Report on Border Queuing Times, June 2000

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For

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Introduction

This report presents estimated queuing delays for passenger vehicles at the San Ysidro and Otay Mesa border crossings for June 2000. It is part of a series of monthly reports sponsored by San Diego Dialogue. The major purpose of these reports is to track changes in waiting times at the border crossings. Wait time estimates are based on data supplied by Metro Networks and the U. S. Customs Service. Methodology for estimating waiting times is explained in the Methodological Note at the end of this report. Wait time estimates for June are based on considerably less data than usual because line length data supplied by Metro Networks were unavailable for the period June 11 through June 25. As a result of this extended period for which data were unavailable, wait time estimates for June may be less representative than usual.

Queuing Delays for Monitored Hours

The reporting system tracks delays for three time periods. On weekdays, the hours tracked are 6 a.m., 7 a.m., 8 a.m., 12 noon, 1 p.m., and 2 p.m. On weekends, the hours tracked are 2 p.m., 3 p.m., and 4 p.m. These represent the morning commute peak, an early-afternoon peak on weekdays, and the mid-afternoon peak on weekends. For current conditions, these time periods are believed to be the most likely to experience delays. The primary statistic reported is the percentage of hours for which the estimated wait time exceeds the standard of 20 minutes.

Figures 1 and 2 show trends in delay for the weekday time periods since October 1998 and for the weekend mid-afternoon peak since January 1999. Wait time distributions were not calculated for weekends prior to January 1999 because data on line lengths were insufficient.

Figures 1 and 2 show that, at San Ysidro, the probability of delays greater than 20 minutes increased between May and June for all periods monitored. At Otay Mesa, the probability of delays greater than 20 minutes increased during the morning peak on weekdays and declined for the other two time periods monitored. When compared with May 1999, the probability of delays greater than 20 minutes was higher for all time periods at San Ysidro; in fact, the probability of delays greater than 20 minutes was at the highest level recorded so far for both weekday peaks. At Otay Mesa it was higher for both weekday time periods but much lower on weekend afternoons.

Figure 1. Trends in Hours with Delays of 20 Minutes or More, San Ysidro

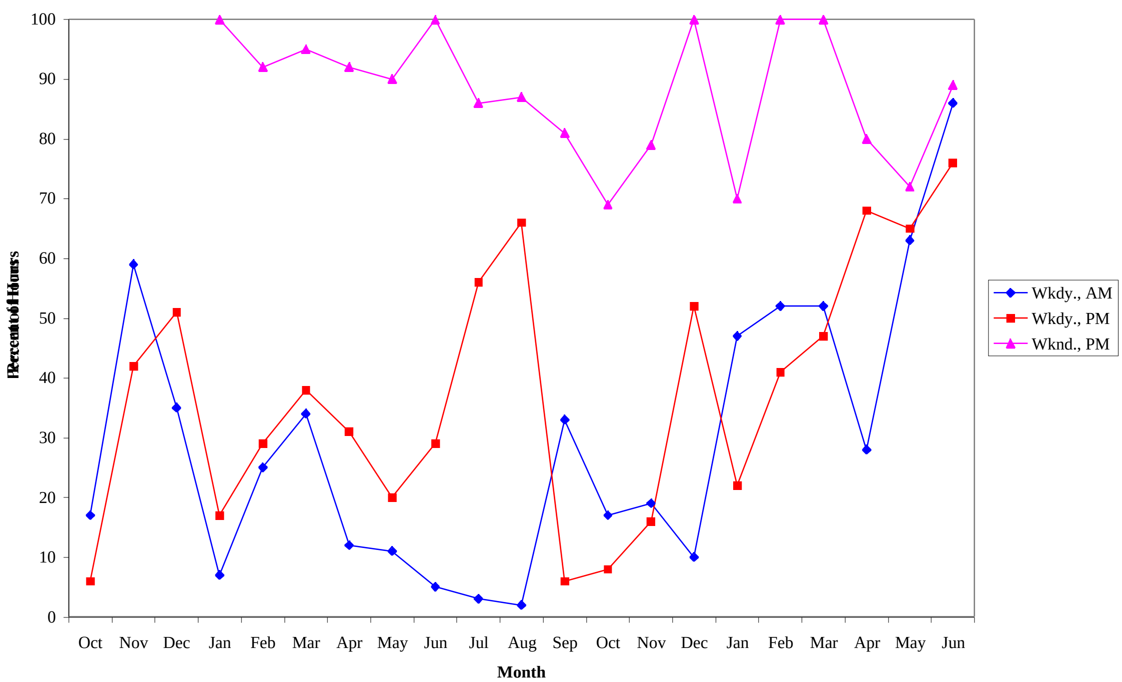
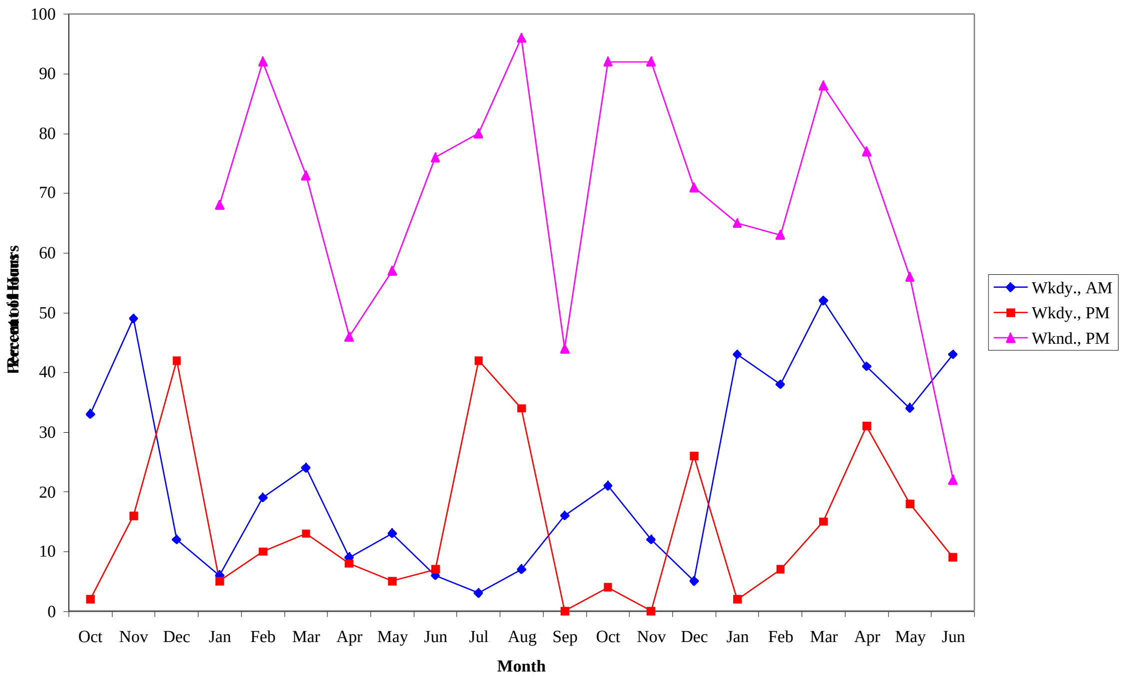


