINCIPLES OF CMS MESSAGE DESIGN

## 5.1 MESSAGE DESIGN CONSIDERATIONS

### INTRODUCTION

To be effective, a CMS must communicate a meaningful message that can be read and understood by motorists within a very short time period. Human factors and traffic operations research have led to the development of fundamental principles and guidelines for CMS message design that are contained in this *Handbook*. The principles and guidelines are based on a solid understanding of motorist physical and information-processing capabilities and are valid *as long as they are consistently and properly applied*.

### BASIC MESSAGE DESIGN CONSIDERATIONS

Knowledge of basic message design considerations is a necessary prelude to designing and displaying effective messages. Message design involves recognition of the basic principles for the following (*I*):

- **Message content** refers to specific information displayed on a CMS. Essentially, what is wrong ahead and what the motorist should do about it are the key elements.
- **Message length** refers to either the number of words or the number of characters and spaces in a CMS message.
- **Message load** refers to the amount of information in the total message, usually expressed in terms of units of information (informational unit).
- **Unit of Informational (Informational Unit)** refers to the answer to a question a motorist might ask. Stated another way, a unit of information is each data item in a message that a motorist could use to make a decision. Each answer is one unit of information. A unit of information typically is one to three words, but at times can be up to four words. The message in the following table has five units of information and serves to illustrate the concept of units of information.

#### MESSAGE-RELATED DEFINITIONS

**CONTENT:** specific information displayed.  
**LENGTH:** number of words or number of characters and spaces.  
**LOAD:** number of units of information in message.  
**UNIT OF INFORMATION:** the answer to a question a motorist might ask.  
**FORMAT:** order of the information units.

<u>UNITS OF INFORMATION</u>		
<u>Question</u>	<u>Answer</u>	<u>Info Unit</u>
1. What happened?	ACCIDENT	1 unit
2. Where?	AT EXIT 12	1 unit
3. What effect on traffic?	MAJOR DELAY	1 unit
4. Who is advisory for?	NEW YORK	1 unit
5. What is advised?	USE ROUTE 46	1 unit

- *Message format* refers to the order and arrangement of the units of information on a CMS.

## MESSAGE CONTENT

If CMSs are to be read and believed by motorists, the content of the message must provide information relative to the wants of the motorist. Above all, motorists want to know if something "ahead" has occurred on the roadway that requires some action on their part such as changing routes. If an incident did occur or roadwork is taking place, then the motorist wants to know the location. If the incident or roadwork is far away, it may not affect them because they planned to exit long before then. Motorists also want to know the effects of the incident or roadwork. Since it is difficult for agencies to accurately estimate delay, the effects of the incident or roadwork can be given in terms of the number of lanes closed (or open).

A CMS message should also present "advice." This appears at the end of the brief message. It may be *REDUCE SPEED*, *EXIT AND TAKE OTHER ROUTES*, or some other advice.

Motorists will ignore advice unless a reason is offered for taking it. The "reason" in most cases is implied by the problem (e.g., *MAJOR ACCIDENT*, *ROADWORK*, *etc.*) or the number of lanes closed (blocked) (e.g., *2 LEFT LANES CLOSED*). However, an explicit reason statement may sometimes be used in a message (e.g., *AVOID 20 MIN DELAY*).

## MESSAGE LENGTH

Because of limited CMS line capacity, it becomes necessary to count the characters in a message to determine if the message will fit. If the message does not fit then approaches to reducing the message length must be employed such as the a) use of acceptable abbreviations, b) elimination of redundant words, and/or c) partition of the message in two phases. It may at times be necessary to reduce the message content. The following subsections deal with various aspects related to message length.

### Reading Time

The maximum allowable length of a CMS message is controlled in part by *reading time*—the time the motorist has available to read the message. Reading time is affected by a) the time that the motorist is within the legibility zone of the CMS, and b) by the amount of activity in the

traffic stream which the motorist must attend to (e.g., reading signs, adjusting vehicle speed, lane positioning, etc.). The entire message must be short enough to allow motorists to glance at the sign (often multiple times) and read and comprehend the message while attending to the driving situation.

### **Message Familiarity**

Message familiarity enhances motorist reading time. When information displayed on a CMS is unfamiliar or when the information being presented is unusual, longer reading times will be required. Obviously, site-specific characteristics and normal CMS operating procedures dictate what information is usual and what is not, and so this factor varies from location to location.

**It takes motorists who are unfamiliar with the message content longer to read a CMS message than motorists who are familiar with the message content.**

**In general, motorists need more time to read unusual messages.**

### **Driver Workload**

Motorists must time-share their attention to the roadway, to traffic, and to reading signs. Adults can read quite fast while sitting at home or while in stopped traffic. However, motorists cannot always devote full attention to reading a CMS while moving. Often drivers must pay attention to more than one task while driving (e.g., driving the vehicle and reading the information on a CMS). In this example, because these tasks must be time-shared, it will take longer to read the CMS than if all of their attention was to be dedicated to the sign.

### **Reading the CMS Message**

Another important consideration is that motorists must generally read the entire message on a CMS to properly comprehend its meaning. In contrast, they do not have to read the entire guide sign to obtain relevant information about guidance. Therefore, it takes a motorist longer to read a CMS message than to read the message on a guide sign.

### **Maximum Message Length**

In a driving situation, the motorist has a limited amount of time to read a message on a sign. He/she can start reading a sign when the words become legible at the *legibility distance* of the sign. Under ideal visibility conditions, about 85 percent of motorists can begin reading a message on the newer aluminum indium gallium phosphide LED CMSs with 18-inch characters at about 800 ft. However, the distance at which motorists can begin reading a message reduces to 600 ft when the sun is behind the CMS or during nighttime conditions (2). Research strongly suggests that an eight-word message (excluding prepositions such as *TO* and *AT*) is approaching the processing limits of drivers traveling at high speeds (1). Longer messages should be avoided because motorists will often reduce their speeds in order to read the message. Guidelines for establishing the maximum message length for various operating speeds and environmental conditions are presented in Module 7.

**CMS messages that are too long for motorists to read while traveling at normal speeds will result in some motorists slowing to read the message.**

## Need to Reduce Message Length

When the complexity of the driving situation increases due to extremes in geometrics, heavier traffic volumes, increased traffic conflicts (e.g., merging, lane changing), or climatological conditions, motorists will attend to those information needs they feel are most important to them and to their safety.

These demands on the motorist will result in less time available to read the CMS message.

In addition, lighting and environmental conditions change. For example, during part of the day, the sun may not affect the legibility of the CMS. However, at those times of the day where the sun shines directly in the eyes of the motorist, the legibility distance for the motorist can be greatly reduced. It may be necessary to reduce the length of the message to account for the reduced visibility during these times.

The CMS message designer should always look for ways to reduce the message length without losing the intent of the message. Unfortunately, there is too much temptation on the part of the message designer to use as much of the space on a CMS as possible. The thought being “if it fits on the CMS, the message is OK.” However, this philosophy results in messages that are too long and sometimes too difficult for motorists to read under prevailing speeds. Reducing message length can sometimes be accomplished by using alternative phrases that are understandable by motorists and have the same meaning as the original. Also, there may be redundancy or unimportant information in the message that can be omitted.

### REDUCE MESSAGE LENGTH WHEN:

- Motorist workload is increased due to extreme geometrics, very heavy traffic, merging, heavy lane changing, or adverse climatological conditions.
- Conditions change during the day that affects motorist visibility to the CMS (e.g., sun in eyes).

### ALWAYS LOOK FOR WAYS TO REDUCE MESSAGE LENGTH WITHOUT LOSING THE INTENT OF THE MESSAGE.

(Guidelines for reducing message length are given in Module 5 and Module 6.)

## UNITS OF INFORMATION

Research and operational experience indicate that no more than four units of information should be in a CMS message when the traffic operating speeds are 35 mi/h or more. No more than five units of information should be displayed when the operating speeds are less than 35 mi/h.

In addition, no more than three units of information should be displayed on a single message phase.

Normally, only one unit of information appears on each line of the CMS. However, a unit of information may be displayed on more than one line. A sign line, however, should not contain more than two units of information.

### ENTIRE MESSAGE:

- No more than 4 units of information for operating speeds of 35 mi/h or more.
- No more than 5 units of information for operating speeds less than 35 mi/h

### LENGTH OF MESSAGE PHASE:

- No more than 3 units of information.

### LENGTH OF MESSAGE LINE:

- No more than 2 units of information.

When a CMS message meeting all informational requirements exceeds the maximum number of units of information that should be displayed on a single sign, tradeoffs must be made to determine what elements of the message should be omitted. (See the next section below for a brief discussion and *Section 8.2 Order of CMS Message Elements* for more details about message element order.)

## MESSAGE FORMAT

The CMS message must contain the proper information in the expected order to allow motorists to easily read and interpret the information and make rational decisions based on that information.

Placement of message elements on the wrong line or in the wrong sequence will result in driver confusion and will increase the time it takes drivers to read messages. Conversely, consistent formatting of information enhances motorist expectations and reduces the time required to read and understand messages

## 5.2 THE BASE CMS MESSAGE

### INTRODUCTION

It has been stated in some publications that the CMS messages for incidents and roadwork should display the following message elements in the order shown (1,3):

- Problem;
- Location of problem; and
- Recommended driver action.

However, an examination of typical messages indicates that, although these are desirable message elements, it is not always possible to provide information on each element for the following reasons:

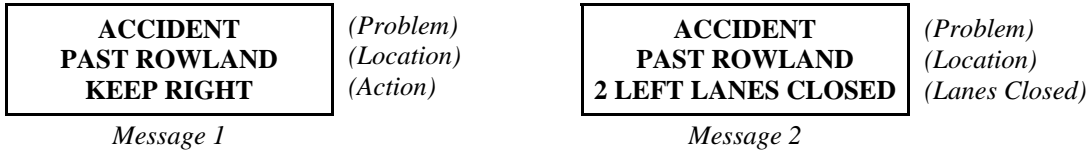
- Sign space and sign legibility constraints may require the CMS operator to reduce the number of informational units that are displayed; and
- Some state policies do not allow the CMS operator to post diversion messages which means that an action message element may have to be omitted.

In addition, it may be beneficial to:

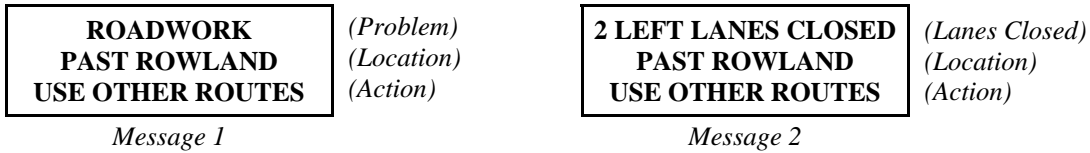
- Substitute other message elements for the *Problem* and *Action* with other message elements that will convey more useful information.

Two examples for one-phase messages are shown below. In the first example, Message 2 with *Problem*, *Location*, and *Lanes Closed (Blocked)* message elements contains more useful

information than Message 1 with a *Problem*, *Location*, and *Action* message elements. Displaying 2 *LEFT LANES CLOSED* in Message 2 not only implies that motorists should merge right, but also gives some indication of the degree of the problem by informing motorists of the number of lanes closed.



In the second example, Message 2 shows a substitution of the *Problem* with a *Lanes Closed* message element that informs the driver about the direction of lane change necessary to move out of the closed lanes.



In 2001, Dudek (4) developed a CMS message design process in recognition that:

- There are variations to the message elements that can be used effectively in a CMS message;
- Message display is a dynamic process in which messages on a particular CMS can change as conditions change after an incident occurs.
- CMS message designers and CMS operators should be aware of the totality of information needed by motorists to make a fully informed and rational decision;
- CMS message designers and CMS operators should be aware that if the totality of driver information needed cannot be displayed in a message, the message length, in most cases, must be reduced; and
- CMS message designers and CMS operators should be aware of the amount and type of information needed by drivers that cannot be displayed.

The message design process begins with a Base CMS Message that is then reduced to ensure that the maximum number of units of information is not exceeded. Decision flow charts for the design of CMS messages for incidents and roadwork are shown in Appendices A and B. The reader interested in detailed step-by-step message design procedures should review the New Jersey DOT *Variable Message Sign Operations Manual* (4).



## GENERAL CONCEPT OF BASE CMS MESSAGE

The *Base CMS Message* is the sum total of all the information that motorists need on the CMS in order to make a fully informed driving decision (e.g., whether to take an alternative route). In most cases, the Base CMS Message will exceed the maximum amount of informational units that

should be displayed on a CMS. Therefore, the Base CMS Message must be reduced in length and content to allow motorists to read, understand, and react to the message.

### THE BASE CMS MESSAGE:

- Is the sum total of all the information that motorists need to make a fully informed driving decision;
- Will normally exceed the maximum amount of informational units that should be displayed; and so
- Must normally be reduced in length and content.

The Base CMS Message elements are as follows:

- *Incident/Roadwork Descriptor* informs the motorist of the unusual situation;
- *Incident/Roadwork Location* informs the motorist about the location of the unusual situation and thus must directly follow the *Incident/Roadwork Descriptor*;
- *Lanes Closed (Blocked)* gives specific information about which lanes or exit ramps are closed or blocked;

### BASE CMS MESSAGE ELEMENTS:

- *Incident/Roadwork Descriptor* (situation description);
- *Incident/Roadwork Location*;
- *Lanes Closed (Blocked)*;
- *Closure Descriptor*;
- *Location of Closure*;
- *Effect on Travel* (e.g., major delay);
- *Audience for Action* (when the action is for a specific group of motorists);
- *Action* (tells motorists what to do); and
- *One Good Reason for Following Action* (usually implied by other message elements).

- *Closure Descriptor* is used in place of the *Incident/Roadwork Descriptor* when all lanes on the facility or exit ramp are closed;
- *Location of Closure* specifically states the location of the freeway closure and is used in place of the *Incident/Roadwork Location*;
- *Effect on Travel* (e.g., MAJOR DELAY) informs the motorist of the severity of the situation (i.e., delay or travel time) and helps the motorist make decisions about whether diversion is appropriate;
- *Audience for Action* is used when the *Action* message element applies to a specific group of motorists rather than all of the motorists traveling past the CMS;
- *Action* message element tells the motorist what to do; and
- *Good Reason for Following the Action* gives a motorist confidence that following the advice on the CMS will result in safer travel and/or significant savings in time.

The *Effect on Travel* and *Good Reason for Following the Action* message elements are oftentimes implied by other elements and need not always be displayed. The possible Base CMS Message elements for various incident and roadwork scenarios are summarized in Table 5-1.

It should be noted that the specific terms for the *Incident/Roadwork Location*, *Lanes Closed (Blocked)*, and *Action* message elements will be different depending upon whether the CMS is on a) the same freeway and relatively close to the incident/roadwork; b) the same freeway but relatively far from the incident/roadwork; or c) a different freeway than the incident/roadwork.

**THE BASE CMS MESSAGE WILL DIFFER DEPENDING UPON WHETHER THE CMS IS ON THE:**

- Same freeway and relatively close to the incident/roadwork;
- Same freeway but relatively far from the incident/roadwork; or
- Different freeway than the incident/roadwork.

**Table 5-1. Possible Base CMS Message Elements in a Message**

Message Element	Incidents			Roadwork	
	Lane(s) Closed	Freeway Blocked <sup>A</sup>	Freeway Closed	Lane(s) Closed	Freeway Closed
Incident/ Roadwork Descriptor	X	X	X	X	X
Incident/Roadwork Location	X	X	X	X	
Lanes Closed (Blocked)	X	X	X	X	X
Closure Descriptor			X		X
Location of Closure			X		X
Effect on Travel	X	X	X	X	X
Audience for Action	X	X	X	X	X
Action	X	X	X	X	X
Good Reason for Following the Action	X	X	X	X	

<sup>A</sup> “Motorists interpret ‘blocked’ as a temporary blockage due to an incident, whereas ‘closed’ indicates a prolonged closure and would be used when law enforcement personnel arrive and close the freeway.

## INCIDENT/ROADWORK DESCRIPTOR

Warnings of hazardous incidents should be displayed under all traffic conditions in peak and off-peak periods (3,5,6). When an incident or roadwork blocks part of the roadway, motorists consider information about the occurrence of an incident as very important and want advance warning (7,8). A question that sometimes arises is “How specific should an incident descriptor be?” One can easily list over 20 incident types that might affect the freeway lanes. Using results of human factors laboratory studies (5), Dudek and Huchingson (1) in the 1986 *Manual on Real-Time Motorist Information Displays* list examples of incident and roadwork terms that should be displayed.

**ACCIDENT**  
**MINOR ACCIDENT**  
**MAJOR ACCIDENT**  
**ROADWORK**

*(Note: the word CRASH is becoming more and more prevalent and is used by some TMCs in place of ACCIDENT. However, human factors studies have not been conducted as of the date of this Handbook to determine motorists' understanding and reading times of CMS messages containing the word CRASH in comparison to messages with ACCIDENT.)*

Recommendations are also given in the *Handbook* to avoid displaying specific descriptors. For example *ACCIDENT* is preferred to more exact descriptions such as *VEHICLE OVERTURNED*. Having a small number of descriptors that induce driver response will a) reduce the number of descriptors that need to be placed in the computer CMS message library, and b) enhance consistency of displayed messages among the CMS operators.

Following completion of human factors research for the New Jersey DOT and evaluation of the frequency and traffic impacts of truck crashes that occur in the state, particularly in northeast New Jersey, Dudek added the following descriptor to the list of incident descriptors in the New Jersey *Variable Message Sign Operations Manual (4)*.

#### **TRUCK ACCIDENT**

The term *TRUCK ACCIDENT* is a general term that includes truck jackknife and truck overturn type crashes. No objective data are available at this time to judge whether drivers interpret *TRUCK ACCIDENT* differently than *MAJOR ACCIDENT* relative to the number of lanes affected, duration of the incident, and severity of the negative impacts on traffic.

Note that the word *ACCIDENT* is recommended rather than *CRASH*. At least one state is now displaying the incident descriptor *CRASH*. It is not a common term used by the general public, and as of this writing it is not certain whether displaying the word increases drivers' reading times.

There are non-vehicle-related incident descriptors that were recommended in the *Handbook on Real-Time Motorist Information Displays*. They are as follows (1):

**SPILLED LOAD  
BROKEN PAVEMENT**

**ICE ON ROAD (BRIDGE)  
FOG**

In addition to the above, some states also display the following:

**HIGH WINDS (BRIDGE)**

**FLOODING**

#### **INCIDENT/ROADWORK LOCATION**

The *Incident/Roadwork Location* message element must directly follow the *Incident/Roadwork Descriptor*. Knowing the location helps the motorist to make judgments as to the distance he/she could be affected. It also provides basic information that can help a motorist determine whether or not he/she wants to leave the freeway. If a motorist decides to leave the freeway, it also helps determine where the motorist can return to the freeway.

## Referencing Location for Familiar and Unfamiliar Motorists

The location can be defined in terms of specific highways, streets, exit ramps, exit ramp numbers or prominent landmarks, or in terms of distance ahead. Results of research show that in some cases commuters and visitors have different informational needs. The visitor has very limited information about a city other than interstate route numbers, whereas, commuters understand most of the intersecting and parallel streets. Thus, messages with local street or highway names familiar to commuters may not be understood by motorists unfamiliar with the area. Also, abbreviations used for local landmarks, bridges, and entertainment and recreational facilities may not be well understood by motorists unfamiliar with the area (9).

**MOTORISTS UNFAMILIAR WITH THE AREA WILL HAVE DIFFICULTY IN UNDERSTANDING:**

- Local street and highway names; and
- Abbreviations for local landmarks, bridges, entertainment and recreational facilities.

Messages for commuters and motorists familiar with the area should be referenced to highways, streets, exit ramps, exit ramp numbers, or prominent landmarks. Motorists unfamiliar with the area prefer to have the location referenced by distance or exit ramp numbers.

When a majority of motorists are commuters, the incident/roadwork location should be referenced to the nearest cross-street or exit ramp. Commuters are highly familiar with cross-street names and exit ramp names (or numbers). When there are no cross-streets or exit ramps in the vicinity of the incident, a prominent landmark (airport, factory, etc.) may be substituted.

When a majority of motorists would be unfamiliar with the names of local cross-streets, the incident/roadwork location should be described in distances to the nearest half-mile. Where numbers are used for exit ramps, the incident location can be referenced to the exit ramp number.

**FOR COMMUTERS:**

Reference location of problem by street names, exit names, exit numbers, or landmarks.

**FOR MOTORISTS UNFAMILIAR WITH THE AREA:**

Reference location of problem by distance or exit numbers.

**ACCIDENT  
AT ROWLAND**

*For motorists familiar with  
the area*

**ACCIDENT  
AT EXIT 12**

*For all motorists*

**ACCIDENT  
1 MILE**

*For motorists unfamiliar  
with the area*

When a lane is closed, it is advisable to display the both where the lane closure begins and where it ends. This information is useful to the motorist in assessing where to return to the freeway if he/she leaves the freeway to avoid the congestion. An example follows.

**Displaying where a lane closure begins and where it ends helps motorists.**

**LEFT LANE CLOSED  
FROM EXIT 12  
TO EXIT 14**

*Shows where the lane  
closure begins and ends*

## Modifiers to Street, Road, and Avenue Names

The abbreviations *ST*, *RD* and *AVE* are used with the names of streets, roads and avenues, respectively. These abbreviations are not required and could be omitted. However, these abbreviations must be used for streets and avenues with the same numeric names in the region (e.g., *7TH ST* vs. *7TH AVE*). An example follows.

***ST*, *RD* and *AVE* are not required and could be omitted.**

**They must be used for streets and avenues with the same numeric names (e.g., *7TH ST*, *7TH AVE*).**

**ACCIDENT  
AT ROWLAND**

*AVE not required*

**ACCIDENT  
AT 7TH AVE**

*AVE required*

## Descriptors for Location

The more common descriptors used by TMCs are listed below.

**1 MILE (*AHEAD*)**

**[number] MILES (*AHEAD*)**

**AT [*highway name, street name, exit ramp number, exit ramp name, landmark*]**

**NEAR [*highway name, street name, exit ramp number, exit ramp name, landmark*]**

Operating agencies should also give consideration to the following location descriptors:

**BEFORE [*highway name, street name, exit ramp number, exit ramp name, landmark*]**

**PAST [*highway name, street name, exit ramp number, exit ramp name, landmark*]**

The advantage of *BEFORE* and *PAST* is that they give the driver information about the location of the incident or roadwork relative to the highway, street, exit, or landmark. This information helps the motorists familiar with the area to know:

- Whether the incident will have an impact on the driver's ability to use the exit ramp near the location of the incident; and
- Which entrance ramps downstream of the incident can use to reenter the freeway.

The information is particularly useful when the incident/roadwork is near a major freeway-to-freeway interchange.

**CMS on Same Freeway as Incident/Roadwork**

If the CMS is on the same freeway as the incident or roadwork, there is no need to display the freeway route number or name because motorists will assume the incident/roadwork is on the same freeway.

**WHEN INCIDENT/ROADWORK IS ON SAME  
FREEWAY AS THE CMS:**

- No need to display route number or name

The sign space could be used to display other information, or the number of units or information could be reduced. The example below illustrates how sign space can be used more effectively by eliminating redundant information about the freeway. Assume that roadwork is on I-84 East and the CMS is upstream of the roadwork on the same freeway. By omitting the redundant information about the freeway number, Message 2 contains additional useful information with the same number of informational units.

**I-84 EAST  
ACCIDENT  
PAST ROWLAND**

*Message 1  
Contains less information*

**ACCIDENT  
PAST ROWLAND  
2 LEFT LANES CLOSED**

*Message 2  
Contains more information*

**CMS on Different Freeway than Incident/Roadwork**

When displaying information about an incident that has occurred on an intersecting freeway, the route number or name must be displayed. An example of a message that can be used when the crash occurs on a downstream intersecting freeway (e.g., I-75 South) is shown below. Note that only the *Problem* and *Location* message elements can be displayed on a one-phase message.

**MAJOR ACCIDENT  
ON I-75 SOUTH  
AT OXFORD**

}

*(Problem)*  
*(Location)*

A review of messages commonly displayed by some TMCs indicated that the *Location* descriptor is sometimes divided and separated within the message. An example is shown below:

**I-75 SOUTH  
MAJOR ACCIDENT  
AT OXFORD**

*(Location)*  
*(Problem)*  
*(Location)*

This message format violates the principles of a) displaying the location after the problem, and b) keeping compatible message units together. The effect that it has on driver reading times is not known at this time, nor is the rationale for using this format. (It could be that the designers consider I-75 SOUTH to be the audience, when in fact it represents the location of the crash).

## LANES CLOSED (BLOCKED)

The *Lanes Closed (Blocked)* message element gives specific information about which lanes or exit ramps are closed or blocked. It helps the driver make a decision (e.g., merge into an open lane, reduce speed, leave the freeway, use another exit ramp, etc.).

### Left and Right Lanes

Acceptable terms when one lane is affected on the left or right side of the freeway are listed below.

**LEFT LANE CLOSED  
RIGHT LANE CLOSED**

**LEFT LANE BLOCKED  
RIGHT LANE BLOCKED**

The term *BLOCKED* is recommended when an incident affects the lane and the police or traffic control personnel have not arrived to direct traffic around the incident. The term *CLOSED* is recommended after the police or traffic control personnel begin directing traffic out of the affected lane. (1)

When more than one lane is affected on either the left or right side of the roadway, then the following terms are acceptable:

**[number] LEFT LANES CLOSED  
[number] RIGHT LANES CLOSED**

**[number] LEFT LANES BLOCKED  
[number] RIGHT LANES BLOCKED**

Some TMCs use a slight variation to the above by placing the direction (i.e., left, right) ahead of the number of lanes. For instance:

**LEFT [number] LANES CLOSED**

Research has not been conducted to evaluate the relative effectiveness of the two alternative descriptors or to determine whether there are differences in driver response. However, in the opinion of the author, there is an important difference: Placing the number before the direction emphasizes the degree of the problem (e.g., *2 LEFT LANES CLOSED*); whereas, placing the number after the direction (e.g., *LEFT 2 LANES CLOSED*) emphasizes the direction of a suggested merge. The author believes that for multilane closures, particularly during the peak periods, it is more important to emphasize the number of lanes affected so that the drivers “think” in terms of diversion decisions rather than lane change decisions.

### Middle Lanes

When the center lane of a three-lane directional freeway is affected, then the descriptors shown below are acceptable.

**CENTER LANE CLOSED**

**CENTER LANE BLOCKED**

Displaying a *Lanes Closed (Blocked)* descriptor when one or more of the middle lanes are closed on a freeway with four or more directional lanes present the TMC managers with additional challenges. In these cases, word descriptors such as *LEFT* and *RIGHT* are ambiguous in

specifying specifically which lanes are affected. On a four-lane section, the following terms might be satisfactory if the two middle lanes were affected:

**2 CENTER LANES CLOSED**

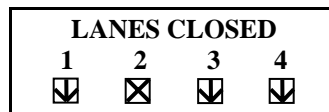
**2 CENTER LANES BLOCKED**

However, if only one lane is closed on a four lane directional section, then the terms do not apply. Similar problems would occur on facilities with more directional lanes. Some TMCs display terms similar to that shown below. No research data are available that supports the use of these terms, particularly with respect to motorist understanding and whether they would notice that one of the middle lanes rather than the left or right lane is affected.

**LEFT CENTER LANE CLOSED**  
**RIGHT CENTER LANE CLOSED**

**LEFT CENTER LANE BLOCKED**  
**RIGHT CENTER LANE BLOCKED**

In such instances, Dudek and Huchingson (*I*) recommend a CMS message (shown below) that contains X's and arrows that are anchored at each lane with lane numbers. This is similar to a message that was displayed on CMSs by Caltrans in the 1970s and 1980s. However, the author of this *Handbook* has not seen this message displayed for a number of years, although, Texas DOT incorporated a similar sign in Typical Traffic Control Plan Sheets in the 1980s for moving maintenance operations.



### **Changes in Number of Freeway Lanes**

The *Lanes Closed (Blocked)* descriptors discussed above apply to cases where the number of freeway lanes at the incident location is the same as number of lanes at the CMS location. In these cases, the driver will know that on a three-lane directional section, for example, if two lanes are closed, only one is open. However, there are many situations where the number of through lanes downstream is not the same as at the CMS location. Thus, it may be more appropriate to display the number of lanes that are open rather than the number closed. Acceptable descriptors are shown below.

**1 LANE OPEN**

**[number] LANES OPEN**

### **All Lanes**

When all of the lanes are affected by the incident then the following descriptors can be used:

**ALL LANES CLOSED**

**ALL LANES BLOCKED**



## CLOSURE DESCRIPTOR

The *Closure Descriptor* message element is used when the police or traffic control personnel close all lanes on the freeway or exit ramp. It can be used in place of the *Incident/Roadwork Descriptor* and displayed on the top line of the CMS. Examples of replacing an *Incident Descriptor* is shown below in Message 2 and Message 3.

<b>ACCIDENT PAST ROWLAND ALL LANES CLOSED</b>
---

(Problem)  
(Location)  
(Lanes Closed)

*Message 1*

<b>ALL LANES CLOSED AT ROWLAND FOLLOW DETOUR</b>
--

(Lanes Closed)  
(Location)  
(Action)

*Message 2*  
Contains more information  
than Message 1

<b>FREEWAY CLOSED AT ROWLAND FOLLOW DETOUR</b>
--

(Lanes Closed)  
(Location)  
(Action)

*Message 3*  
Contains more information  
than Message 1

## Closure Descriptors

The following descriptors are acceptable:

**FREEWAY CLOSED**

**ALL LANES CLOSED**

## LOCATION OF CLOSURE

The location of a freeway closure will be at an exit ramp that will normally be different than the actual incident location. The *Location of Closure* message element specifically states the location where the freeway is closed and would be used in place of the *Incident/Roadwork Location*. Typical *Location of Closure* descriptors are shown below.

**1 MILE (AHEAD)**  
**[number] MILES (AHEAD)**  
**AT [exit ramp number, exit ramp name]**

## EFFECT ON TRAVEL

The *Effect on Travel* message element informs the motorist of the severity of the situation in terms of delay or travel time and helps the motorist make informed decisions about whether diversion is appropriate. In addition, it can imply the expected arrival time (in general terms) to the motorist's destination.

## Delay

Motorists interpret *DELAY* (shown in minutes) as being relative to their normal expected travel time to traverse the freeway and arrive at their destination. *DELAY* implies that it will take that much longer than usual. *DELAY* does not mean that the motorist will be held up in traffic at one location for that long or that it will take that long to remove an incident.

**[number] MIN DELAY means that the motorist can expect his/her trip to be that much longer than usual.**

**AVOID [number] MIN DELAY gives the advantage of the stated diversion route over the existing route.**

**SAVE [number] MIN also gives the advantage of the stated diversion route over the primary route.**

Delay information can be displayed in terms of “[number] Minutes Delay,” “Avoid [number] Minutes Delay,” or “Save [number] Minutes.” If the delay is expressed in the first form, it refers to travel time on the primary route and should appear in the CMS message after the *Incident/Roadwork Descriptor* and the *Incident/Roadwork Location* (if displayed). If delay is expressed in terms of “Avoid [number] Minutes Delay,” or “Save [number] Minutes,” the reference is to an advantage of using the alternative route and should appear after the *Action* message element that mentions the alternative route. The following examples illustrate the different ways that delay information could be displayed.

**20 MIN DELAY  
TAKE US-33**

*Example of  
“X MIN DELAY”*

**TAKE US-33  
AVOID 20 MIN DELAY**

*Example of  
“AVOID X MIN DELAY”*

**TAKE US-33  
SAVE 20 MIN**

*Example of  
“SAVE X MIN”*

It is most useful to the motorist to display specific delay times. However, when displaying a value (number) the CMS operator must have full confidence that the delay values are reasonably accurate. This is a number that motorists can sometimes check. Motorist confidence in the CMS system can be adversely affected if the numbers are not reasonably accurate.

If it is not possible to gather reasonably accurate information on specific delay times, an alternative is to display generic delay information such as:

**MAJOR DELAY  
MINOR DELAY**

Results of studies reported by Dudek and Huchingson in 1998 showed that the average New Jersey motorist interprets *MAJOR DELAY* as implying the delay is at least 45 minutes (10).

Sometimes the *Effect on Travel* element can be combined with the *Incident/Roadwork Descriptor*. In the case of delay, the following descriptors have specific meaning to motorists:

**MAJOR ACCIDENT  
MINOR ACCIDENT**

Results of studies reported by Dudek, et al. in the mid-1970s (5) in Dallas showed that at that time, the average driver interpreted *MAJOR ACCIDENT* to result in a delay of 22 minutes or more, and *MINOR ACCIDENT* implied a delay not more than 15 minutes. In a more recent study, the results show that the average New Jersey driver interprets *MAJOR ACCIDENT* to mean that they can expect delays of 45 minutes or more (10). The results indicate that motorists expect more delay when a major crash occurs than they did in the mid-1970s.

**Travel Time**

Another form of an *Effect on Travel* element is travel time. Travel time is very useful to motorists because it gives them some indication as to the potential arrival time to their destination. Also, travel times can be displayed during the peak and off-peak periods and has the added advantage that a message will be displayed on the CMS more frequently rather than having the sign blank in the absence of an incident.

A small number of TMCs have recently begun displaying travel times on CMSs. In some cases, travel times are displayed during the peak periods, and in other cases it is displayed both peak and off-peak.

The posted travel times are calculated from speed measurements at two successive detector stations or are measured directly with automated vehicle identification (AVI) equipment. Although the travel time information is historical in nature, it is fairly recent. Because of rapidly changing traffic conditions, it is difficult to post travel time information manually. It is more efficient to display travel times automatically using system software.

Although display of travel times is advantageous, the following possible credibility issues have created concerns for some CMS operators:

- Display of historic travel times; and
- Daily repetition of the same travel times displayed to commuters.

First, current technology does not allow TMCs to accurately predict travel times, thus recent historical travel times are displayed. Motorists can easily measure their own travel times and dispute incorrectly posted travel times. If “10 minutes” is displayed on a CMS and it takes motorists 15 minutes, credibility may be weakened. To circumvent this concern, TransStar in Houston displays the time of day of the most recent calculation of travel times in the format below.

<p><b>TRAVEL TIME TO I-610 20 MIN AT 8:20</b></p>
---

Another approach that is used by TransGuide in San Antonio is to display a range of the estimated travel time as shown in the example below.

**TRAVEL TIME  
TO US-281  
8-12 MINUTES**

The results of studies in 2000 by Dudek et al. (11) indicate that displaying recent historical travel times may not be a credibility issue provided that the differences in expected and actual travel times are not significantly different. The authors evaluated two alternative travel time messages that are shown below: one that contained the specific travel time (not a range) without the time of day, and the second with a specific travel time with the time of day posted. The studies were conducted in Dallas, El Paso, Fort Worth, Houston, and San Antonio.

**TRAVEL TIME  
TO DOWNTOWN  
20 MINUTES**

*Study Sign Alternative 1*

**TRAVEL TIME  
TO DOWNTOWN  
AT 7:20 A.M.  
20 MINUTES**

*Study Sign Alternative 2*

Table 5-2 shows some of the results of the study. As shown, only about 10 percent of the motorists expected the travel time to be exactly as that shown on the CMS. Also, there was not a significant difference in motorist interpretation of the two CMS messages.

**Table 5-2 Motorist Response to Question About the Meaning of the Travel Time Information in the Texas Studies (Ref 11)**

CMS Message	“Exactly 20 Minutes”	“About 20 Minutes”	“Less Than 20 Minutes”	“More Than 20 Minutes”	“Unable to Determine”
Study Sign Alternative 1	11%	76%	2%	9%	2%
Study Sign Alternative 2	10%	64%	7%	13%	6%

The second concern with displaying travel time on a regular basis is the possibility that commuter drivers may see the same travel times posted daily if traffic conditions do not change from day to day and may begin to ignore the CMS at later dates, and thus may not read the sign when important incident information is presented. To date, no research has been conducted to validate or disprove this concern.

**AUDIENCE FOR ACTION**

The *Audience for Action* message element is used when the *Action* applies to a specific group of motorists rather than all of the motorists traveling past the CMS. It alerts a specific group of motorists that the action part of the message applies to them. When the *Action* applies to all motorists on the

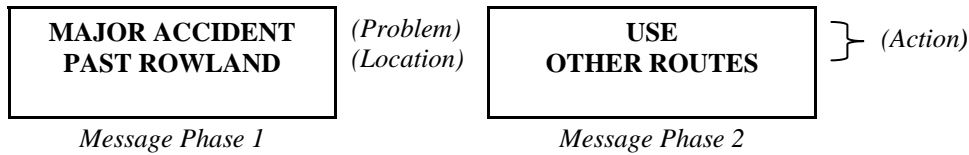
**WHEN THE ACTION APPLIES TO:**

- **ALL MOTORISTS** – Do NOT use *Audience for Action* message element.
- **A SEGMENT OF MOTORISTS** – Use *Audience for Action* message element.

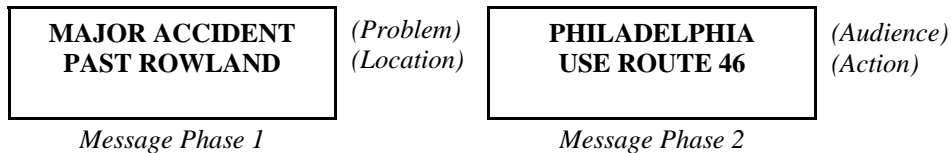
highway at the location of the CMS, then the statement is not displayed. When the *Action* applies to only a segment of the motorists, then the *Audience for Action* message element should. Alerting only the motorists to whom the action applies avoids confusion.

Motorists expect that when they see an *Audience for Action* message element on the CMS, they will also see an *Action* message element. An *Audience for Action* message element must always be accompanied with an *Action* statement.

**An *Audience for Action* message element must always be accompanied with an *Action* message element.**



*Action message element applies to all drivers passing CMS*



*Action message element applies to a specific group of drivers (Philadelphia traffic)*

The CMS message designer must know the intended audience for the message that will be displayed. In some cases, commuters and visitors have different informational needs. The visitor has very limited information about a city other than interstate route numbers, whereas, commuters understand most of the intersecting and parallel streets. Thus, messages with local street or highway names familiar to commuters may not be understood by motorists unfamiliar with the area. Also, the same is true for abbreviations used for local landmarks, bridges, and entertainment and recreational facilities (9).

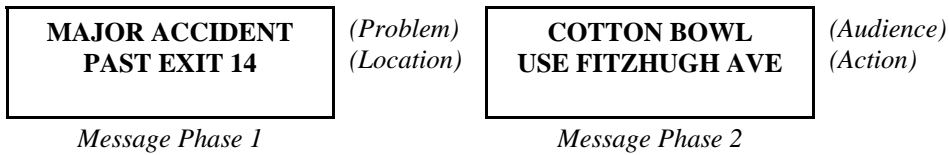
**MOTORISTS UNFAMILIAR WITH THE AREA WILL HAVE DIFFICULTY IN UNDERSTANDING:**

- Local street and highway names; and
- Abbreviations for local landmarks, bridges, entertainment and recreational facilities.

Generally, the word *TRAFFIC* after a destination is not necessary. The reader of a sign can only be a motorist who is a part of the traffic stream, so *NEW YORK, TAKE NEXT EXIT* can only mean *NEW YORK TRAFFIC, TAKE NEXT EXIT*.

**Generally, the word *TRAFFIC* after a destination name is not necessary.**

The primary exception to this message design principle is when the location of the incident—either in terms of the cross street, miles ahead, or simply *AHEAD*—is not displayed, it is frequently necessary to display *TRAFFIC* after the destination. The following examples are presented to illustrate messages for the Meadowlands, a major event center in northeast New Jersey.



*“TRAFFIC” not required*



*“TRAFFIC” required*

If *TRAFFIC* were omitted from the second message, motorists could interpret the message to mean that a crash occurred near the Meadowlands.

City destinations appearing on a CMS must be consistent with existing signing practices. Nicknames should be avoided. For example, *PHILADELPHIA* should be used rather than the nickname *PHILLY*.

**Names used for cities must be identical to those appearing on existing static signs.**

Many cities have large areas known locally by a single name, but which house smaller facilities that are known by a wider group of motorists who are not from the local area. An example is Fair Park near downtown Dallas that contains the better-known Cotton Bowl Stadium. Caution should be exercised when signing for these areas so that the name displayed is consistent with the name used by non-local motorists. For instance, in the example above, the lesser known name *Fair Park* would be confusing to non-local motorists if the activity was being held in the *Cotton Bowl*--a specific, more widely known destination.

**Names used for major generators must be specific and address the exact place where the activity takes place.**

## **ACTION**

The *Action* message element is necessary because it tells the motorist what to do. Every incident management CMS message should have an action statement. Omitting the *Action* leaves the motorist with a great deal of uncertainty as to the best course of action. The *Action* message element will vary depending upon whether the incident is on the same freeway as the CMS or on a downstream intersecting freeway.

*Action* message elements are classified according to signing situations that involve either “No diversion” or a “Diversion.”

## No Diversion

When there is no need to encourage drivers to divert from the freeway, then typical *Action* message elements for CMSs located on the same freeway as the incident are as follows:

**PREPARE TO STOP  
REDUCE SPEED.**

## Diversion

Diversion messages are classified according to whether the message encourages:

- Diversion to a non-specific route (soft diversion), or
- Diversion to a specific route.

### *Diversion to a Non-Specific Route (Soft Diversion)*

A Soft Diversion *Action* message element is used when drivers are advised to take other routes but the specific route is not specified in the CMS message. It might be displayed for a variety of reasons including:

- The CMS operator is unaware of the traffic conditions on the most logical alternative routes;
- It is important to display an *Action* before the CMS operator has had a chance to assess the full impact of the incident;
- It is important to display an *Action* before the police arrive and establish positive diversion routes; and/or
- It is against agency policy to divert traffic to specific alternative routes.

Typical descriptors for soft diversion messages are listed below.

**USE OTHER ROUTES  
EXIT AND USE OTHER ROUTES**

Many TMCs display the term *USE ALTERNATE ROUTES*. However, *USE OTHER ROUTES* is shorter and well understood by drivers and is the preferred choice.

### *Diversion to a Specific Route*

In this case, drivers are advised to take a specific alternative route. The *Action* message element will be influenced by the type of diversion route the drivers are advised to take. Dudek (4) categorized five types of diversion routes for incidents and one type for roadwork. These are discussed in *Section 5.4 Diversion/Detour Route Descriptions for Incidents and Roadwork Situations*.

In practice, very few state agencies divert traffic to specific routes when freeway incidents occur. Only two of seven states responding to a survey conducted as part of the research for this report stated that they occasionally divert traffic to local city streets, but only with involvement of the local agencies. Some of the state agencies divert traffic to specific routes but only if the routes are other interstate or state highway.

The common requirement for diversion routes Type 1 through 4 (defined later in *Section 5.5 Diversion/Detour Route Descriptors for Incident and Roadwork Situations*) is the availability of surveillance on the diversion route. The CMS operator must know the conditions on the alternative route before messages advising drivers to use that route are displayed. Acceptable terms for the *Action* message element for Type 1, 2, 3, and 4 diversion routes are shown below. Note that the cardinal direction (i.e., *NORTH, SOUTH, EAST, WEST*) must be included in the *Action* message element when applicable. The meanings of the words *USE, TAKE, and FOLLOW* are discussed in *Section 5.4 Word and Phrase Meanings and Criteria*.

