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ELIMINATING THE FAST LANE
AT THE PACIFIC HIGHWAY CROSSING:
RESULTS OF A PILOT PROJECT*

by

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INTRODUCTION

A 2010 study of the Southbound Pacific Highway Crossing (PHC) focused on alternative configurations for an under-utilized approach lane and inspection booth (Springer, 2010). At the time of the study, both the lane and the booth were restricted to enrollees in the FAST, or Free and Secure Trade, program (USCBP, 2005). The FAST program was designed to encourage members of the trucking industry to increase freight security by rewarding qualifying participants with shorter travel times. To qualify for FAST, carriers, drivers, and shippers are required to follow certain security procedures which enhance the safety and security of the border. Trucks enrolled in FAST were then allowed to use a dedicated lane and inspection booth, thereby bypassing the potentially long queues in the general-purpose (GP) commercial freight lanes. Prior to the 2010 study, anecdotal information suggested that the FAST lane and FAST inspection booth were grossly underutilized; data gathered for the study during the summer of 2009 subsequently showed that only 22.5% of all trucks using the Southbound PHC were eligible for the FAST lane and booth (WCOG, 2010).

With one inspection booth dedicated to FAST, and two other booths handling the remaining freight traffic, the FAST ratio of 22.5% resulted in FAST waiting times that were much lower than those for trucks using the GP booths. The 2009 data survey found that average waiting times for a GP booth were more than four times greater than the average waiting time for a truck in the FAST lane. For carriers to willingly enroll in FAST, there needs to be some benefit to doing so, and lower average waiting time is clearly such a benefit. However, some concern was expressed that the relatively low level of FAST enrollment was insufficient justification for the longer waiting times imposed on GP trucks by reserving one of the three booths for FAST trucks. Furthermore, seventy-three percent of all southbound trucks using the

FAST lane were empty: the rules of the FAST program make it easier for an empty truck to be FAST-qualified, as in such a circumstance there is no shipper and therefore no need to ensure that the shipper is FAST-qualified. Thus, despite a significant difference in expected waiting times between the FAST and GP lanes, less than ten percent of all southbound trucks were using FAST for transporting freight (Davidson, 2009).

One of the configurations examined by Springer (2010) was the opening up of the FAST lane and FAST booth to all traffic. Springer estimated that opening the southbound FAST lane to all freight would, assuming 2009 traffic conditions, cut overall average waiting time by a factor of three, although waiting times for FAST trucks would increase while waiting times for GP trucks decreased. The increase in average waiting time for FAST trucks would be by less than a factor of two, however, while the average waiting time for *all* trucks would be less than two minutes in the newly-configured border crossing. These results were based on a specific set of assumptions, the most important of which was traffic volume: southbound freight traffic at the PHC was at a ten-year low in 2009, and an increase in traffic would lead to longer waits for FAST trucks that were no longer able to access a dedicated FAST lane.

Nonetheless, the benefits of lower overall waiting times were deemed to be worth the potential cost, and a pilot project examining just such a configuration was approved. In February, March, and April 2011, data were collected over a period of several days while two different lane configurations were in operation at the southbound PHC: the *baseline* configuration involving one FAST lane and booth, and one GP lane and two GP booths; and a *pilot* configuration with a single GP lane and three GP booths (Davidson, 2011). The results of this experiment are discussed in the remainder of this paper.

THE 2011 DATA SURVEY

Data were collected over a total of twenty-six days in February, March, and April. Eleven days were observed under baseline conditions. Observations were then suspended while the southbound PHC signage and lane markings were altered to support the no-FAST pilot configuration. After the border crossing was reconfigured, fifteen days of data were collected on southbound trucks. For each day of data collection, a crew of observers with time-synchronized handheld data recorders noted arrival and departure times at the end of the different queues, booths, and stop points (e.g., the radiation portal monitor). This data enables the analyst to determine the arrival rates, waiting times, and inspection times for southbound trucks during the study period. Data collection for each day was scheduled to begin at 8:00 AM and to end at 3:00 PM for survey days on Monday through Thursday; for Friday, Saturday, and Sunday, data collection began at 7:00 AM and ended at 2:00 PM.

Although both the baseline and pilot configuration data were collected within a two-month period, it is important to remember that conditions during these two short time frames were not identical. Generally speaking, average waiting time increases as the average inspection time increases or as the average arrival rate increases. Thus, any difference in average waiting times during the baseline and pilot configuration phases would likely be partly due to differences in arrival rates and inspection times during the two phases. Table 1 shows the differences in overall average arrival rates and inspection times for the baseline and pilot configurations, as well as reporting those items for the 2009 study and two earlier studies of the southbound PHC in 2006 (WCOG, 2007) and 2002 (USDOT, 2003). The reported data include arrival and inspection times averaged across the weekdays (Monday through Friday) of the 2011 studies.

	2002	2006	2009	2011 Baseline	2011 Pilot
% FAST	NA	35%	23%	23%	NA
Arrivals/Hour	78	65	51	53	64
Inspect Time-FAST (Sec)	NA	86	75	79	NA
Inspect Time-GP (Sec)	57	120	98	106	102
Inspect Time-Average	57	108	93	100	102

Table 1. Summary Data from Five Studies of Southbound PHC Freight.

First, note that total truck traffic was greater during the 2011 pilot phase than during the 2011 baseline phase: the average number of trucks arriving per hour jumped from fifty-three in late February and early March to sixty-four in late March and early April. Second, note that the inspection time, averaged across all trucks, was two seconds greater (102 versus 100) during the pilot phase than in the baseline phase. Thus, *everything else being equal*, one would expect to see longer waiting times during the pilot phase than during the baseline phase, since the pilot phase experienced longer inspection times and higher traffic volume. Of course, everything else won't be equal, as opening up the FAST lane to GP trucks is expected to lower overall average waiting times. Nevertheless, it is important to realize that any reduction in average waiting time in the pilot phase occurred *even though the underlying traffic volume and inspection time conditions were worse*.

It is important to note that the arrival rates reported in Table 1 and in the remainder of this report are most likely on the low side of the true values. During each day of the study, some trucks entered the queue without having their arrival time recorded. This was particularly the case for the baseline phase of the study, as some non-FAST qualified trucks would routinely use the FAST lane to “jump the queue” before merging back into the GP lane. The arrival of these

trucks was not recorded, as they never properly arrived at the end of the FAST or GP lane queue where the data observers were stationed.

The number of unrecorded arrivals can be roughly estimated by examining the number of recorded inspection times with no corresponding arrivals linked by license plate values. Since there are also records of truck arrivals with no matching inspection times, however, it is possible that many of these inspection records represent trucks whose arrivals were recorded but had their license plate mis-entered. Thus, the difference between the number of inspected trucks with no recorded arrival, and the number of arriving trucks with no recorded inspection time, serves as an estimate of the number of unrecorded arrivals. This information is presented below in Table 2 for both the baseline and pilot phases. Note that this analysis was restricted to the study hours between 9:30 AM and 1:30 PM; including earlier or later times would bias the results, since trucks inspected earlier in the morning had usually arrived before data collection began, and trucks arriving later in the afternoon were frequently not inspected until after data collection had ceased. The total results for each phase are converted into an hourly estimate of how many additional trucks were likely arriving each hour, above those numbers reported in Table 1. Note that although this hourly additional arrival rate is highest for the baseline phase, possibly due to the queue-jumping behavior cited earlier, there were still apparently many missed arrivals in the pilot phase as well.

