Traffic Impacts During the Goodwill Games

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Washington State Department of Transportation
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16. ABSTRACT

This study analyzes the impacts of the Goodwill Games on traffic congestion in the Seattle-Tacoma metropolitan corridor. The study concentrates on the combined impacts of increased traffic volumes resulting from Goodwill Games events, and the traffic mitigation measures designed to relieve the congestion resulting from those events. The study emphasis is on traffic congestion near the largest venues, Husky Stadium, Cheney Stadium, the Tacoma Dome, and the Seattle Center.

The study considers traffic volume, traffic speed, incident response, and transit ridership data from a number of sources. The basic conclusions of the report are that in most cases the increased traffic expected for the Goodwill Games and the savings from measures implemented to mitigate those volume increases balanced each other. The result was that traffic conditions remained fairly normal throughout the Games. In some instances, traffic improved (for example, on many days peak period traffic speeds increased on SR-520), and in other instances, particularly when incidents occurred during peak travel periods, traffic conditions were worse than normal. However, average traffic conditions changed little during the Games.

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Final Report

Research Project GC8719, Task 29
Goodwill Games Traffic Impacts

TRAFFIC IMPACTS DURING THE GOODWILL GAMES

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TRAFFIC IMPACTS DURING THE GOODWILL GAMES

SUMMARY

The 1990 edition of the Goodwill Games took place over 15 days, from July 20th through August 5th, in the state of Washington. Because of the size of the Games, local traffic planners expected that traffic volumes generated by the scheduled sporting and cultural events, combined with the existing level of traffic congestion in the metropolitan area, would produce unprecedented levels of congestion, especially near the largest sports venues.

Because of these fears, a large number of traffic mitigation efforts were undertaken by the Seattle Goodwill Games Organizing Committee, the Washington State Department of Transportation (WSDOT), the Washington State Patrol (WSP), the Municipality of Metropolitan Seattle (Metro), the University of Washington (UW), the Washington Tow Truck Operators Association, the Professional Tow Truck Operators of Pierce County, and other agencies and organizations. The Federal Highway Administration (FHWA) supported these mitigation efforts with funding, advice and temporary staff support.

Mitigation measures undertaken by these agencies included the addition of quick response service patrols by the Washington State Patrol and Washington Tow Truck Operators Association, the creation of off-roadway temporary storage locations for disabled vehicles, transit service improvements, telephone hotlines for traffic information, a mass media information campaign aimed at increasing mass transit usage to the Goodwill Games events, and employer transportation programs aimed at reducing peak period commute trips.

This study was commissioned to analyze the impacts of these various factors and programs on traffic performance and congestion. The study was restricted to the Seattle-Tacoma metropolitan corridor, with specific emphasis on traffic congestion near the following venue sites:

- Husky Stadium at the University of Washington, which hosted the opening ceremonies and track and field events,
- Cheney Stadium in Tacoma, which hosted the baseball games,
- the Seattle Coliseum and Seattle Center, which hosted the basketball games and the press center, and
- the Tacoma Dome, which hosted gymnastics, figure skating and the final two rounds of ice hockey.

A variety of traffic and transit information was collected both specifically for this project and from ongoing data collection efforts. The study looked at the impacts of the Goodwill Games on traffic volumes and speeds, transit ridership, incident frequency and duration, and general public opinion. The findings of the study are summarized below.

FINDINGS

The findings in this summary are divided by type of data that were collected and location of the metropolitan area.

Traffic Volumes — Tacoma

Impacts on Tacoma traffic volumes from the Goodwill Games were relatively minor. In several cases, specific event traffic or incidents caused unusual congestion, and in some cases, lighter than normal traffic volumes were observed. However, on the average little impact was apparent from the available traffic monitoring data. In Tacoma, reliable volume data were available for SR-16 and SR-509. Some volume data were available for I-5, but the reliability of these data were not good.

Daily traffic volumes on SR-16 were essentially unchanged during the Goodwill Games. Slight rises were measured for the average daily Thursday and average daily Friday traffic flows, but these increases were small and well within the bounds of normal traffic volume variation. On the remaining days of the week, Goodwill Games traffic

volumes fell between the traffic volumes that were measured before the Games began and after the Games ended.

Daily traffic volumes on SR-509 did increase slightly during the weekends of the Goodwill Games (Friday through Sunday), but this change was not statistically significant. Little or no noticeable change in traffic occurred during the other days of the week. (Figure i.) Hourly volumes on SR-509 did increase slightly as a result of Goodwill Games event traffic, but again, these changes were well within the range of normal variation. Figure ii illustrates the measured increases in northbound traffic on SR-509 as a result of late afternoon and evening events at the Tacoma Dome.

Traffic Volumes — Seattle

As in Tacoma, traffic data collected in Seattle showed that only relatively small changes in traffic volumes occurred during the Goodwill Games. On specific days and near specific event locations, traffic volumes changed noticeably (Figure iii shows the impact of the Opening Ceremonies on July 21st), but for the 15-day event period, the measured changes tended to be within the range of normal variation in traffic volumes.

Traffic volumes on the Ship Canal bridge (see Figures iv and v) reflected the impact of the transportation demand management methods implemented to reduce peak period traffic. However, although daily traffic decreased by 2,350 vehicles per day northbound and 3,000 vehicles per day southbound, neither of these changes were statistically significant.

Elsewhere on I-5 in Seattle, traffic volumes did not decrease. For example, at Yesler, northbound average weekday volumes on I-5 increased over 2,300 vehicle per day during the Games. Similarly, data collected on I-5 at NE 107th showed an increase in southbound traffic, and no statistically significant change in daily volumes in either direction.

Significant reductions in daily volumes were observed on SR-520, but only on the section on the eastern side of Lake Washington. West of the bridge, measured volume

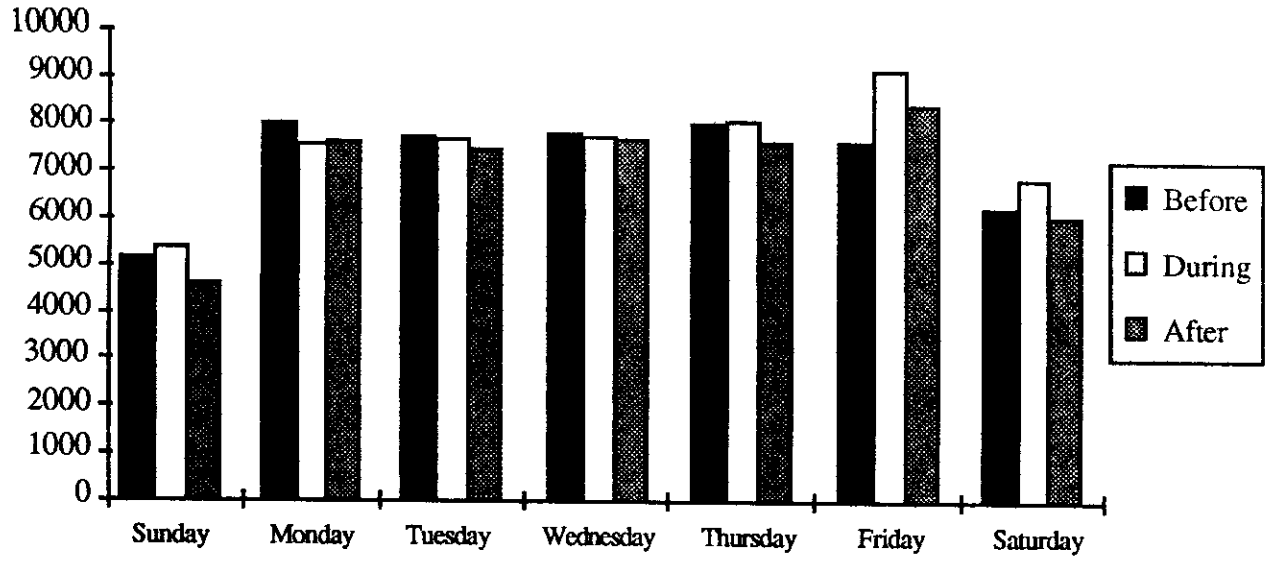

Figure i. Daily Traffic Volumes by Day of Week - Before, During and After the Goodwill Games SR-509, Northbound at Union Station in Tacoma

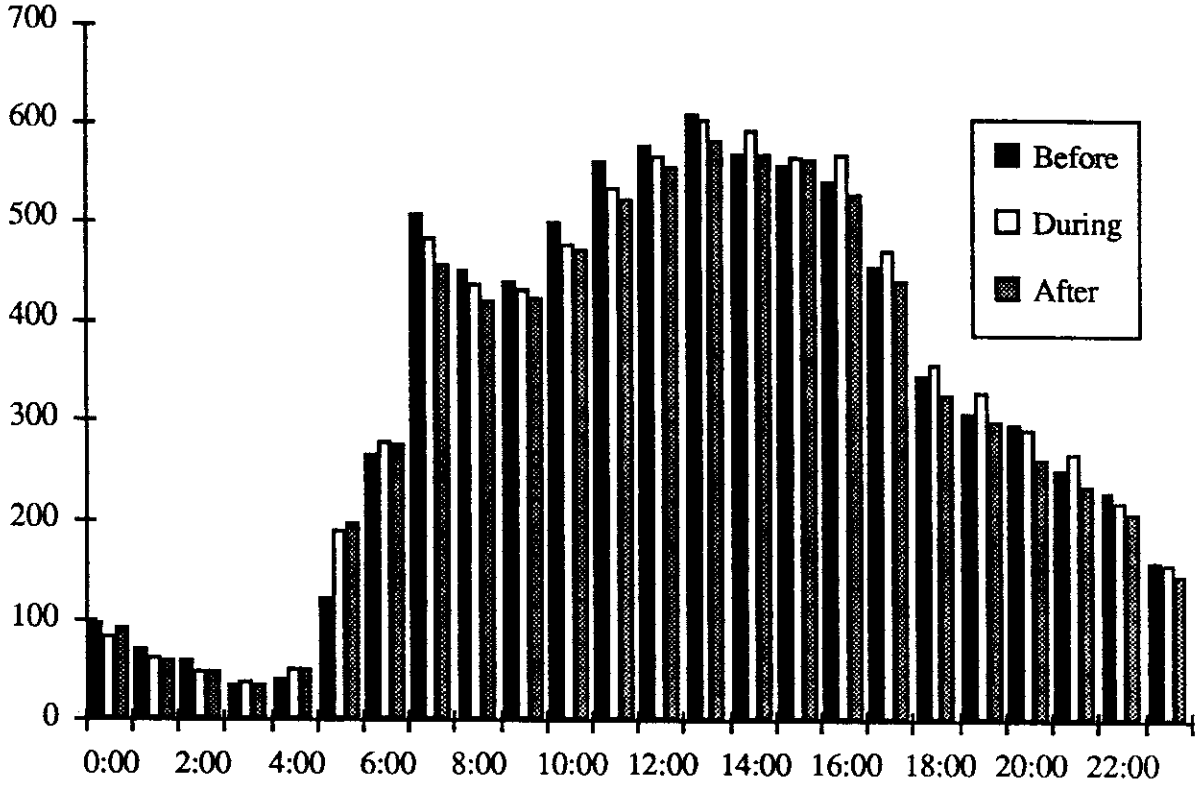

Figure ii. Weekday Average Hourly Traffic Volumes Before, During and After the Goodwill Games - SR-509 Northbound at Union Station

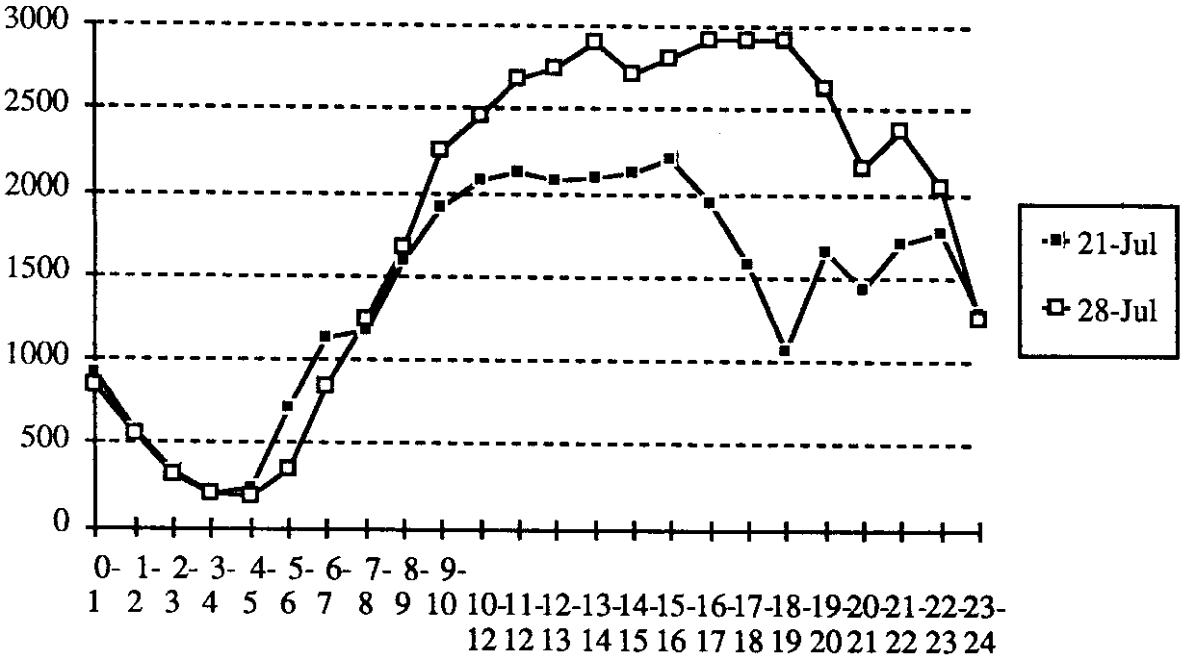

Figure iii. Westbound SR-520 Traffic Volumes

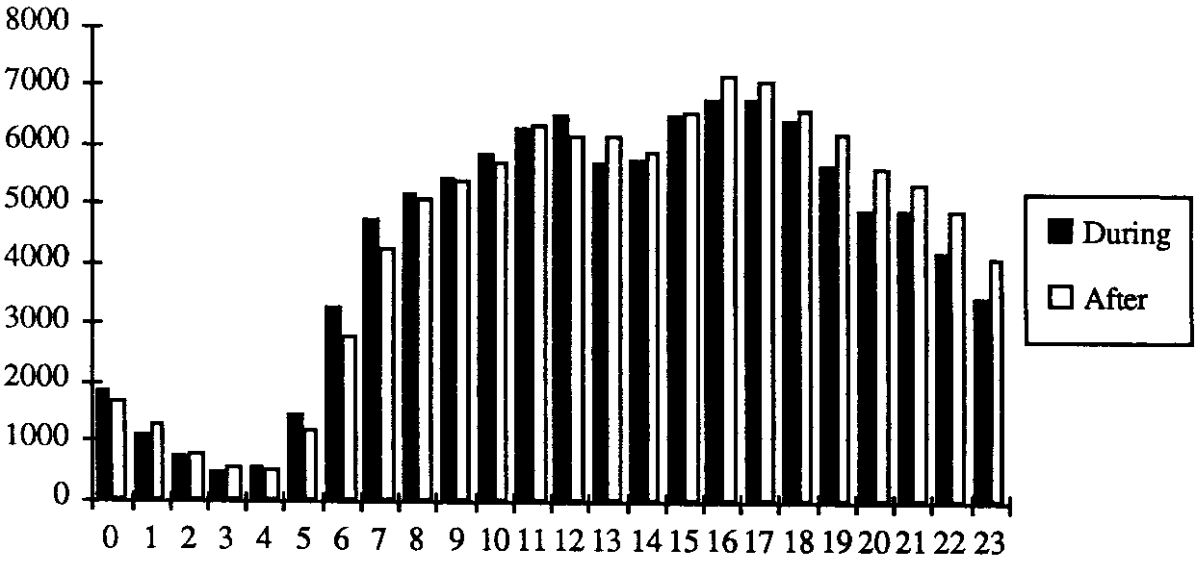

Figure iv. Northbound Traffic Volumes on I-5 at the Ship Canal

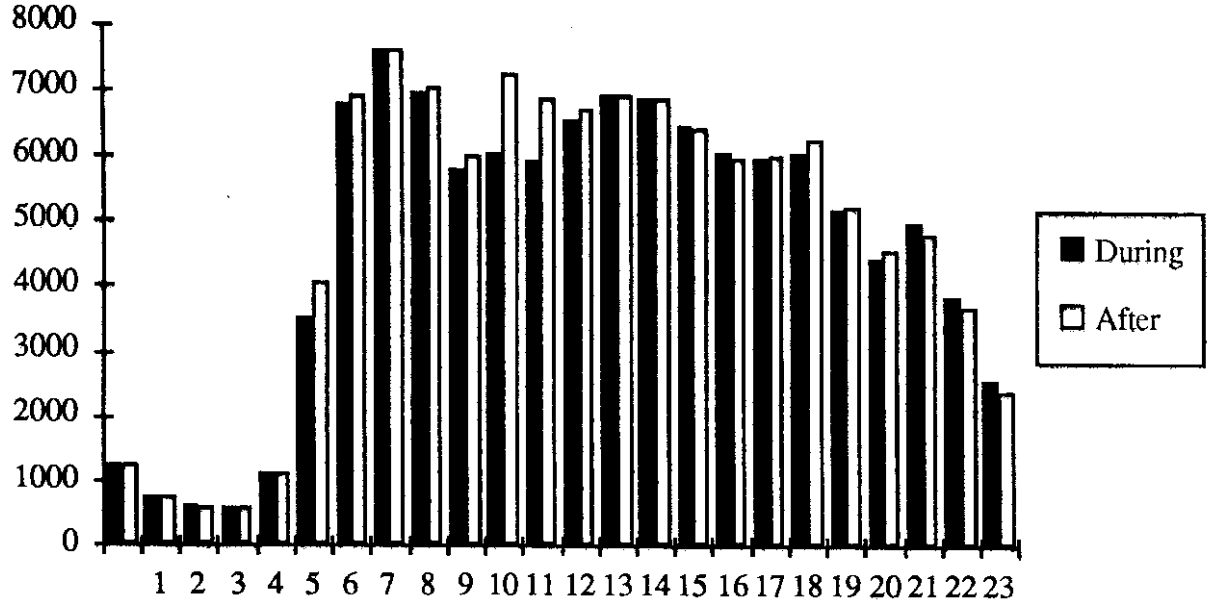

Figure v. Southbound Traffic Volumes on I-5 at the Ship Canal

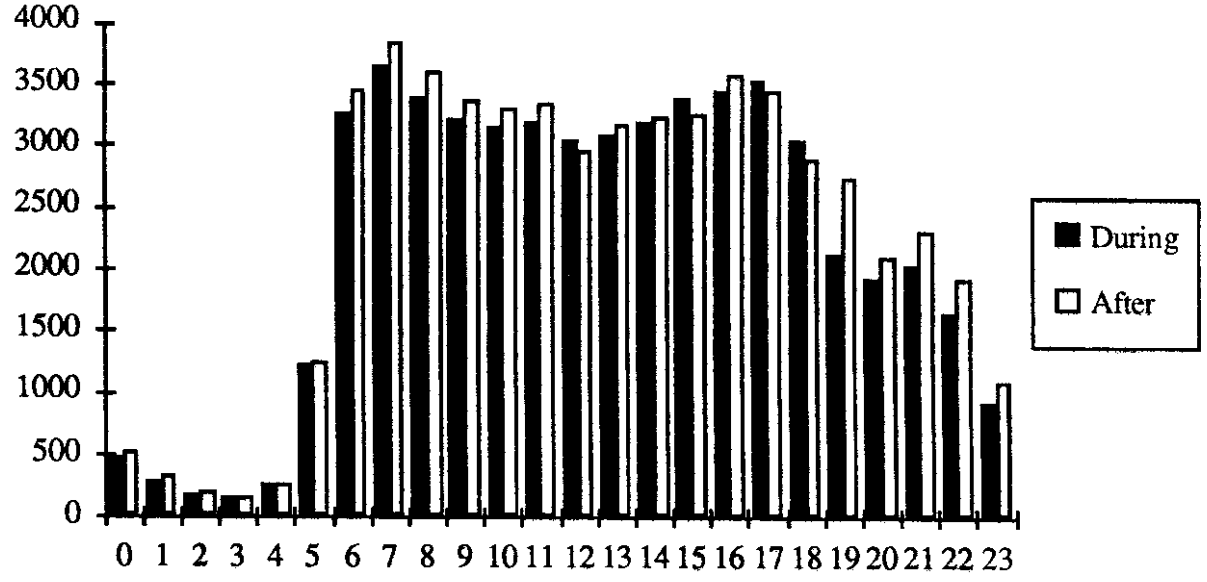

Figure vi. Westbound Traffic Volumes on SR-520 During and After the Goodwill Games

changes were marginal and not statistically significant. East of the bridge, traffic volumes decreased in both directions, and both decreases were statistically significant at the 95 percent level of confidence. Westbound, traffic volumes decreased by 2,500 vehicles per average weekday. Eastbound this decrease was around 3,000 vehicles per weekday. A significant portion of these decreases came from the peak travel periods (see Figure vi).

Equipment failures on I-90 prevented the accurate determination of traffic impacts on that facility.

Vehicle Speed — Tacoma

Speed data were available for I-5 in Tacoma from dual loop counters placed by the WSDOT Transportation Data Office. No changes in average daily speed were apparent from these data. However, some slowing of vehicles was measured southbound in the evening at Fife (see Figure vii). Decreases in average vehicle speed did not occur every evening, and the available data suggested strongly that incidents might be as likely a cause of the measured delays as added traffic due to the Goodwill Games. A similar reduction in vehicle speed was not measured on the northbound approaches to the central Tacoma freeway exits.

Vehicle Speed — SR-520

Special travel time studies were undertaken to determine vehicle speeds on SR-520. Data were collected both in the morning and evening for westbound traffic from the 108th Street overpass in Bellevue to the Montlake Flyer Stop in Seattle. For eastbound traffic, data were collected at the 10th Avenue overpass, the Montlake Flyer Stop, and the old toll plaza. In general, traffic speed improved for SR-520 trips throughout the day (See Figure viii). For westbound SR-520 in the morning, this improvement took the form of a delayed onset of congestion and an earlier dissipation of that congestion when it did occur (see Figure ix). In the afternoon, this decrease in congestion was smaller and less obvious.