**EXIT AND USE** [*highway name, street name, route number*]  
**EXIT AT** [*highway name, street name, route number*] /  
    **USE** [*highway name, street name, route number*]  
**TAKE** [*exit ramp name*] **EXIT**  
**TAKE** [*exit ramp name*] **EXIT** /  
    **USE** [*highway name, street name, route number*]  
**TAKE EXIT** [*exit ramp number*]  
**TAKE EXIT** [*exit ramp number*] /  
    **USE** [*highway name, street name, route number*]  
**TAKE** [*highway name, street name, route number*]  
**TAKE** [*highway name, street name, route number*] /  
    **USE** [*highway name, street name, route number*]  
**TAKE NEXT EXIT**  
**TAKE NEXT** [*number*] **EXITS**  
**USE** [*highway name, street name, route number*]  
**TUNE RADIO TO** [*number*] **AM (or FM)**

A Type 5 diversion route is a pre-established route that is designated as the detour route when emergency conditions require closing the freeway. A Type 6 route applies to the roadwork detour specified in the Traffic Control Plan. Acceptable terms for the *Action* message element for a Type 5 diversion route and Type 6 detour route (defined in Section 5.3) are shown below. Note that the cardinal direction must be included when applicable.

**EXIT AND FOLLOW DETOUR**  
**EXIT AND FOLLOW SIGNS**  
**EXIT AT** [*highway name, street name, route number*] /  
    **FOLLOW DETOUR**  
**EXIT AT** [*highway name, street name, route number*] /  
    **FOLLOW SIGNS**  
**TAKE** [*exit ramp name*] **EXIT** /  
    **FOLLOW DETOUR**  
**TAKE** [*exit ramp name*] **EXIT** /  
    **FOLLOW SIGNS**



**TAKE EXIT [exit ramp number] /  
FOLLOW DETOUR  
TAKE EXIT [exit ramp number] /  
FOLLOW SIGNS  
TAKE [highway name, street name, route number] /  
FOLLOW DETOUR  
TAKE [highway name, street name, route number] /  
FOLLOW SIGNS  
TAKE NEXT EXIT**

## **GOOD REASON FOR FOLLOWING THE ACTION**

When a motorist is advised to take an alternative route, he/she must be confident that it is the correct decision and that doing so will result in significant savings in time. Therefore, the motorist should be given a *Good Reason for Following the Action*. In most cases, the good reason is implied through the *Incident or Roadwork Descriptor, Lanes Closed (Blocked)* and *Effect on Travel* elements of the message and need not be displayed separately. For example, *MAJOR ACCIDENT* implies major delay and gives the reason for following the advice. However, in other situations, a specific *Good Reason for Following the Action* may be needed. When needed, the following message elements are acceptable:

**AVOID DELAY  
AVOID MAJOR DELAY  
BEST ROUTE TO [destination]**

If the delay and/or travel times can be accurately estimated, then specific information can be displayed as follows:

**AVOID [number] MIN DELAY  
SAVE [number] MIN**

Four examples of messages that include a *Good Reason for Following the Action* are shown below

**KYLE STADIUM  
USE OXFORD AVE  
AVOID MAJOR DELAY**

**BEST ROUTE TO  
KYLE STADIUM  
USE OXFORD AVE**

**KYLE STADIUM  
USE OXFORD AVE  
AVOID 20 MIN DELAY**

**KYLE STADIUM  
USE OXFORD AVE  
SAVE 20 MIN**

### 5.3 REDUCING UNITS OF INFORMATION FROM THE BASE CMS MESSAGE

In most cases, a Base CMS Message required for the incident or roadwork situation will contain more units of information than is acceptable to display for the prevailing freeway speed and current environmental conditions. Therefore, the number of units of information must be reduced. The CMS message designer should first use the *Initial Reduction Approaches* and then the *Secondary Reduction Approaches* that are discussed in the sections that follow. After these approaches are applied, then the message designer should follow the principles set discussed in *Priority Reduction Principles* on page 5-30.

**THE NUMBER OF UNITS OF INFORMATION CONTAINED IN A BASE CMS MESSAGE CAN BE REDUCED BY:**

- First applying the Initial Reduction Approaches;
- Then applying Secondary Reduction Approaches;
- Then applying the Priority Reduction Principles.

#### INITIAL REDUCTION APPROACHES

CMS messages should be as short as possible. Therefore, the message designer should look for ways to reduce long messages or Base CMS Messages that exceed the maximum number of information units that should be displayed for the given situation. Units of information can be reduced without losing information content or the important information by:

**UNITS OF INFORMATION CAN BE REDUCED BY:**

- Omitting unimportant words/phrases;
- Omitting redundant information; and/or
- Combining Base CMS Message elements.

- Omitting unimportant words/phrases;
- Omitting redundant information; and/or
- Combining Base CMS Message elements.

#### Omitting Unimportant Words/Phrases

At times it is possible to use alternative phrases that are understandable by motorists and have the same meaning as the original. The example below illustrates how message length can be reduced.

The Original Message:

**ROAD CLOSED AHEAD  
DUE TO CONSTRUCTION  
FOLLOW DETOUR ROUTE**

Can Be Shortened To:

**ROAD CLOSED  
1 MILE  
FOLLOW DETOUR**

With Better Results.

In the above, the most important message elements are the road is closed and the location of the closure. The reason *DUE TO CONSTRUCTION* is not necessary to display and can be omitted.

In addition, the word *AHEAD* can be omitted because it is obvious to motorists by simply stating *ROAD CLOSED*.

### Omitting Evident or Redundant Information

It is not necessary nor is it desirable to make reference to the freeway if the CMS is on the same freeway as the incident/roadwork. For example, if a major crash occurs on northbound I-276 just past I-80 which blocks all the lanes, reference to *ON I-276 NORTH* in the first example message in Table 5-3 should be omitted since this information is evident to motorists and increases the units of information and the length of the message.

**INCIDENT AND ROADWORK MESSAGES CAN BE REDUCED BY:**

- Omitting reference to the same freeway if the incident/ roadwork and CMS are on the same freeway.

In the second example in Table 5-3, the *Action* message element (i.e., *KEEP RIGHT*) is redundant to the *Lanes Closed* message element (i.e., *2 LEFT LANES CLOSED*), and should be omitted. It is obvious that the motorists should move to the right lanes if the left lanes are closed.

**Table 5-3. Examples of Omitting Evident or Redundant Information**

Message Element and Message	Revised Message
<u>Incident on Same Freeway as CMS</u>	
<i>Incident Descriptor</i> MAJOR ACCIDENT	MAJOR ACCIDENT
<i>Location</i> ON I-276 NORTH PAST I-80	PAST I-80
<i>Lanes Blocked</i> ALL LANES BLOCKED	ALL LANES BLOCKED
<u>Redundant Lane Closed and Action Message Elements</u>	
<i>Incident Descriptor</i> MAJOR ACCIDENT	MAJOR ACCIDENT
<i>Location</i> PAST EXIT 32	PAST EXIT 32
<i>Lanes Closed</i> 2 LEFT LANES CLOSED	2 LEFT LANES CLOSED
<i>Action</i> KEEP RIGHT	

### Combining Base CMS Message Elements

#### *Incident Messages*

#### Combining Incident Descriptor, Location and Lanes Closed (Blocked) Message Elements

In an effort to reduce the length of CMS messages, it is sometimes necessary and, in most cases, useful to combine the *Incident*

**INCIDENT MESSAGES CAN BE REDUCED BY:**

- Combining *Incident Descriptor, Incident Location and Lanes Closed (Blocked)* message elements.

*Descriptor, Incident Location and Lanes Closed (Blocked)* message elements. For example, when a major crash occurs that blocks all of the lanes, the term *FREEWAY BLOCKED* can be used in place of the longer combination of *MAJOR ACCIDENT* and *ALL LANES BLOCKED*. Examples of combining *Incident Descriptor, Incident Location and Lanes Closed (Blocked)* message elements are shown in Table 5-4.

**Table 5-4 Examples of Combining *Incident Descriptor, Incident Location and Lanes Closed (Blocked)* Message Elements**

Message Element and Message		Revised Message
<u>Incident on Same Freeway as CMS</u>		
<i>Incident Descriptor</i>	<b>MAJOR ACCIDENT</b>	<b>FREEWAY BLOCKED PAST I-80</b>
<i>Location</i>	<b>PAST I-80</b>	
<i>Lanes Blocked</i>	<b>ALL LANES BLOCKED</b>	
<u>Incident on Another Freeway than CMS</u>		
<i>Incident Descriptor</i>	<b>MAJOR ACCIDENT</b>	<b>I-76 WEST BLOCKED AT WALT WHITMAN BRIDGE</b>
<i>Location</i>	<b>ON I-76 WEST AT WALT WHITMAN BRIDGE</b>	
<i>Lanes Blocked</i>	<b>ALL LANES BLOCKED</b>	
<u>Closed Roadway Due to Incident on Same Freeway as CMS</u>		
<i>Incident Descriptor</i>	<b>TRUCK ACCIDENT</b>	<b>FREEWAY CLOSED</b>
<i>Location</i>	<b>PAST I-80</b>	
<i>Lanes Closed</i>	<b>ALL LANES CLOSED</b>	<b>EXIT AT I-80 FOLLOW DETOUR</b>
<i>Location of Closure</i>	<b>AT I-80</b>	
<i>Audience for Action</i>	<b>I-287 NORTH TRAFFIC</b>	
<i>Action</i>	<b>EXIT AT I-80 FOLLOW DETOUR</b>	
<u>Closed Exit Ramp at Major Interchange on Same Freeway as CMS</u>		
<i>Incident Descriptor</i>	<b>MAJOR ACCIDENT</b>	<b>RAMP CLOSED</b>
<i>Location</i>	<b>ON I-80 EAST RAMP</b>	
<i>Lanes Closed</i>	<b>RAMP CLOSED</b>	<b>TO I-80 EAST EXIT AT US-10 FOLLOW DETOUR</b>
<i>Location of Closure</i>	<b>TO I-80 EAST</b>	
<i>Audience for Action</i>	<b>I-287 NORTH TRAFFIC</b>	
<i>Action</i>	<b>EXIT AT US-10 FOLLOW DETOUR</b>	

Combining Location of Closure Message Element and Action Message Element

When the freeway is closed and a detour route set in place with signs, police and/or traffic control personnel, and the CMS is on the same freeway and close to the closure, then the *Location of Closure* message element becomes unnecessary to display because it will be contained in the *Action* message element. One of the examples in Table 5-4 is repeated in Table 5-5 to illustrate the concept. In the Table 5-5, the *Location of Closure (AT I-80)* is combined with the *Action (EXIT AT I-80/ FOLLOW DETOUR)* and should be omitted because it is redundant.

**WHEN THE FREEWAY IS CLOSED, INCIDENT MESSAGES CAN BE REDUCED FURTHER BY:**

- **Combining *Location of Closure* message element and *Action* message element.**

**Table 5-5. Example of Combining *Location of Closure* Message Element with *Action* Message Element**

Message Element and Message		Revised Message
<u>Closed Roadway Due to Incident on Same Freeway as CMS</u>		
<i>Incident Descriptor</i>	<b>TRUCK ACCIDENT</b>	<b>FREEWAY CLOSED</b>
<i>Location</i>	<b>PAST I-80</b>	
<i>Lanes Closed</i>	<b>ALL LANES CLOSED</b>	
<i>Location of Closure</i>	<b>AT I-80</b>	
<i>Audience for Action</i>	<b>I-287 NORTH TRAFFIC</b>	
<i>Action</i>	<b>EXIT AT I-80 FOLLOW DETOUR</b>	

***Roadwork Messages***

Combining Roadwork Descriptor Message Element with Lanes Closed Message Element

When motorists are about to encounter roadwork on the freeway, it is more important for them to know that lanes are closed and, more specifically, which lanes are closed rather than be given information on a CMS that roadwork is taking place on the freeway. The information about the roadwork will ordinarily be displayed on static signs as part of the work zone traffic control plan, and displaying the information on a CMS is redundant and takes up space for more relevant information. For example, if the roadwork requires closure of the two left freeway lanes, the *Roadwork Descriptor (ROADWORK)* can be omitted on the first line of the CMS and replaced with the *Lanes Closed* message element **2 LEFT LANES CLOSED**.

**ROADWORK MESSAGES CAN BE REDUCED BY:**

- **Combining *Roadwork Descriptor* message element with *Lanes Closed* message element; or**
- **Combining *Roadwork Descriptor*, *Closure Location* and *Lanes Closed* message elements.**

Examples of how the *Roadwork Descriptor* message element can be replaced with the *Lanes Closed* message element are shown in Table 5-6.

**Table 5-6. Examples of Combining *Roadwork Descriptor* Message Element with *Lanes Closed* Message Element**

Message Element and Message	Revised Message
<p><u>Roadwork on Same Freeway as CMS</u></p> <p><i>Roadwork Descriptor</i>     <b>ROADWORK</b>  <i>Lane Closure Location</i>   <b>PAST I-80</b>  <i>Lanes Closed</i>               <b>2 LEFT LANES CLOSED</b></p>	<p><b>2 LEFT LANES CLOSED PAST I-80</b></p> <p><b>2 LEFT LANES CLOSED AT EXIT 42</b></p> <p><b>FREEWAY CLOSED</b></p> <p><b>EXIT AT I-80 FOLLOW DETOUR</b></p>
<p><u>Roadwork on Same Freeway as CMS</u></p> <p><i>Roadwork Descriptor</i>     <b>ROADWORK</b>  <i>Lane Closure Location</i>   <b>AT EXIT 42</b>  <i>Lanes Closed</i>               <b>2 LEFT LANES CLOSED</b></p>	
<p><u>Closed Roadway Due to Roadwork on Same Freeway as CMS</u></p> <p><i>Roadwork Descriptor</i>     <b>ROADWORK</b>  <i>Lane Closure Location</i>   <b>AT ROUTE 46</b>  <i>Lanes Closed</i>               <b>ALL LANES CLOSED</b>  <i>Location of Closure</i>       <b>I-80</b>  <i>Audience for Action</i>     <b>I-287 NORTH TRAFFIC</b>  <i>Action</i>                       <b>EXIT AT I-80</b>                                        <b>FOLLOW DETOUR</b></p>	

Combining Roadwork Descriptor, Closure Location and Lanes Closed Message Elements

When the CMS gives information about roadwork closures on an intersecting freeway, it is oftentimes desirable and necessary to combine the *Roadwork Descriptor*, *Closure Location*, and *Lanes Closed* message elements. An example is shown in Table 5-6.

Combining Location of Closure Message Element and Action Message Element

When the freeway is closed and a detour route set in place with signs, police and/or traffic control personnel, and the CMS is on the same freeway and close to the closure, then the *Location of Closure* message element becomes unnecessary to display because it will be contained in the *Action* message element. One of the examples in Table 5-6 is repeated in Table 5-7 to illustrate the concept. In Table 5-8, the *Location of Closure* (*AT I-80*) is combined with the *Action* (*EXIT AT I-80/ FOLLOW DETOUR*) and should be omitted because it is redundant.

**WHEN THE FREEWAY IS CLOSED, ROADWORK MESSAGES CAN BE REDUCED FURTHER BY:**

- **Combining *Location of Closure* message element and *Action* message element.**

**Table 5-7. Example of Combining Roadwork Descriptor, Closure Location and Lanes Closed Message Elements**

Message Element and Message		Revised Message
<u>Roadwork on Different Highway than CMS</u>		
<i>Roadwork Descriptor</i>	<b>ROADWORK</b>	<b>I-80 EAST CLOSED FROM EXIT 52 TO EXIT 53</b>
<i>Closure Location</i>	<b>ON I-80 EAST FROM EXIT 52 TO EXIT 53</b>	
<i>Lanes Closed</i>	<b>ALL LANES CLOSED</b>	
		<i>(Note: The above message can be shortened by using EXIT 52 – EXIT 53, thus eliminating the third line.)</i>

**Table 5-8. Example of Combining Location of Closure Message Element and Action Message Element**

Message Element and Message		Revised Message
<u>Closed Roadway Due to Roadwork on Same Freeway as CMS</u>		
<i>Roadwork Descriptor</i>	<b>ROADWORK</b>	<b>FREEWAY CLOSED</b>
<i>Lane Closure Location</i>	<b>AT ROUTE 46</b>	
<i>Lanes Closed</i>	<b>ALL LANES CLOSED</b>	
<i>Location of Closure</i>	<b>AT I-80</b>	
<i>Audience for Action</i>	<b>I-287 NORTH TRAFFIC</b>	
<i>Action</i>	<b>EXIT AT I-80 FOLLOW DETOUR</b>	<b>EXIT AT I-80 FOLLOW DETOUR</b>

## SECONDARY REDUCTION APPROACH

### Reducing the Number of Destinations in the Audience for Action Message Element

After the Initial Reduction Approaches have been applied to the Base CMS Message, it may still be possible to reduce the number of informational units, if required, when the *Audience for Action* message element contains more than two *Audiences*. A decision will have to be made by the message designer concerning which of the two *Audiences* should be addressed in the message. The second *Audience* must then be omitted from the *Action* message element. In the example shown in Table 5-9, a Base CMS Message with five units of information was reduced to the message shown on the left side with four units of information.

**Table 5-9. Example of Reducing Number of Destinations in the Action Message Element**

Reduced Message After Applying Initial Reduction Approaches	Revised Message								
<p style="text-align: center;"><u>Roadwork on Different Highway than CMS</u></p> <table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 50%;"><b>I-76 CLOSED</b></td> <td style="text-align: center; width: 50%;"><b>BEST ROUTE TO PHILADELPHIA/ I-95 USE RTE 73 NORTH</b></td> </tr> <tr> <td style="text-align: center;"><i>Phase 1</i></td> <td style="text-align: center;"><i>Phase 2</i></td> </tr> </table>	<b>I-76 CLOSED</b>	<b>BEST ROUTE TO PHILADELPHIA/ I-95 USE RTE 73 NORTH</b>	<i>Phase 1</i>	<i>Phase 2</i>	<table style="width: 100%; border: none;"> <tr> <td style="text-align: center; width: 50%;"><b>I-76 CLOSED</b></td> <td style="text-align: center; width: 50%;"><b>BEST ROUTE TO PHILADELPHIA USE RTE-73 NORTH</b></td> </tr> <tr> <td style="text-align: center;"><i>Phase 1</i></td> <td style="text-align: center;"><i>Phase 2</i></td> </tr> </table>	<b>I-76 CLOSED</b>	<b>BEST ROUTE TO PHILADELPHIA USE RTE-73 NORTH</b>	<i>Phase 1</i>	<i>Phase 2</i>
<b>I-76 CLOSED</b>	<b>BEST ROUTE TO PHILADELPHIA/ I-95 USE RTE 73 NORTH</b>								
<i>Phase 1</i>	<i>Phase 2</i>								
<b>I-76 CLOSED</b>	<b>BEST ROUTE TO PHILADELPHIA USE RTE-73 NORTH</b>								
<i>Phase 1</i>	<i>Phase 2</i>								

The original message has the following five units of information:

- *I-76 CLOSED* 1 unit
- *BEST ROUTE TO* 1 unit
- *PHILADELPHIA/ I-95* 2 units
- *USE RTE-73 NORTH* 1 unit

Five units of information exceed the maximum number of units that motorists can read and comprehend while traveling at high freeway speeds. The message must therefore be reduced to four units of information. In the revised message, the destination *I-95* is omitted in preference to *PHILADELPHIA*, resulting in an acceptable four-unit message.

- *I-76 CLOSED* 1 unit
- *BEST ROUTE TO* 1 unit
- *PHILADELPHIA* 1 unit
- *USE RTE-73 NORTH* 1 unit

### **PRIORITY REDUCTION PRINCIPLES**

After the Initial and the Secondary Reduction Approaches are applied and the Base CMS Message still has more units of information than should be displayed to motorists at the prevailing freeway speed, then the Priority Reduction Principles discussed in this section should be applied.

There is a priority of information that motorists need in order to make driving decisions when incidents occur or lanes are closed due to roadwork. The information needed by motorists in order of priority for incidents and roadwork is shown in Tables 5.10 and 5.11.



**Table 5-10. Information Order of Priority Order for Incidents**

Message Elements For Lane Closure Incidents	Message Elements For Freeway/Expressway Closure Incidents
<ol style="list-style-type: none"> <li>1. Incident Descriptor (Problem)</li> <li>2. Incident Location</li> <li>3. Lanes Closed (Blocked)</li> <li>4. Speed Reduction Action (if needed)</li> <li>5. Diversion Action (if needed)</li> <li>6. Audience for Action (if needed)</li> <li>7. Effect on Travel (if needed)</li> <li>8. Good Reason of Following Diversion Action (if needed)</li> </ol>	<ol style="list-style-type: none"> <li>1. Closure Descriptor (Problem)</li> <li>2. Location of Closure</li> <li>3. Speed Reduction Action (if needed)</li> <li>4. Diversion Action</li> <li>5. Audience for Action (if needed)</li> <li>6. Effect on Travel (if needed)</li> </ol>

**Table 5-11. Information Order of Priority for Roadwork**

Message Elements For Lane Closure for Work Zones	Message Elements For Freeway Closure for Work Zones
<ol style="list-style-type: none"> <li>1. Roadwork Descriptor</li> <li>2. Roadwork Location</li> <li>3. Lanes Closed</li> <li>4. Speed Reduction Action (if needed)</li> <li>5. Diversion Action</li> <li>6. Audience for Action (if needed)</li> </ol>	<ol style="list-style-type: none"> <li>1. Freeway Closure</li> <li>2. Location of Closure</li> <li>3. Speed Reduction Action (if needed)</li> <li>4. Diversion Action</li> <li>5. Audience for Action (if needed)</li> </ol>

Although *the Incident Descriptor* and the *Roadwork Descriptor* are useful to motorists these message elements can be replaced with the *Lanes Closed* message element.

When the number of information units exceeds the maximum that should be displayed under prevailing speeds and the Initial Reduction Approaches and the Secondary Reduction Approach have been applied, then the message designer must begin eliminating informational units. **This is done by eliminating units of information starting with the lowest priority.**

## 5.4 WORD AND PHRASE MEANINGS AND CRITERIA

### SELECTING FROM ALTERNATIVE WORDS AND PHRASES

#### Use, Take, and Follow

The *Action* message element requires an action verb. In general, the three verbs *USE*, *TAKE*, and *FOLLOW* are synonymous and no strong preference exists. The verb *USE* has been employed more often because it is slightly shorter. There are, however, small differences in meaning which make one verb preferable to another in certain CMS messages.

The verb *USE* should be selected to indicate a route that will carry the motorist to his/her destination. The destination could be a major generator or a point of return to the freeway.

***USE*: a route that will carry motorists to the destination.**  
***TAKE*: directive to begin the first “leg” of route.**  
***FOLLOW*: motorist will be guided by other signs along the route.**  
***EXIT*: sometimes used as a verb.**  
***GO*: not used.**

The verb *TAKE* should be selected to identify an interconnecting highway or ramp that motorists are advised to use. The highway might be the exclusive diversion highway, or it might define the first “leg” of the diversion route. For example, *TAKE US-33* indicates that the diversion route US-33 interconnects with the current highway.

The verb *FOLLOW* carries the additional connotation that the motorist will be guided by other signs along the route. *FOLLOW* should never be used when guidance is not available.

The verb *EXIT* may also be used as a verb in action message statements that are displayed on a freeway. When *EXIT* is employed as a verb, it should usually be followed by the name of the cross street or highway associated with the exit ramp (e.g., *EXIT AT ROWLAND*). It is never followed with an exit number (e.g., *EXIT AT EXIT 22*).

The verb *GO* is not used in CMS messages for route guidance, but may be used in highway advisory radio messages. It connotes initiation of action, but would be out of place in situations where *USE* or *TAKE* is appropriate.

**MAJOR ACCIDENT  
AT EXIT 12  
USE US-33**

*Example of USE*

**BEST ROUTE  
TO NEW YORK  
TAKE NEXT EXIT**

*Example of TAKE*

**MAJOR ACCIDENT  
AT ROWLAND  
EXIT AT BASEL  
FOLLOW DETOUR**

*Example of FOLLOW  
(Note: the message should  
be split into two phases.)*

## Construction vs. Roadwork

The word *ROADWORK* may be substituted for the longer word *CONSTRUCTION*. Human factors studies showed that 59 percent of the drivers surveyed in New Jersey interpret the words *CONSTRUCTION* and *ROADWORK* to have the same meaning. The other 41 percent stated that the meanings differ. To these 41 percent, *CONSTRUCTION* implied larger-scale, longer-term work such as building bridges. (9)

There are two disadvantages to displaying the word *CONSTRUCTION*. First, it is a longer and more complex word than *ROADWORK* and, therefore, will take longer for motorists to read. Second, the word *CONSTRUCTION* will not fit on an eight-character line of a portable sign and, therefore, must either be abbreviated with *CONST* or replaced with the word *ROADWORK*.

***ROADWORK* may be substituted for the longer word *CONSTRUCTION*.**

Results of human factors studies showed that approximately 95 percent of New Jersey drivers and 85 percent of Texas drivers surveyed understood the abbreviation *CONST* to mean *CONSTRUCTION* (9,12).

### Exit vs. Ramp

When referring to an off ramp, the word *EXIT* should be used in messages on CMSs located on a freeway. The word *RAMP* should not be used because it has different shades of meaning for some motorists.

Results of human factors studies indicated that 26 percent of the New Jersey drivers and more than 40 percent of Texas drivers surveyed believed that the two terms have different meanings. A high percentage of the drivers believed that the term *EXIT* is for when the motorist gets off the freeway, and *RAMP* is for when the motorist gets on. The word *RAMP* also implied a freeway-to-freeway connector ramp or a lane directly into a rest stop. (11)

### A Dash vs. Thru

A hyphen may be substituted for the term *THRU* to indicate a set of inclusive days (e.g., TUE – THURS to indicate Tuesday thru Thursday). Ninety-two percent of motorists surveyed in New Jersey correctly stated the days of the week when a hyphen was used. (13) It is suggested that a space be inserted on both sides of the hyphen.

**ROADWORK  
TUE THRU THUR**

*Message 1  
Acceptable*

**ROADWORK  
TUE - THUR**

*Message 2  
Acceptable*

### Nite vs. Night

The term *NITE* may be used in place of *NIGHT*. Human factors studies resulted in data that showed most New Jersey motorists understand the term *NITE* as a substitute for *NIGHT* (13).

**ROADWORK  
TUE - THUR  
NIGHTS**

*Message 1  
Acceptable*

**ROADWORK  
TUE - THUR  
NITES**

*Message 2  
Acceptable*

### For 1 Week

Frequently roadwork is performed over a 1-week period (i.e., seven consecutive days). Although the term *FOR 1 WEEK* takes less CMS space, it should not be used to indicate the seven-day work period. The results of human factor studies in New Jersey and Texas revealed that the term *FOR 1 WEEK* was ambiguous as to whether the roadwork begins the date the message was

viewed, the next day, or from the beginning of the current or next week, and thus should not be used in a CMS message (10,13).

## **Weekend**

Oftentimes, major lane or roadway closures are necessary on the weekend. Although it is desirable to present the inclusive days and hours (e.g., *FRI 6 PM – MON 5 AM*), the portable CMS is limited to eight characters per line. If a word such as *WEEKEND* can be used rather than days and hours, then the message can be made much shorter in length.

However, human factors studies in New Jersey and Texas indicated that word *WEEKEND* should not be used if either the roadwork begins on Friday evening or ends on Monday morning. However, it may be satisfactory to use it if the work begins on Saturday morning and ends on Sunday evening. The results of human factors studies in New Jersey indicated that 60 percent of the motorists would believe the work would begin on Saturday morning and 79 percent would believe the work would end on Sunday evening (13). In Texas, 62 percent of the motorists would believe the work would begin on Saturday morning and 69 percent would believe the work would end on Sunday evening (11).

## **Lane Shift, Traffic Shifts, Lanes Change, and New Traffic Pattern**

There are several terms that have sometimes been used in work zones to indicate a temporary alignment change (i.e., all lanes shift left or right). Results of human factors research indicate that the following terms should not be used (14):

- *LANES SHIFT*;
- *TRAFFIC SHIFTS*;
- *LANES CHANGE*; and
- *NEW TRAFFIC PATTERN*.

Instead, the following term should be used:

- *LANES SHIFT / STAY IN LANE*.

The results of human factors studies revealed that a large majority of the motorists surveyed in New Jersey believed that they would have to merge with traffic in another lane when the terms *LANES SHIFT* (53 percent), *TRAFFIC SHIFTS* (52 percent), *LANE CHANGES* (73 percent), or *NEW TRAFFIC PATTERN* (42 percent) was displayed. Therefore, these terms would encourage undesirable lane changing. Most of the motorists surveyed (81 percent) understood that they would not have to merge to another lane when the term *LANES SHIFT/STAY IN LANE* was used. (14)

## **Calendar Dates**

It is desirable to notify motorists of upcoming roadwork or of a special event that will impact traffic. In the past, calendar dates have been used (e.g., *OCT 10 – OCT 12*) to indicate when the roadwork or special event activity begins and/or ends. However, results of human factors studies

showed that drivers have difficulties in corresponding calendar dates with specific days of the week.

Therefore, use days of the week (e.g., *TUE – THUR*) rather than calendar dates (e.g., *OCT 10 – OCT 12*). The use of days of the week is preferred over calendar dates.

Results of human factors studies showed that only 11 percent and 21 percent of the drivers surveyed in New Jersey and Texas were able to give correct days of the week when calendar dates were displayed even though the days were during the next week (see Message 1). In contrast, 93 and 85 percent gave the correct days of the week when Message 2 was shown.

**ROAD CLOSED**  
**~~{OCT 10 – OCT 12}~~**

*Message 1*  
*Unacceptable*

**ROAD CLOSED**  
**TUES - THUR**

*Message 2*  
*Acceptable*

## **5.5 DIVERSION/DETOUR ROUTE DESCRIPTIONS FOR INCIDENT AND ROADWORK SITUATIONS**

### **INTRODUCTION**

The *Action* message element that involves traffic diversion is influenced by the type of diversion route that will be used by motorists to travel around the incident. Six diversion route types have been identified for use in this *Handbook*. These are described and summarized in the next section.

### **DIVERSION/DETOUR ROUTE TYPES**

#### **Type 1 Diversion Route**

The Type 1 diversion route has a major road (e.g., frontage road, arterial, etc.) that is basically parallel and close to the primary freeway and offers opportunities for motorists to either turn toward the freeway and reenter downstream of the incident; or head directly to the major destination.

Some form of surveillance (electronic or human) exists on the diversion route and sends information about traffic conditions to the traffic management center. Therefore, the CMS operator has knowledge of the traffic conditions on both the primary freeway and the diversion route.

Guide signs and/or trailblazers to the freeway or major destination **may not be** present. However, commuters most likely know the crossroads that will allow them to drive back to the freeway once they pass the incident or know the route to the major destination. Police and/or traffic control personnel are not guiding traffic along the diversion route.

The Type 1 diversion route is generally applicable when:

- Lanes are blocked due to an incident;
- Lanes are closed due to an incident;
- Freeway is totally blocked due to an incident;
- Freeway is closed due to an incident;
- Lanes are closed due to roadwork; or
- Freeway is closed due to roadwork.

### **Type 2 Diversion Route**

The Type 2 diversion route has one or more primary major roads (e.g., arterials, other freeways, etc.) that offer opportunities for motorists who exit to either turn toward the freeway and reenter downstream of the incident or head directly to the major destination.

Some form of surveillance (electronic or human) exists on the diversion route and sends information about traffic conditions to the TOC. Therefore, the CMS operator has knowledge of the traffic conditions on both the primary freeway and the diversion route.

Existing static guide signs and/or trailblazers to the freeway or to the major destination **are** present. Police and/or traffic control personnel are not guiding traffic along the diversion route.

The Type 2 diversion route is generally applicable when:

- Lanes are blocked due to an incident;
- Lanes are closed due to an incident;
- Freeway is totally blocked due to an incident;
- Freeway is closed due to an incident;
- Lanes are closed due to roadwork; or
- Freeway is closed due to roadwork.

### **Type 3 Diversion Route**

The Type 3 diversion route has one or more primary major roads (e.g., arterials, other freeways, etc.) that offer opportunities for motorists to either turn toward the freeway and reenter downstream of the incident or head directly to the major destination.

Some form of surveillance (electronic or human) exists on the diversion route and sends information about traffic conditions to the TOC. Therefore, the CMS operator has knowledge of the traffic conditions on both the primary freeway and the diversion route.

Static guide signs and/or trailblazers to the freeway or to the major destination **are not** present. Police and/or traffic control personnel are guiding traffic along the diversion route.

The Type 3 diversion route is generally applicable when:

- Freeway is closed due to an incident.

#### **Type 4 Diversion Route**

The Type 4 diversion route has one or more primary major roads (e.g., arterials, other freeways, etc.) that offer opportunities for motorists to either turn toward the freeway and reenter downstream of the incident or head directly to the major destination.

Some form of surveillance (electronic or human) exists on the diversion route and sends information about traffic conditions to the TOC. Therefore, the CMS operator has knowledge of the traffic conditions on both the primary freeway and the diversion route.

Existing static guide signs and/or trailblazers to the freeway or to the major destination **are** present. In addition, police and/or traffic control personnel are guiding traffic along the diversion route.

The Type 4 diversion route is generally applicable when:

- Freeway is closed due to an incident.

#### **Type 5 Diversion Route: Incident Emergency Route Plan**

The Type 5 diversion route has one or more primary major roads (e.g., arterials, other freeways, etc.) that offer opportunities for motorists to either turn toward the freeway and reenter downstream of the incident; or head directly to the major destination.

Existing static guide signs and/or trailblazers to the freeway or to the major destination may not be present. Diversion/detour signs are installed after the incident occurs. In addition, police and/or traffic control personnel are guiding traffic along the diversion route.

The Type 5 Diversion Route is applicable when:

- Freeway is closed due to an incident.

#### **Type 6 Detour Route: Traffic Control Plan for Roadwork Closure**

The Type 6 detour route is a route that has been established and contains the full complement of traffic control devices specified in the traffic control plan for the major roadwork project.

The Type 6 detour route is applicable when:

- Freeway is closed due to roadwork.

## Summary of Diversion/Detour Route Types

A summary of the characteristics for diversion/detour route types is shown in Table 5-12.

**Table 5-12. Characteristics of Diversion/Detour Routes (Ref 4)**

Characteristics	Diversion/Detour Route					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Electronic and/or human surveillance on diversion route	X	X	X	X		
Existing guide signs and/or trailblazers to freeway or destination on diversion route		X		X		
Police and/or traffic control personnel at critical decision points on diversion route			X	X	X	
Incident Emergency Route Plan signing					X	
Roadwork Traffic Control Plan traffic control devices						X

## 5.6 MESSAGES AFTER INCIDENT IS REMOVED

### BEFORE CONGESTION CLEARS

The signing responsibilities do not end when the incident is removed from the freeway lanes because congestion may still exist on the freeway, particularly following a major incident. The objectives of messages at this time are to:

- Inform motorists that the incident has been removed;
- Advise motorists that all lanes are open to traffic; and/or
- Advise motorists of the freeway congestion.

It is important to inform motorists who have seen a previous CMS message or have received information via radio or other media of a major incident that the incident has been removed from the lanes and all lanes are open to traffic. This is important for drivers to make informed decisions, particularly in light of the fact that most freeway drivers would prefer to use the freeway (8).

In regard to posting the limits of the congestion, there is a dilemma--the length of queue is continuously decreasing. Therefore, motorists who see a message with the limits of the congestion (e.g., *FROM EXIT 2 TO EXIT 4*) on a CMS upstream of the queue will actually experience less congestion than that shown on the sign. Thus it may be best display information that the incident has been cleared from the freeway and that all lanes are open. An example of a message is shown below.

<p><b>ACCIDENT CLEARED ALL LANES OPEN</b></p>
---



Ordinarily it is beneficial to display the location of the incident. However, since the queue is dissipating downstream (clearance wave moving upstream) the location where the drivers can begin traveling at higher speeds will be farther upstream of where the incident occurred. Therefore, it is preferred that the location of the incident not be displayed.

## **AFTER CONGESTION CLEARS**

After the congestion due to the incident dissipates, it is advisable to display a message for a short period of time to advise that all the lanes are open to traffic. Either the message shown above or a message that simply states *ALL LANES OPEN* can be displayed.

## **5.7 MESSAGES TO SUPPORT HIGHWAY ADVISORY RADIO**

CMSs are sometimes used to inform motorists to tune to an HAR station when the circumstances of the incident or roadwork dictate the need for more information than can be displayed on a CMS. This can be done via an *Action* message element in a CMS message, or simply as a sole advisory to tune to the HAR station. Examples of messages are shown below.

<p><b>MAJOR ACCIDENT PAST ROWLAND TUNE RADIO TO 530 AM</b></p>
--

*Alternative 1*

<p><b>TRAFFIC ADVISORY TUNE RADIO TO 530 AM</b></p>
---

*Alternative 2*

In the second alternative, having a static sign with beacons that would flash when it is desirable for drivers to tune to the radio station would be preferred to using the overhead CMS for this purpose. The CMS would be best used for displaying relevant traffic and highway information.

## **5.8 MESSAGES FOR TRUCKS AND HAZARDOUS CARGO RESTRICTIONS**

A review of the literature revealed that there were no reported studies that addressed special CMS messages for truck drivers to inform them of truck or hazardous cargo restrictions. Therefore, this section of the *Handbook* merely summarizes current practices.

### **TRUCK RESTRICTIONS**

Truck restrictions on highways are stipulated by using static regulatory signs such as the R5-3 “No Truck” symbol sign, R5-4 COMMERCIAL VEHICLE EXCLUDED sign, or R5-5 TRUCKS WITH LUGS PROHIBITED sign. The word message *NO TRUCKS* can be used as an alternate to the symbol sign (3). Sometimes it is necessary or desirable to regulate trucks in a dynamic sense.

Perhaps the system of CMSs for truck prohibition with the longest experience and highest visibility is the system on the New Jersey Turnpike. A section of the Turnpike is a dual-dual highway with trucks prohibited from the inside roadway. Rotating drum CMSs with color-coded messages and panels are used to regulate vehicle movement, and divert traffic from the inside roadway to the outside roadway, or vice-versa, when a major incident occurs on one of the roadways.

## **HAZARDOUS CARGO RESTRICTIONS**

Hazardous cargo restrictions on highways are stipulated by using the R14-3 Hazardous Cargo Prohibited symbol sign (3). There is no alternate word message in the MUTCD.

If it is likely that drivers may divert to an alternative route that has hazardous cargo restrictions after an incident occurs on the freeway, it may be necessary or desirable to display messages on the CMS to advise truck drivers of the restrictions. In other cases, it may be desirable to reemphasize the restrictions that are stipulated by static signs by posting a message on a CMS.

## **5.9 USE OF GRAPHICS IN MESSAGES**

The positive effectiveness of shape and color for regulatory, warning, guide, tourist oriented direction, recreational, and cultural interest areas are well established for static signs. Graphics in the form of interstate and state highway shields were introduced many years ago and were well received by the motoring public. Several symbols were introduced into the highway signing system with the previous edition of the MUTCD. Research by Hawkins et al. (15) and Picha et al. (16) indicated that drivers understood many of the symbols, but some symbols were met with limited understanding. Some of the latter symbols have been removed in the newer edition of the MUTCD (3). The advantages of good graphics/symbols are that the information can be read and understood quicker and farther upstream of the sign in comparison to word messages.

Research by Huchingson et al. (17) showed that drivers exhibited a strong preference for having the route marker displayed (e.g., interstate shield) on the CMS in comparison to the written version (e.g., I-295). Knoblauch et al. (18) reported on research to evaluate the following symbols that might be used on portable CMSs: crash (European), congestion (European), advance flagger, lane reduction transition, and two-way traffic arrows. The results showed that less than 50 percent of the drivers tested were able to correctly interpret the crash symbol that is used in Europe at distances of 570 ft or more. Subject comprehension of the European congestion symbol was virtually nonexistent. Also, potentially dangerous meanings were frequently associated with the symbol. The most common potentially dangerous meaning involved the drivers believing the symbol indicated three lanes ahead, one for each vehicle displayed in the picture. Similarly, potentially dangerous interpretations were found for the advance flagger symbol. The lane reduction transition symbol was found to be illegible from distances of 570 ft and greater, and was understood by only 80 percent of the drivers when the symbol was viewed at 400 ft. Although two-way traffic arrows were understood better than the other symbols tested, more than 10 percent had potentially dangerous interpretations.

The current day typical CMS (with three or four lines of text) is not capable of displaying graphics and symbols that would be beneficial to drivers. It is possible to show symbols on full matrix CMSs, but this has to be done by compromising the required size of letters used in the full message.

The shape and color requirements in the MUTCD (3) suggest that the common types of symbols for regulation and warning cannot be used on current types of CMSs used by TMCs. Until highway agencies can afford to install stadium and arena type full-matrix, full-color signs, use of graphics and symbols will be limited.

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## MODULE 6. DEALING WITH LONG MESSAGES

After the CMS message designer selects the necessary elements of the Base CMS Message and reduces the Base CMS Message using the approaches discussed in Section 5.3 *Reducing Units of Information from the Base CMS Message*, the designer might still find that the message is still too long to be displayed on one message phase. Additional guidelines and helpful hints for splitting and reducing the length of messages are presented in this section of the *Handbook*.

### 6.1 SPLITTING MESSAGES

When a CMS message is too long to fit on one phase, it can be split and displayed on multiple phases that are shown sequentially. When it is necessary to divide a message and display it on more than one phase, the five principles below must be used.

#### MESSAGE SPLITTING PRINCIPLES:

- No more than two phases should be used;
- Each phase must be understood by itself;
- Compatible units of information should be displayed on the same phase;
- A message line should not contain portions of two different units of information; and
- No more than three units of information should be displayed on a single phase at high freeway speeds.

#### 1. NO MORE THAN TWO PHASES SHOULD BE USED

Research has shown that for the typical three- or four-line CMSs, motorists have difficulty in reading messages displayed on more than two phases (1). The MUTCD (2) in *Section 2E.21 Changeable Message Signs* specifies that

*“A three-line changeable message sign shall be limited to not more than two messages . . .”*

Although the MUTCD states “two messages,” it most likely is referring to one message displayed on “two phases.” Certainly, only one message should be displayed at a time.

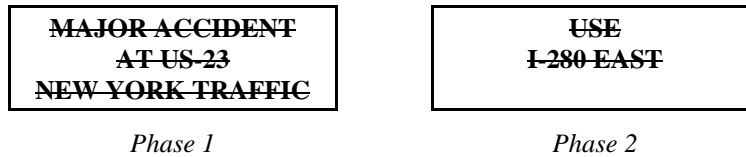
Guidance in Part 6 of the MUTCD is given in *Section 6F.52 Portable Changeable Message Signs* as follows:

*“When a message is longer than two phases, additional Portable Changeable Message signs should be used.”*

#### 2. EACH PHASE MUST BE UNDERSTOOD BY ITSELF

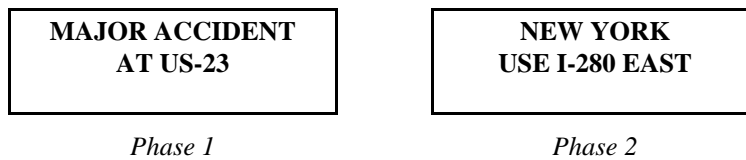
Each message phase must be understood by itself because either phase may be read first by the passing motorist. Typically, the problem and location appear on the first phase and the advisory and attention statement (if needed) on the second phase (3,4,5). The following two examples help illustrate Principle 2.

