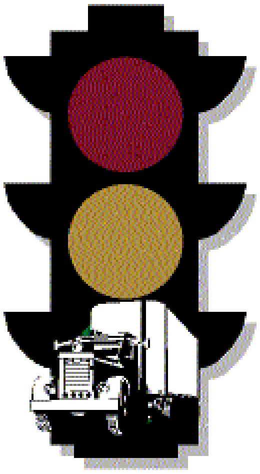

Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLANS 7 and 9

Simulating the Impact of Electronic Screening on Travel Time, Fuel Consumption and Weigh Station Efficiency

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

PREFACE

This is the combined final report for Detailed Test #7, System Simulation and Detailed Test #9, Fuel Test. Because the methodologies for these two test plans are closely related, it was appropriate to describe the effort and document the findings in a single report.

This report follows the outline provided in Exhibit 3-4 on page 31 of the Oregon Green Light Evaluation Plan (*Document Gleval -96.01)*. Chapter I, Introduction, places the report in the context of the overall evaluation, summarizes the role of electronic screening at weigh stations, and briefly introduces the evaluation methodology. Chapter II, Individual Test Summary includes a description of the field data collection at the Woodburn Port of Entry and the development and validation of the simulation models. Chapter III, Overall Evaluation Results, presents the output of the simulation model for selected scenarios. Chapter IV, Conclusions and Recommendations summarizes the findings and recommends additional applications of the simulation models.

Appendix One contains the field data collection forms. Appendix Two is a narrative description of the challenges faced in developing a weigh station model using CORSIM traffic simulation software. Appendix Three is the user's manual for the weigh station model developed in Arena. The User's Manual was given to the Oregon Department of Transportation along with a user's version of the model. Appendix Four contains the findings of 12 simulation runs in table format.

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EXECUTIVE SUMMARY

The objective of this portion of the Oregon Green Light evaluation is to quantify the benefits of electronic screening in terms of travel time and fuel consumption savings for motor carriers and improved efficiency of the weigh station. Because the evaluation was conducted concurrently with the deployment of the technology, it was not practical to measure the actual impact of electronic screening. Simulation was selected as the means for meeting the evaluation objective.

Computer simulation is a powerful technique for testing the impact of changes in systems where the effect of such changes cannot be determined analytically. Simulation models are distinctly different from analytical models. Simulation models are "run" where analytical models are "solved". Where analytical models are often used to prove or disprove relationships among variables based on empirical evidence, simulation models are used to explore and prepare for theoretical future events based on observed system dynamics. The comparison of the field data with the model's outputs establishes a level of confidence that the model is capable of simulating the existing conditions of the weigh station. The confidence in the simulation model yields a similar level of confidence in the model outputs obtained under the electronic screening strategy. In other words, once it has been established that the model replicates the dynamics of the actual system with an acceptable level of confidence, it can be used to analyze operating procedures, decision rules, and changes in physical layout without disrupting ongoing operations.

Simulation models are thus an appropriate tool for traffic analysis, such as that required in the evaluation of electronic screening at a weigh station, in which field experiments would be impractical. Using simulation software, it is possible to compare and contrast different operational scenarios. The animation features of the simulation make it possible to illustrate the functionality of the weigh station and electronic screening to a broad audience.

The Woodburn Port of Entry (Woodburn) is the focus of this evaluation. Woodburn, which is located 20 miles south of Portland on Interstate 5, is the busiest weigh station in Oregon. According to the 1998 Annual Summary for Motor Carrier Services, 887,780 vehicles entered the Port of Entry. The Woodburn Port of Entry is also significant in that it is the first weigh station in Oregon to complete installation of an electronic screening system.

Two simulation models were used in combination to measure the effectiveness of electronic screening at the Woodburn Port of Entry. Measures of effectiveness include the number of unobserved bypasses, travel time-savings for electronically screened vehicles, percent of vehicles screened both electronically and manually, and changes in fuel consumption. The first of the two weigh station simulation models was developed using Arena simulation software. The model calculates the number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses), determines the percent of the overall southbound truck traffic screened both electronically and manually, and determines the travel time saved when compliant trucks are screened electronically at mainline speed. A second simulation model was developed using CORSIM, a traffic simulation software. It was used in combination with Arena to predict fuel consumption.

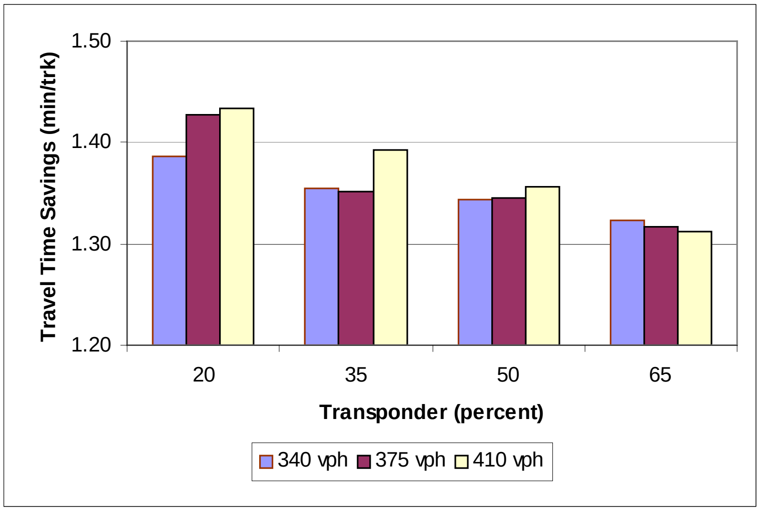
The simulation findings indicate that electronic screening will reduce travel time and fuel consumption for trucks participating in the electronic screening programs, or transponder equipped trucks. Findings also indicate that electronic screening will also decrease the occurrence of unobserved bypasses resulting from full queues and increase the percentage of trucks being screened for safety and compliance. The effectiveness of electronic screening will be situational. Several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures will determine the degree to which the electronic screening program meets its objectives.

To better understand the future impact of electronic screening, the simulation models were used to compare and contrast several scenarios, each with a different combination of truck volumes and transponder rates (the transponder rate is defined as the percentage of truck traffic participating in the Oregon Green Light program or, in other words, the percentage of trucks equipped with a transponder). Once it was verified that base simulation model replicated the actual system at an acceptable level of confidence, simulation runs were conducted for vehicle per hour (vph) rates of 340, 375, and 410. To put this in context, the data collection crew observed an average of 270 vehicles (trucks) per hour in May of 1997. The most recent traffic data available to the Oregon Department of Transportation's planning office indicate that truck traffic in the vicinity of Woodburn on the south bound lane of Interstate 5 is growing at an annual rate of 2.6 percent. Assuming that traffic growth rate remains constant, 340 vph would be realized in the year 2003, 375 vph in 2010 and 410 vph in 2013. The Oregon DOT’s planning office recently made projections that truck traffic may be increasing at a more rapid rate of seven percent annually. At a seven percent annual growth rate in truck traffic, the vehicles per hour rate at Woodburn would be 403 vph in 2003, 644 vph in 2010 and 788 vph in 2013. The model, however, was run using the more conservative projections.

For each truck traffic volume scenario, simulation runs were made with transponder rates of 20 percent, 35 percent, 50 percent, and 65 percent. The simulation output is included in table format as Appendix Four.

Travel Time

The following bar chart summarizes time-savings for bypass vehicles in each scenario. For all scenarios, time-savings for electronically screened vehicles fell within a range of 1.43 minutes at 410 vehicles per hour and a 20 percent transponder rate to 1.31 minutes at 410 vehicles per hour and a 65 percent transponder rate.