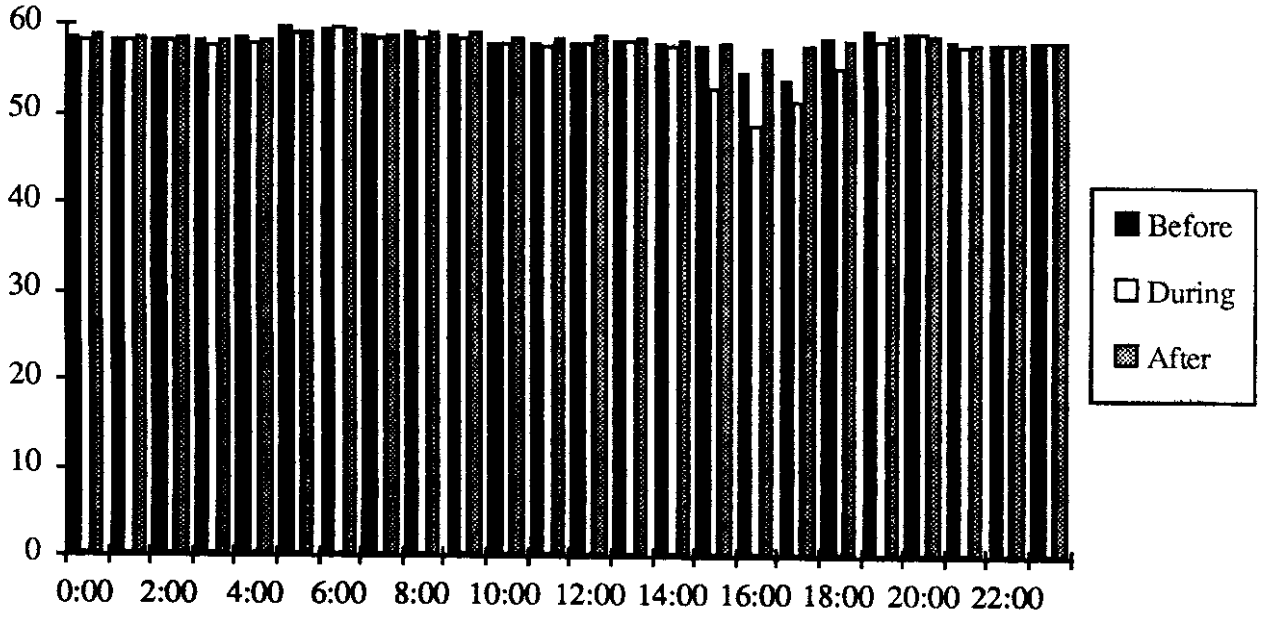

Figure vii. Weekday Hourly Traffic Speeds Before, During and After the Goodwill Games — Interstate 5, Southbound at Fife

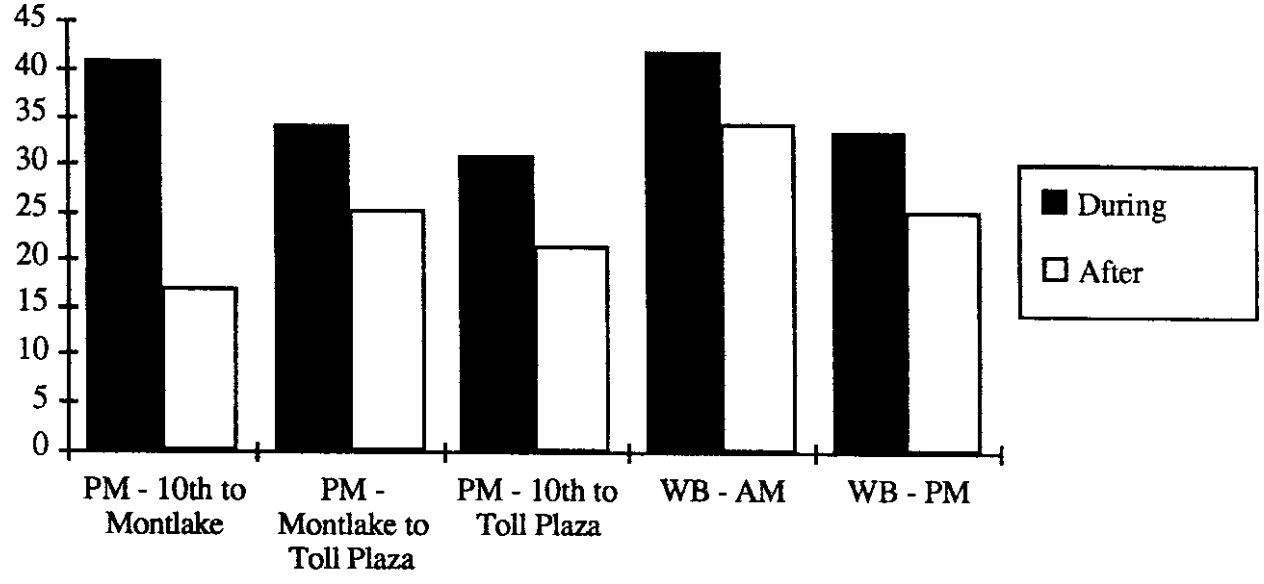

Figure viii. Average Speeds Before and After the Goodwill Games on SR-520

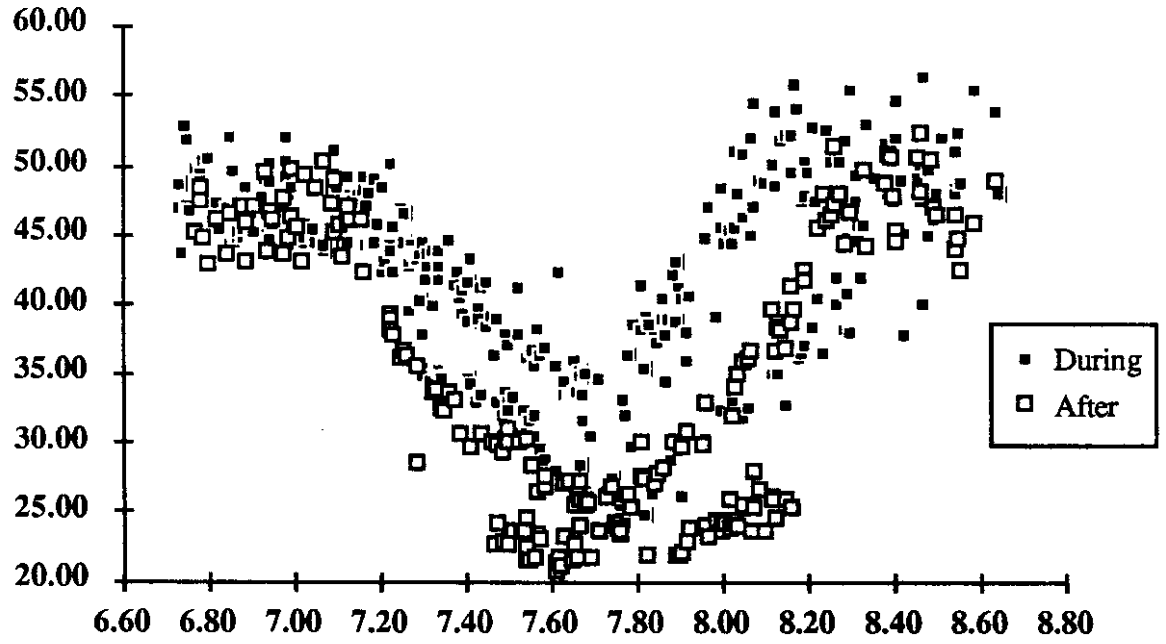

Figure ix. During and After Vehicle Speeds on WB SR-520 in the AM Commute Period

Eastbound improvements in average vehicle speed ranged from an increase of just under 9 miles per hour between Montlake and the eastern end of the floating bridge and 24 miles per hour between I-5 and Montlake Blvd.

Bus Ridership

Bus ridership on Metro increased substantially during July, primarily as a result of the Goodwill Games. Adjusted weekly ridership increased 10.4 percent over the same figure for 1989. Total ridership for July increased 7 percent over 1989, despite the fact that 1989 had more weekdays than 1990. A major part of this increase was a result of transit ridership to the Goodwill Games Opening Ceremonies, which approached 40,000 passengers. This ridership was roughly twice what Metro carries to Husky stadium for a comparatively sized crowd during the college football season.

Telephone Hotlines

Both the Metro and WSDOT telephone information lines where overwhelmed with requests for information. On Friday, July 20th, (the day before the Opening Ceremonies) almost 52,000 calls were made to the Metro information line. Only 3,843 of those calls were answered as a result of limits in the number of telephone lines and operators that were available at any time. WSDOT experienced similar demand for its traffic information number, although WSDOT did not track the number of calls that could not be answered by their system.

Service Patrols and Incident Response

The operation of service patrol vehicles improved the ability of the WSDOT and WSP to both identify and locate incidents. This was shown by the increased number of incidents first reported by service patrol drivers, the decreased response time required to reach incident sites, and the decrease in incident duration in areas served by the service patrols. While the available data did not provide strong statistical confidence in the measured improvements in incident duration, a number of contributing factors provided support for the conclusion that the service patrols significantly improved incident response on the metropolitan freeway system.

The first of these supporting facts was that the duration of incidents consistently decreased in the two study areas that contained service patrols, while the duration of similar incidents in areas without service patrols often increased (see Figure x). Since no other major changes in incident response procedures occurred during this study's time frame, the differences in incident response characteristics between the geographic areas could logically be attributed to the service patrols. The second supporting factor was that the decreases in incident duration measured for this effort did not include the savings in incident duration that resulted from improved detection time. While the response time the WSP service patrols saved could be crudely estimated (close to 5 minutes per incident according to the CAD database), it was not possible to estimate how long incidents would have remained

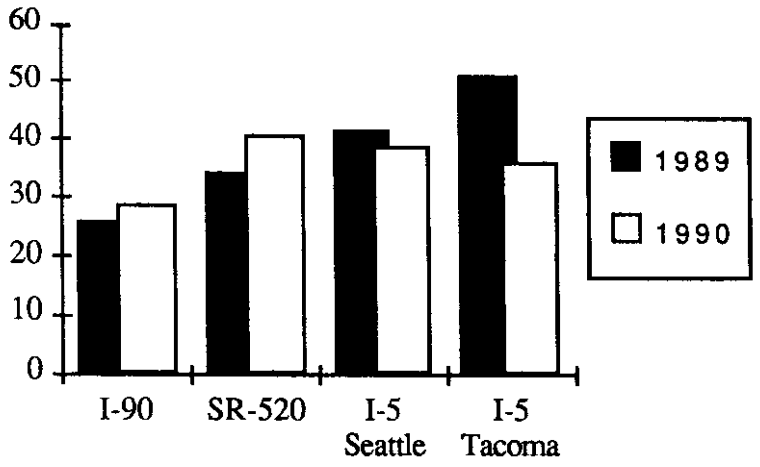

Figure x. Duration of Incidents Involving Accidents

undetected if a service patrol vehicle had not first identified them. These improvements in identifying incidents are particularly important in areas such as Tacoma where no formal surveillance control and driver information (SC&DI) system exists. The 300 percent increase in incidents attributed to the Tacoma Service Patrol showed how valuable extra incident detection can be.

CONCLUSIONS

The authors conclude that the traffic mitigation measures undertaken by the cooperating agencies in the metropolitan area succeeded in containing the expected traffic congestion during the Goodwill Games. In some areas traffic improved during the Games; in most areas, traffic remained near normal levels; and in some individual cases, severe congestion still occurred (for example, the first Friday of events near the King County Aquatics Center). However, the few cases of severe congestion were almost always caused by a combination of severe incidents and heavy traffic volumes. While the service patrols and other incident response actions implemented by WSDOT and other agencies decreased the time required to respond to these incidents, these measures did not (and can

not be expected to have) totally eliminate the impact of incidents on congested facilities, particularly during peak travel times.

In general, the cooperating agencies achieved the objective of informing the local population of the potential for expected traffic congestion and provided ways to deal with that congestion While much of the public was not aware of many of the transportation services available to them, enough people changed their travel patterns to maintain normal traffic flow despite the increase in trips generated as a result of the Games.

Those areas that received the most media attention also received the best public response. Most notably, as a result of an extensive public information campaign, over 50 percent of the spectators attending the Opening Ceremonies used public transportation. Other areas that received less publicity (such as the Service Patrols) operated effectively, achieved their basic goals, and contributed towards smooth traffic operations, but did so without gaining the attention of much of the general public.

The end result was a system that worked well enough to operate relatively unnoticed once the Games got under way. The authors consider this a sign of success, and the hallmark of a smoothly functioning transportation system.

INTRODUCTION AND RESEARCH APPROACH

BACKGROUND

The Goodwill Games are a large, international gathering of world class athletes competing in a variety of sporting events. Coincident with the athletic events are a series of cultural events (plays, concerts, arts displays, etc) aimed at broadening the world's understanding of different cultures and traditions.

The 1990 edition of the Goodwill Games took place over 15 days, from July 20th through August 5th, in the state of Washington. The majority of sporting venues were located within the Seattle-Tacoma metropolitan area. The largest sporting venues included the following:

- Husky Stadium at the University of Washington, which hosted the opening ceremonies and track and field events,
- Cheney Stadium in Tacoma, which hosted the baseball games,
- the Seattle Coliseum and Seattle Center, which hosted the basketball games and the press center, and
- the Tacoma Dome, which hosted gymnastics, figure skating and the final two rounds of ice hockey.

Other sporting and cultural events were scattered throughout the metropolitan region, with some events held in Spokane and the Tri-cities area.

Because of the size of the Games, their unique international flavor, and nationwide media coverage from both the Turner Broadcasting Network (which sponsored the games) and the "regular" sports press, event planners expected a large influx of tourists to the metropolitan area, with large crowds attending the events. When local traffic planners combined the traffic volumes expected for the sporting and cultural events (many of which were scheduled to start during the early evening rush hours) with the existing level of

traffic congestion in the metropolitan area, unprecedented levels of traffic congestion were forecast, especially near the largest sports venues.

As a result of these fears, a large number of traffic mitigation efforts were undertaken by the Seattle Goodwill Games Organizing Committee, the Washington State Department of Transportation (WSDOT), the Washington State Patrol (WSP), the Municipality of Metropolitan Seattle (Metro), the University of Washington (UW), the Washington Tow Truck Operators Association, the Professional Tow Truck Operators of Pierce County, and other agencies and organizations. The Federal Highway Administration (FHWA) supported these mitigation efforts with funding, advice and loan staff.

These mitigation measures included the operation of special quick response service patrol vehicles and tow trucks on the most congested portions of the metropolitan freeway system, a system of special bus routes designed to serve the larger event venues from existing park-and-ride facilities, a telephone hotline that contained traffic information, and an extensive media campaign designed to recommend transportation options to motorists who would normally drive their personal vehicles during the periods when the Games would impact traffic.

This study was commissioned to analyze the impacts of these various factors and programs on traffic performance and congestion.

RESEARCH APPROACH

The basic research approach for this project was to collect data from available traffic monitoring sources for periods before and during the Goodwill Games to compare the performance of the system with and without the traffic mitigation measures implemented by the cooperating agencies and organizations. The traffic monitoring data, consisting of volume and lane occupancy data on I-5 in Seattle and volume information on I-5, SR-16, and SR-509 in Tacoma, were supplemented with data from several sources.

- Incident report forms were filled out by tow truck operators and WSP service patrol officers after each roadside assistance stop.
- Observers positioned in Tacoma to help detect incidents also submitted data sheets indicating the number and time of incidents they observed.
- Data were collected from the WSP Computer Aided Dispatch (CAD) system, which monitors WSP officer activity.
- Motorists who were helped by service patrol drivers in Tacoma were given a stamped, pre-addressed postcard that requested comments on the service provided.
- Travel time information was collected during peak commute periods on SR-520 across the Evergreen Point floating bridge.
- Speed data from dual loop detectors were collected on I-5 in Fife and Tacoma.
- Transit ridership information was obtained from Metro.
- Vehicle occupancy rates for five sites on I-5 and SR-520 were collected during the games, as were data at these sites from prior studies.
- Finally, a short telephone survey was conducted to determine the public's impression of the Goodwill Games traffic, traffic mitigation measures, and the service patrols.

However, data collection outside of routine traffic volume and vehicle speed monitoring information was limited by the relatively small size of the project budget.

The collected information was converted into a series of standardized formats and used to compare traffic conditions before, during, and after the Games. Statistics were used whenever possible to determine when measured changes were significant and when they were more likely random occurrences within the normal traffic stream. When statistically valid changes occurred, additional analyses were performed to determine

whether those changes could confidently be attributed to the Goodwill Games and/or the Goodwill Games traffic mitigation measures.

STUDY AREA

While the Goodwill Games event venues were scattered throughout the Puget Sound region, as well as some locations in Spokane and the Tri-cities, the majority of traffic congestion concerns were centered on the larger sports facilities (listed above) in Seattle and Tacoma. These sports facilities were located next to highways that already exhibited significant routine traffic congestion during peak travel periods. The transportation facilities of most concern were the following:

- SR-520 near the floating bridge (between I-5 and I-405),
- I-5 through Seattle,
- I-5 approaching the Tacoma Dome, and
- SR-16 approaching Cheney stadium.

A map showing these highways and their relation to the largest Goodwill Games venues is provided as Figure 1.

SPECIFIC MITIGATION MEASURES

Several specific traffic mitigation measures were implemented to limit the traffic congestion expected during the Goodwill Games. These special measures are described below.

WSP Service Patrols

The WSP operated six service patrol vehicles during the period of July 17 to August 5, 1990. The service patrols operated in addition to the normal complement of WSP officers regularly assigned to monitor traffic on the Seattle metropolitan freeway system. The WSP service patrols consisted of four Jeep Cherokees and two Nissan Pathfinders, all of which were equipped with push bumpers and incident response supplies

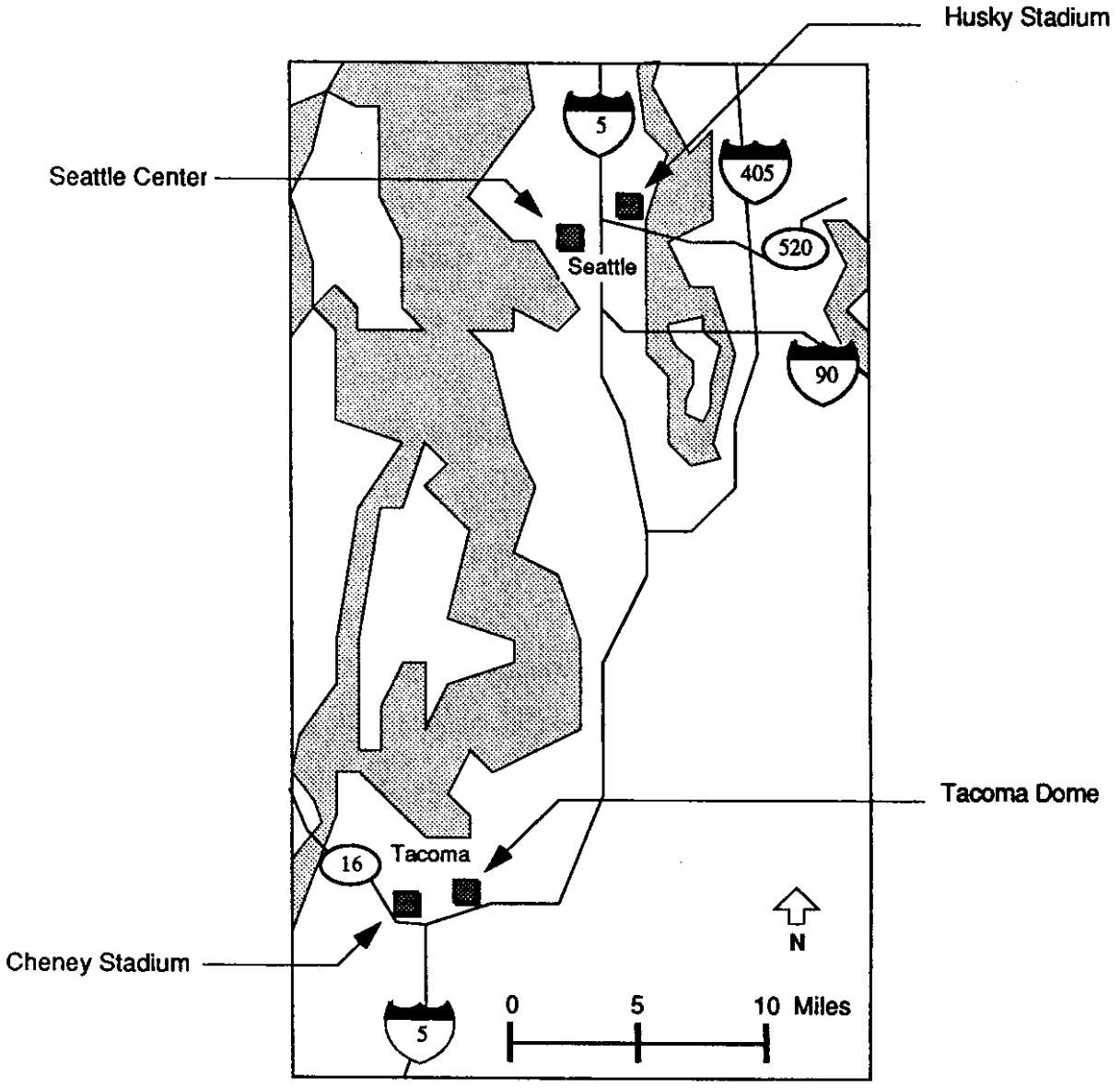

Figure 1. 1990 Goodwill Games Main Venues

(anti-freeze, cones, vests, sand). Winches were also provided on some vehicles to assist in moving disabled vehicles.

The WSP service patrol vehicles operated on a fixed time table, regardless of the specific Goodwill Games events scheduled for a given day. Three service patrol vehicles operated between 10:00 AM and 6:00 PM and the other three vehicles worked from 1:00 PM to 9:00 PM, seven days per week. Thus, six vehicles operated during the PM peak, the period expected to have the worst congestion problems because of the combination of the existing PM peak traffic volumes and traffic headed to Goodwill Games venues in the late afternoon.

The six vehicles patrolled the portion of the I-5 corridor pictured in Figure 2. Each vehicle was assigned to a particular patrol area. Six different response areas were defined to help spread the service patrol vehicles evenly throughout the covered area. Response vehicles were permitted to cross patrol zone boundaries as needed, and during time periods when only three vehicles were in service, each vehicle monitored more than one service zone.