	Baseline	Pilot
Trucks served between 9:30 and 13:30 with no recorded arrival	262	216
Trucks arriving between 9:30 and 13:30 with no recorded service	140	72
Estimated unrecorded arrivals between 9:30 and 13:30	122	144
Estimated unrecorded arrivals per hour	4	3

Table 2. Hourly Arrival Rate Adjustments for Freight Data

Before moving on to a detailed analysis of the data, consider the results of the earlier studies listed in Table 1. In doing this comparison, we will not consider the arrival rate adjustments shown in Table 2, as these adjustments were not made for the earlier data even though it is likely that a similar phenomenon (unrecorded arrivals) occurred. If the rate of missed arrivals was roughly similar to that experienced in 2011, which seems a reasonable assumption, it is valid to make comparisons between years based on the raw uncorrected numbers in Table 1. We also need to add the caveat that the earlier studies from 2002, 2006, and 2009 were based on averaging results over nine hours of daily data (8:00 AM – 5:00 PM), while the studies from 2011 are based on results from at most seven hours of daily data collection (8:00 AM – 3:00 PM, Monday through Thursday; and 8:00 AM – 2:00 PM, Friday). In addition, the earlier studies were conducted during the summer, so there may be seasonality differences exhibited in the data. Nonetheless, one may still cautiously state that the traffic volume in 2011 appears below that observed in 2002, while that of the 2011 pilot approaches the volume of 2006. The 2011 baseline traffic levels seem roughly comparable to 2009. Interestingly, the inspection times for 2011 are somewhat higher than in 2009. With similar or greater arrival rates and slower inspection times, we would expect average waiting times for the 2011 studies to be higher than those observed in 2009.

In the remainder of the report, the results of the 2011 studies will be presented in detail. First, the overall performance results, i.e. the waiting time data for the two different configurations, will be examined. This will be the data of primary interest to most readers of this report. However, given the impact of the underlying conditions on system waiting times, subsequent sections will examine arrival rates, inspection times, and other important system characteristics in detail. Finally, a conclusion will summarize the results.

WAITING TIMES

Consider first the distribution of waiting times under each of the different configurations, and for each of the differently qualified trucks. Only weekday (Monday through Friday) data were considered for all of the distributions shown below. “Waiting time” is defined as starting when a truck joins the queue, and ending when it leaves its position at the front of the queue to go to the appropriate booth. Figure 1 shows four different waiting time distributions: one for the 700 weekday FAST trucks during the baseline phase; one for the 2,091 weekday GP trucks during the baseline phase; one for the 5,628 weekday trucks during the pilot phase; and one for the 3,823 weekday trucks in the pilot phase during “normal” pilot days.

For four of the fifteen days in the pilot phase, there were operational issues that resulted in longer waits. These included a truck breaking down in a booth, computer logon problems during a shift change, and a false radiation alert. No such service problems were encountered

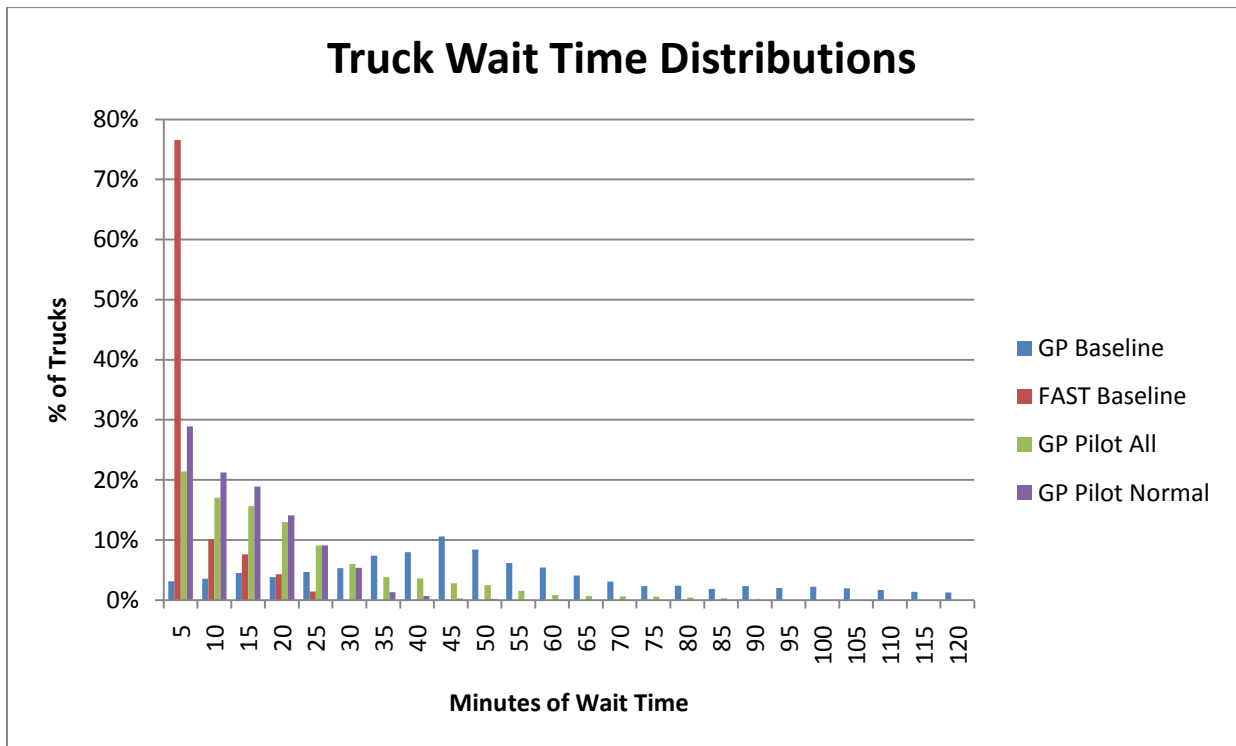


Figure 1: Waiting Time Distributions for Different Configurations and Truck Types.

during the baseline phase, so for comparison purposes it is important to consider the “normal” pilot data. However, the manner in which the distributions are affected by extraordinary events is also of interest, so the uncensored pilot data are also shown.

First, notice the large difference in the distributions for the GP baseline and the FAST baseline waiting times. During the baseline phase, nearly eighty percent of all FAST trucks waited less than five minutes before moving to the FAST booth, while the “typical” GP truck waited between forty and forty-five minutes. Virtually no FAST trucks waited more than twenty-five minutes, while some GP trucks waited over two hours (a small percentage of the GP trucks had waiting times greater than 120 minutes, not shown on the chart). Second, note that under “normal” conditions, almost thirty percent of all trucks in the pilot phase waited less than five minutes; very few trucks waited more than forty minutes. Once the service disruptions are considered, the pilot phase results deteriorate but not alarmingly so: over twenty percent of the trucks waited less than five minutes, while very few were waiting more than an hour. For ease of comparison, the left-most portion of Figure 1 is reproduced below in Figure 1A to facilitate this comparison.

The data shown in Figures 1 and 1A are drawn from across several days. To see the variety across different days, examine the chart of waiting time data shown in Figure 2. It shows the average and ninety-ninth percentile waiting times, by day, for each of the days of the baseline and pilot phases of the study. The ninety-ninth percentile waiting times are defined as values below which one would expect ninety-nine percent of the waiting times for that day to occur.¹ Weekend days are shown by shaded brown bars, while days in which one of the disruptive

¹ The ninety-ninth percentiles were estimated by adding 2.33 standard deviations to the mean. While this calculation of the ninety-ninth percentile is exact only for normally distributed data, for the non-normally distributed waiting times it approximates a “practical” upper bound and serves as a reasonable measure of dispersion about the mean.

