Generation and Assessment of Incident Management Strategies

Volume IV: Seattle-Area Incident Management – Assessment and Recommendations

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16. ABSTRACT

This four-volume technical report describes a study of freeway incidents and incident management strategies in the Seattle area. The study statistically analyzed the frequency and duration of freeway incidents on sections of I-5 and SR 520 in Seattle. In addition, a traffic simulation model was operationalized to assess the traffic related impacts of incidents. The findings show that Seattle-area incident management currently responds well to inclement weather and special events (e.g., major sporting games) but has problems with severe accidents. The ongoing operationalization of accident investigation sites and incident equipment storage sites can be expected to improve severe accident management, but response personnel training and the addition of more dedicated tow truck service are also needed. Finally, the study shows that, from a traffic impact perspective, the section of I-5 in downtown Seattle is in need of the most incident management attention.

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GENERATION AND ASSESSMENT OF INCIDENT MANAGEMENT STRATEGIES

VOLUME IV: SEATTLE-AREA INCIDENT MANAGEMENT: ASSESSMENT AND RECOMMENDATIONS

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SUMMARY

The four volumes of this report contain a wealth of information relating to the review of incident management methods used in the United States, Seattle-area incident characteristics, Seattle-area incident impacts, and an assessment of Seattle's incident management record. The findings of this study show areas in which incident response is working well and areas where improvements could be made. Generally, the researchers found that WSP and the TSMC handle special events (sporting games), inclement weather, and rush hours well. Moreover, detection and response times are, for the most part, good. For the areas that need improvement, the following recommendations are made:

1. The study's models of accident duration indicated that problems exist with the management of severe accidents. Incident response storage sites would improve this situation, as would more dedicated tow trucks and better incident response operating procedures (fire departments, in particular, seemed unaware of the urgency needed in clearing the incident).
2. The incident response storage site program shows great promise, but it must be expanded to achieve something of a "critical-mass." Probably eight to ten sites are needed to service the study area (Figure 2.1), with locations preferably on on-ramps.
3. Accident investigation sites are promising, but not for the most impacted areas of the study (Zones 3 and 4, Figure 2.1) because of severe space limitations. However, the investigation sites should be of some value in Zones 5 and 6, as planned, providing that appropriate promotional support is available.

4. Zones 3 and 4 created the largest incident impacts in the study area. Although incident response storage sites might help in this area, accident investigation sites would really not be economically feasible because of space limitations. The authors recommend that monitoring/response in this area be improved and that dedicated tow trucks be operated in these zones.

5. The traffic simulation indicated that during peak periods, traffic diversion (i.e., alternative routes) provides some relief, and radio reports are a valuable part of this effort. However, significant additional systemwide benefits can not be accrued by physically diverting traffic because of congestion already present on alternative routes (see Figure 6.1, Volume III). Thus, additional route diversion is not the answer; shorter incident duration is.

6. Education and awareness programs offer a very cost-effective approach to incident management. The authors recommend that regular incident-related information be circulated to WSP and that annual training classes be held so that troopers are aware of new techniques and incident management facilities. Also, a public awareness campaign that stressed the magnitude of incident impacts could provide a reduction in the frequency and length of incidents and increase use of accident investigation sites (i.e., convince the public of their value).

CHAPTER 1
INTRODUCTION

Volumes II and III of this project report have presented analyses of Seattle-area incident-related data and incident-related traffic impacts, respectively. The purpose of this volume is to synthesize these analyses and to translate their findings into substantive observations and recommendations regarding incident management strategies in the Seattle area. Ideally, such recommendations will form the basis for improved incident management strategies.

This volume begins with an assessment of incident management in the Seattle area from April 1987 to March 1989. The basis of this assessment is the data analysis presented in Volume II, and conclusions are drawn relative to the performance of the incident management procedures that existed during this time period. Next, two recent Seattle-area incident management strategies (incident response storage sites and accident investigation sites) are discussed at length. This discussion also includes an evaluation of their current and future effectiveness. Suggestions for future incident management strategies are then presented. Financial, institutional, and educational barriers to the development of effective strategies to minimize the impacts of incidents are discussed.

CHAPTER 2

ASSESSMENT OF SEATTLE-AREA INCIDENT MANAGEMENT (APRIL 1987-MARCH 1989)

From April 1987 to March 1989, over 5,000 accidents were reported in the six zone area shown in Figure 2.1, and over 3,000 disablements were reported in the same area from April 1988 to March 1989 (see Volume II of this report for complete details of these data). With such a large number of data to draw upon, some acute observations can be made about incident management in the specified area.