The cost of the WSP service was estimated as $38 per hour for labor and capital, plus an undetermined per mile cost associated with the use of fuel, oil, and tires.

Tow Truck Patrols in Tacoma

The Washington Tow Truck Operators Association operated six tow trucks as service patrols in the Tacoma area pictured in Figure 3. The tow truck work shifts were more variable than the WSP shifts in Seattle. Because the event times at the Tacoma Dome and Cheney Stadium varied by event (i.e., some days events started earlier than others, particularly when different sports were being played in the Tacoma Dome), tow truck service patrol schedules were adjusted to ensure that schedules coincided with the event traffic generated in Tacoma. The Tacoma tow truck shift times are shown in Table 1.

The vehicles used in Tacoma were the conventional tow trucks normally operated by commercial towing firms in the Tacoma area. No modifications to these vehicles were

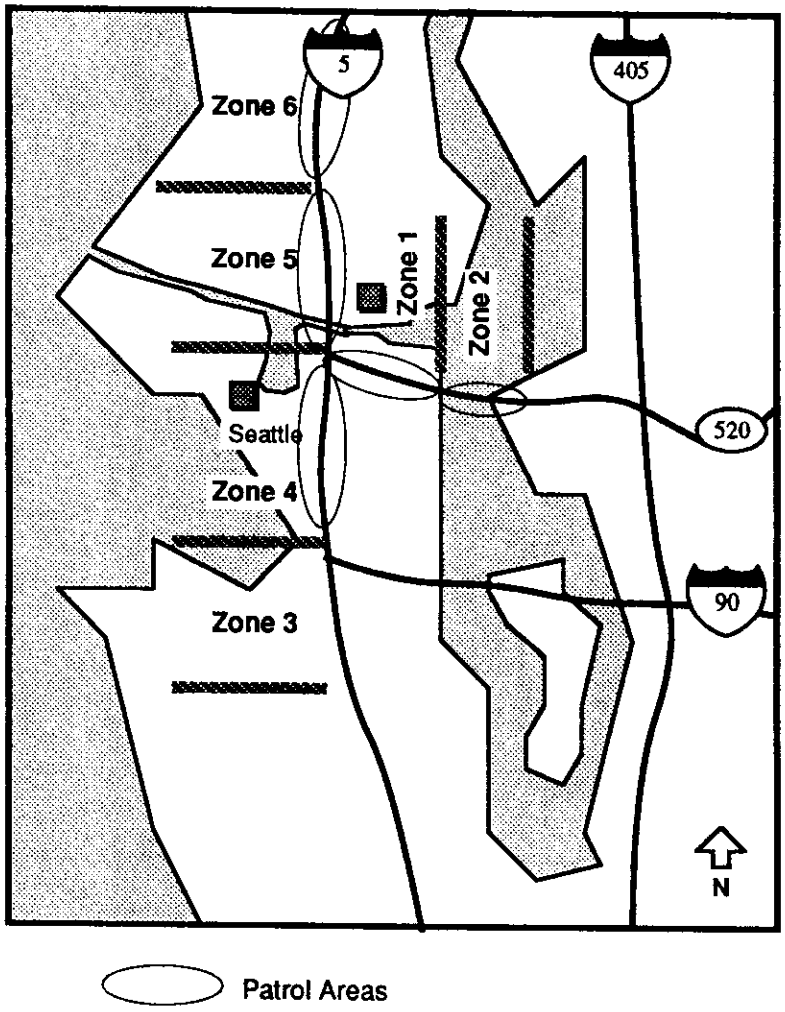

Figure 2. Seattle Service Patrol Area Map

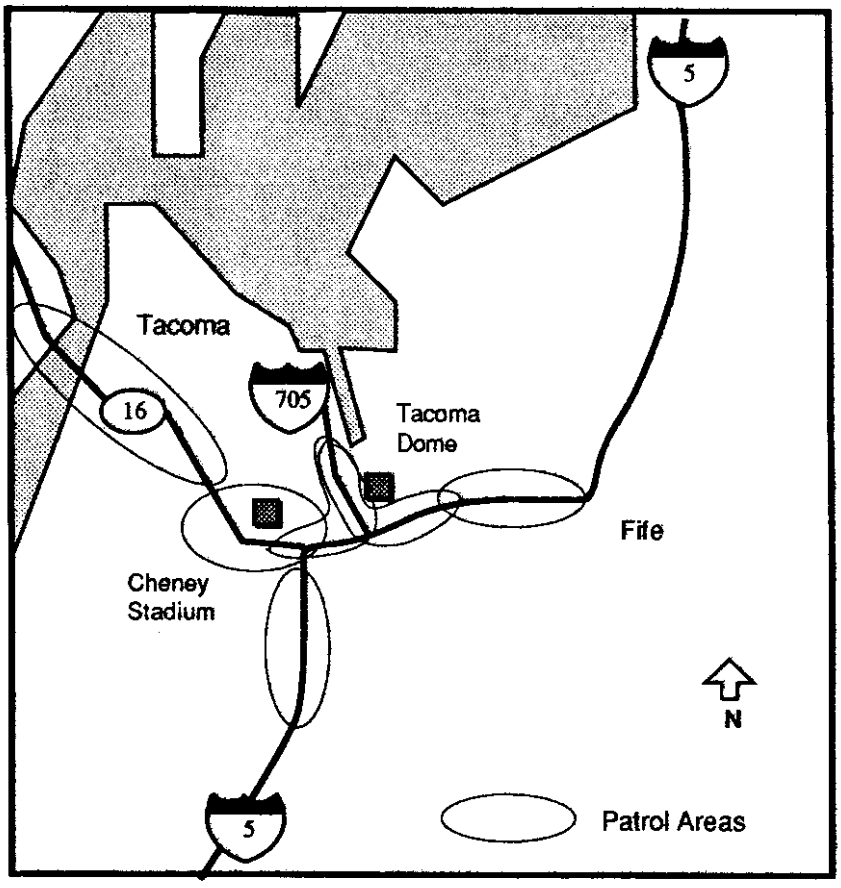

Figure 3. Tacoma Service Patrol Area Map

TABLE 1
TACOMA TOW TRUCK SERVICE PATROL SCHEDULE

	FR 7/20	SA 7/21	SU 7/22	TH 7/26	FR 7/27	SA 7/28	SU 7/29	MO 7/30	TU 7/31	TH 8/2	FR 8/3	SA 8/4	SU 8/5
Morning													
Area 1		10:00			7:00	7:00	7:00	7:00	7:00			8:30	8:30
		1:00			10:00	10:00	10:00	10:00	10:00			11:30	11:30
Area 2		10:00										8:30	8:30
		1:00										11:30	11:30
Area 3		10:00										8:30	8:30
		1:00										11:30	11:30
Area 4		10:00										8:30	8:30
		1:00										11:30	11:30
Area 5		10:00			7:00	7:00	7:00	7:00	7:00			8:30	8:30
		1:00			10:00	10:00	10:00	10:00	10:00			11:30	11:30
Area 6					7:00	7:00	7:00	7:00	7:00			8:30	8:30
					10:00	10:00	10:00	10:00	10:00			11:30	11:30
Afternoon													
Area 1	3:45		3:00	3:30	3:00	3:00	3:00	3:30	3:30	2:00	4:00	5:30	5:30
	6:45		6:00	6:30	7:00	6:30	6:30	6:30	6:30	5:00	7:00	8:30	8:30
Area 2	3:45		3:00	3:30	3:00	3:00	3:00	3:30	3:30	2:00	4:00	5:30	5:30
	6:45		6:00	6:30	7:00	6:00	6:00	6:30	6:30	5:00	7:00	8:30	8:30
Area 3	3:45		3:00	3:30	3:00	3:00	3:00	3:30	3:30	2:00	4:00	5:30	5:30
	6:45		6:00	6:30	7:00	6:00	6:00	6:30	6:30	5:00	7:00	8:30	8:30
Area 4	3:45		3:00	3:30	3:00	3:00	3:00	3:30	3:30	2:00	4:00	5:30	5:30
	6:45		6:00	6:30	7:00	6:00	6:00	6:30	6:30	5:00	7:00	8:30	8:30
Area 5	3:45		3:00	3:30	3:00	3:00	3:00	3:30	3:30	2:00	4:00	5:30	5:30
	6:45		6:00	6:30	7:00	6:30	6:30	6:30	6:30	5:00	7:00	8:30	8:30
Area 6				3:30	3:00	3:00	3:00	3:30	3:30				
				6:30	7:00	6:30	6:30	6:30	6:30				

made for this demonstration. The cost of this service was $75 per hour. A major portion of this cost was contributed by the Tow Truck Operator's Association. The remainder was paid for by FHWA.

Disabled vehicles in Tacoma were towed to one of ten temporary storage sites. These sites are identified in Table 2 and Figure 4. All disabled vehicles that could not be quickly moved from the roadway under their own power were towed under this arrangement. Once at the temporary storage site, vehicle owners were given 30 minutes to repair their vehicles or call a tow company that would move the disabled vehicles to the destination of the drivers' choice. Vehicles not removed from the temporary storage site were impounded.

Tow trucks providing the free, service patrol tow were not allowed to recruit business from their patrol work. That is, the tow trucks were not allowed stay at the temporary storage site to provide a second tow (this time for a fee) and move a vehicle from the storage site to a second location.

In practice, the service patrol tow trucks often removed disabled vehicles directly to a garage or gas station (without charge), and the 30-minute time limit for removing a disabled vehicle from the temporary storage sites was flexibly enforced to avoid vehicle impoundments whenever possible.

METRO Service Improvements

Metro and Pierce Transit provided a number of special bus routes (and additional buses on existing routes) to improve mass transportation to a number of the Goodwill Games athletic venues.

In Tacoma, a special shuttle bus provided service to Cheney Stadium from three remote parking lots. These lots were at the Tacoma Elks Lodge, the Tacoma Central shopping area, and the Tacoma Community College. Directions for using these lots were provided in area newspapers and in a brochure available from Payless drugstores, U.S. Bank, and KING broadcasting, all of which helped sponsor the Goodwill Games. The

TABLE 2

TEMPORARY VEHICLE STORAGE LOTS

LOCATION	DESCRIPTION OF SITE
Seattle	
Lot 5A	SR 5 at 56th Street: Park and Ride Lot in southwest corner of the 56th Street/Alaska Street intersection
Lot 5B	SR 5 at 38th Street: Metropolitan Park District of Tacoma, gravel parking area on 37th Street northwest side of 38th Street interchange.
Lot 5C	SR 5/I-705 interchange: Park and Ride Lot located under I-705 between Puyallup Avenue and East 26th Street
Lot 5D	SR 5 at Portland Avenue interchange: Lot located at Tacoma Sewer Treatment Plant under north end of Portland Avenue viaduct.
Lot 5E	SR 5 at Port of Tacoma interchange: Gravel lot north of World Trade Center of Tacoma.
Tacoma	
Lot 16A	SR 16 at Sprague Avenue: South end of parking lot for DSHS Building at Sprague Avenue and 19th Street
Lot 16B	SR 16 at Union Avenue: Target parking lot
Lot 16C	SR 16 at Center Street: Park and Ride Lot located adjacent to eastbound ramp terminals
Lot 16D	SR 16 at 6th Avenue: Spaces in Project Engineer's office parking lot at 6th Avenue and Pearl Street
Lot 16E	SR 16 at Jackson Avenue: Park and Ride Lot on 6th Avenue (old approach to the Narrows Bridge)

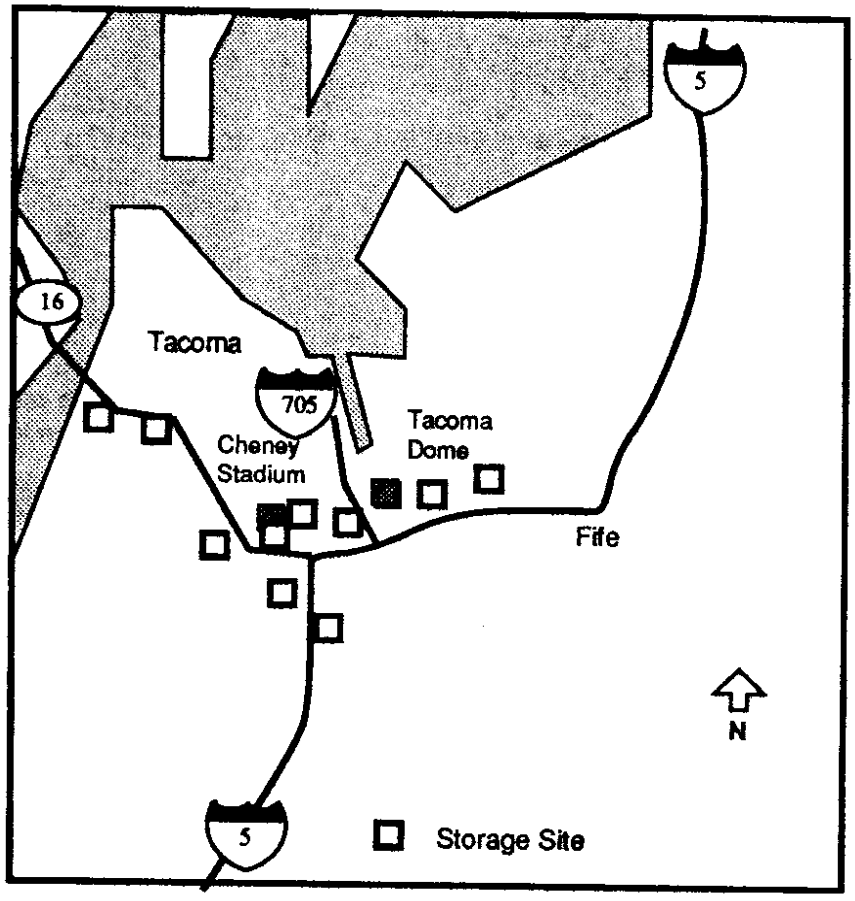

Figure 4. Disabled Vehicle Temporary Storage Sites

shuttle bus to Cheney stadium cost $1 round trip and operated on a 15-minute headway. No additional special bus service was provided for the Tacoma Dome.

In Seattle, special bus service was provided to the University of Washington and to the King County Aquatics Center. To the University of Washington, special park-and-ride service operated from eight remote park and ride lots. For the track and field events, some additional service to the University was provided from Seattle, Bellevue, and north of the University. Expanded bus service along existing routes was also provided for both the Opening Ceremonies and the track and field events.

The literature provided by the Goodwill Games Organizing Committee also indicated off-site parking lots with easy access to Metro routes that served the University.

The cost of using the Metro service was $2 round trip for the special Opening Game Ceremonies, and regular transit fare at all other times (.55¢ off-peak within Seattle, .75¢ in the peak period in Seattle, $1.00 off-peak if the trip crossed the city line, and $1.25 if the trip crossed the city line during the peak period).

Telephone Hotline

Two telephone systems were used to handle requests for transportation information during the Goodwill Games. The first was the conventional Metro transit information line. The second was a telephone system WSDOT installed to disseminate traffic congestion information. Both numbers were printed on transportation advisory brochures handed out at stores and banks in the metropolitan area, and were published in newspaper supplements that described the available transportation alternatives for traveling to the games.

The Metro information line connected the caller to a Metro Information Services Operator who could provide the caller with bus schedule information. This telephone line was also used by regular Metro riders calling for schedule information for non-Goodwill Games trips.

The WSDOT hotline was a new traffic information source. When using this service, the caller was connected to a taped message. The recording was made and updated

by WSDOT personnel at the Traffic Systems Management Center (TSMC). The recording listed congestion points TSMC operators observed as part of their routine traffic surveillance functions. WSDOT personnel updated the tape recording as conditions changed and as staffing permitted.

Media Traffic Information Campaign

As part of their efforts to assist with the Goodwill Games, a number of the radio and TV stations in the metropolitan area increased their broadcasts of traffic information. These increases occurred both during the peak periods, when longer and more frequent traffic reports were given, as well as in the off-peak periods, when traffic reports were added. (Stations had previously not provided routine, off-peak traffic reports.)

In addition to these traffic broadcasts, local stations produced a number of specials concerning the Goodwill Games events. These segments often included special sections on how to reach the event venues and how to limit the effects of traffic congestion when attending the games.

Finally, all of the major local newspapers provided information concerning the transportation alternatives available for upcoming events. This campaign was particularly strong for the Opening Ceremonies and was less obvious for the smaller sports venues.

Employer Programs

Because of the expected traffic congestion problems, employers in the metropolitan area were asked to help mitigate the expected traffic congestion problems. Generally, employers were asked to allow employees additional latitude in traveling to and from work to reduce the number of automobiles on the road. The plans considered included the following:

- allowing increased flexibility in work times (to reduce total peak hour trips through increased use of flex time),
- providing special incentives for carpooling or mass transit during the Games, and

- encouraging employees to take at least some vacation time during the Games (thus reducing the total number of persons commuting to work during the Games).

A major contributor to this effort was the Seattle Goodwill Games Organizing committee itself, which provided special bus passes to its employees and volunteers to help reduce their dependence on cars to get to and from the event venues.

WSDOT Operational Measures

WSDOT instituted a number of operational enhancements during the Games. These enhancements included the placement of blue advisory signs on the freeways indicating the correct off-ramps to use to reach Games venues, the rescheduling of construction work so that no traffic disruptions due to construction took place during the Games (this moratorium was observed by all jurisdictions in the metropolitan area), the addition of staff to the traffic operations center, and an increase in the dissemination of traffic information to the news media.

FINDINGS

This chapter presents the results of the study's data analysis. It is important to note that traffic varies considerably under normal conditions, and a variety of factors affected traffic performance during the Goodwill Games. As a result, it was difficult to determine

- which of the measured changes were directly a result of the Goodwill Games;
- which were the result of the traffic mitigation measures taken as part of the games; and
- which were caused by other occurring events or would have occurred anyway.

The results are divided into categories based on the type of data that were analyzed.

TRAFFIC VOLUMES

The impact of the Goodwill Games on traffic volumes was one of the largest concerns of area transportation planners. They assumed that the combination of Goodwill Games event traffic and normal evening peak period traffic would create severe congestion. Many of the traffic mitigation measures taken in Tacoma and Seattle were designed to reduce the demand for automobile transportation during the Goodwill Games in order to reduce the number of instances in which excessive traffic volumes caused or significantly contributed to congested roadways. Figure 5 shows the location of traffic volume counts described below.

Tacoma

The Goodwill Games' impacts on Tacoma traffic volumes were relatively minor. In several cases, specific event traffic or incidents caused unusual congestion, and in some cases, lighter than normal traffic volumes were observed. However, on the average little impact was apparent from the available traffic monitoring data. Observations at specific locations are described below.

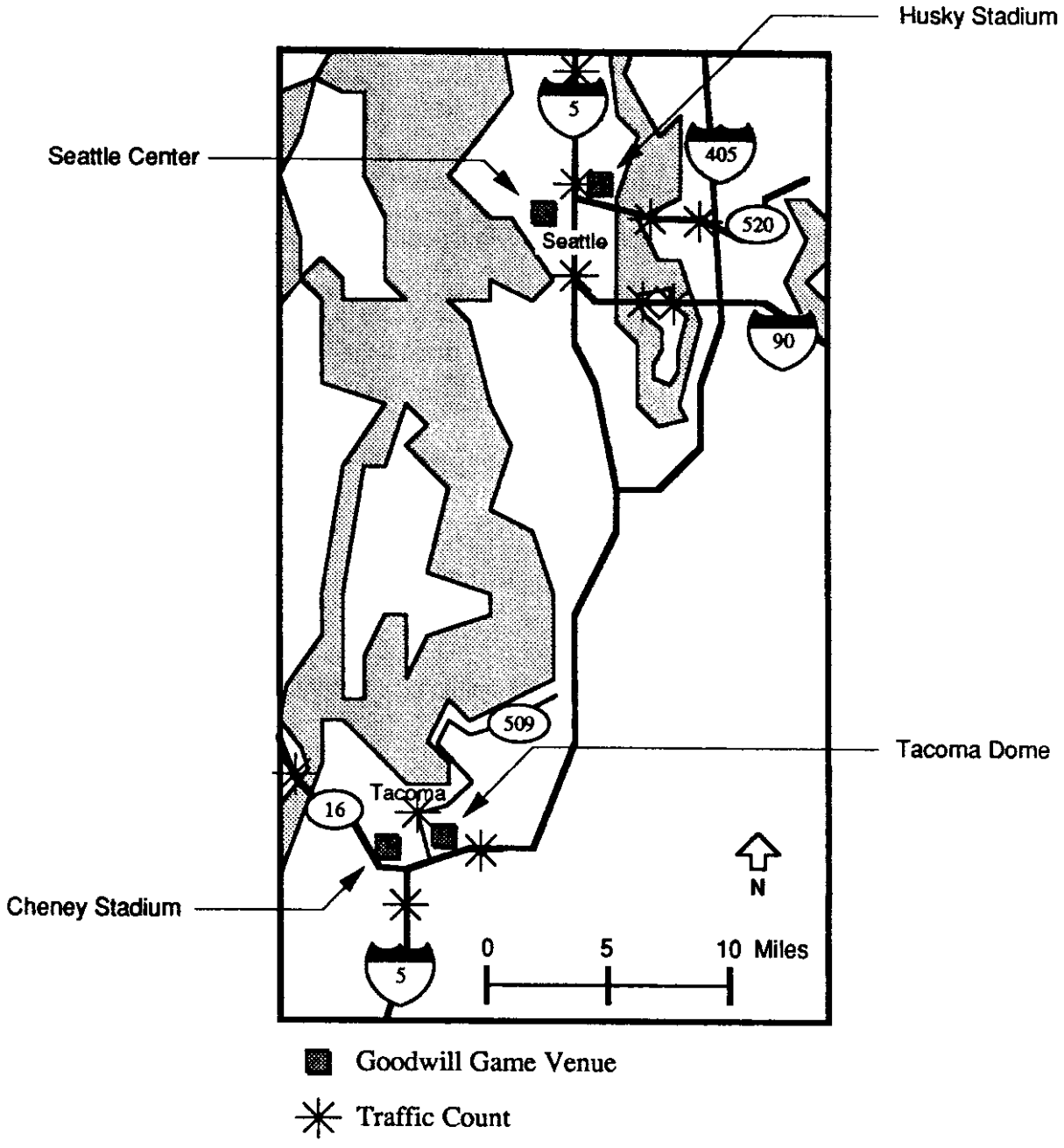

Figure 5. 1990 Goodwill Games Traffic Count Locations

SR-16

Data on SR-16 traffic volumes were obtained from a permanent WSDOT counter located near the Tacoma Narrows Bridge. Data from this counter demonstrated that daily traffic volumes on SR-16 remained essentially unchanged during the Goodwill Games. Slight rises were measured for the average daily Thursday and average daily Friday traffic flows, but these increases were small and well within the bounds of normal traffic volume variation. On the remaining days of the week, Goodwill Games traffic volumes fell between the traffic volumes that were measured before the games began and after the games had ended.