Figure 2. Trends in Hours with Delays of 20 Minutes or More, Otay Mesa



As discussed in previous reports, increases in delay reflect either increases in demand, decreases in output, or both, and decreases in delay reflect either decreases in demand or increases in output. The increase in delay between May and June at San Ysidro may reflect a decrease in output, since output was slightly lower than in May for most times of day. The increase in delay during the morning peak at Otay Mesa was probably due to an increase in demand, since output was substantially higher than in May for most times of day (see Figures 11 and 12).

Wait Times by Time of Day

Figures 3 and 4 present graphs of average waiting times and the standard deviation of waiting time by time of day for weekdays during June 2000. These give an idea of how waiting times vary for different times of day and also of the amount of variation in waiting times at particular times of day. All times are given according to the 24-hour or military clock, i. e. 17 = 1700 = 5:00 p.m., etc.

During May, average wait times at San Ysidro peaked at 1 p.m., but did not vary much between 6 a.m. and 2 p.m. At Otay Mesa, the longest average waits were during the morning peak, with a lower peak at 3 p.m. Standard deviations were between 5 and 10 minutes at Otay Mesa and around 10 minutes at San Ysidro, except that the standard deviation was 15 minutes at 11 p.m. This high value of the standard deviation probably reflects a lack of data, since it was based on only two observations. Otherwise, the standard deviations appear to be normal.