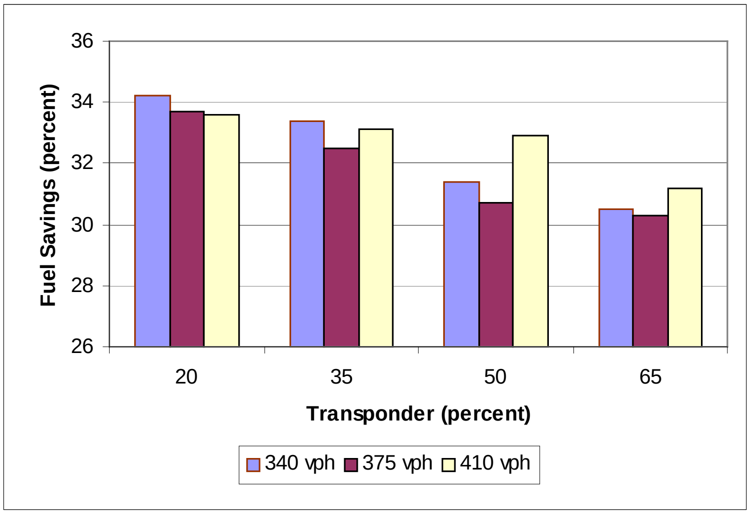
Reduced travel time is an incentive for trucks to participate in an electronic screening program. There is no singularly accepted estimate for the value of travel time saved for commercial vehicles. If one accepts the estimate put forth by Waters, Wong, and Meagle (7), the value of time saved for motor carriers, in 1998 dollars, is $34.00 per hour. The value of one pass for an electronically screened vehicle at the Woodburn weigh station in the scenarios examined, would range from $.74 to $.81.

Electronic screening improves the efficiency of the entire Port of Entry system. Even trucks that do not participate in the screening program stand to benefit. As more vehicles are electronically screened on the mainline, the queue and therefore the delay within the weigh station subsides. The cumulative time savings for all commercial vehicles will be quite significant. Using the 340 vehicles per hour scenario as an example, the cumulative time savings for all trucks passing the weigh station within any given hour, ranges from 1 hour and forty two minutes with the transponder rate at 20 percent, to five hours and twenty three minutes with the transponder rate at 65 percent.

Fuel Consumption

The CORSIM simulation model is used to predict the fuel consumption at Woodburn. For the scenarios selected, the CORSIM weigh station model indicates that electronic screening systems reduce relative fuel consumption for the electronically screened vehicles.

The fuel consumption values drawn from the CORSIM simulation model were reported in relative terms. The relative fuel savings for the twelve scenarios that were simulated, are illustrated on the following bar chart.

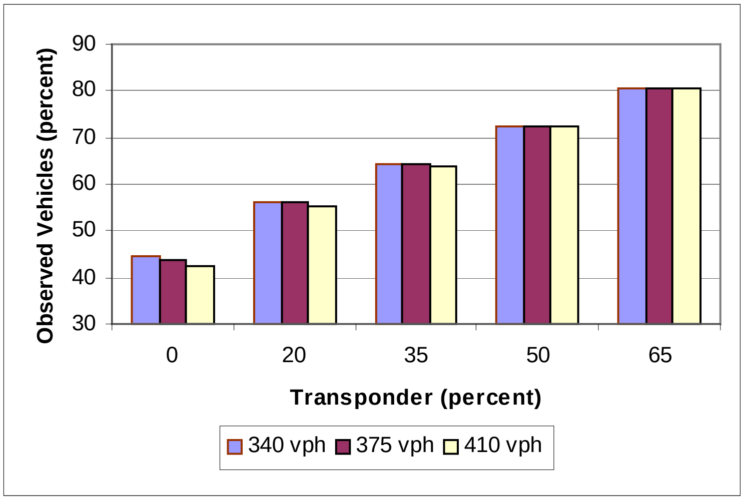


In the CORSIM model, the mainline and weigh station segments have common beginning and ending points. The fuel savings are reported in terms of percentage of fuel saved from the beginning point to the end point for a truck remaining on the mainline as compared to a truck of equal dimensions passing through the weigh station. For example, the first bar on the chart shows that an electronically screened truck in the scenario in which there are 340 vehicles per hour and 20 percent of the vehicles are equipped with transponders, uses 35% less fuel within the segment.

Percentage of Commercial Vehicles Screened -Electronically and Manually

Currently, as trucks enter the Woodburn Port of Entry, they pass over a slow speed weigh in motion scale. Based on a predetermined weight threshold (i.e. 75% of the legal limit), trucks are automatically sorted and directed to, either continue along the bypass lane and return to the mainline, or proceed to one of the two static scales. The trucks that stop at the static scales can be visually checked for obvious safety problems. Commercial vehicle enforcement personnel can also identify the vehicle by plate number and check compliance and safety records.

With the slow speed ramp WIM, all entering trucks are at least screened for weight. By diverting a portion of the truck traffic away from the static scales, congestion within the Port of Entry is minimized. However, from an enforcement perspective, a static scale weighing is of greater value as it allows for weight, safety and regulatory compliance checks. With the exception of the visual inspection, mainline electronic screening is similar to the static scale or manual screening as it allows for weight, safety, and regulatory compliance checks. The simulation model was used to predict the percentage of overall truck traffic that would be either electronically screened on the mainline or stopped at the static scale.



With a sufficient percentage of vehicles participating in Oregon's electronic screening program, the Woodburn Port of Entry will be able to process, (i.e. screen vehicles, both electronically and manually for safety, regulatory compliance, and weight) a substantially higher percentage of the truck traffic. By increasing capacity, electronic screening extends the design life of the facility.

Unobserved Bypasses

Unobserved bypasses are most often the direct result of commercial vehicle traffic exceeding the capacity of the Port of Entry. When the Port of Entry reaches capacity and the queue begins to spill out onto the mainline, the commercial vehicle enforcement officers temporarily close both the static scales and the ramp weigh-in-motion scale and direct additional commercial vehicles to entirely bypass the Port of Entry. The facility remains closed until the queue subsides. Because electronic screening diminishes the queue within the weigh station, as participation in the electronic screening program increases, the number of unobserved bypasses will decrease.

Commercial vehicle enforcement personnel consider the elimination of unobserved bypasses a major benefit of electronic screening. Because it is the objective of the Oregon Department of Transportation to weigh all vehicles that pass by the Woodburn Port of Entry, a one percent unobserved bypass rate is not acceptable. As the following table illustrates, with sufficient transponder rates, the occurrence of unobserved bypasses that are the direct result of lack of storage capacity within the Port of Entry will be eliminated. It should be noted, however, that congestion within the Port of Entry is not always the result of lack of capacity. Electronic screening will not resolve congestion that results from an incident within the queue or at the scale house.

Unobserved Bypasses %	340 Vehicles Per Hour	375 Vehicles Per Hour	410 Vehicles Per Hour
@ 0% Transponder Rate	1	3	6
@ 20% Transponder Rate	0	0	2
@ 35% Transponder Rate	0	0	1
@ 50% Transponder Rate	0	0	0
@ 65% Transponder Rate	0	0	0

The table reflects the output of the weigh station simulation model. It is the predicted performance of the Woodburn Port of Entry under 15 different scenarios. The third column, for example, shows the percentage of vehicles that would bypass unobserved with the truck traffic volume at 410 vehicles per hour. With no transponders, the model predicts that 6% of the overall truck traffic would be allowed to bypass unobserved as a direct result of a full queue. With 20% of the trucks equipped with transponders, the queue would be diminished to the point where only 2% of the overall truck traffic would be allowed to bypass unobserved as a result of a full queue. If the transponder rates were to reach 50%, the model predicts that unobserved bypasses that could be attributed to lack of capacity would be eliminated.

1. INTRODUCTION

The Oregon Department of Transportation (ODOT) is in the process of implementing the state's Intelligent Transportation System for Commercial Vehicle Operations (ITS/CVO) plan. Through the Green Light project, Oregon is installing 22 mainline preclearance systems featuring weigh-in-motion (WIM) scales and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. As part of the evaluation component of the Green Light project, a series of detailed test plans were developed. These test plans document the objectives as well as the procedures and methodologies of the evaluation.

This report outlines the data collection activities, methodology and findings for the Detailed Test Plan #7, System Simulation, which includes performance measures;
Predict total vehicles processed.
Predict number and length of service interruptions
Predict average travel time savings by vehicle.

and Detailed Test Plan #9 Fuel Test, which includes performance measure;
Estimate changes in fuel use.