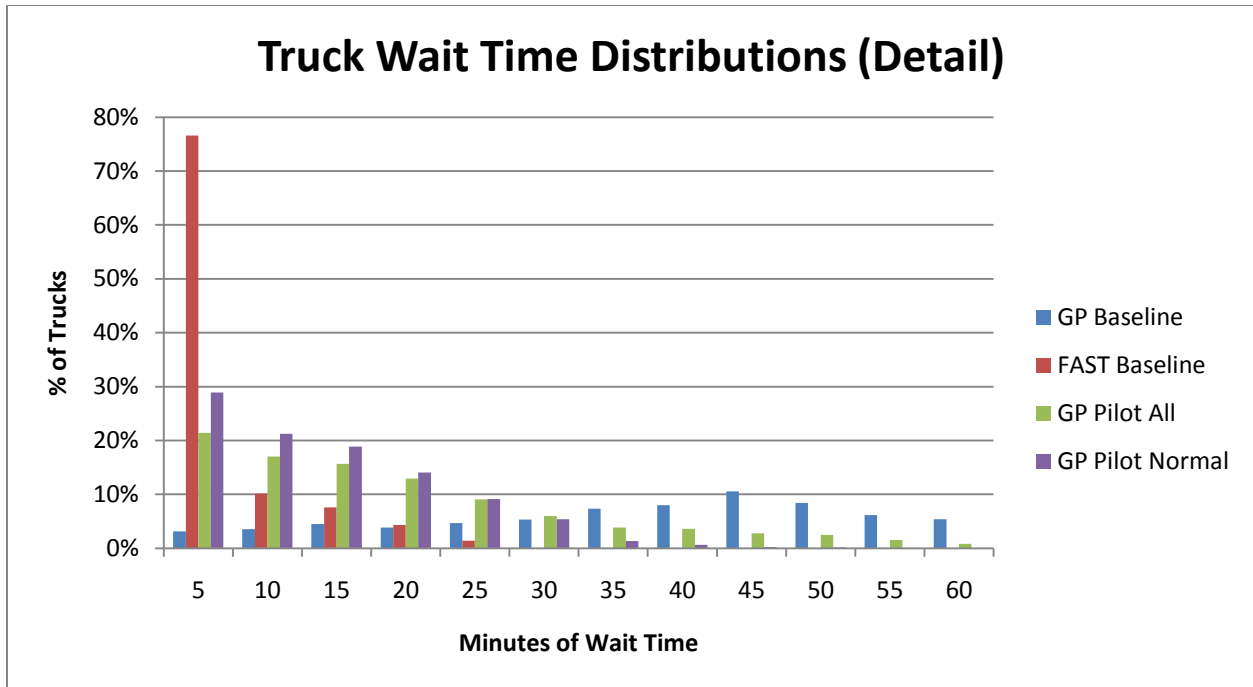


Figure 1A: Waiting Time Distributions for Different Configurations and Truck Types (Detail).

events occurred are indicated by shaded blue bars. The baseline phase of the study ranges from 02-25 to 03-10; daily average and ninety-ninth percentile waiting times are shown for both the FAST and GP trucks. Note that, for each day, the waiting times for FAST trucks are much lower than those for GP trucks during the baseline phase. The daily waiting time plot of GP trucks during the baseline phase is very susceptible to dramatic swings up and down, presumably in response to slight changes in operating conditions. This is characteristic of a system operating at relatively high levels of utilization. In contrast, the average and ninety-ninth percentile waiting times for all trucks in the pilot phase, beginning 03-21 and running most subsequent days until 04-07, fluctuates around a lower average value and is more consistent than the GP waiting times in the baseline phase. The service disruptions in the pilot phase have a noticeable but not a dramatic impact on the average waiting time.

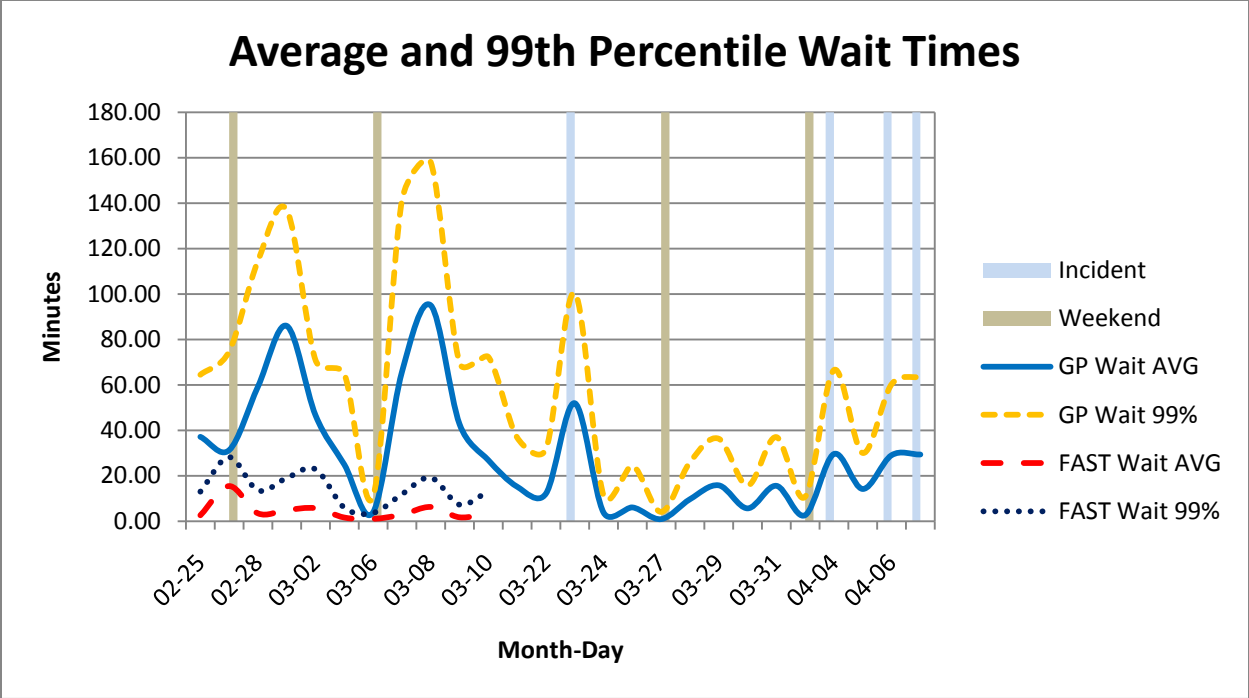


Figure 2: Average and 99th Percentile Waiting times for FAST and GP Lanes.

To see the variation in waiting time *within* the different days, consider the chart of waiting time data for FAST trucks during the baseline phase shown below in Figure 3. For each of the weekdays of the baseline phase, average waiting times were calculated for all FAST trucks arriving within each half-hour increment. The red line, or “Grand Avg,” represents the average waiting time for FAST trucks arriving at a certain time of day during the baseline phase. As one can see, it starts around four minutes in the morning and drops to around two minutes in the afternoon. However, there is variability from day-to-day about this average. The “worst case” maximum average waiting time for each time increment is also shown, as is the “best case” minimum average wait. It is important to realize that the “worst” and “best” cases do not represent a “worst” and “best” day, respectively, but rather the “worst” or “best” of all the days for each half-hour increment.