Figure 3. Wait Times, Weekdays, San Ysidro, June 2000

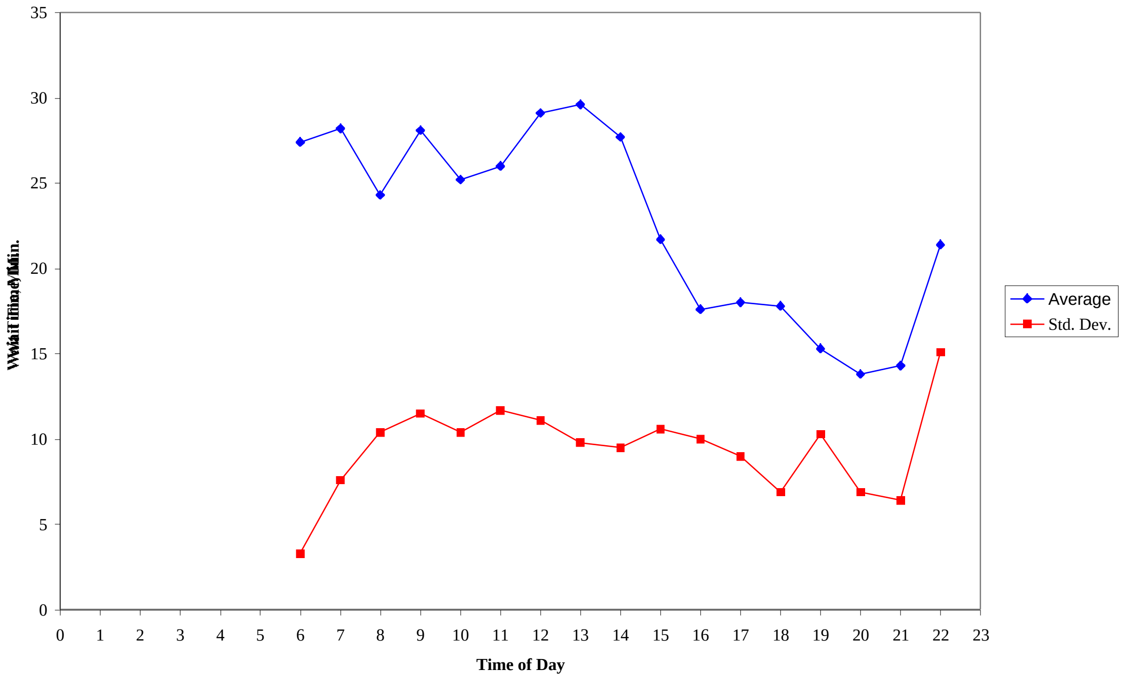
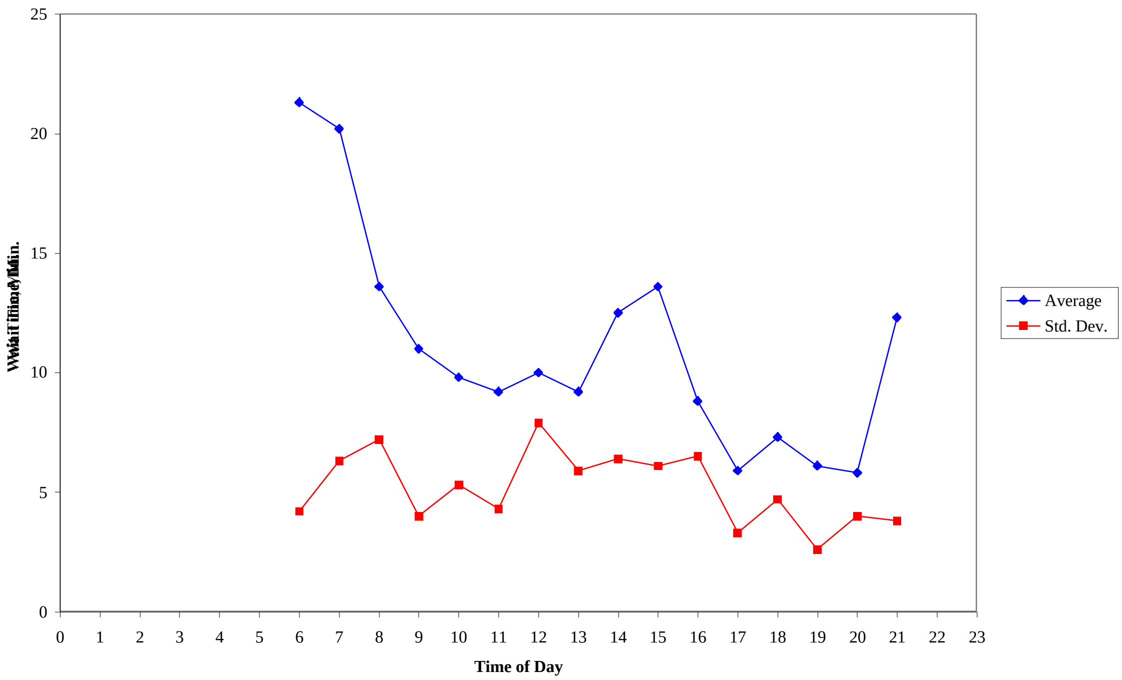


Figure 4. Wait Times, Weekdays, Otay Mesa, June 2000



As a general rule, there is a probability of about 70% of experiencing a delay between the mean minus one standard deviation and the mean plus one standard deviation. Because the delay distributions are skewed, however, the median of the delay distribution is less than the mean (the value reported in Figures 3 and 4), but the probability of delays greater than the mean plus one standard deviation is greater than that of delays less than the mean minus one standard deviation.

Figures 5 – 10 show the overall distribution of wait time for the three time periods currently monitored. These graphs show the probability of wait times greater than a specified value. For instance, Figure 5 shows that for the morning peak at San Ysidro in June, the probability of a wait greater than or equal to 20 minutes was about 86 percent, and that of a wait greater than or equal to 30 minutes was about 30 percent.

Numbers of Vehicles Processed

Figures 11 and 12 show trends in the numbers of vehicles processed by the U. S. Customs Service and the Immigration and Naturalization Service at the two border crossings. These are significant because they provide insight into the reasons for changes in the average delay. In general, delay will increase if either demand increases without any increase in the number of vehicles processed or the number of vehicles processed declines, without any decrease in demand. Figures 11 and 12 show that in June the number of vehicles processed at San Ysidro declined slightly relative to May at most times of day and increased substantially at most times of day at Otay Mesa.

Figure 5. Probability of Wait Time Greater Than Specified Amount, Weekday Morning Peak, San Ysidro, June 2000