**Example of an UNACCEPTABLE MESSAGE SPLIT with a phase that is not understood by itself**



In Phase 1, the message *MAJOR ACCIDENT/ AT US-23/ NEW YORK TRAFFIC* is not understood by itself. This is because the *Audience (NEW YORK TRAFFIC)* is not compatible with the *Incident Descriptor* and *Incident Location* message elements. The *Audience* message element should be combined with the *Action (USE I-280 EAST)* so that the two terms *NEW YORK* and *USE I-280 EAST* are on the same message phase as shown below.

**Example of an ACCEPTABLE MESSAGE SPLIT with each phase understood by itself**

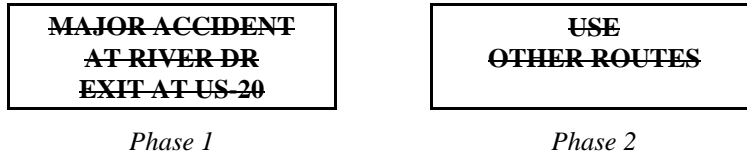


**3. COMPATIBLE UNITS OF INFORMATION SHOULD BE DISPLAYED ON THE SAME PHASE**

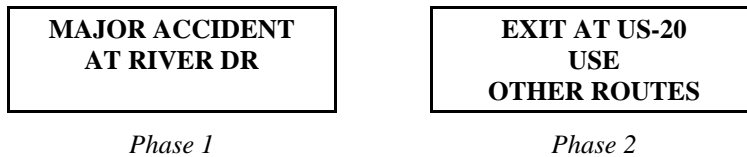
Compatible units of information should be displayed on the same phase (3,4,5). The previous examples shown for Principle 2 also help to illustrate Principle 3. The *Incident Descriptor (MAJOR ACCIDENT)* and the *Incident Location (AT ROUTE 23)* message elements are compatible and can be displayed on the same phase. Also, the *Audience (NEW YORK)* and *Action (USE I-280 EAST)* message elements are compatible and can be displayed on the same phase. In contrast, the *Audience (NEW YORK)* message element is not compatible with the *Incident Descriptor (MAJOR ACCIDENT)* and the *Incident Location (USE I-280 EAST)*.

Another illustration of the violation of Principle 3 and the corrected message are shown in the examples below. The first example (UNACCEPTABLE MESSAGE SPLIT) shows two *Action* message elements that are split. One action is on the first phase and the second action on the second phase. The two *Action* message elements should be displayed on the same message phase as shown in the second example (ACCEPTABLE MESSAGE SPLIT).

**Example of an *UNACCEPTABLE MESSAGE SPLIT* with phase that is not compatible**



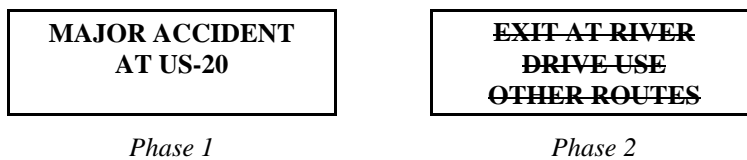
**Example of an *ACCEPTABLE MESSAGE SPLIT* with each phase compatible**



**4. A MESSAGE LINE SHOULD NOT CONTAIN PORTIONS OF TWO DIFFERENT UNITS OF INFORMATION**

Sometimes, two interrelated units of information are too long for each to fit on one line when it is desirable to display both in the same message phase. The temptation, at times, is to “squeeze” both units of information on the same phase by splitting each unit and displaying portions of each unit on the same line. This should be avoided because it confuses motorists and increases reading time (3,4,5). An example of an unacceptable message split is shown below. Note the unacceptable splitting and combining of portions of the two message units of information in Phase 2 (i.e., combining DRIVE and USE on the second line of Phase 2 from the two units of information EXIT AT RIVER DRIVE and USE OTHER ROUTES).

**Example of *UNACCEPTABLE SPLITTING AND COMBINING PORTIONS OF TWO MESSAGE UNITS OF INFORMATION ON THE SAME LINE***



In most cases, the unacceptable message can be corrected by using better terms in the message phase or by using abbreviations. In the example above, the unacceptable message can be corrected by using abbreviations as shown in the acceptable message below.

**Example of an ACCEPTABLE MESSAGE SPLIT OF UNITS OF INFORMATION ON SEPARATE LINES**

MAJOR ACCIDENT  
AT US-20

*Phase 1*

EXIT AT RIVER DR  
USE  
OTHER ROUTES

*Phase 2*

**5. NO MORE THAN THREE UNITS OF INFORMATION SHOULD BE DISPLAYED ON A SINGLE PHASE WHEN HIGHWAY SPEEDS ARE HIGH**

Research has shown that, at typical freeway speeds, no more than three units of information should be displayed on a single message phase (1,3). Phase 2 in the example below has the following four units of information that motorists destined to Philadelphia and to I-95 (two *Audiences*) must read in order to make a diversion decision:

- Unit 1 – *BEST ROUTE TO*;
- Unit 2 – *PHILADELPHIA*;
- Unit 3 – *I-95*; and
- Unit 4 – *USE RT-322*.

The four-unit message phase is too complex for motorists to read and understand while traveling at high freeway speeds.

**Example of an UNACCEPTABLE MESSAGE PHASE with four units of information (Phase 2)**

3 LANES CLOSED  
AT I-295

*Phase 1*

BEST ROUTE TO  
PHILADELPHIA/I-95  
USE US-32

*Phase 2*

One alternative solution is to direct the *Action* message element to only one of the two *Audiences*. The decision would need to be made whether it is best to advise motorists destined to Philadelphia or destined to I-95. In the acceptable message below, the *Action* is directed to the Philadelphia-bound motorists.

**Example of an ACCEPTABLE MESSAGE PHASE with three units of information (Phase 2)**

3 LANES CLOSED  
AT I-295

*Phase 1*

BEST ROUTE TO  
PHILADELPHIA  
USE US-32

*Phase 2*



## 6.2 REDUCING MESSAGE LENGTH

Always look for ways to reduce the message length without losing the intent of the message by:

- Deleting “dead” words, and/or
- Using abbreviations.

**MESSAGE LENGTH CAN BE REDUCED BY:**

- Omitting “dead” words; and/or
- Using abbreviations.

### DELETING “DEAD” WORDS

“Dead” words should be deleted whenever possible. “Dead” words are ones that 99 percent of local motorists would assume without being told.

#### Street, Avenue or Boulevard

One example of a “dead” word is the use of “street”, “avenue”, or “boulevard” following a familiar arterial name. These words are not required and could be omitted. There are exceptions to this principle that are discussed on *Modifiers to Street, Road, and Avenue Names* discussed on page 5-11.

#### Ahead

Another “dead” word is “ahead.” It is not necessary to tell motorists that an incident or roadwork is “ahead” when the CMS is on the same freeway as the event because it will be understood by motorists that the event is ahead.

### USING ABBREVIATIONS

#### Acceptable Abbreviations

The MUTCD (2) contains lists of abbreviations that are a) acceptable, b) acceptable, but only with a prompt word, and c) unacceptable. Many of the abbreviations appear to be based on research conducted by Dudek et al. (1) in Texas in the early 1980s, and Hustad and Dudek (6) in New Jersey in 1997. The studies were conducted to determine acceptable abbreviations for words and phrases that might be displayed on CMSs. The acceptability/unacceptability of some of the abbreviations were further tested by Dudek and Huchingson (7) in New Jersey in 1998 and Durkop and Dudek (8) in Texas in 2000. Other abbreviations in the MUTCD appear to be the result of common usage on static signs (e.g., *CD* for civil defense, *H* for hospital, *JCT* for junction, etc.).

Table 6-1 shows a selected number of acceptable abbreviations for a number of words that might sometimes be used in CMS messages. Acceptability was defined as 85 percent or more of drivers interpreting the abbreviation correctly (1,6,8). Keep in mind that the abbreviated words in Table 6-1 would normally appear in a CMS message with at least one other word (prompt word). Since 85 percent or more of drivers tested understood the abbreviations without any prompt words (with the exceptions to those noted in the next paragraph), it speaks to the “strength” of understandability for these abbreviations.

**Table 6-1. Selected MUTCD Acceptable Abbreviations (Ref 2)**

Word Message	Standard Abbreviation
Afternoon / Evening	PM
Alternate	ALT
Avenue	AVE
Boulevard	BLVD
Center	CNTR
Drive	DR
East	E
Emergency	EMER
Entrance, Enter	ENT
Expressway	EXPWY
Feet	FT
FM Radio	FM
Freeway	FRWY, FWY
Friday	FRI
Hazardous Material	HAZMAT
Highway	HWY
Information	INFO
Junction / Intersection	JCT
Lane	LN
Left	LFT
Maintenance	MAINT
Mile(s)	MI
Miles Per Hour	MPH or M.P.H.
Minute(s)	MIN
Monday	MON
Morning / Late Night	AM

Word Message	Standard Abbreviation
Normal	NORM
North	N
Parking	PKING
Parkway	PKWY
Right	RHT
Road	RD
Saturday	SAT
Service	SERV
Shoulder	SHLDR
Slippery	SLIP
South	S
Speed	SPD
Street	ST
Sunday	SUN
Telephone	PHONE
Temporary	TEMP
Thursday	THURS
Traffic	TRAF
Travelers	TRAVLRS
Tuesday	TUES
US Numbered Route	US
Vehicles	VEH
Warning	WARN
Wednesday	WED
West	W

It should be noted that not all of the abbreviations in Table 6-1 taken from the MUTCD were understood by 85 percent or more of the drivers that were tested. For example, the cardinal directions (*N, S, E, W*) when shown without a prompt word or number were understood by only 12 percent of the drivers tested in studies by Dudek et al. conducted in the early 1980s (1). The abbreviation *MI* for *MILE(S)* and the abbreviation *MIN* for *MINUTES* were understood by only 72 percent of the drivers. However, understanding of these abbreviations increased above 85 percent when they were used by a prompt word.

It should also be noted that the author of this *Handbook* did not find documentation of research that reported on the understandability of the abbreviation *RHT* for *RIGHT*. However, the abbreviations *RGT* was evaluated and found to be acceptable when shown with a prompt word (e.g., *KEEP RGT*,

*RGT LANE*). This is not to say that *RHT* would not be understood when used with the same prompt words.

A list of MUTCD acceptable abbreviations when used with a prompt word is given in Table 6-2. Additional words/phrases that can be abbreviated in CMS messages determined from research by Hustad and Dudek (6) and Durkop and Dudek (8) are given in Table 6-3.

**Table 6-2. MUTCD Abbreviations That Are Acceptable Only with a Prompt Word (Ref 2)**

Word Message	Acceptable Abbreviation	Prompt Word
Access	ACCS	Road
Ahead	AHD	FOG*
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
Hazardous	HAZ	Driving
Interstate	I	[number]

Word Message	Acceptable Abbreviation	Prompt Word
Local	LOC	Traffic
Lower	LWR	Level
Major	MAJ	Accident
Minor	MNR	Accident
Oversized	OVRSZ	Load
Prepare	PREP	To Stop
Pavement	PVMT	Wet*
Quality	QLTY	Air*
Roadwork	RDWK	Ahead
Route	RT	Best*
Township	TWNSHP	Limits
Turnpike	TRNPK	[name]*
Upper	UPR	Level
Vehicle	VEH	Stalled*

\* These prompt words should precede the abbreviation

**Table 6-3. Additional Acceptable Abbreviations (Ref 6,8)**

Word	Phrase	Acceptable Abbreviation	Word	Phrase	Acceptable Abbreviation
Accident	Accident at Major Accident Minor Accident	ACCDT AT MAJ ACCDT MNR ACCDT	Major	Major Accident	MAJ ACCDT
			Minor	Minor Accident	MNR ACCDT
Closed	Lane Closed	LN CLSD	Parking	Parking Lot	PRK LOT
Lane	Lane Closed	LN CLSD	Pavement	Wet Pavement	WET PVMT
Level	Lower Level	LOWER LVL LOWR LVL	Route	Detour Route	DETOUR RTE
Level	Upper Level	UPPER LVL	Upper	Upper Level	UPR LEVEL UPPR LEVEL
Lower	Lower Level	LWR LEVEL	Weight	Weight Limit	WT LIMIT

### Unacceptable Abbreviations

A number of abbreviations found to be unacceptable are given in the MUTCD (2). These are shown in Table 6-4.

**Table 6-4. Unacceptable Abbreviations (Ref 2)**

Abbreviation	Intended Word	Common 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

In addition to those shown in Table 6-4, a number of additional abbreviations were found to be unacceptable by Dudek et al. (1) in Texas in the early 1980s, and Hustad and Dudek (6), Dudek and Huchingson (7), and Durkop and Dudek (8) even when used in a context of a CMS message. That is, they were understood by less than 85 percent of the drivers surveyed. These additional unacceptable abbreviations are shown in Table 6-5.

**Table 6-5. Additional Unacceptable Abbreviations (Ref 6,8)**

<b>Word</b>	<b>Phrase</b>	<b>Unacceptable Abbreviation</b>
Alternative	Alternative Routes	<del>ALT</del> <del>RTS</del>
Congestion	Major Congestion	<del>MAJ</del> <del>CONG</del>
County Road	County Road [number]	<del>CR</del> [number] <del>CO RD</del> [number]
Eastbound	Eastbound Traffic	<del>EB</del> TRAFFIC
Incident	Incident At	<del>INCID</del> AT <del>INCIDT</del> AT
Interchange	Interchange 14	<del>INTCH</del> 14
Northbound	Northbound Traffic US 180 Northbound	<del>NB</del> TRAFFIC US 180 <del>NB</del>
Road Work	Road Work	<del>RD</del> <del>WK</del>
Route	Detour Route	DETOUR <del>RT</del>
Southbound	Southbound Traffic US 75 Southbound	<del>SB</del> TRAFFIC US 75 <del>SB</del>
Vicinity	Vicinity Of	<del>VIC</del> OF
Westbound	Westbound Traffic US 180 Westbound	<del>WB</del> TRAFFIC US 180 <del>WB</del>

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6. Hustad, M. and C.L. Dudek. Driver Understanding of Abbreviations for Changeable Message Signs in New Jersey. In *Transportation Research Record 1689*, TRB, National Research Council, Washington, D.C., 1999, pp 46-52.

7. Dudek, C.L. and R.D. Huchingson. *Technical Memorandum 7296-5-5, Results of Human Factors Studies in New Jersey: Time and Day Issues*. (Unpublished) Prepared for the New Jersey Department of Transportation, January 1998.
8. Durkop, B. and C.L. Dudek. Texas Driver Understanding of Abbreviations for Changeable Message Signs. In *Transportation Research Record 1748*, TRB, National Research Council, Washington, D.C., 2001, pp 87-95.

# MODULE 7. ESTABLISHING THE MAXIMUM MESSAGE LENGTH

## 7.1 MESSAGE LENGTH AND CMS VIEWING DISTANCE REQUIREMENTS

The maximum length of message that should be displayed on a CMS at a location depends not only on the perception and information processing capabilities of motorists, but also on how far away they can detect the sign and how far they can adequately read the message.

**Available reading distance to the CMS (coupled with traveling speed) dictates the amount of time the motorist has to read the sign. Any obstruction that comes between the motorist and the CMS within this viewing distance will hinder the motorist from reading the entire message.**

Highway signs must project a message so that the driver can:

1. Detect the sign,
2. Read and understand the sign,
3. Make appropriate decisions base on the information gained from the sign.

And if necessary:

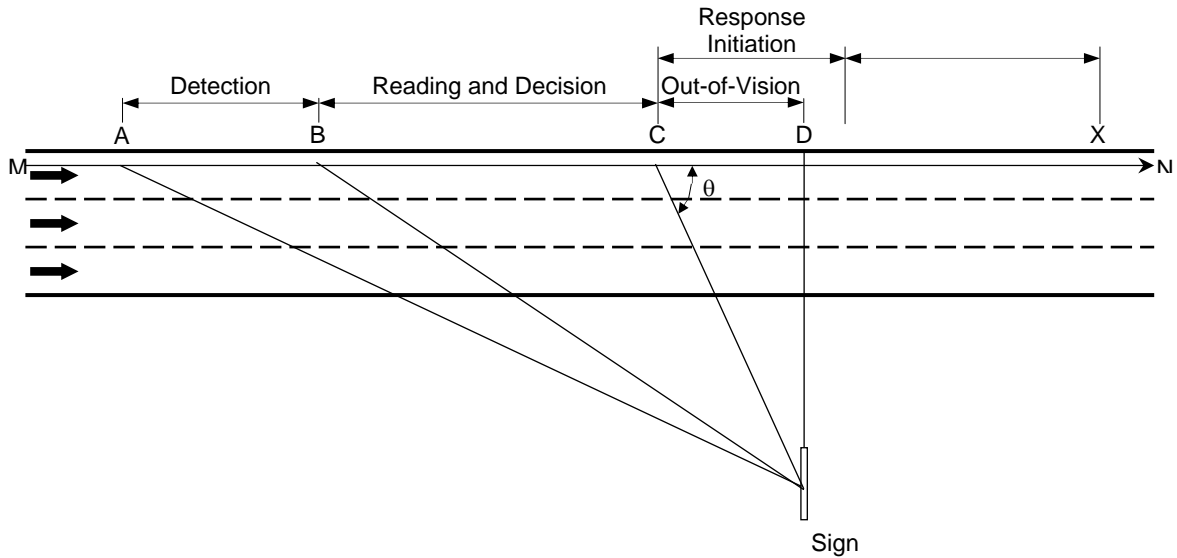
4. Initiate a control response, and
5. Complete the required maneuver.

Thus a driver's distance requirements of a sign can be derived from allotments of time to each of these five components. (*I*)

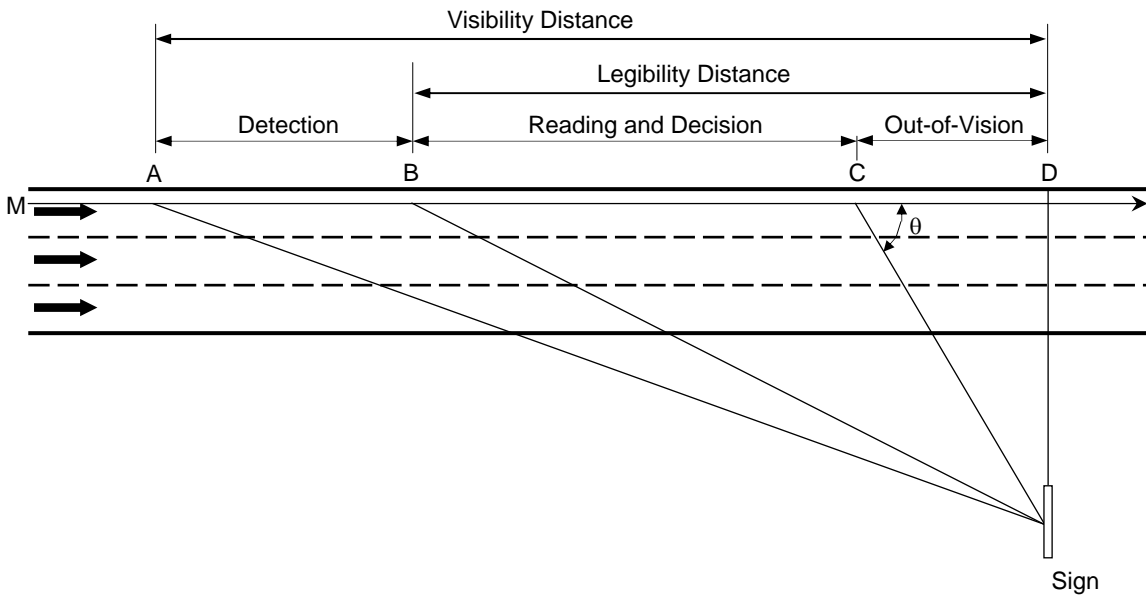
Some of the relationships involved for a driver traveling in the third lane from the shoulder to read a portable changeable message sign (PCMS) or a ground-mounted sign are shown in Figure 7-1. Line M-N represents the eye of the driver while traveling from left to right. Point A in the figure is the location at which the driver detects the sign in the environment although he/she cannot yet read the message. Point B is the location at which the sign message becomes legible and the driver can begin reading the message. Point C represents a cut-off location. The cut-off location, established by the angle  $\theta$  (theta), is the point where the driver may no longer read the sign without losing peripheral sight of the roadway ahead. Thus, the message is exposed to the driver while he/she is between Points B and C (distance B-C); however, the message is normally not read while the driver is between Points C and D (distance C-D) because it would require significant head turning. The distance C-D is sometimes referred to as the *out-of-vision distance*. After a driver decides on an action, he/she responds and completes the appropriate maneuver.

There are exceptions to using the five components to determine a driver's distance requirements. CMSs, for example, do not typically require a driver to initiate and complete a maneuver prior to reaching the sign. Thus for CMSs, only the sign detection distance (A-B), reading and decision distance (B-C), and the out-of-view distance (C-D) are relevant to the analysis (see Figure 7-2).

The distances traveled by the driver during each of these three components are governed in large part by the speed of the vehicle.



**Figure 7-1. Sign Detection, Reading, Decision, Response Initiation, and Response Relationships**



**Figure 7-2. CMS Detection, Reading, Decision, and Out-of-Vision Relationships**

The minimum required visibility distance (A-D) in Figure 7-2 is the distance for the driver to first detect the presence of the CMS. The minimum required legibility distance (B-D) represents the distance from the CMS that a driver must begin reading the CMS message. Similar



relationships exist for permanently mounted overhead CMSs. The only difference is that the angle  $\theta$  is in the vertical rather than horizontal direction.

The message viewing distance, the distance during which a driver can read the CMS message, (coupled with the speed that the driver is traveling) dictates the amount of time he/she has available to read a CMS. The message viewing distance necessary to read a message of a given length (in terms of units of information presented) is illustrated in Figure 7-3. Any obstruction that comes between the motorist and the sign within the minimum required viewing distance hinders the motorist from reading the entire message. At higher speeds, distances as great as 800 ft are needed for messages that contain 4 units of information.

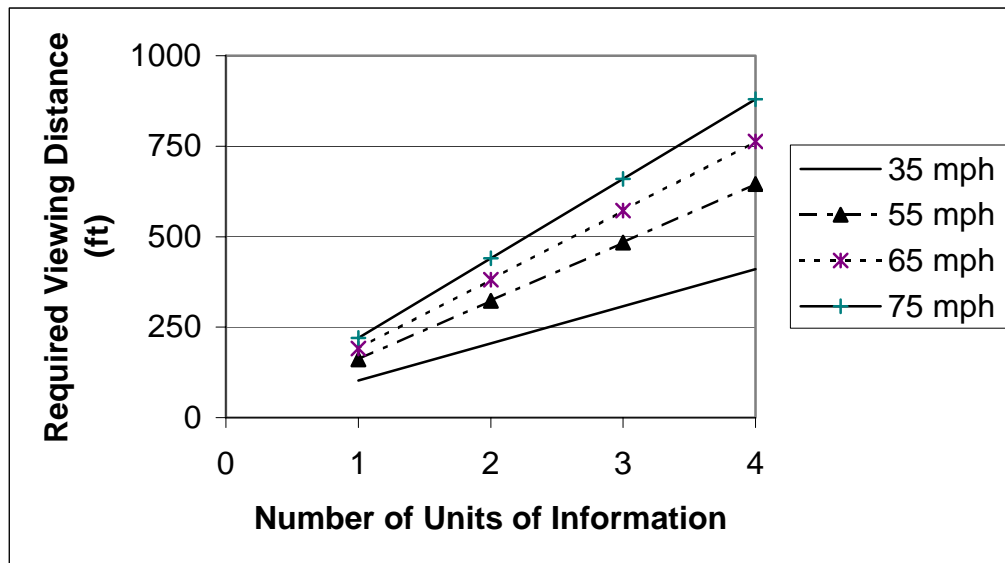
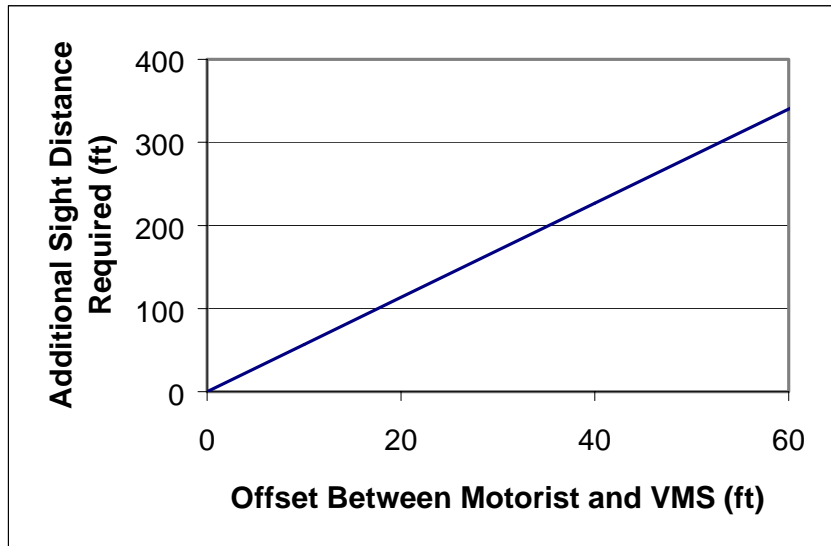


Figure 7-3. Required CMS Message Viewing Distances (Ref 2)

The values in Figure 7-3 are for CMSs mounted directly over the travel lanes. However, for CMSs positioned off to the side of the roadway (either permanent-mounted or portable), additional sight distance is required to ensure that the message is read entirely while still within the driver's field of vision (assumed to be  $10^\circ$  right or left of head-on viewing). The distances that should be added to the values in Figure 7-3 for a given lateral offset between the motorist and the center of the CMS are shown in Figure 7-4. Note that the additional sight distance required can be quite significant for larger offsets, adding 300 ft or more to the necessary sight distance between the motorist and the CMS.



**Figure 7-4. Additional Sight Distance Required for Lateral CMS Offset (Ref 2)**

The maximum distance at which a motorist can first correctly identify letters and words on a CMS is termed the *legibility distance* of the sign. In some situations, a motorist may not be able to utilize the maximum possible legibility distance (and thus, viewing time) of a particular CMS technology or design. Lighting conditions (day vs. night and position of the sun) can reduce the legibility distance to the CMS. Roadway geometric features such as vertical or horizontal curvature (around sight obstructions) as well as spot obstructions such as overpasses and sign bridges can also restrict CMS viewing distances. A number of environmental factors or conditions also impact CMS visibility. Rain and fog (and even snow) scatter and block light rays from a CMS as that light travels through the atmosphere. Finally, the presence of a significant number of trucks on the roadway will likewise limit the ability of motorists to adequately view a CMS positioned on the side of the roadway.

**THE LEGIBILITY DISTANCE TO A CMS MAY BE LESS THAN EXPECTED BECAUSE OF:**

- **Lighting conditions,**
- **Sun position,**
- **Vertical curvature,**
- **Horizontal curvature,**
- **Spot obstructions,**
- **Rain or fog, and**
- **Trucks in the traffic stream.**

**THEREFORE, THE MAXIMUM ALLOWABLE NUMBER OF UNITS OF INFORMATION MAY HAVE TO BE REDUCED.**

Just as factors such as reduced lane widths and sharp grades reduce the ideal traffic-carrying capacity of a roadway, one or more of these conditions can constrain the available CMS viewing distances to values lower than what are ideal. This means that there may not always be enough viewing time for a motorist to read a CMS message providing four units of information (5 units on lower speed roadways), and so shorter messages may have to be used.

Adjustments that may need to be made to the Base Maximum Message Length assumed to be available for a particular type of CMS are described in the following sections for five major conditions:

- Day and night operations,
- Vertical curves,
- Horizontal curves,
- Presence of a large proportion of trucks, and
- Presence of rain or fog.

## 7.2 MAXIMUM CMS LEGIBILITY DISTANCES FOR DAY AND NIGHT OPERATIONS

The legibility of a CMS depends on the design characteristics of the sign. Key design parameters are the type of display technology (light-emitting, light-reflecting, etc.), height and width of the characters, the stroke width of the characters, and the type of font displayed. Legibility distances proposed for use in CMS message design (based on results of several studies) are presented in Table 7-1 (3). These distances represent standard font (all uppercase), 18-inch character heights, 13-inch (approximate) character widths, and about 2.5-inch stroke (pixel) widths. Smaller characters would yield shorter distances. *(Note: Character heights on CMSs used on freeways and other high-speed highways should not be less than 18 inches (4).)*

The legibility distances shown in Table 7-1 affect the maximum number of units of information that should be displayed on a CMS which will allow motorists to read and comprehend the message at prevailing highway operating speeds. Based on these distances, the maximum number of informational units that motorists can actually read and comprehend in a CMS message is summarized in Table 7-2. These numbers establish the Base Maximum Message Length.

**Table 7-1. Suggested CMS Legibility Distances for Use in Message Design (ft) (Ref 3)**

Condition	Light-Emitting Diode <sup>A</sup>	Fiberoptic	Incandescent Bulb	Reflective Disk
Mid-Day	800	800	700	600
Washout	800	800	700	400
Backlight	600	500	400	250
Nighttime	600	600	600	250

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs

**Table 7-2. Maximum Number of Units of Information in CMS Message  
(Base Maximum Message Length) (Ref 3)**

	Light-Emitting Diode <sup>A</sup>			Fiberoptic			Incandescent Bulb			Reflective Disk		
	0-35 mi/h	36-55 mi/h	56-70 mi/h	0-35 mi/h	36-55 mi/h	56-70 mi/h	0-35 mi/h	36-55 mi/h	56-70 mi/h	0-35 mi/h	36-55 mi/h	56-70 mi/h
Mid-Day	5 units	4 units	4 units	5 units	4 units	4 units	5 units	4 units	3 units	5 units	4 units	3 units
Washout	5 units	4 units	4 units	5 units	4 units	4 units	5 units	4 units	3 units	4 units	3 units	2 units
Backlight	4 units	4 units	3 units	4 units	3 units	2 units	4 units	3 units	2 units	2 units	1 unit	1 unit
Nighttime	4 units	4 units	3 units	4 units	4 units	3 units	4 units	3 units	3 units	3 units	2 units	1 unit

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs

### **7.3 UNITS OF INFORMATION REDUCTIONS FOR VERTICAL CURVES - LED CMSs**

#### **INTRODUCTION**

Generally speaking, permanent CMSs mounted above the travel lanes are not affected by the presence of crest vertical curves on freeways. Vertical curvature is established based on safe stopping sight distances to a rather small (i.e., 6-inch) object located on the roadway, based on the design speed of the roadway. The high (20 to 25 ft) typical mounting heights of permanent CMSs provide viewing distances over the curve which usually exceed the visual capabilities of the signs themselves. However, this is often not the case for portable CMS positioned on the shoulder of the roadway. Furthermore, conditions where actual operating speeds are higher than the design speed of the vertical curve (i.e., non-freeway-type applications) can sometimes provide less viewing times than is normally assumed to exist.

#### **REDUCTIONS FOR VERTICAL CURVE DESIGN SPEEDS 45 MI/H AND ABOVE**

No reductions in the number of units of information are required for LED CMSs. Therefore, use the Base Maximum Message Length shown in Table 7-2 for the traffic operating speed on the highway.

#### **REDUCTIONS FOR VERTICAL CURVE DESIGN SPEEDS BELOW 45 MI/H**

Vertical curve design speeds lower than 45 mi/h require that the number of informational units be reduced to account for the lower legibility. The number of units that must be subtracted from the Base Maximum Message Length shown in Table 7-2 when LED signs are used are given in Tables 7-3 and 7-4 for PERMANENT CMSs with mounting heights of 20 and 25 ft and offsets of 0, 20 and 60 ft. The number of units that must be subtracted from the Base Maximum Message Length shown in Table 7-2 when LED signs are used are given in Tables 7-5 and 7-6 for PORTABLE CMSs with mounting heights of 7 and 10 ft and offsets of 20 and 60 ft.

## EXAMPLES

### Example 1

#### *Question*

A permanent LED CMS mounted 20 ft above the roadway is located to the right of a six-lane urban arterial. The sign is positioned such that the offset from the CMS to the motorist in the left lane is approximately 60 ft. It is located at the downstream end of a 600-foot crest vertical curve that is designed for 35 mi/h. Does the Base Maximum Message Length have to be reduced in this situation?

#### *Answer*

Yes. Using Table 7-3 for a 60-ft offset and 35 mi/h operating speed, the Base Maximum Message Length must be reduced by 3 units in all viewing conditions (mid-day, washout, backlight, and nighttime).

### Example 2

#### *Question*

A portable LED CMS that is 7 ft high is located in the middle of a 20-foot median on a four-lane freeway with a 6-foot inside paved shoulder. The sign is placed on the downstream end of a 1200-foot crest vertical curve. The design speed of the curve is 60 mi/h. Does the curve constrain the amount of information that can be presented on the CMS?

#### *Answer*

Since the design speed of the curve is greater than 45 mi/h, a sight distance restriction is not expected for the portable CMS. No reduction in Base Maximum Message Length is necessary.

**Table 7-3. Number of Units of Information that Must Be Subtracted from Number Given in Table 7-2 Due to Vertical Curve  
PERMANENT LED CMS<sup>A</sup>  
Mounting Height: 20 ft (Ref 2)**

Condition	Vertical Curve Speed								
	Overhead			20-Foot Offset			60-Foot Offset		
	30 mi/h	35 mi/h	40 mi/h	30 mi/h	35 mi/h	40 mi/h	30 mi/h	35 mi/h	40 mi/h
Mid-Day	1 unit	0 unit	0 unit	2 units	0 unit	0 unit	5 units	3 units	1 unit
Washout	1 unit	0 unit	0 unit	2 units	0 unit	0 unit	5 units	3 units	1 unit
Backlight	0 unit	0 unit	0 unit	1 unit	0 unit	0 unit	4 units	3 units	1 unit
Nighttime	0 unit	0 unit	0 unit	1 unit	0 unit	0 unit	4 units	3 units	1 unit

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

**Table 7-4. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Vertical Curve  
PERMANENT LED CMS<sup>A</sup>  
Mounting Height: 25 ft (Ref 2)**

Condition	Vertical Curve Design Speed								
	Overhead			20-Foot Offset			60-Foot Offset		
	30 mi/h	35 mi/h	40 mi/h	30 mi/h	35 mi/h	40 mi/h	30 mi/h	35 mi/h	40 mi/h
Mid-Day	0 unit	0 unit	0 unit	2 units	1 unit	0 unit	5 units	4 units	1 unit
Washout	0 unit	0 unit	0 unit	2 units	1 unit	0 unit	5 units	4 units	1 unit
Backlight	0 unit	0 unit	0 unit	1 unit	0 unit	0 unit	4 units	3 units	1 unit
Nighttime	0 unit	0 unit	0 unit	1 unit	0 unit	0 unit	4 units	3 units	1 unit

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

**Table 7-5. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Vertical Curve  
PORTABLE LED CMS<sup>A</sup>  
Mounting Height: 7 ft (Ref 2)**

Condition	Vertical Curve Design Speed					
	20-Foot Offset			60-Foot Offset		
	30 mi/h	35 mi/h	40 mi/h	30 mi/h	35 mi/h	40 mi/h
Mid-Day	3 units	2 units	1 unit	5 units	5 units	3 units
Washout	3 units	2 units	1 unit	5 units	5 units	3 units
Backlight	2 units	1 unit	1 unit	4 units	4 units	2 units
Nighttime	2 units	1 unit	1 unit	4 units	4 units	2 units

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

**Table 7-6. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Vertical Curve  
PORTABLE LED CMS<sup>A</sup>  
Mounting Height: 10 ft (Ref 2)**

Condition	Vertical Curve Design Speed					
	20-Foot Offset			60-Foot Offset		
	30 mi/h	35 mi/h	40 mi/h	30 mi/h	35 mi/h	40 mi/h
Mid-Day	2 units	2 units	1 unit	5 units	4 units	3 units
Washout	2 units	2 units	1 unit	5 units	4 units	3 units
Backlight	1 unit	1 unit	0 unit	4 units	3 units	2 units
Nighttime	1 unit	1 unit	0 unit	4 units	3 units	2 units

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

## 7.4 UNITS OF INFORMATION REDUCTIONS FOR HORIZONTAL CURVES – LED CMSs

### INTRODUCTION

Whereas vertical curvature design is based on stopping sight distance, design criteria for horizontal curvature is based on driver comfort and the friction between the tires and the roadway. With respect to CMS visibility and viewing time, **if the sign is properly located horizontal curvature will generally not impact viewing distance of permanent CMSs** mounted over travel lanes or adjacent to the travel lanes (in the median or off to the right). They will extend above most obstructions that may exist on the roadside and so will not be affected by any horizontal curvature (although certain spot obstructions such as overhead signs or luminaires may be more problematic to CMS viewing on horizontal curves).

However, the situation is different **if the sign is not properly located horizontal curvature will impact viewing distance of permanent CMSs**. Viewing distance to portable CMSs placed on the side of the road within the curve (on the right side of a right-hand curve, on the left side of a left-hand curve) will also be impacted. If objects (construction vehicles, trees, etc.) are located close to the edge of a roadway on the same side as the CMS, a driver in the closest lane may not be able to see around the object and fully read and comprehend the message.

### REDUCTIONS FOR HORIZONTAL CURVES FOR PERMANENT CMSs

No reduction is necessary for permanent CMSs.

### REDUCTIONS FOR HORIZONTAL CURVES FOR PORTABLE CMSs

Tables 7-7 through 7-9 give the number of units of information that must be subtracted from the Basic Maximum Message Length when LED signs are used and the portable CMS is offset 2 ft. Similar numbers to subtract when the portable CMS is offset 10 ft are given in Tables 7-10 through 7-12.

### EXAMPLES

#### Example 1

##### *Question*

A portable LED CMS is to be placed 2 ft from the edge of travel lanes on a rural highway upstream of a work zone towards the end of a long (2500 ft) horizontal curve. Traffic speeds on the roadway average 65 mi/h. A bridge overpass abutment is located upstream of the CMS along the curve as well. The abutment is 50 ft from the edge of the travel lane. The curve radius is 1500 ft. The CMS will not be in washout or backlighted conditions during the day, and will not

have overhead lighting present at night. Does the Base Maximum Message Length have to be reduced in this situation?

***Answer***

For the characteristics identified, go to Table 7-9. A curve radius of 1500 ft and obstruction offset of 50 ft does not require a reduction in Base Maximum Message Length for either the backlight overhead or nighttime viewing conditions. However, it does require a 1 unit reduction for mid-day and washout.

**Example 2**

***Question***

A portable CMS is to be used to assist in providing trailblazer information along a detour route for a section of freeway. The sign will be placed 10 ft from the travel lanes. The diversion route is an urban arterial with vehicle operating speeds about 40 mi/h. The operating agency is contemplating the location of the sign towards the end of the 750-foot horizontal curve with curve radius of 500 ft. A brick wall located 20 ft from the roadway is used to separate the roadway from the adjacent neighborhood. Does the curve constrain the amount of information that can be presented on the CMS?

***Answer***

For the characteristics identified, go to Table 7-11. A curve radius of 500 ft and obstruction offset of 20 ft does require the Base Maximum Message Length to be reduced by 4 units in the mid-day and washout viewing conditions, and reduced by 3 units under backlight and nighttime viewing conditions. In effect, not enough sight distance is available at this location to provide any information on a portable CMS. An alternative location for the CMS should be found.



**Table 7-7. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Horizontal Curve  
PORTABLE LED CMS<sup>A</sup>  
Offset: 2 ft (Ref 2)**

**Traffic Operating Speeds: 0-35 mi/h**

Curve Radii (ft)	Mid-Day and Washout							Backlight and Nighttime						
	Offset of Sight Obstruction From Edge of Travel Lanes (ft)							Offset of Sight Obstruction From Edge of Travel Lanes (ft)						
	10	20	50	100	150	200	250	10	20	50	100	150	200	250
250	4 units	4 units	2 units	1 unit	1 unit	1 unit		3 units	3 units	1 unit				
500	4 units	3 units	1 unit	1 unit				3 units	2 units					
750	4 units	2 units	1 unit	1 unit				3 units	2 units					
1000	3 units	2 units	1 unit					2 units	1 unit					
1250	3 units	2 units	1 unit					2 units	1 unit					
1500	3 units	1 unit	1 unit					2 units	1 unit					
1750	3 units	1 unit						2 units	1 unit					
2000	3 units	1 unit						2 units	1 unit					
2250	2 units	1 unit						1 unit						
2500	2 units	1 unit						1 unit						
2750	2 units	1 unit						1 unit						
3000	2 units	1 unit						1 unit						
4000	1 unit	1 unit												
5000	1 unit													
7500	1 unit													
10000	1 unit													

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

**Table 7-8. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Horizontal Curve  
PORTABLE LED CMS<sup>A</sup>  
Offset: 2 ft (Ref 2)**

**Traffic Operating Speeds: 36-55 mi/h**

Curve Radii (ft)	Mid-Day and Washout							Backlight and Nighttime						
	Offset of Sight Obstruction From Edge of Travel Lanes (ft)							Offset of Sight Obstruction From Edge of Travel Lanes (ft)						
	10	20	50	100	150	200	250	10	20	50	100	150	200	250
250	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
500	3 units	3 units	2 units	1 unit				3 units	3 units	2 units	1 unit			
750	3 units	3 units	1 unit					3 units	3 units	1 unit				
1000	3 units	2 units	1 unit					3 units	2 units	1 unit				
1250	3 units	2 units						3 units	2 units					
1500	3 units	2 units						3 units	2 units					
1750	3 units	2 units						3 units	2 units					
2000	3 units	1 unit						3 units	1 unit					
2250	3 units	1 unit						3 units	1 unit					
2500	2 units	1 unit						2 units	1 unit					
2750	2 units	1 unit						2 units	1 unit					
3000	2 units	1 unit						2units	1 unit					
4000	2 units							2 units						
5000	2 units							2 units						
7500	1 unit							1 unit						
10000	1 unit													

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

N/A Adequate sight distance not available for any message.

**Table 7-9. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Horizontal Curve  
PORTABLE LED CMS<sup>A</sup>  
Offset: 2 ft (Ref 2)**

**Traffic Operating Speeds: 56-70 mi/h**

Curve Radii (ft)	Mid-Day and Washout							Backlight and Nighttime							
	Offset of Sight Obstruction From Edge of Travel Lanes (ft)							Offset of Sight Obstruction From Edge of Travel Lanes (ft)							
	10	20	50	100	150	200	250	10	20	50	100	150	200	250	
250	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
500	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
750	3 units	3 units	2 units	1 unit				2 units	1 unit						
1000	3 units	3 units	2 units					1 unit	1 unit						
1250	3 units	3 units	1 unit					1 unit	1 unit						
1500	3 units	2 units	1 unit					1 unit							
1750	3 units	2 units	1 unit					1 unit							
2000	3 units	2 units						1 unit							
2250	3 units	2 units						1 unit							
2500	3 units	2 units						1 unit							
2750	3 units	2 units						1 unit							
3000	3 units	2 units						1 unit							
4000	2 units	1 unit													
5000	2 units														
7500	2 units														
10000	2 units														

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

N/A Adequate sight distance not available for any message.