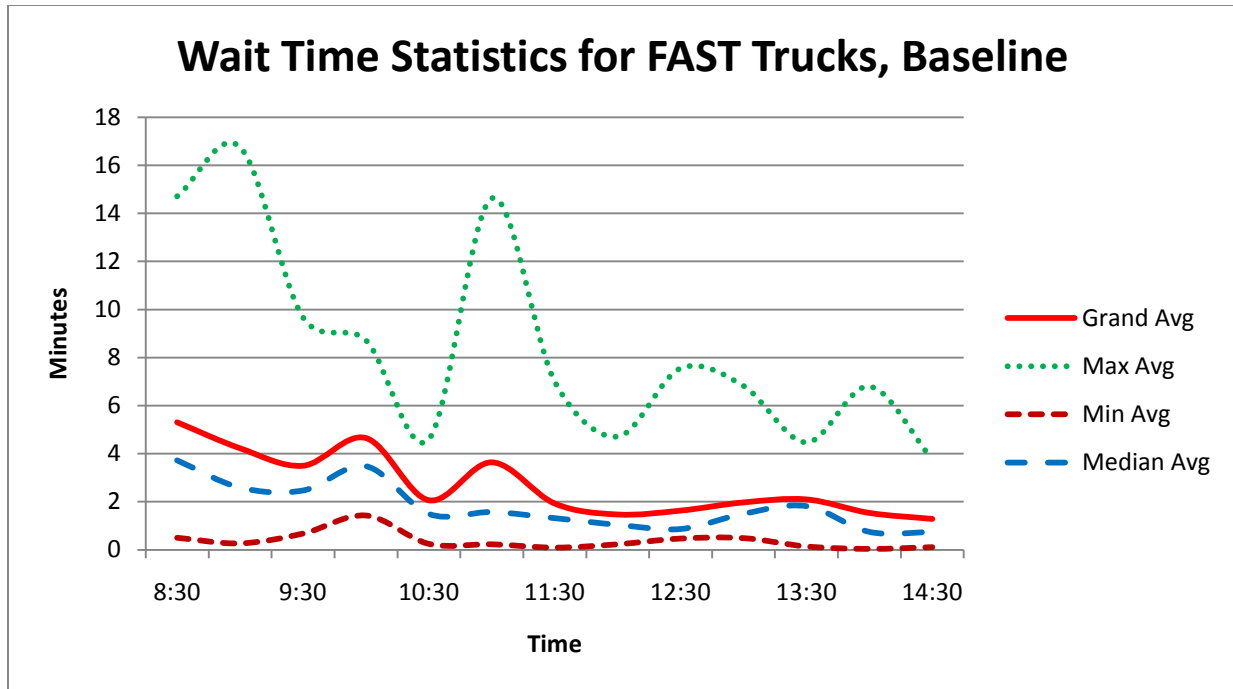


Figure 3: Mean, Median, Max, and Min of Average Daily Waiting Times by Hour: FAST-Baseline.

One can see that sometimes the FAST trucks do not wait at all, while in a “worst” case scenario a truck might wait seventeen minutes. Since the distribution of average waiting times is clearly not symmetric, the median or “mid-point” of the daily averages is also shown. As would be expected when there is a high potential maximum and a bound on the minimum (i.e., the average waiting time can’t be below zero), the median average waiting time is a bit smaller than the grand average waiting time.

Now consider a similar chart for the GP trucks during the baseline phase (see Figure 4). Note that the time axis ends at 1:30 PM, not 2:30 PM; this is because many GP trucks that arrived after 13:30 had not yet been inspected when the daily study ended at 3:00 PM, so their waiting time could not be calculated. Thus, including in the chart the waiting times that existed for GP trucks arriving between 1:30 PM and 2:30 PM would show waiting times decreasing dramatically at the end of the day, when in actuality many trucks were waiting so long that their waiting times could not be calculated. This anomalous result occurs towards the end of the

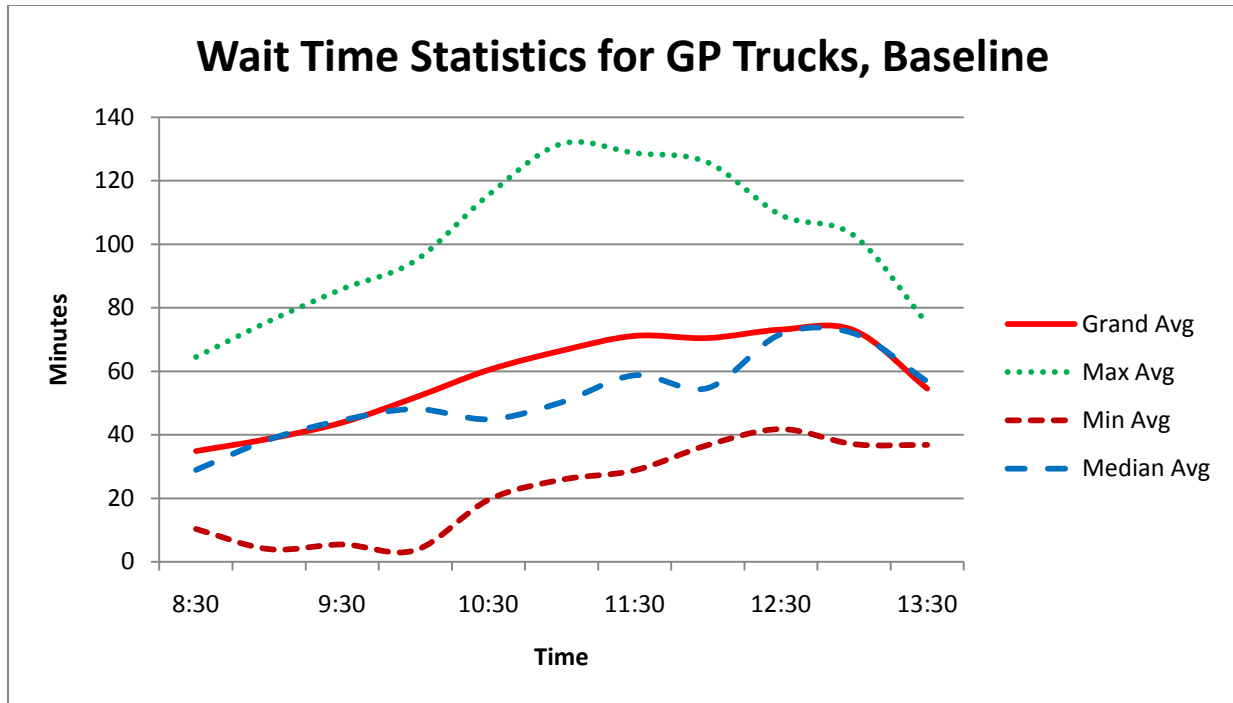


Figure 4: Mean, Median, Max, and Min of Average Daily Waiting Times by Hour: GP-Baseline.

shift when waiting times are initially modest and then increase dramatically; if the long waiting times cannot be included in the average because they are not recorded, the small number of recorded shorter waiting times biases the estimate of average waiting time downward. Not surprisingly, the daily average waiting time profile for GP trucks is much worse than for FAST trucks, with average waits surpassing an hour during the middle of the day, and reaching two hours on at least one survey day.

In contrast, the daily average waiting time profile for all trucks on a “normal” day in the pilot phase is remarkably improved. As shown in Figure 5, average waiting times for trucks arriving early hover around ten minutes before growing to twenty minutes mid-day; maximum average waiting time on “bad” days never exceeds forty-five minutes. When the four days with service anomalies are considered as well, the daily waiting time profile worsens, but it still features a grand average waiting time of roughly twenty-five minutes (see Figure 6).

