

Experience in Handling Freeway Corridor Incidents in Houston

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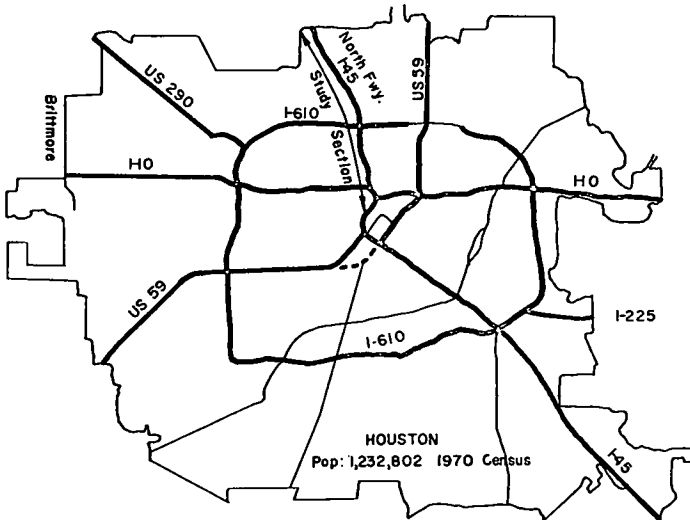
The need to improve the operational efficiency and safety of urban streets and freeways is greater now than ever before. But at the same time urban areas are faced with an increasing problem of traffic congestion caused by capacity-reducing incidents. The incidents are serviced by many organizations in many ways, but few cities have an efficient and coordinated procedure to restore urban roadways to peak efficiency after an incident occurs. The Texas Highway Department, City of Houston, and the Texas Transportation Institute are working toward a solution of this problem. Current practices for the detection and removal of freeway incidents and the results of research studies on response times by police, effects of accidents on traffic operations, and the effectiveness of emergency call-box systems are reviewed. Recommendations are presented for the improvement of the total incident management system in Houston.

Houston has an excellent freeway system. Six radial freeways are connected by an inner freeway loop at the central business district and by Interstate 610 approximately 6 miles from the inner loop (Fig. 1). A belt road that will circle the Houston area approximately 12 miles from the CBD is under construction.

The freeways have the following geometric design characteristics: freeway shoulders on both sides of the roadway, roadways at grade with the surface street system, overpasses at the interchanges, parallel frontage roads with frequent entrance and exit ramps, and a separation between frontage road and freeway that can be traversed by emergency vehicles. The freeways are generally well lighted by highway luminaires and lighting from commercial developments adjacent to the freeways and frontage roads. Only in the immediate area of major interchanges of freeways does the design deviate from these characteristics.

The geometric design of the freeway has a significant impact on incident management. There are only a few miles of urban freeways in Houston on which a disabled motorist could be considered trapped. In most instances, motorists can leave their vehicles and walk a few hundred feet to summon aid. Emergency vehicles can use the shoulders and parallel frontage roads to reach the scene and can cross the separation between freeway lanes and the frontage roads to provide service to stranded motorists.

Figure 1. Map of Houston freeways.



THE PROBLEM

Why are transportation engineers concerned with better management of traffic incidents? First, there is a need to make the best use of existing roadways in the urban area, whether for private automobiles, buses, or car pools. Second, there are better techniques, procedures, and systems available for controlling traffic and providing service to motorists that will keep freeways and arterial streets clear of capacity-reducing incidents. Third, there are problems in implementing these innovations of surveillance, communication, control, and service.

The need for more efficient operation is demonstrated daily when traffic overloads urban streets and freeways during the morning and afternoon peak periods and when the slightest disturbance to traffic causes delays and hazardous conditions. The problems of implementing improvements in incident management are many, but a few of those experienced in Houston are discussed below.

Most urban areas have had increases in traffic and congestion similar to Houston. As the traffic problems have increased, procedures for handling traffic incidents have evolved to meet the situation. Organizations responsible for these procedures have attempted to stay abreast of increasing demands and, for the most part, have succeeded. This success contributes to the problem of implementation. It is difficult to convince administrators that more money should be allocated, more equipment should be purchased, and new organizational responsibilities should be developed to improve what is now a good operation. As one official stated, "All accidents are reported, all vehicles removed from the travel lanes, all trash and debris are picked up in a reasonable time period. What more do we want?" Costs seem to be the primary deterrent even though studies and demonstrations have provided cost-benefit data. Benefits due to the reduction in response time from reasonable to very reasonable are not so apparent as the costs of the systems.