These are four of the nine measures of effectiveness that make up evaluation goal #2; Assessment of Efficiency.

The objective of this portion of the evaluation was to quantify the benefits of electronic screening realized by participating motor carriers in terms of travel time and fuel consumption savings and by the state realized through the improved efficiency of the weigh station. Because the evaluation was conducted concurrently with the deployment of the technology, it was not practical to measure the actual impact of electronic screening. Simulation was selected as a means to meet the evaluation objective.

The impact of electronic screening will be affected by several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon’s commercial vehicle enforcement policies and procedures. Using simulation models of the weigh station, it is possible to compare and contrast different operational scenarios. In addition, the animation feature of one of the two simulation software programs used in this evaluation makes it possible to illustrate the functionality of the weigh station and electronic screening to a broader audience.

The Woodburn Port of Entry (Woodburn), located thirty-five miles south of Portland on Interstate 5, is the focus of this evaluation. Woodburn is the busiest weigh station in Oregon, and was the first to complete installation of an electronic screening system.

Two simulation models were used in combination to measure the impact of electronic screening for a set of 12 scenarios. Each scenario has a different combination of assumptions regarding transponder usage rates and overall traffic volume. The first weigh station model, developed using Arena simulation software, was used to predict the number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses) and determines the travel time saved when compliant trucks are screened electronically at mainline speed.

Because Arena is not a simulation software specifically designed for traffic engineering, by itself it was not capable of predicting fuel savings resulting from electronic screening. CORSIM, perhaps the most widely used traffic simulation software in the United States, is capable of measuring fuel consumption. However, CORSIM does not allow for dynamic assignment of vehicle characteristics, which is necessary for simulating the process of electronic screening. Both models were used in combination to take advantage of Arena’s dynamic assignment capabilities and CORSIM’s ability to simulate fuel usage.

This report documents the application of the simulation models at the Woodburn weigh station. The simulation results indicate that electronic screening would substantially reduce travel time, and fuel consumption for motor carries, increase the percentage of vehicles being screened, and reduce the number of unobserved bypasses. One of the advantages of simulation is that it allows for the analysis of hypothetical scenarios. Each of these performance measures can be predicted for a variety of scenarios, assuming different growth rates in truck traffic and/or transponder usage. This study concludes that electronic screening is a feasible option for increasing capacity of the weigh station without expanding the physical infrastructure

Along with this written report, the Oregon Department of Transportation was furnished a copy of the weigh station model developed in Arena, one of the two computer simulation models used in the evaluation. With the model, the Oregon Department of Transportation staff is able to modify the input parameters (traffic levels, motor carrier participation levels) and observe the effect of electronic screening on weigh station efficiency and travel time savings.

2. INDIVIDUAL TEST SUMMARY

2.1 FIELD DATA COLLECTION

Field data were collected at the Woodburn Port of Entry in preparation for the development of the simulation models. The models are based on the existing throughput activity and geometry of the weigh station. Once the simulation models were developed, the field data were also used for validation, or to ensure the functionality of the models was not significantly different than the functionality of the weigh station. This chapter describes the data collection procedures and functionality of the weigh station as observed by the data collection crew

2.1.2 Observed Functionality of the Weigh Station

In May of 1997, the data collection crew observed throughput truck volumes averaging 270 trucks per hour during peak periods. All approaching vehicles weighing over 20,000 pounds must enter the weigh station. When the weigh station reaches capacity and the truck queue begins to extend out into the mainline, a "closed" sign is illuminated upstream from the weigh station. All trucks are then allowed to bypass the weigh station until the queue subsides.

As trucks enter the weigh station they pass over a slow speed weigh-in-motion (WIM) scale. The truck's weight and axle spacings are recorded. Based on a predetermined weight threshold (i.e., 75 percent of the legal limit), trucks are automatically sorted and directed to either continue along the bypass lane and return to the mainline or proceed to one of two static scales for a more precise weighing and visual inspection. Overhead directional arrows are used to signal drivers to the appropriate lane.

2.1.3 Data Collection Procedures

The traffic data collection was conducted at the Woodburn weigh station on May 5, 1997, to determine the following parameters:
Traffic volume and truck percentage on each mainline lane
Number of unobserved bypasses, (trucks bypassing the weigh station due to a full queue)
Average travel time between designated points inside the weigh station
Truck counts at the weigh station entrance, ramp bypass lane, and static scales

Duration of each truck’s stop on the static scale platform (i.e., service time)

The data collection crew consisted of 11 individuals. The crew was made up of students and staff from Oregon State University and staff from the Iowa State University's Center for Transportation Research and Education. Data were collected from five points. Four of the points were inside the weigh station and the fifth was on an overpass, approximately 200 feet upstream of the weigh station entrance and in view of the mainline. Each data collection point had both an observer and a recorder. The data collection points are shown in Figure 1. Points one through four are located at the weigh station’s entrance ramp, ramp WIM sorter, static scales, and the ramp back to the mainline, respectively.

With a ramp bypass lane and two static scales, one on each side of the scale house, trucks follow one of three possible routes through the weigh station. The objective of the data collection was to capture the throughput routes and point to point movements during both morning and afternoon peak periods and a non-peak period of early afternoon. A total of six hours of data were collected in three two-hour sessions. Data collection sessions were carefully synchronized using stopwatches and two-way radios. Sample data collection forms are included in Appendix One.

The similarities between traffic movements through an unsignalized intersection and truck traffic movements at a static scale weigh station led to the use of a data collection method suggested for delay study at an unsignalized intersection. In this method, total delay at the intersection is defined as "...the total elapsed time from when a vehicle joins the queue until the vehicle departs from the stopped position at the head of the queue.” (1, p.2-9) The same method was used to measure total delay and average travel time between designated points inside the weigh station.

Upon completion of the data collection, each truck’s plate number and arrival times at each observation point were entered into a database back at the CTRE office. Concurrent data collection made it possible to determine the travel time for each truck between the designated points inside the weigh station simply by matching plate numbers in the database system. The database also makes it possible to determine the routes of each truck. There were three routes of interest;

> Truck enters weigh station, follows directional arrow to static scale #1, exits weigh station.

Truck enters weigh station, follows directional arrow to static scale #2, exits weigh station.

Truck enters weigh station, is directed to bypass static scales and exits weigh station.

By identifying the points at which each truck is observed, it is possible to trace its route.