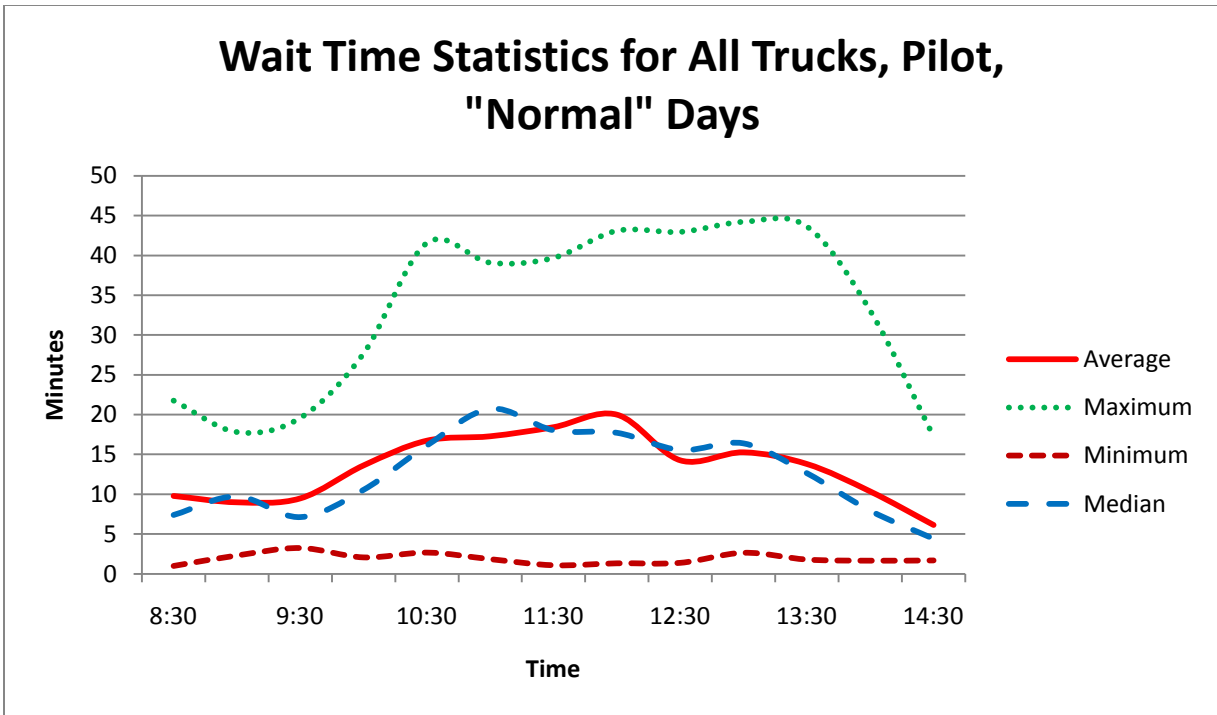


Figure 5: Mean, Median, Max, and Min of Average Daily Waiting Times by Hour: Normal-Pilot.

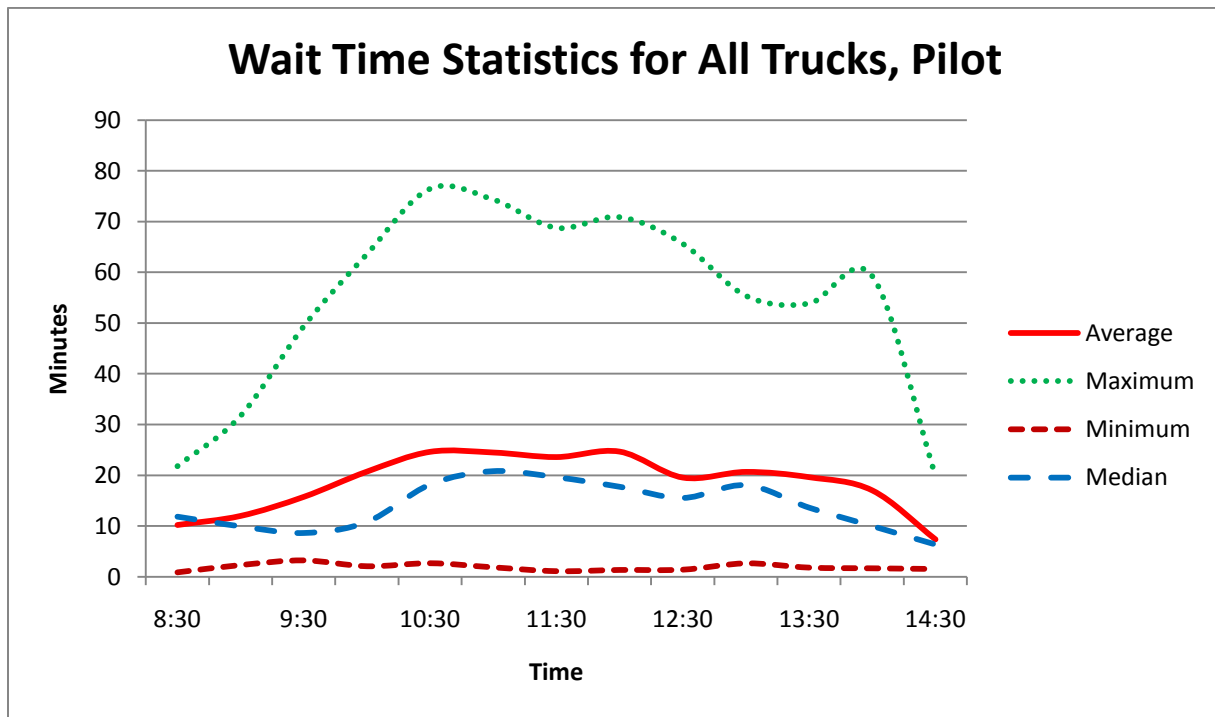


Figure 6: Mean, Median, Max, and Min of Average Daily Waiting times by Hour: Pilot.

As expected, waiting times for trucks in the GP lane were much greater than for those in the FAST lane in the baseline configuration. Also as expected, eliminating the FAST lane reduces waiting times for GP trucks while increasing them for FAST-qualified trucks. In the pilot phase, the wait time for the combined traffic stream (regular trucks & FAST-qualified trucks) ranged from ten to twenty minutes -- a decline from a forty-to-eighty minute range for regular trucks and an increase from the previous two-to-four minute range for FAST trucks.

ARRIVAL RATES

As mentioned earlier in this study, “everything else is *not* equal,” so the observed difference in average waiting times must be considered in conjunction with changes in the underlying conditions during the two phases of the study. As also noted earlier, the arrival rates, with or without the adjustment for unrecorded arrivals, were not identical during the baseline and pilot phase: traffic volume was heavier in the pilot phase, and this would be expected to increase the waiting times observed during the pilot phase. The total number of weekday (Monday-Friday) recorded arrivals during the baseline phase were 688 FAST trucks and 2,297 GP trucks, while 5,266 weekday trucks arrived during the longer pilot phase.

Figure 7 shows the un-adjusted arrivals per day recorded over the course of the baseline and pilot phases; the dramatically lower-volume weekend days are marked with a shaded bar.² The higher traffic volumes of the pilot phase are clear from the chart: overall traffic volume barely exceeds four hundred trucks per day (8:00 AM – 3:00 PM) during the baseline period, while a daily threshold of five hundred trucks is reached two days throughout the pilot period. Note that with the adjustment for unrecorded arrivals discussed earlier, this difference would

² It should be noted that arrival data for one day in the baseline phase, namely 03-07-2011, is not included since some of the data were accidentally lost.