Another problem of implementation is that a full-time system for handling infrequent and nonrecurring freeway incidents has the appearance of being an inefficient operation when it stands ready for long periods of time. When the department heads of the Texas Highway Department were instructed to reduce fuel consumption by 15 percent, one of the first cutbacks was the freeway courtesy patrol, although this

service probably reduces the fuel consumption of thousands of vehicles. When the patrol service was compared to other maintenance operations, such as pavement repair, street sweeping, hardware maintenance, landscaping, and trash pickup, its effectiveness was not properly evaluated.

A third problem is that incident management affects governmental and operational agencies, and coordination of their activities is essential. In most situations, there are no questions of which agency is in charge and what actions must be taken to clear an incident. Even in situations involving major capacity reductions and requiring special decisions, the problems are usually time and availability of facilities; but often matters of jurisdiction can complicate the management process. The formation of a multiagency organization to cope with these matters is both a problem and a solution.

Finally, semiautomated and fully automated systems for incident detection and location and for traffic control and driver information are subsystems of large traffic surveillance and control networks. The problems in implementing these larger systems are the same as those listed above but are greater in scope and magnitude.

INCIDENT CLEARANCE PROCEDURES IN HOUSTON

Incidents that cause a reduction in traffic capacity and safety can be grouped into four categories: accidents, disabled vehicles, debris or lost cargo, and environmental conditions. By far, the most important and the most numerous incident is the traffic accident.

Clearing Accidents

Most accidents on urban freeways in Houston are handled in a similar manner. The accident is reported to the police by telephone or radio from a patrol unit. The appropriate police vehicle is dispatched by radio to the scene. Wrecker vehicles monitor the police radio transmissions and respond without being requested. On arrival, the police assess the situation, determine whether additional emergency vehicles are required, tend to the injured, and clear the roadway. If there are no injuries or fatalities, the vehicles are moved from the freeway lane by the drivers or by the wrecker service before the police unit arrives. If there is a spillage of cargo or damage to a highway structure, the police contact the highway department. The police then conduct the accident investigation, and the vehicles and drivers are released from the accident scene.

In 1968, studies were conducted on the Gulf Freeway on the time required to clear an accident scene. A 14-camera closed-circuit television (CCTV) system for detection and location was used to collect data on more than 250 accidents and the following results were obtained (1):

<u>Procedure</u>	<u>Average Time (min)</u>
Detecting and locating incident	1
Police responding after being dispatched	11
Clearing incident from freeway	4
Conducting accident investigation	<u>25</u>
Total	41

During the last 3 years, the research program has been working with the Texas Highway Department and the Houston Police Department to reduce the total time required to clear the roadway and to reduce the total time an incident affects freeway flow. The detection-location time was considered to be a maximum of 1 minute in this study because of the CCTV system. Normal methods of detection may require

30 minutes longer. Response time can be reduced if adequate manpower and communications are available. The time required to clear a roadway may be greatly improved for major incidents by providing the necessary equipment quickly, but most minor incidents are moved as quickly as possible without special assistance. The time for investigation may or may not be reduced, but its effect on freeway traffic can be minimized. The development of this research program is discussed later in this report.

Clearing Disabled Vehicles

When a disabled vehicle blocks a freeway lane, the police respond in the same manner as for an accident. The police assist in removing the vehicle to the shoulder of the roadway and in obtaining service that the motorist might require. The average response time is approximately the same as for accidents, but the clearance time is higher because all vehicles are not operative.

When a disabled vehicle is parked on the shoulder of the freeway, a police unit does not respond unless directed to do so by the dispatcher or when requested by the motorist. The highway department provides a courtesy patrol that stops and offers assistance to vehicles parked on the shoulder.

If a vehicle remains on the shoulder unattended for 48 hours, it is classified as abandoned and a wrecker is called by the police to remove the vehicle to the city pound.

Clearing Debris or Spilled Cargo

The highway department is responsible for keeping the roadway clear of debris. Normal sweeping and trash pickup operations are conducted daily. When unusual debris is reported to the department, a field unit in the area is dispatched. The procedure for clearing the roadway is left to the discretion of the field crew. They may request additional personnel and equipment to provide traffic control and protection for the field crew, but the usual procedure is to use flagmen and cones in light traffic and maintenance vehicles equipped with signs and flashers in moderate to heavy traffic.