**Table 7-10. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Horizontal Curve  
PORTABLE LED CMS<sup>A</sup>  
Offset: 10 ft (Ref 2)**

**Traffic Operating Speeds: 0-35 mi/h**

Curve Radii (ft)	Mid-Day and Washout							Backlight and Nighttime						
	Offset of Sight Obstruction From Edge of Travel Lanes (ft)							Offset of Sight Obstruction From Edge of Travel Lanes (ft)						
	10	20	50	100	150	200	250	10	20	50	100	150	200	250
250	5 units	4 units	2 units	1 unit	1 unit			4 units	3 units	1 unit				
500	5 units	3 units	1 unit					4 units	2 units					
750	5 units	3 units	1 unit					4 units	2 units					
1000	5 units	3 units	1 unit					4 units	2 units					
1250	5 units	2 units						4 units	1 unit					
1500	5 units	2 units						4 units	1 unit					
1750	5 units	2 units						4 units	1 unit					
2000	5 units	1 unit						4 units						
2250	5 units	1 unit						4 units						
2500	5 units	1 unit						4 units						
2750	5 units	1 unit						4 units						
3000	5 units	1 unit						4 units						
4000	5 units	1 unit						4 units						
5000	5 units							4 units						
7500	5 units							4 units						
10000	5 units							4 units						

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

**Table 7-11. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Horizontal Curve  
PORTABLE LED CMS<sup>A</sup>  
Offset: 10 ft (Ref 2)**

**Traffic Operating Speeds: 36-55 mi/h**

Curve Radii (ft)	Mid-Day and Washout							Backlight and Nighttime						
	Offset of Sight Obstruction From Edge of Travel Lanes (ft)							Offset of Sight Obstruction From Edge of Travel Lanes (ft)						
	10	20	50	100	150	200	250	10	20	50	100	150	200	250
250	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
500	5 units	4 units	3 units	2 units	1 unit	1 unit		5 units	3 units	2 units	1 unit			
750	5 units	4 units	2 units	1 unit	1 unit			5 units	3 units					
1000	5 units	4 units	2 units	1 unit				5 units	3 units					
1250	5 units	3 units	1 unit					5 units	2 units					
1500	5 units	3 units	1 unit					5 units	2 units					
1750	5 units	3 units	1 unit					5 units	2 units					
2000	5 units	3 units	1 unit					5 units	2 units					
2250	5 units	3 units	1 unit					5 units	2 units					
2500	5 units	3 units	1 unit					5 units	2 units					
2750	5 units	2 units						5 units	1 unit					
3000	5 units	2 units						5 units	1 unit					
4000	5 units	2 units						5 units						
5000	5 units	1 unit						5 units						
7500	5 units	1 unit						5 units						
10000	5 units	1 unit						5 units						

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

N/A Adequate sight distance not available for any message.

**Table 7-12. Number of Units of Information that Must Be Subtracted from  
Number Given in Table 7-2 Due to Horizontal Curve  
PORTABLE LED CMS<sup>A</sup>  
Offset: 10 ft (Ref 2)**

**Traffic Operating Speeds: 56-70 mi/h**

Curve Radii (ft)	Mid-Day and Washout							Backlight and Nighttime							
	Offset of Sight Obstruction From Edge of Travel Lanes (ft)							Offset of Sight Obstruction From Edge of Travel Lanes (ft)							
	10	20	50	100	150	200	250	10	20	50	100	150	200	250	
250	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
500	N/A	N/A	N/A	N/A	N/A	1 unit		N/A	N/A	N/A	N/A	N/A	N/A	N/A	
750	5 units	4 units	3 units	2 units	1 unit			4 units	3 units	2 units	1 unit				
1000	5 units	4 units	3 units	1 unit	1 unit			4 units	3 units	2 units					
1250	5 units	4 units	2 units	1 unit	1 unit			4 units	3 units	1 unit					
1500	5 units	4 units	2 units	1 unit				4 units	3 units	1 unit					
1750	5 units	4 units	2 units	1 unit				4 units	3 units	1 unit					
2000	5 units	3 units	1 unit	1 unit				4 units	2 units						
2250	5 units	3 units	1 unit					4 units	2 units						
2500	5 units	3 units	1 unit					4 units	2 units						
2750	5 units	3 units	1 unit					4 units	2 units						
3000	5 units	3 units	1 unit					4 units	2 units						
4000	5 units	3 units	1 unit					4 units	2 units						
5000	5 units	2 units						4 units	1 unit						
7500	5 units	2 units						4 units	1 unit						
10000	5 units	1 unit						4 units							

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

N/A Adequate sight distance not available for any message.

## **7.5 UNITS OF INFORMATION REDUCTIONS FOR RAIN AND FOG**

Rain and fog are additional factors that can influence the amount of information that can be presented on a CMS. Both conditions deteriorate the amount of light that is coming from the CMS (either direct illumination from the light pixels on the CMS or reflected by the CMS from other light sources such as the sun, overhead lighting, or automobile headlights). This reduces the contrast between the sign legend and its background. If the contrast becomes too low, motorists cannot read the CMS message.

For light-emitting CMSs, contrast ratios are at their minimums on bright, sunny days because the sun increases the background luminance of the signs. Under cloudy conditions, the luminance of the legend will be much greater than the background and can create very large contrast ratios. Unfortunately, data on typical CMS background luminance or contrast ratios on cloudy, rainy, or foggy days are not available (in actuality, there may not be a true “typical” cloudy day anyway). Conversely, contrast ratios for light-reflecting CMSs decrease as external lighting levels decrease, becoming zero (or nearly so) as the amount of light falling on the sign reaches zero. A procedure for determining the effects of rain and fog on the number of units of information that can be displayed is available elsewhere (NJDOT *Manual*).

Because the majority of CMSs are light-emitting technologies, the following section is provided for those signs.

### **REDUCTIONS FOR RAIN**

The effect of rainfall on desired CMS message lengths is believed to be relatively insignificant under most operating conditions. The exception to this situation is when rainfall intensities exceed 2 inches per hour. Under these conditions, the CMS operator should reduce the units of information on a portable LED CMS by one if the operating speed on the roadway exceeds 55 mi/h. Portable LED CMS generally utilize fewer numbers of LEDs per pixel and so typically generate lower character luminance levels than permanent CMS. The higher character luminance levels of permanent LED CMS now in use is believed to provide significant contrast even under heavy rain.

### **REDUCTIONS FOR FOG**

The effect of fog is more significant. The reductions in the base number of information units that can be displayed on a portable LED CMS under daytime conditions under various operating speed and CMS offset scenarios are presented in Table 7-13. As noted previously, reductions for permanent LED CMS are not suggested due to their much higher character luminance values (and thus much higher contrast ratios).

## EXAMPLE

### Question

A portable LED CMS is being used in the median of a divided rural highway (offset between CMS and right lane motorist is 60 ft). A heavy fog is present that limits visibility to approximately ½ mile. Does this condition require a reduction in the Base Maximum Message Length?

### Answer

Using Table 7-13 for a 60-ft offset and an assumed traffic speed of greater than 56 mi/h (since it is a rural highway) and a ½-mi visibility, no reduction is necessary. If the fog had been thicker and reduced visibility to ¼ mile, then the Base Maximum Message Length would have to be reduced by 2 units.

**Table 7-13. Number of Units of Information that Must Be Subtracted from Number Given in Table 7-2 Due to Effects of Fog in Daytime Conditions PORTABLE LED<sup>A</sup> CMS (Ref 2)**

Visibility Range in Fog	No Offset			20-Ft Offset			60-Ft Offset		
	0-35 mi/h	36-55 mi/h	56-70 mi/h	0-35 mi/h	36-55 mi/h	56-70 mi/h	0-35 mi/h	36-55 mi/h	56-70 mi/h
1/2 mi	0	0	0	0	0	0	0	0	0
1/4 mi	0	0	1 unit	0	1 unit	1 unit	2 units	2 units	2 units
1/10 mi	2 units	2 units	2 units	3 units	3 units	3 units	5 units <sup>B</sup>	4 units <sup>B</sup>	4 units <sup>B</sup>

<sup>A</sup> Valid only for the newer aluminum indium gallium phosphide (or equivalent) LEDs.

<sup>B</sup> Adequate sight distance not available for any message under this viewing condition.



## **7.6 UNITS OF INFORMATION REDUCTIONS WHEN LARGE TRUCKS ARE PRESENT**

### **INTRODUCTION**

Large trucks can be a major cause of sight obstructions to CMSs. Motorists in vehicles travelling closely behind or adjacent to a truck may be limited in the amount of time they have to read a CMS. If they follow too closely, they may not be able to see the CMS at all. This can occur in some instances for permanent overhead CMS as well. However, the majority of concerns relating to trucks pertain to the portable CMS located off to the side of the travel lanes.

Evaluating truck obstructions of CMS requires a slightly different analysis approach than that used for horizontal and vertical curvature. This is because a motorist has the ability to adjust his or her speed slightly relative to that of a truck and find a travel position that allows for adequate viewing. However, as the number of trucks on the roadway increases, the amount of roadway space that a motorist can travel in with an unobstructed view decreases. If the number of vehicles travelling on the facility approaches or exceeds the number that can “fit” into the unobstructed viewing spaces, then some motorists will not be able to read all of a CMS message. Depending on the specific message being presented, this can begin to create operational problems on the facility.

### **EFFECT OF LARGE TRUCKS ON CMS VIEWING**

A detailed procedure to assess the impact of large trucks upon CMS viewing time is given elsewhere (NJDOT *Manual*). This procedure computes the amount of roadway space available for adequate CMS viewing and compares it to the amount of traffic on the roadway that needs to use that space. In this section, this analysis is simplified to a series of tables designed to assist the operator in determining the influence of large trucks on the ability of motorists in the overall traffic stream to adequately read a CMS message containing the maximum base number of information units.

Tables 7-14 through 7-17 present the estimated percentage of motorists on the roadway who would likely be able to read an entire CMS message that consists of the maximum base number of units of information. Separate tables are provided for four major roadway cross-sections (two-lane, two-way highway; four-lane roadway; six-lane roadway; and eight-lane roadway). The numbers represent average conditions for messages on high-quality LED CMSs. Assumptions have been made regarding the distribution of large trucks across the various travel lanes in a given direction. These assumptions are noted at the bottom of the tables. The percentages also assume that all truck drivers will be able to adequately see the CMS (since they sit higher than a typical automobile).

The tables illustrate how quickly viewing conditions can degrade as truck volumes increase. The point of the tables is not to define a specific threshold between acceptable and unacceptable viewing conditions for CMSs. Rather, the information contained in the tables should be used in deciding when less information should be presented on a CMS, or where a redundant CMS may

be needed. If redundant CMS are used, consideration should also be given to placing them on the left side of the roadway (the percentages in the tables assume the CMS is placed on the right side of the roadway 10 ft from the travel lanes).

**Table 7-14. Percent of Motorists Able to Fully Read a CMS Message  
With Maximum Base Number of Units  
Two-Lane, Two-Way Highway (Ref 2)**

Percent Trucks	Operating Speed Range								
	0-35 mi/h			36-55 mi/h			56-70 mi/h		
	500 vph	1000 vph	1500 vph	500 Vph	1000 vph	1500 vph	500 vph	1000 vph	1500 vph
5	95	95	90	100	95	95	100	95	90
10	95	90	85	95	90	85	95	90	80
20	90	80	70	90	85	75	90	85	70
30	90	75	65	90	80	65	90	80	60
50	85	70	55	85	75	60	90	75	50*

\* Under these conditions, only truck drivers are assumed to be able to see the CMS.

**Table 7-15. Percent of Motorists Able to Fully Read a CMS Message  
With Maximum Base Number of Units  
Four-Lane Roadway: Two Lanes in Each Direction (Ref 2)**

Percent Trucks	Operating Speed Range								
	0-35 mi/h			36-55 mi/h			56-70 mi/h		
	1000 vph	2000 vph	3000 vph	1000 Vph	2000 vph	3000 vph	1000 vph	2000 vph	3000 vph
5	95	90	85	95	90	85	95	90	80
10	90	80	70	90	80	70	90	80	65
20	80	65	45	80	65	45	85	65	40
30	75	50	30*	75	55	30	75	55	30*
50	70	50*	50*	70	50*	50*	75	50*	50*

Note: Assumes an 85%/15% split of truck traffic in shoulder and median travel lanes.

\* Under these conditions, only truck drivers are assumed to be able to see the CMS.

**Table 7-16. Percent of Motorists Able to Fully Read a CMS Message  
With Maximum Base Number of Units  
Six-Lane Roadway: Three Lanes in Each Direction (Ref 2)**

Percent Trucks	Operating Speed Range								
	0-35 mi/h			36-55 mi/h			56-70 mi/h		
	2000 vph	4000 vph	6000 vph	2000 Vph	4000 vph	6000 vph	2000 vph	4000 vph	6000 vph
5	90	75	65	90	80	65	90	80	65
10	80	55	35	80	60	35	80	60	40
20	60	25	20*	65	25	20*	65	25	20*
30	50	30*	30*	50	30*	30*	50	30*	30*
50	50*	50*	50*	50*	50*	50*	50*	50*	50*

Note: Assumes an 85%/15%/0% split of truck traffic in shoulder, center, and median travel lanes, respectively.

\* Under these conditions, only truck drivers are assumed to be able to see the CMS.

**Table 7-17. Percent of Motorists Able to Fully Read a CMS Message  
With Maximum Base Number of Units  
Eight-Lane Roadway: Four Lanes in Each Direction (Ref 2)**

Percent Trucks	Operating Speed Range								
	0-35 mi/h			36-55 mi/h			56-70 mi/h		
	2000 vph	4000 vph	6000 vph	2000 Vph	4000 vph	6000 vph	2000 vph	4000 vph	6000 vph
5	90	80	70	90	80	70	90	80	70
10	80	60	45	80	65	45	80	65	45
20	65	35	20*	70	35	20*	65	35	20*
30	60	30*	30*	60	30*	30*	55	30*	30*
50	50*	50*	50*	50*	50*	50*	50*	50*	50*

Note: Assumes an 70%/20%/10%/0% split of truck traffic in shoulder, right center, left center, and median travel lanes, respectively.

\* Under these conditions, only truck drivers are assumed to be able to see the CMS.

## 7.7 FINAL MESSAGE REDUCTION PRIORITIES

### PRIORITY REDUCTION PRINCIPLES

After the message reduction approaches and requirements presented in Modules 6 and 7 have been applied to the Base CMS Message and the message still has more units of information than should be displayed to motorists at the prevailing freeway speed, then the Priority Reduction Principles discussed in this section should be applied.

There is a priority of information that motorists need in order to make driving decisions when incidents occur or lanes are closed due to roadwork. The information needed by motorists in order of priority for incidents and roadwork is shown in Tables 5-10 and 5-11.

Although *the Incident Descriptor* and the *Roadwork Descriptor* are useful to motorists these message elements can be replaced with the *Lanes Closed* message element.

When the number of information units exceeds the maximum that should be displayed under prevailing speeds and the Initial Reduction Approaches and the Secondary Reduction Approach have been applied, then the message designer must begin eliminating informational units. **This is done by eliminating units of information starting with the lowest priority (4).**

### REFERENCES

1. Perchonok, K. and L. Pollack. *Luminous Requirements for Traffic Signs, A Comparison of Sign Performance and Requirements*. Report FHWA/RD-81/158, FHWA, U.S. Department of Transportation, Washington, D.C., December 1981.
2. Ullman, G.L. *Message Length and VMS Viewing Distance Requirements*. Contribution to *Variable Message Sign Operations Manual*. By C.L. Dudek, Report FHWA-NJ-2001-10, New Jersey Department of Transportation, December 2001.
3. Ullman, G.L. and C.L. Dudek. *Maximum VMS Legibility Distances for Day and Night Operations*. Contribution to *Variable Message Sign Operations Manual*. By C.L. Dudek, Report FHWA-NJ-2001-10, New Jersey Department of Transportation, December 2001.
4. Dudek, C.L. and R.D. Huchingson. *Manual on Real-Time Motorist Information Displays*. Report FHWA-IP-86-16. FHWA, U.S. Department of Transportation, August 1986.
5. Dudek, C.L. *Variable Message Sign Operations Manual*. Report FHWA-NJ-2001-10, New Jersey Department of Transportation, December 2001.

# MODULE 8. FORMATTING MESSAGES

## 8.1 INTRODUCTION

The order that information is placed and arranged on the CMS significantly affects reading time. Guidelines for the order of information is dependent upon whether (1,2):

- An *Incident Descriptor* or *Roadwork Descriptor* message element is part of the message; or
- The *Incident Descriptor* or *Roadwork Descriptor* message element is replaced by or combined with a *Lanes Closed* message element.

(See Section 8.3 *Modifying Messages to Improve Effectiveness* for reformatting examples.)

## 8.2 ORDER OF CMS MESSAGE ELEMENTS

### MESSAGES WITH *INCIDENT DESCRIPTOR* MESSAGE ELEMENT

The format order for messages that contain an *Incident Descriptor* message element (e.g., *ACCIDENT*) is summarized in Table 8-1 for the cases when lane-closure (blockage) incidents occur or when incidents occur that require closing the freeway.

**Table 8-1. Format Order When *Incident Descriptor* Message Element is Used for Incidents (Ref 1)**

Message Elements for Lane Closure Incidents	Message Elements for Freeway Closure Incidents
1. Incident Descriptor 2. Incident Location 3. Lanes Closed (Blocked) 4. Audience for Action (if needed) 5. Action 6. Good Reason for Following Action <sup>A</sup>	1. Incident Descriptor 2. Incident Location 3. Lanes Closed (Blocked) 4. Audience for Action (if needed) 5. Action

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then the *Good Reason for Following Action* message element is placed before the *Action* message element.

When the message is split into two phases, then the combinations of formatting shown in Table 8-2 should be used:

**Table 8-2. Format Order for Two-Phase Messages When *Incident Descriptor* Message Element is Used for Incidents (Ref 1)**

Message Phase 1	Message Phase 2
1. Incident Descriptor 2. Incident Location	3. Lanes Closed (Blocked) 4. Action
1. Incident Descriptor 2. Incident Location	3. Audience for Action 4. Action
1. Incident Descriptor 2. Incident Location 3. Lanes Closed (Blocked)	4. Audience for Action 5. Action
1. Incident Descriptor 2. Incident Location	3. Audience for Action 4. Action 5. Good Reason for Following Action <sup>A</sup>

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.

**MESSAGES WITH *ROAD WORK DESCRIPTOR* MESSAGE ELEMENT**

The format order for messages that contain a *Road Work Descriptor* message element (e.g., *ROADWORK*) is summarized in Table 8-3 for the cases when lane closures occur due to roadwork and when the roadwork requires closing the freeway.

**Table 8-3. Format Order When *Roadwork Descriptor* Message Element is Used for Roadwork (Ref 1)**

Message Elements for Lane Closures	Message Elements for Freeway Closures
1. Roadwork Descriptor 2. Lane Closure Location 3. Lanes Closed 4. Audience for Action (if needed) 5. Action 6. Good Reason for Following Action <sup>A</sup>	1. Roadwork Descriptor 2. Closure Location 3. Lanes Closed 4. Audience for Action (if needed) 5. Action

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.

When the message is split into two phases, then the combinations of formatting shown in Table 8-4 should be used.

**Table 8-4. Format Order for Two-Phase Messages When *Roadwork Descriptor* Message Element is Used for Roadwork (Ref 1)**

Message Phase 1	Message Phase 2
1. Roadwork Descriptor 2. Lane Closure Location	3. Lanes Closed 4. Action
1. Roadwork Descriptor 2. Lane Closure Location	3. Audience for Action 4. Action
1. Roadwork Descriptor 2. Lane Closure Location 3. Lanes Closed	4. Audience for Action 5. Action
1. Roadwork Descriptor 2. Lane Closure Location	3. Audience for Action 4. Action 5. Good Reason for Following Action <sup>A</sup>

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.

## MESSAGES WITHOUT *INCIDENT DESCRIPTOR* MESSAGE ELEMENT

The format order for messages in which the *Incident Descriptor* message element is replaced by or combined with a *Lanes Closed* message element is shown in Table 8-5.

**Table 8-5. Format Order When *Incident Descriptor* Message Element is Replaced by or Combined with the *Lanes Closed* Message Element for Incidents (Ref 1)**

Message Elements for Lane Closure Incidents	Message Elements for Freeway Closure Incidents
1. Lanes Closed (Blocked) 2. Lane Closure (Blockage) Location 3. Audience for Action (if needed) 4. Action 5. Good Reason for Following Action <sup>A</sup>	1. Freeway Closure (Blocked) 2. Location of Closure 3. Audience for Action (if needed) 4. Action 5. Good Reason for Following Action <sup>A</sup>

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.

When the message is split into two phases, then the combinations of formatting shown in Table 8-6 should be used:

**Table 8-6. Format Order for Two-Phase Messages When *Incident Descriptor* Message Element is Replaced by or Combined with the *Lanes Closed* Message Element for Incidents (Ref 1)**

Message Phase 1	Message Phase 2
1. Lanes Closed (Blocked) 2. Lane Closure (Blockage) Location	3. Audience for Action 4. Action
1. Lanes Closed (Blocked) 2. Lane Closure (Blockage) Location	3. Audience for Action 4. Action 5. Good Reason for Following Action <sup>A</sup>
1. Freeway Closed (Blocked) 2. Location of Closure	3. Audience for Action 4. Action

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.

## MESSAGES WITHOUT *ROADWORK DESCRIPTOR* MESSAGE ELEMENT

The format order for messages in which the *Roadwork Descriptor* message element is replaced by or combined with a *Lanes Closed* message element is shown in Table 8-7.

**Table 8-7. Format Order When *Roadwork Descriptor* Message Element is Replaced by or Combined with a *Lane Closed* Message Element for Roadwork (Ref 1)**

Message Elements for Lane Closures	Message Elements for Freeway Closures
1. Lanes Closed 2. Lane Closure Location 3. Audience for Action (if needed) 4. Action 5. Good Reason for Following Action <sup>A</sup>	1. Freeway Closed 2. Closure Location 3. Audience for Action (if needed) 4. Action

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.

When the message is split into two phases, then the combinations of formatting shown in Table 8-8 should be used.

**Table 8-8. Format Order For Two-Phase Messages When *Roadwork Descriptor* Message Element is Replaced with or Combined with a *Lane Closed* Message Element for Roadwork (Ref 1)**

Message Phase 1	Message Phase 2
1. Lanes Closed 2. Lane Closure Location	3. Audience for Action 4. Action
1. Lanes Closed 2. Lane Closure Location	3. Audience for Action 4. Action 5. Good Reason for Following Action <sup>A</sup>
1. Freeway Closed 2. Closure Location	3. Audience for Action 4. Action

<sup>A</sup> When *BEST ROUTE TO* is used as the Good Reason, then *the Good Reason for Following Action* message element is placed before the *Action* message element.



### **8.3 EXAMPLE MESSAGES: APPLYING CMS MESSAGE DESIGN PRINCIPLES**

Principles of CMS message design for incidents and roadwork were presented in Module 5. The objective this section of the Manual is to illustrate the application of many of the design principles using examples and to provide a quick reference guide for designing messages.

As one examines the large number of alternative terms that are available for each of the CMS message elements, it becomes apparent that there are numerous combinations of messages that can be used—too numerous to list each combination. Therefore, only typical example messages are shown in this section of the Manual to illustrate specific principles of message design.

The CMS messages apply only to situations where a maximum of 4 units of information can be displayed.

# LANE BLOCKAGE INCIDENTS

## CMS On Same Freeway Upstream and Relatively Close to the Incident

**Table 8-9. CMS Message Examples for Lane Blockage Incidents  
CMS Close to Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Blocked message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT AT ROWLAND DR RIGHT LANE BLOCKED		ACCIDENT AT ROWLAND	RIGHT LANE BLOCKED
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND 3 RIGHT LANES BLOCKD			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND 3 RIGHT LANES BLOCKD			
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT NEAR I-287 2 RIGHT LANES BLOCKD		ACCIDENT NEAR I-287	2 RIGHT LANES BLOCKED
<ul style="list-style-type: none"> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 RIGHT LANES BLOCKD NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	ACCIDENT PAST ROWLAND	2 RIGHT LANES BLOCKD PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 RIGHT LANES BLOCKD PAST ROWLAND	PREPARE TO STOP		
	2 RIGHT LANES BLOCKD PAST ROWLAND PREPARE TO STOP			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

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Table 8-9 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ACCIDENT BEFORE ROWLAND	2 RIGHT LANES BLOCKD USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 RIGHT LANES BLOCKD BEFORE ROWLAND	USE OTHER ROUTES		
	2 RIGHT LANES BLOCKD BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	ACCIDENT AT ROWLAND	2 RIGHT LANES BLOCKD USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 RIGHT LANES BLOCKD AT ROWLAND	USE MONROE BLVD		
	2 RIGHT LANES BLOCKD AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 RIGHT LANES BLOCKD AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Same Freeway But Relatively Far from Incident

**Table 8-10. CMS Message Examples for Lane Blockage Incidents  
CMS Relatively Far from Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Blocked message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT AT ROWLAND DR 1 LANE BLOCKED		ACCIDENT AT ROWLAND	RIGHT LANE BLOCKED
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND 3 LANES BLOCKED			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND 3 LANES BLOCKED			
<ul style="list-style-type: none"> <li>• Distance for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT 1 MILE 2 LANES BLOCKED		ACCIDENT 1 MILE	2 LANES BLOCKED
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT NEAR I-287 2 LANES BLOCKED		ACCIDENT NEAR ROWLAND	2 RIGHT LANES BLOCKED
<ul style="list-style-type: none"> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	ACCIDENT PAST ROWLAND	2 LANES BLOCKED PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED PAST ROWLAND ----- 2 LANES BLOCKED PAST ROWLAND PREPARE TO STOP	PREPARE TO STOP		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

**Table 8-10 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ACCIDENT BEFORE ROWLAND	2 LANES BLOCKED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED BEFORE ROWLAND	USE OTHER ROUTES		
	----- 2 LANES BLOCKED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	2 LANES BLOCKED USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED AT ROWLAND	USE MONROE BLVD		
	----- 2 LANES BLOCKED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	----- MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Different Freeway than Incident

**Table 8-11. CMS Message Examples for Lane Blockage Incidents  
CMS on Different Freeway than Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• No Lanes Blocked message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT ON I-80 WEST AT ROWLAND DR			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT ON I-80 WEST AT ROWLAND			
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-11 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ACCIDENT ON I-80 WEST BEFORE ROWLAND	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED ON I-80 WEST BEFORE ROWLAND	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	ACCIDENT ON I-80 WEST AT ROWLAND	USE TILLMAN DR		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	2 LANES BLOCKED ON I-80 WEST AT ROWLAND	USE TILLMAN DR		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Blocked message element.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND	USE RT-42 SOUTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	(Requires a five-unit message.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

# LANE CLOSURE INCIDENTS

## CMS On Same Freeway and Relatively Close to the Incident

Table 8-12. CMS Message Examples for Lane Closure Incidents  
CMS Close to Incident<sup>A</sup> (Ref 1)

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT AT ROWLAND DR RIGHT LANE CLOSED		ACCIDENT AT ROWLAND	RIGHT LANE CLOSED
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND 3 RIGHT LANES CLOSED			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND 3 RIGHT LANES CLOSED			
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT NEAR I-287 2 RIGHT LANES CLOSED		ACCIDENT NEAR I-287	2 RIGHT LANES CLOSED
<ul style="list-style-type: none"> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	ACCIDENT PAST ROWLAND	2 RIGHT LANES CLOSED PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED PAST ROWLAND	PREPARE TO STOP		
	2 RIGHT LANES CLOSED PAST ROWLAND PREPARE TO STOP			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

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Table 8-12 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ACCIDENT BEFORE ROWLAND	2 RIGHT LANES CLOSED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED BEFORE ROWLAND	USE OTHER ROUTES		
	2 RIGHT LANES CLOSED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	ACCIDENT AT ROWLAND	2 RIGHT LANES CLOSED USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED AT ROWLAND	USE MONROE BLVD		
	2 RIGHT LANES CLOSED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Same Freeway But Relatively Far from Incident

**Table 8-13. CMS Message Examples for Lane Closure Incidents  
CMS Relatively Far from Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT AT ROWLAND DR 1 LANE CLOSED		ACCIDENT AT ROWLAND	RIGHT LANE CLOSED
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND 3 LANES CLOSED			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND 3 LANES CLOSED			
<ul style="list-style-type: none"> <li>• Distance for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT 1 MILE 2 LANES CLOSED		ACCIDENT 1 MILE	2 LANES CLOSED
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT NEAR I-287 2 LANES CLOSED		ACCIDENT NEAR I-287	2 RIGHT LANES CLOSED
<ul style="list-style-type: none"> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	ACCIDENT PAST ROWLAND	2 LANES CLOSED PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED PAST ROWLAND ----- 2 LANES CLOSED PAST ROWLAND PREPARE TO STOP	PREPARE TO STOP		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-13 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ACCIDENT BEFORE ROWLAND	2 LANES CLOSED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED BEFORE ROWLAND	USE OTHER ROUTES		
	2 LANES CLOSED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	2 LANES CLOSED USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED AT ROWLAND	USE MONROE BLVD		
	2 LANES CLOSED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

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## CMS On Different Freeway than Incident

**Table 8-14. CMS Message Examples for Lane Closure Incidents  
CMS on Different Freeway than Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• No Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT ON I-80 WEST AT ROWLAND DR			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT ON I-80 WEST AT ROWLAND			
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	ACCIDENT ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-14 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ACCIDENT ON I-80 WEST BEFORE ROWLAND	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED ON I-80 WEST BEFORE ROWLAND	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	ACCIDENT ON I-80 WEST AT ROWLAND	USE TILLMAN DR		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED ON I-80 WEST AT ROWLAND	USE TILLMAN DR		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND	USE RT-42 SOUTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	(Requires a five-unit message.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

# INCIDENTS THAT BLOCK ALL LANES

## CMS On Same Freeway and Relatively Close to the Incident

**Table 8-15. CMS Message Examples for Incidents that Block All Lanes  
CMS Close to Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• "ACCIDENT" for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Blocked message element.</li> <li>• No Action message element.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• "MAJOR ACCIDENT" for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND DR ALL LANES BLOCKED			
<ul style="list-style-type: none"> <li>• "TRUCK ACCIDENT" for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND ALL LANES BLOCKED			
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT NEAR I-287 ALL LANES BLOCKED		ACCIDENT NEAR I-287	ALL LANES BLOCKED
<ul style="list-style-type: none"> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	MAJOR ACCIDENT PAST ROWLAND	ALL LANES BLOCKED PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED PAST ROWLAND	PREPARE TO STOP		
	FREEWAY BLOCKED PAST ROWLAND PREPARE TO STOP			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-15 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	MAJOR ACCIDENT BEFORE ROWLAND	ALL LANES BLOCKED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED BEFORE ROWLAND	USE OTHER ROUTES		
	FREEWAY BLOCKED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	ALL LANES BLOCKED USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED AT ROWLAND	USE MONROE BLVD		
	FREEWAY BLOCKED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Same Freeway But Relatively Far from Incident

**Table 8-16. CMS Message Examples for Incidents that Block All Lanes  
CMS Relatively Far from Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Blocked message element.</li> <li>• No Action message element.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND DR ALL LANES BLOCKED			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND ALL LANES BLOCKED			
<ul style="list-style-type: none"> <li>• Distance for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT 1 MILE ALL LANES BLOCKED		MAJOR ACCIDENT 1 MILE	ALL LANES BLOCKED
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT NEAR I-287 ALL LANES BLOCKED			
<ul style="list-style-type: none"> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	MAJOR ACCIDENT PAST ROWLAND		ALL LANES BLOCKED PREPARE TO STOP	
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED PAST ROWLAND		PREPARE TO STOP	
	----- FREEWAY BLOCKED PAST ROWLAND PREPARE TO STOP			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.



Table 8-16 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	MAJOR ACCIDENT BEFORE ROWLAND	ALL LANES BLOCKED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED BEFORE ROWLAND	USE OTHER ROUTES		
	FREEWAY BLOCKED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	ALL LANES BLOCKED USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED AT ROWLAND	USE MONROE BLVD		
	FREEWAY BLOCKED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY BLOCKED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Different Freeway than Incident

**Table 8-17. CMS Message Examples for Incidents that Block All Lanes  
CMS on Different Freeway than Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• No Lanes Blocked message element.</li> <li>• No Action message element.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT for Incident Descriptor message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND DR			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT ON I-80 WEST AT ROWLAND			
<ul style="list-style-type: none"> <li>• Highway name (number) for Incident (Blockage) Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Combining Incident Descriptor and Incident (Blockage) Location message elements.</li> </ul>	I-80 WEST BLOCKED NEAR I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Incident Descriptor and Incident (Blockage) Location message elements.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-17 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST BEFORE ROWLAND	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Incident Descriptor and Incident (Blockage) Location message elements.</li> </ul>	I-80 WEST BLOCKED BEFORE ROWLAND	USE OTHER ROUTES		
	I-80 WEST BLOCKED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND	USE TILLMAN DR		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Incident (Blockage) Location message elements.</li> </ul>	I-80 WEST BLOCKED AT ROWLAND	USE TILLMAN DR		
	I-80 WEST BLOCKED AT ROWLAND USE TILLMAN DR			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Incident (Blockage) Location message elements.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND	USE RT-42 SOUTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Blocked message element.</li> </ul>	(Requires a five-unit message.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

# INCIDENTS THAT REQUIRE CLOSING THE FREEWAY

## CMS On Same Freeway and Relatively Close to the Closure

Table 8-18. CMS Message Examples for Incidents that Require Closing the Freeway  
CMS Close to Incident<sup>A</sup> (Ref 1)

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> <li>• Lanes Closed message element.</li> <li>• Closure Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT RIVER RD ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• Highway name (number) for Closure Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT AT I-287 ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED		PREPARE TO STOP	
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT RIVER RD		PREPARE TO STOP	
	FREEWAY CLOSED AT RIVER RD PREPARE TO STOP			

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<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-18 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT RIVER RD	USE OTHER ROUTES		
	FREEWAY CLOSED AT RIVER RD USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED	USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT RIVER RD	USE MONROE BLVD		
	FREEWAY CLOSED AT RIVER RD USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Good reason is implied by <i>FREEWAY CLOSED</i> in above message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (<i>MAJOR ACCIDENT</i>).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (<i>TRUCK ACCIDENT</i>).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-18 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> <li>• Implied good reason for following Action message element (ALL LANES CLOSED).</li> </ul>	FREEWAY CLOSED AT RIVER RD	USE RT-42 SOUTH		
	FREEWAY CLOSED AT RIVER RD USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> <li>• Implied good reason for following Action message element (ALL LANES CLOSED).</li> </ul>	FREEWAY CLOSED AT RIVER RD	PHILADELPHIA USE I-676 NORTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> </ul>	MAJOR ACCIDENT EXIT AT RIVER RD ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD			
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Good reason is implied by FREEWAY CLOSED in above message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RIVER RD		
	MAJOR ACCIDENT AT ROWLAND USE RIVER RD			
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE RIVER RD		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

**Table 8-18 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> <li>• Implied good reason for following Action message element (<i>ALL LANES CLOSED</i>).</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD			
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> <li>• Implied good reason for following Action message element (<i>ALL LANES CLOSED</i>).</li> </ul>	FREEWAY CLOSED	PHILADELPHIA USE RIVER RD		
	FREEWAY CLOSED PHILADELPHIA USE RIVER RD			
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> </ul>	MAJOR ACCIDENT ALL LANES CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements..</li> </ul>	(Good reason is implied by <i>FREEWAY CLOSED</i> in above message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Implied good reason for following Action message element (<i>MAJOR ACCIDENT</i>).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	EXIT AT RIVER RD FOLLOW DETOUR		
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (<i>TRUCK ACCIDENT</i>).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA EXIT AT RIVER RD		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

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**Table 8-18 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 5 Diversion Route.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	FREEWAY CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> <li>• <i>Diversion message for specific audience.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	FREEWAY CLOSED	PHILADELPHIA EXIT AT RIVER RD		
	FREEWAY CLOSED PHILADELPHIA EXIT AT RIVER RD			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.



## CMS On Same Freeway But Relatively Far from Closure

**Table 8-19. CMS Message Examples for Incidents that Require Closing the Freeway  
CMS Relatively Far from Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> <li>• Lanes Closed message element.</li> <li>• Closure Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT AT RIVER RD ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• Highway name (number) for Closure Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT AT I-287 ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED		PREPARE TO STOP	
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT RIVER RD		PREPARE TO STOP	
	----- FREEWAY CLOSED AT RIVER RD PREPARE TO STOP		-----	-----

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-19 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT RIVER RD	USE OTHER ROUTES		
	FREEWAY CLOSED AT RIVER RD USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT AT RIVER RD ALL LANES CLOSED	USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT RIVER RD	USE MONROE BLVD		
	FREEWAY CLOSED AT RIVER RD USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	(Good reason is implied by <i>FREEWAY CLOSED</i> in above message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (<i>MAJOR ACCIDENT</i>).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RT-42 SOUTH		
	MAJOR ACCIDENT AT ROWLAND USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (<i>TRUCK ACCIDENT</i>).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

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**Table 8-19 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 1 or Type 2 Diversion Route.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	FREEWAY CLOSED AT RIVER RD	USE RT-42 SOUTH		
	FREEWAY CLOSED AT RIVER RD USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 1 or Type 2 Diversion Route.</i></li> <li>• <i>Diversion message for specific audience.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	FREEWAY CLOSED AT RIVER RD	PHILADELPHIA USE I-676 NORTH		
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> </ul>	MAJOR ACCIDENT EXIT AT RIVER RD ALL LANES CLOSED			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> <li>• <i>Good reason for following Action message element.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> </ul>	(Good reason is implied by <i>FREEWAY CLOSED</i> in above message.)			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> <li>• <i>Implied good reason for following Action message element (MAJOR ACCIDENT).</i></li> <li>• <i>No Lanes Closed message element.</i></li> </ul>	MAJOR ACCIDENT AT ROWLAND	USE RIVER RD		
	MAJOR ACCIDENT AT ROWLAND USE RIVER RD			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> <li>• <i>Diversion message for specific audience.</i></li> <li>• <i>Implied good reason for following Action message element (TRUCK ACCIDENT).</i></li> <li>• <i>No Lanes Closed message element.</i></li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA USE RIVER RD		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-19 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> <li>• Implied good reason for following Action message element (ALL LANES CLOSED).</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD			
<ul style="list-style-type: none"> <li>• Diversion to Type 3 or Type 4 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> <li>• Implied good reason for following Action message element (ALL LANES CLOSED).</li> </ul>	FREEWAY CLOSED	PHILADELPHIA USE RIVER RD		
	FREEWAY CLOSED PHILADELPHIA USE RIVER RD			
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> </ul>	MAJOR ACCIDENT ALL LANES CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Lanes Closed message elements.</li> </ul>	(Good reason is implied by FREEWAY CLOSED in above message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT AT ROWLAND	EXIT AT RIVER RD FOLLOW DETOUR		
<ul style="list-style-type: none"> <li>• Diversion to Type 5 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	TRUCK ACCIDENT AT ROWLAND	PHILADELPHIA EXIT AT RIVER RD		

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<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

**Table 8-19 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 5 Diversion Route.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	FREEWAY CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 3 or Type 4 Diversion Route.</i></li> <li>• <i>Diversion message for specific audience.</i></li> <li>• <i>Combining Incident Descriptor and Lanes Closed message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	FREEWAY CLOSED	PHILADELPHIA EXIT AT RIVER RD		
	FREEWAY CLOSED PHILADELPHIA EXIT AT RIVER RD			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Different Freeway than Closure

**Table 8-20. CMS Message Examples for Incidents that Require Closing the Freeway  
CMS on Different Freeway than Incident<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• “MAJOR ACCIDENT” for Incident Descriptor message element.</li> <li>• Incident (Blockage) Location message element.</li> <li>• No Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT RIVER RD			
<ul style="list-style-type: none"> <li>• “TRUCK ACCIDENT” for Incident Descriptor message element.</li> </ul>	TRUCK ACCIDENT ON I-80 WEST AT RIVER RD			
<ul style="list-style-type: none"> <li>• Highway name (number) for Closure Location message element.</li> <li>• No Action message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT I-287			
<ul style="list-style-type: none"> <li>• Combining Incident Descriptor and Closure Location message elements.</li> </ul>	I-80 WEST CLOSED AT I-287			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion</li> <li>• Combining Incident Descriptor and Closure Location message elements.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-20 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT RIVER RD	USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Incident Descriptor and Closure Location message elements.</li> </ul>	I-80 WEST CLOSED AT RIVER RD USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT RIVER RD	USE MONROE BLVD		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Incident Descriptor and Closure Location message elements.</li> </ul>	I-80 WEST CLOSED AT RIVER RD USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Incident Descriptor and Closure Location message elements.</li> </ul>	(Good reason is implied by FREEWAY CLOSED in above message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Implied good reason for following Action message element (MAJOR ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	MAJOR ACCIDENT ON I-80 WEST AT ROWLAND	USE RT-42 SOUTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (TRUCK ACCIDENT).</li> <li>• No Lanes Closed message element.</li> </ul>	(Requires a five-unit message.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

**Table 8-20 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 1 or Type 2 Diversion Route.</i></li> <li>• <i>Combining Incident Descriptor and Closure Location message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	I-80 WEST CLOSED AT RIVER RD USE RT-42 SOUTH			
<ul style="list-style-type: none"> <li>• <i>Diversion to Type 1 or Type 2 Diversion Route.</i></li> <li>• <i>Diversion message for specific audience.</i></li> <li>• <i>Combining Incident Descriptor and Closure Location message elements.</i></li> <li>• <i>Implied good reason for following Action message element (ALL LANES CLOSED).</i></li> </ul>	I-80 WEST CLOSED AT RIVER RD	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.