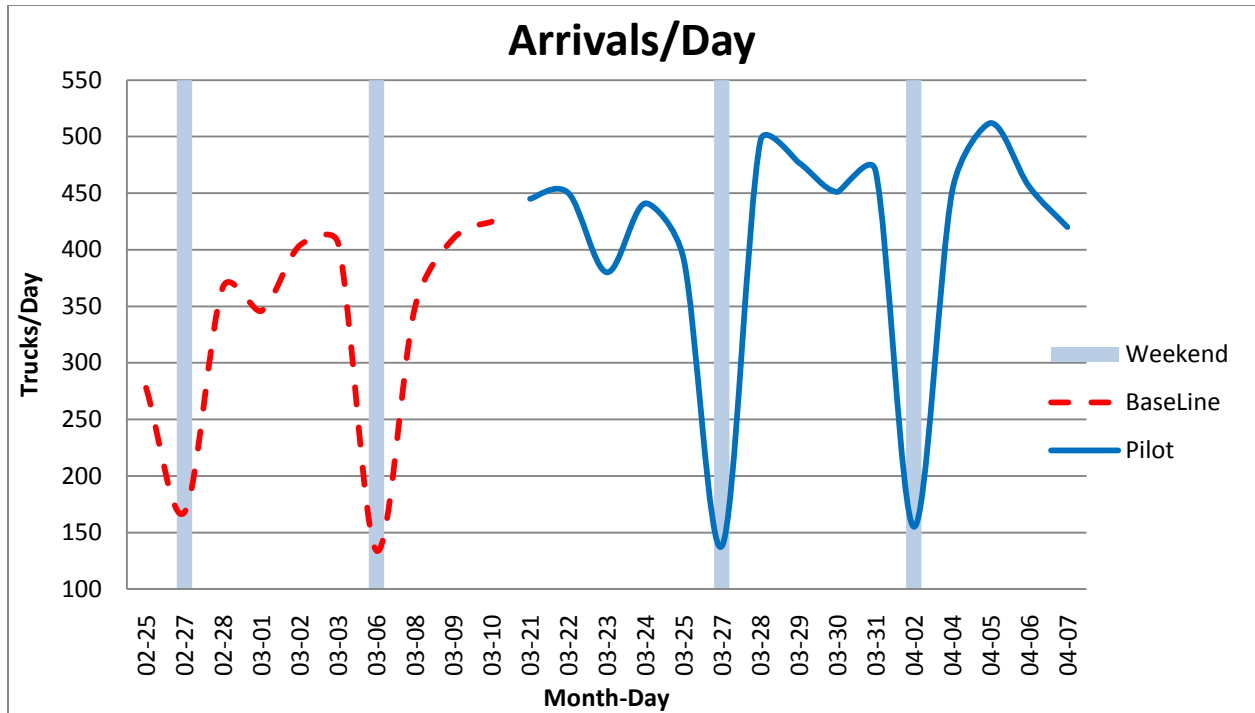


Figure 7: Arrivals per Day (8:00 AM-3:00 PM): Baseline and Pilot Phases.

shrink: based on the hourly estimates in Table 2, the increase in the average daily arrival rate over seven hours would be twenty-seven trucks during the baseline phase and nineteen in the pilot phase.

In the same manner as the approach taken with waiting times, one can construct daily profiles of arrival rates for each phase of the study. Figure 8 shows the average, median, maximum, and minimum arrival rates of trucks entering the FAST lane on weekdays during the baseline phase. Similar figures for the arrival rates of GP trucks during the baseline phase, and for the arrival rates of all trucks in the pilot phase, are shown in Figures 9 and 10, respectively. While these charts confirm the higher overall traffic volume for the pilot phase, they are also interesting in what they reveal concerning the pattern of arrivals during the daily survey schedule: FAST trucks appear at roughly the same rate throughout the day, while GP trucks arrive mostly in the morning. The greater fraction of GP trucks in the mix of vehicles ensures that this same pattern exhibits itself when all trucks are blended together in the pilot phase.

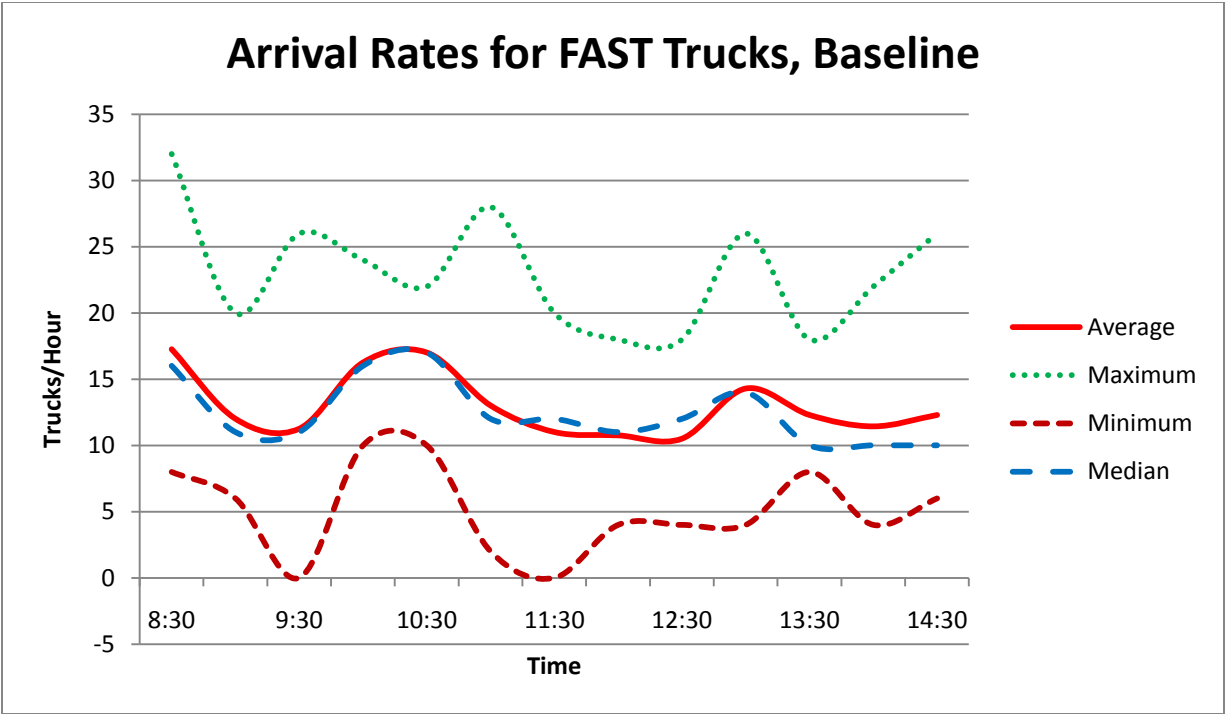


Figure 8: Mean, Median, Max, and Min of Arrival Rates by Hour: FAST-Baseline.

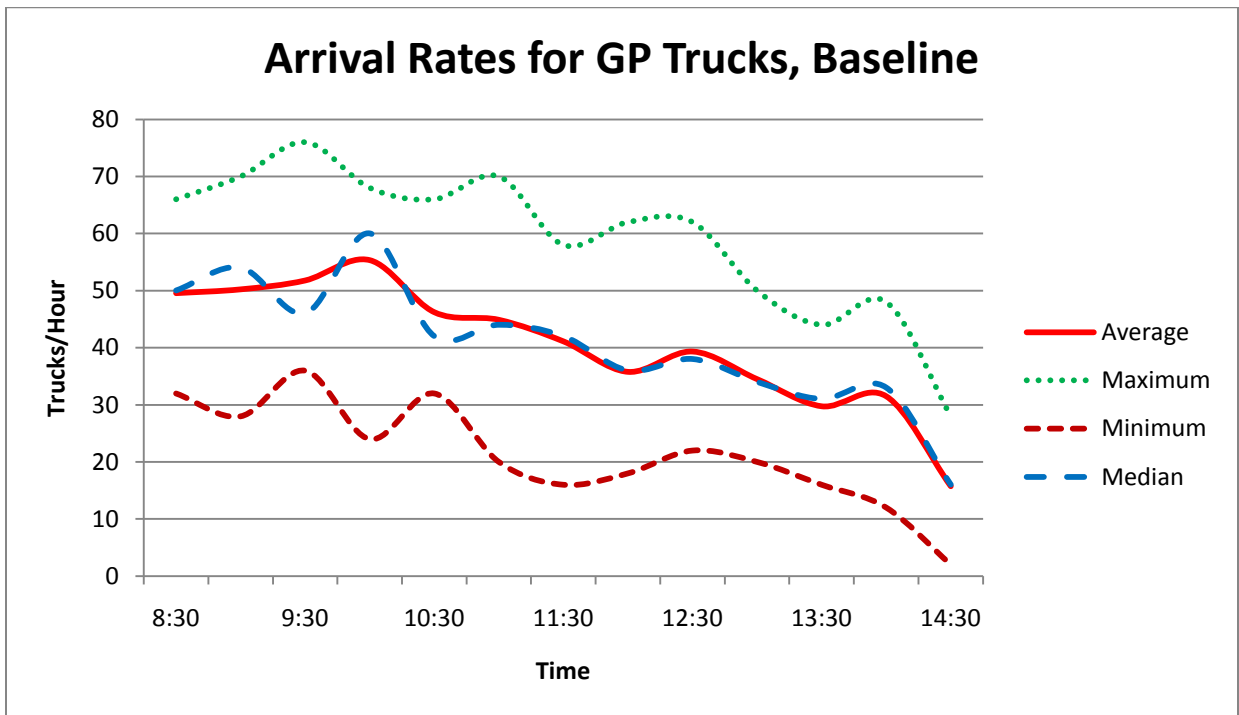


Figure 9: Mean, Median, Max, and Min of Arrival Rates by Hour: GP-Baseline.