SR-509

Data on SR-509 were available from a permanent traffic counter near Union Station operated by the WSDOT Transportation Data Office. Data from this location showed a slightly greater impact from the Goodwill Games events than the impact observed on SR-16. On a daily basis, traffic on SR-509 increased during the weekends of the Goodwill Games (Friday through Sunday), but this change was not statistically significant. Little or no noticeable change in traffic occurred during the other days of the week (Figure 6).

Hourly data available for SR-509 did show some impact from Goodwill Games event traffic, but again, these changes were well within the range of normal variation in traffic volumes. Figure 7 shows an increase in traffic (northbound) on SR-509 during the late afternoons and evenings of the Goodwill Games. These times corresponded to events at the Tacoma Dome, indicating the increased travel associated with patrons looking for parking near the Dome and leaving the Dome after the events.

Southbound traffic volumes (Figure 8) at this same location showed similar increases except in the late evening (6 PM to midnight). These increases were attributed to Goodwill Games activities because no other cause for increases in traffic existed for this portion of SR-509. (The southbound traffic flow on SR-509 would have been less impacted after a Tacoma Dome event than the northbound flow before the event because

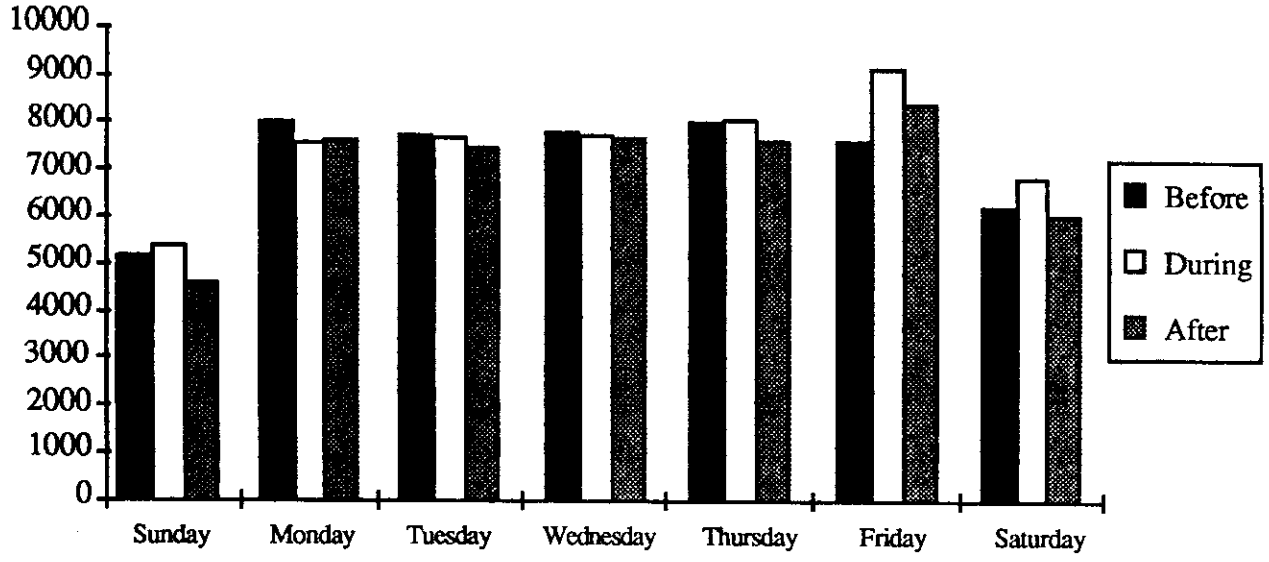

Figure 6. Daily Traffic Volumes by Day of Week - Before, During and After the Goodwill Games SR-509, Northbound at Union Station in Tacoma

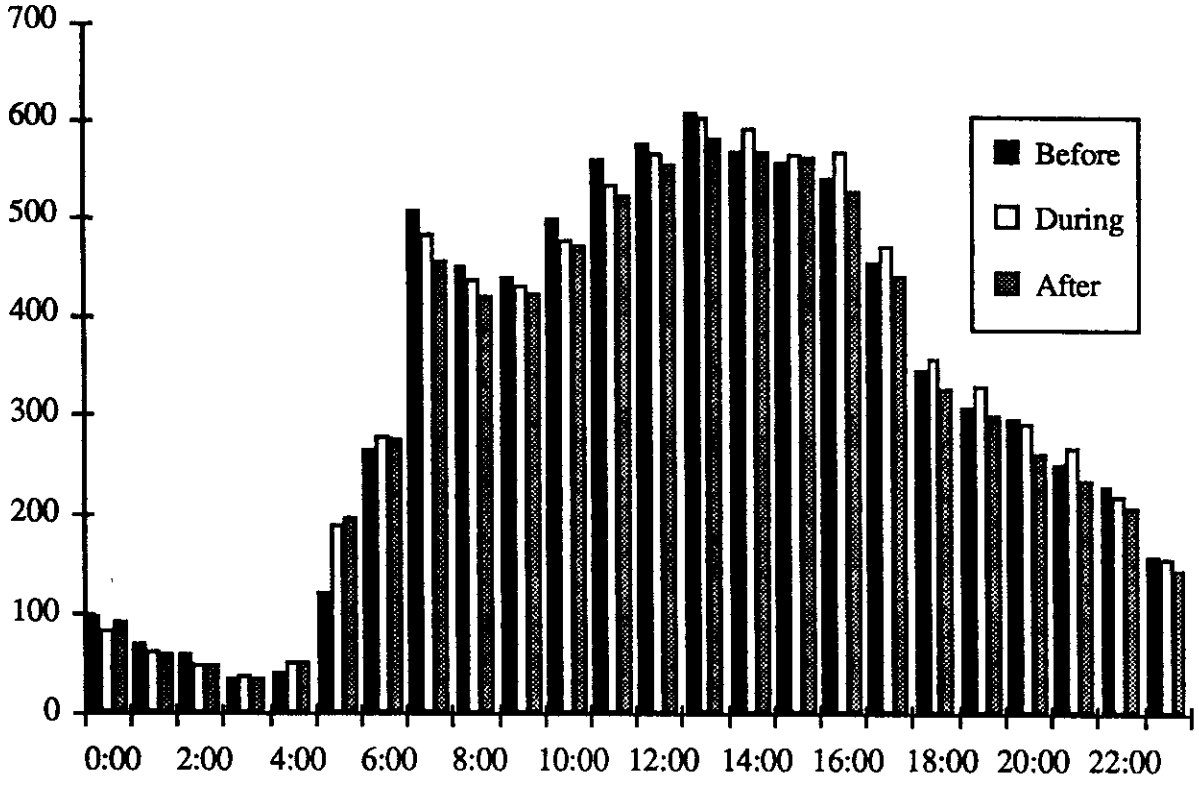

Figure 7. Weekday Average Hourly Traffic Volumes Before, During and After the Goodwill Games - SR-509 Northbound at Union Station

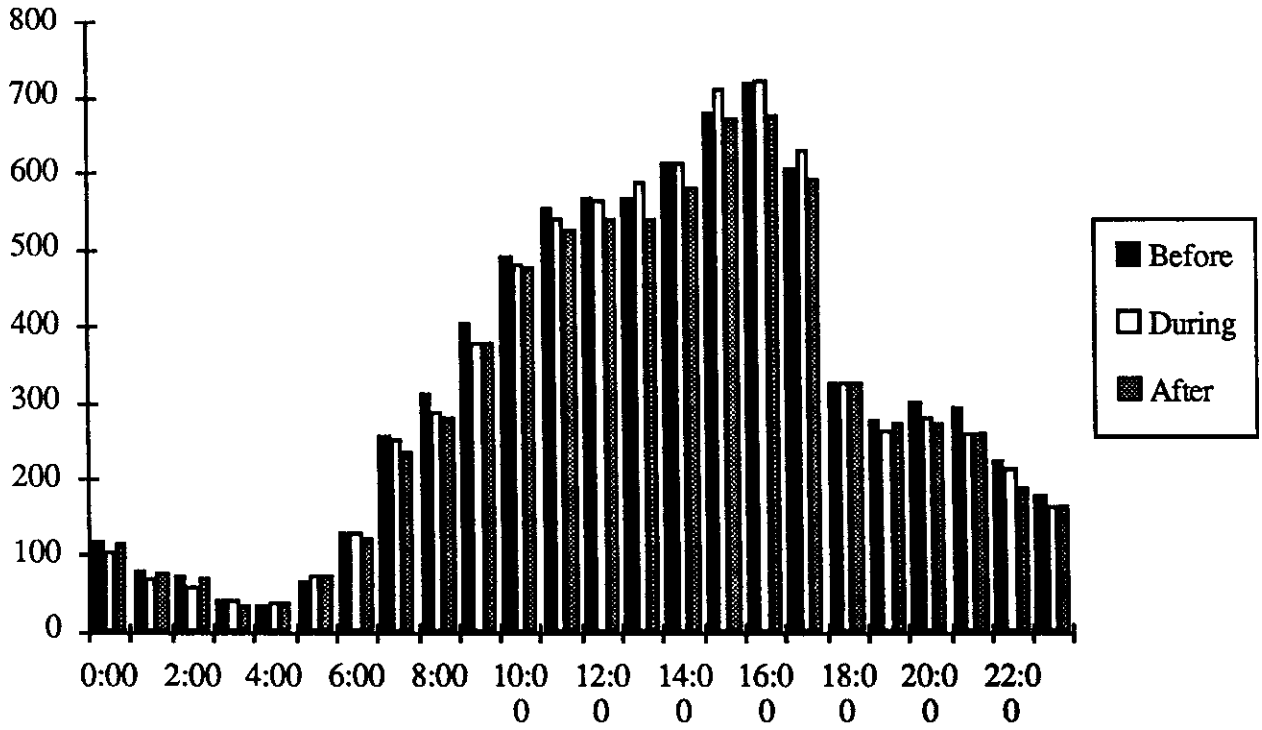

Figure 8. Weekday Average Hourly Traffic Volumes Before, During and After the Goodwill Games - SR-509 Southbound at Union Station

patrons drive farther while looking for parking than they do when leaving that parking space.) Even near the Tacoma Dome, the normal variation in traffic volumes was considerably greater than the difference between volumes before and during the Goodwill Games.

I-5

Traffic volume information on I-5 in Tacoma was sketchy because of traffic counter failures. A number of the loops associated with the counters located on I-5 malfunctioned during the Games. The loops that remained operational provided a reasonable measure of traffic speed at each location; however, the lost data prevented the accurate measurement of traffic volumes at the I-5 sites.

Seattle

As in Tacoma, traffic data collected in Seattle showed that only relatively small changes in traffic volumes occurred during the Goodwill Games. On specific days and near specific event locations, traffic volumes changed noticeably (see Figure 9), but for the 15-day event period, the measured changes tended to be within the range of normal variation in traffic volumes.

Details about traffic volumes in Seattle are described by facility below.

I-5

Traffic volumes were measured at a number of locations along I-5 in Seattle. Data are presented below for sites on I-5 near Yesler Way, the Ship Canal bridge, and near NE 107th Street. As in Tacoma, traffic counter equipment failures limited the usefulness of some of these data, but unlike in Tacoma, the remaining data were sufficient to provide a summary of traffic changes during the Goodwill Games. More significantly, traffic volumes on this route normally vary considerably, and this variation made it difficult to determine whether the measured changes in volume were significantly different from normal conditions and could be attributed to the Goodwill Games.

At Yesler, southbound weekday volumes on I-5 decreased an average of 1,300 vehicles each day during the Goodwill Games. However, the northbound weekday traffic volumes at Yesler increased by over 2,300 vehicle per day. The northbound increase was statistically significant at the 90 percent confidence level, but the southbound decrease was not statistically significant. This discrepancy is difficult to explain. In addition, a large part of the traffic volume changes at Yesler took place outside of the peak periods, rather than during the commuter travel periods targeted by the transportation demand management campaigns that coincided with the Goodwill Games (see Figures 10 and 11). This fact led to the conclusion that most of the measured changes were not caused by the Games themselves but were due to other factors.

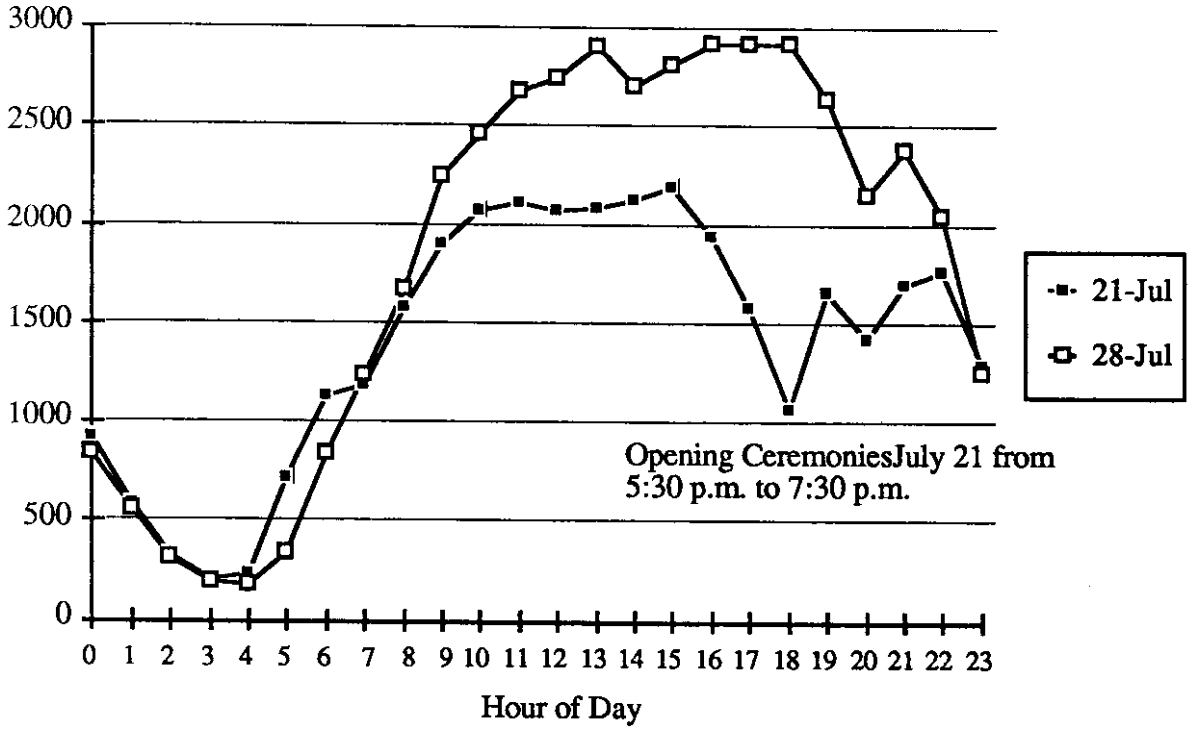

Figure 9. Westbound SR-520 Traffic Volumes

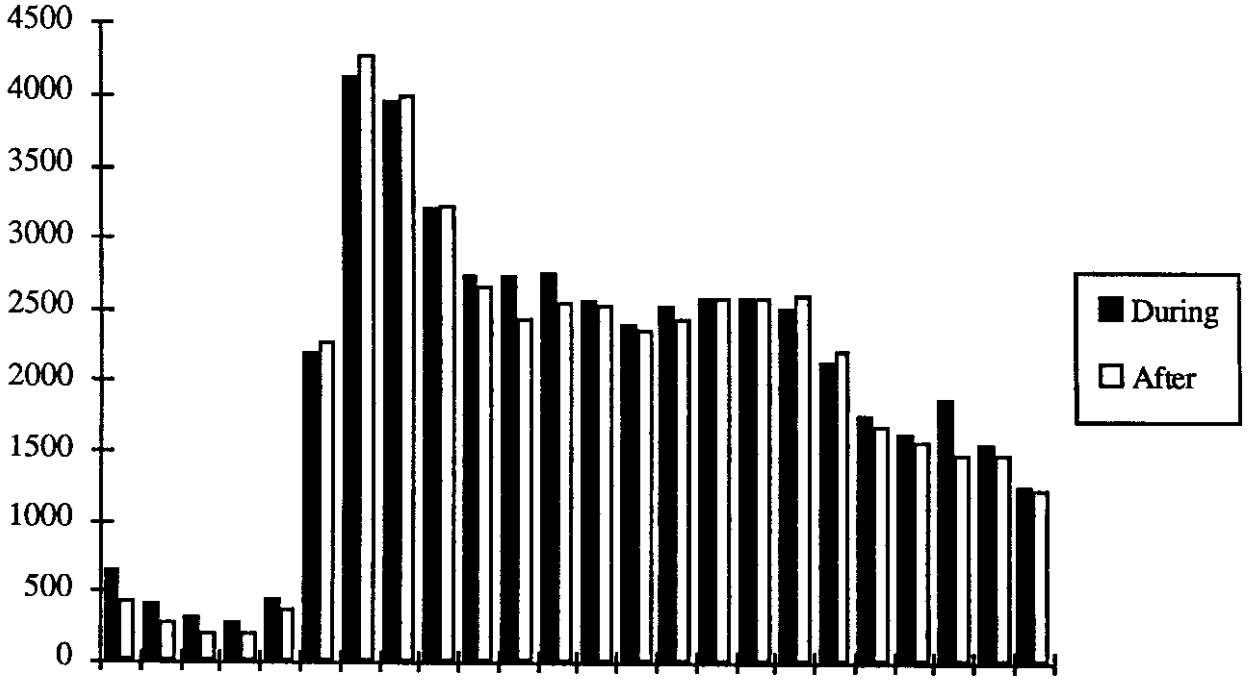

Figure 10. Northbound Traffic Volumes on I-5 at Yesler During and After the Goodwill Games

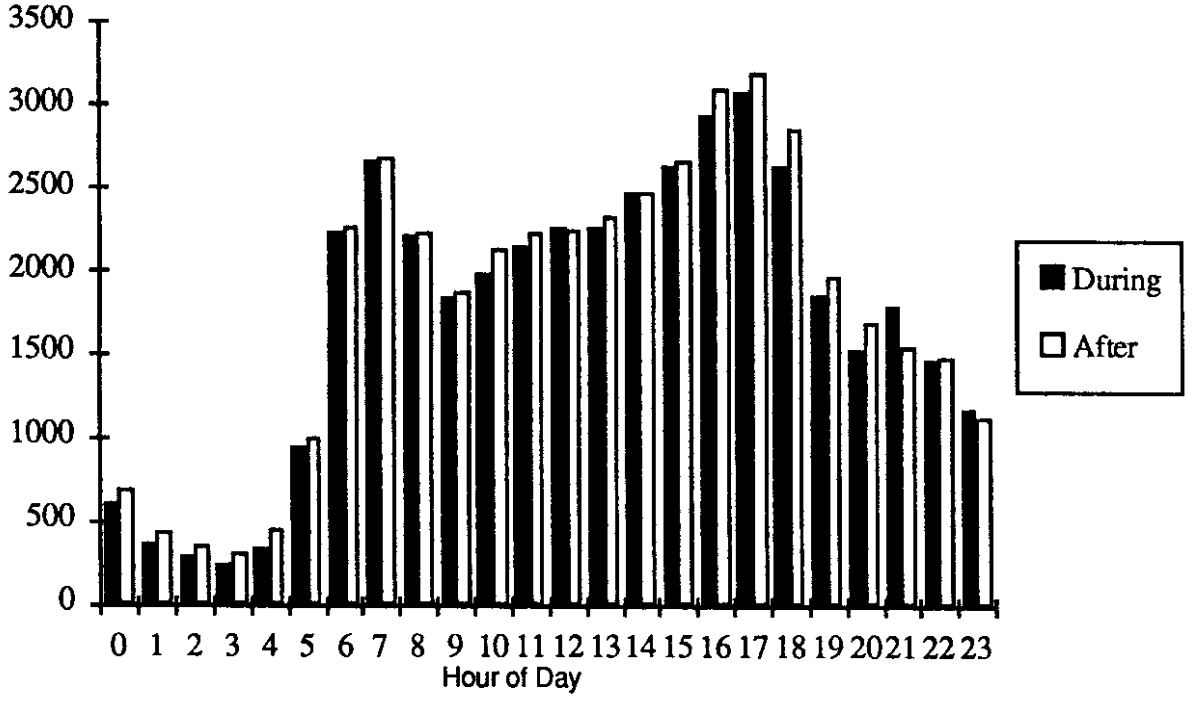

Figure 11. Southbound Traffic Volumes on I-5 at Yesler During and After the Goodwill Games

Traffic volumes on the Ship Canal bridge showed the type of impact expected from the transportation demand management methods. At this location, in both directions, total weekday traffic decreased during the Goodwill Games. Northbound at the Ship Canal, average weekday traffic decreased by 2,350 vehicles per day during the Goodwill Games. Southbound, a decrease of 3,000 vehicles per day was observed. However, neither of these measured changes was statistically significant.

A large portion of the measured changes in traffic volumes at the Ship Canal bridge occurred during the commute periods. These travelers (along with persons attending events) constituted the primary target audience of the traffic mitigation measures undertaken by local agencies. In the morning, southbound traffic crossing the ship canal decreased measurably, while southbound midday and evening traffic remained essentially constant.

Similarly, traffic in the northbound evening movement decreased during the Games, while the other movements showed less change (see Figures 12 and 13). These changes reflected reductions in vehicle travel associated with workers' vacations and shifts to alternative modes of transportation.

Farther north on I-5, at NE 107th Street, measured southbound traffic volumes increased during the 15 days of the Goodwill Games. Northbound traffic decreased, but only slightly. These changes were not statistically significant. This pattern replicated that measured at Yesler rather than at the Ship Canal, although the majority of commuter traffic would have passed through both data collection points.

In both NE 107th Street cases, the hourly traffic patterns (see Figures 14 and 15) showed no significant changes. The measured changes northbound appeared to have occurred in the very early morning, before the morning peak period, indicating that they were probably unrelated to the Goodwill Games. The southbound volume increases occurred throughout the day, and many of the largest increases occurred in the late morning. This was a time when the Goodwill Games would not have been likely to generate extensive new travel. Consequently, the Games had little impact on the measured changes in traffic patterns.