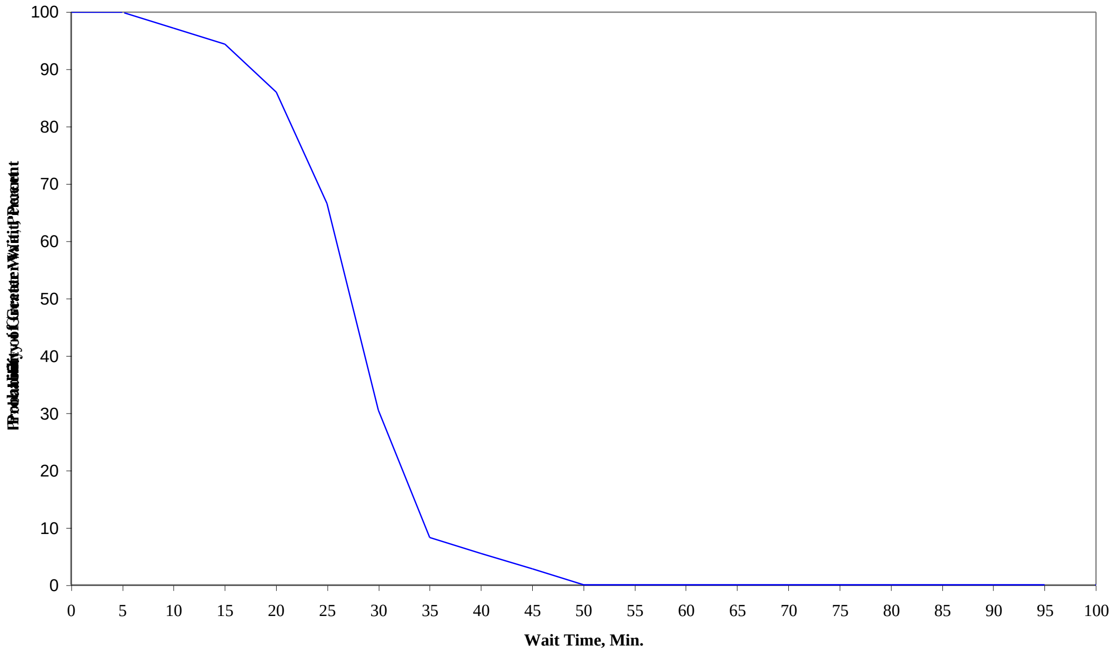


Figure 6. Probability of Wait Time Greater Than Specified Amount, Weekday Early Afternoon, San Ysidro, June 2000

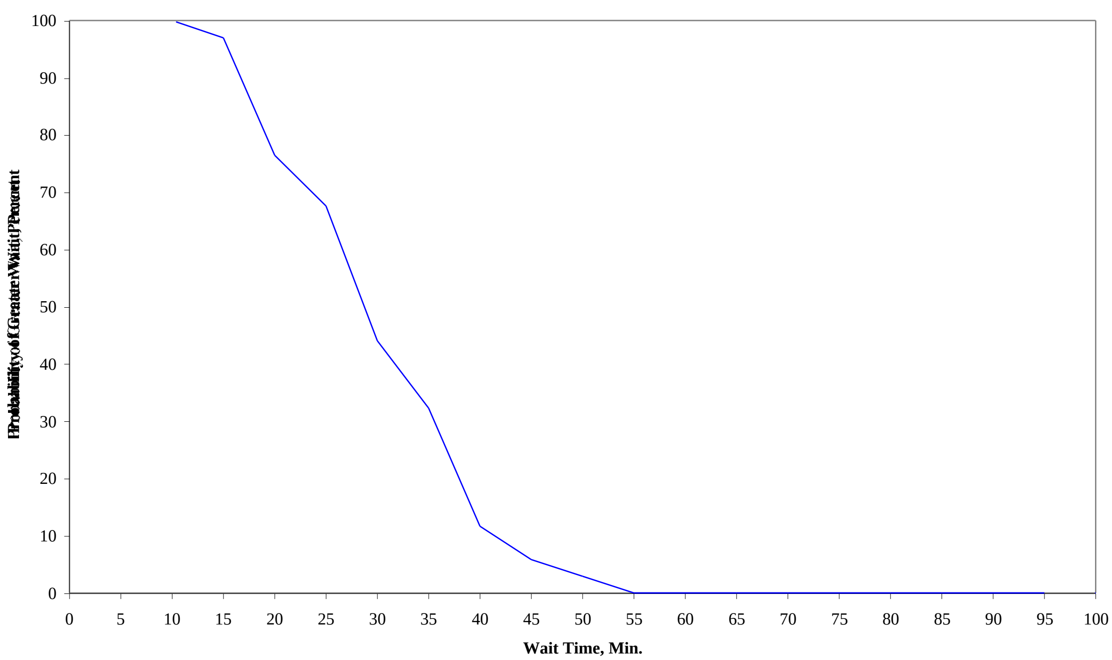


Figure 7. Probability of Wait Time Greater Than Specified Amount, Weekend Afternoons, San Ysidro, June 2000