When a truck spills its cargo, the police and the highway department are notified. The operator of the truck may obtain help from his company to salvage the cargo, but, if the time required to clear the roadway is critical, the police and highway department provide the traffic control and heavy-duty equipment necessary.

Clearing Ice and Water

Houston experiences flooding and icing several times a year. The Texas Highway Department is responsible for maintaining the roadways under these conditions. Flooding is of short duration, and critical locations are well known. Temporary barricades and signs are erected to direct traffic around these areas.

Icing conditions are also of short duration but usually affect all freeways. If icing is limited to bridges, sand and salt are spread as soon as possible and the roadways are open to traffic. If icing is severe, the freeways are closed to all traffic by barricades placed at the entrance ramps.

RESPONSIBLE ORGANIZATIONS

Police Departments

Houston freeways are under the jurisdiction of the local police agencies. The police departments are responsible for law enforcement, accident investigation, and traffic control around incidents.

Motorcycles

Each of the six freeways is patrolled by two motorcycle officers to provide fast response to a call and to provide visual surveillance of freeway and traffic conditions. These patrolmen assist in the clearance procedure by directing traffic and calling for the appropriate equipment and personnel. They do not conduct accident investigations.

Radio patrol vehicles

The police provide vehicle patrols that cover specific areas of the city. These units are not normally used for traffic control or accident investigation, but respond to incidents in the same manner as the motorcycle patrolmen.

Three-wheeled motorcycles

Three-wheeled motorcycle units are used for point control and limited patrol duty in the CBD. If additional personnel are required to control traffic at a freeway incident, these patrolmen are assigned.

Accident investigators

Accident investigators are assigned to patrol specific areas of the city, but respond to other areas if directed by the central radio dispatcher. There are only 25 accident investigation vehicles on call at any one time. During inclement weather when the accident rate increases, there are not enough accident investigators to respond to each call. Public service announcements advising motorists to report minor accidents to the police station within 24 hours are made by the radio stations.

Wrecker Service

The wrecker service for the clearance of freeway incidents is provided by private companies. The city licensed 100 emergency wreckers that respond to all accidents and another 573 that respond only upon request of the driver or the police. The location of an incident is obtained by the wrecker service in several ways:

1. A driver observes an incident,
2. A call is made by a motorist requesting assistance,
3. Police calls are monitored by the wrecker service, or
4. Police central dispatcher requests assistance of a wrecker service.

The wrecker service usually arrives at the scene of the incident before the police. There are ordinances controlling the activity of wreckers at an incident scene and establishing the rates for services. The procedure that allows emergency wreckers to respond without being called by the police or individuals has both merits and disadvantages. The most important benefit is that the time of response is most assuredly less than that of any other system. The major disadvantage is the disturbance caused by several wreckers waiting at the accident scene for the completion of the investigation. However, with constant monitoring of the wrecker service by the police department and the Houston Wrecker Association, this system will continue to provide good service.

An emergency wrecker can clear vehicles from the freeway before an accident investigator arrives if the accident involves only property damage and the drivers of the vehicles give their consent. There are no charges for this work.

Emergency Service

Houston operates an ambulance service under the supervision of the fire department. Ambulances and fire vehicles are dispatched to freeway incidents through the police and fire dispatchers. Calls for assistance may come from an individual or the police unit responding to the call. The direction and control of these vehicles at the incident are under the supervision of the fire department. Response time for those services is very good. The average response time from the fire station to the accident scene is 5.5 min, and the total time from alarm to arrival at the hospital is 21.6 min. These figures were compiled from data on 28,000 accidents in 1973.

A medical heliport was recently opened in the Houston Medical Center. It has been used to transport patients from one hospital to another over long distances. Helicopters have not been used to respond to an accident location in the Houston area.

Operational Organization

The Texas Highway Department is responsible for the design, maintenance, and operations of the freeway system. Therefore, because freeway incidents impair the operation of the freeway and may also cause damage to the roadway surface or other physical structure, the department must be responsive to incidents.

Roadway conditions

Many of these incidents are handled in a routine manner: the removal of trash and small debris, repair of small pavement failures, replacement of damaged hardware along the roadway, and treatment of roadways for ice and snow conditions. Those incidents that are less predictable and that involve motorists are not handled in a routine way.