SR-520

On SR-520 the traffic impacts west of the floating bridge were somewhat different than those east of the floating bridge. Volumes west of the bridge were measured at the 10th Avenue overcrossing, while volumes east of the bridge were measured at the old toll plaza.

At 10th Avenue no measured volume changes were statistically significant. Measured westbound average weekday volumes increased marginally during the Games, but the magnitude of this volume change was insignificant. The eastbound volumes on SR-520 at 10th Avenue remained essentially unchanged during the games, although individual weekdays showed abnormal volumes. These abnormalities were usually caused

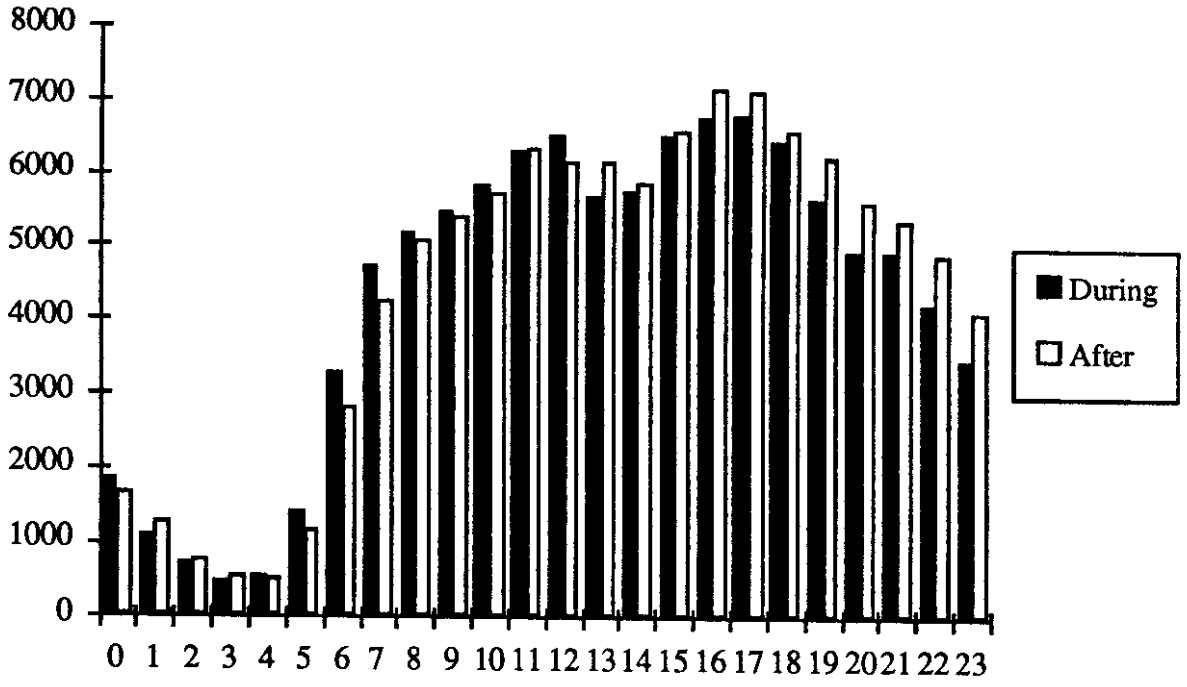

Figure 12. Northbound Traffic Volumes on I-5 at the Ship Canal

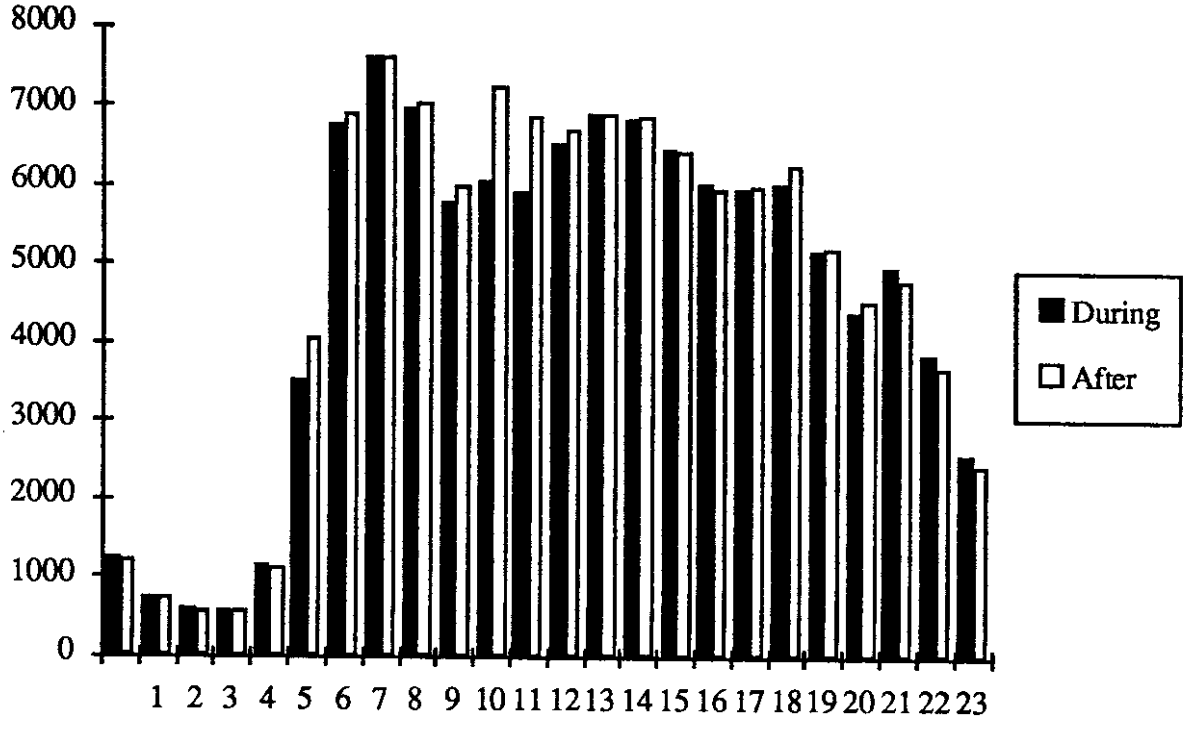

Figure 13. Southbound Traffic Volumes on I-5 at the Ship Canal

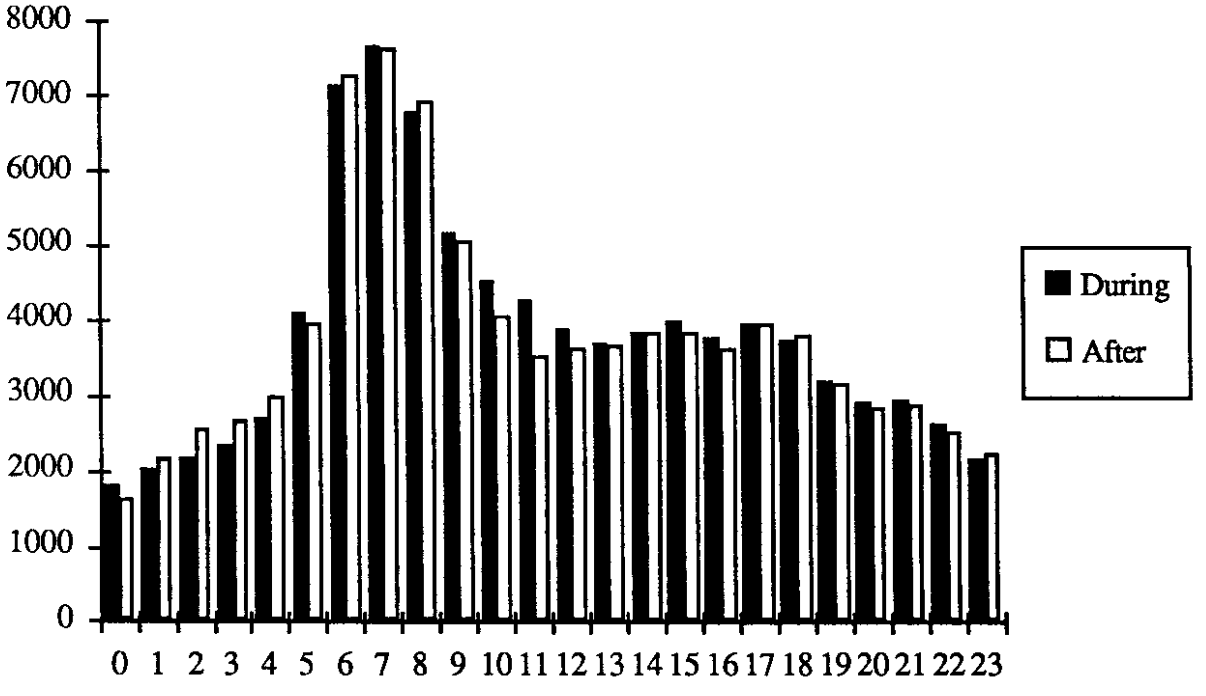

Figure 14. Southbound Traffic Volumes on I-5 at NE 107th Street

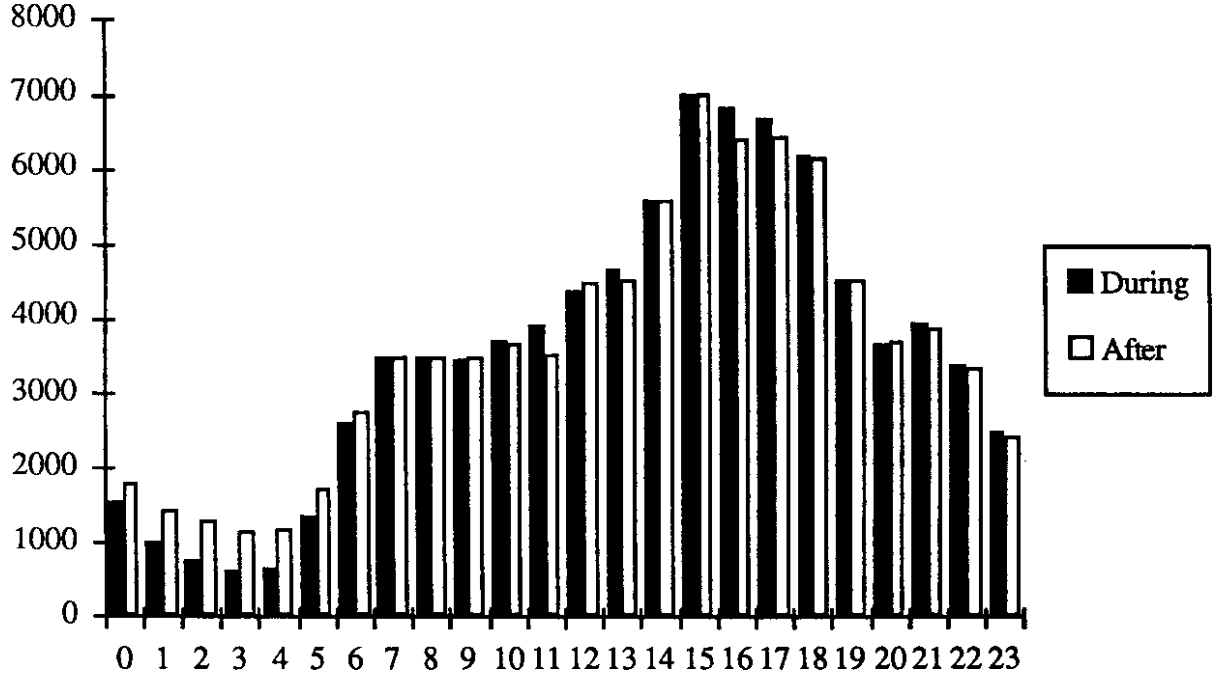

Figure 15. Northbound Traffic Volumes on I-5 at NE 107th Street

by an incident either on SR-520 or elsewhere in the metropolitan area. These volume fluctuations are illustrated in Figure 16, which shows the eastbound hourly volume profile for three Mondays during the games.

On the eastern side of Lake Washington, measured traffic volumes decreased in both directions, and both decreases were statistically significant at the 95 percent level of confidence. Westbound, this measured decrease was roughly 2,500 vehicles per average weekday. Eastbound this decrease was around 3,000 vehicles per weekday. For this section of SR-520, a significant portion of the measured decreases appeared to have occurred in the peak travel periods (see Figure 17). The one exception to this was the westbound PM commute movement, which was affected by event traffic going to the University of Washington and the Seattle Center (see Figure 18). The available data did not provide sufficient insight to adequately explain the differences in travel patterns on the western and eastern ends of the floating bridge, although part of the cause was probably due to event traffic heading to and from the University of Washington.

I-90

Two data collection locations were selected on I-90 for analysis of the Games traffic. However, eastbound data collection failed at both sites during the Games. In the westbound direction, significant changes in daily traffic volumes were measured by the functioning equipment, but the collected data showed extremely high variations in traffic volumes during the data collection period. (The measured variation was as much as 50 percent of total daily traffic.) This variation led to the conclusion that the westbound data collection locations also contained malfunctioning sensors and may not have accurately recorded the traffic volumes.

Both data collection locations showed an increase in measured traffic volumes during the Games, but the magnitude of change was very different between the two stations. The station at 110th measured a statistically valid 10,000 vehicle per day increase,

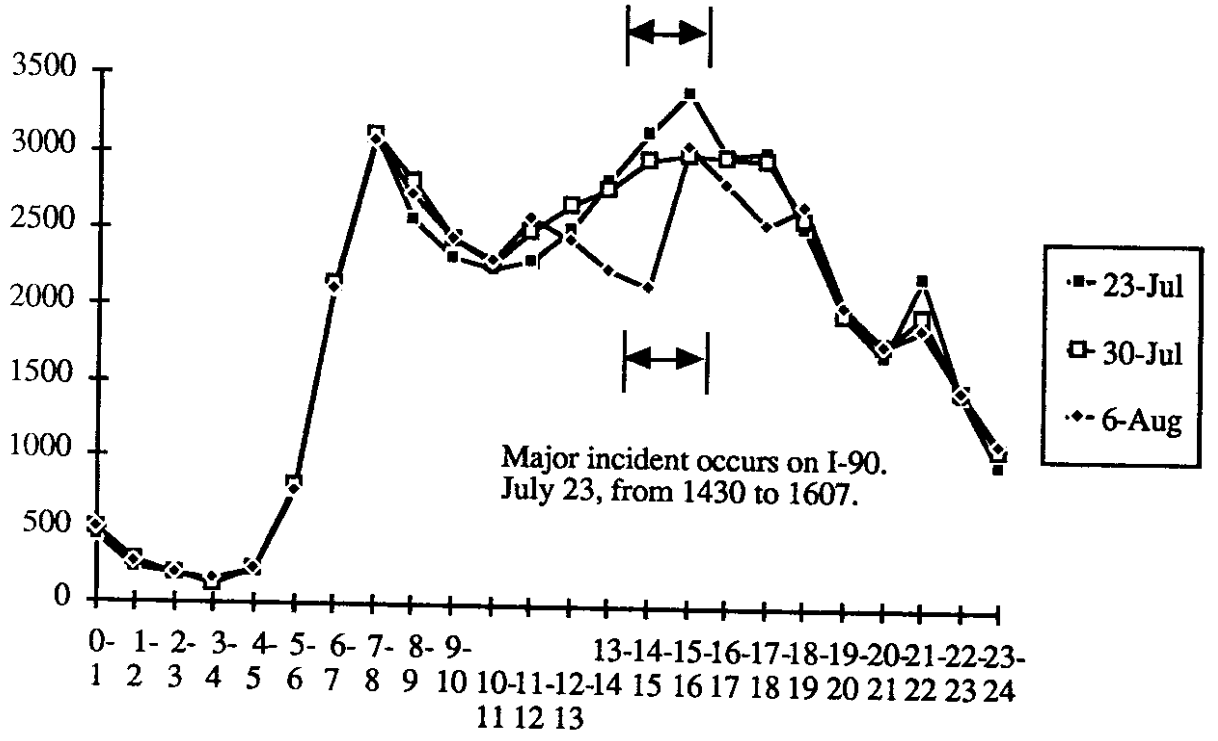

Figure 16. Eastbound Traffic Volumes on SR-520 at 10th

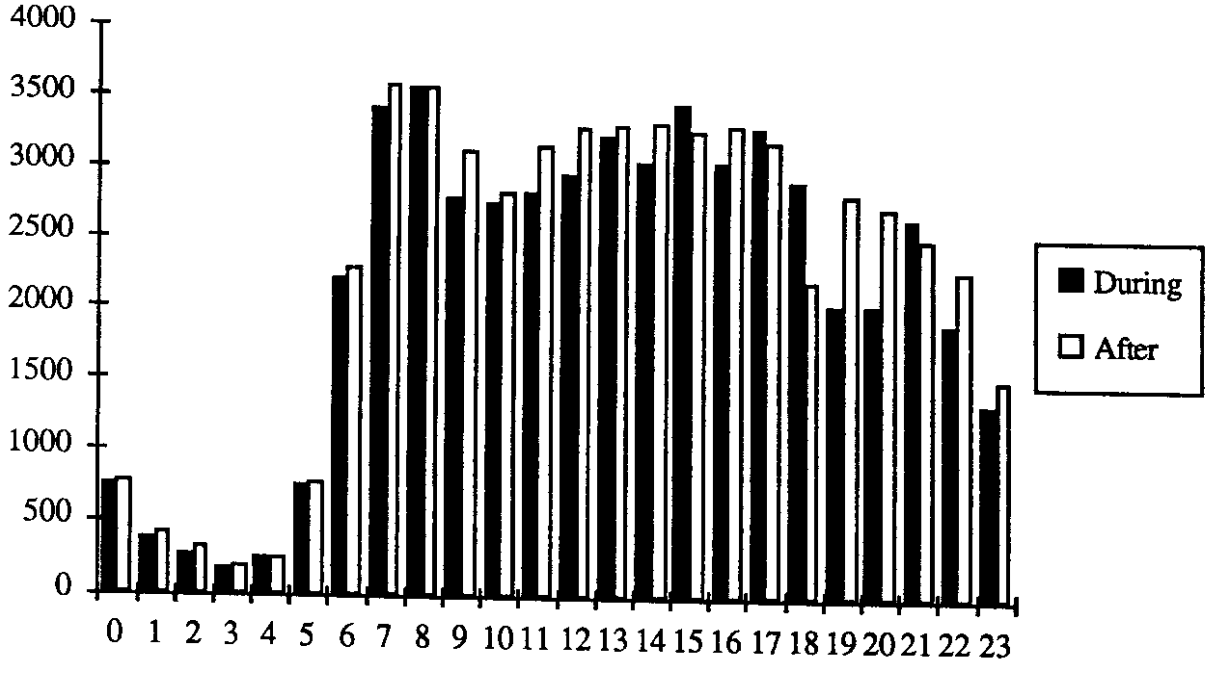

Figure 17. Eastbound Traffic Volumes on SR-520 During and After the Goodwill Games

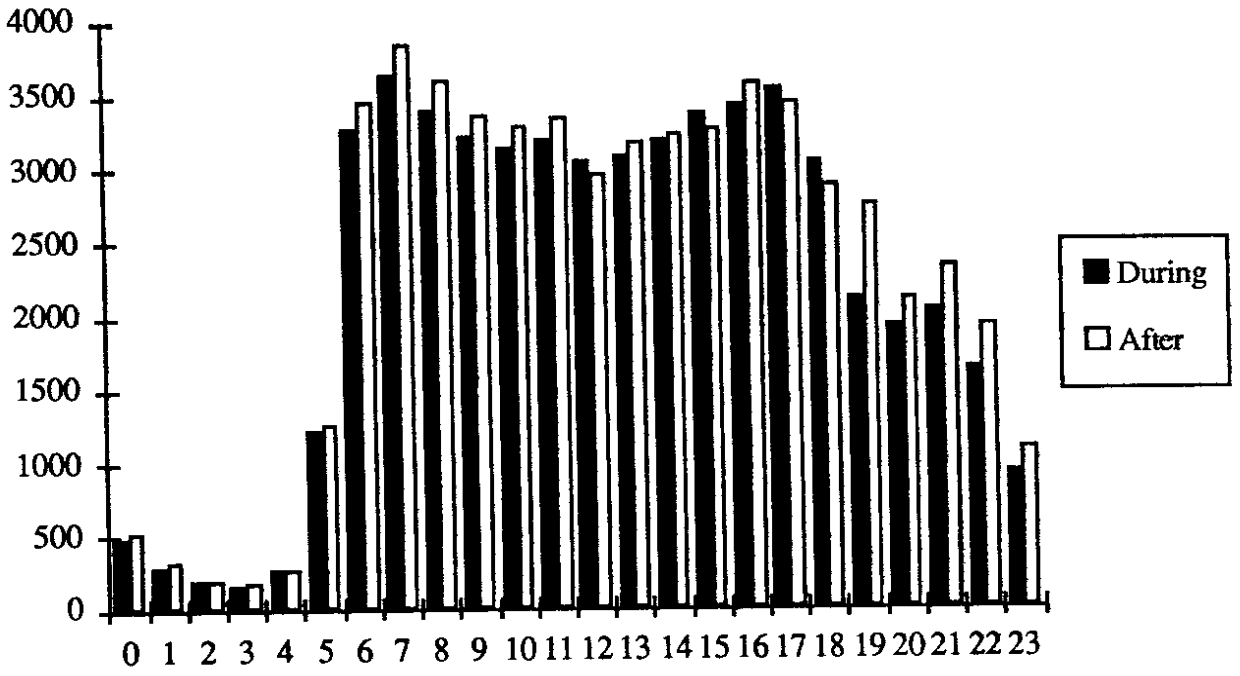

Figure 18. Westbound Traffic Volumes on SR-520 During and After the Goodwill Games

while the station at 76th showed a statistically insignificant increase of 1,600 vehicles per day.

The project team believes that I-90 absorbed some of the decrease in SR-520 traffic volumes. However, the 10,000 vehicle increase measured at 110th was more likely due to machine error than actual changes in traffic volume.

VEHICLE SPEED

In Tacoma, three permanent traffic recorder (PTR) stations provided speed estimates aggregated to 5-minute totals (total volume of vehicles within predefined speed ranges for each 5-minute interval). The PTRs that provided this data used dual inductance loop technology to calculate the speed of passing vehicles.

On SR-520, special travel time studies were performed to obtain estimates of vehicle speeds across the Evergreen Point Floating Bridge. Travel time runs were made in

both the AM and PM periods in both directions of travel. Travel times were collected both during and after the Goodwill Games.