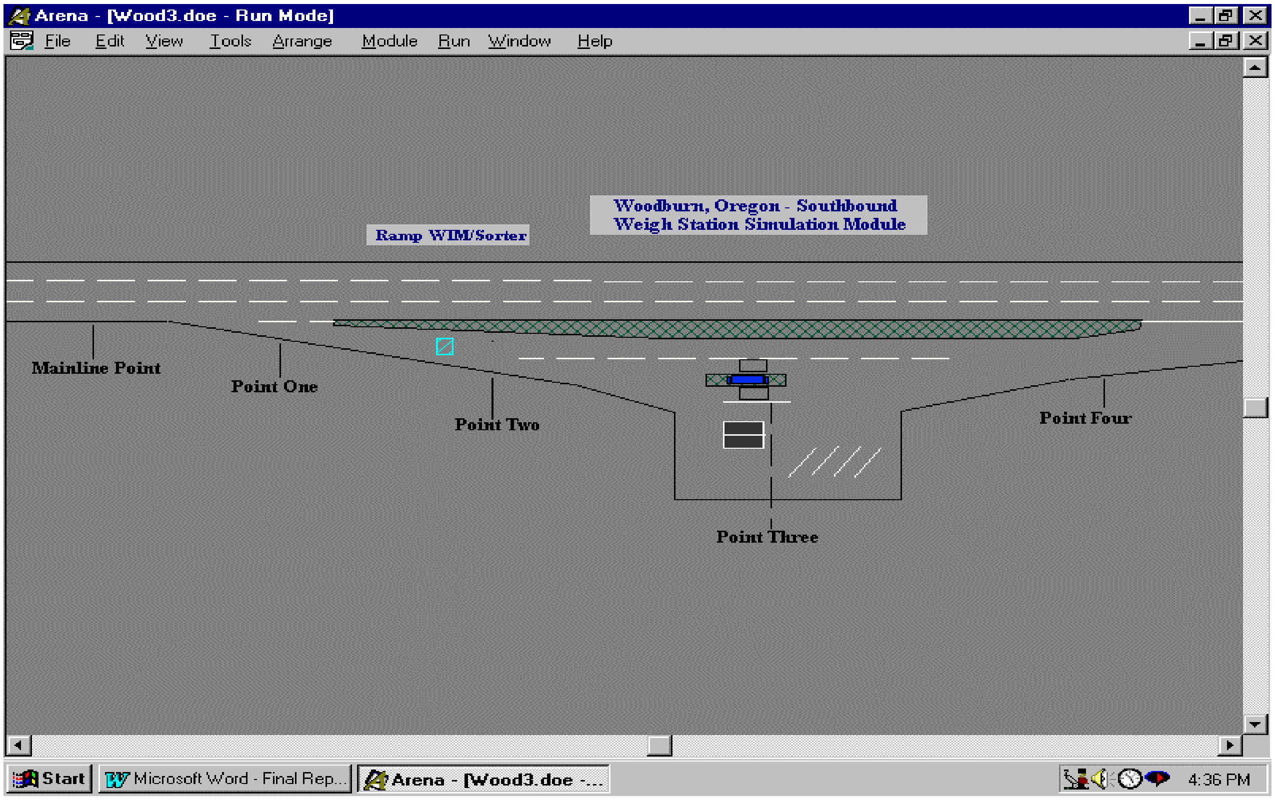


Figure 1. Data Collection Points at the Woodburn Port of Entry

Mainline traffic counts were conducted from an overpass located directly above the deceleration lane upstream from the weigh station entrance. Car and truck traffic volumes were collected for each of the three mainline lanes. Using plate numbers as identifiers, truck arrival times were recorded at each of the data collection points within the weigh station. The data collection team members located at the two static scales recorded both arrival and departure times of each truck. A third individual was stationed at point one to observe and record unobserved bypasses.

The time difference between the arrival and departure of trucks at the two static scales (points 3a and 3b) is referred to as static scale service time. Moreover, the time difference between the truck arrival time at point two and its departure time at point three is referred to as total delay at static scales. This is the total time elapsed from when the truck starts to slow down (point 2) to join the queue leading to static scales until it departs the scale platform (point 3).

The truck traffic volume, traffic counts at designated points throughout the weigh station, and service times are incorporated in the models to simulate traffic operations at the Woodburn weigh station. The other parameters, such as static scale total delay (d_{23}) as well as travel times between points one to two (d_{12}), one to four (d_{14}) and three to four (d_{34}) and the percent of unobserved bypasses, are used in validation processes. The observed travel times are compared to the models' results to establish a level of confidence in the models.

2.2 METHODOLOGY: SIMULATION MODEL DEVELOPMENT FOR DETAILED TEST #7

Computer simulation is a powerful technique for testing the impact of changes in systems where the effect of such changes cannot be determined analytically (2). It is an appropriate tool for traffic analysis, such as that required in the evaluation of electronic screening at a weigh station, in which field experiments would be impractical. Although field experiments could be designed to assess the impact of electronic screening on fuel consumption, travel time, total vehicles processed, and unobserved bypasses, the cost and complexity of such experiments make them impractical. Furthermore, the findings of such field experiments would be valid for present traffic conditions only. With simulation, once the field data have been duplicated, it is possible to manipulate the model and simulate other traffic conditions.

Because weigh stations are, in essence, traffic facilities consisting of freeway segments, off and on ramps and connecting street segments, their operations can be simulated using traffic simulation software. A review of existing traffic simulation models, such as CORSIM (3) and INTEGRATION (4), indicated that they are not readily applicable for evaluation of electronic screening at weigh stations. Weigh stations that have been equipped with electronic screening allow enforcement officers to differentiate between individual trucks as they approach the weigh station. Routes are assigned to individual trucks based on a predetermined set of criteria. That is, drivers are signaled to either pull into the weigh station for a static weighing or to remain on the mainline, bypassing the weigh station entirely. These models do not allow for dynamic change in truck characteristics, which would be necessary to simulate the Automated Vehicle Identification (AVI) function of electronic screening

It was determined that modifying existing traffic simulation programs to simulate dynamic change in truck characteristics would be very difficult and expensive. Instead, a weigh station simulation model was built using Arena simulation software (5). Using the weigh station model developed in Arena, it is possible to predict:
total vehicles processed (cleared and not cleared)
number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses)
average time savings for each vehicle by allowing compliant trucks to be screened electronically at mainline speed

To determine the effect of electronic screening on fuel consumption, the output of the Arena weigh station simulation model is used as input in a second model. The second model was developed in CORSIM, the traffic simulation software. The CORSIM model allows for the simulation of fuel consumption.

To establish a level of confidence, both weigh station simulation models are calibrated against the traffic data collected at the Woodburn weigh station. A summary of the model's input parameters, which were drawn from the traffic data, is included in Table 1. This chapter describes the development and validation processes of these two models in detail.

2.2.1 Arena Weigh Station Model

The Arena weigh station model design is based on the existing geometry and functionality of the Woodburn weigh station. The Arena model is specifically designed to simulate traffic operations in and around the weigh station facility. It simulates truck movement through a weigh station, the weighing of the trucks, and inspection. With Arena, it is also possible to simulate the decision-making logic that is associated with the electronic screening system's assignment of bypass or pull-in flags to the approaching trucks. Figure 2 represents the electronic screening bypass and pull-in logic.

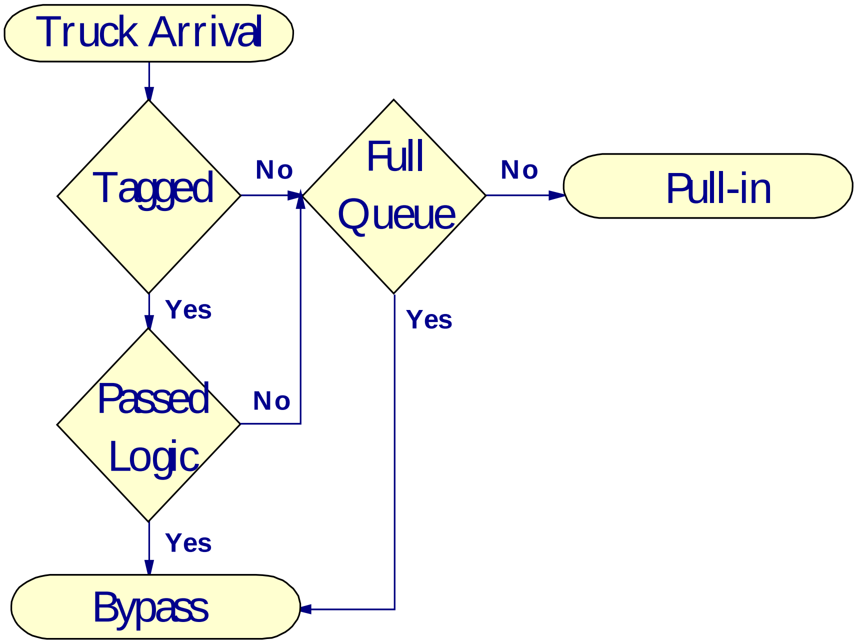


Figure 2. Electronic Screening System Bypass/Pull-in Logic

Based on exponential distribution, the model generates vehicle characteristics and assigns these characteristics to each entity (truck) approaching the weigh station on the mainline. For example, if the user decides to test the implication of having 10 percent of the population of trucks equipped with transponders, the program randomly allocates transponders to 10 percent of the entities. Other attributes are assigned following a discrete or continuous probability function. These attributes could include such vehicle characteristics as classification, axle spacing, and axle weights.