Disabled vehicles

The Texas Highway Department provides a limited patrol service that responds to motorists whose vehicles are disabled. This courtesy patrol is free to the motorist, although remuneration is requested on a voluntary basis for the cost of gasoline. The courtesy patrol does not perform enforcement functions such as traffic control or accident investigation, but it does provide protection by signs, flares, and similar devices. The patrol provides limited mechanical assistance, gasoline, oil, and water and assists the motorist in obtaining other necessary services to remove the vehicle from the freeway.

The patrol is under the supervision of the maintenance section of the Texas Highway Department. The patrol follows an established route over 64 miles of freeway and reports incidents by radio to the central office of the department, but the patrol is not dispatched to incidents off the primary route.

In addition, all field personnel of the Texas Highway Department are instructed to render service to motorists on the roadside when it can be done safely. On urban freeways, it is often advisable not to stop unless the service vehicle is equipped with adequate flashers, signs, and other equipment.

Accidents

Most traffic accidents do not require the services of the Texas Highway Department to restore the roadway surface or structure to its potential capacity. There are cases, however, that require special handling such as cargo spill that reduces the coefficient of friction of the pavement, clearance of equipment and vehicles that require heavy-duty wreckers, cranes, or other construction machinery, and the damage of roadway or structures by fire or impact that may reduce the strength of the structure. The

department is notified by the police agency when such an event occurs, and the district office dispatches the appropriate personnel and equipment to the scene.

RECENT DEVELOPMENTS IN INCIDENT MANAGEMENT

The procedure for incident management on freeways and arterial streets consists of

1. Detection and location,
2. Response,
3. Clearance, and
4. Report or accident investigation.

Detection and Location of Incident

The time required to detect and locate an incident varies greatly depending on the severity of the incident, location of roadside communications, traffic volume, location of freeway patrols, and many other factors. To reduce this time to a minimum for all incidents would be extremely costly in personnel and equipment, but there are only a few incidents for which cost-effective solutions that would reduce the time by as much as 50 percent are not available.

The usual manner for reporting accidents to the police is by public telephone. The use of a two-way mobile radio by motorists passing an incident scene is increasing and is being coordinated by such organizations as REACT (2). In Houston, other methods for improving accident detection and location time are being investigated.

Emergency call-box system

A few years ago, the Texas Highway Department installed a motorist aid call-box system along 11 miles of I-45 (3). The system design was a four-button radio communication to the central dispatching office of the police department. These four buttons indicated the type of service requested and the location of the call. This system has been removed from the freeway and there are no other roadside motorist aid systems now in operation in Texas, although they are being included in the design of new freeway surveillance and control projects. The failure of this system was not due to the mechanical or electrical operation of the equipment but to the lack of coordination and direction by those agencies responsible for responding to the calls placed on the system. Although the call boxes had separate buttons for fire, service, wrecker, and police, a police patrol unit responded to each call regardless of the type and called for additional service by radio upon his arrival at the scene. There were a large number of false or gone-on-arrival calls received by the police, which prompted the police dispatcher to give a low priority to the call-box system. The reason for the gone-on-arrival calls is not clear, but many can be traced to the length of time required for the response to the call. Another very important factor is that many of these roadside units were placed in close proximity to roadside service centers, such as service stations, shopping centers, and other forms of communications. Still another factor is the charges that were made for services rendered when calls were placed on the call box. These charges were very often much higher than the motorist was willing to pay and, after placing a call often, the motorist decided to seek service on his own. The police were never too enthusiastic about this system and their reluctance to provide faster service to calls placed on this system eventually led to its removal.

Electronic incident detection systems

The research program on the Gulf Freeway Surveillance and Control Project led to the development and testing of incident detection systems. These systems are used to

detect shock waves for the operation of warning signs and to alert television monitors of impending congestion and the possibility of accidents or stalled vehicles blocking the roadway. These programs have been successful in detecting shock waves during high and moderate levels of volume (4, 5).

This program is being extended to the study of incidents under low-volume conditions. These programs will be applied on those sections of roadway where disabled vehicles are not easily detected or reached by emergency vehicles.

Also, the study of the detection and computer system has included the system design to automatically detect and locate lane-blocking incidents under high to moderate traffic volumes.