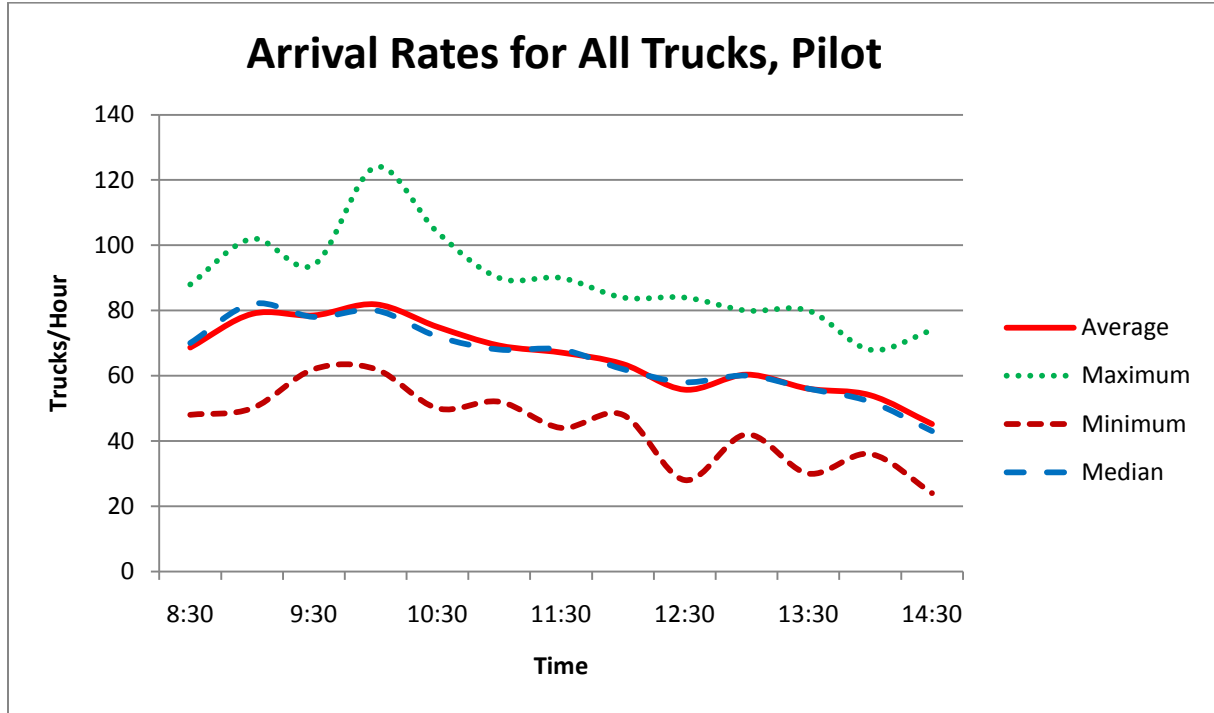


Figure 10: Mean, Median, Max, and Min of Arrival Rates by Hour: Pilot.

Another statistic that is potentially useful for policymakers is the percentage of FAST-qualified trucks using the southbound PHC during the baseline period. This cannot be used to compare the two phases of the 2011 study, but the earlier low enrollment in FAST at the southbound PHC was a concern and a motivation for this study. Table 1 showed that the overall percentage of FAST enrollees in the 2011 baseline phase was virtually unchanged from that observed in the 2009 study: 22.5% was the observed ratio in 2009, while the current study revealed a FAST ratio of 23.0%. Apart from a jump on one of the weekend days of the baseline phase, Figure 11 shows that this ratio mostly ranged from 20% to 25%.³

³ The ratio from 02-26-11 is not reported in Figure 11 since many FAST arrivals were not recorded as such.

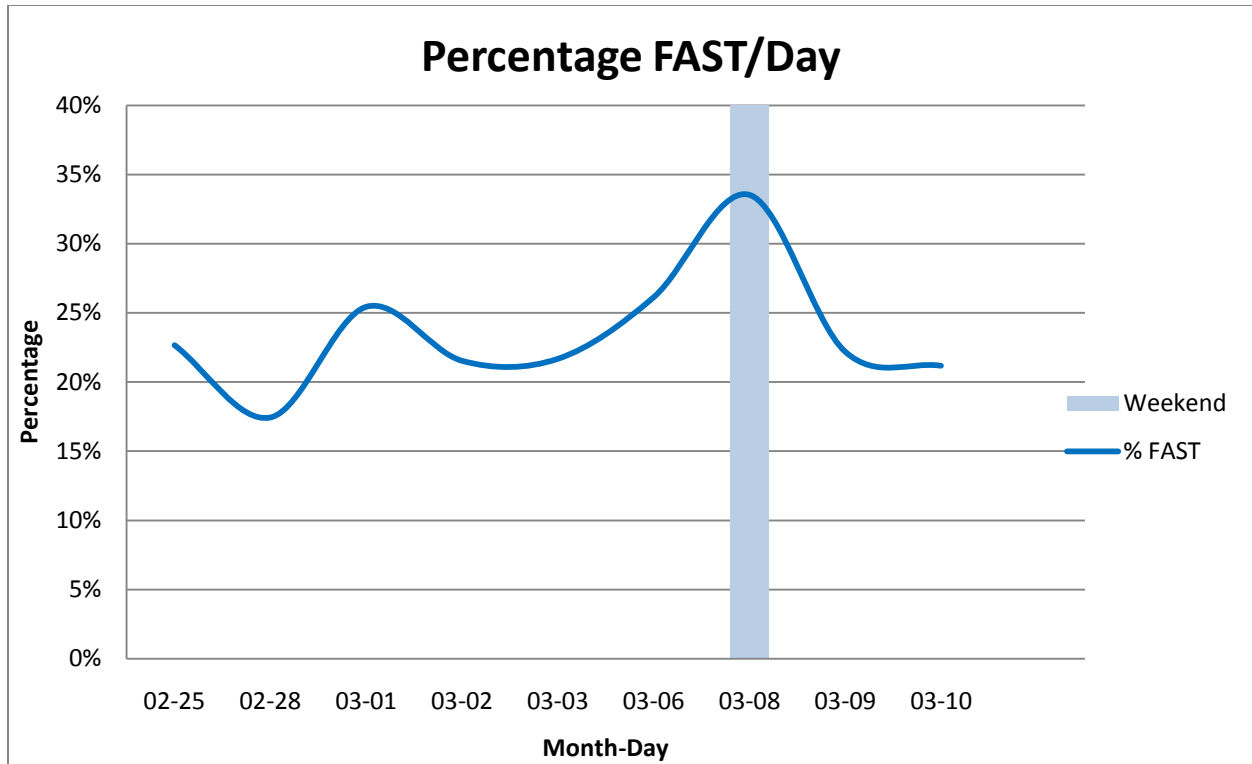


Figure 11: Percentage of Arrivals During Baseline Phase That Are FAST-Enrollees.

INSPECTION TIMES

In addition to different arrival rates, the other key element that can affect the waiting time results is a difference between average inspection times during the two phases. Actually, there are two distinct times that determine how fast trucks can be processed, and they both must be examined. The most obvious of these two times is the inspection time. This is defined as the time that the truck spends at the booth, and is calculated as the difference between the booth departure time and the booth arrival time. As mentioned earlier, the combined average inspection time during the 2011 pilot phase was slightly larger than the GP average inspection time during the 2011 baseline phase; this would generally lead to longer waiting times in the pilot phase. This difference is barely perceptible in the chart of inspection time data shown below in Figure 12. More notable, perhaps, is the strong consistency on a day-to-day basis in

average inspection times within a given phase. A total of 6,400 weekday inspection times were recorded in the pilot phase, while 786 FAST trucks and 2,432 GP trucks were recorded in the baseline phase.