# LANE CLOSURES DURING ROADWORK

## CMS On Same Freeway and Relatively Close to the Roadwork

**Table 8-21. CMS Message Examples for Lane Closures During Roadwork  
CMS Close to Lane Closure<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK AT ROWLAND DR RIGHT LANE CLOSED		ROADWORK AT ROWLAND	RIGHT LANE CLOSED
<ul style="list-style-type: none"> <li>• Highway name (number) for Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK NEAR I-287 2 RIGHT LANES CLOSED		ROADWORK NEAR I-287	2 RIGHT LANES CLOSED
<ul style="list-style-type: none"> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Displaying the limits of the Lane Closure Location message element.</li> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED FROM I-287 TO ROWLAND			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	ROADWORK PAST ROWLAND	2 RIGHT LANES CLOSED PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Lane Closure Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED PAST ROWLAND	PREPARE TO STOP		
	2 RIGHT LANES CLOSED PAST ROWLAND PREPARE TO STOP			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-21 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ROADWORK BEFORE ROWLAND	2 RIGHT LANES CLOSED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Lane Closure Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED BEFORE ROWLAND	USE OTHER ROUTES		
	2 RIGHT LANES CLOSED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED AT ROWLAND	USE MONROE BLVD		
	2 RIGHT LANES CLOSED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (2 lanes closed).</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 RIGHT LANES CLOSED AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Same Freeway But Relatively Far from the Roadwork

**Table 8-22. CMS Message Examples for Lane Closures During Roadwork  
CMS Far Upstream of Lane Closure<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK AT ROWLAND DR 1 LANE CLOSED		ROADWORK AT ROWLAND	1 LANE CLOSED
<ul style="list-style-type: none"> <li>• Highway name (number) for Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK NEAR I-287 2 LANES CLOSED		ROADWORK NEAR I-287	2 LANES CLOSED
<ul style="list-style-type: none"> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Displaying the limits of the Lane Closure Location message element.</li> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED FROM I-287 TO ROWLAND			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	ROADWORK PAST ROWLAND	2 LANES CLOSED PREPARE TO STOP		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Lane Closure Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED PAST ROWLAND ----- 2 LANES CLOSED PAST ROWLAND PREPARE TO STOP	PREPARE TO STOP -----		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-22 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ROADWORK BEFORE ROWLAND	2 LANES CLOSED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Lane Closure Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED BEFORE ROWLAND	USE OTHER ROUTES		
	2 LANES CLOSED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED AT ROWLAND	USE MONROE BLVD		
	2 LANES CLOSED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED AT ROWLAND	USE MONROE BLVD AVOID DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (2 lanes closed).</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED AT ROWLAND	PHILADELPHIA USE I-676 NORTH		

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Different Freeway than the Roadwork

**Table 8-23. CMS Message Examples for Lane Closures During Roadwork  
CMS on Different Freeway Than Lane Closure<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	(Requires a four-line CMS.)			
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK ON I-80 WEST AT ROWLAND DR			
<ul style="list-style-type: none"> <li>• Highway name (number) for Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	2 LANES CLOSED ON I-80 WEST NEAR I-287			
<ul style="list-style-type: none"> <li>• Displaying the limits of the Lane Closure Location message element.</li> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	(Requires a four-line CMS.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Replacing Lane Closure Descriptor message element with Lanes Closed message element.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

**Table 8-23 Continued**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Replacing Lane Closure Descriptor message element with Lanes Closed message element.</li> </ul>	(Requires a four-line CMS.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Requires a four-line CMS.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (2 lanes closed).</li> <li>• Replacing Incident Descriptor message element with Lanes Closed message element.</li> </ul>	(Requires a five-unit message.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

# ROADWORK REQUIRING TOTAL FREEWAY CLOSURE

## CMS On Same Freeway and Relatively Close to the Closure

Table 8-24. CMS Message Examples for Roadwork Requiring Total Freeway Closure  
CMS Close to Closure<sup>A</sup> (Ref 1)

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK AT ROWLAND ALL LANES CLOSED		ROADWORK AT ROWLAND	ALL LANES CLOSED
<ul style="list-style-type: none"> <li>• Highway name (number) for Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK NEAR I-287 ALL LANES CLOSED		ROADWORK NEAR I-287	ALL LANES CLOSED
<ul style="list-style-type: none"> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	FREEWAY CLOSED FROM I-287 TO ROWLAND			
<ul style="list-style-type: none"> <li>• Action message element.</li> </ul>	ROADWORK ALL LANES CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-24 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (2 lanes closed).</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 6 Detour Route.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.



## CMS On Same Freeway But Relatively Far from the Closure

**Table 8-25. CMS Message Examples for Roadwork Requiring Total Freeway Closure  
CMS Relatively Far from Closure<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK AT ROWLAND DR ALL LANES CLOSED		ROADWORK AT ROWLAND	ALL LANES CLOSED
<ul style="list-style-type: none"> <li>• Highway name (number) for Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	ROADWORK NEAR I-287 ALL LANES CLOSED		ROADWORK NEAR I-287	ALL LANES CLOSED
<ul style="list-style-type: none"> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	FREEWAY CLOSED FROM I-287 TO ROWLAND			
<ul style="list-style-type: none"> <li>• Action message element.</li> </ul>	ROADWORK ALL LANES CLOSED	EXIT AT RIVER RD FOLLOW DETOUR		
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-25 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	ROADWORK BEFORE ROWLAND	ALL LANES CLOSED USE OTHER ROUTES		
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED BEFORE ROWLAND	USE OTHER ROUTES		
	FREEWAY CLOSED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT ROWLAND	USE MONROE BLVD		
	FREEWAY CLOSED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT ROWLAND	USE MONROE BLVD AVOID MAJOR DELAY		
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (FREEWAY CLOSED).</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED AT ROWLAND	PHILADELPHIA USE I-676 NORTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 6 Detour Route.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	FREEWAY CLOSED EXIT AT RIVER RD FOLLOW DETOUR			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## CMS On Different Freeway than the Roadwork and Closure

**Table 8-26. CMS Message Examples for Roadwork Requiring Total Freeway Closure  
CMS on Different Freeway<sup>A</sup> (Ref 1)**

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “ROADWORK” for Roadwork Descriptor message element.</li> <li>• Lane Closure Location message element.</li> <li>• Lanes Closed message element.</li> <li>• No Action message element.</li> </ul>	(Requires four-line sign.)			
<ul style="list-style-type: none"> <li>• Highway name (number) for Lane Closure Location message element.</li> <li>• No Action message element.</li> </ul>	(Requires four-line sign.)			
<ul style="list-style-type: none"> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	I-80 WEST CLOSED NEAR I-287			
<ul style="list-style-type: none"> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> <li>• Replacing Roadwork Descriptor message element with Lanes Closed message element.</li> </ul>	I-80 WEST CLOSED FROM I-287 TO ROWLAND			
<ul style="list-style-type: none"> <li>• Action message element.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> </ul>	(Does not apply in this case.)			
<ul style="list-style-type: none"> <li>• Action message element.</li> <li>• No diversion.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

Table 8-26 Continued

Message Characteristics Highlights	Permanent CMS		Portable CMS <sup>B</sup>	
	Phase 1	Phase 2	Phase 1	Phase 2
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> </ul>	(Requires a five-unit message.)			
<ul style="list-style-type: none"> <li>• “Soft” diversion.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	I-80 WEST CLOSED BEFORE ROWLAND USE OTHER ROUTES			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	I-80 WEST CLOSED AT ROWLAND USE MONROE BLVD			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Good reason for following Action message element.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Requires a four-line sign.)			
<ul style="list-style-type: none"> <li>• Diversion to Type 1 or Type 2 Diversion Route.</li> <li>• Diversion message for specific audience.</li> <li>• Implied good reason for following Action message element (FREEWAY CLOSED).</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	I-80 WEST CLOSED AT ROWLAND	PHILADELPHIA USE I-676 NORTH		
<ul style="list-style-type: none"> <li>• Diversion to Type 6 Detour Route.</li> <li>• Combining Roadwork Descriptor and Lanes Closed message elements.</li> </ul>	(Does not apply in this case.)			

<sup>A</sup> Permanent CMS: 3 lines, 20 characters per line; Portable CMS: 3 lines, 8 characters per line. All messages are for operating speeds above 35 mi/h and thus are limited to 4 units of information.

<sup>B</sup> Blank cells indicate that the message cannot be displayed on a portable CMS.

## **8.4 MODIFYING MESSAGES TO IMPROVE EFFECTIVENESS**

This section of the Manual contains recommended improvements to several poorly designed CMS messages that have been observed by the author in different parts of the United States. Notes that highlight the reasons for the recommended changes to the observed messages are also provided.

It should be noted that in the examples given the freeway and highway numbers and names have been changed from the original.

## EXAMPLES OF IMPROVED MESSAGES FOR INCIDENTS

Table 8-27. Incident Messages (Ref 1)

Old Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
ACCIDENT AHEAD USE CAUTION		ACCIDENT AT [location]		<ul style="list-style-type: none"> <li>● It is best to give the location of the incident. Knowledge of the incident location is useful to motorists to make diversion and other driving decisions.</li> <li>● <b>AHEAD</b> is redundant and need not be displayed because it is understood by motorists that the crash is ahead on the freeway.</li> </ul>
ACCIDENT AHEAD 21ST STREET USE CAUTION		ACCIDENT AT 21ST STREET 2 LEFT LANES CLOSED		<ul style="list-style-type: none"> <li>● <b>AT</b> should be displayed before the location of the incident.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● Knowledge of which lanes are closed is useful to motorists to determine which lanes they should use to travel past the incident.</li> <li>● <b>AHEAD</b> is redundant and need not be displayed because it is understood by motorists that the crash is ahead on the freeway.</li> </ul>
ACCIDENT AHEAD I-84 EXPECT DELAYS		ACCIDENT AT [location] 2 LEFT LANES CLOSED		<ul style="list-style-type: none"> <li>● It is best to give the location of the incident rather than the information that the crash is on I-84. If the CMS is on I-84, it will be understood by motorists that the crash is on I-84 and it need not be displayed.</li> <li>● Knowledge of the incident location is useful to motorists to make diversion and other driving decisions.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● Knowledge of which lanes are closed is useful to motorists to determine which lanes they should use to travel past the incident.</li> <li>● <b>AHEAD</b> is redundant and need not be displayed because it is understood by motorists that the crash is ahead on I-84.</li> </ul>

Table 8-27 Continued

Old Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
ACCIDENT AHEAD LEFT LANES USE CAUTION		ACCIDENT AT [location] 2 LEFT LANES CLOSED		<ul style="list-style-type: none"> <li>● It is best to give the location of the incident rather than the information that the crash is ahead. Knowledge of the incident location is useful to motorists to make diversion and other driving decisions.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● <i>AHEAD</i> is redundant and need not be displayed because it is understood by motorists that the crash is ahead.</li> </ul>
ACCIDENT AHEAD ONE RIGHT LANE OPEN	ACCIDENT AHEAD BROOK BRIDGE EXPECT DELAYS	ACCIDENT AT BROOK BRIDGE 2 LEFT LANES CLOSED		<ul style="list-style-type: none"> <li>● The current message has five units of information and can be reduced to three units.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● Knowledge of which lanes are closed is useful to motorists to determine which lanes they should use to travel past the incident.</li> <li>● <i>AHEAD</i> is redundant and need not be displayed because it is understood by motorists that the crash is ahead on the freeway.</li> </ul>
ACCIDENT AHEAD REDUCE SPEED MERGE LEFT	RIGHT LANE CLOSED AHEAD DRIVE CAREFULLY	ACCIDENT AT [location] RIGHT LANE CLOSED		<ul style="list-style-type: none"> <li>● The current message has five units of information and can be reduced to three units.</li> <li>● It is best to give the location of the crash. Knowledge of the crash location is useful to motorists to make diversion and other driving decisions.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● <i>AHEAD</i> is redundant and need not be displayed because it is understood by motorists that the crash is ahead on the freeway.</li> <li>● <i>MERGE LEFT</i> is redundant to <i>RIGHT LANE CLOSED</i> and can be omitted.</li> </ul>
MAJOR ACCIDENT AT ROWLAND CLEARED AT 5:10	2 LEFT LANES CLOSED EXPECT DELAY	MAJOR ACCIDENT AT ROWLAND CLEARED AT 5:10		<ul style="list-style-type: none"> <li>● Conflicting information is given in the current message. The first message phase states that the crash was cleared at 5:10; the second phase states that two lanes are closed. The recommended message is based on the assumption that the former is true.</li> </ul>

Table 8-27 Continued

Old Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
ALL LANES CLOSED AHEAD KEEP RIGHT		FREEWAY CLOSED EXIT AT [location] FOLLOW DETOUR		<ul style="list-style-type: none"> <li>● <b>FREEWAY CLOSED</b> is used rather than <b>ALL LANES CLOSED</b> because it is shorter and means the same thing to motorists.</li> <li>● Telling motorists where to exit is useful.</li> <li>● Telling motorists to follow a detour that is set up because of the closure gives motorists the assurance that they will have positive guidance along the alternative route.</li> </ul>
ACCIDENT IH-84 EAST AT ROWLAND	USE ALTERNATE ROUTES	ACCIDENT AT ROWLAND	USE OTHER ROUTES	<ul style="list-style-type: none"> <li>● If the CMS is located on I-84 East, the crash is understood to be on I-84 East and it need not be displayed.</li> <li>● <b>OTHER</b> is used rather than <b>ALTERNATE</b> because it is shorter and easier to read and will be understood by motorists.</li> </ul>
		----- ACCIDENT AT ROWLAND USE OTHER ROUTES	-----	
		ACCIDENT ON I-84 EAST AT ROWLAND	USE OTHER ROUTES	<ul style="list-style-type: none"> <li>● If the CMS is located on a cross freeway to I-84 East, then <b>ON I-84 EAST</b> must be displayed.</li> <li>● <b>I-84</b> should be used rather than <b>IH-84</b>. Human factors research by TTI revealed that motorists do not understand "IH."</li> </ul>
IH-84 EAST ACCIDENT AT ROWLAND	USE ALTERNATE ROUTES	ACCIDENT AT ROWLAND USE OTHER ROUTES		<ul style="list-style-type: none"> <li>● If the CMS is located on I-84 EAST, the crash is understood to be on I-84 EAST and it need not be displayed.</li> <li>● The problem <b>ACCIDENT</b> should always be on the top line.</li> <li>● <b>OTHER</b> is used rather than <b>ALTERNATE</b> because it is shorter and easier to read and will be understood by motorists.</li> </ul>
IH-84 EAST ACCIDENT DOWNTOWN	TWO LEFT LANES CLOSED	ACCIDENT NEAR DOWNTOWN 2 LEFT LANES CLOSED		<ul style="list-style-type: none"> <li>● If the CMS is located on I-84 East, the crash is understood to be on I-84 East and it need not be displayed.</li> <li>● The problem <b>ACCIDENT</b> should always be on the top line.</li> <li>● <b>2</b> should be used rather than <b>TWO</b> because it is shorter and more easily read by motorists.</li> <li>● <b>NEAR</b> is displayed in front of <b>DOWNTOWN</b> to reduce possibility of confusion as to the location of the crash.</li> </ul>



**Table 8-27 Continued**

Old Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
IH-84 EB AT ROWLAND MAJOR ACCIDENT		MAJOR ACCIDENT AT ROWLAND 2 LANES CLOSED		<ul style="list-style-type: none"> <li>● The incident should be displayed on the top line followed by the location.</li> <li>● The word <b>AT</b> should be separated from the first unit of information and be placed with the location of the incident (second unit of information). A message line should not contain portions of two different units of information.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● Human factors research conducted by TTI revealed that a large majority of motorists do not understand the meaning of the abbreviation <b>EB</b>.</li> </ul>
IH-84 EAST CLOSED AT ROWLAND	USE ALTERNATE ROUTES	FREEWAY CLOSED AT ROWLAND USE OTHER ROUTES		<ul style="list-style-type: none"> <li>● <b>FREEWAY</b> is used rather than <b>I-84 EAST</b> because it is shorter and easier to read and is well understood to mean the freeway on which the motorist is traveling.</li> <li>● The word <b>CLOSED</b> from the first unit of information should be separated from the word <b>AT</b> from the second unit of information. A message line should not contain portions of two different units of information.</li> <li>● <b>OTHER</b> is used rather than <b>ALTERNATE</b> because it is shorter and easier to read.</li> </ul>
MAJOR ACCIDENT AT ROWLAND ON MAIN LANES	AVOID DELAY USE ALTERNATE ROUTE	MAJOR ACCIDENT AT ROWLAND USE OTHER ROUTES		<ul style="list-style-type: none"> <li>● Information that the crash is <b>ON MAIN LANES</b> will be understood by motorists and it need not be displayed.</li> <li>● <b>OTHER</b> is used rather than <b>ALTERNATE</b> because it is shorter and easier to read.</li> <li>● The motorist would assume that if told to use other routes the motorist would avoid delay. Thus <b>AVOID DELAY</b> need not be displayed.</li> </ul>

Table 8-27 Continued

Old Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
IH-84 EB AT ROWLAND ACCIDENT	2 LEFT LANES CLOSED EXPECT DELAY	ACCIDENT AT ROWLAND 2 LEFT LANES CLOSED		<ul style="list-style-type: none"> <li>● If the CMS is located on I-84 EAST, the crash is understood to be on I-84 EAST and it need not be displayed.</li> <li>● The word <i>AT</i> should be separated from the first unit of information and be placed with the location of the incident (second unit of information). A message line should not contain portions of two different units of information.</li> <li>● Knowledge of the number of lanes closed is useful to motorists to evaluate the potential amount of delay.</li> <li>● <i>AHEAD</i> is redundant and need not be displayed because it is understood by motorists that the crash is ahead on I-84.</li> <li>● The abbreviation <i>EB</i> should not be used. Recent human factors studies conducted by TTI indicated that a large percentage of motorists would not understand the abbreviation <i>EB</i>.</li> <li>● When two lanes are closed due to a crash, most motorists will <i>EXPECT DELAYS</i>. Thus, it can be omitted.</li> </ul>
IH-84 EB AT ROWLAND FREEWAY CLOSED	AVOID DELAY USE ALTERNATE ROUTES	FREEWAY CLOSED AT ROWLAND USE OTHER ROUTES		<ul style="list-style-type: none"> <li>● The current message has five units of information and can be reduced to three units.</li> <li>● The incident should be displayed on the top line followed by the incident location.</li> <li>● Human factors research conducted by TTI revealed that a large majority of motorists do not understand the meaning of the abbreviation <i>EB</i>.</li> <li>● <i>OTHER</i> is used rather than <i>ALTERNATE</i> because it is shorter and easier to read and will be understood by motorists</li> </ul>
FREEWAY CLOSED AT ROWLAND MAJOR ACCIDENT	ALL TRAFFIC EXIT ROWLAND	FREEWAY CLOSED	EXIT AT ROWLAND USE SERVICE RD	<ul style="list-style-type: none"> <li>● The current message has five units of information and can be reduced to four units.</li> <li>● <i>FREEWAY CLOSED</i> is used rather than <i>MAJOR ACCIDENT</i> because it represents the immediate problem the motorists will face.</li> <li>● If the freeway is closed, the motorists will understand that <i>ALL TRAFFIC</i> must exit. The recommendation is to tell the motorists that they should <i>EXIT AT WASHINGTON</i> and then <i>USE SERVICE ROAD</i> to bypass the incident.</li> </ul>
		FREEWAY CLOSED EXIT AT ROWLAND USE SERVICE RD		

**Table 8-27 Continued**

## EXAMPLES OF IMPROVED MESSAGES FOR ROADWORK

Table 8.28. Roadwork Messages (Ref 1)

Old Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
LEFT LANE CLOSED AHEAD EXPECT DELAY		LFT LANE CLOSED AT [location] EXPECT DELAY		<ul style="list-style-type: none"> <li>It is best to give the location of the lane closure. Knowledge of the lane closure location is useful to motorists to make diversion and other driving decisions.</li> <li><b>AHEAD</b> is redundant and need not be displayed because it is understood by motorists that the lane closure is ahead on the freeway.</li> </ul>
RIGHT TWO LANES CLOSED KEEP LEFT		2 RIGHT LANES CLOSED AT [location]		<ul style="list-style-type: none"> <li>It is best to give the location of the lane closure. Knowledge of the lane closure location is useful to motorists to make diversion and other driving decisions.</li> <li><b>2</b> should be used rather than <b>TWO</b> because it is shorter and more easily read by motorists.</li> <li><b>KEEP LEFT</b> is redundant and need not be displayed.</li> </ul>
IH 84 REDUCED TO ONE LANE AHEAD	RIVERSIDE TO WOODWARD EXPECT DELAY	2 LANES CLOSED FROM RIVERSIDE TO WOODWARD		<ul style="list-style-type: none"> <li>The current message has five units of information and can be reduced to three units.</li> <li>If the CMS is located on I-84, the lanes closures are understood to be on I-84 and it need not be displayed.</li> <li>Giving the limits of the lane closures as was done in the current message is an excellent means of informing motorists the extent of the closure and where they may return to the freeway should they decide to divert.</li> </ul>
LANE CLOSURES BEGIN TUESDAY 8 P.M. - 6 A.M.	LANE CLOSURES TUES - THURS 8 P.M. - 6 A.M.	1 LANE CLOSED TUES - THURS 8 PM - 6 AM		<ul style="list-style-type: none"> <li>The current message has two phases with only the middle line changing information between phases. Motorists may not notice the subtle change of only the middle line. The message can be reduced to a simple one-phase, three-unit message.</li> <li><b>TUES - THURS</b> is more descriptive than <b>BEGIN TUESDAY</b>. However, including it in the message would result in a five-unit message.</li> </ul>

Table 8-28 Continued

Current Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
LEFT TWO LANES CLOSED AT ROWLAND CONSIDER DETOUR		2 LEFT LANES CLOSED AT ROWLAND USE OTHER ROUTES		<ul style="list-style-type: none"> <li>The word <b>CLOSED</b> in the first unit of information should be separated from the second unit of information and be placed with the problem (first unit of information). A message line should not contain portions of two different units of information.</li> <li><b>2</b> should be used rather than <b>TWO</b> because it is shorter and more easily read by motorists.</li> <li><b>USE OTHER ROUTES</b> is used rather than <b>CONSIDER DETOUR</b>. <b>DETOUR</b> implies to motorists that positive guidance will be provided along a route in the form of trailblazers for motorists to follow around the incident and/or police control.</li> </ul>
RIGHT TWO LANES CLOSED DOWNTOWN		2 RIGHT LANES CLOSED NEAR DOWNTOWN		<ul style="list-style-type: none"> <li><b>2</b> should be used rather than <b>TWO</b> because it is shorter and more easily read by motorists.</li> <li><b>NEAR</b> is displayed in front of <b>DOWNTOWN</b> to reduce possibility of confusion as to the location of the lane closure.</li> </ul>
CAUTION INTERSTATE 84 EASTBOUND	RIGHT THREE LANES CLOSED AHEAD	3 RIGHT LANES CLOSED AT [location]		<ul style="list-style-type: none"> <li>This current message has five units of information that can be reduced to three units.</li> <li>If the CMS is located on I-84 East, the lane closures are understood to be on I-84 East and it need not be displayed.</li> <li><b>3</b> should be used rather than <b>THREE</b> because it is shorter and more easily read by motorists.</li> <li>It is best to give the location of the lane closure. Knowledge of the lane closure location is useful to motorists to make diversion and other driving decisions.</li> <li>The long word <b>INTERSTATE</b> should not be used; instead, use <b>I-</b>.</li> </ul>
IH-84 EASTBOUND	RIGHT THREE LANES CLOSED	3 RIGHT LANES CLOSED AT [location]		<ul style="list-style-type: none"> <li>If the CMS is located on I-84 EAST, the lane closures are understood to be on I-84 EAST and it need not be displayed.</li> <li><b>3</b> should be used rather than <b>THREE</b> because it is shorter and more easily read by motorists.</li> <li>It is best to give the location of the lane closure. Knowledge of the lane closure location is useful to motorists to make diversion and other driving decisions.</li> </ul>

Table 8-28 Continued

Current Message		Recommended Message		Notes
First Phase	Second Phase	First Phase	Second Phase	
IH-84 EAST DOWNTOWN ROAD WORK	THRU TRAFFIC USE LEFT TWO LANES	ROADWORK NEAR DOWNTOWN	THRU TRAFFIC USE LEFT 2 LANES	<ul style="list-style-type: none"> <li>● The problem, <b>ROADWORK</b> should be displayed on the first line.</li> <li>● If the CMS is located on I-84 East, the roadwork is understood to be on I-84 East and it need not be displayed.</li> <li>● <b>2</b> should be used rather than <b>TWO</b> because it is shorter and more easily read by motorists.</li> <li>● The second message phase is reformatted slightly to enhance readability.</li> </ul>
IH-84 EAST ROAD WORK	AT ROWLAND ON RAMP	ROADWORK AT ROWLAND 2 LANES CLOSED		<ul style="list-style-type: none"> <li>● The problem, <b>ROADWORK</b> should be displayed on the first line.</li> <li>● Since the CMS is located on I-84 East, the roadwork is understood to be on I-84 East and it need not be displayed.</li> <li>● <b>2</b> should be used rather than <b>TWO</b> because it is shorter and more easily read by motorists.</li> <li>● The message should include the number of lanes that are closed.</li> </ul>
US-59 SB EXIT RAMP CLOSED UNTIL DEC 1998	DETOUR US-59 NORTH TO MUNSON	RAMP TO US-59 S CLOSED	USE US-59 NORTH TO MUNSON	<ul style="list-style-type: none"> <li>● The current message has six units of information and must be reduced to a maximum of four units. This is accomplished by omitting the least relevant unit of information, namely, <b>UNTIL DEC 1998</b>. About six days prior to the opening of the ramp, the CMS can display the day of the week when the ramp will be open, if the agency desires.</li> <li>● The abbreviation <b>SB</b> should not be used. Recent human factors studies conducted by TTI indicated that a large majority of motorists do not understand the meaning of the abbreviation <b>SB</b>.</li> </ul>

## REFERENCES

1. Dudek, C.L. *Variable Message Sign Operations Manual*. Report FHWA-NJ-2001-10, New Jersey Department of Transportation, December 2001.
2. Dudek, C.L. and R.D. Huchingson. *Manual on Real-Time Motorist Information Displays*. Report FHWA-IP-86-16. FHWA, U.S. Department of Transportation, August 1986.

# MODULE 9. DYNAMIC FEATURES ON CMSs

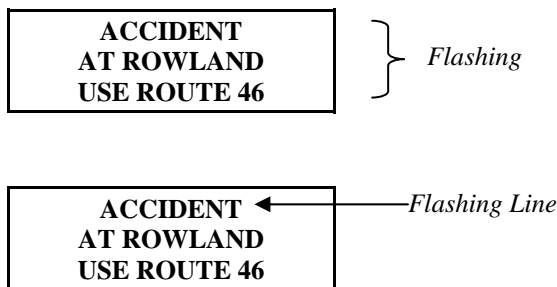
## 9.1 INTRODUCTION

Many CMSs have the capabilities to create dynamic features within a message. Two of the more common features being used by some TMCs are:

- Flashing a message or a line in a message, and
- Alternating lines in a two-phase message.

## 9.2 FLASHING MESSAGES OR LINES

Several state DOTs currently display CMS messages that flash or have one line that flashes in the belief that the features attract the attention of drivers and emphasize the importance of the message. Examples of these CMS features are shown below



Only a limited amount of research has been conducted on this topic, and the effects that flashing has on drivers while traveling on a freeway are not fully known. Dudek et al. and Dudek and Ullman (1,2) reported on single-task human factors laboratory studies that were conducted in Dallas, El Paso, Fort Worth, Houston, and San Antonio to initially examine whether the practice of flashing a one-phase message or one line in a one-phase, three-line message affects the amount of time it takes a driver to read and comprehend the message, or affects a driver's ability to comprehend the message. Follow-up driving simulator studies were conducted to gain greater insight on the effects of these dynamic CMS features while the subjects were under secondary work load (3).

### *Flashing One-Phase, Three-Line Messages*

The results of the single-task study showed that in a laboratory setting, flashing one-phase, three-line messages did not adversely affect subject recall and comprehension to a significant degree in comparison to when the message was not flashed. However, the average reading times were significantly longer when the message was flashed. In contrast, for the driving simulator studies, the results indicated that unfamiliar drivers would have difficulty in understanding all parts of the entire message when it is flashed. In addition, no differences were found in average reading time between the flashing and static messages. This latter result suggests that further research should



be conducted to resolve the disagreement in reading time for the flashing message. However, given that one of the two studies resulted in significantly longer reading time for the flashing message and lower comprehension levels for unfamiliar drivers, the use of the flashing dynamic mode cannot be recommended at this time

***Flashing One Line of One-Phase, Three-Line Messages***

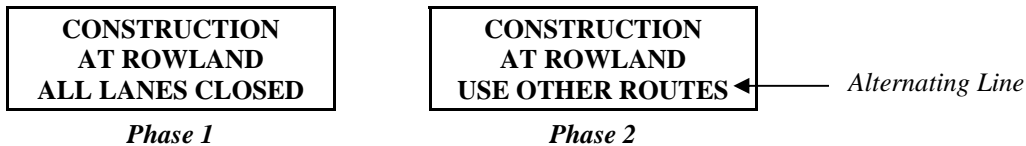
Flashing one line of three-line messages significantly increased average reading time during both the laboratory and the driving simulator studies. In addition, comprehension levels were lower during both studies. The results strongly imply that CMS messages should not be displayed with single flashing lines.

**9.3 ALTERNATING A LINE IN A TWO-PHASE MESSAGE**

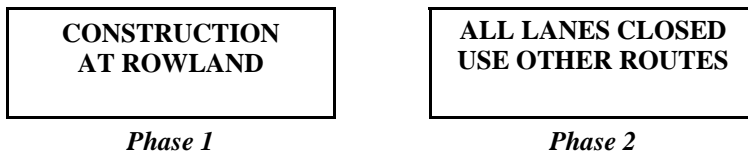
Another operating practice of interest is formatting a message in such a way that the top two lines remain constant and a third bottom line is changed on the second phase of a message. In essence the CMS operates as it were a two-phase message, but with information on two lines constant and redundant between the two phases. An example of a message with alternating text on one line of a three-line CMS while keeping the other two lines of text the same (redundant) is shown below.



In both the laboratory study and the driving simulator study, two alternative styles of messages were. Examples of the two alternative messages styles evaluated are shown below.



*Alternative 1: Message with redundancy*



*Alternative 2: Message without redundancy*

The results of the both studies indicated that alternating one line of text and keeping the other two lines constant did not adversely affect message recall. However, average reading times

increased significantly. The subject preferences were evenly split between having and not having redundant information in both phases of the message. The results strongly imply that alternating line messages should not be displayed.

The alternating line approach has enticed personnel at some TMCs to display messages using formats that violate the principles presented in this *Manual*. Shown below are two messages that the author observed that illustrate how one can easily violate good formatting principles. As shown in the messages, the *Incident Location* message element was displayed on the first two lines followed by the *Incident Descriptor* and the *Lanes Affected* message elements—a violation of formatting principles presented in this *Manual*.

<b>I-77 NORTH AT ROWLAND ACCIDENT</b>	<i>(Location)</i> <i>(Location)</i> <i>(Incident Descriptor)</i>	<b>I-77 NORTH AT ROWLAND FREEWAY CLOSED</b>	<i>(Location)</i> <i>(Location)</i> <i>(Lanes Affected)</i>
<i>Phase 1</i>		<i>Phase 2</i>	

<b>I-77 NORTH AT ROWLAND DUE TO ACCIDENT</b>	<i>(Location)</i> <i>(Location)</i> <i>(Incident Descriptor)</i>	<b>I-77 NORTH AT ROWLAND <del>2 RIGHT LANES CLOSED</del></b>	<i>(Location)</i> <i>(Location)</i> <i>(Lanes Affected)</i>
<i>Phase 1</i>		<i>Phase 2</i>	

## REFERENCES

1. Dudek, C.L., N. Trout, S. Booth, and G. Ullman. *Improved Dynamic Message Sign Messages and Operations*. Report FHWA/TX/-01/1882-2, Texas Department of Transportation, October 2000.
2. Dudek, C.L. and G.L. Ullman. *Flashing Messages, Flashing Lines, and Alternating One-Line on Changeable Message Signs*. In *Transportation Research Record 1803*, TRB, National Research Council, Washington, D.C., 2002, pp 94-101.
3. Dudek, C.L., S.D. Schrock, and G.L. Ullman. *Impacts of Using Dynamic Features to Display Messages on Changeable Message Signs*. Report FHWA-HOP-05-069, FHWA, U.S. Department of Transportation, Washington, D.C., August 2005.



# **MODULE 10. CMS OPERATIONS PROCEDURES AND GUIDELINES**

## **10.1 INTRODUCTION**

*Module 3 CMS Operations Policies* contained guidelines to assist transportation agencies in developing statewide or regional policies for the operation of CMSs. Module 10 contains a listing and discussions of items that a state may want to include in a document that contains CMS operations procedures and guidelines. These procedures and guidelines would establish the day-to-day operation of the CMSs for a given agency. The operations guidelines are influenced by the policies established by the state. TMC managers should consider developing an Operations Procedures and Guidelines Manual that includes the items listed below. The Manual will be a very useful document for staff working in the TMC.

1. Responsibility for operation of CMS system
2. Days and hours of operation
3. CMS Operators
4. Responsibilities of CMS Operators
5. Authority to design messages
6. Authority to display messages
7. Authority to display messages during off TMC hours
8. Requests for CMS messages from agency persons outside of TMC
9. Requests for CMS messages from other agencies
10. Documentation of CMS usage
11. Verifying the incident prior to displaying message
12. Verifying the message via CCTV
13. Message libraries vs. developing messages as the need arises
14. Automated display of messages
15. Automatic shutoff of CMS messages
16. Grouping operations of more than one CMS
17. Use of CMSs during construction
18. Use of CMSs during non-incident related conditions
19. Operation of CMSs with Lane Control Signals
20. Use of CMS messages as part of the freeway management system operational strategies (along with ramp meters and traffic intersection signals)
21. Information needed about incident and alternative route before message is displayed
22. Priority of message types
23. Priority when two events (incidents, roadwork, etc.) are on the freeway at the same time
24. Format of messages
25. Maximum number of units of information in messages for each CMS
26. Reducing message size when lighting conditions change
27. Reducing the number of units of information in messages to account for their effects on driver's ability to read messages
28. Messages displayed prior to identification of specifics of an incident
29. Acceptable message words/terms for

- Incident/Roadwork Descriptor
    - *Use of the term CRASH rather than ACCIDENT*
  - Incident/Roadwork Location
  - Closure Descriptor
  - Location of Closure
  - Effect on Travel
  - Audience for Action
  - Action
30. Acceptable abbreviation terms
  31. Use of one-phase and two-phase messages
  32. Use and criteria for flashing messages
  33. Use and criteria for flashing a message line
  34. Flashing beacons on CMSs
  35. Messages after an incident is removed from the freeway lanes before congestion clears
  36. Messages after incident is removed from freeway lanes after congestion clears
  37. Location and positioning of CMSs
  38. On-site control of CMSs
  39. Coordination with other agencies
  40. Display of congestion information during and immediately following incidents
  41. Display of “all clear” messages after an incident has been removed from the freeway lanes
  42. CMS messages to support HAR
  43. Messages for truck and hazardous cargo restrictions
  44. Use of graphics in messages

Information contained in Modules 1 through 9 should be helpful in formulating procedures and guidelines for many of the issues listed above. The sections that follow in this Module address those issues in the list that were not here-to-for addressed in the *Manual*.

## **10.2 DAYS AND HOURS OF OPERATION**

An agency will establish the operating hours of the TMC. The hours of operation vary among state DOT agencies varying from early morning to late evening five days a week, to 24 hour per day, 7 days per week.

If the TMC is not staffed 24/7, credibility could be compromised if the CMSs are not operating when major events that result in severe congestion occur (crashes, holiday traffic, etc.). Thus, the TMC manager should make arrangements to ensure that messages are displayed on the appropriate CMSs during off hours.

### 10.3 CMS OPERATORS

The CMS operators are often the critical link between the DOT agency TMC and the motorists. They are the ones who ultimately control and monitor what is displayed on CMSs. No matter how automated the CMS message posting practices, proper CMS operations requires well-trained individuals to operate the system. Some of the desirable skills needed by operators are as follows:

- Common sense,
- Ability to make decisions under stress,
- Ability to understand and follow written and oral procedures,
- Writing and verbal abilities,
- People skills,
- Computer skills,
- General knowledge of transportation,
- Familiarity with local and statewide roadway network,
- Technical knowledge, and
- Basic knowledge of electronics.

Recruitment and retention of qualified operators is a challenge, particularly when the TMC operates 24/7. Thus, TMC managers should establish practices concerning CMS operator

- Recruiting,
- Hiring,
- Training,
- Retaining, and
- Performance.

### 10.4 RESPONSIBILITIES OF CMS OPERATORS

The TMC manager should consider preparing written responsibilities of CMS operators, procedures with respect to operator shifts, and responsibilities of CMS operators at the beginning and end of each shift. These help the CMS operators in understanding their responsibilities, provide clarity to work schedules, and help maintain operational consistency among the operators. Below is an operator's mission statement contained in the Arizona DOT Traffic Operations Center Manual (1).

*“The operator’s primary mission is to assure the safety of the motoring public. The operator must understand the system, be able to make sound decisions, and quickly implement the proper procedures for routine and emergency actions. This is accomplished through a thorough understanding and working knowledge of TOC policies and procedures. Timely and accurate responses to all reports of incidents and requests for information, services, or ADOT equipment is required at all times.*”

*The operator must provide quality information in a prompt and courteous manner to the public, public agencies, and ADOT personnel. When a situation arises that the operator cannot resolve, the TOC Supervisor or designee will be advised immediately and a proper response will be provided as rapidly as possible.*

*The Traffic Management System (TMS) is a computerized system designed to assist with management of traffic occurrences. The system cannot react to emergencies without input from the operator. The TMS must be monitored continuously to enable the operator to give timely and accurate notification to the proper agencies.”*

Below are statements of procedures established by the Arizona DOT (1).

*“There are three shifts: a) morning shift (6 AM to 2 PM), b) evening shift (2 PM to 10 PM), and c) graveyard shift (10 PM to 6 AM). Each operator and shift supervisor works 8 hours a day, five days a week. At the end of each shift, each operator will:*

- *Discuss any ongoing incidents or issues with the operator going off-shift.*
- *Access and read E-mail.*
- *Scan all monitors to determine traffic conditions and verify the status of any incident.*
- *Review closed incidents for previous 24 hours on the Operator Workstation (OW).*
- *Review Highway Condition Reporting System (HCRS) status. Check for any incidents that are being worked by other districts.*
- *Check HCRS entries for quality*

*At the end of each shift, every operator will:*

- *Verify that the OW incident logs are completely up-to-date.*
- *Advise the incoming operator of any pending issues.*
- *Leave the work area in a clean and orderly condition.*
- *Make sure all customer inquiries received during their shift have been handled.*

*All operators may be assigned additional duties as necessary by the Operations Supervisor.”*

## **10.5 AUTHORITY TO DESIGN MESSAGES**

Results of interviews with state DOT representatives revealed that CMS operators at some TMCs have the authority to design messages and to display the messages they design without TMC supervisor approval of the messages. This practice is more likely to occur at TMCs that

operate a small number of CMSs or where the software has not been developed to a level that will suggest messages for display based on minimal input by the operator, or present the operator with a standardized message template.

Allowing operators to design messages without supervision can have serious negative credibility consequences because there is no assurance that the messages will adhere to sound design principles. Also, this practice increases the likelihood of inconsistent messages among the many operators.

## **10.6 DOCUMENTATION OF CMS USAGE**

It is important to document CMS benefits as operational needs increase and resources dwindle. Continuous record keeping of the use of CMS during incidents, roadwork, inclement weather, special events, etc. will be useful in documenting the benefits of the CMS system. Documentation of when CMS messages deployed and the specific message displayed is important to evaluate the effectiveness of the messages in the library and CMS locations. The logs are also important for possible tort defense (*I*).

CMS benefits may be quantified in order to arrive at benefit/cost ratios. For example, when an incident occurs, a CMS message upstream of the incident can inform motorists to exit and take an alternate, thus preventing them from standing in a traffic jam. Knowing the time of the incident, the time the message is displayed, number and percentage of vehicles diverted, and the conditions on the freeway and alternate route, one can determine an estimated cost savings because of the use of the CMS (*I*).

## **10.7 GROUPING OPERATIONS OF MORE THAN ONE CMS**

Some transportation agencies use an automation technique referred to as grouping. Grouping allows the TMC manager to place a certain number of signs into a group and associate a specific message with each sign so that when a single command is given by the CMS operator the messages on all the CMSs in the group change appropriately. This further simplifies system operations and helps keep incomplete or conflicting information from being displayed. An example of automatic grouping of messages from Houston is shown in Figure 10-1.

## **REFERENCES**

1. Arizona Department of Transportation, Transportation Technology Group. Traffic Operations Center (TOC) Operations Manual. January 2002.
2. Dudek, C.L. *Changeable Message Signs*. National Cooperative Research Highway Program, Synthesis of Highway Practice 237, TRB, National Research Council, 1997.