In an electronic screening system, a decision-making engine is triggered when a transponder-equipped truck passes the Advance AVI reader site located on the mainline. Each transponder has a unique identification number. The state motor carrier database, which resides on the roadside server, is automatically queried as the truck passes the AVI reader. The screening decision is based on the information gathered from the motor carrier database and the WIM data (e.g., axle weights and spacing). Dimensional data collected from the mainline WIM is checked against allowable weight and size criteria and to determine the truck's compliance with weight regulations.

If a truck successfully satisfies all the conditions stated in the logic, it is awarded a bypass flag. If not, it must enter the upcoming weigh station (pull-in). All trucks that are not assigned a transponder must also enter the weigh station. The logic used by the simulation is the same as that found in the electronic screening system.

The weigh station model has been verified and the results of the simulation have been validated by comparing the travel time collected in the field to those generated by the simulation without the availability of electronic screening. The validation procedure will be described in more detail later in the section.

2.2.2 Input and Output Data

The Arena weigh station simulation model is based on both actual truck traffic patterns and geometry data collected at the Woodburn weigh station and data obtained from the Oregon Department of Transportation. The default data, shown in Table 1, represent the existing conditions at Woodburn. The model, however, allows the user to modify the default parameters to examine different scenarios.

Table 1. Woodburn Simulation Input Parameters

Parameters	Morning	Noon	Afternoon
Total traffic volume (vph)	2201	1926	3705
Trucks as percentage of total traffic	12%	15%	7%
Ramp bypass rate: Percent of trucks directed to bypass static scales and return to mainline)	54%	57%	52%
Scale (a) utilization rate: Of the two scales, this is the percentage of trucks directed to scale (a).	56%	58%	58%
Safety inspection rate: Percent of trucks pulled over for a safety inspection. *	3%	3%	3%
Average safety inspection time in minutes	20	20	20

Figure 3 presents an example of parameters that can be modified prior to a simulation run at the Woodburn weigh station. The static scale weighing duration is not listed among the changeable parameters in Figure 3. The weighing times are randomly generated according to a statistical distribution which, once programmed, may not be modified by the users.

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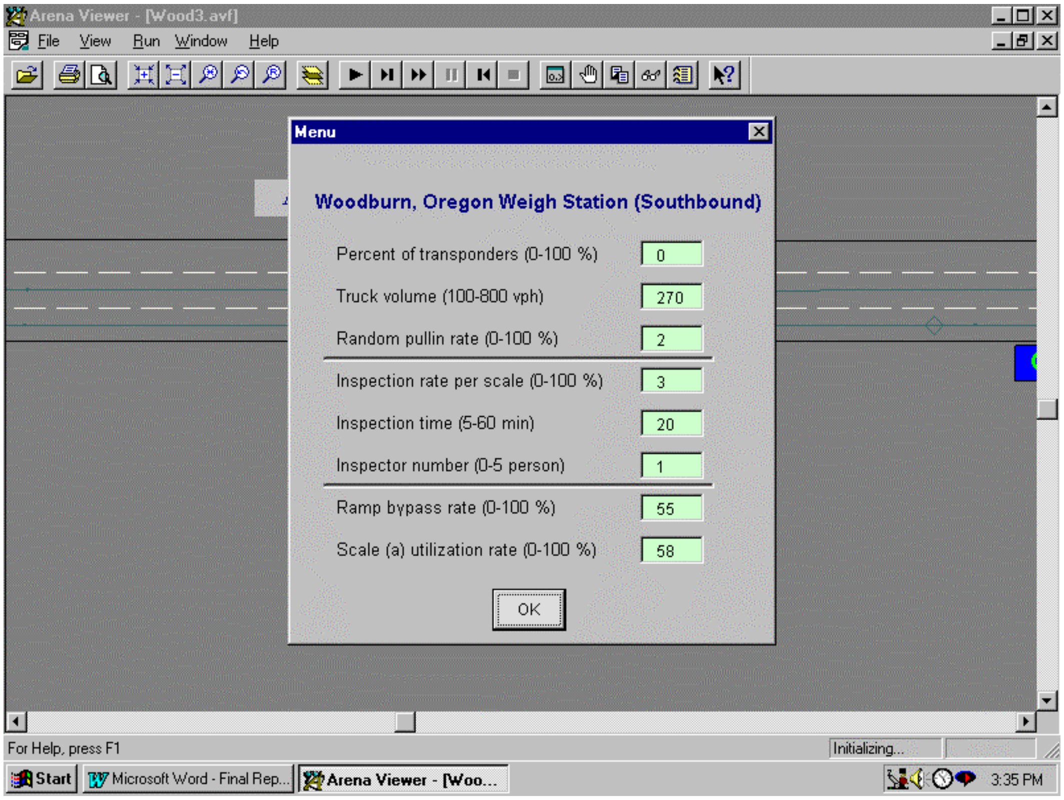
* The field data provide no good statistical distribution for the duration of a safety inspection as less than four percent of trucks were observed being inspected. The menu screen allows the user to estimate both the average duration of an inspection and the number of inspectors on duty.

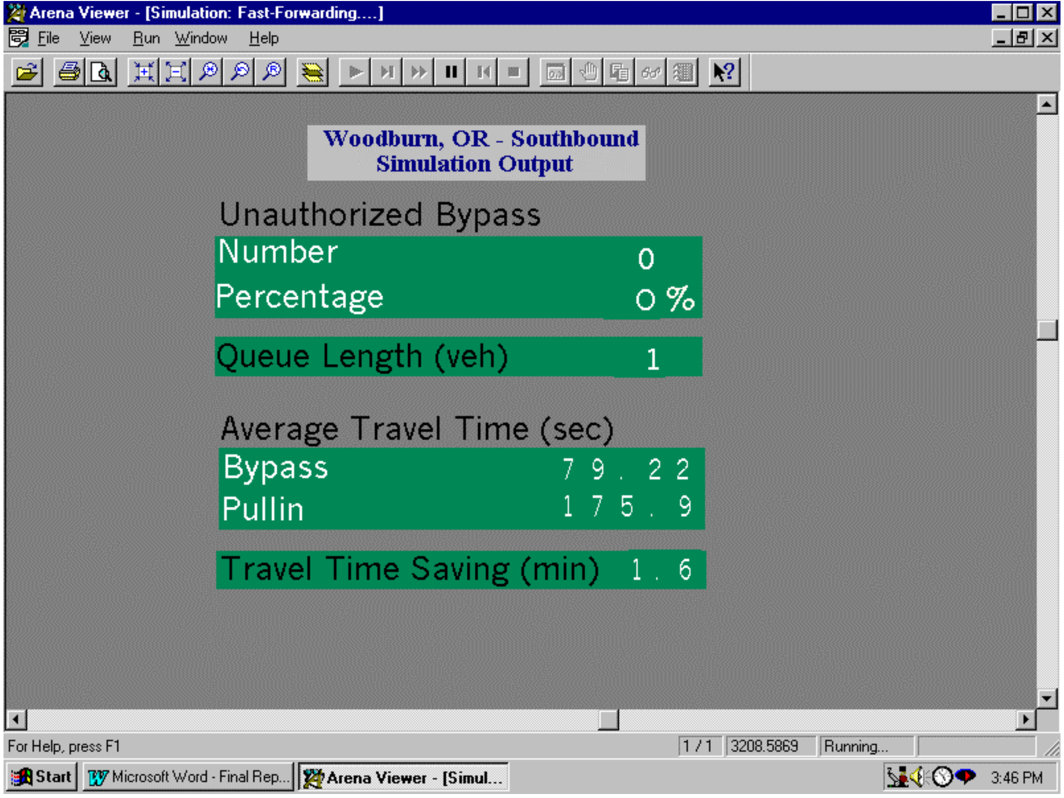


Woodburn, Oregon Weigh Station (Southbound)

Percent of transponders (0-100 %) 0
Truck volume (100-800 vph) 270
Random pullin rate (0-100 %) 2
Inspection rate per scale (0-100 %) 3
Inspection time (5-60 min) 20
Inspector number (0-5 person) 1
Ramp bypass rate (0-100 %) 55
Scale (a) utilization rate (0-100 %) 58

Figure 3. Woodburn Simulation Model Menu

The output data can be displayed during and upon completion of a model run. It includes those performance measures that were of direct interest in our study: the total number of unobserved bypasses, truck travel time savings, percentage of bypass versus percentage of pull-in vehicles. Other output parameters include the queue length, the average time in the system, and total number of trucks processed per hour. Figure 4 shows a summary of the results during a simulation run of the Woodburn weigh station.