TROOPER RESPONSE AND ACCIDENT REPORT TIMES

The average trooper response times (i.e., the time between when the call was received at the dispatch office and when the trooper arrived at the accident scene) was just over 4 minutes. This must be viewed as an outstanding response time, particularly in light of the often sparse personnel resources that are available to the Washington State Patrol (WSP).

Almost equally impressive is the accident report time of just over 5 minutes (i.e., the time between when the accident occurred and when it was reported at the dispatch office). This low report time is a testament to an excellent freeway surveillance system (closed circuit television, CCTV) and generally good communication between the Traffic Systems Management Center (TSMC) at Roanoke and the WSP.

Although these individual response times are impressive, combined they suggest that, on average, nearly 10 minutes transpire before a trooper arrives on the scene of an accident. This time can be very costly in terms of lost vehicle-hours. For example, the traffic simulations undertaken in Volume III of this report indicated that a 75 percent capacity reduction, caused by an accident on the Ship Canal bridge (on I-5, Zone 5) in the pm peak rush period will result in 1,123 lost vehicle-hours in the first 10 minutes after the accident. With a value of a vehicle-hour of roughly $10 (with an average vehicle

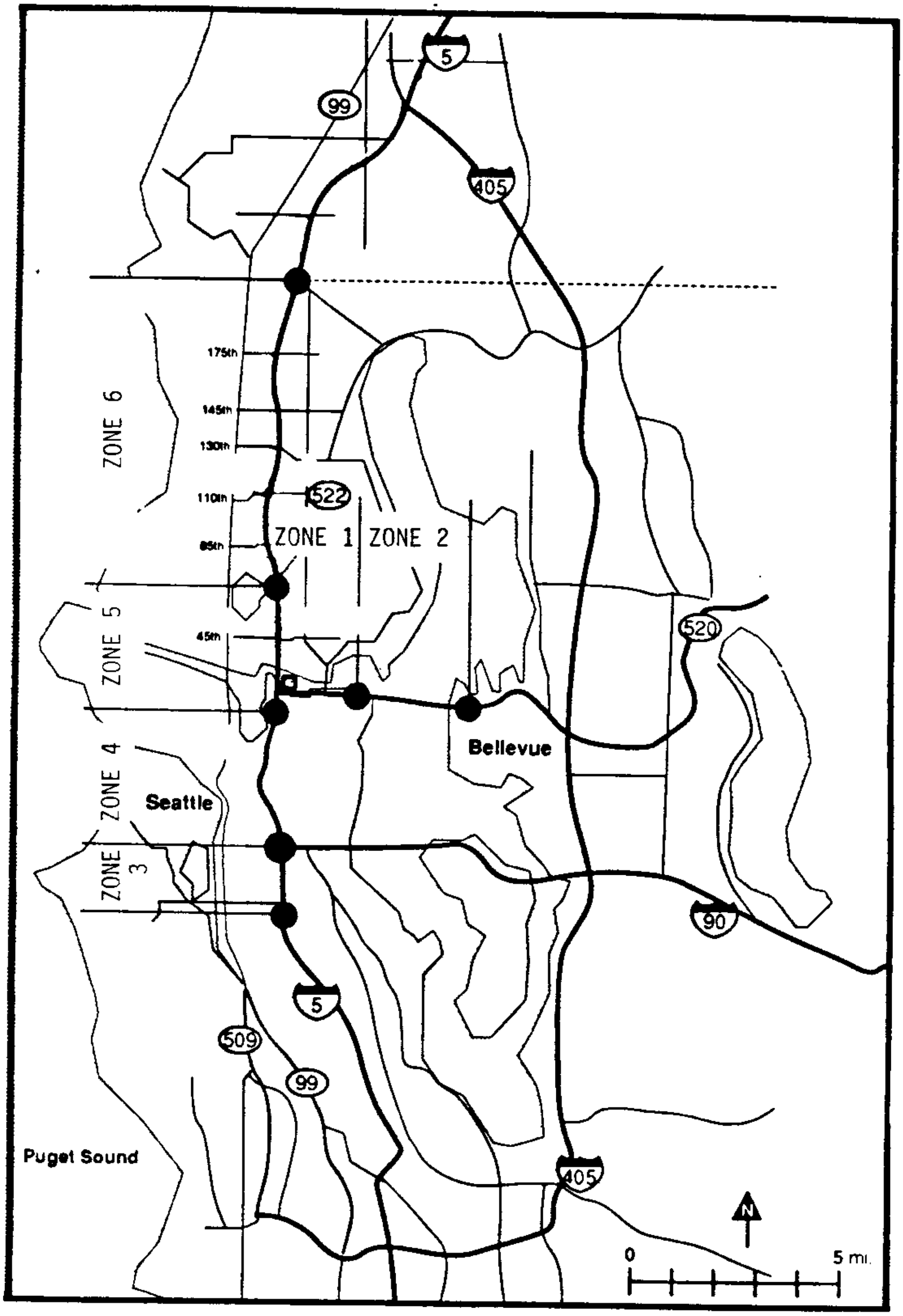


Figure 2.1 Incident Location Zones

occupancy of 1.5, including HOVs, this translates into a reasonable person-hour rate of about $6.70), $11,230 of worth of commuting time is lost before a trooper arrives at the scene of an accident. Thus, any improvement in detection and response would be of great value. Potential methods for minimizing detection and response times are discussed in detail later.

ACCIDENT SEVERITY AND DURATION

The accident duration models estimated from the two-year data (see Volume II) suggested that severe accidents in the study area tend to be problematic from a management perspective. Evidence of this were the positive coefficient estimates (suggesting increased accident duration, see Table 5.3, Volume II) for accident severity variables such as number of lanes blocked, number of vehicles involved, property damage in dollars, number of injuries, and whether a truck or bus was involved. The fact that these severity measures increased accident duration implied that substantial benefits could be gained from the development of better management strategies to deal with severe accidents. The data collection process and conversations with responsible officials led to two observations about this accident severity problem. First, the response times for tow trucks, which are often required to clear severe accidents (involving trucks, buses, multiple vehicles, high property damage, and so on) are highly variable. This variability is likely the result of troopers having to rely on non-dedicated, private tow-truck services. The provision of a dedicated service (as is currently the case on the Lake Washington bridges) in critical locations in the I-5 corridor would be of great value. Second, fire departments, which are often called to the scene of severe accidents, have standard operating procedures that greatly increase durations and impacts, since they typically close additional lanes. There is a critical need for fire departments to improve their incident management proficiency.