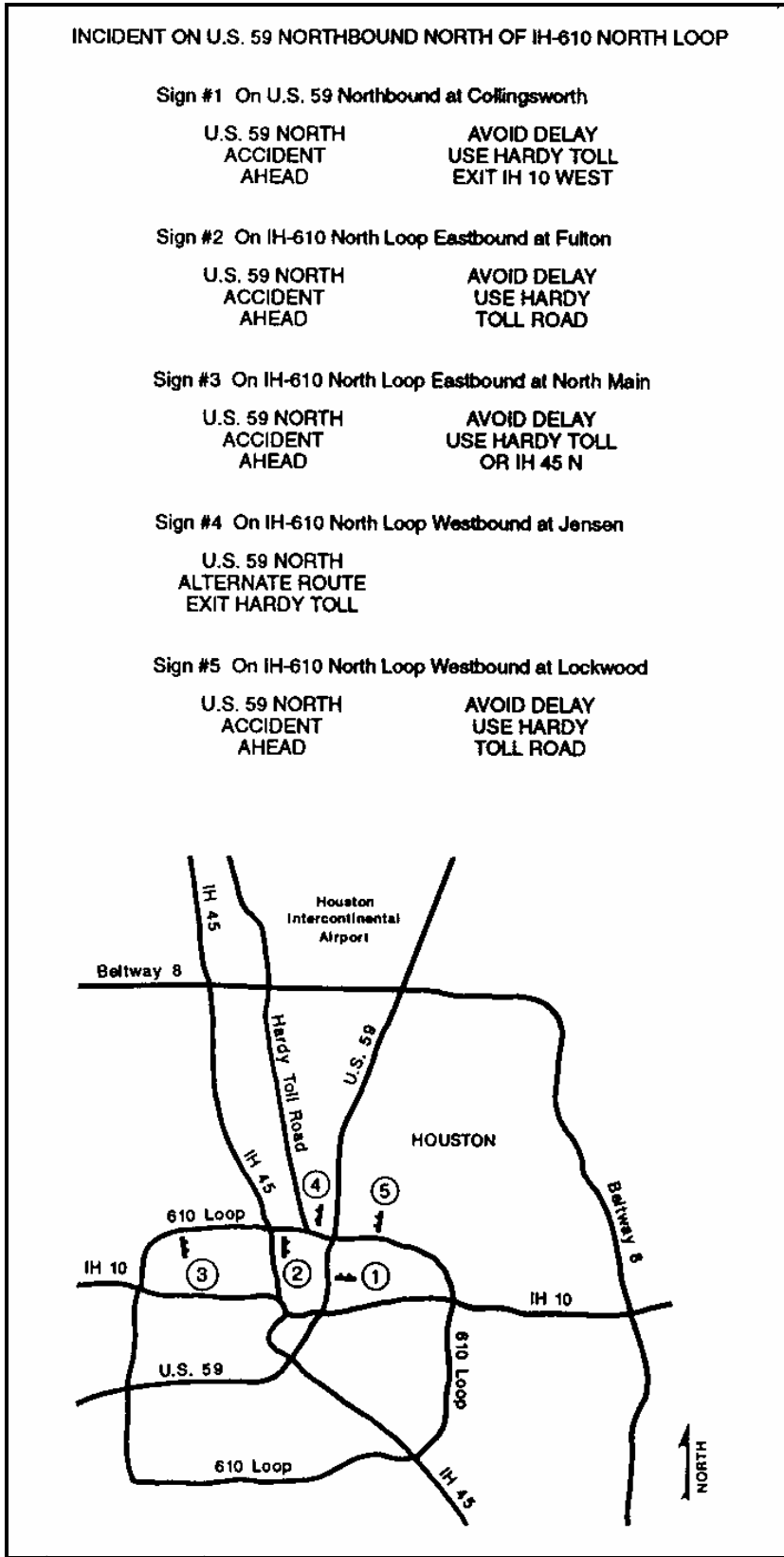
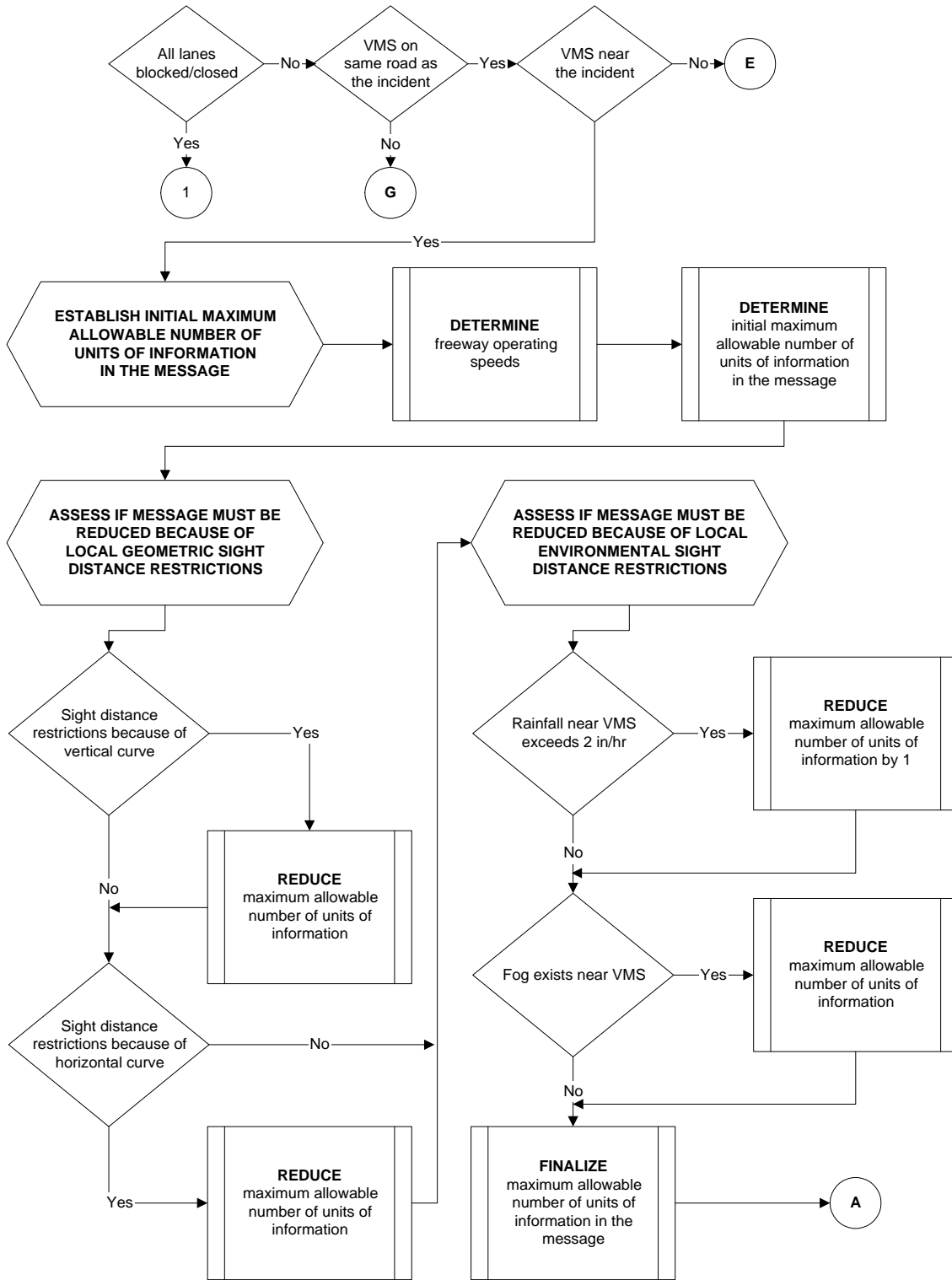


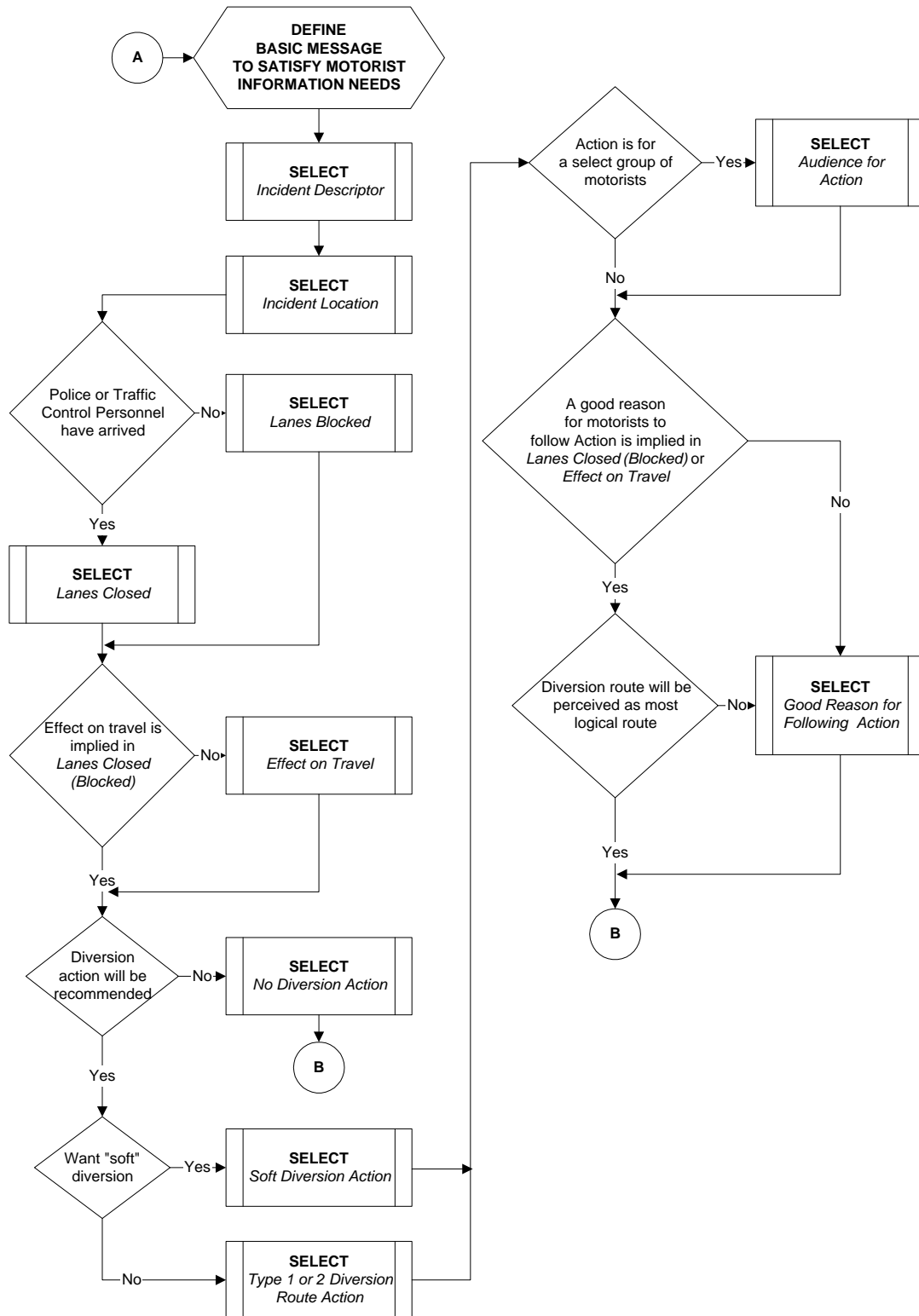
Figure 10-1. Example of Automatic CMS Grouping – Houston TranStar (Ref 2)

# APPENDIX A - CMS MESSAGE DESIGN PROCESS: INCIDENTS



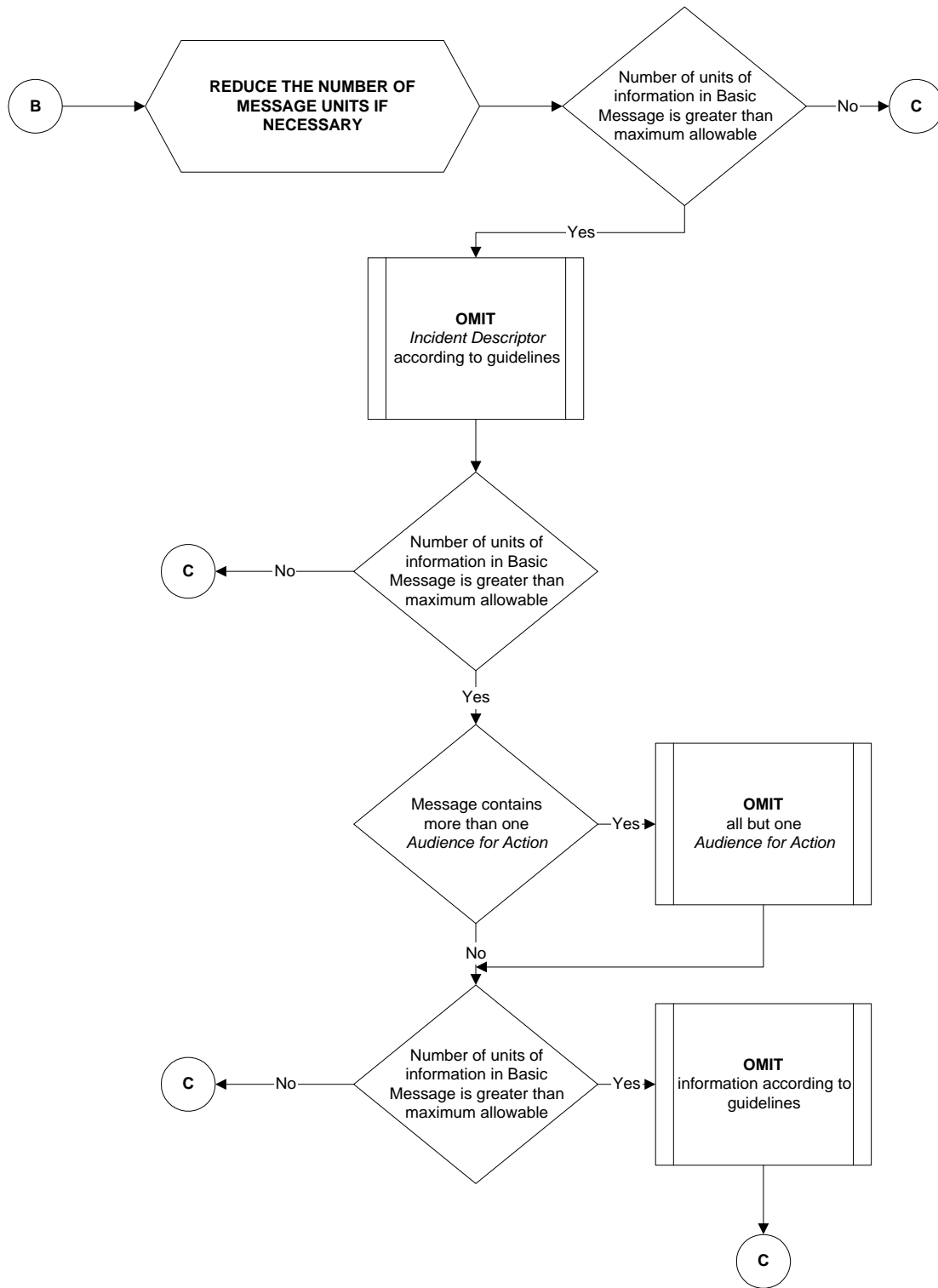
(a) Lane-Closure (Blockage)

Figure A-1. CMS Message Design Flowchart for Incidents



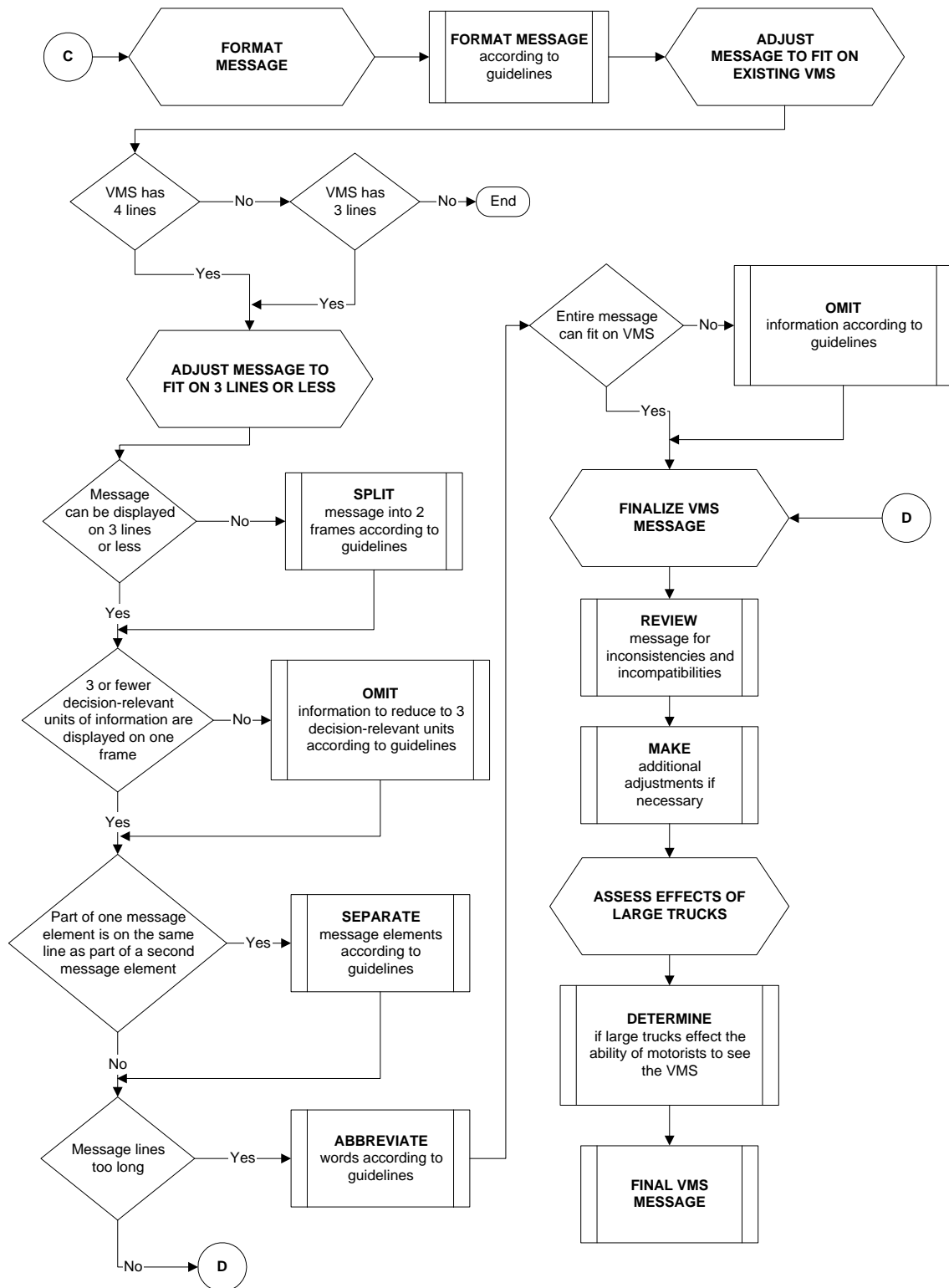
(a) Lane-Closure (Blockage)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



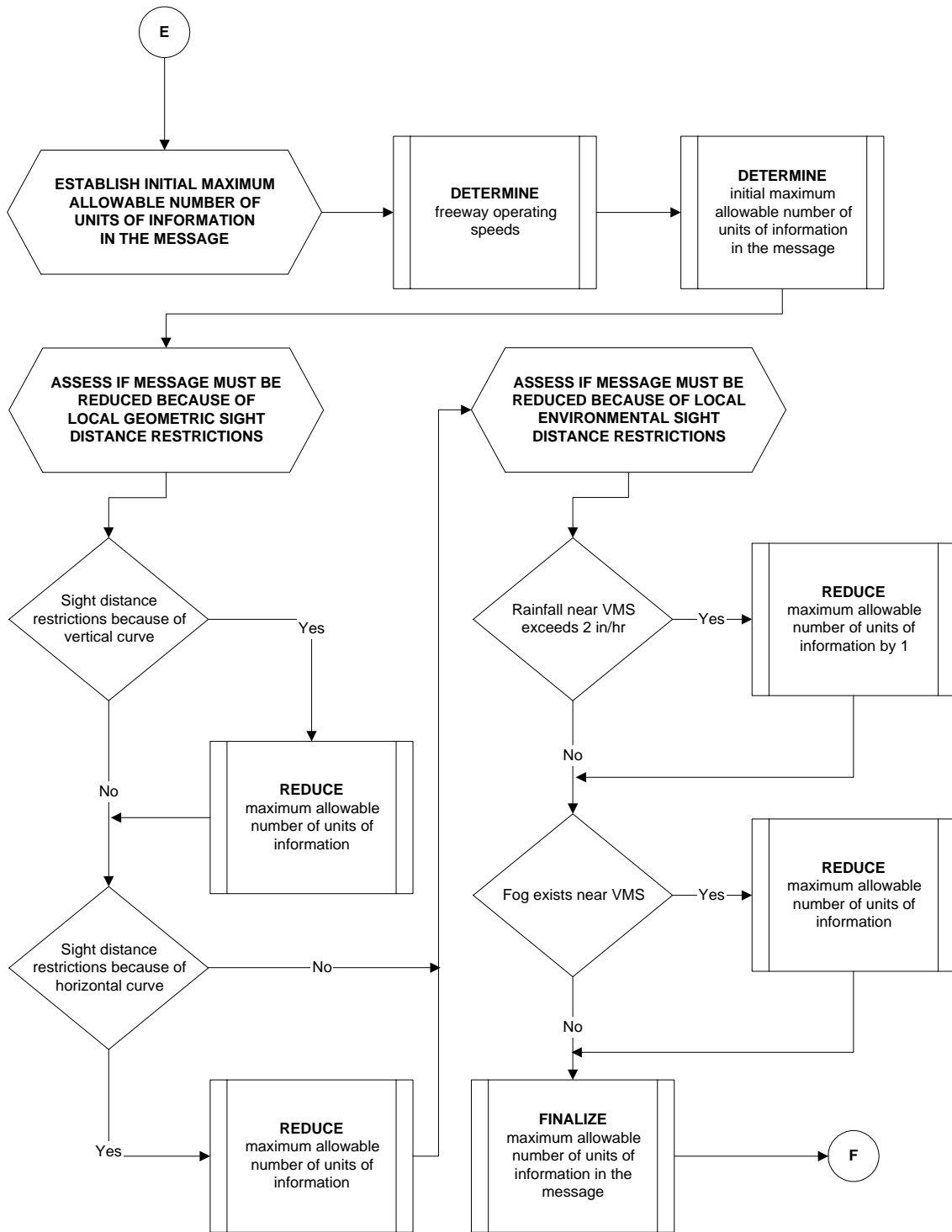
(a) Lane-Closure (Blockage)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



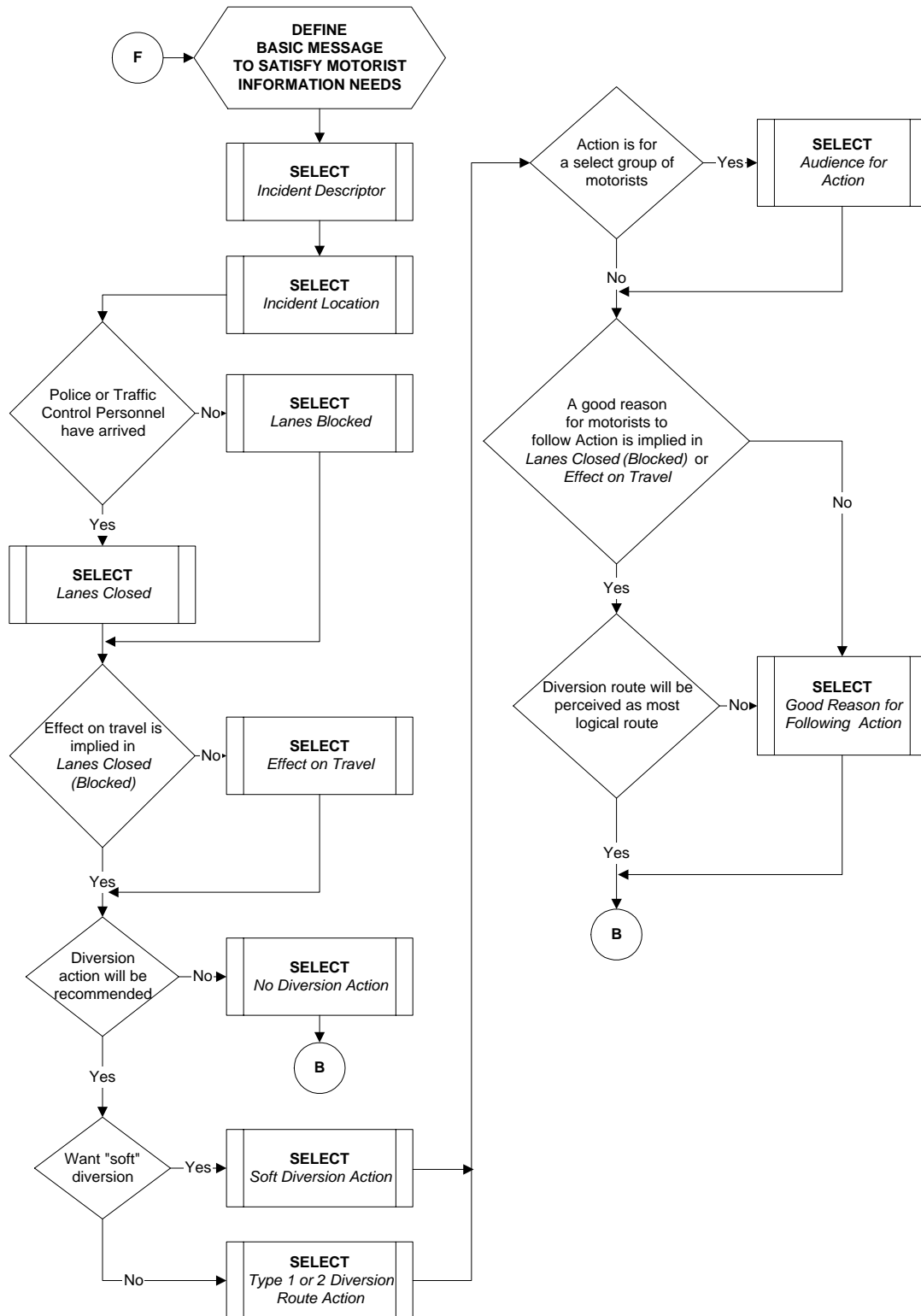
(a) Lane-Closure (Blockage)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



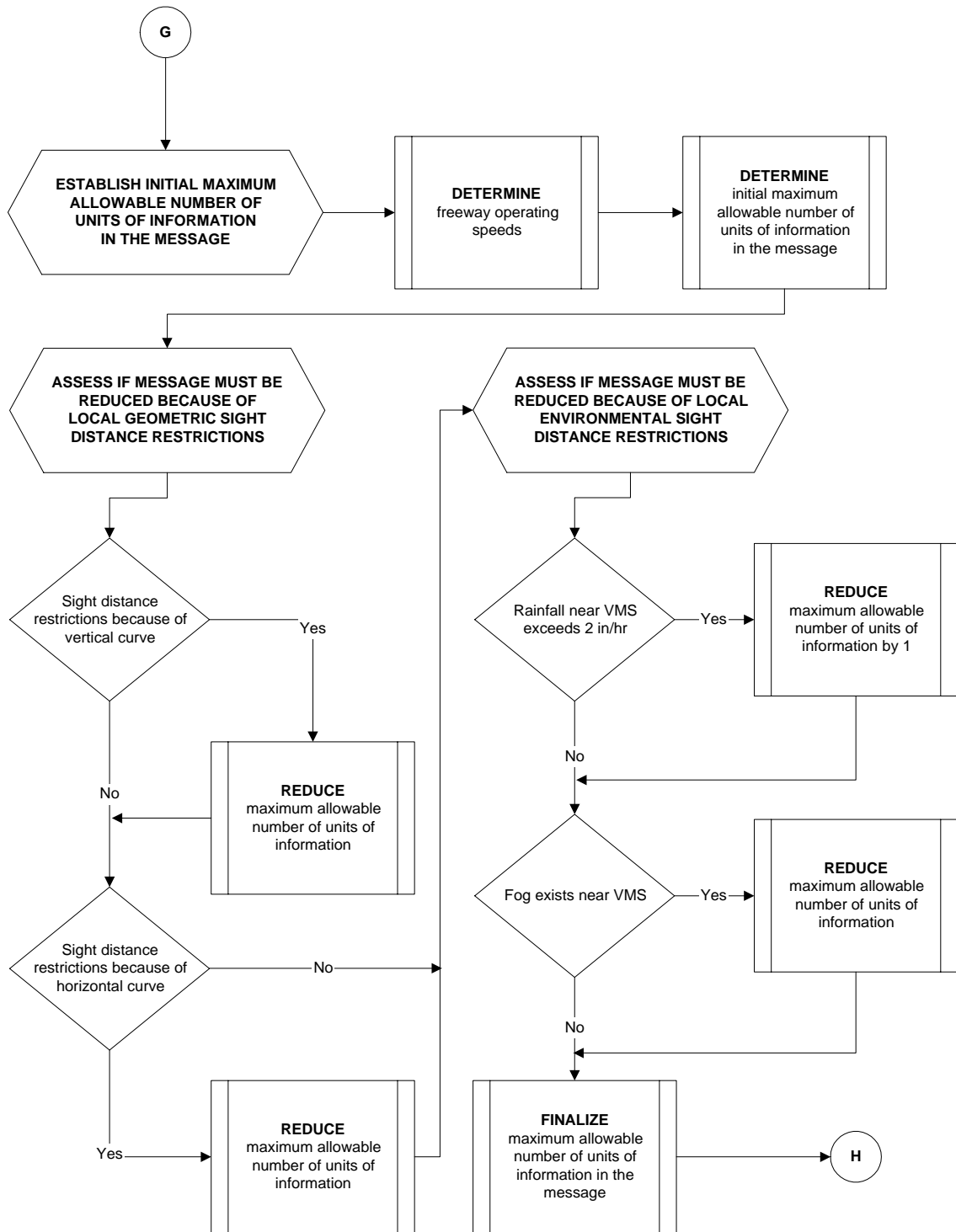
(a) Lane-Closure (Blockage)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



(a) Lane-Closure (Blockage)

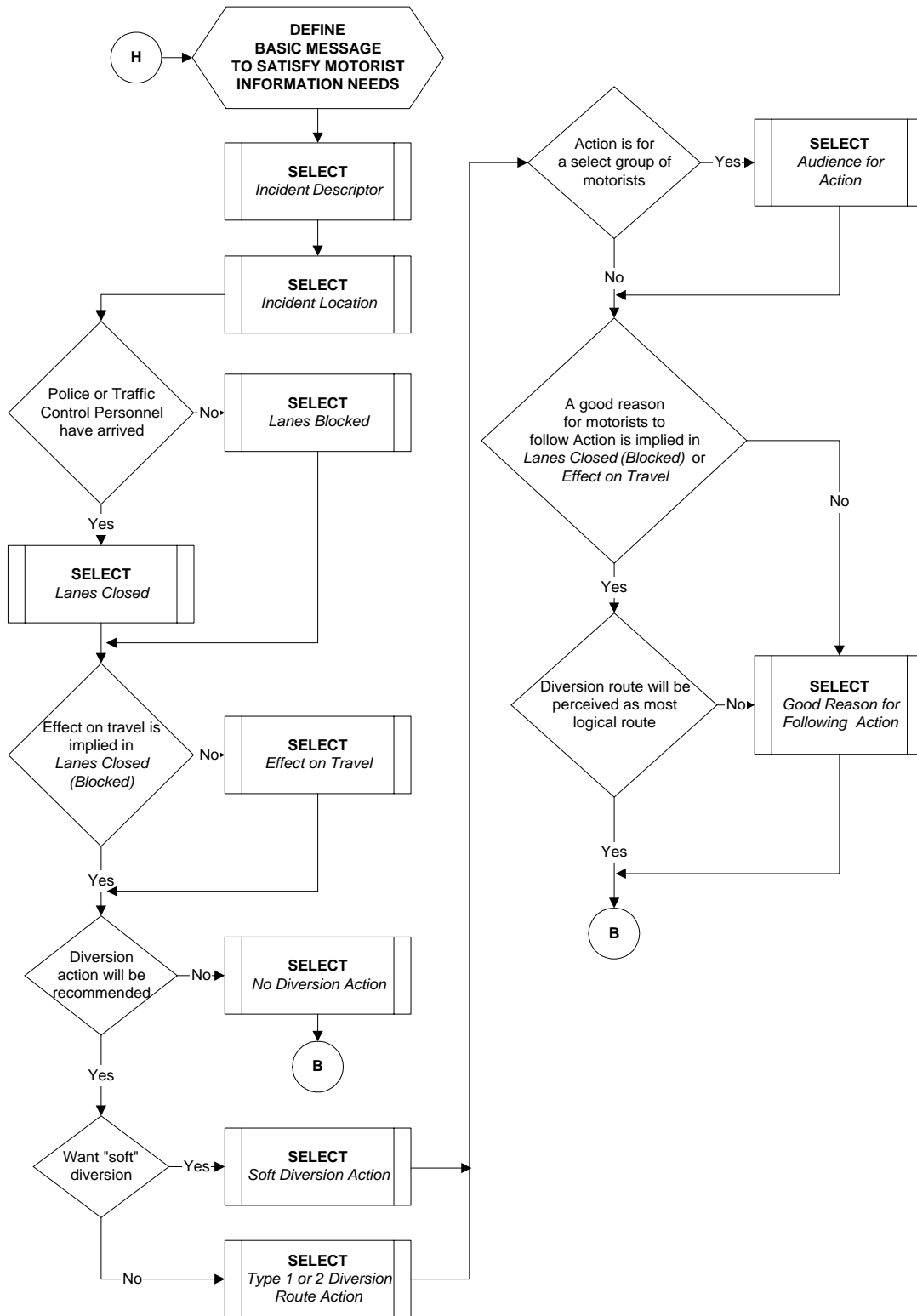
Figure A-1. CMS Message Design Flowchart for Incidents (continued)



(a) Lane-Closure (Blockage)

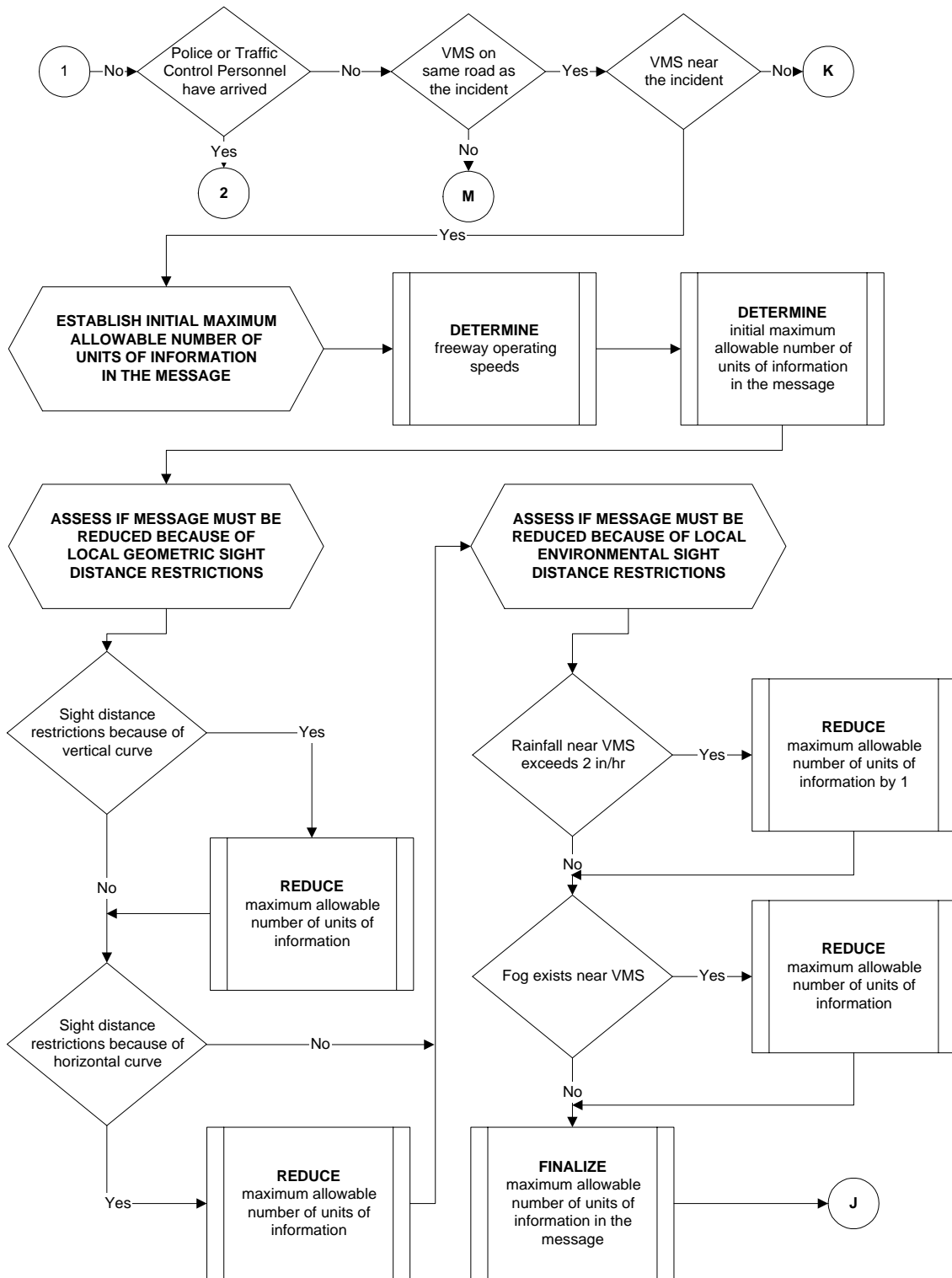
Figure A-1. CMS Message Design Flowchart for Incidents (continued)





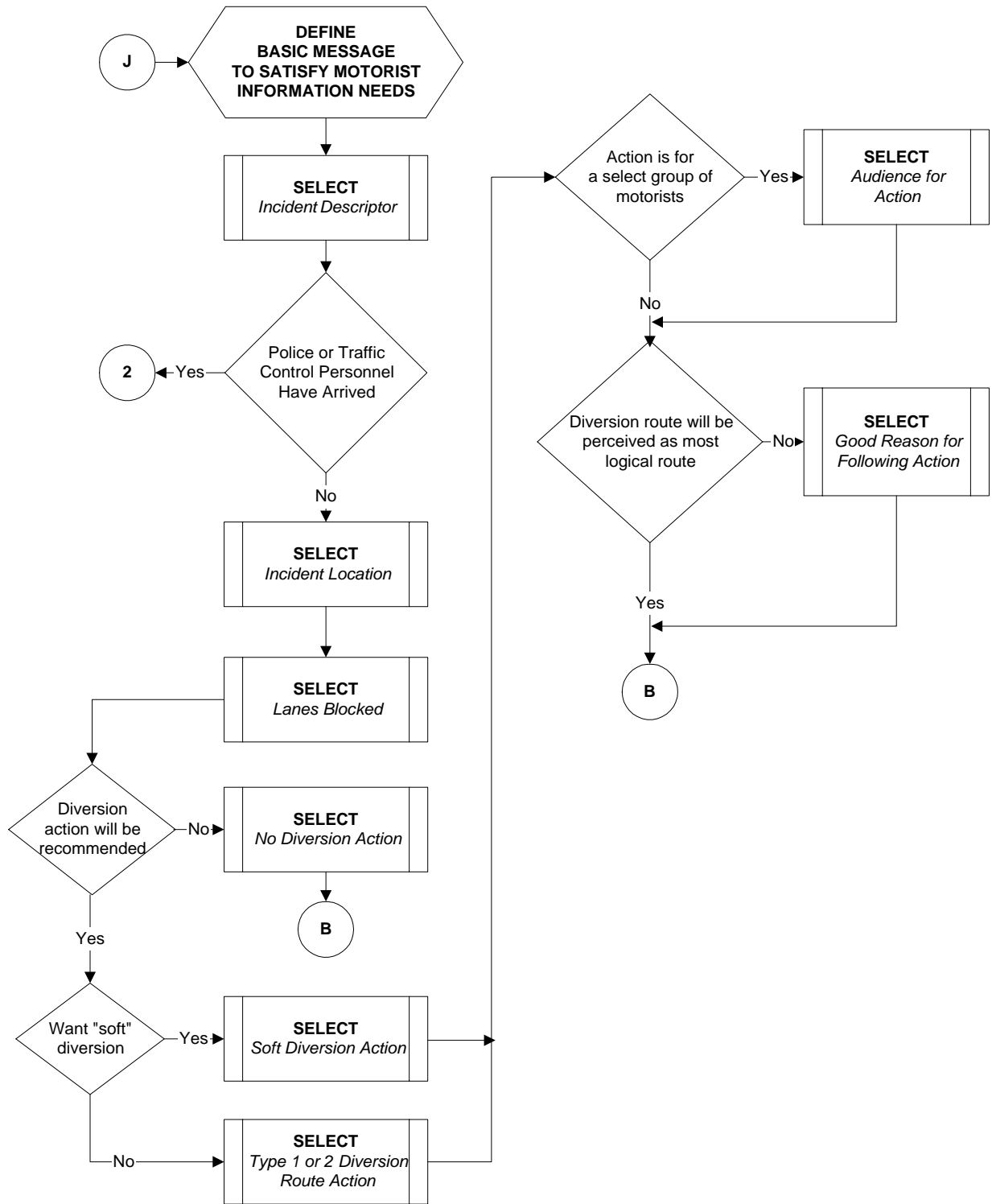
(a) Lane-Closure (Blockage)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



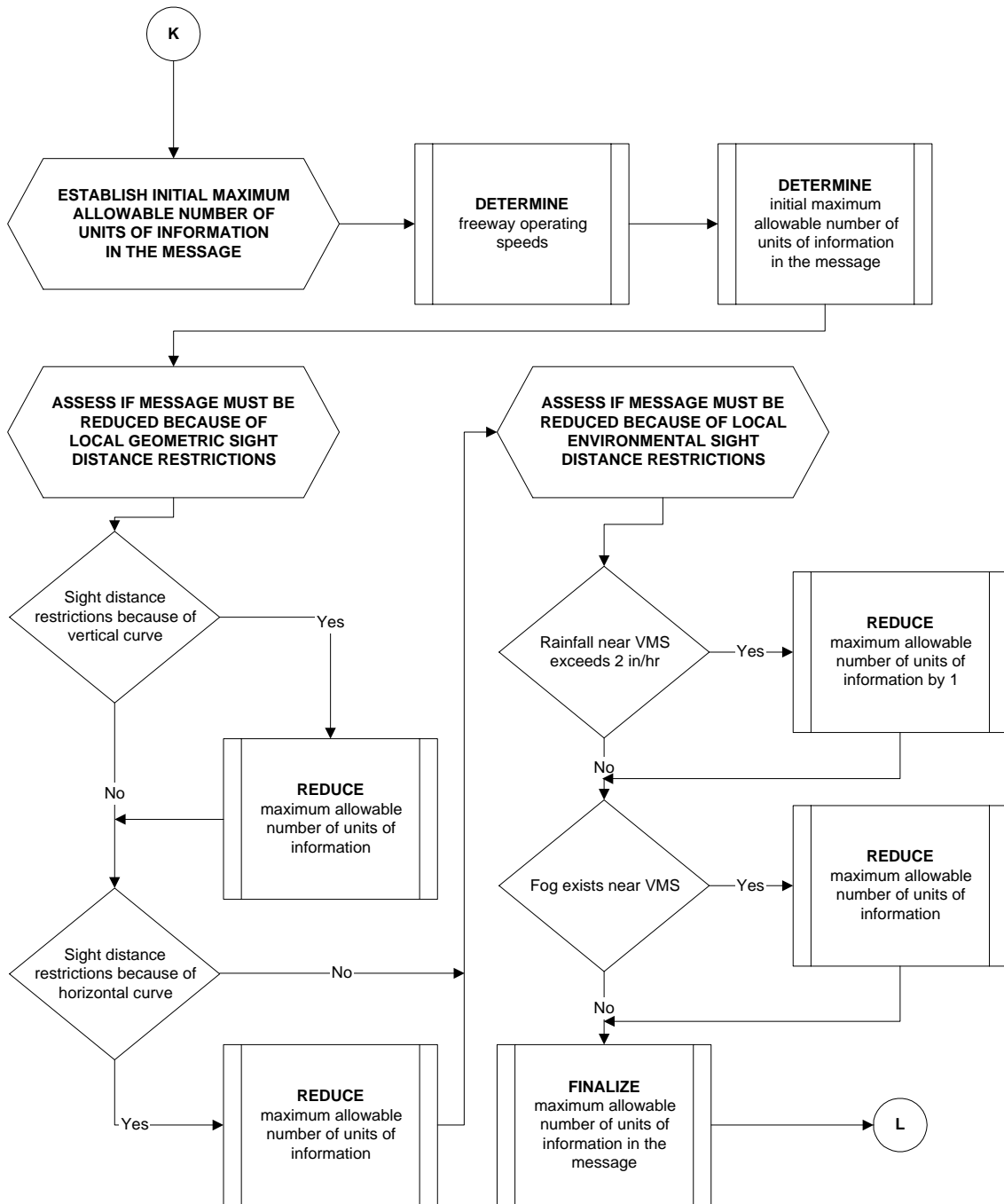
(b) All Lanes Closed (Blocked)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