The results of these speed analyses are given below.

Tacoma on I-5

No changes in average daily speed were apparent in the data collected at the Tacoma sites. However, traffic speed is usually more an issue within the peak hours, rather than a "daily" issue. (The consistently high speed of traffic in the off-peak periods usually masks the impact of congestion during the peak periods or the occurrence of slow speeds that result from incidents that last less than one hour.) Thus, the analysis of speed data in Tacoma used the 5-minute aggregations of average speed that were available and monitored how speed changed over time within each day.

The available data showed that the Goodwill Games did have some impact on the average speed of vehicles on I-5 during the evening peak periods. Figure 18 shows average hourly speeds for weekdays southbound on I-5 at Fife. This graph shows that measured average speeds decreased during the Games in comparison to both before and after data. The high variation in the speed data and the tremendous impact of incidents left the researchers unable to determine whether this measured change was a function of the Goodwill Games or just a random occurrence.

The corresponding data collection station for northbound I-5 at Fife (Figure 20) did not show this pattern. The fact that southbound traffic (heading to the Tacoma Dome and Cheney stadium, but in the opposite direction from the Tacoma evening commute traffic) slowed while northbound evening traffic did not confirms the belief that the measured reduction in speed was caused, at least in part, by event traffic.

The northbound Fife station measured event traffic at a time (late evening) when background traffic levels were very small and a large portion of the roadway's capacity was still available for new traffic. Thus no speed reduction was observed for this portion of the

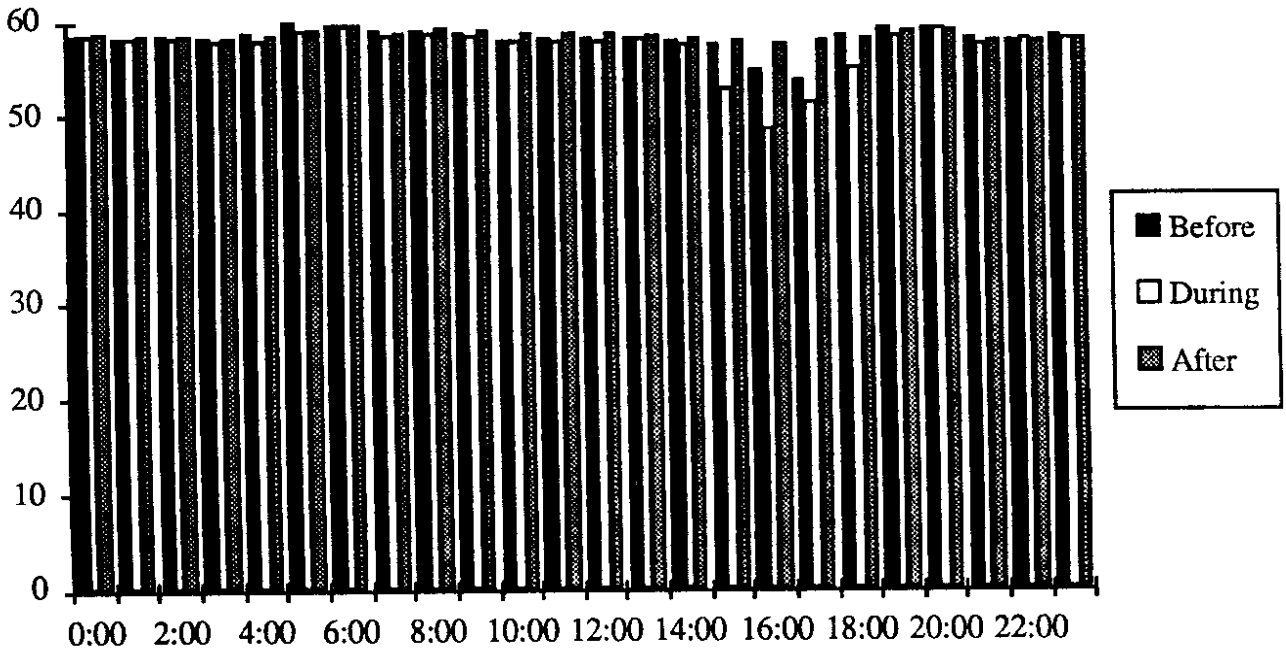

Figure 19. Weekday Hourly Traffic Speeds Before, During and After the Goodwill Games - Interstate 5, Southbound at Fife

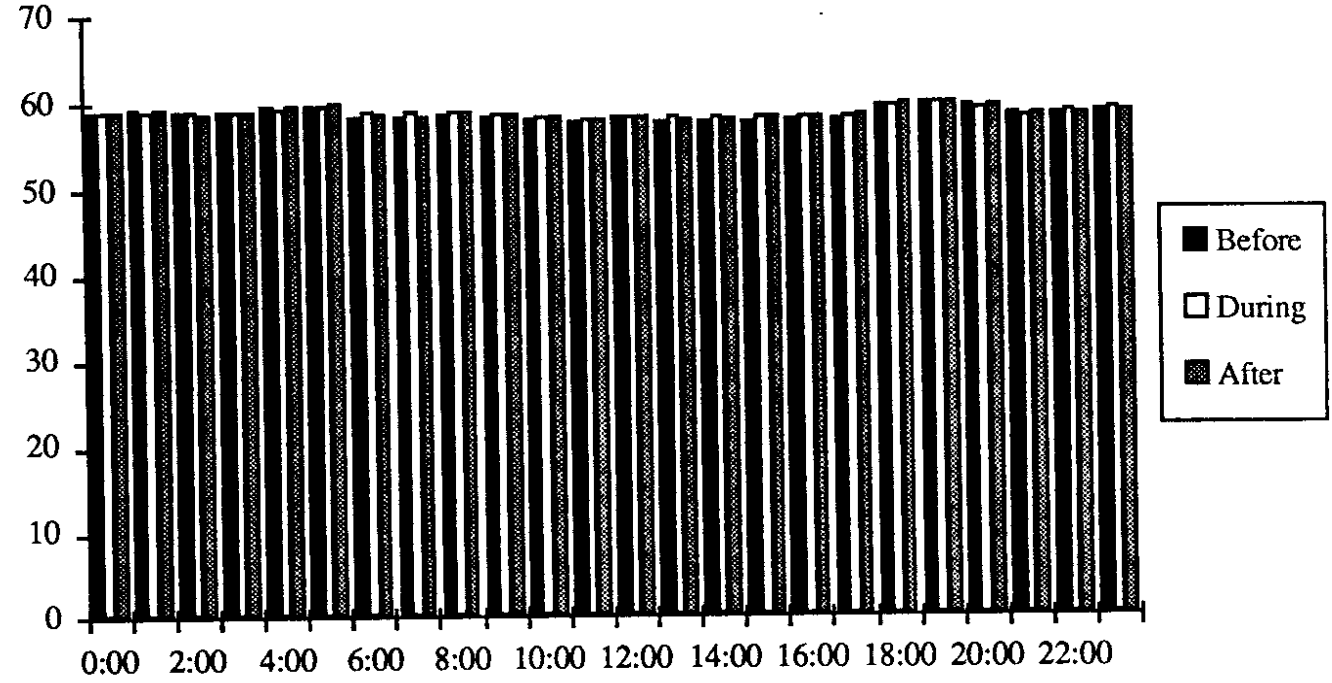

Figure 20. Weekday Hourly Traffic Speeds Before, During and After the Goodwill Games - Interstate 5, Northbound at Fife

roadway despite the increased traffic volumes associated with the ends of events held in Tacoma.

Northbound hourly speeds south of Tacoma (48th street) did not show significant changes as a result of the Goodwill Games. This may mean that more traffic was drawn to the Tacoma events from the north (which has a greater population) than from the south, or it may indicate that the slow traffic observed southbound at Fife was due more to incidents and less to Goodwill Games traffic. Insufficient data were available to determine which of these two assumptions was correct.

However, the hourly traffic speed estimates did show the impacts of the peak period morning traffic on average vehicle speed and the general impacts of congestion throughout the day in Tacoma (Figure 21).

Seattle on SR-520

Commute period travel times were collected on SR-520 during and after the Goodwill Games. Because the existing traffic monitoring equipment in Seattle did not provide speed estimates on this facility, these data were collected with portable computers and a license plate technique developed by the WSDOT and the UW.

Data were collected for both morning and evening westbound traffic from the 108th Street overpass in Bellevue to the Montlake Flyer stop in Seattle. For eastbound traffic, data were collected at the 10th Avenue overpass, the Montlake Flyer stop, and the old toll plaza. In the eastbound direction, data were only collected in the evening peak. These data allowed the analysis of the impacts of Goodwill Games events on traffic conditions primarily affected by traffic going towards Husky Stadium and downtown Seattle. The findings of this data collection effort are given below.

In general, traffic speed improved for all traffic movements analyzed as part of this study (see Figure 22). The increase in vehicle speed (decreased travel time) was partly explained by a slight reduction in vehicle trips made during the commute periods, but some

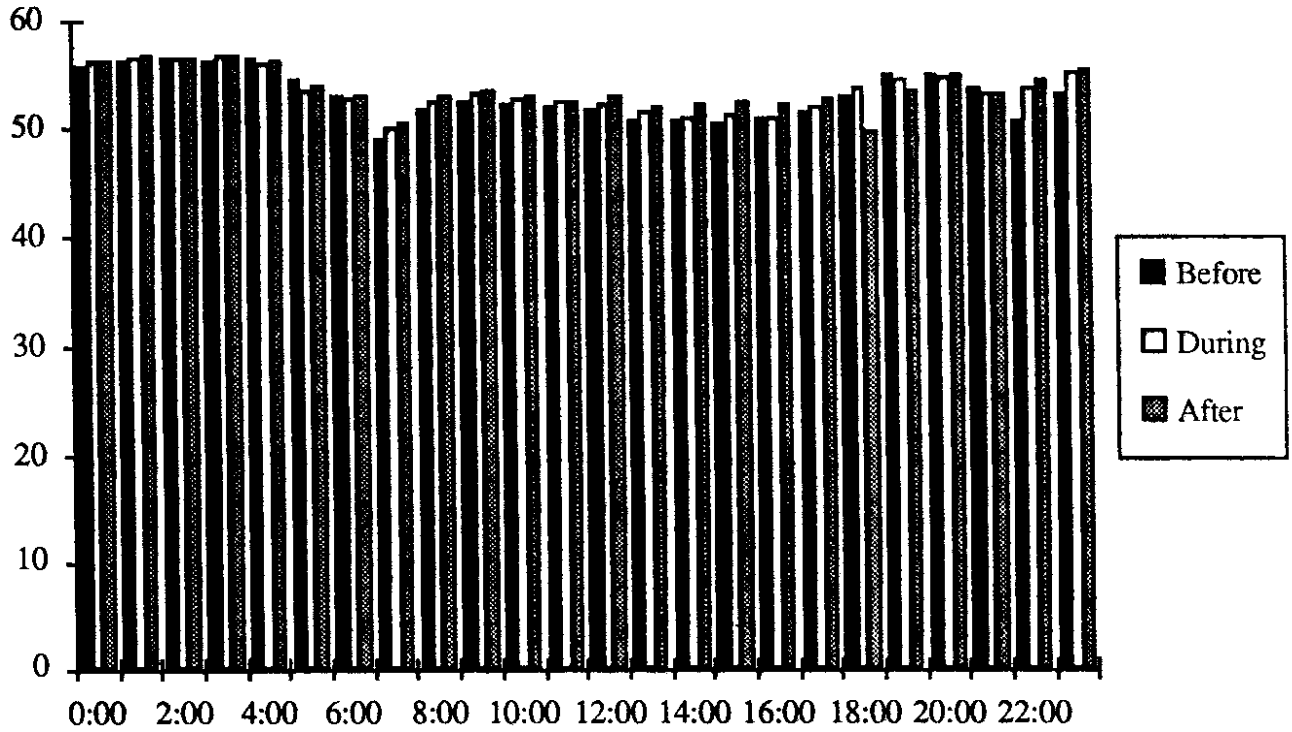

Figure 21. Weekday Average Hourly Traffic Speeds, Northbound at 48th Street

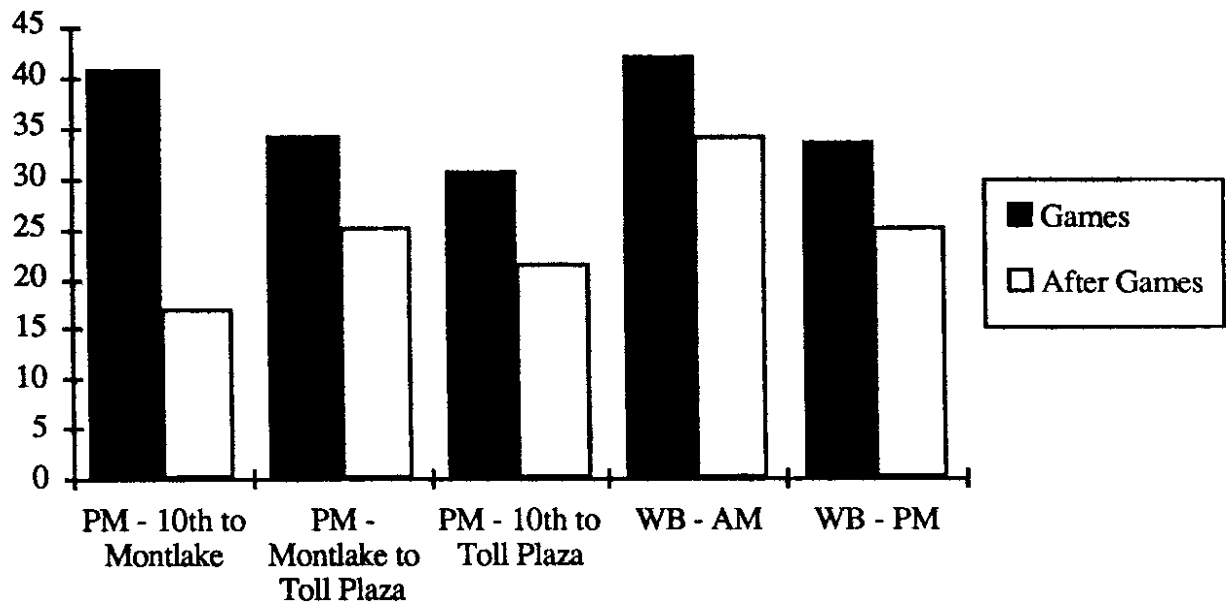

Figure 22. Average Speeds Before and After The Goodwill Games on SR-520

of the observed changes were due to incidents (or lack of incidents), which were unrelated to the Goodwill Games.

AM Westbound Traffic

This is the heaviest peak morning commute direction on SR-520, although traffic congestion also occurs in the eastbound direction at this time of day. Figure 23 shows the normal pattern of traffic westbound on SR-520 between 6:45 and 8:30 AM. This pattern starts with vehicles traveling near the speed limit (note that each square in Figure 23 represents one vehicle's travel speed through the monitored road section, and that some variation occurs naturally within the actual speed of the vehicles measured) until congestion reaches a point at which traffic flow begins to break down (roughly 7:10 AM in Figure 23). Once traffic flow breaks down, the queue increases in length until traffic volumes approaching the bridge begin to lighten at the end of the peak period (a little after 8:00 AM in Figure 23). As the queue grows, the total travel time on the facility between the study points increases. (Note that once the queue reaches 108th, the measured delay stops growing because of the limitations in the data collection technique. However, the total delay experienced by the traveler continues to increase until the actual total queue length starts to decrease.) The increased travel time results in increased delay and the decrease in vehicle speed shown in Figure 23. Eventually, as the queue dissipates, traffic returns to normal operating conditions.

This variation in travel times on the facility made it difficult to compare statistically whether the Goodwill Games had an impact on vehicle speeds and motorist delay. Figure 24 shows all of the peak AM travel time data points collected in the "during" and "after" time periods. This graph shows that the congested period of operation of SR-520 generally started later and ended earlier during the Games than after the Games, and that much of the time, even during the congested conditions, traffic speeds were slightly higher during the Games than after the Games. The graph also shows the difference in mean vehicle speed between the periods during the Games (42.0 mph) and after the Games (34.3 mph).

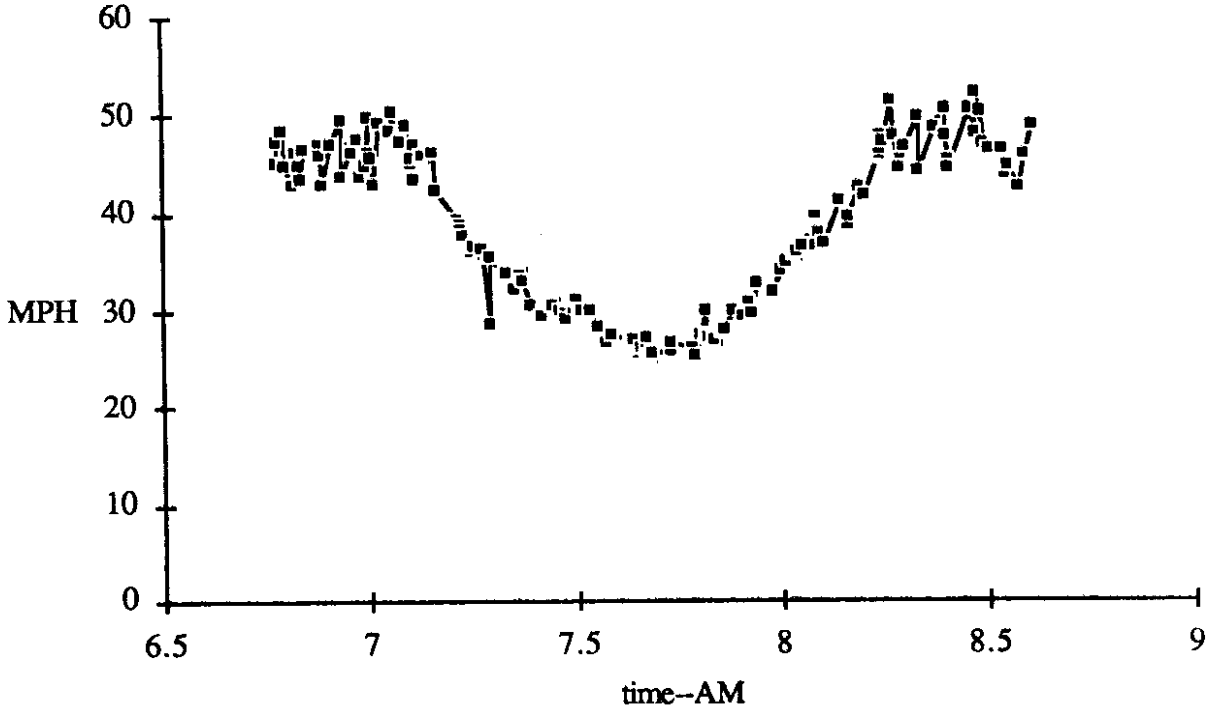

Figure 23. Morning Westbound Traffic Speed Pattern on SR-520

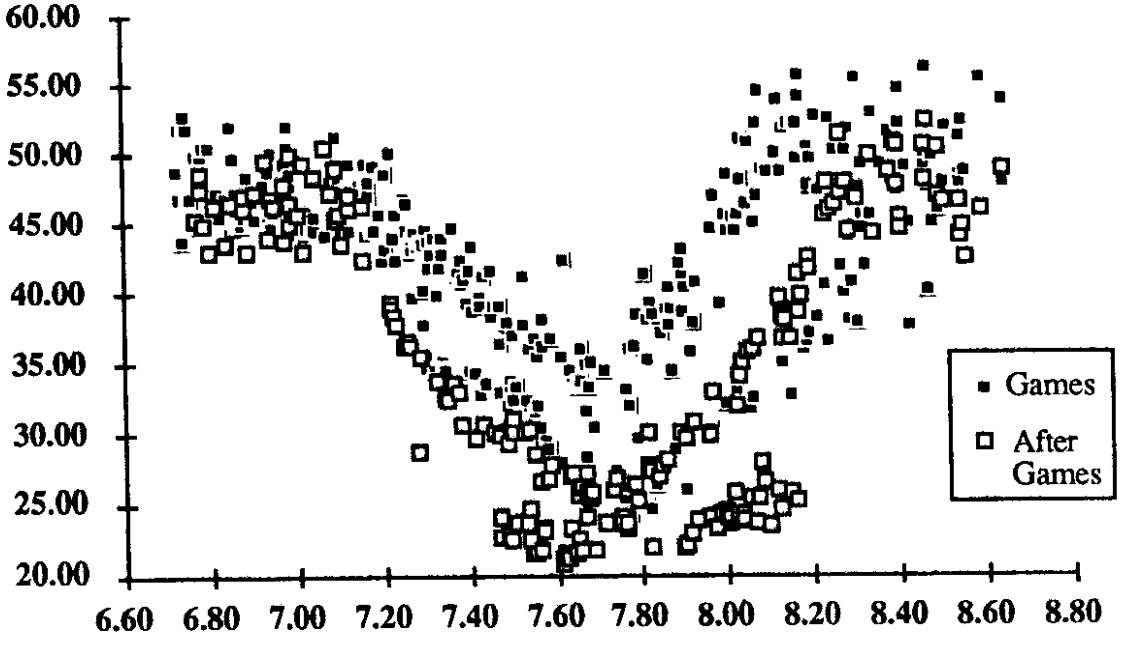

Figure 24. During and After Vehicle Speeds On WB SR-520 in the AM Commute Period

These improvements in vehicle speed were most likely the result of small decreases in traffic volume demand on SR-520 during the Games. Thanks to the encouragement of the Games organizers and various operating agencies (WSDOT included) many metropolitan area residents took vacation or changed travel modes during the Games. At other times in the year, similar reductions in vehicle trips (for example, during the Christmas holidays) has traditionally resulted in similarly improved AM commute conditions.

Unfortunately, the differences observed in this exhibit could not be confirmed as statistically significant. The difference between the two basic traffic patterns was too small for reliable statistical inference, given the normal day-to-day variation in the traffic performance on this facility and the limited number of days for which data could be collected during the Goodwill Games.

PM Westbound Traffic

This traffic movement showed somewhat different results than the morning commute patterns. The westbound evening movement contained both the normal commute traffic and, on one of the days that data were collected, Goodwill Games event traffic headed to Husky stadium.

As can be seen in Figure 25, the traffic during the Goodwill Games tended to be very similar to that experienced after the Games had ended. One day during the Goodwill Games had higher than normal traffic speeds, but that day occurred when events no longer occurred at Husky Stadium. The other two days of data collection during the Games showed normal congestion.