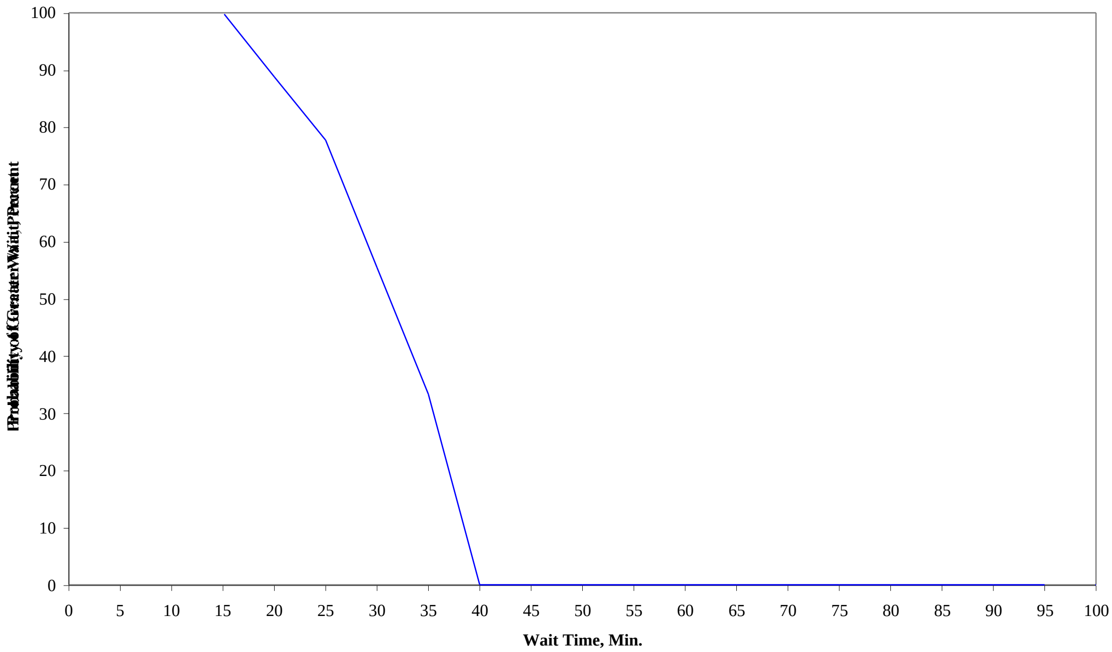


Figure 8. Probability of Wait Time Greater Than Specified Amount, Weekday Morning Peak, Otay Mesa, June 2000

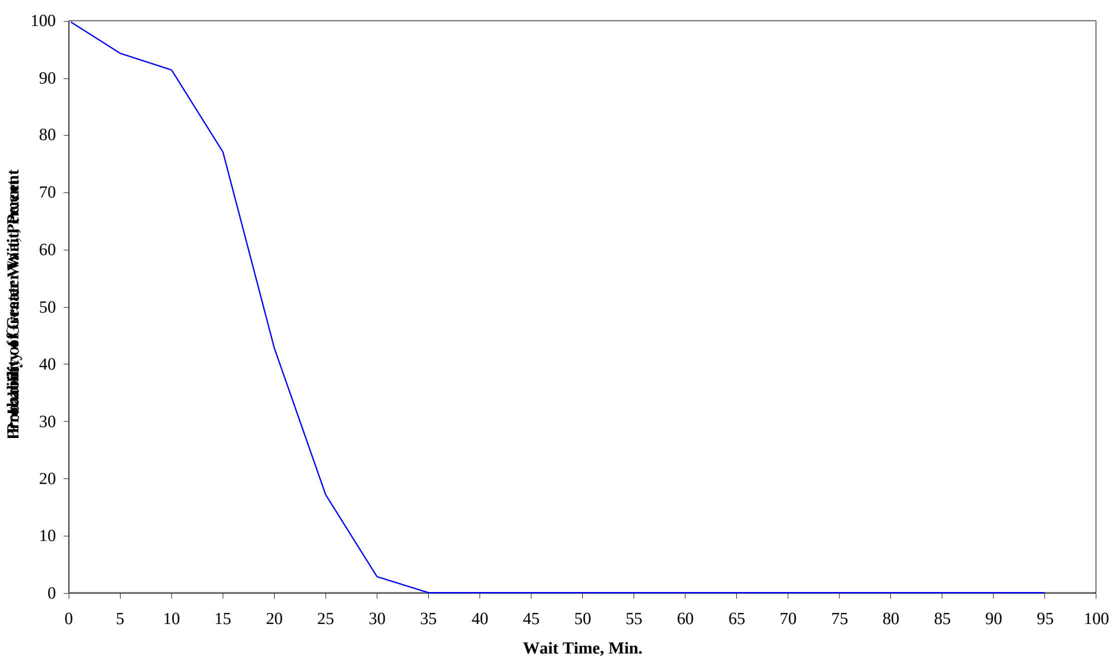


Figure 9. Probability of Wait Time Greater Than Specified Amount, Weekday Early Afternoon, Otay Mesa, June 2000

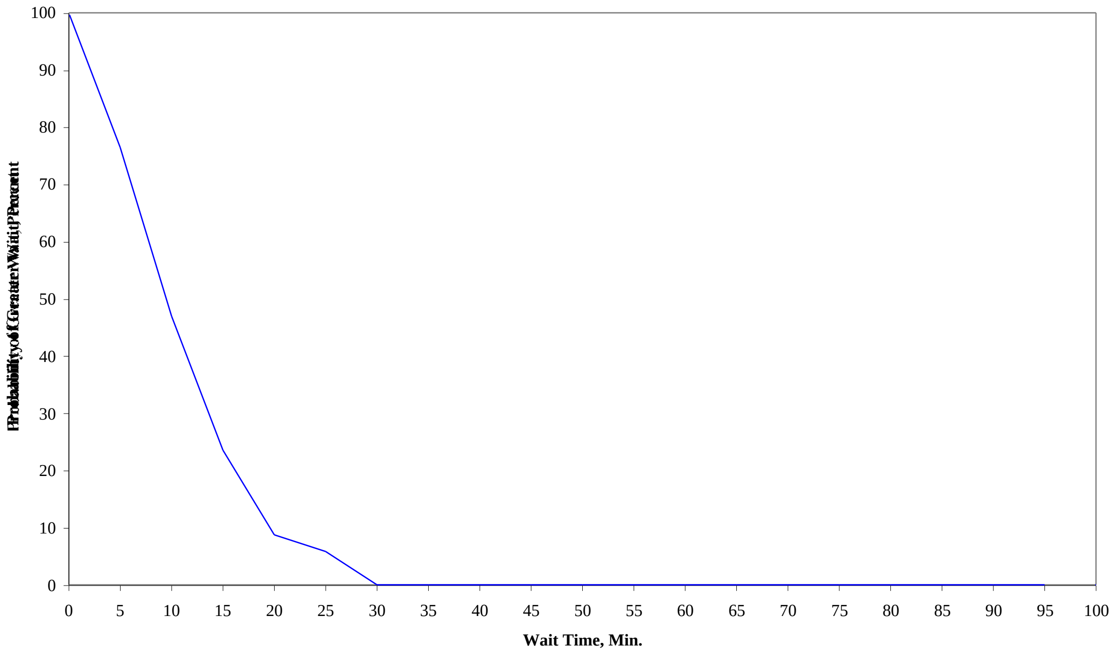


Figure 10. Probability of Wait Time Greater Than Specified Amount, Weekend Afternoons, Otay Mesa, June 2000