As still further modeling evidence of the trouble that currently exists in managing severe accidents, the log-logistic scale parameters (Table 5.3, Volume II) were less than 1 for all zones. These parameters indicate that the hazard function is monotonically decreasing or, in other words, the longer that the accident lasts, the less likely it is to be cleared soon. This finding suggests that increasing severity is a problem at all severity levels, and not just at the most catastrophic accident extremes as might be expected. If only the most severe accidents were problematic, the log-logistic scale would be greater than 1, indicating an increasing hazard (i.e., less severe accidents are likely to end soon the longer they last) rather than a decreasing hazard (i.e., most severe accidents are less likely to end soon the longer they last). Thus, as severe accidents became better managed, one would expect the scale parameter to exceed 1.

One qualification is necessary before this severity discussion is concluded. Recall that the duration models estimated in Volume II were drawn only from accidents that could be matched (accident reports linked to WSP dispatch data). As discussed in Volume II, these matched accidents naturally tended to be more severe than accidents in general because of more careful reporting and so on. Thus, since the data were biased somewhat toward severe accidents, the log-logistic scale parameter estimated in Volume II would be expected to be lower than it would have been if duration information had been available on all accidents. However, most likely this downward bias is not strong enough to negate the validity of the scale parameter discussion above.

RUSH HOUR RESPONSE

The duration model parameter estimates (Table 5.3, Volume II) indicated that accidents have shorter durations during rush hours. This likely reflects the generally heightened awareness of the WSP, as well as extra WSP efforts to clear the road as quickly as possible. The rush hour performance is commendable, but it implies that accidents could be cleared faster during non-peak periods.

SPECIAL EVENTS AND ENVIRONMENTAL FACTORS

The accident frequency models (Table 5.2, Volume II) showed that sporting events, inclement weather, and adverse road surfaces all increase the likelihood of an accident, and that these likelihoods increase at different rates in different zones within the study area. However, these special event and weather effects did not affect the duration of the accident (i.e., variables do not enter the duration models with acceptable statistical significance, Table 5.3, Volume II), demonstrating that incident management is responding well to such occurrences.

CHAPTER 3

RECENT INCIDENT MANAGEMENT STRATEGIES IN THE SEATTLE AREA

In the past year there has been a strong interest in improving the manner in which incidents are managed in the Seattle area. The outgrowth of this interest has resulted in two strategies: (1) incident response storage sites, and (2) accident investigation sites. Both of these strategies have met with some success in other areas of the country (see Volume I), so hopes have been high for their eventual success in Seattle. The following discussion describes these two incident management efforts and evaluates their potential effectiveness.