The second processing time that must be examined is the transition time. When a truck approaches the front of the queue, it must wait at the entrance to a radiation portal monitor (RPM) while the truck before it is being inspected at the booth. When the truck at the booth departs, the truck waiting at the RPM entrance passes through the RPM and advances to the booth. The length of time required to move through the RPM and arrive at the booth is referred to as the transition time. The average and ninety-ninth percentile of the transition times for both phases of the study are shown in Figure 13. Remarkably, they are quite consistent across both truck types (FAST and GP) and phases (baseline and pilot). The transition time is the same for a FAST truck or a GP truck and is not affected by the configuration.

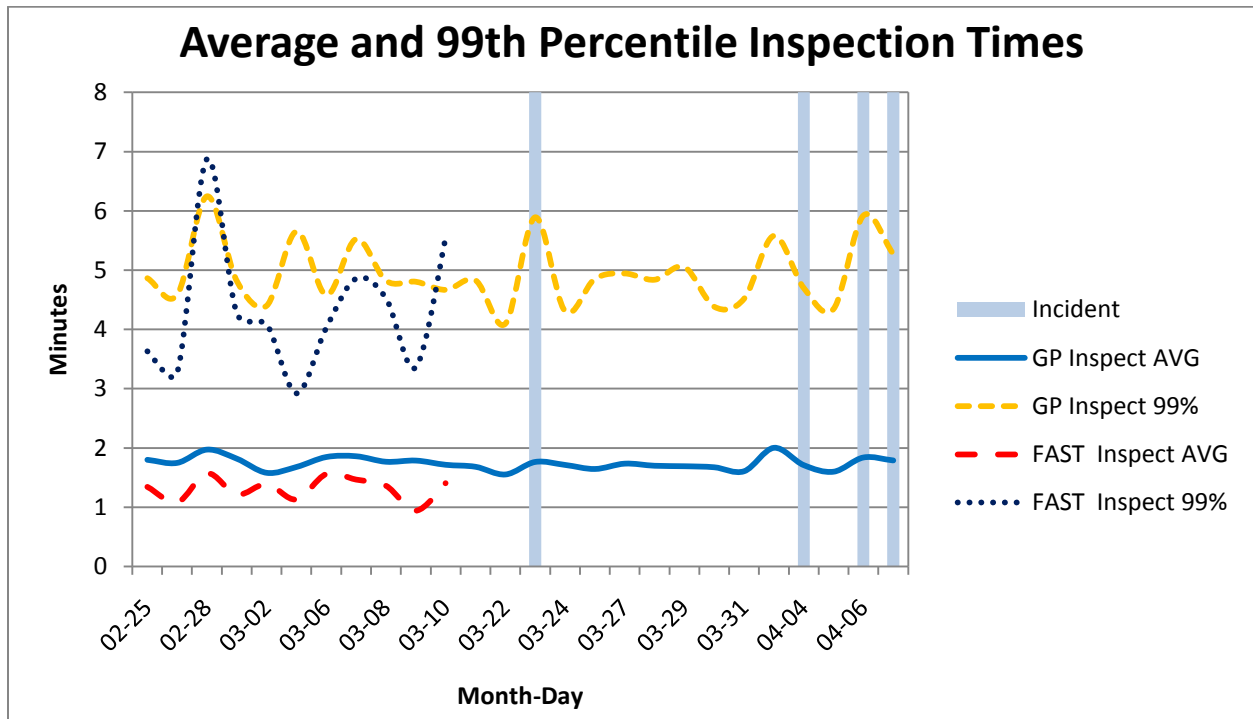


Figure 12: Average and 99th Percentile Inspection Times.

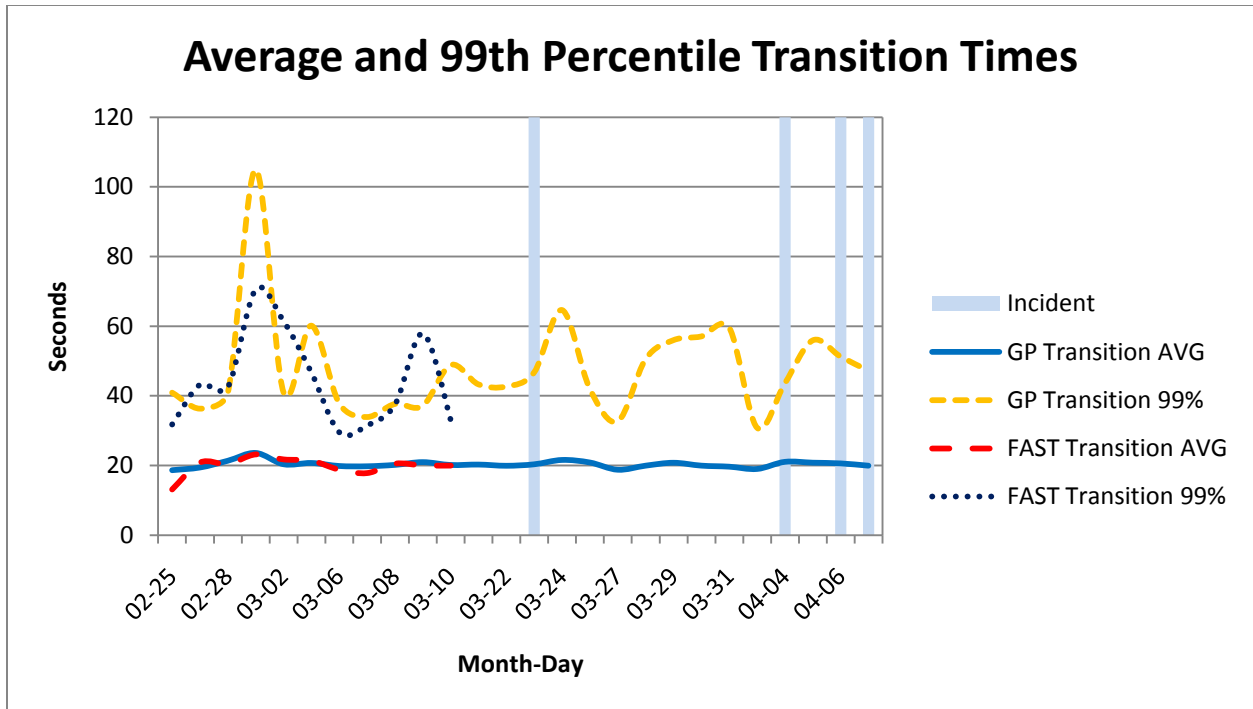


Figure 13: Average and 99th Percentile Transition Times.

CONCLUSION

Results of a 2009 data survey suggested that the FAST lane and booth at the southbound PHC was insufficiently utilized to justify the severe waits which resulted for trucks not qualified for the FAST program. Consequently, a field experiment was approved for 2011 which compared the current baseline configuration of the southbound PHC with a new pilot configuration that opened up the FAST lane and booth to general purpose-traffic. During the experiment, background conditions worsened during the pilot phase of the project: traffic volume was markedly higher, and inspection times were slightly higher. Nonetheless, wait times dropped dramatically for GP trucks in the pilot configuration: average waiting times of over an hour dropped to twenty minutes for the same time of day. Twenty minutes, of course, is higher than the single-digit average waiting times previously experienced by FAST trucks. However, with more than three quarters of the southbound trucks unable to use the FAST lane, the

experiment suggests a dramatic drop in total system-wide waiting could be accomplished by reverting the FAST lane and booth to all truck traffic. Finally, it should be noted that a more precise verdict on the relative benefits of the baseline and pilot configurations will have to wait for a simulation analysis, where the background factors affecting each configuration – arrival rates and inspection times – can be rigorously controlled.

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