Freeway patrols

The Texas Highway Department's courtesy patrol is being studied to determine whether a more optimum routing and dispatching system can be employed for the same costs, equipment, and personnel.

Television surveillance

Television surveillance is operated on a 6-mile section of one freeway in Houston. The Texas Highway Department has provided observers to man the television system for a 12-hour period from 6:30 a.m. until 6:30 p.m. These observers note any breakdown that significantly affects the traffic flow and safety of the freeway and report by telephone to the police or the highway department's maintenance section the location and type of incident. Under this set of guidelines, incidents located off the travel lanes, such as disabled vehicles on the shoulder or on the outer separation of the freeway, are not usually reported unless they have been involved in an accident or in some other way are distracting to freeway motorists. Television surveillance of course has its limitations, and particularly during periods of light flow the detection of incidents is difficult. Also, the system is not used during hours of darkness, although new developments in CCTV design will enable such use. The department feels that television surveillance is a necessary part of an urban freeway surveillance system and intends to include CCTV as part of its operational design. A microwave television system is being tested for application to remote or temporary installations.

Aerial surveillance

A radio station provides aerial surveillance, but the reports of incidents are not official and are not a part of the highway department or police department. However, it does provide some additional information to motorists, particularly about location of accidents or major incidents. This system is only used during morning and afternoon peak hours and suffers from the same type of visual limitations that television surveillance does.

The Houston area does not have a coordinated system for surveillance except for the Gulf Freeway, which has a system of electronic and video surveillance operated by the highway department and monitored by the police department. The patrol systems, operated independently by the highway department and the police department, provide good surveillance and response to the incident.

Response to Incidents

The second step in clearing incidents from the freeway is response by emergency vehicles. Four years ago, a study was conducted of the time required for police units to arrive at the scene of the accident after receiving a call from the central dispatcher over the radio system. The high variation of response time, from 2 min to more than 30 min, was due to factors such as the location of the accident, availability of police

units, condition of traffic, and time of day. On the average, the police responded to incidents on the Gulf Freeway in 11 min. The response time for the wrecker service was considerably shorter, because they stand by the freeways and are able to respond to a police call immediately. A sample of response times during 1974 in this same area showed similar results: an average response time of 11 min. So, although the police have been actively engaged in the operation of the Gulf Freeway surveillance project, police reporting and responding procedures have not changed. At the same time these latest response time studies were made, the staff of the Freeway Surveillance and Control Project measured the response times that were possible by having a vehicle standing by at the control center. The results indicated that the average response time per incident could be reduced by 5 min.

There are approximately 600 accidents per year in the area of the control center. If 300 accidents caused serious congestion, then reducing the time that one or more lanes are blocked is significant. Steps are being taken to have the police department implement this response procedure.

Clearance of Freeway Incidents

Observations have been made on the time required for the police and wrecker units to clear an accident or disabled vehicle from a freeway lane. The distribution varies from 1 min to more than 20 min; approximately 80 percent of the accidents are removed in 4 min or less. Because most of the accidents on our urban freeways are of the minor rear-end type, most vehicles are still operative. The clearance of vehicles from a freeway is of high priority to the police unit at the scene. Therefore, reductions in time for this phase of the clearance procedure are not to be expected. However, vehicles can and should be removed from the freeway before a policeman arrives. If both vehicles are operative and no one is injured, the motorists should move to the shoulder. The Houston Wrecker Association has an agreement with the police department that permits a wrecker to assist in clearance of vehicles before a policeman arrives, if there are no injuries and if the motorists give their consent. There is no charge for the removal to the shoulder. These facts are not widely known by the motoring public, and there are no plans to promote these and other accident procedures with the public.

The time required to clear major accidents involving large numbers of vehicles, heavy trucks, or the spillage of unusual cargo can be improved. It has been the custom to allow companies to provide the necessary equipment to clear their own trucks and cargo if that equipment could be transported to the accident scene in a reasonable period of time. However, during periods of the day when a blockage of the freeway is most critical, this privilege has been restricted. The police and the highway departments have developed an agreement that allows the highway department to provide the necessary heavy-duty equipment to remove trucks or cargo when requested by the police. This agreement was cleared by the Texas Attorney General in the event of legal problems due to vehicle or cargo damage sustained in the removal procedure.