INCIDENT RESPONSE STORAGE SITES

As Seattle area freeway congestion has grown, methods to mitigate the adverse impacts of congestion have become an increasing concern. One method of mitigation is to quicken incident response and resolution time. One way to quicken incident response and resolution time is to develop incident response storage sites. This section presents a summary of Seattle-area incident response storage site development, current use, and future plans.

Development

The situations that created the need for storage sites were incidents that demanded equipment that the State Patrol cars did not have. To get the supplies needed to control traffic and return traffic to normal conditions, the State Trooper at an incident either had to request someone from the WSDOT maintenance crew to come (if the incident was during the day), or get WSDOT maintenance personnel out of their homes (if the incident was after work hours). Since calling for this kind of help was time consuming and the needs were generally very simple, the State Patrol and maintenance crews requested that incident response storage sites be made available. Examples of the equipment needed include a broom to sweep up a small amount of glass and debris, an absorbent pad to clean up a small quantity of spilled oil/gas, or barriers and signs for simple traffic control. The storage sites would contain commonly requested equipment and be close to points of high incident occurrence, so that the State Patrol could have quick access to them.

The plan was initially installed in October 1988 as a pilot program by Susan Everett, the Construction Traffic Engineer at the WSDOT Traffic Systems Management Center (TSMC). Since the TSMC is located at a well known site very near the junction of Interstate 5 and State Route 520, a point of high incident occurrence, the TSMC building was chosen as the location for the first storage site. Shelves were built in a closet with outside access, the lock was removed from the door, and the closet and space outside the closet were stocked with commonly needed supplies and equipment (Table 3.1). The storage site was ready for use by the first of November.

TABLE 3.1. EQUIPMENT AND WORK FOR THE EQUIPMENT STORAGE SITE

Quantity	Equipment	Cost ($)	
2	Flat Tip Shovels	(12.91 ea)	25.82
2	Brooms	(5.36 ea)	10.72
10	Flares (36/case)	(0.88 ea)	316.80
50	Sandbags	(2.33 ea)	116.50
8	Rollup Signs, Mini-Stands and Storage Bags		1,638.16
	2 Accident Ahead	(185.65 ea)	
	2 Right/Left Lane Closed	(200.95 ea)	
	2 Merge Right	(185.65 ea)	
	2 Merge Left	(185.65 ea)	
2	Plastic Bags (20-30 gals.)	(31.41/case)	62.82
2	Plastic Bags (50-55 gals.)	(51.21/case)	102.42
25	Maxicones	(26.90 ea)	726.97
24	4' Maxirail	(21.95 ea)	569.47
25	2' Maxirail	(10.35 ea)	279.71
300	Absorption Pads	(48.49/100)	157.25
16	10' Absorption Booms	(60.73/4)	262.60

Work	Cost
Development and Planning (Susan Everett)	$1,981.00
Build Shelves and Lighting (WSDOT Crew)	934.00
Total	$7,184.24

As a parallel effort to the storage site installation, emergency traffic control plans (Figures 3.1 and 3.2) that included storage site equipment were designed for the Washington State Patrol to use as a guide when responding to major incidents. The plans did not meet the Manual of Uniform Traffic Control Devices (MUTCD) standards, so they were not incorporated into the approved traffic control plan.

Designing and furnishing the storage site, as seen in Table 3.1, were fairly inexpensive. The traffic control devices, signs and cones, were a large part of the equipment costs.