Woodburn, OR - Southbound
Simulation Output

Unauthorized Bypass
Number 0
Percentage 0 %

Queue Length (veh) 1

Average Travel Time (sec)
Bypass 79.22
Pullin 175.9

Travel Time Saving (min) 1.6

1 / 1 3208.5869 Running...

Figure 4. Woodburn Simulation Sample Output

2.2.3 Model Validation

The model will provide results that are not identical to the observed system. The purpose of model validation is to determine if the model replicates the actual system at an acceptable level of confidence (6). The simulation results are compared to the field data to validate the weigh station simulation module.

The static scale total delay (d_{23}) and travel time between designated points inside the Woodburn weigh station (d_{12}, d_{34}, and d_{14}) are available through the field data collection. The collected field data represent the existing conditions at the weigh station (i.e., no transponder-equipped truck participation). No unobserved bypasses were detected during data collection. The simulated static scale total delay and travel times are determined by running the weigh station simulation model, using the traffic volume and service time collected at peak and off-peak periods.

The simulation results are naturally subject to random fluctuations within the model. To account for this variation, interval estimates or confidence intervals are provided along with the point estimate of mean for each of the performance measures. Table 2 compares the field data to the simulation results which were obtained from 10 two-hour simulation runs. This table also includes the 95 percent confidence intervals for evaluation of the generated point estimate of means. These confidence intervals provide lower and upper limits of the true point estimate of averages. Therefore, it can be stated with 95 percent confidence that the true noon average total delay (d_{23a}), for example, is within less than four percent of the average delay (56 seconds).

Table 2. Woodburn Field and Simulation Results

Parameters	Morning			Noon			Afternoon		
	Field	Model		Field	Model		Field	Model	
	Avg	Avg	C.I.	Avg	Avg	C.I.	Avg	Avg	C.I.
Travel time (d_{12}), sec.	49	20	20, 20	19	21	21, 22	17	18	18, 18
Total delay (d_{23a}), sec.	41	43	41, 44	54	56	54, 58	50	52	49, 54
Total delay (d_{23b}), sec.	39	38	37, 38	57	55	52, 58	45	42	42, 43
Travel time (d_{3a4}), sec.	52	51	50, 51	53	56	55, 56	62	57	57, 57
Travel time (d_{3b4}), sec.	56	54	54, 54	58	58	57, 58	57	58	57, 59
Travel time (d_{14}), sec.	75	50	50, 50	64	61	61, 61	62	61	61, 61

It is noted in Table 2 that the observed average travel time from point one to two (d_{12}) during the morning session (i.e., 49 seconds) is more than twice that obtained by the model (i.e., 20 seconds). This discrepancy is due to a lack of synchronization between individuals stationed at point one and those stationed at the other data collection points. The individuals at point one had a late start in recording arrival times and plate numbers of arriving trucks. The inaccuracy of data recording at point one during the morning session also resulted in discrepancy between the average field and model travel time from point one to four (d_{14}). The second and third data collection sessions were successfully synchronized.

The comparison of the field data with the model's outputs establishes a level of confidence that the model is capable of simulating the existing conditions of the weigh station. The confidence in the simulation model yields a similar level of confidence in the model outputs obtained under the electronic screening strategy.

2.3 METHODOLOGY: SIMULATION MODEL DEVELOPMENT FOR DETAILED TEST #9

2.3.1 Developing a Weigh Station Model in CORSIM

Although Arena was effective for measuring travel time savings, the occurrence of unobserved bypasses at an electronically screened weigh station, it was sufficient for simulating fuel consumption. Therefore, a second weigh station model was developed using CORSIM to examine the impact of electronic screening in terms of fuel consumption savings at the Woodburn weigh station. The functionality of the weigh station was simulated using both Arena and CORSIM. The Arena weigh station model simulates electronic screening and determines truck movements through the weigh station. The CORSIM model is used to simulate traffic operations at the weigh station using the traffic flow characteristics produced by the Arena model.

CORSIM is sponsored and supported by the Federal Highway Administration. It combines FRESIM and NETSIM. NETSIM is a microsimulation model that represents the traffic movements on local street networks. Its companion model, FRESIM, follows the same concept in modeling traffic operation on freeways. CORSIM predicts operational performance of an integrated system consisting of local streets and freeways. The integration of the two models enables CORSIM to capture, for example, effects of a freeway ramp spill-over onto a local street and to measure delay on adjacent streets as a result of traffic re-routing due to a freeway incident.

Like the Arena model, the CORSIM model is based on the existing geometry and functionality of the Woodburn weigh station. The weigh station facility is modeled in NETSIM and interfaced with the freeway segment that is modeled in FRESIM. The two static scales inside the weigh station are represented by pre-timed traffic signals. The signal timings are adjusted to account for the trucks' stoppage time on static scale platforms. Also like the Arena model, the static scale stoppage times and the truck traffic flow within the weigh station facility are based on collected field data. The average fuel consumption of trucks that enter the weigh station (pull-ins) was compared with the fuel consumption of those trucks that are electronically cleared on the mainline (bypasses). The difference is the fuel consumption savings attributable to electronic screening.

The CORSIM input file consists of a sequence of "record types." Each record carries a specific set of data that can only be modified within defined boundaries. These records enable CORSIM to model the system's operations and traffic network of the case study weigh station. They do not, however, allow users to change records' data structures or to assign new vehicle characteristics, which would be required for modeling electronic screening systems. These limitations were resolved by incorporating the output of the Arena weigh station simulation model.

As more trucks become equipped with transponders, the queue within the weigh station and thus the number of unobserved bypasses will decrease. This, in turn, changes the traffic patterns and traffic flow within the weigh station. As described earlier, Arena weigh station simulation model is able to determine traffic flow assuming different percentages of trucks participating in the electronic screening program. The simulated traffic patterns from the Arena model (shown in Table 3) are used to develop a weigh station model in CORSIM. Through this unique process, illustrated in Figure 5, it is possible to determine fuel consumption at the electronically screened weigh station for a variety of scenarios.

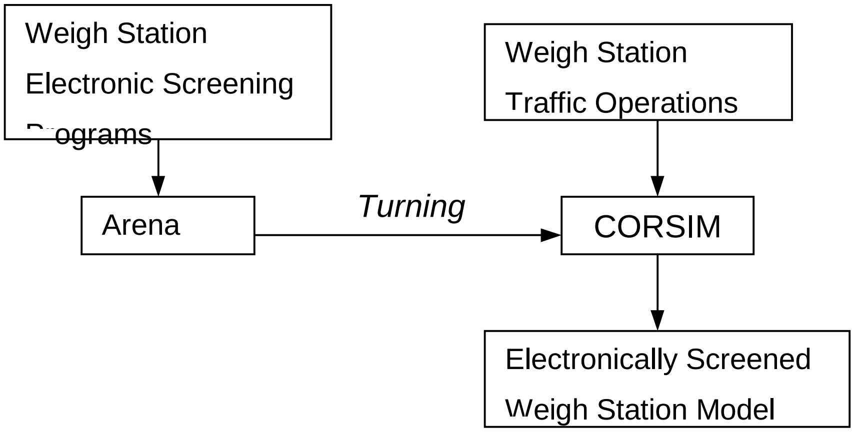


Figure 5. Data Flow Diagram of Electronic Screening Modeling in CORSIM

2.3.2 Model Calibration

CORSIM is an accepted traffic simulation model among transportation professionals. However, because weigh station modeling was a new application, the model was validated and the results' calculation process was verified.