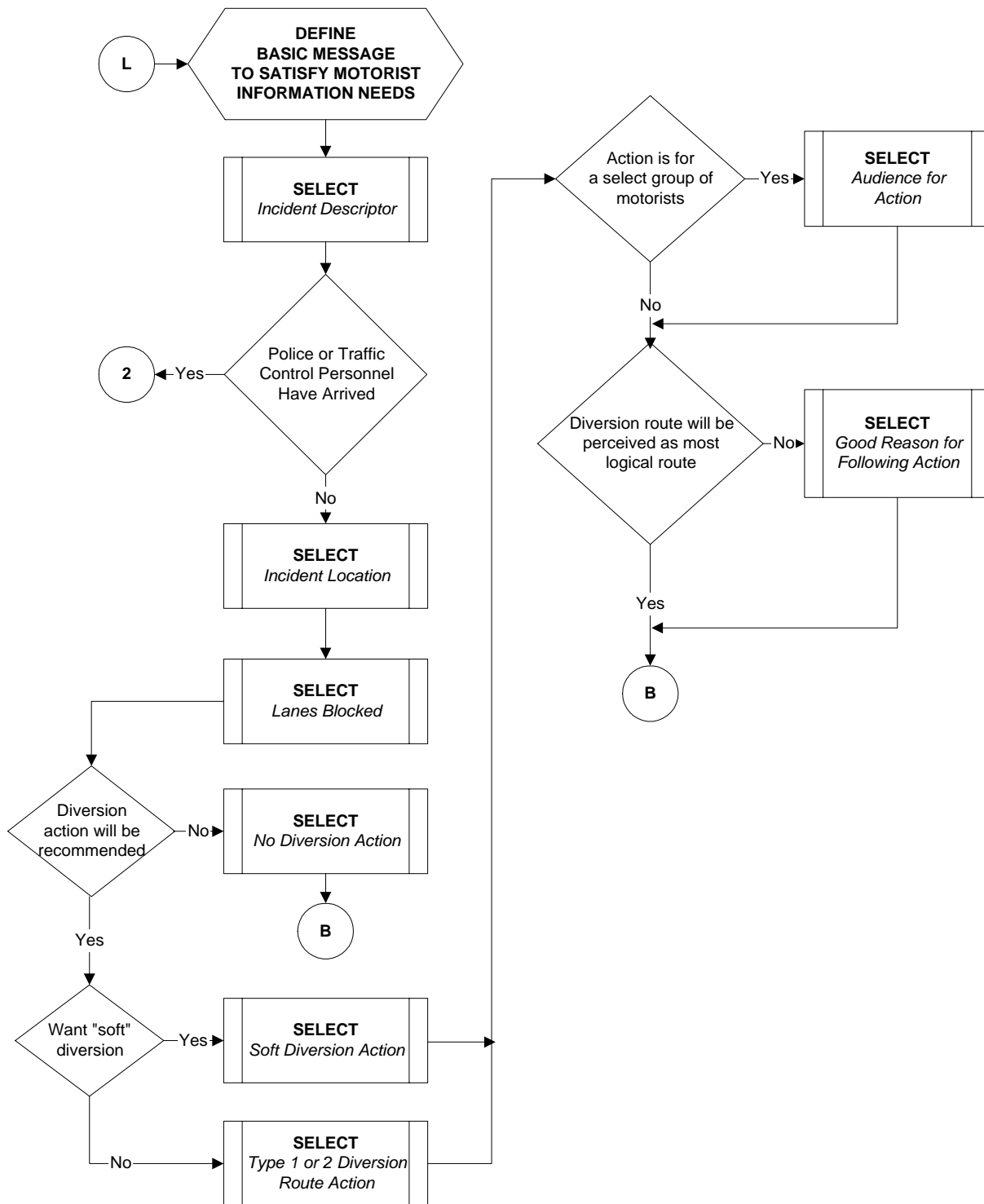
(b) All Lanes Closed (Blocked)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



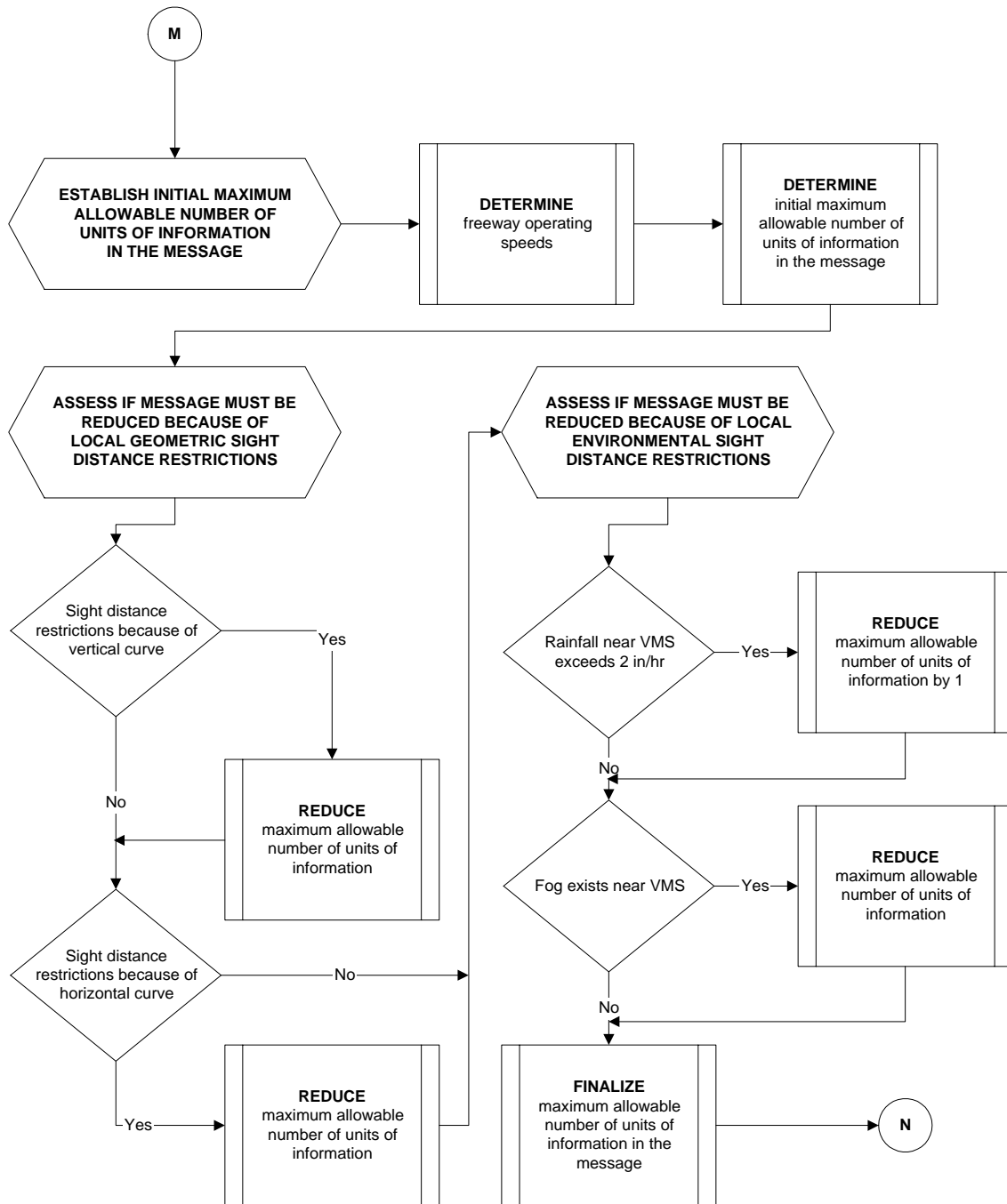
(b) All Lanes Closed (Blocked)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



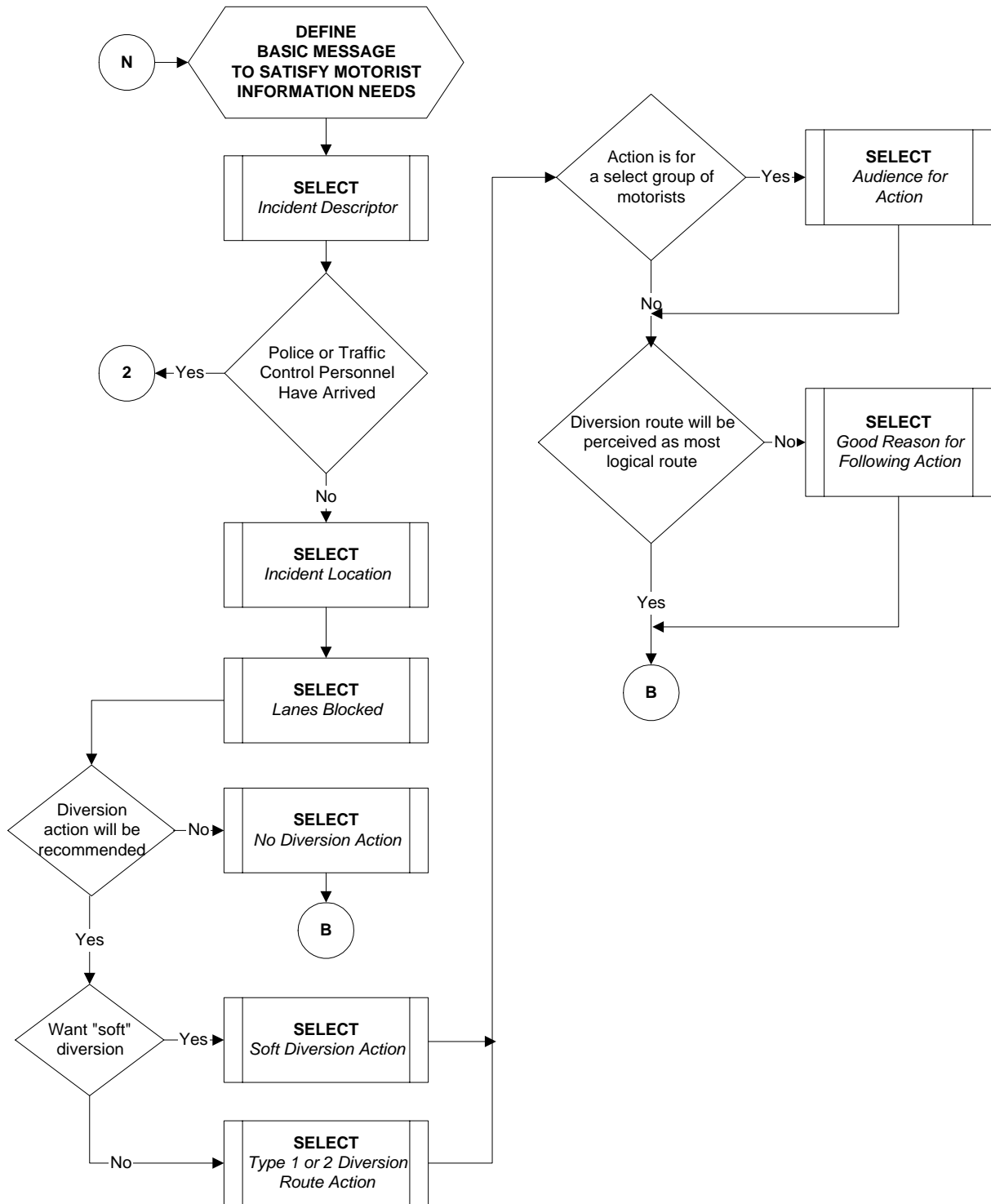
(b) All Lanes Closed (Blocked)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



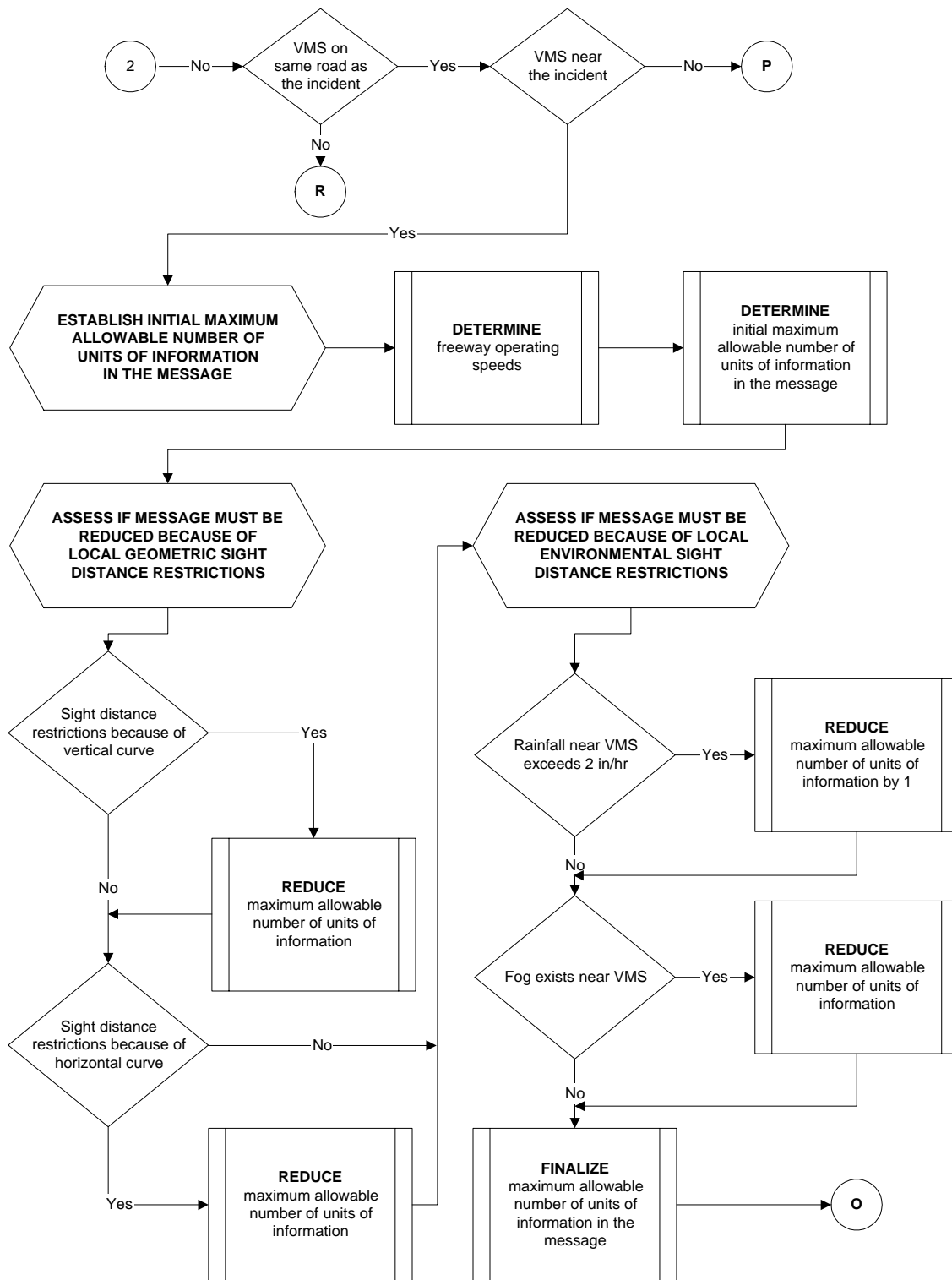
(b) All Lanes Closed (Blocked)

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



(b) All Lanes Closed (Blocked)

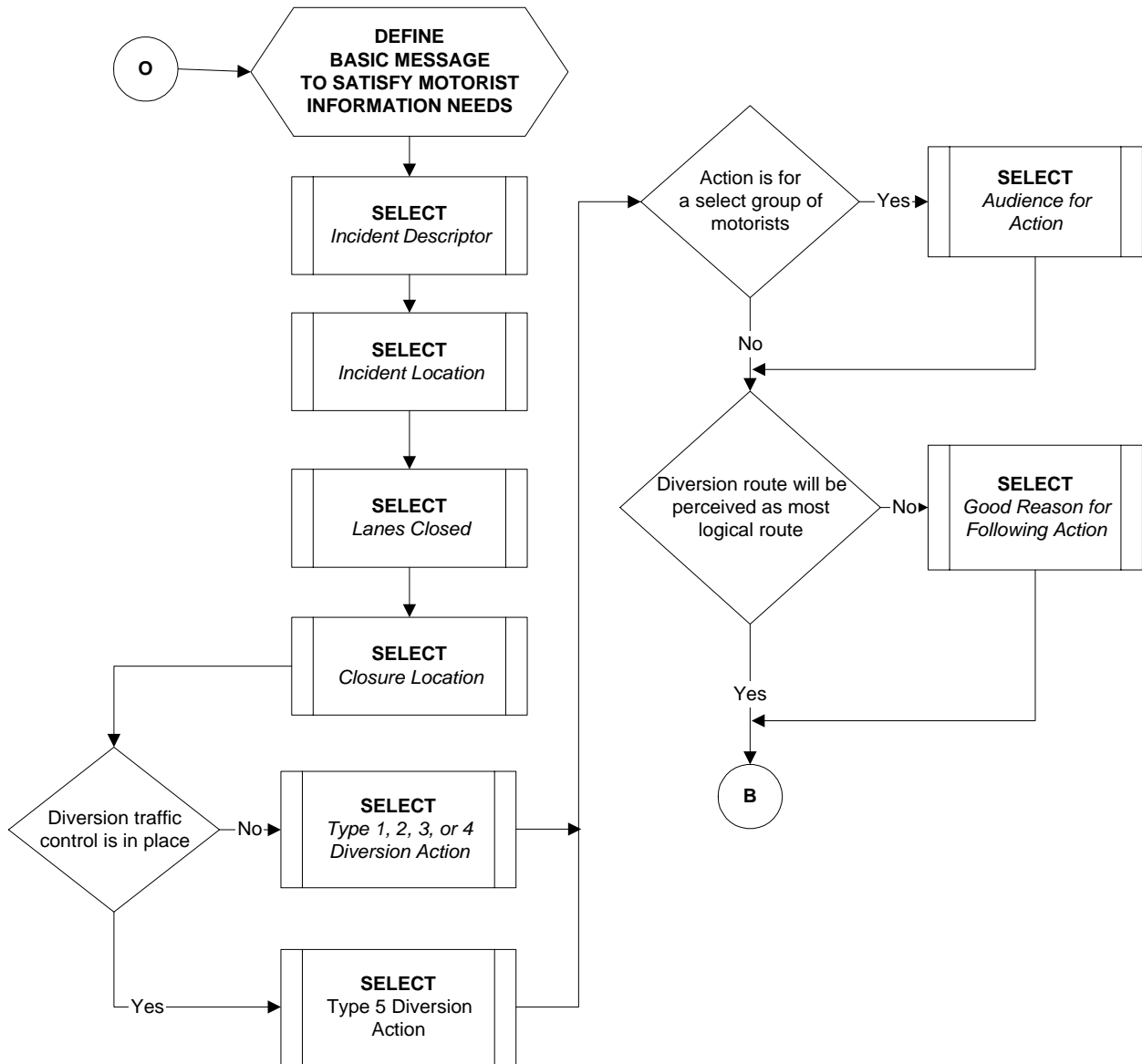
Figure A-1. CMS Message Design Flowchart for Incidents (continued)



(c) Closing the Freeway

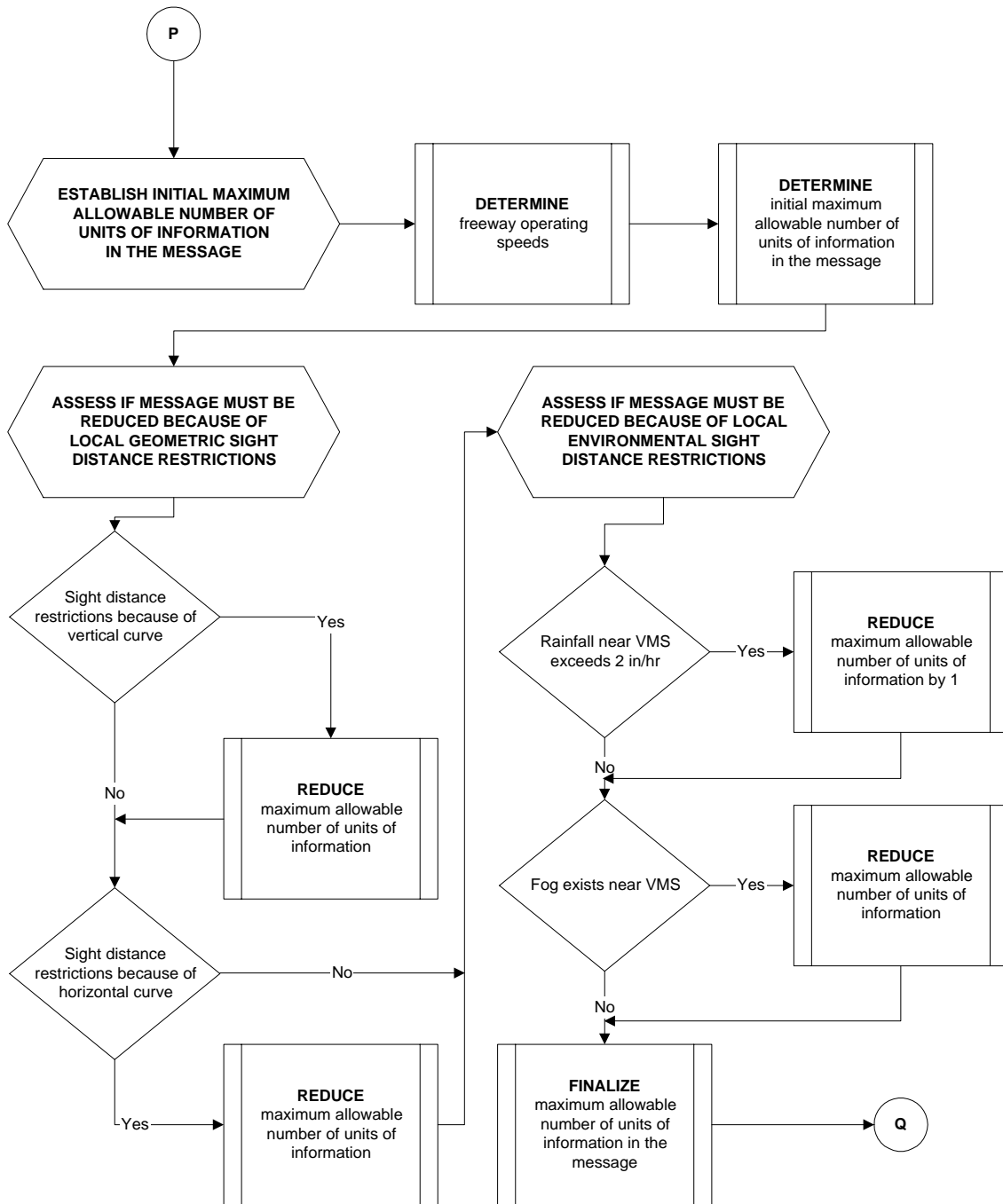
Figure A-1. CMS Message Design Flowchart for Incidents (continued)





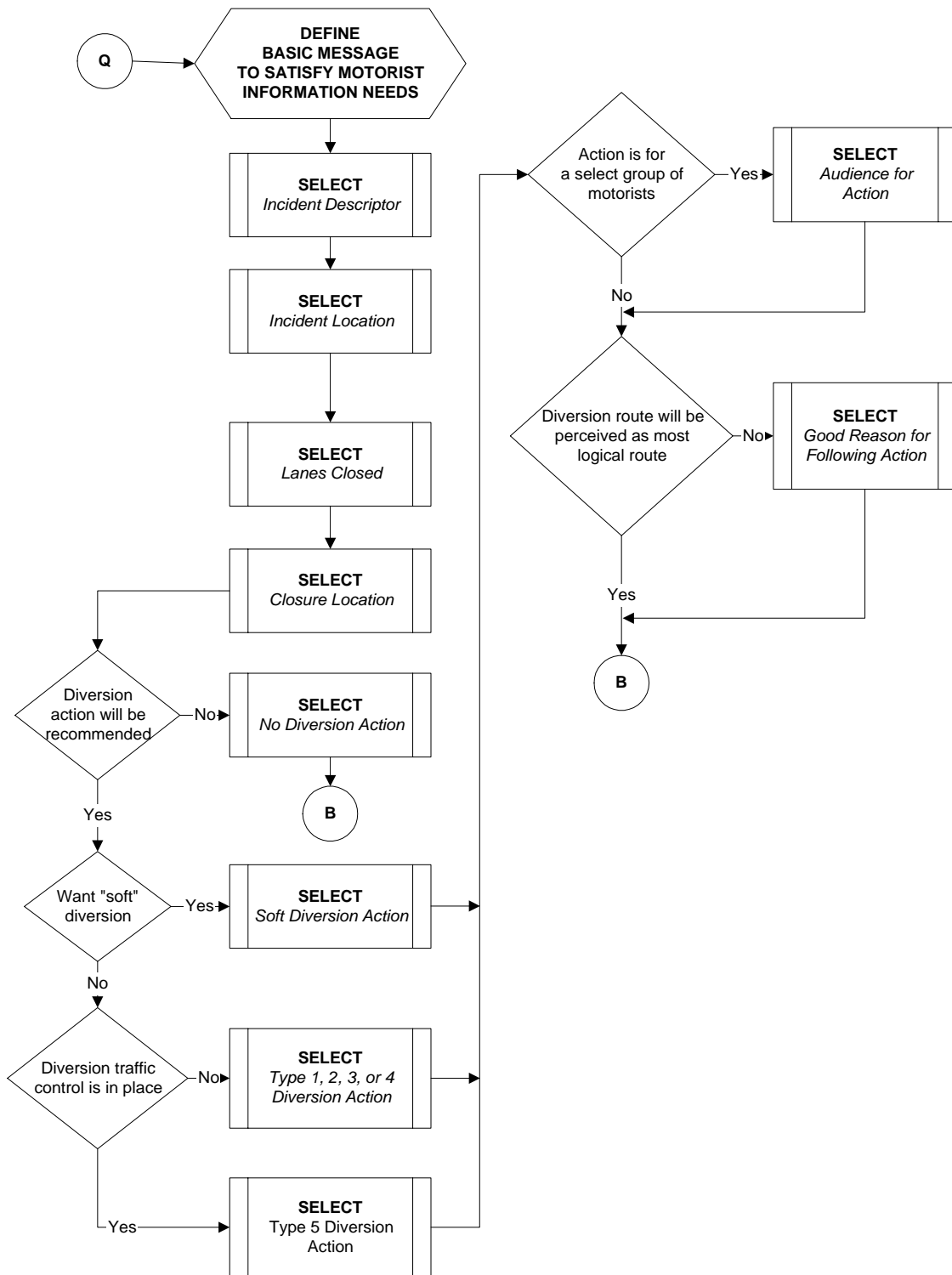
(c) Closing the Freeway

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



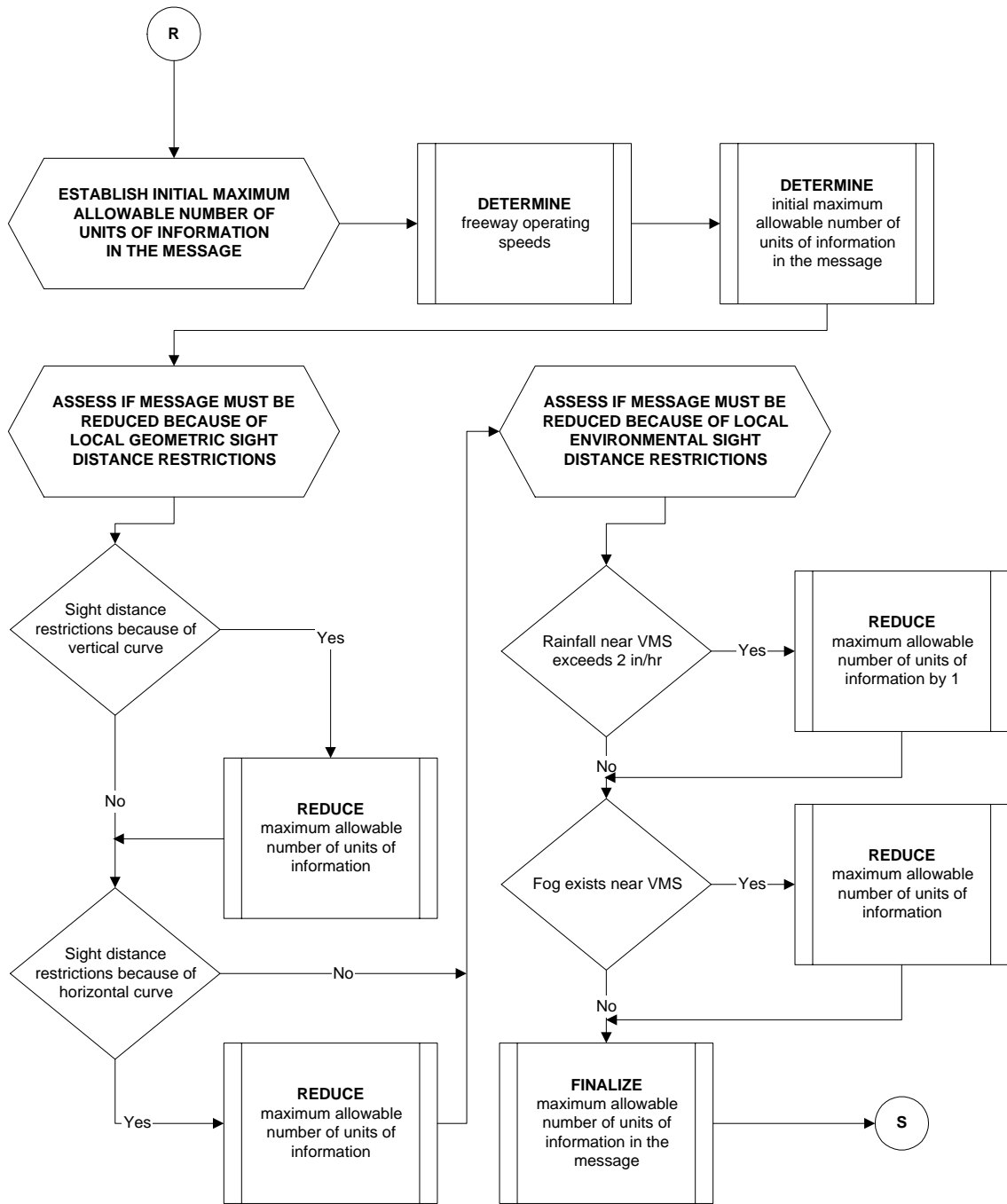
(c) Closing the Freeway

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



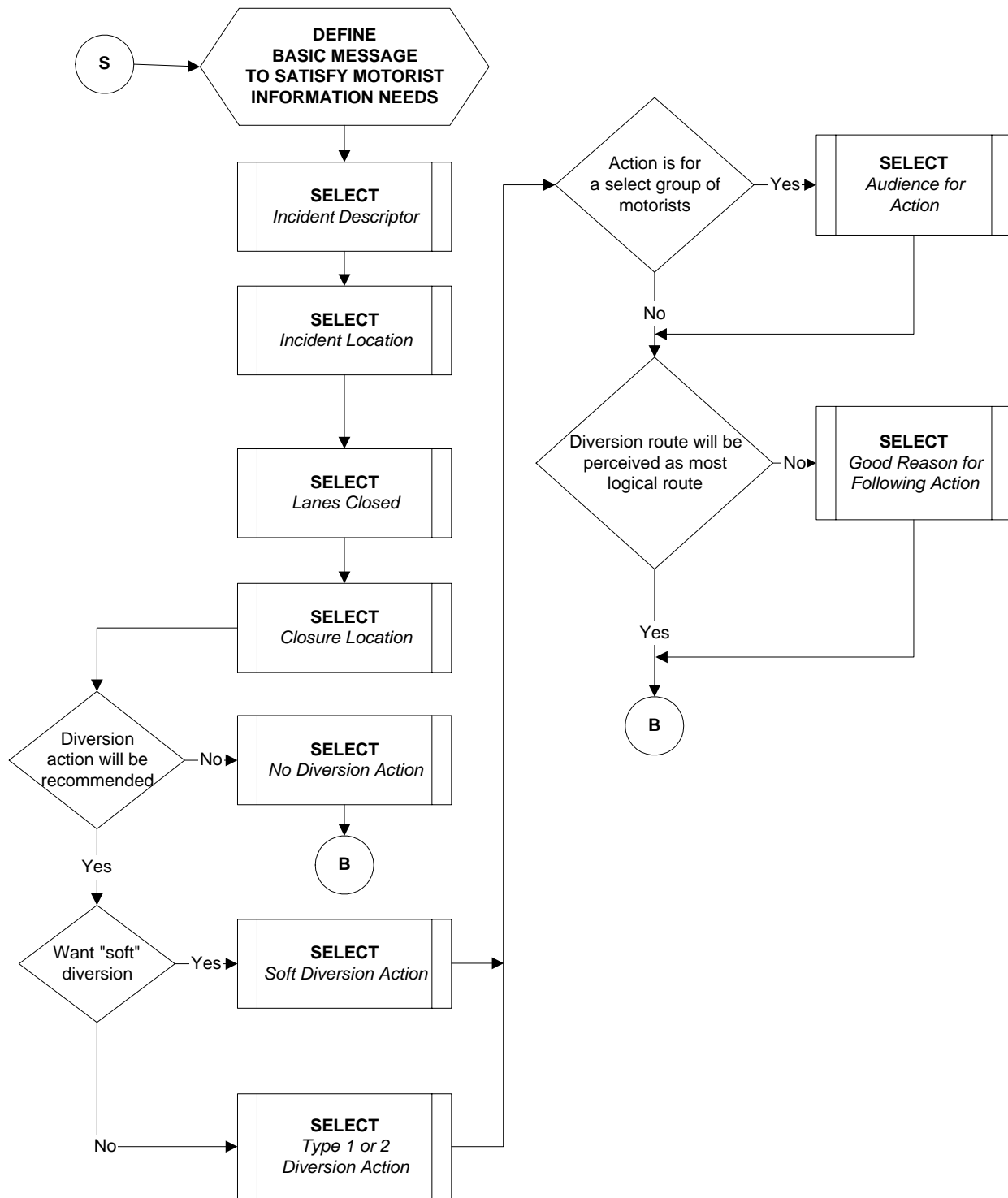
(c) Closing the Freeway

Figure A-1. CMS Message Design Flowchart for Incidents (continued)



(c) Closing the Freeway

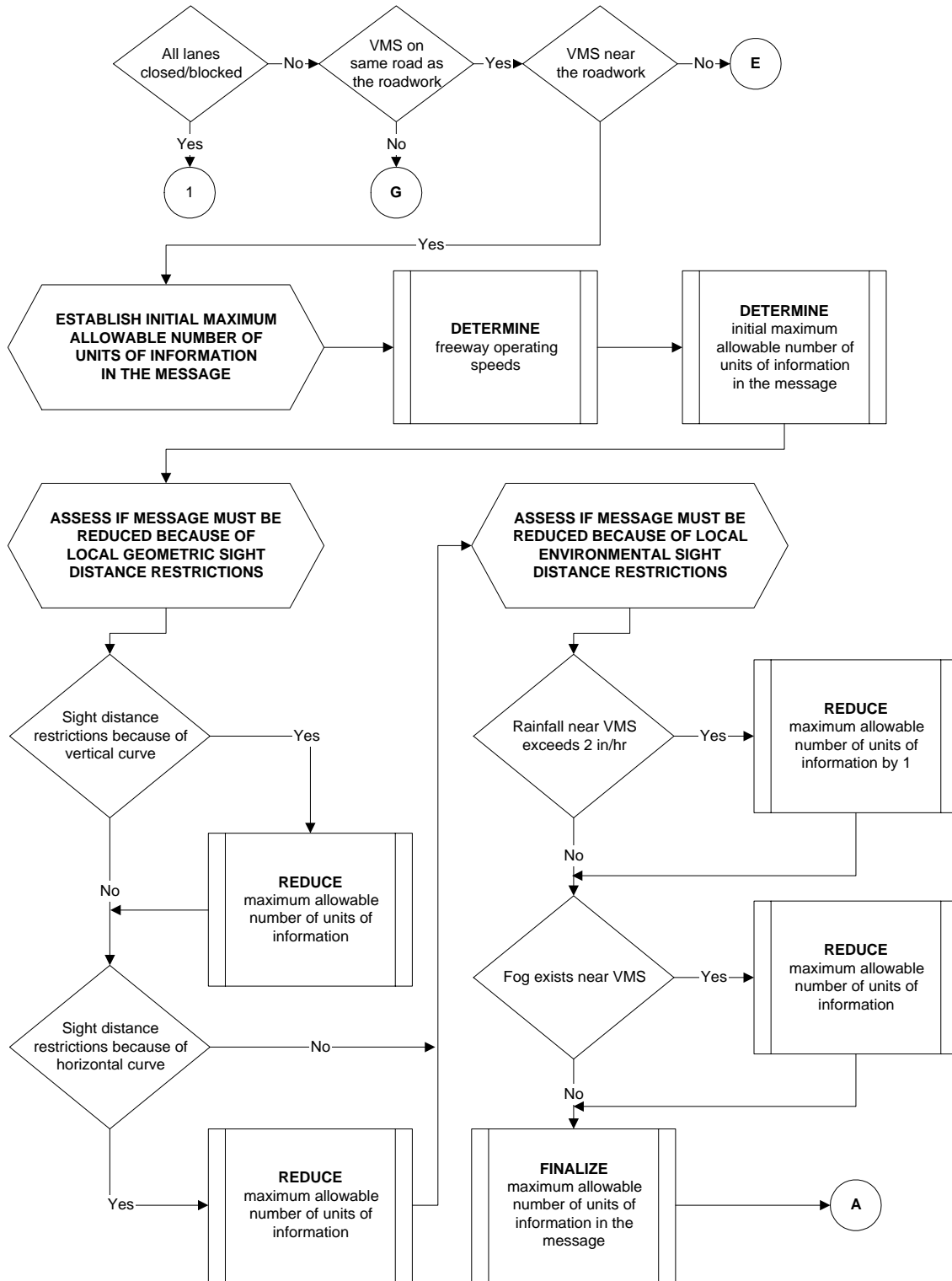
Figure A-1. CMS Message Design Flowchart for Incidents (continued)



(c) Closing the Freeway

Figure A-1. CMS Message Design Flowchart for Incidents (continued)

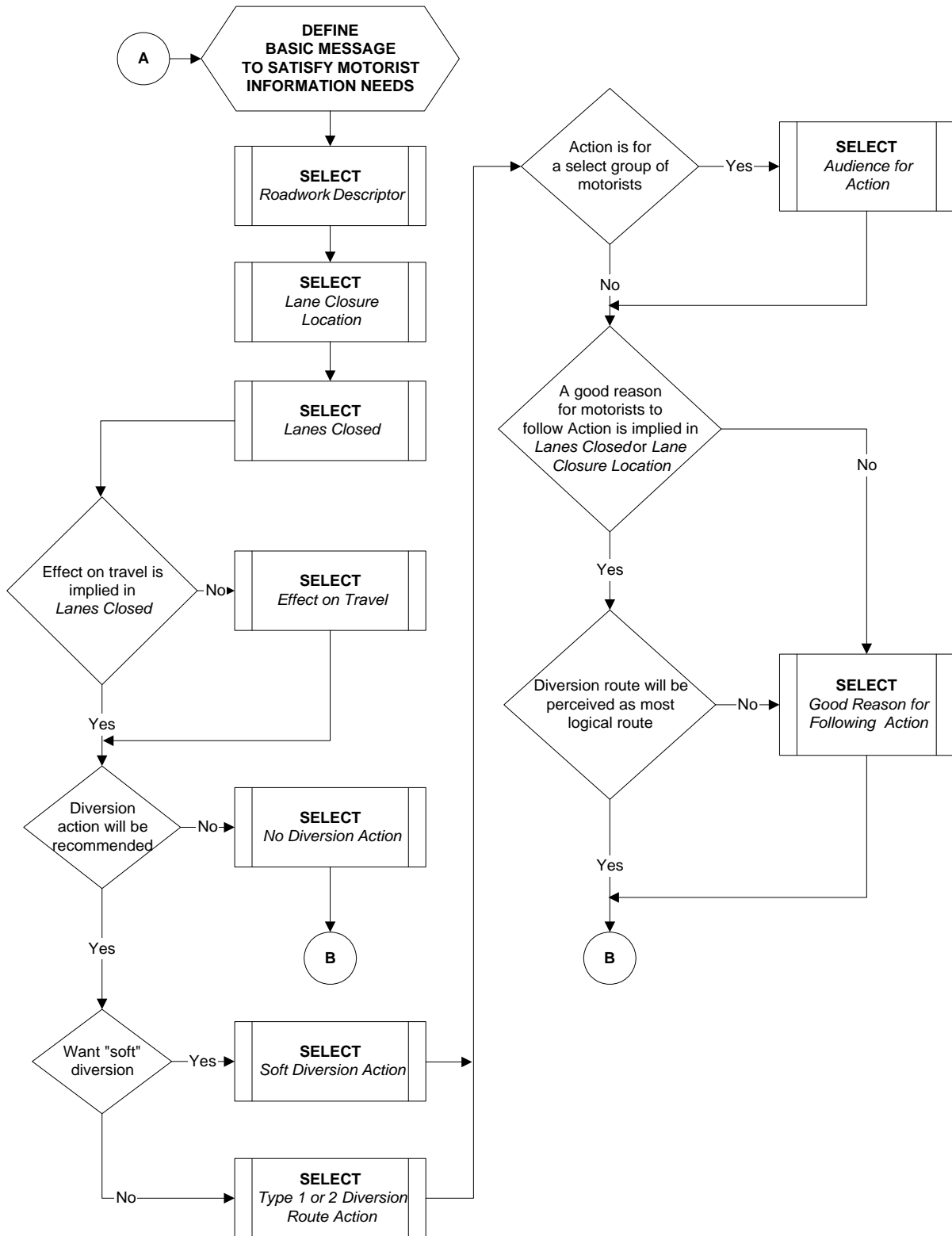
# APPENDIX B - CMS MESSAGE DESIGN PROCESS: ROADWORK



(a) R

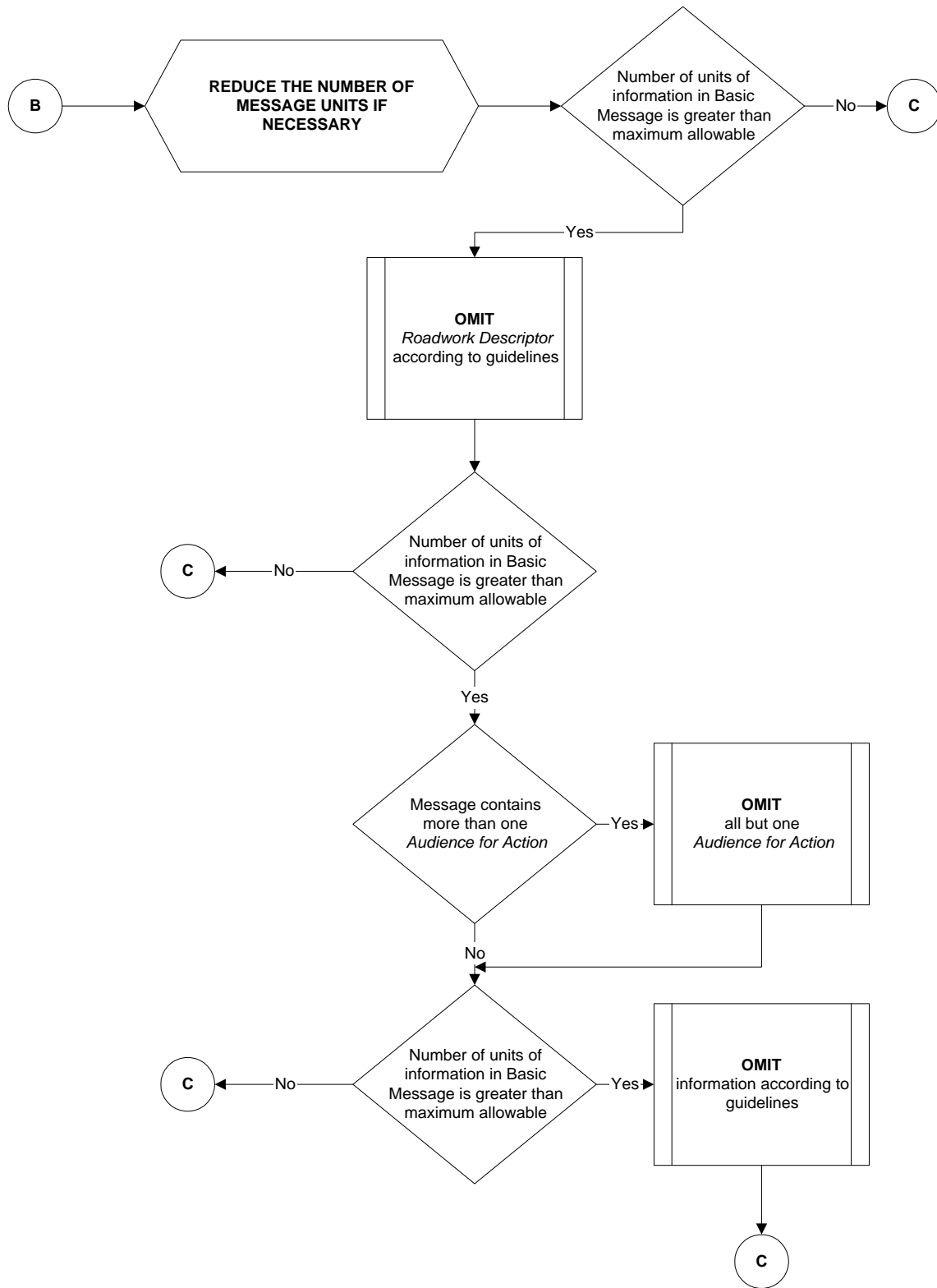
requiring Lane Closure(s)