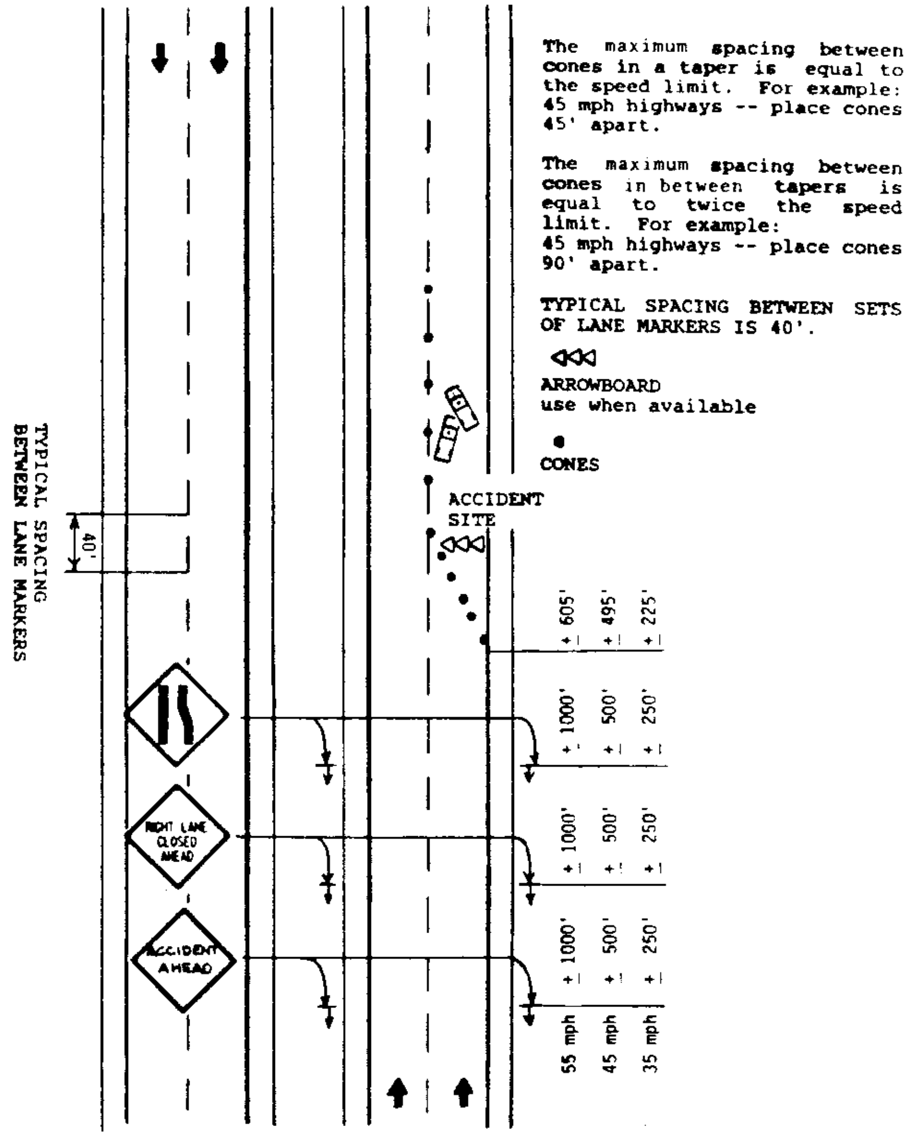
Current Use

Use of the storage site to this point has been fairly light. The shovels, six cases of flares, and 36 sand bags are the only equipment used so far. The flares and sandbags have since been restocked. It was heavily used during several snow storms right after the site was installed, but since then, use has been low. Apparently, the other equipment has not been used because no major incidents have occurred near the storage site, and since the site has not been used often, it has been easily forgotten.

Further Plans

WSDOT personnel feel that the main reasons the storage site are not used more are that (1) response times suffer since the trooper must stop at the storage sties; and (2) troopers and maintenance crews do not remember the site is available. Because storage sites do seem to be needed facilities, periodic flyers to WSDOT maintenance and the State Patrol reminding them of the storage site availability might help in establishing its use. Another possible solution would be to bring the Sergeants to the site and give them simple training on how to use the equipment so that they know and remember the site.

The future goal of such a program is to have similar sites at major interchanges along the freeway network so that storage sites will be near any incident. Locations along Interstate 5 would include Northgate, SR 520, I-90, Downtown, Michigan Street, I-405, 320th Street, and one site in Tacoma. On-ramps would be logical places to put the sites,



THIS TRAFFIC CONTROL PLAN IS FOR EMERGENCY USE ONLY. FOR OTHER LANE CLOSURES, SEE WSDOT STANDARD PLANS AND THE MUTCD.

Figure 3.1 Closing One Lane of a Multilane Highway

The maximum spacing between cones in a taper is equal to the speed limit. For example:

55 mph highways: place cones 55' apart.

45 mph highways: place cones 45' apart.

The maximum spacing between cones in between tapers is equal to twice the speed limit. For example:

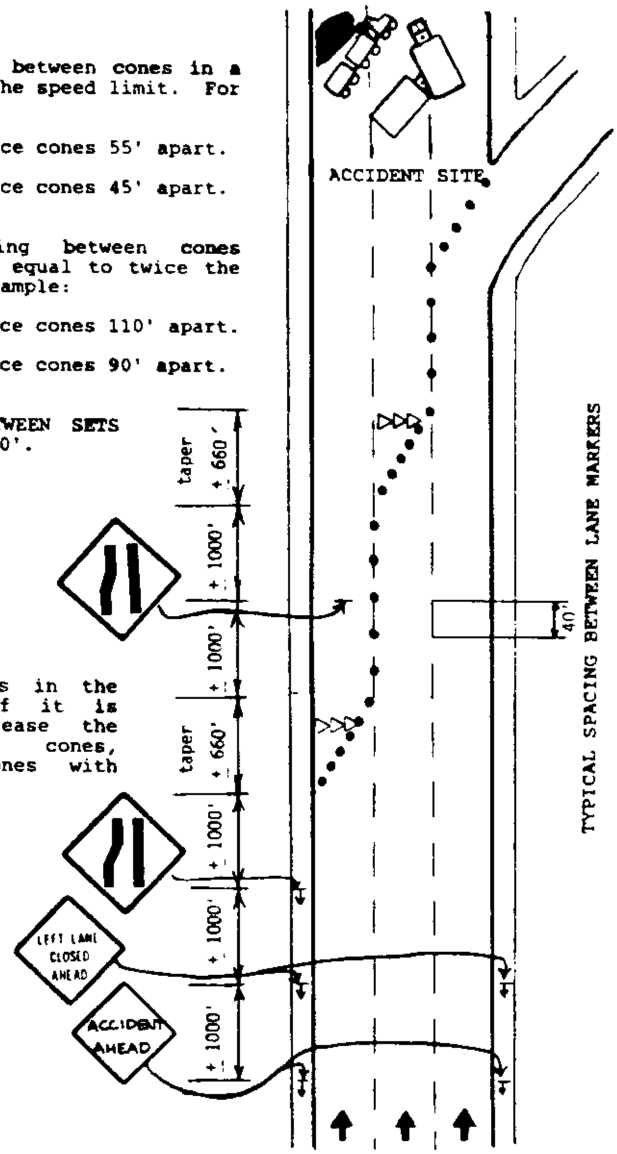
55 mph highways: place cones 110' apart.

45 mph highways: place cones 90' apart.

TYPICAL SPACING BETWEEN SETS OF LANE MARKERS IS 40'.

ARROWBOARD
use when available

CONES
There are 25 cones in the storage area. If it is necessary to increase the spacing between cones, supplement the cones with flares.



THIS TRAFFIC CONTROL PLAN IS FOR EMERGENCY USE ONLY. FOR OTHER LANE CLOSURES, SEE WSDOT STANDARD PLANS AND THE MUTCD.

Figure 3.2 Closing Multilane Highway for an Incident since they usually offer quite a bit ofroom near the road. Since they do not need power or very much storage room, shipping crates, inconspicuously placed, would be inexpensive and would keep the equipment dry. To accomplish the goal of distributed storage sites, Susan Everett expressed that a full time person would be needed to arrange and develop the sites.

Evaluation Summary

On the basis of the data and conversations with WSDOT personnel, the authors believe that three aspects of the storage site concept are necessary to ensure success. First, as discussed above, WSDOT must be continually made aware of the existence of such sites and develop a habit of using them. This can be achieved when the storage sites are located at a number of key points in the study area and reach a "critical mass." The current single site, while a solid effort, simply does not have the program visibility necessary for success.

Second, as mentioned in the previous section, location is very important. While the TSMC site was thought at first to be an excellent location, WSDOT now feels that better locations would be strategic on-ramps. Again, the problem is one of quantity; if just one site is to be chosen, the TSMC site is a good compromise location. However, in the recommended multi-site system, the TSMC would be a sub-optimal location that would tend to slow trooper response times relative to the more usable on-ramp sites. Third, the incident management position recently created at the TSMC is key to success, as it assures that individual responsibility and attention will be given to the program.

ACCIDENT INVESTIGATION SITES

One administrative option of incident management is accident investigation site use. Accident investigation sites have been analyzed in a number of papers (see Volume I). These papers discussed the promotional issues of accident investigation site use in large cities; their administration, location, design, and operation; legal matters; insurance; accident information collection; and the effects of property damage on accident severity.

Requirements

Accident investigation sites need an area of level ground large enough to park five cars (min. 1000 ft^2), a pay phone on a pole, electricity for security lighting, and a shelter for accident reports.

Seattle Program

Because of the apparent effectiveness of accident investigation sites in other states, WSDOT has started an accident investigation site program in the North Interstate 5 area. These sites were selected because the North Interstate 5 area is the established control corridor for traffic related improvements. The future goal is to establish accident investigation sites at key locations along the Interstate 5 system within King County.

Five sites that required little or no site work and were convenient to I-5 were initially proposed: one on each side of the freeway at Northgate, one on each side of the freeway at 45th Street, and one at Mercer Street. The locations of these sites are shown in Figure 3.3. The work and costs required to implement these five accident investigation sites are listed in Table 3.2. Because of budget constraints, installation has been pared to the three least costly locations, sites three, four, and five.