The measured afternoon traffic pattern also differed from the morning traffic pattern described above. Some congestion already existed before the beginning of the data collection period, and congestion had not cleared by the end of the data collection period. From these results, it can be surmised that total congestion was worse during the PM peak than during the morning peak. This difference in congestion levels was partly due to

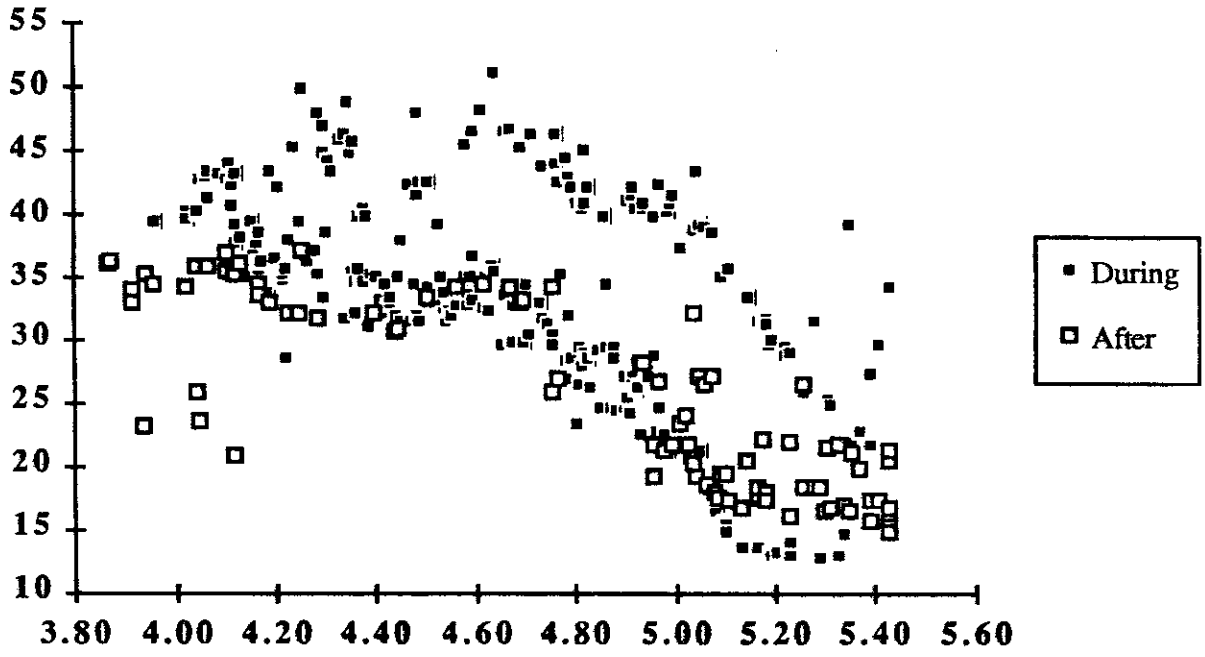

Figure 25. Westbound Evening Traffic Speeds on SR-520, During and After the Goodwill Games

Goodwill Games event traffic (headed to either the University of Washington or the Seattle Center) and partly due to the normal addition of shopping and other midday trips to the commute traffic.

PM Eastbound Traffic

This traffic movement was measured both leading to the Evergreen Point Floating Bridge (Montlake) and from Montlake to the eastern end of the bridge. Figure 26 shows the collection of "before" and "after" speeds for the road section between I-5 and Montlake Blvd. Figure 27 illustrates the speeds between Montlake and the eastern end of the bridge, and Figure 28 shows the average speed from I-5 to the eastern end of the bridge.

All three graphs show how variable traffic conditions are on SR 520. This variability can be seen both over time within a day, and between days. On several of the

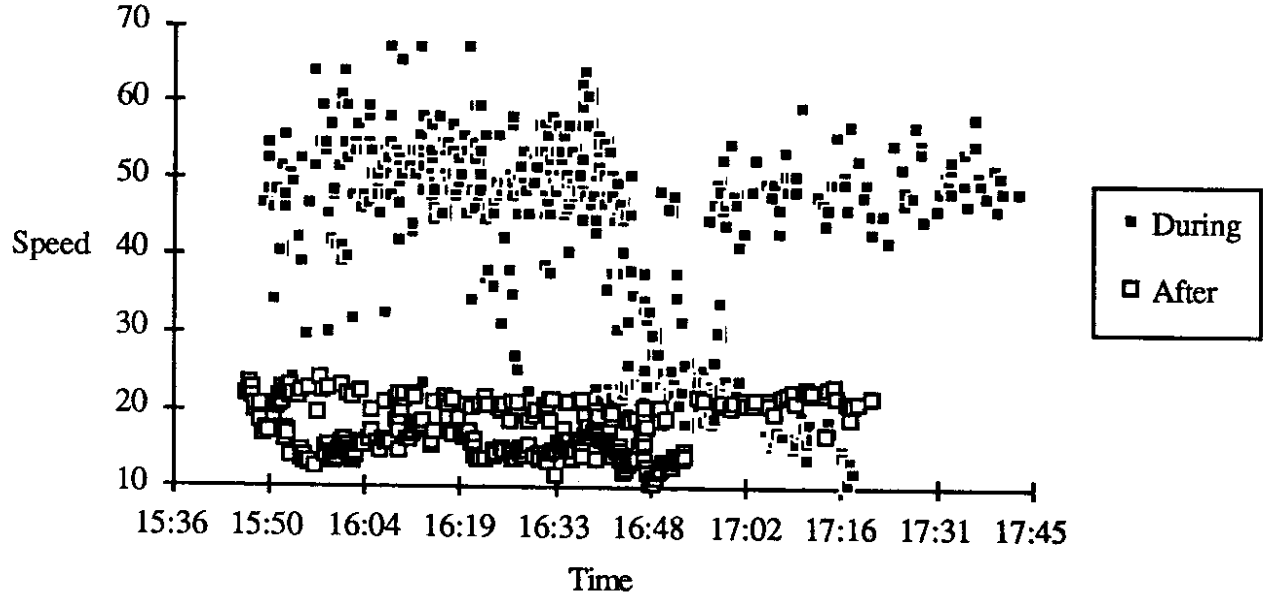

Figure 26. Eastbound Traffic Speeds On Sr-520 From 10th to Montlake During and After the Goodwill Games

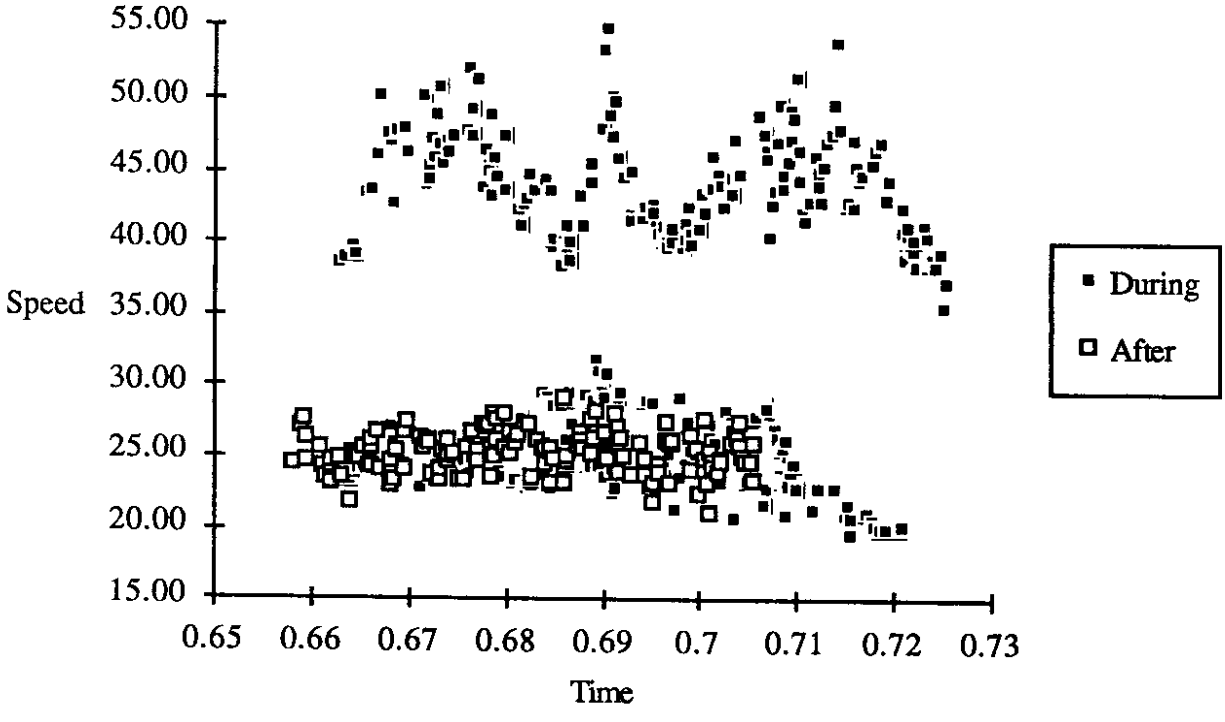

Figure 27. Vehicle Speeds Eastbound on SR-520 From Montlake to the Old Toll Plaza

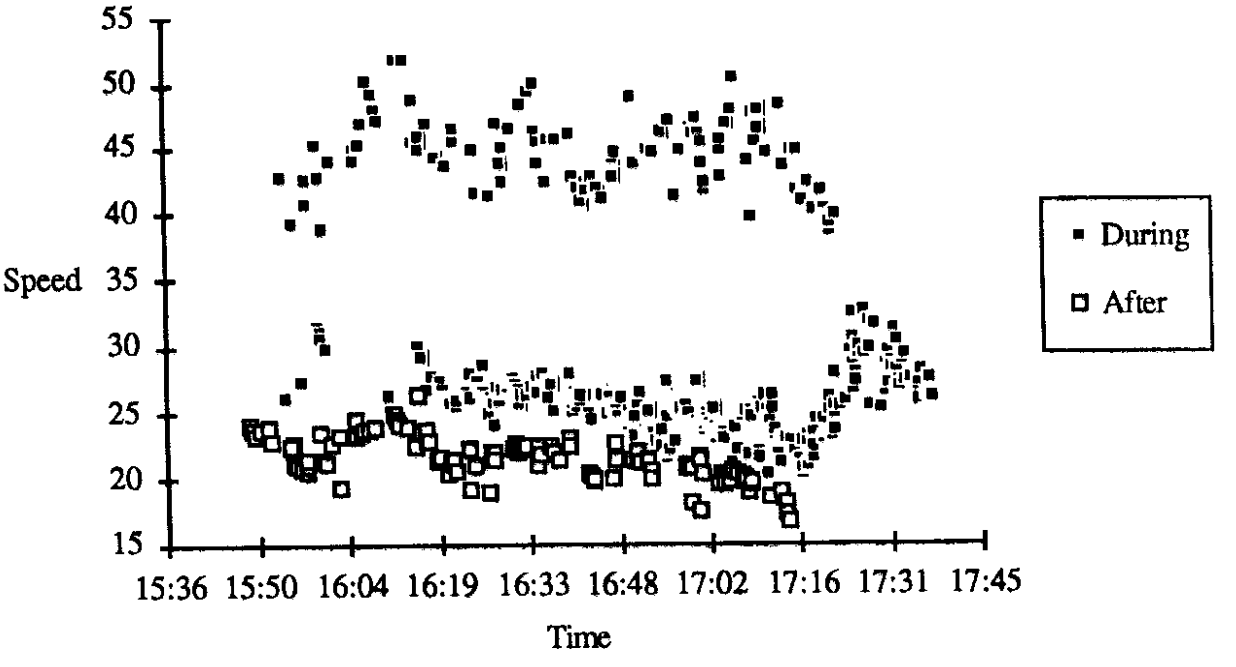

Figure 28. Eastbound Traffic Speeds on SR-520 From 10th to the Toll Plaza During and After the Goodwill Games

days during the Goodwill Games, little traffic congestion existed throughout the study period. Average speeds on the facility ranged from 40 to 55 mph. However, on other days during the Goodwill Games and on the days data were collected after the Goodwill Games, congestion caused speeds to average between 15 and 25 mph.

While the difference between 20 and 50 mph was statistically significant, the limited number of days of data included in the dataset made it impossible to determine whether the traffic improved throughout the Goodwill Games, or only on some days. It is possible to say that on several days, traffic congestion was very light, and that traffic speeds measured on these "light" days were significantly better than measured on days after the Games had ended. However, some days during the Goodwill Games SR-520 also experienced heavy

congestion, and the resulting speeds were no different than those measured after the Games had ended.

In addition, while no "good" days were measured in the "after" data collection period for this study, these same "good" conditions do occur normally, and not enough data were collected to determine how often these "good" conditions normally occur. Thus, it was not possible to determine whether the rate at which "good" conditions occurred was higher during the Goodwill Games than at normal times.

If the data collected were representative of all days during the Goodwill Games and representative of normal operating conditions, then significant improvements in travel speed on eastbound SR-520 occurred during the Goodwill Games. Improvements ranged from an increase of just under 9 miles per hour between Montlake and the eastern end of the floating bridge to an increase of 24 miles per hour between I-5 and Montlake Blvd.

BUS RIDERSHIP

Bus ridership on Metro increased substantially during July, primarily as a result of the Goodwill Games. Adjusted weekly ridership increased 10.4 percent[1] over the same figure for 1989. Total ridership for July increased 7 percent over 1989, despite the fact that 1989 had more weekdays than 1990. A major part of this increase was a result of transit ridership to the Goodwill Games Opening Ceremonies, which approached 40,000 passengers. This ridership was roughly twice what Metro carries to Husky stadium for a comparatively sized crowd during the college football season. Ridership to Husky Stadium for the initial days of track and field events was approximately 4,500 or roughly 6.8 percent of total trips.

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[1]Metro July 1990 Ridership Report, Research and Market Strategy Division

According to an internal Metro memo, the revenue provided by the Opening Ceremonies crowd actually exceeded the cost of the service hours provided by Metro[2]. (It was not clear what costs were included in the memo's $50 cost per service hour charge.)

Ridership to other Games venues could not be provided by Metro or Pierce transit.

TELEPHONE INFORMATION LINES

As discussed in the first chapter, two telephone services were provided during the Goodwill Games to provide traffic and transportation information to the public. The first was Metro's customer information line, which was designed to provide transit information (fares, schedules and directions) to potential transit patrons. The second was a new service provided by WSDOT, which gave traffic congestion information via a recorded message. Both telephone hotlines were heavily used during the Games.

The evaluation of these services was based on the amount they were used and WSDOT's public telephone survey.

Metro Information Line

The Metro information line was deluged with calls. Despite assigning the maximum number of available staff to the information lines and using extensive amounts of overtime, Metro was unable to answer a large number of calls. On Friday, July 20th, (the day before the Opening Ceremonies) almost 52,000 calls were made to the Metro information line. Only 3,843 of those calls could be answered because of limitations in the number of phone lines and Metro staff available for this function. Similar results can be seen later in the first week of the Games (see Table 3 below). As the Games continued, calls to the Metro Information Line decreased, but they were still higher than normal.

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[2]July 25, 1990 memo from Ann Haruki to Paul Toliver.

TABLE 3

Calls To The METRO Information Hotline

	Fri 20	Sat 21	Sun 22	Mon 23	Tues 24
Calls Dialed	51,978	57,552	25,412	61,974	36,278
Calls Answered	3,843	3,819	3,622	4,358	4,503
Percent Answered	7.4%	6.6%	14.3%	7.0%	12.4 %

TABLE 4[3]

Calls To WSDOT Traffic Information Line

Date	7/17	7/18	7/19	7/20	7/21	7/22	7/23	7/24	7/25
Calls Answered	218	218	218	561	654	391	200	234	195
Date	7/26	7/27	7/28	7/29	7/30	7/31	8/1	8/2	8/3
Calls Answered	259	164	125	100	117	172	124	124	124
Date	8/4	8/5	8/6						
Calls Answered	75	77	70						

WSDOT Traffic Hotline

Similar to the Metro phone line, the WSDOT traffic hotline received many more calls than it could handle during the beginning of the Goodwill Games. The total number of calls handled by the WSDOT system also decreased as the events continued (see Table 4).

It is not clear whether the number of calls to the hotline dropped because motorists

- were not receiving the information they needed,
- had decided to take alternative means of transportation,

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[3]Some statistics represented total calls for several days, averaged to represent an "average" day. In addition, data were not always collected for a 24 hour day, and the project team had to adjust these data to represent consistent time periods..

- had decided they were not going to change their driving habits as a result of the available information, or
- were able to get equivalent traffic information from the increased traffic coverage time provided by various radio and TV stations.

Insufficient information was obtained from the telephone survey to answer this question.

The telephone survey did indicate that roughly 25 percent of the population knew about the WSDOT telephone hotline, although only just over 1 percent of those polled actually called the system.

IMPACTS OF OTHER INFORMATION SERVICES

The telephone survey indicated that the a large portion of the population was aware of an increase in the traffic and transportation information during the Goodwill Games. Just under 70 percent (68.8) of the people polled noticed an increase in information available through radio and TV broadcasts. This information, plus the expected or experienced traffic congestion, caused roughly 10 percent of those polled to change their commuting patterns during the Games. While this change was small, if it had been spread evenly throughout the peak periods, it would have had a significant impact on volume related traffic congestion and would have created the changes measured on SR-520 and on the Ship Canal Bridge.

INCIDENT DETECTION AND CLEARANCE

Two sources of data, the WSP CAD files and service patrol reports, were available for analyzing the impacts of the service patrols provided by WSP and the Washington Tow Truck Drivers Association. To determine the impacts of the service patrols, incident conditions during the Games were compared to incident conditions for the same time period in 1989. In addition, the metropolitan area was divided into four separate regions for analysis. Two of these areas included locations where service patrols operated (I-5 in

Seattle and I-5 in Tacoma) and two served as controls for the analysis (I-90 and SR-520 in Seattle).

The principal limitations of the available data (or any incident related data) were that incidents are fairly rare occurrences and have a large inherent variability. (That is, a small incident can last a very short time, while a large incident can last several hours.) This variability meant that the impact of specific response measures was very difficult to measure, and it was almost impossible to obtain statistical confidence concerning those impacts or measured changes in incident characteristics.

Number of Incidents

The number of incidents reported in the CAD system increased between 1989 and 1990 from 927 to 1,188. The distribution of these incidents among geographic study areas is shown in Figure 29. This increase was attributed to three factors:

- an increase in hazardous conditions on the studied facilities,
- an increase in traffic volumes (and thus exposure rates) between 1989 and 1990 because of both traffic growth and the Goodwill Games, and
- increased detection of incidents as a result of the service patrols.

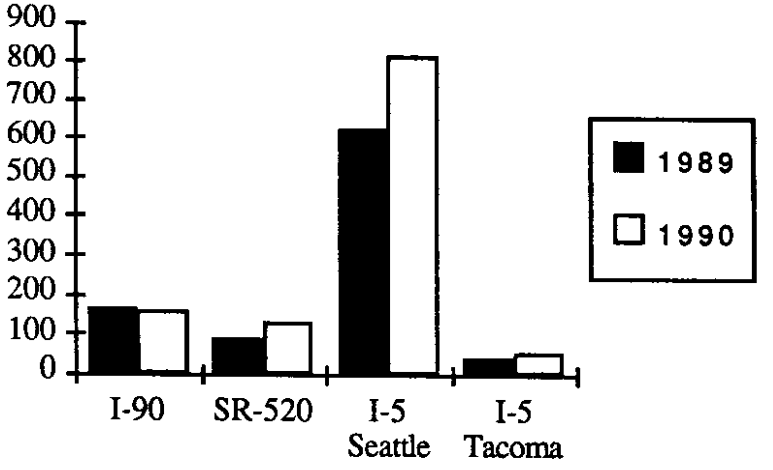

Figure 29. Number of Incidents Reported

The greatest increase (73 percent) in detected incidents occurred in the disabled vehicle category in the Seattle I-5 section of the study area. The fact that this area had the largest increase in incidents supports the theory that at least part of the increase in reported incidents was due to the greater presence of WSP officers in the study area. (The Tacoma area added non-WSP patrol vehicles, and many of their smaller assists were not reported to WSP dispatch and thus did not enter the CAD file.) The larger presence of WSP officers as a result of the service patrol effort increased the likelihood that WSP officers saw disabled vehicles and also placed WSP officers in a better position to assist vehicles stalled on that facility.

Two of the other study areas (I-5 Tacoma and SR-520) also saw increases in the number of incidents reported in 1990. While these increases were fairly small in number, they were a large percentage. Incidents on I-5 in Tacoma increased by 30 percent, while incidents on SR-520 increased 44 percent. Increases of this magnitude confirm the need for the state to apply more resources towards managing incidents to maintain freeway performance, but they say little about the effectiveness of the service patrols themselves.

The only facility that saw a decrease in incidents between 1989 and 1990 was I-90, which experienced a marginal decrease of 3 percent. This change was insignificant, given the variable nature of incidents.

Accidents

The two response areas in which service patrols operated during the 1990 period (Tacoma on I-5, Seattle on I-5) showed decreases in the average duration of incidents involving accidents (see Figure 30). In contrast, the two geographic areas that did not have new service patrols both showed an increase in average accident duration.

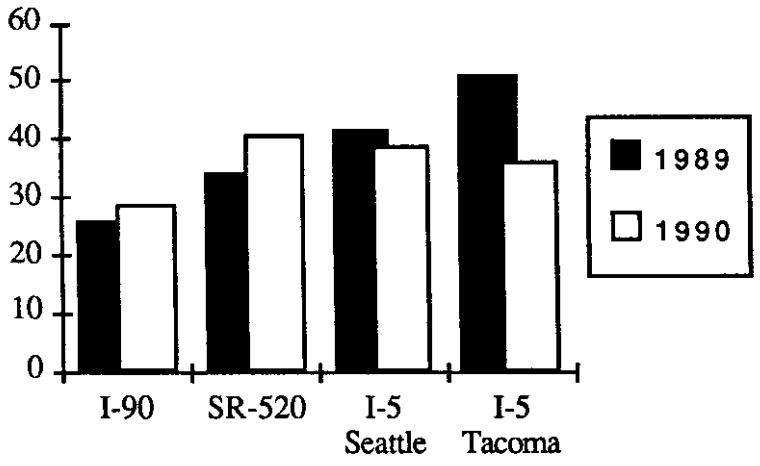

Figure 30. Duration of Incidents Involving Accidents

The largest decrease in the duration of incidents that involved accidents was over 15 minutes per accident on I-5 in Tacoma. I-5 in Seattle had a decrease of only 3 minutes. The larger measured decrease in incident duration in Tacoma was expected because tow trucks served as the service patrol vehicles in that area. Use of tow trucks meant that a towing service was on the scene quickly for all incidents, reducing the time necessary for towing equipment to arrive at an accident site.