Figure B-1. CMS Message Design Flowchart for Roadwork



(a) Requiring Lane Closure(s)

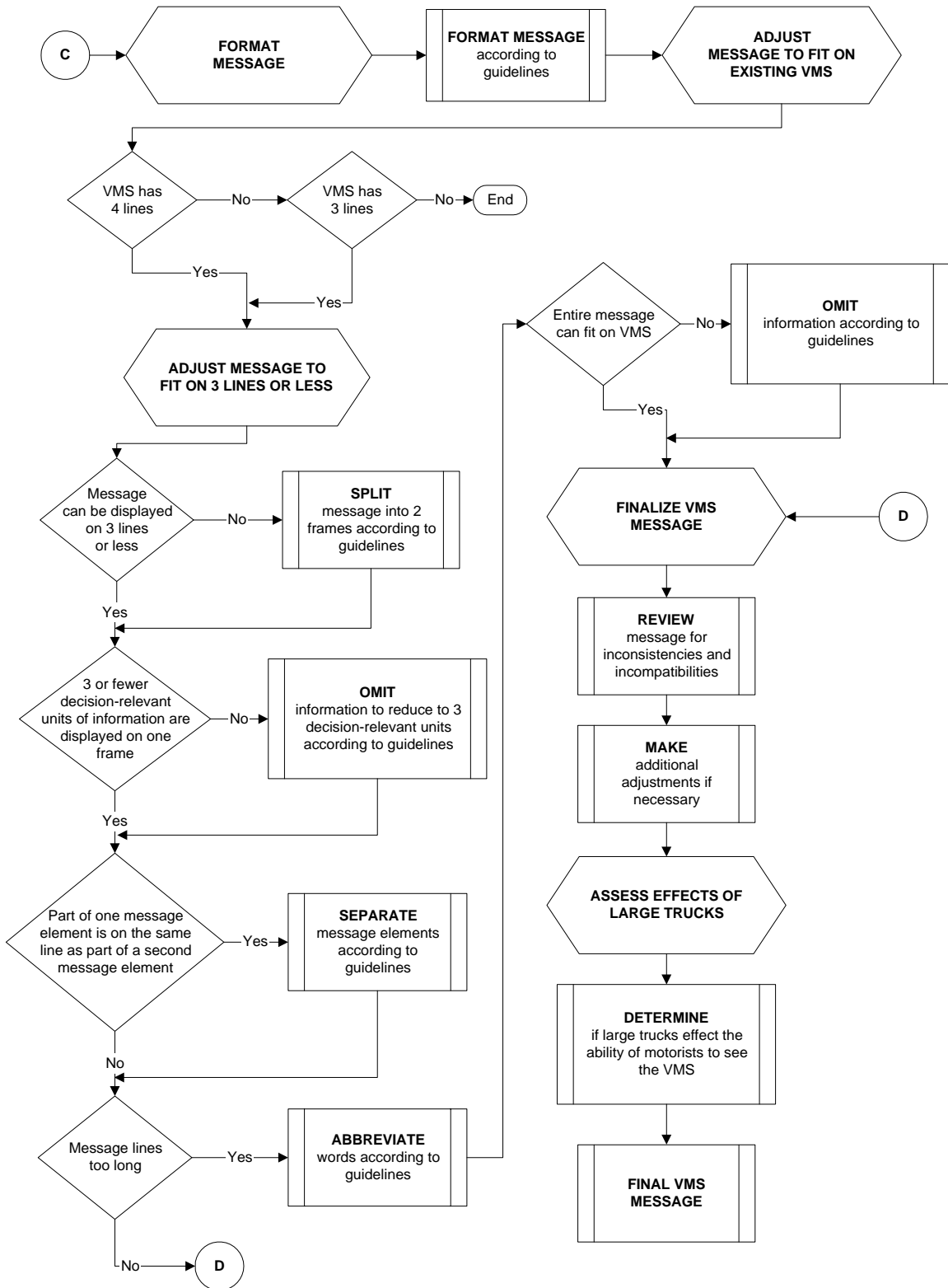
Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



(a) Requiring Lane Closure(s)

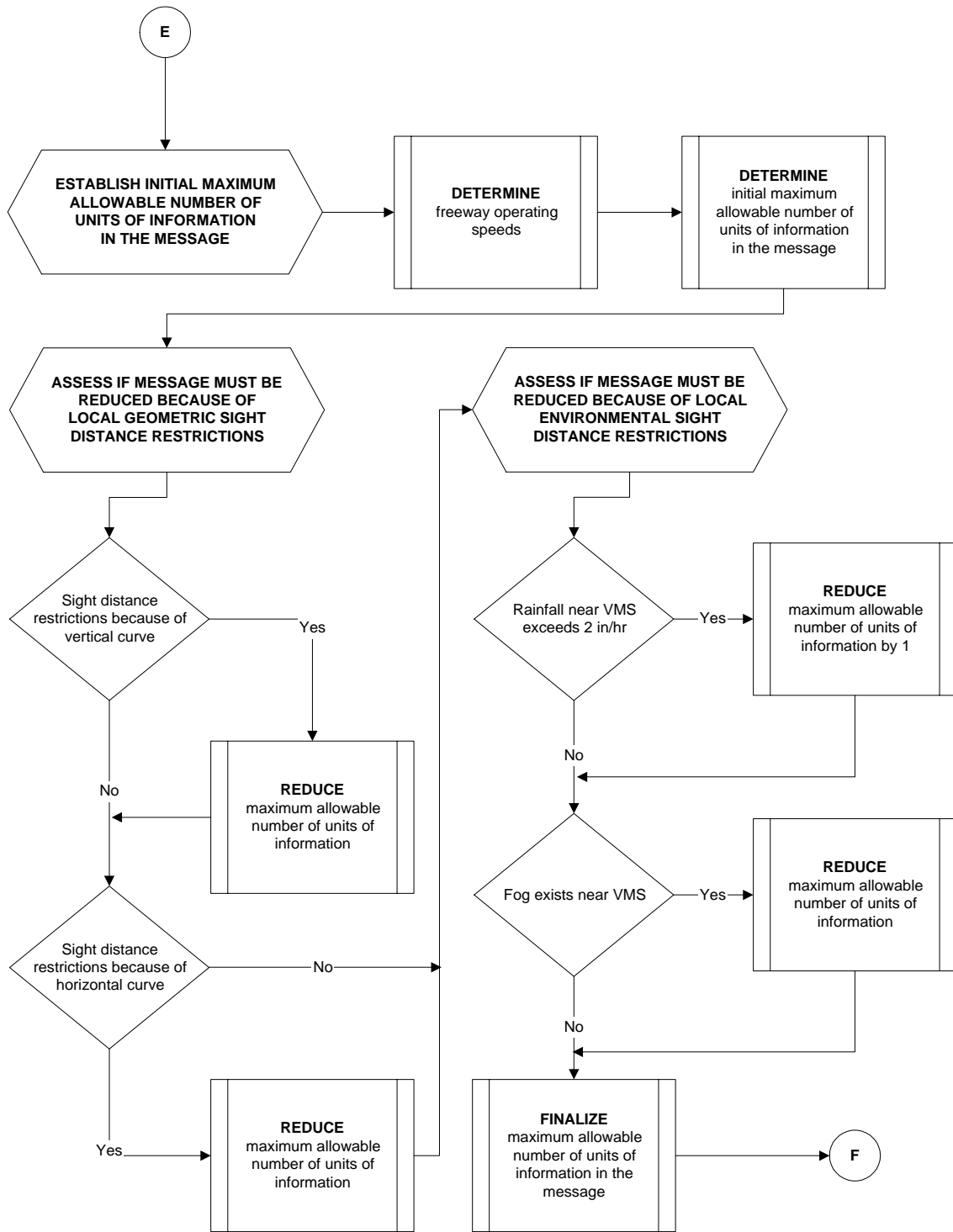
Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)





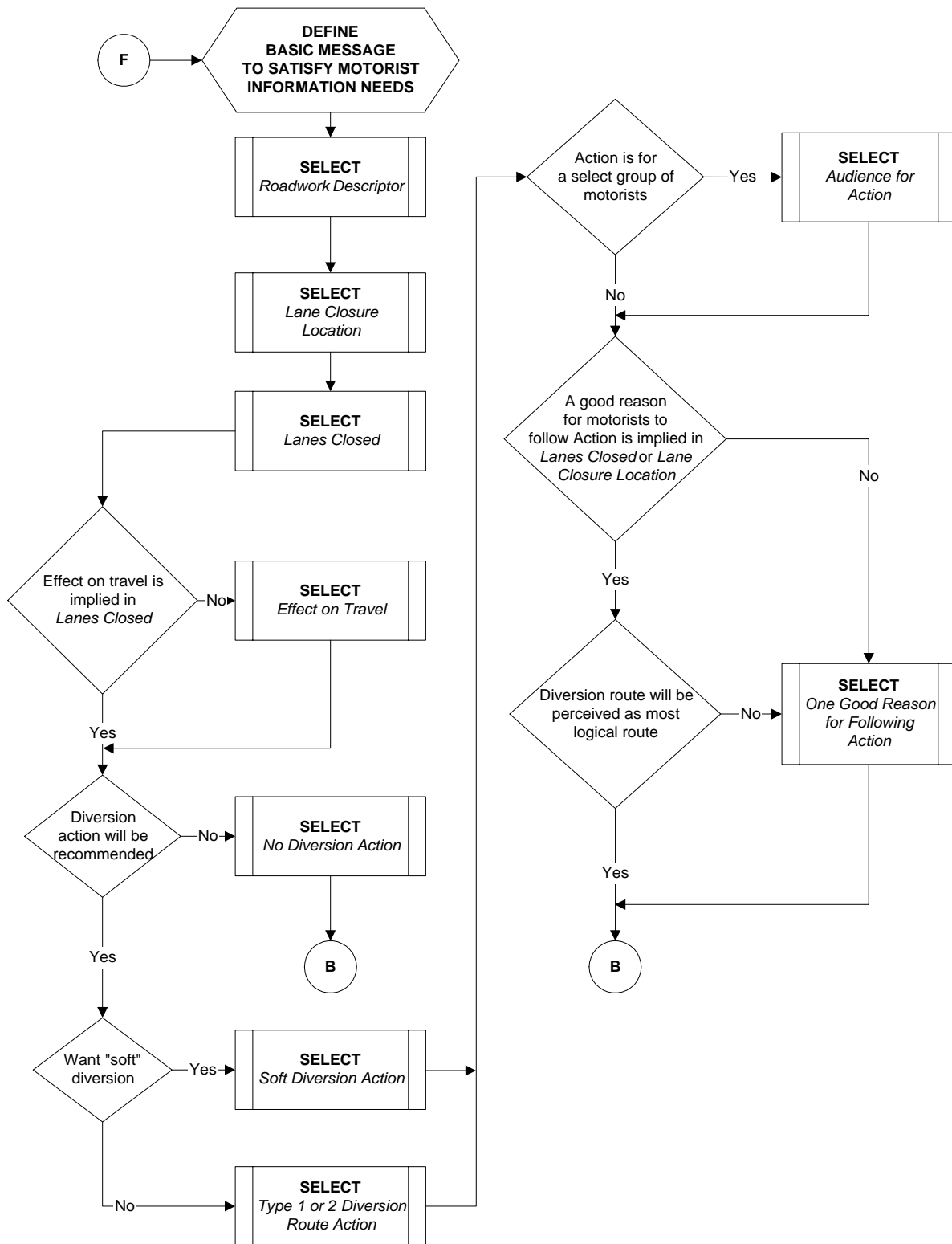
(a) Requiring Lane Closure(s)

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



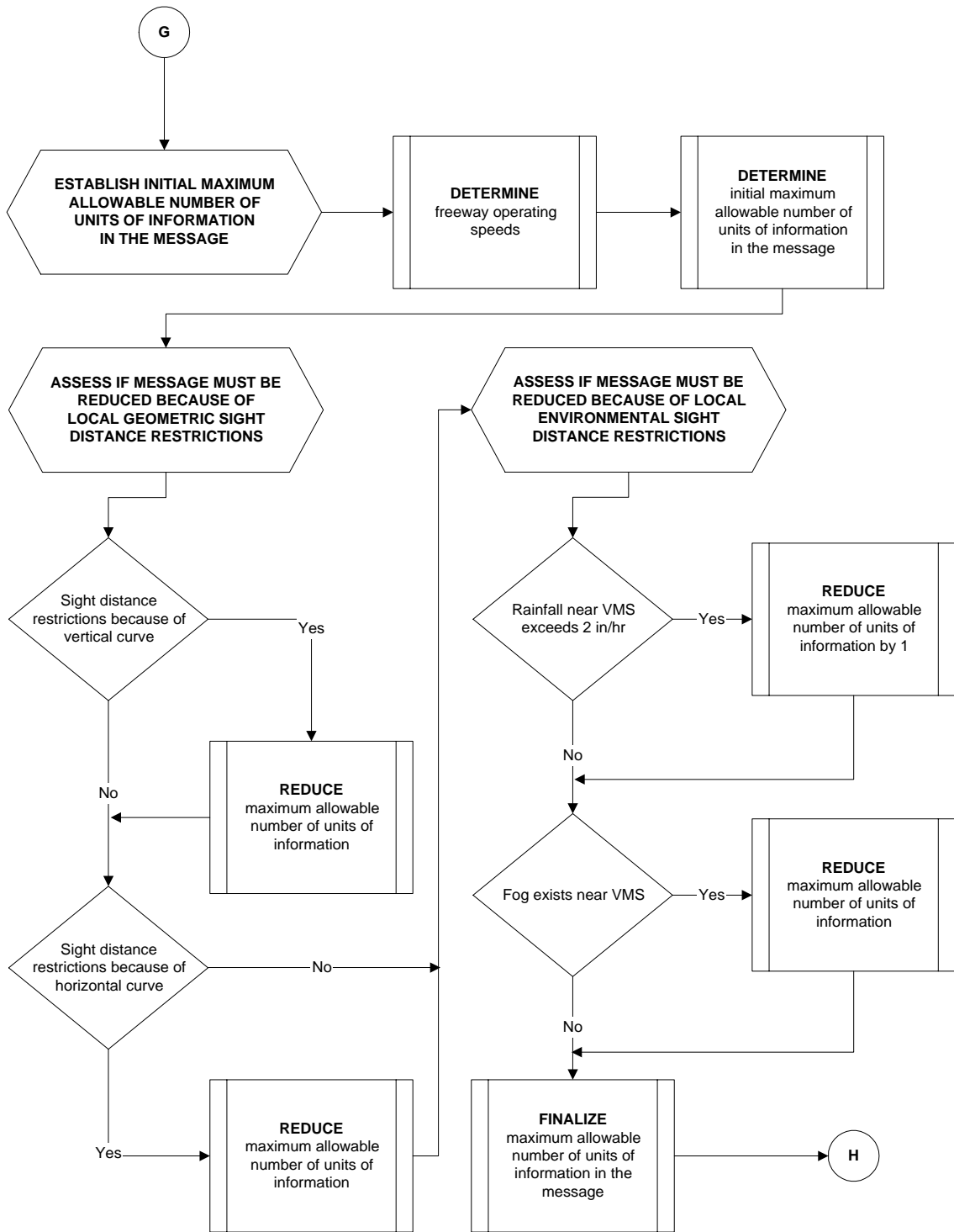
(a) Requiring Lane Closure(s)

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



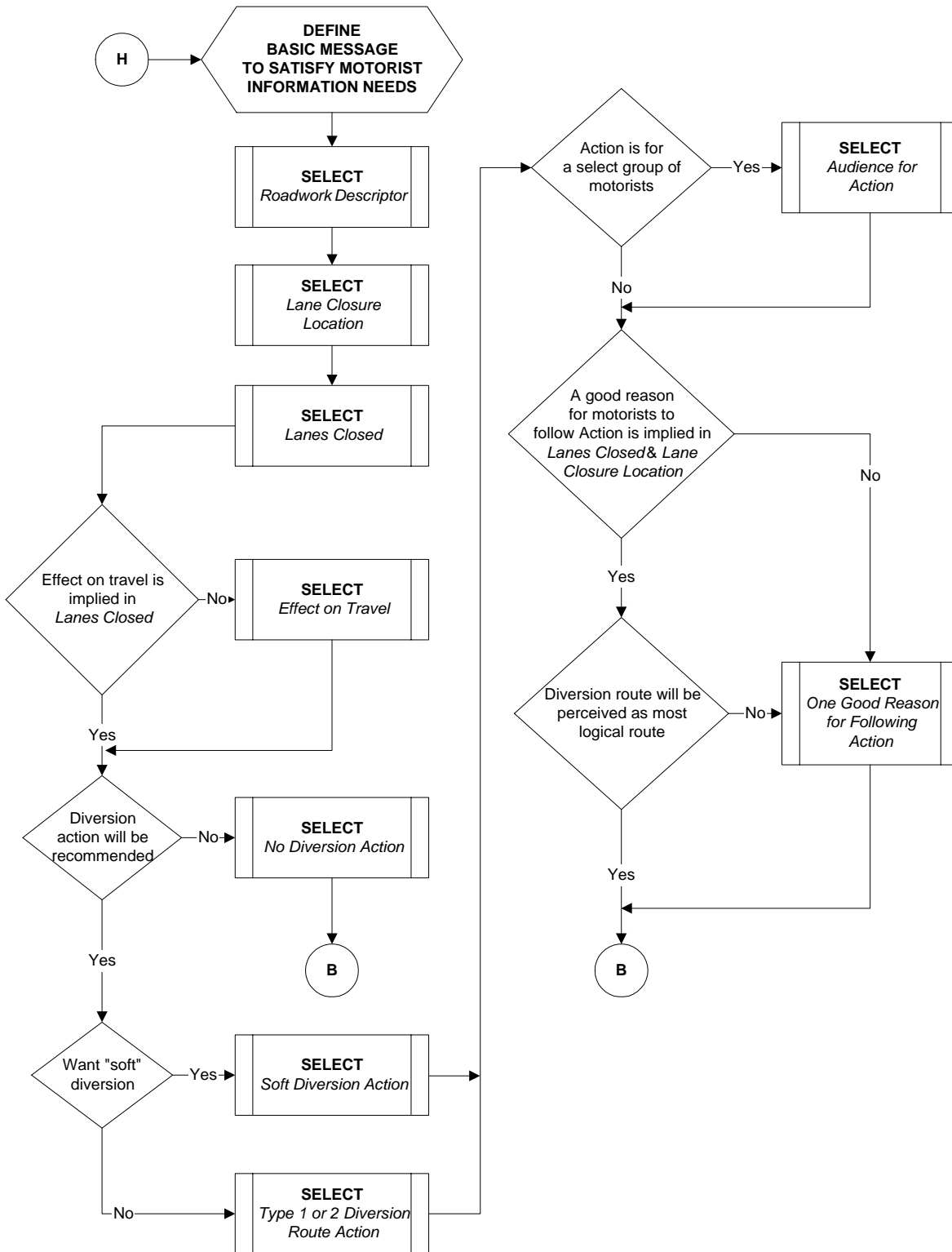
(a) Requiring Lane Closure(s)

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



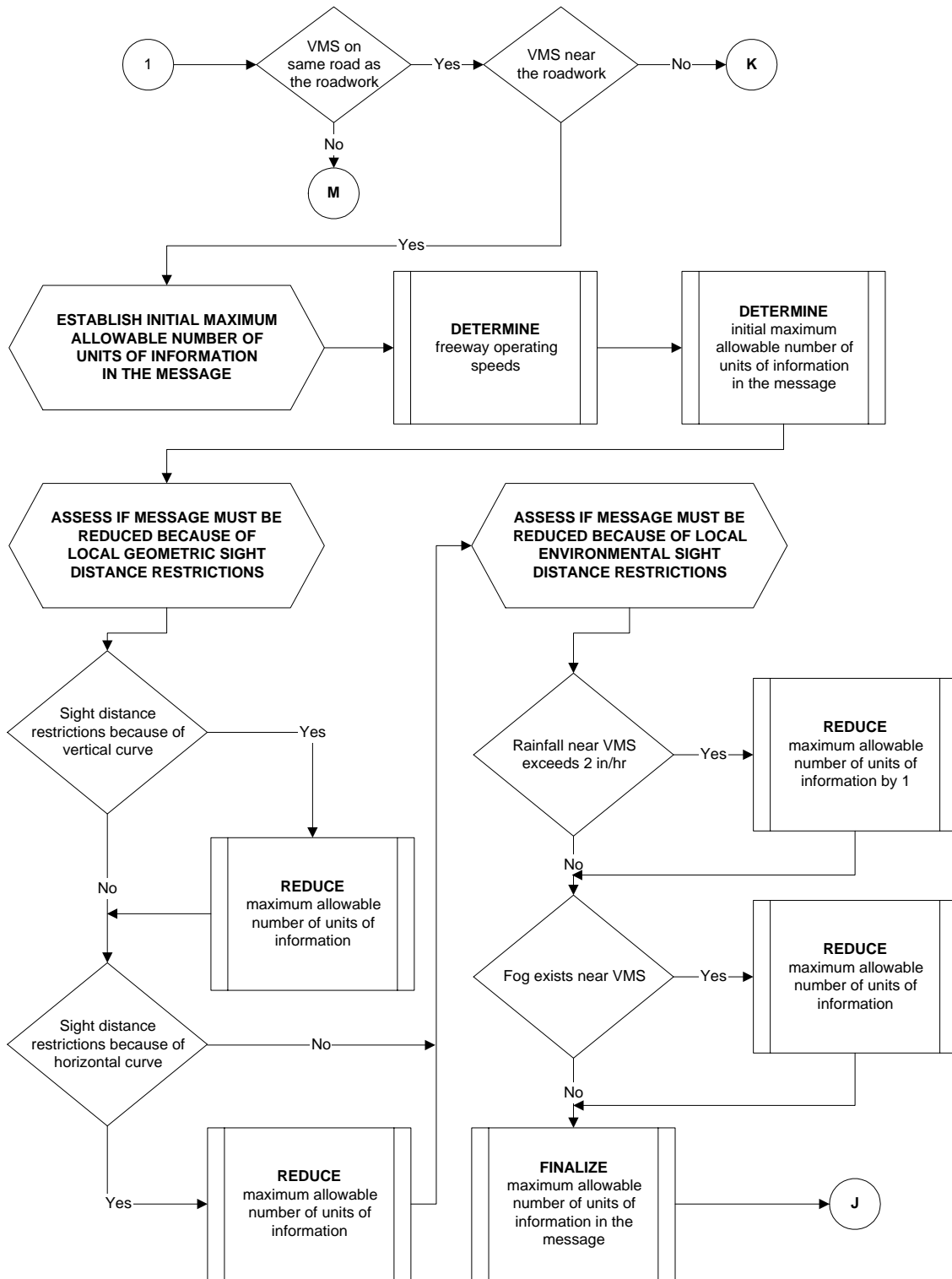
(a) Requiring Lane Closure(s)

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



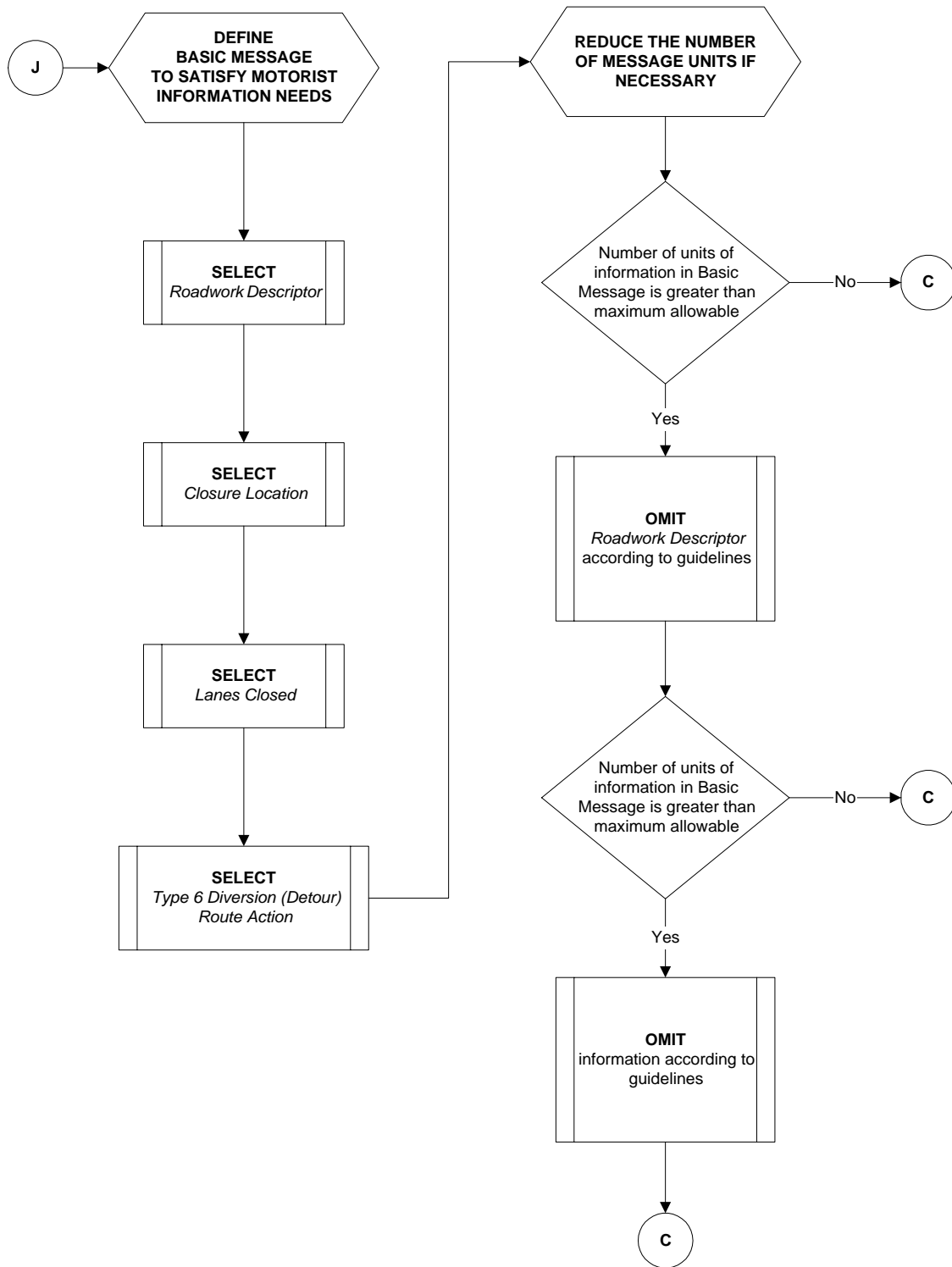
(a) Requiring Lane Closure(s)

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



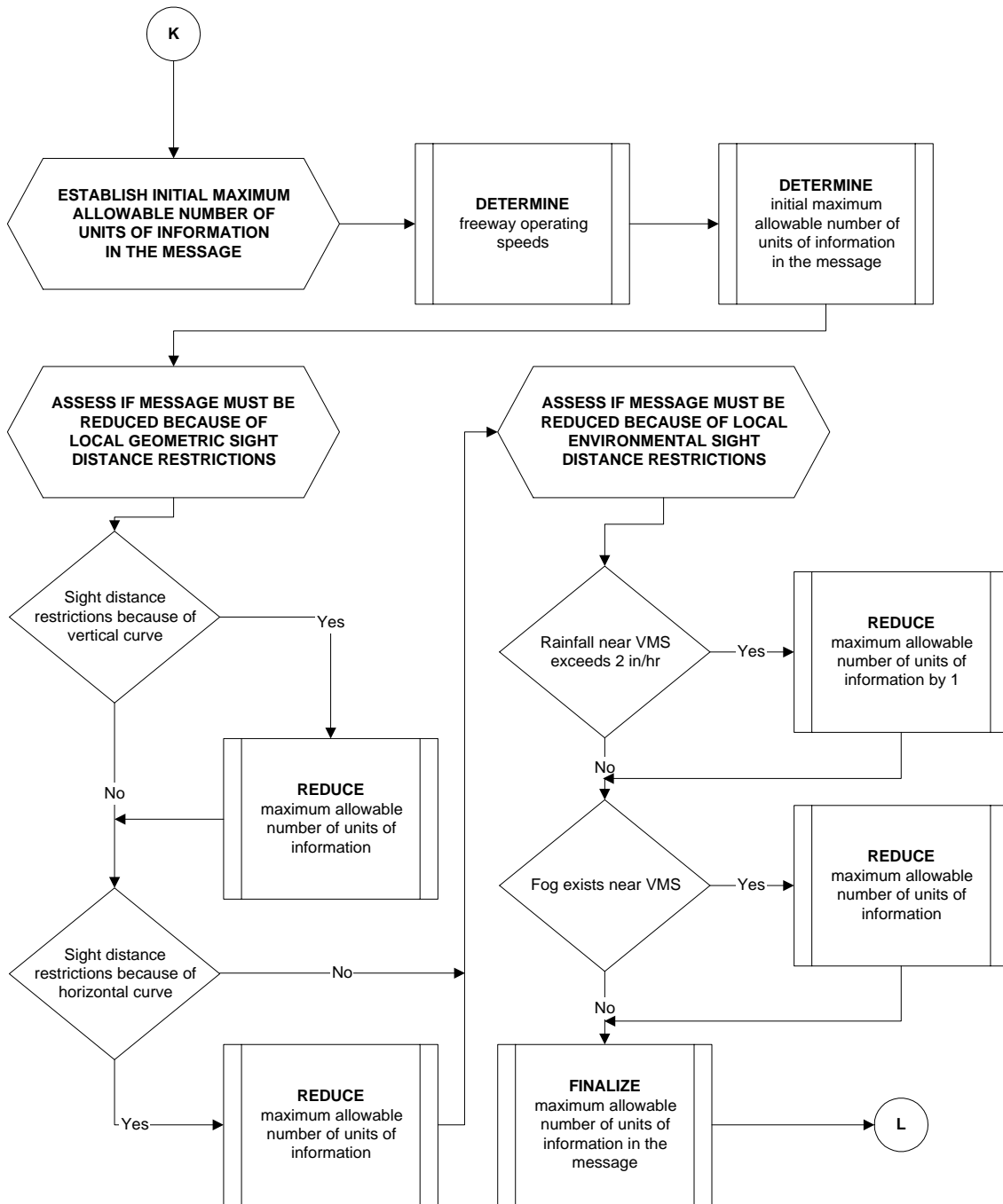
(b) Requiring Closure of Freeway

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



(b) Requiring Closure of Freeway

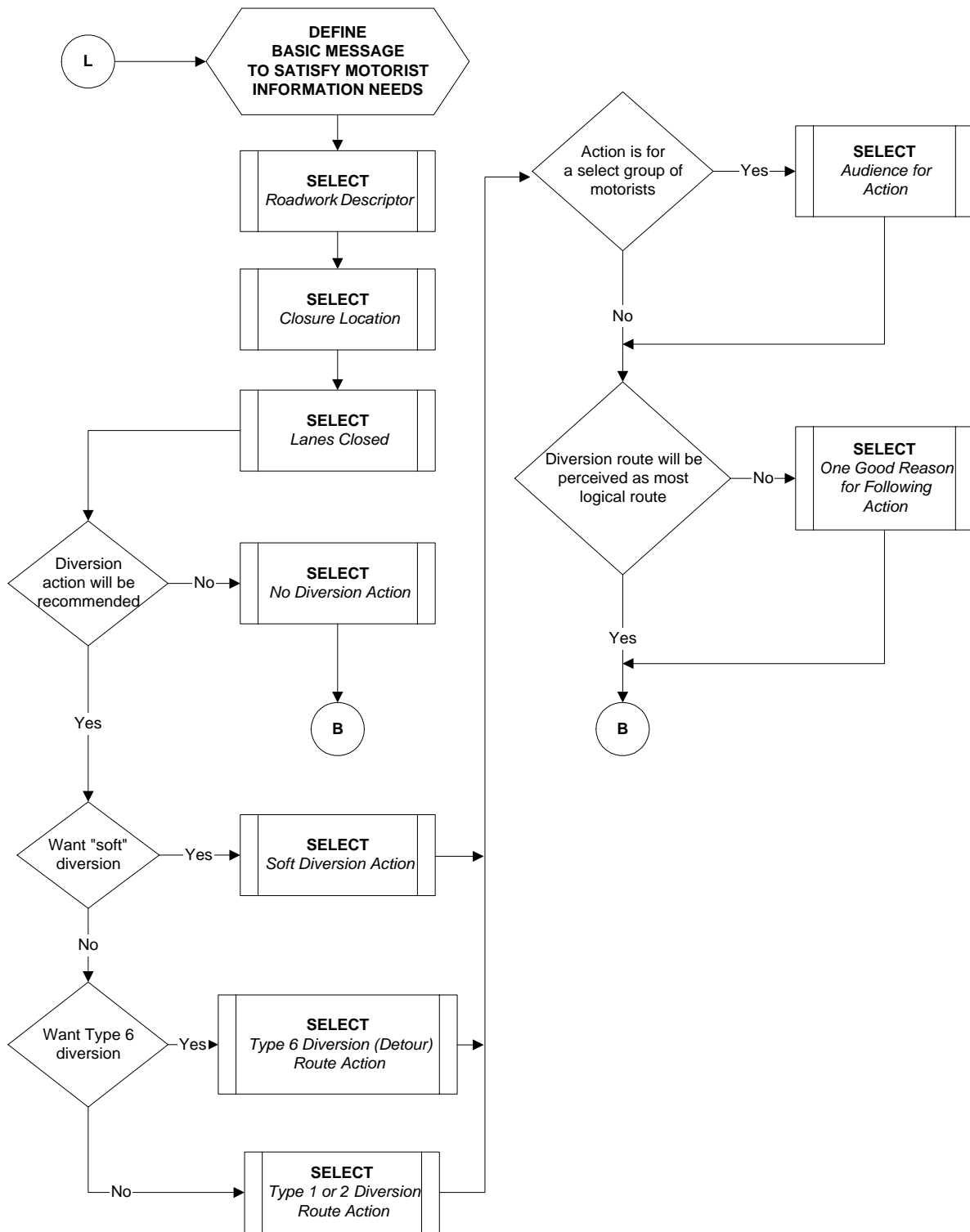
Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



(b) Requiring Closure of Freeway

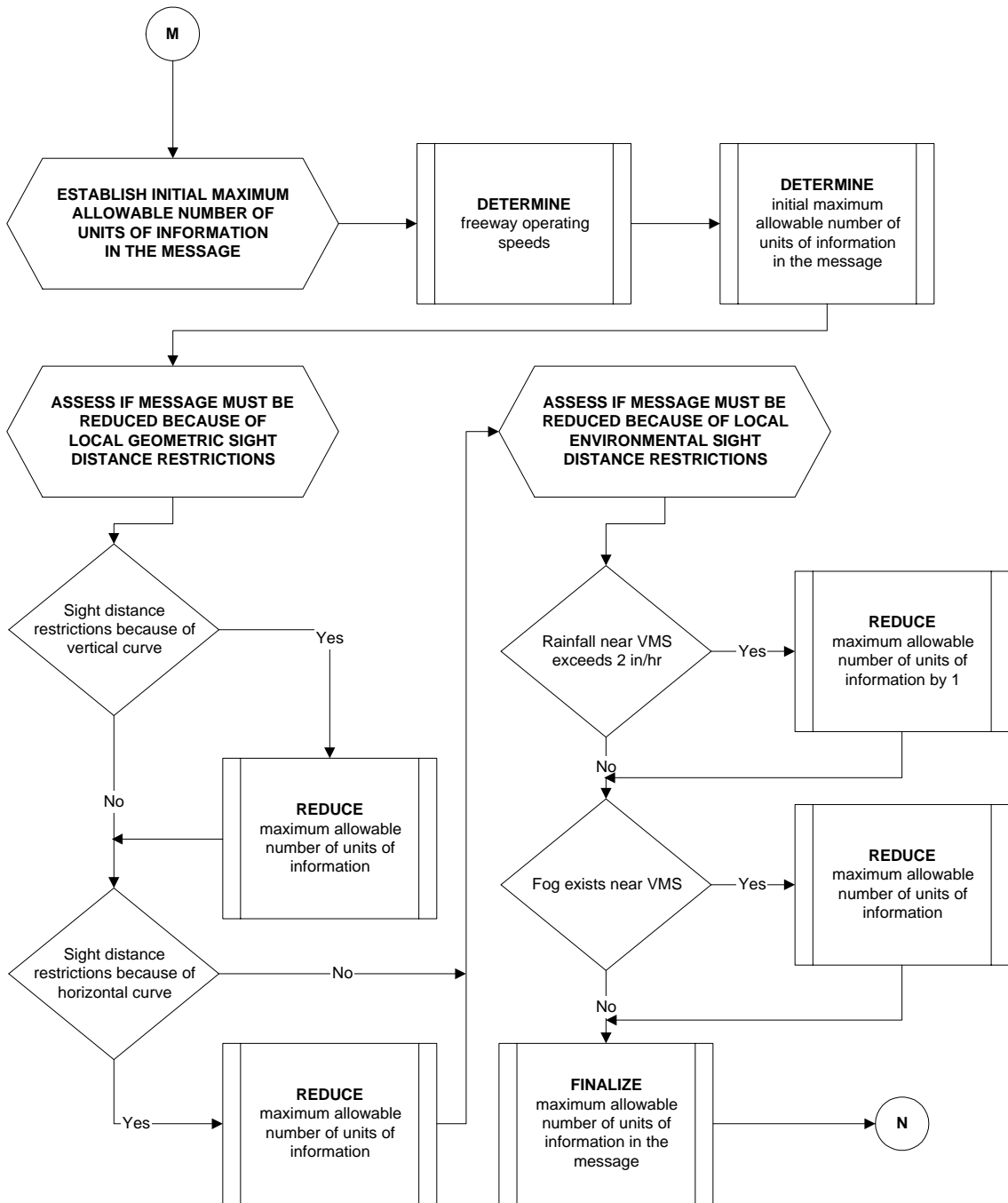
Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)





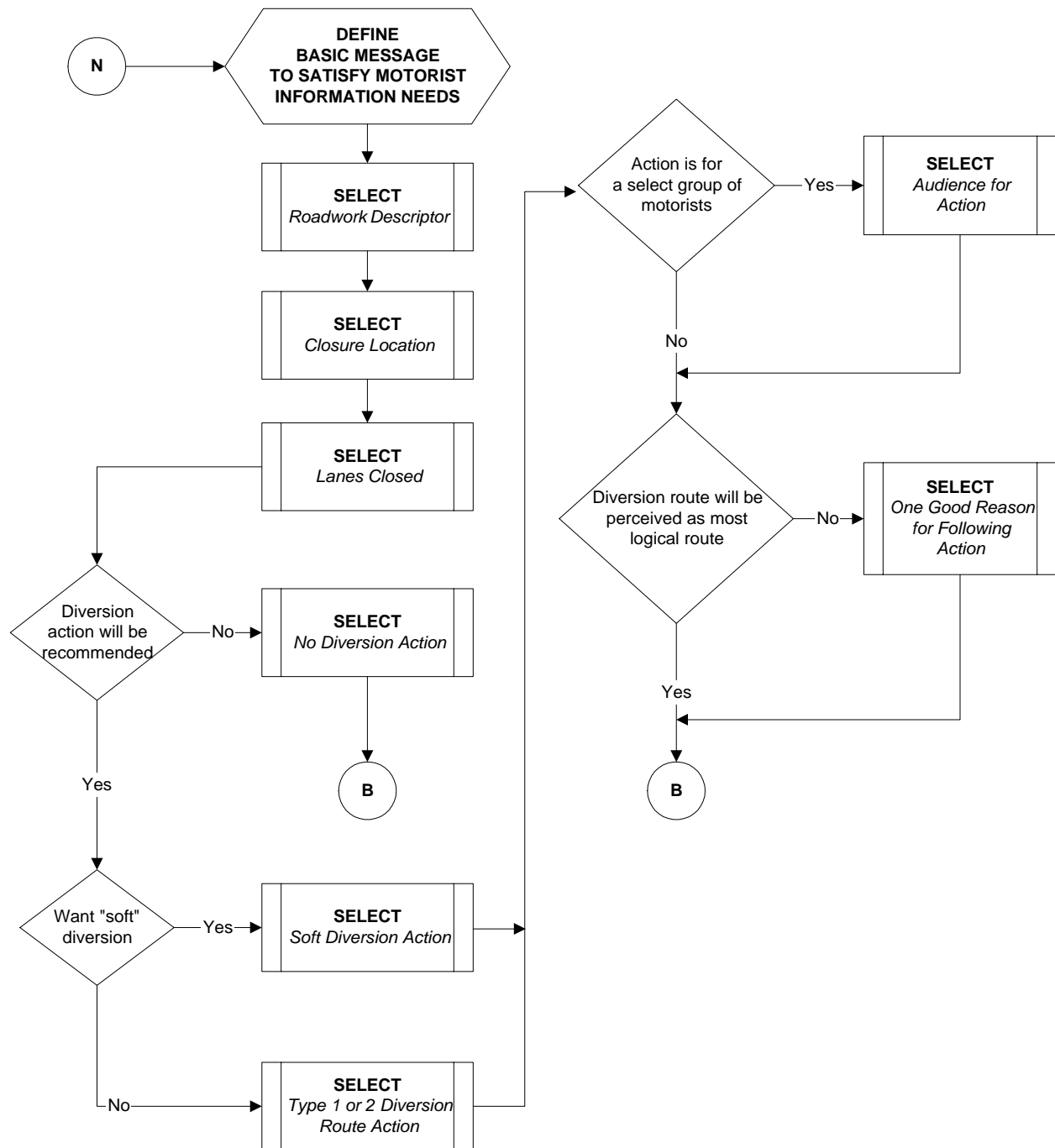
(b) Requiring Closure of Freeway

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)



(b) Requiring Closure of Freeway

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued).



(b) Requiring Closure of Freeway

Figure B-1. CMS Message Design Flowchart for Roadwork (Continued)