TABLE 3.2
ACCIDENT INVESTIGATION SITE WORK AND COSTS

	Cost ($)				
Work	Site 1	Site 2	Site 3	Site 4	Site 5
Asphalt	3,000	3,000		3,600	2,000
Clear and Grub	400				
Concrete Driveway	350	350			
CSTC	1,300	1,300		1,480	800
Curb	300	300			
Electricity	500				
Fence		1,540			
Gravel Barrow	500				
Signs	100	100	100	100	100
Storage Box	100	200		100	100
Striping	140	140	140	160	115
Subtotal	6,690	6,930	240	5,440	3,115
Total	22,415				

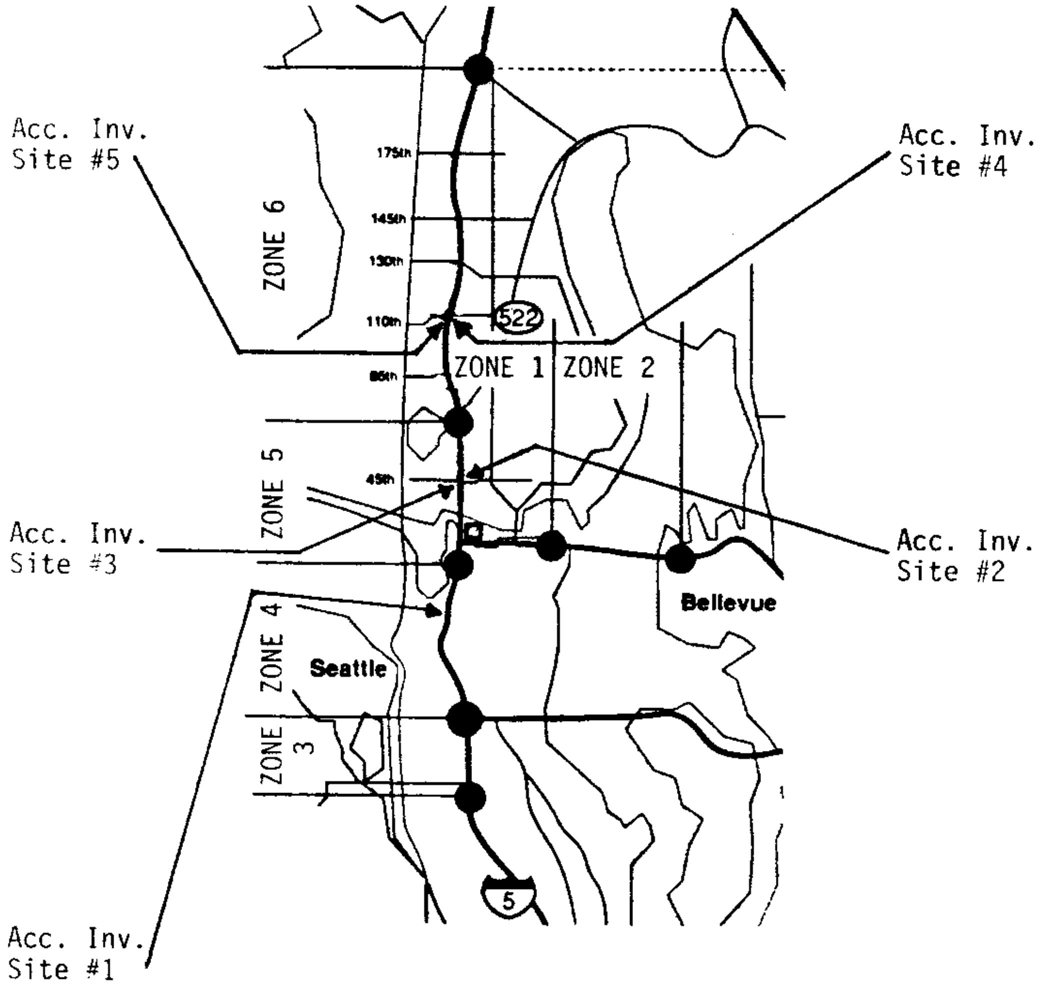


Figure 3.3 Accident Investigation Sites

Besides sending necessary letters and preparing plans for the accident investigation sites, no further work has been done. The delay is primarily the result of personnel movement (Susan Everett left her position at the TSMC), and, in the absence of her replacement, no one has been available to carry out the required administrative tasks.