Despite the size of the decrease in accident duration time in the Tacoma I-5 study area, the measured change was not statistically significant. The change was not significant because of the large variation in the time required to clear incidents that involve accidents (caused by differences in the severity of accidents) and the relatively small number of accidents that occur in the Tacoma I-5 study area during a month. That is, this change could also have been due to a chance reduction in the number of very large accidents.

However, it is important to note that the standard deviation of the average accident duration also decreased in the areas that contained service patrols (see Figure 31). This decrease was mostly due to fewer long duration incidents.

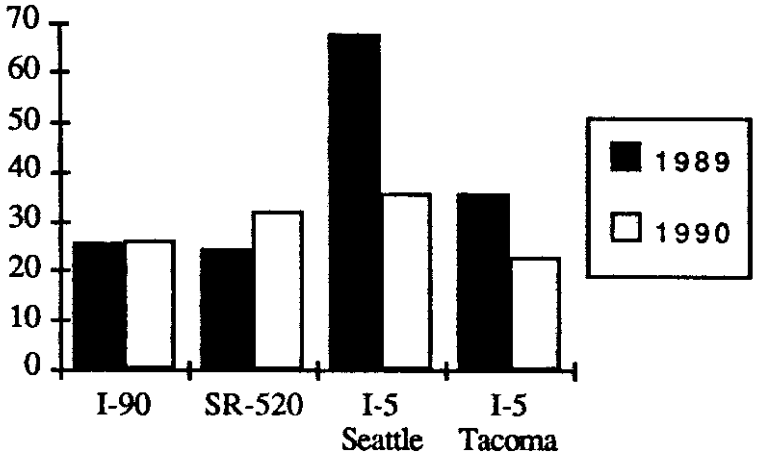

Figure 31. Standard Deviation of Accident Duration

As pointed out above, this reduction in long duration incidents was partly the result of luck (no gasoline truck accidents occurred in 1990) and partly the result of tow trucks (in Tacoma) or trained WSP officers (in Seattle) reaching the scene quickly, ensuring that equipment appropriate for the incident also arrived quickly at the scene.

Debris Clearance

In many cases, incidents were caused by debris that has been accidentally deposited on a roadway. First, the vehicles that slowed to avoid the debris caused congestion; second, vehicles hit the debris and became disabled or caused accidents. In both of the service patrol study areas, the number of incidents caused by debris increased slightly during the Goodwill Games. The duration of incidents caused by debris decreased in the Seattle study area but increased in Tacoma (see Figure 32).

The decrease in the duration of incidents caused by debris in Seattle (from an average of 33 minutes to just under 15 minutes) was statistically significant at the 80 percent confidence level. The change in Tacoma was not statistically significant (and was probably meaningless) because only two debris related incidents occurred in the 1989 data collection period. The lack of data made the statistical comparison of 1989 and 1990 untrustworthy for this statistic.

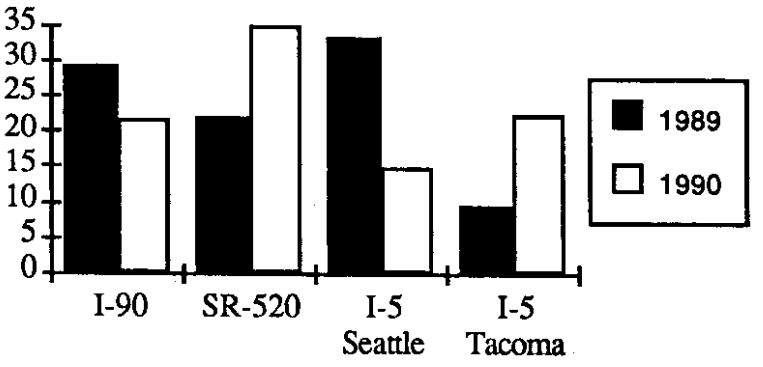

Figure 32. Duration of Incidents Caused By Debris

Tow Truck Service

In all four study areas, the time required to clear an incident that required a tow truck decreased during the Goodwill Games service patrol demonstration (see Figure 33). This decrease was the greatest on I-5 in Tacoma because of the service patrol tow trucks. It was the smallest on I-90 (which was already serviced by two tow trucks during peak periods) and SR-520 (whose existing service of one tow truck during peak periods was increased to two tow trucks during peak periods).

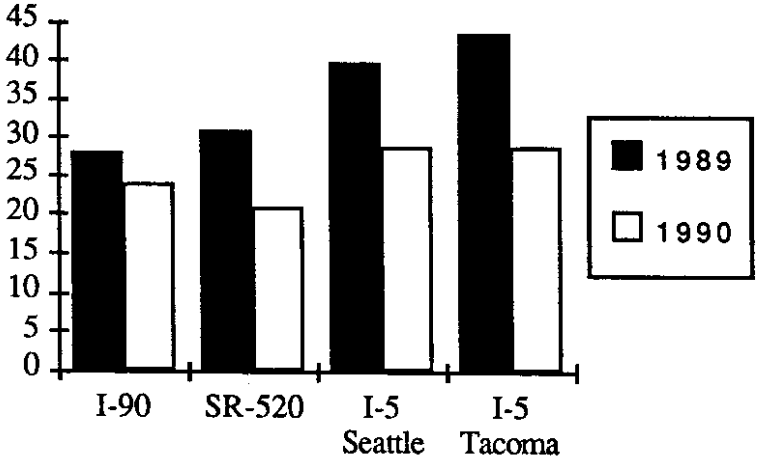

Figure 33. Duration of Tow Truck Involved Incidents

As with incidents involving accidents, the standard deviation of the duration of incidents that required a tow truck also decreased during the Goodwill Games. Again, this decrease was greatest on I-5 in Tacoma, where the average duration of an incident requiring a tow truck dropped over 14 minutes, and the standard deviation dropped over 20 minutes. This decrease in duration time for incidents requiring tow trucks was statistically significant at the 80 percent confidence level and was directly attributed to the presence of tow trucks in the patrol area.

Disabled Vehicles

The impact of the service patrols on incidents involving disabled vehicles was also positive. The durations of disabled vehicle incidents were reduced in both Seattle and Tacoma on I-5. At the same time, in those parts of the service area without service patrols, the durations of these incidents either increased (SR-520) or decreased marginally (I-90). These differences are illustrated in Figure 34.

The decrease in the duration of disabled vehicle incidents on I-5 in Seattle was particularly substantial. A reduction of over 6 minutes in average incident duration (from 24.7 minutes to 18.4 minutes) was statistically significant at a 99 percent confidence level. It was directly attributed to the ability of WSP service patrol officers to quickly clear most

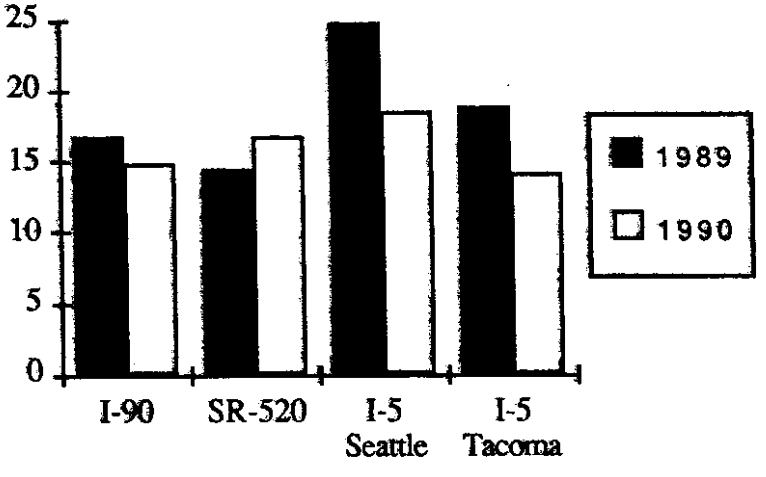

Figure 34. Duration of Disabled Vehicle Incidents

disabled vehicles from the roadway, either by using push bumpers or extra supplies (such as anti-freeze) carried in the service patrol vehicles. In Seattle, the variation in the time required to clear disabled vehicles also decreased. Again, this reduction was directly attributed to the early presence of WSP officers on the scene with enough equipment to clear the vast majority of incidents. The other three study areas did not exhibit this kind of improvement.

These findings are particularly important because disabled vehicles caused over 60 percent of all reported incidents in the CAD system.

Truck Involved Incidents

Incidents that included trucks were noted within the CAD system. Because trucks pose special incident response difficulties, the impact of the service patrols on incidents involving trucks was studied separately from other incident types. These incidents are included within the other categories used above.

In Seattle, a decrease in the durations of incidents involving trucks occurred on both I-90 and on I-5 during the Goodwill Games. (Because of a lack of data on truck incidents from 1989, the I-5 site in Tacoma was removed from this part of the analysis.) Despite reflecting a measured drop of over 24 minutes, the change on I-5 was not statistically significant because of the extremely large degree of variability in the time required to clear truck incidents. (The standard deviation of the mean value in 1989 was 135 minutes.) While the change in durations on I-90 was statistically significant, the project team was able to identify at least two long-duration truck incidents that were missing (for unknown reasons) from the CAD records. These incidents would have increased the mean truck incident duration time enough that the measured change would not have been significant.

Response Times

When service patrol vehicles encountered a disabled vehicle or identified an accident before the incident was detected by other means, they provided a significant improvement in response time for incidents. While this study could not measure the time savings

provided by the patrolling vehicles (i.e., how long an incident would have remained undetected if the service patrol had not detected it), it could estimate the time a WSP officer usually took to reach an incident location after receiving a dispatcher's call. This time value represented the response time saved by service patrols, even if those patrols did not actually provide an improvement in the detection of incidents.

Analysis of the WSP CAD data indicated that on the average in 1989, a WSP trooper required almost 15 minutes to reach the scene of an incident on I-5 (in both Seattle and Tacoma) after that incident had been reported to WSP dispatchers. This figure includes incidents that were initially discovered by a patrolling trooper and for which response time was essentially zero. (According to the CAD data, such discovery occurred roughly 25 percent of the time without service patrols.) The standard deviation of this initial response time was 23 minutes. These values showed that in some instances, the response time required to reach an identified incident was quite high because of both congestion and the need for WSP officers to respond to more pressing emergencies.

During the Goodwill Games, thanks to the service patrols, these values improved markedly. The average response time for a WSP officer dropped to just over 10 minutes (a 5-minute improvement), with a standard deviation of 18 minutes. Moreover, 37 percent of the incidents reported through the CAD system were discovered by WSP officers (including the WSP service patrol officers).

The impacts of the service patrol were also observed in other parts of Seattle. On SR-520, only 14.6 percent of the WSP CAD reported incidents were initially observed by a WSP officer, and the mean response time was just under 13 minutes. On I-90, the mean response time was 11 minutes, and 20.3 percent of the incidents had no response time. Both of these results indicate the improved detection of incidents that resulted from the presence of the service patrols.

AUTO OCCUPANCY

Automobile occupancy data were collected at five locations in the study area. These included

- SR-520 west of the floating bridge,
- I-5 at NE 45th street in Seattle,
- I-5 at Albro just south of the Seattle CBD,
- I-5 near Fife (just north of the Tacoma CBD), and
- I-5 near Carlyle Road (south of the Tacoma CBD).

These locations correspond to locations where automobile occupancy count data are being routinely collected as part of the WSDOT vehicle occupancy monitoring program.

Data were collected two times at each of these locations in the peak direction of travel during the Goodwill Games. These data were collected to determine whether the travel patterns of area commuters were affected by the traffic mitigation measures described earlier in this report. The collected data were then compared to the vehicle occupancies measured as part of WSDOT's regular monitoring process.

The results of these comparisons are displayed in Figure 35. These data showed that average auto occupancies did not change significantly during the Goodwill Games. While occupancies did increase slightly on most facilities, these measured increases were well within the range of normally expected variation. Likewise, one facility (I-5 south of Tacoma) showed a slight decrease in auto occupancy, but these measured changes were also well within the range of expected variation.

PUBLIC PERCEPTION OF TRAFFIC CONDITIONS

The telephone survey provided one estimate of the public's perception of traffic conditions during the Goodwill Games. The survey indicated that 8 percent of the public perceived that traffic conditions improved during the games, 26 percent thought that conditions were worse during the games, and 66 percent did not notice a change in traffic conditions.

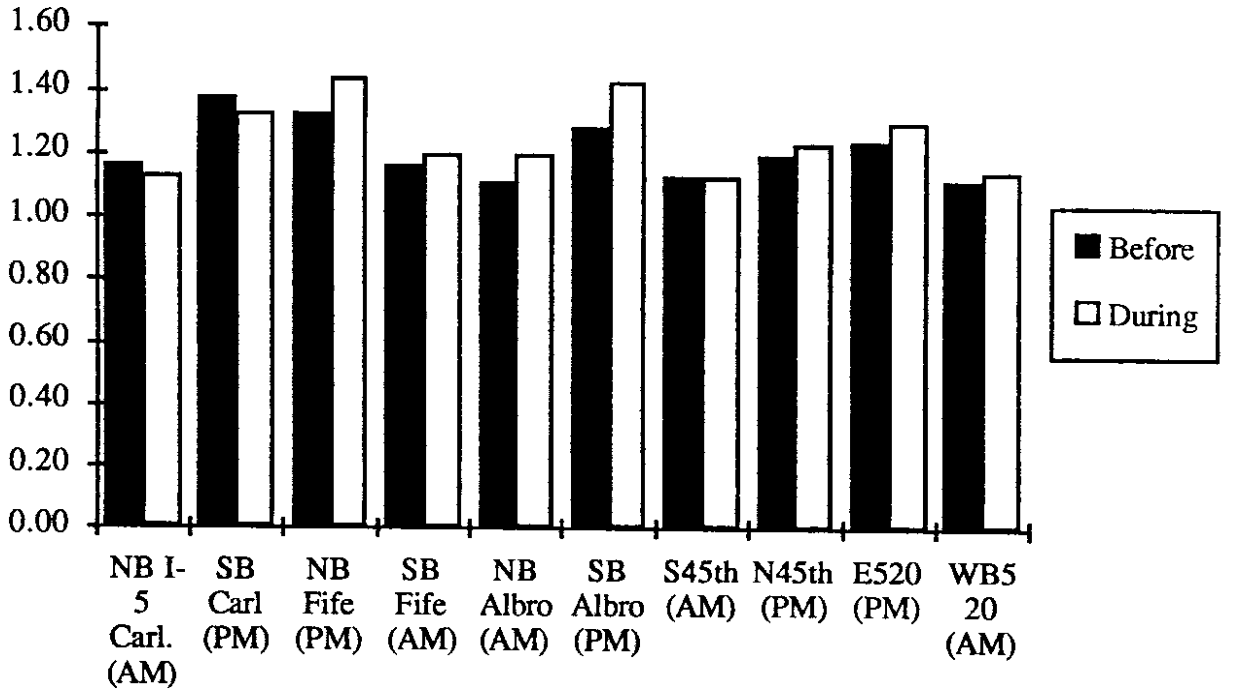

Figure 35. Auto Occupancy Before and During the Goodwill Games

An informal poll of a variety of transportation professionals produced a consensus that traffic conditions were marginally better than normal away from the Games venues, but marginally worse than normal near those venues. This view appears to be supported by the data presented above.

The difference in perception may have been in part due to the press coverage of traffic conditions. In the first few days of the Games, several major incidents caused substantial delays to motorists. In reporting on the congestion, the press emphasized the fact that many people going to scheduled events were late reaching the venues as a result of the congestion. While this congestion was primarily incident related rather than venue related, it was still congestion and still received a large amount of press coverage.

Conversely, the improvements that did occur during the commute periods were relatively modest (congestion still occurred on most routes; it simply started a few minutes

later and ended a few minutes earlier than normal) and were thus not newsworthy. In many cases, the improvements were difficult to quantify even as part of this study. This lack of a clear improvement, as well as a lack of news coverage of those improvements, meant that few members of the general public perceived that traffic flow had actually improved.

INTERPRETATION OF THE FINDINGS

GENERAL TRAFFIC IMPACTS

Two opposing events happened during the Goodwill Games. The first was that traffic increased significantly during the peak commute hours as spectators traveled to Games' events. This increased traffic was expected to add to the existing levels of heavy congestion. The second was that cooperating local agencies implemented traffic mitigation measures to reduce the traffic impact of the Goodwill Games. These mitigation measures were designed to reduce total vehicular traffic both by encouraging the use of higher occupancy modes of travel and by altering travel patterns to eliminate extraneous trips or reorient trips to less congested locations or times of the day.

The available data showed that both of these events occurred. The examination of average volume and vehicle speed data showed that overall, only minor changes in traffic patterns occurred. The facilities that were most affected by the Goodwill Games and for which drivers had the best alternatives to single occupant automobiles (e.g., SR-520) showed the greatest change in driver behavior, while those roads that were least affected by the Goodwill Games event venues and for which motorists had the poorest alternatives to single occupancy vehicles (i.e., I-5 south of the Seattle CBD) showed the least impact from both the event traffic and the traffic mitigation measures. Nevertheless, in all cases, the changes in traffic patterns were small.

As was expected, the Goodwill Games events generated large traffic volumes. However, even these event volumes (while being larger than "normal" traffic volumes) were lower than volumes generated by most other events of similar size. Of particular note were the large number of transit riders to the Opening Ceremonies of the Goodwill Games (with 70,000 spectators) and the fairly small increase in westbound evening traffic volumes on SR-520, despite an average attendance of over 23,000 people per day attending the track events.

IMPACTS OF THE SERVICE PATROLS

The operation of service patrol vehicles was expected to produce the following results:

- decrease the time required to identify and locate incidents,
- decrease the time required to clear most incidents, and
- improve traffic flow by accomplishing the previous two tasks.

The data presented in the preceding chapter indicated that these goals were achieved, although the statistical confidence in this conclusion was weak because of the limitations inherent in measuring incident duration estimates.

The service patrol vehicles appeared to have succeeded in improving the ability of the WSDOT and WSP to both identify and locate incidents. This improvement was shown both by the increased number of incidents first reported by service patrol drivers and by the decreased response times required to reach the incident scenes. In addition, as shown by the consistent reduction in incident durations measured throughout the service patrol areas, those incidents were also cleared more quickly than before (or without) the service patrols. While the available data did not provide strong statistical confidence in the measured improvements in incident durations, a number of contributing factors provided support for the conclusion that the service patrols significantly improved incident response on the metropolitan freeway system.

One of the most important supporting facts was that the durations of incidents consistently decreased in the two study areas that contained service patrols, while the durations of similar incidents in areas without service patrols often increased. Since no other major changes in incident response procedures occurred during this study's time frame, the differences in incident response characteristics between the geographic areas could logically be attributed to the service patrols.

The second supporting factor was that the decreases in incident durations described above did not include the savings in incident duration that resulted from improved detection

time. While it was possible to provide a crude estimate of the response time saved by the WSP service patrols (close to 5 minutes per incident, according to the CAD database), the researchers could not estimate how long various incidents would have remained undetected before they were reported if a service patrol vehicle had not identified the incident. These improvements in identifying incidents are particularly important in areas like Tacoma, where no formal surveillance control and driver information (SC&DI) system exists. In Tacoma the number of incidents reported by tow truck drivers was three times the number reported through the WSP CAD system.

A third factor apparent from a comparison of the tow truck operator's reports and the WSP CAD files in Tacoma was that the service patrols provided responses to minor incidents that conventional WSP officers often could not provide because of various time and resource constraints. The fact that the Tacoma tow truck service patrols responded to more than three times as many incidents as were reported in the WSP CAD database showed how constrained WSP resources were in providing motorist assistance. Many of the incidents reported by tow truck service patrols but not in the WSP CAD file consisted of disabled vehicles that would have initially been overlooked by otherwise occupied WSP troopers. Quick attention to, and removal of, these types of vehicles not only reduces distractions to motorists on the facility (and thereby improves facility performance), it also removes hazards from the roadway that cause additional incidents and other safety problems.

Unfortunately, the study could not measure the results of these improvements in terms of decreases in total vehicle delay or increased traffic performance. The available traffic monitoring data were insufficient to accurately monitor the impacts of the service patrols on traffic performance during the Goodwill Games. Traffic performance was too varied during the demonstration, and too many factors that impact traffic performance were not "normal" or controlled during the service patrol demonstration. Thus, the researchers could not calculate changes in traffic flow attributable to the service patrol demonstration.

However, if the service patrols did cause the decreases in incident detection time, initial response time, and (in many cases) incident clearance time measured in this study, they would also have decreased the amount of time that incidents disrupted traffic.

CONCLUSIONS

The authors conclude that the traffic mitigation measures undertaken by the cooperating agencies in the metropolitan area succeeded in containing the expected traffic congestion during the Goodwill Games. In some areas traffic improved during the Games. In most areas, traffic remained near normal levels, and in some individual cases, severe congestion still occurred (for example, the first Friday of events near the King County Aquatics Center). However, the few cases of severe congestion were almost always caused by the simultaneous combination of severe incidents and heavy traffic volumes. While the service patrols and other incident response actions implemented by WSDOT and other agencies decreased the time required to respond to these incidents, these measures did not (and could not be expected to) totally eliminate the impact of incidents on congested facilities, particularly during peak travel times.

In general, the cooperating agencies achieved the objective of informing the local population of the potential for expected traffic congestion and provided ways to deal with that congestion. While much of the public was not aware of many of the transportation services available to them, enough people changed their travel patterns to maintain normal traffic flow. In some cases, public response was so strong that it overwhelmed an agency's ability to respond (e.g., Metro's public information line), and this may have prevented more significant improvements in the functioning of the transportation system.

Those areas that received the most media attention also received the best public response. Most notably, as a result of an extensive public information campaign, roughly 50 percent of the people attending the Opening Ceremonies used public transportation. Other areas that received less publicity (such as the Service Patrols) operated effectively, achieved their basic goals, and contributed towards smooth traffic operations, but did so without gaining the attention of the general public.

The end result was a system that worked well enough to go relatively unnoticed once the Games got under way. The authors consider this a sign of success, and the hallmark of a smoothly functioning transportation system.

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