Investigation of Accidents

The time required to complete accident investigation reports was studied in Houston in 1968-69. The time for the investigation of an accident on the freeways ranged from 5 to 70 min and averaged 25 min. The procedure at that time allowed the investigating officer to move the vehicles from the travel lanes to the shoulder of the freeway or to the outer separation and to conduct the investigation at that location. The officer had the prerogative to move the accident vehicles from the scene to a parallel street or to another area in the immediate vicinity if, in his opinion, it was safe to do so. However, most officers preferred to leave the vehicle adjacent to the roadway. The city ordinance on the responsibility of the motorist involved in an accident states that, if the accident results only in vehicle damage, the person shall immediately stop the

vehicle at the scene of the accident, or as close thereto as possible, and shall remain at the scene of such accident until he has fulfilled the requirements of exchanging information and reporting to the police officer. It also states that every such stop shall be made without obstructing traffic more than is necessary, a statement that is not understood by the public. In the event that the accident results in injury or fatalities, the vehicle should remain in place long enough to have the occupants cared for and to determine the state and cause of the accident. The highway department has worked with the police department during the past several years to encourage the removal of all accident and emergency vehicles, such as wreckers and police units, from the roadway and from the field of view of the freeway when the accident involves only property damage. The highway department has constructed an Accident Investigation Site (AIS) system on 6 miles of the Gulf Freeway (6). This system consists of designated parking areas—some specially constructed paved aprons under overpasses, others designated curb parking on city street systems in the immediate area of the freeway—where the accident investigation is conducted. The results of removing an accident scene from the field of view of the motorist are obvious to laymen and traffic engineers. The accident scene is a distraction that causes a reduction in speed, which results in a reduction in flow rates past the accident scene, even though all lanes are open. This reduction is 25 to 35 percent of the capacity of the roadway for a six-lane freeway, in the direction of the accident. Often, similar reductions in speeds and flow rates are observed in the opposing lanes of travel.

The benefits of removal of the accident from the shoulder and outer separation of the freeway to a site out of view of the freeway motorists can be calculated in terms of total delay to freeway traffic. Other benefits of reduced congestion on freeway lanes, such as operating costs and the reduction of secondary accidents, can be estimated. The costs of installing such an AIS system, which consists of signing, small special-duty parking aprons, and lighting of the parking area, are low. In a 1-year study of the system on the Gulf Freeway, the benefit-cost ratio was calculated to be 28 to 1, even though only the reduction in delay to the freeway in the direction of the accident was used in the analysis and only 65 percent of all accidents were removed from view of the freeway. It is estimated that 85 percent of the accidents can be moved from the freeway for conduct of the investigation.

A training and public relations film is being prepared on the AIS system and the responsibilities of the public in the event of an accident.

RECOMMENDATIONS

The following recommendations are made to improve the incident management system in Houston.

1. Establish a central communications center for the purpose of maintaining a current-status board for roadway conditions, maintenance and construction activities, and traffic incidents on the urban freeways. This facility should be expanded to include major arterials and suburban freeways as time and resources permit. The center should be directed by an organization that has the responsibility and authority to control all activities on the urban roadway system to maintain safe and effective traffic operations.
2. Improve the frequency of patrols by coordinating the police and highway department activities.
3. Improve the response time of patrols to an incident by permitting the highway department patrol to be dispatched, increasing the number of patrol units during peak periods, and assigning special police units for the purpose of responding to incidents during peak traffic periods.
4. Develop contingency plans for diverting traffic from the urban freeways to the frontage roads and surface street system.
5. Expand the AIS concept to all urban freeways and major arterials.

6. Develop more detailed guidelines for the clearance of incidents that require special equipment and personnel.

These six recommendations are basically people-oriented, and the capital outlay is small. Many of these activities are being conducted daily but simply require coordination with other activities to be more effective. There are many other recommendations that can be made: Develop an electronic and radio surveillance system to reduce the time of detection, increase the size and number of freeway patrol units to reduce the time of response and clearance of incidents, and reform the accident investigation procedure to shorten the time that police personnel are involved. All of these things will be done in time, but emphasis should be placed on those things that can be done now within the constraints of time, money, and organizational responsibilities.

SUMMARY

Management of freeway incidents in Houston may be described as unstructured and loosely coordinated, but responsive and effective. All agencies, acting somewhat independently, provide good service, but service can be achieved if a higher degree of coordination can be developed, if more personnel and facilities can be dedicated to this important function, and if proven new and experimental systems of surveillance and control are made operational.

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