Evaluation Summary

The concept of accident investigation sites certainly holds promise for incident mitigation in the Seattle area. There are the obvious problems of informing the public and developing good usage patterns. But beyond these problems is a fundamental location dilemma. Currently, most accident investigation sites are planned for Zones 5 and 6 (see Figure 3.3), but the incident impacts in these zones, in terms of vehicle-hours lost per minute of incident duration (see Figure 3.17, Volume III) are much less than the impacts of incidents that occur in Zones 3 and 4. (Only one of the five planned sites is in this area.) Therefore, perhaps Zones 3 and 4 should be the target of such efforts; however, the availability of space necessary to operationalize accident investigation sites in these zones is extremely limited. Thus the fundamental weakness of accident investigation sites is that they are difficult to implement in the most critical-need areas, which tend to be characterized by very limited space and poor geometrics. These are the physical problems that lead to unresolvable congestion and, as a consequence, higher disablement and accident rates with high impact potential. For the Seattle area, the authors feel that accident investigation sites will be, in all practicality, a potentially effective strategy in low and intermediate impact areas (e.g., Zones 5 and 6) but, because of space and financial limitations, they will not be well suited to most high impact areas (e.g., Zones 3 and 4).

CHAPTER 4

RECOMMENDATIONS FOR FUTURE INCIDENT MANAGEMENT STRATEGIES

This chapter presents a number of suggested directions for future incident management efforts in the Seattle area. These suggestions are based on the data collection effort, traffic simulations, and discussions with WSDOT and WSP personnel. The suggestions are broadly classified into three areas; (1) education and awareness, (2) resource and personnel allocations, and (3) detection and reporting. A discussion of these areas follows.

EDUCATION AND AWARENESS

Experience to date with storage sites and accident investigation sites indicates that awareness is a key obstacle to success. The disappointing decline in the use of the existing TSMC storage site can be largely attributed to ease of accessibility and a lack of awareness among WSP troopers. Therefore, publicity relating to any incident management program must be a continuing effort (before, during, and after implementation).

Education for incident response personnel on better managing traffic around the incident (e.g., Figures 3.1 and 3.2) is also strongly needed. This education could best be accomplished with an annual, one-day program in which troopers and fire department personnel are briefed and updated on state-of-the-art developments in incident management. Such a program could also serve as a forum for increasing awareness of storage sites, accident investigation sites, and other strategies that may be implemented in the future.

It is important that incident response personnel be made aware of the incredible cost, in terms of lost vehicle-hours, of incidents. For example, a 60-minute incident causing a 75 percent reduction in capacity on the I-5 Ship Canal bridge has an average commuting time cost of roughly $2,700 per minute of incident duration (assuming a value of time of $10 per vehicle-hour, see Table 3.5, Volume III). Also, the longer the incident lasts, the higher are the per minute costs. Therefore, response personnel (particularly the fire department) must be made aware of the economics involved in restoring roadway capacity.

Driver education and awareness has potential benefits. Drivers must be convinced not to slow down to view incidents (i.e., the gaper effect). This study's simulation of the gaper effect (Table 3.7, Volume III) indicated that hundreds of vehicle hours are lost because of gaping. A public awareness brochure outlining the cost of incidents (i.e., presenting some of the findings of this report) may be effective in increasing public awareness and improving the public's response to incidents.

RESOURCE AND PERSONNEL ALLOCATION

Our findings suggest that, given the limited resources allocated to incident management, resources and personnel are reasonably well allocated. Evidence of this is the minimal effect that special events and differences in zonal accident rates have on incident duration. However, the response to incidents should be prioritized according to the impacts that are likely to result. In this regard, incident management in Zones 3 and 4 seems to be under allocated, particularly since the impacts of an incident in this area are much greater than the impacts of a comparable incident in all other areas. SR-520, for example, appears to have received most of the incident management attention to date (in the study area), perhaps because of the obvious lack of diversion routes (on the floating bridge) and its impressively long queues. However, the I-5 corridor in central Seattle has few, if any, truly feasible diversion routes, and the amount of traffic carried on I-5 is nearly twice that carried on SR-520. Therefore, more attention should be paid to I-5, specifically in Zones 3 and 4. An obvious immediate need would be the provision of a dedicated tow truck, as is currently the case for the Lake Washington floating bridges.

DETECTION/RESPONSE

As discussed in Chapter 2, the average incident detection time (just over 5 minutes) and average response time (just over 4 minutes) are both fairly small. However, any additional reduction in these times will have great potential benefits, since the commuter cost per minute can easily exceed $2,000 (see above). Thus it is important for the TSMC to upgrade its detection methodology as technology progresses, and for WSP troopers to continue to strive toward any reduction in response times. The continued use of cellular phones for reporting purposes should be encouraged either by radio stations or WSDOT.