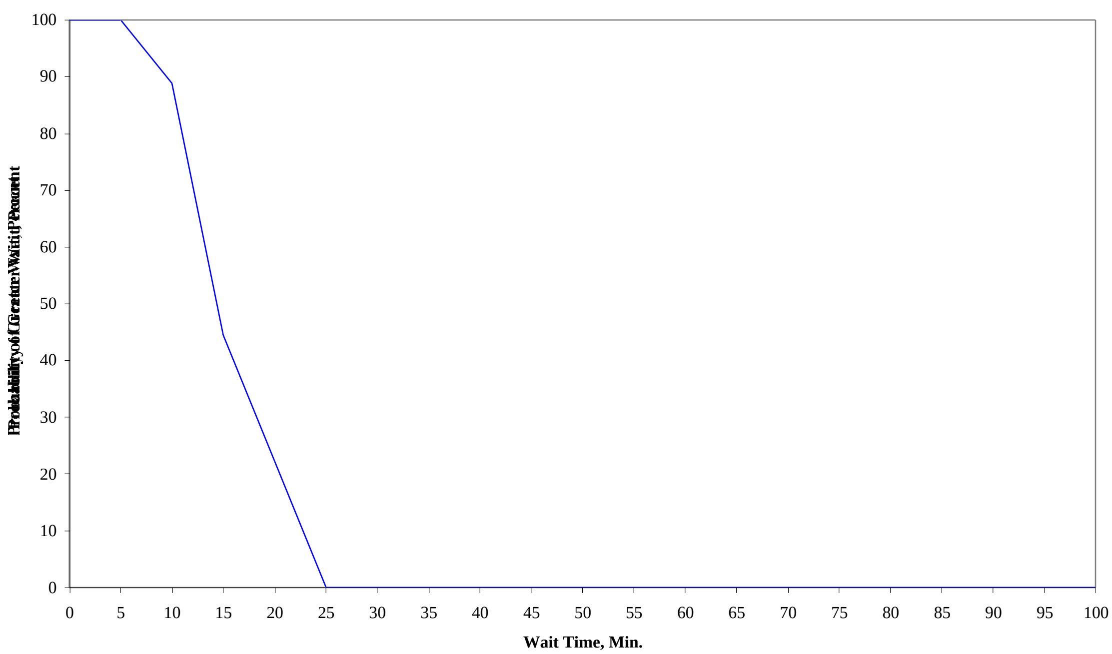


Figure 11. Average Number of Vehicles Inspected, Weekdays, San Ysidro

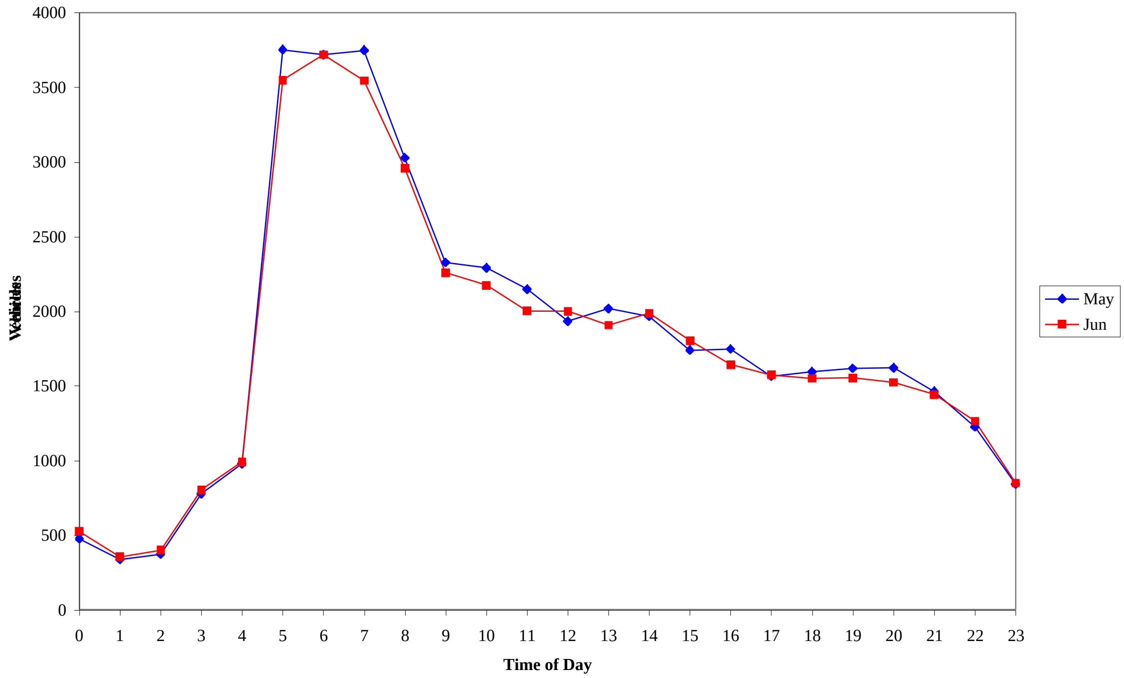
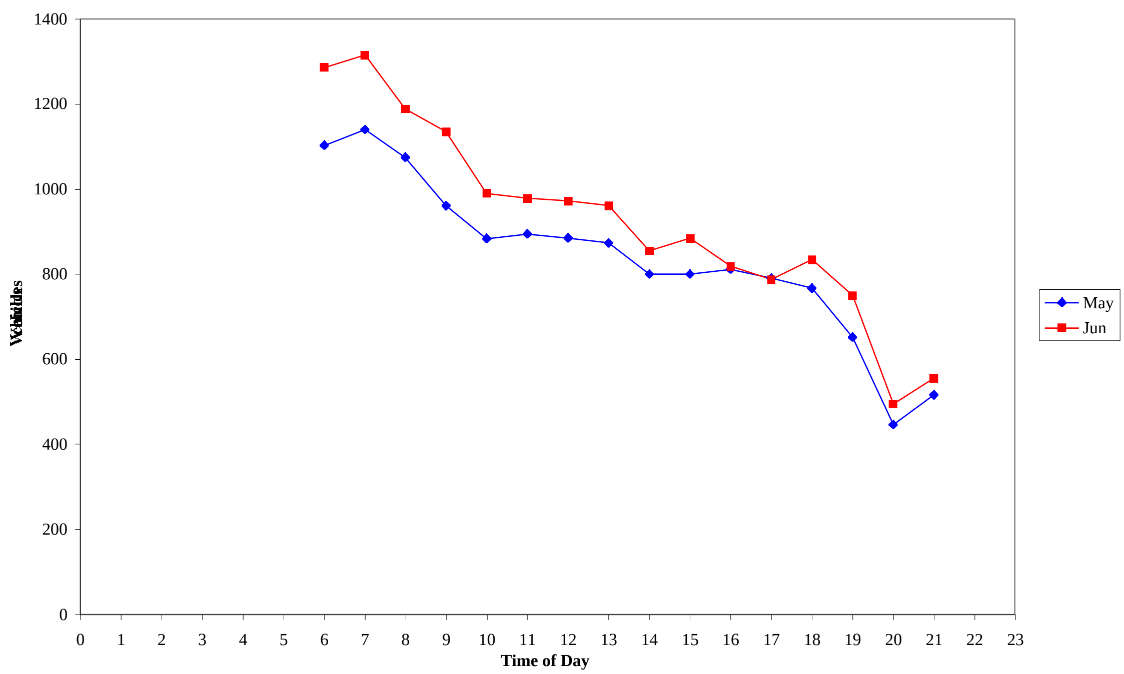


Figure 12. Average Number of Vehicles Inspected, Weekdays, Otay Mesa



Study to Improve Wait Time Estimates

As discussed in previous reports, San Diego State University has been conducting a study for San Diego Dialogue and the Immigration and Naturalization Service (INS) in an attempt to improve estimates of wait times. This study is currently under review. This is the fourth of a series of features that will describe the study and discuss its preliminary findings.

The main purpose of the study was to develop a standardized methodology for estimating wait times at San Ysidro in real time. Major objectives were to verify and improve the queue size estimation portion of the procedure, develop a method for predicting vehicle processing rates from historical data, outline a procedure for routinely collecting line length data in real time, determine the accuracy of the resulting estimation procedure, and develop software to implement it in real time. The previous installment described wait time estimation procedures developed by the project.

The calculation of wait time estimates requires data on queue sizes and queue output rates. Real-time calculations require estimates of output over the immediate future. The method for projecting vehicle processing rates was discussed in the previous installment. Queue size data, on the other hand, have to be collected in real time. As discussed in the previous installment, the number of vehicles in different parts of the queue is estimated from line lengths. Consequently, line length data needs to be collected on a routine basis.

Currently, line length data is collected by Metro Networks using a ground observer stationed in Mexico. In addition, the INS and Customs Service estimate wait times based on observation of line lengths from the Port of Entry Building at San Ysidro. The INS expressed a preference to manage the routine data collection itself (as opposed to contracting this function out), but cannot always relay on observation from the Port or Entry Building, since lines often extend out of the field of vision from this point.

Three options were considered: ground observers employed by INS, traffic detectors used to determine the approximate position of the ends of the lines, and remotely-controlled video cameras. Of these, use of video cameras, supplemented by direct observation from the Port Building, was recommended as being most cost-effective.

The major difficulties in collecting line length data at San Ysidro are the curving alignments of the approaches and the presence of overhead structures that block vision. In order to cover most of the area occupied by the queues, video cameras must be located at three different locations: the roof of the Lloyd's Building, the roof of the Pueblo Amigo Hotel, and the first vehicular bridge crossing the approaches south of the border. In case of very long lines, even these three locations may be inadequate.

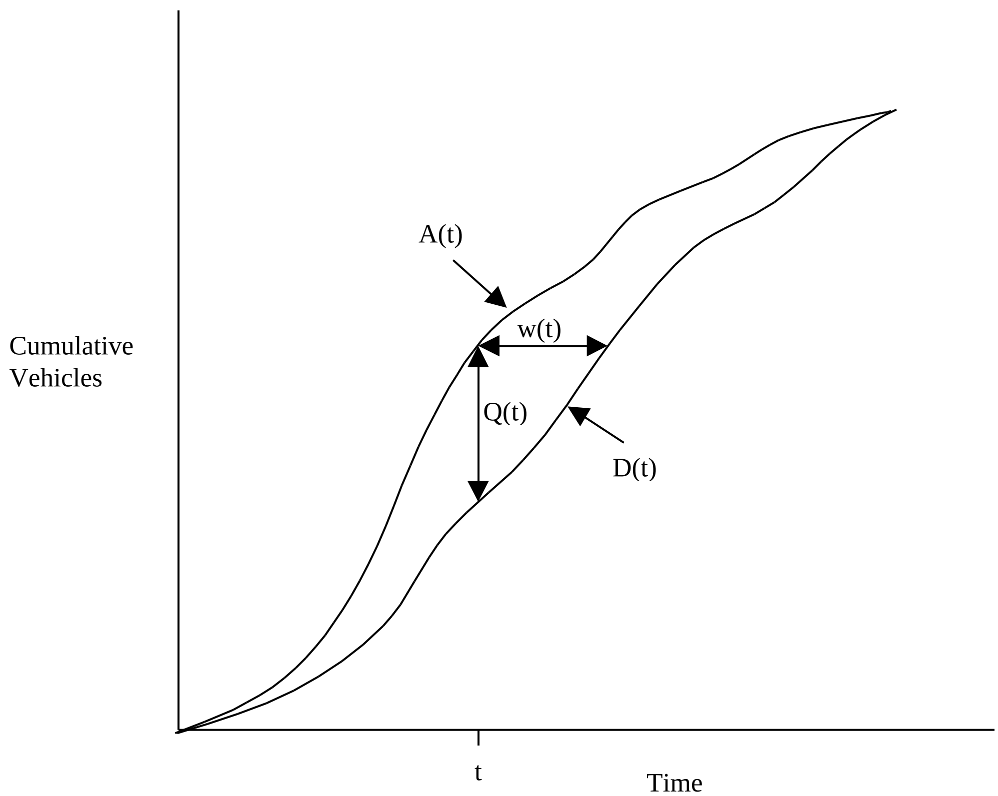
Future installments will further describe study activities, present the results of the study, and discuss some of its implications for both the prediction of wait times and the use of such data in the management of the Port of Entry. The next installment will focus on findings related to the accuracy of wait time estimates.

Note on Methodology

The methodology used to estimate waiting times in queues at border checkpoints for San Diego Dialogue is based on some fundamentals of queuing theory. Figure 13 illustrates important features of the method.

The diagram is a graph of the cumulative number of vehicles at the border crossing versus time. The line *A*(*t*) represents the cumulative number of vehicles that have arrived at any time after some arbitrary time zero (at which time there is no queue) and the line *D*(*t*) represents the cumulative

Figure 13. Queuing Diagram



number of vehicles that have departed from the queue by any given time. Thus the vertical distance between *A*(*t*) and *D*(*t*), labeled *Q*(*t*), represents the number of vehicles in the queue at any time *t*, and
the horizontal distance *w*(*t*) represents the average wait time for a vehicle arriving close to time *t*. In cases in which the order of service is strictly first-come-first-served, *w*(*t*) is the wait

time of the vehicle arriving at *t*; however, if different vehicles move through the queue at different speeds, so that the order of service is not strictly first in, first out, (as in this case) it is only an estimate of the average wait time for a vehicle arriving at approximately time *t*.

In the case of the San Diego border crossings, data on the queue output are provided by the U. S. Customs Service, which reports the total number of vehicles processed on an hourly basis.

Estimates of the total number of vehicles in queue are derived from estimated queue lengths reported by Metro Networks every half hour. Average waiting times are calculated for every hour by dividing the estimated number of vehicles in queue by the number of vehicles processed during the hour beginning at that time and then multiplying by 60 to convert the waiting time to minutes. In other words, the estimated average wait time at 8:00 a.m. is 60 times the estimated number of vehicles in queue at 8:00 divided by the number of vehicles processed between 8:00 and 9:00.

The major difficulty in this procedure is estimating the total number of vehicles in the queue from the queue length data supplied by Metro Networks. The data reported are an estimate (based on the location of the end of the queue) of the number on vehicles in a single line from the upstream end of the queue to the gates. Because the lines split at several points as they move toward the gates, not all the lines are this long, and it is necessary to estimate the number of lines that are of various lengths. For instance, if the queue is very short, and there are *n* gates open, the total number of vehicles in the queue is approximately *n* times the queue length. Once the queue length exceeds that of the shortest line (from the point of the split to the gate), however, the total number of vehicles is less than *n* times the reported queue length. In theory, the total number of vehicles in queue is a function of the reported queue length and the particular gates that are open. In practice, however, no data are available on *which* gates are open, so the estimation procedure is actually based on the reported queue length and the *number* of gates that are open. At San Ysidro, the situation is further complicated by the fact that there are several entrances feeding the right side of the queuing area, and queues on these are not necessarily of equal length.

It should be emphasized that these calculations are only an *estimate* of the *average* delay at any given time. The true average delay will vary about that estimate, and in the absence of a detailed study, it is not possible to say exactly how large the error is nor whether the estimates may be biased. In addition, individual wait times will differ from the average, even if it is completely accurate, since different lines move at different speeds. Variations in line speed result from both random variations in processing time at the gates, and (more importantly) differences in the number of times the longer lines split. The primary purpose of these calculations is to track changes in delays over time, and they should be adequate for that purpose, since any biases should stay the same from one month to the next.