The output of the CORSIM model was compared to both the field data and the output of the Arena model. To determine that the model replicates the actual system at an acceptable level of confidence, the travel times collected in the field are compared to those generated by the CORSIM model. To ensure the fuel consumption calculation procedure is valid, the CORSIM models travel time savings are compared to those generated by the Arena weigh station model.

The CORSIM model consists of a network of segments, nodes and links. To compare fuel consumption, the links were grouped to form the subsegments c_1, c_2, m, and w. These subsegments were then grouped into the weigh station segment and the mainline segment. Sub segments $c_{1,}$ c_2 are common to the mainline and weigh station segment. The mainline also includes sub segment m and the weigh station includes subsegment w. These sub segments are labeled in Figure 7.

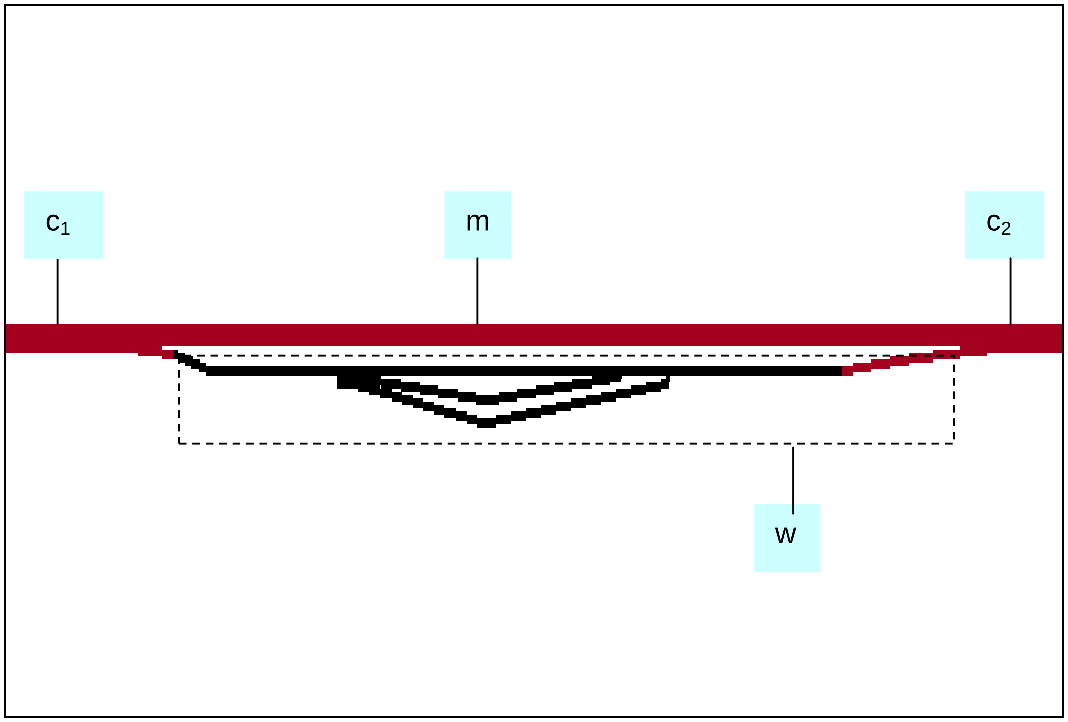


Figure 7. Woodburn Weigh Station Layout in CORSIM

2.3.3 Results Validation

The CORSIM weigh station model validation is based on 10 hours of accumulated simulation time. The input parameters were the existing conditions at the case study weigh station. The CORSIM model's nodes within the weigh station segment are consistent with the field data collection points. Figure 6 compares the simulation results to the collected field data. Links within the weigh station are shown on the x-axis.. For example, d_{23a} is the link from data collection point two to the inner static scale. The corresponding bars represent the observed and simulated travel times for each of these links. This comparison establishes a level of confidence that the model is capable of simulating the traffic operations at the weigh station.

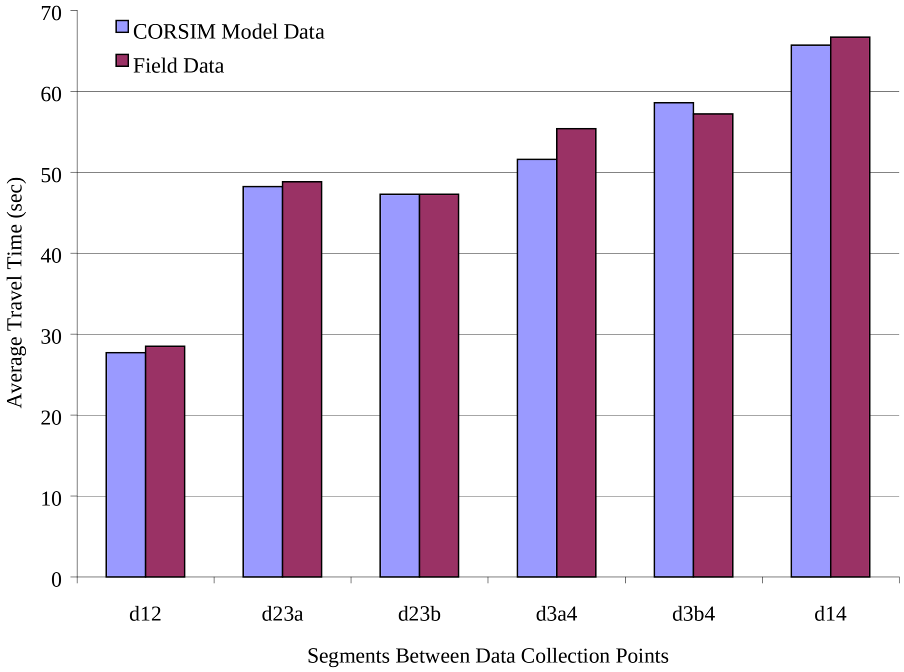


Figure 6. Validation Results – Field and CORSIM Model Data Comparison

2.3.4 Calculation Verification

The output files provide measures of fuel consumption, emission, and travel time of the simulated system by link and for the system as a whole. Within the weigh station segment, nodes are established at each data collection point. The total fuel consumption for both the mainline and weigh station segments are determined by adding the amount of fuel consumed on each of the links within the two segments.

For the common subsegment labeled c_1, which is upstream of the weigh station, it is understood that trucks that pull into the weigh station are able to coast and thus actually use less fuel than those that are allowed to bypass. Because CORSIM provides aggregate fuel consumption by link, a step was added to determine the difference in fuel consumption between bypass and pull-in vehicles in subsegment c_1. To determine the effect of electronic screening, the CORSIM model was run first with a selected transponder rate greater than zero and run again assuming a zero transponder rate, that is, all trucks entered the weigh station. Each run produced 749 vehicles. For purposes of demonstration we use a transponder rate of 20 percent. The output of the first run indicated that total fuel consumption for subsegment c_1 with a 20 percent transponder rate was 212.2 gallons. For the second run with a zero transponder rate, the total fuel consumption for subsegment c_1 was 210.78 gallons. The difference between the two runs, (212.2-210.78=1.42 gallons) was divided by the number of vehicles that bypassed (749*.20=150 vehicles). From this we conclude that the additional fuel consumption per bypass vehicle in segment c1 was 1.42 gal./150 vehicles, or .0095 gallons per truck. This step ensures that trucks that bypass the weigh station are properly assigned additional fuel consumption as they remain at freeway speeds. Link c_1 is unique in that it is the only link in which trucks that bypass use more fuel than those that pull in. The fuel consumption calculation of pull-in and bypass trucks on link c_1 is summarized in the following two equations:

$$PF_{c1} = \frac{f_{oc1}}{n} \tag{1}$$

$$BF_{c1} = \frac{f_{rc1} - f_{oc1}}{(r+u)n} + \frac{f_{oc1}}{n} \tag{2}$$

where:

PF_{c1} = gallons of fuel per pull-in truck on c_1 link

BF_{c1} = gallons of fuel per bypass truck on c_1 link

f_{oc1} = total fuel consumption on c_1 link in all pull-in case; (gal)

n = total number of trucks on c_1 link

r = percent of participating transponder-equipped trucks

u = percent of unobserved bypass trucks

f_{rc1} = total fuel consumption on c_1 link for ($r+u$) percent of trucks; (gal)

The next common link downstream of the weigh station (c_2) requires that trucks reentering the mainline traffic stream accelerate to freeway speeds. The fuel consumption for this link is calculated in the same manner as the segment located upstream of the weigh station. In segment c_2, as in segments m and w, the pull in vehicle consumes more fuel than the bypass vehicle. Equations 3 and 4 formulate the fuel consumption calculation of pull-in and bypass trucks on the downstream common link.

$$PF_{c2} = \frac{f_{oc2}}{n_{oc2}} \tag{3}$$

$$BF_{c2} = \frac{f_{oc2}}{n_{oc2}} - \frac{f_{oc2} - f_{rc2}}{(r+u)n} \tag{4}$$

where:

PF_{c2} = gallons of fuel per pull-in truck on c_2 link

BF_{c2} = gallons of fuel per bypass truck on c_2 link

f_{oc2} = total fuel consumption on c_2 link in all pull-in case; (gal)

n_{oc2} = total number of trucks on c_2 link in all pull-in case

f_{rc2} = total fuel consumption on c_2 link for (r+u) percent of trucks; (gal)

Given the pull-in and bypass fuel consumption in Equations 5 and 6, the total amount of fuel consumed for each truck type in each segment (mainline and weigh station) is determined. The relative fuel consumption savings are calculated by using Equation 7.

$$PF_w = \frac{f_w}{(1-r+u)n} \tag{5}$$

$$BF_m = \frac{f_m}{(r+u)n} \tag{6}$$

$$RFS = \frac{\sum\limits_{(c1+c2+w)} PF - \sum\limits_{(c1+c2+m)} BF}{\sum\limits_{(c1+c2+w)} PF} \tag{7}$$

where:

PF_w = gallons of fuel per pull-in truck inside the weigh station (w)

BF_m = gallons of fuel per bypass truck on m link

f_w = total fuel consumption on w links for (1-r+u) percent of trucks; (gal)

f_m = total fuel consumption on m links for (r+u) percent of trucks; (gal)

RFS = relative fuel consumption savings; (percent)

$\sum\limits_{(c1+c2+w)} PF$ = gallons of fuel per pull-in truck on the weigh station segment

$\sum\limits_{(c1+c2+w)} BF$ = gallons of fuel per bypass truck on the mainline segment

To determine the relative fuel consumption savings (RFS) at, for example, 20 percent transponder rate, equations 1 through 6 must be solved first. Using the following values, obtained from a 10 hour run of the CORSIM weigh station simulation model, Equation 7 indicates that each bypass truck consumes 29.7 percent less fuel than a pull-in truck.

f_{oc1} = 1576 gallons

f_{rc1} = 1630 gallons

n = 5998 trucks

$r = 0.20$

$u = 0.12$; obtained from the Arena model output

$f_{oc2} = 2946$ gallons

$n_{oc2} = 5994$ trucks

$f_{rc2} = 2870$ gallons

$f_w = 2195$ gallons

$f_m = 319$ gallons

The calculation procedure for fuel consumption is verified by comparing travel times, which are similarly calculated, to those determined by the Arena weigh station model. The Arena weigh station model is programmed to automatically determine the bypass and pull-in travel times. Figure 8 shows that the travel time savings (travel time difference between the mainline and weigh station segments) in both models follow a similar trend. This verifies the validity of the process in the fuel consumption determination at the Woodburn weigh station in CORSIM.

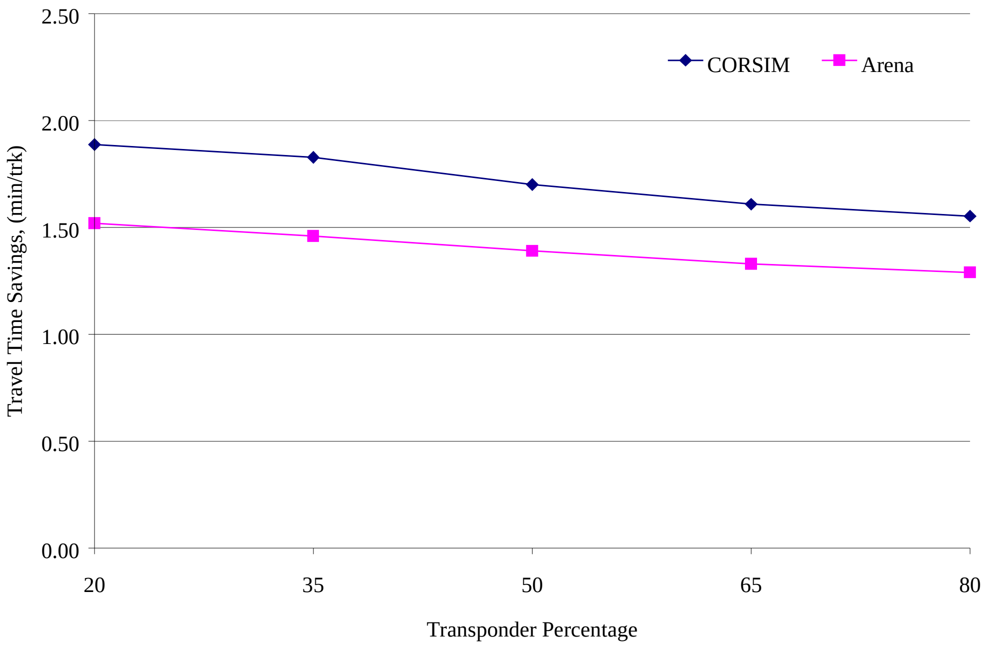


Figure 8. Verification of Fuel Consumption Calculation Procedure

3. OVERALL EVALUATION RESULTS

Electronic screening will reduce travel time and fuel consumption for both participating and, to a lesser degree, non-participating trucks. Electronic screening will also decrease the occurrence of unobserved bypasses resulting from full queues. The impact of electronic screening will be affected by several variables including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures.

To better understand the future impact of electronic screening, we used the simulation models to compare and contrast several combinations of truck volumes and transponder rates (percentage of trucks with transponders). Simulation runs were conducted for vehicle per hour (vph) rates of 340, 375, and 410. To put this in context, the data collection crew observed an average of 270 vehicles (trucks) per hour in May of 1997. The most recent traffic data available to the Oregon Department of Transportation's planning office indicate that truck traffic in the vicinity of Woodburn on the south bound lane of Interstate 5 is currently growing at an annual rate of 2.6 percent. Assuming that traffic growth rate remains constant, 340 vph would be realized in the year 2003, 375 vph in 2010, and 410 vph in 2013.

For each truck traffic volume scenario, simulation runs were made with transponder rates of 20 percent, 35 percent, 50 percent, and 65 percent. The simulation output is included in table format as Appendix Four.

3.1 DETAILED TEST #7, MEASURE 2.3.1 PREDICT TOTAL VEHICLES PROCESSED

Currently, all trucks that enter the Woodburn Port of Entry pass over a slow speed weigh-in-motion scale. Based on a predetermined weight threshold (i.e. 75 percent of the legal limit), trucks are automatically sorted and directed to, either continue along the bypass lane and return to the mainline, or proceed to one of the two static scales. The trucks that stop at the static scales can be visually checked for obvious safety problems. Commercial vehicle enforcement personnel can also identify the vehicle by plate number and check compliance and safety records.

With the slow speed ramp WIM, all entering trucks are at least screened for weight. By diverting a portion of the truck traffic away from the static scales, congestion within the Port of Entry is minimized. However, from an enforcement perspective, a static scale weighing is of greater value as it allows for weight, safety and regulatory compliance checks. With the exception of the visual inspection, mainline electronic screening is similar to the static scale or manual screening as it allows for weight, safety, and regulatory compliance checks. The simulation model was used to predict the percentage of overall truck traffic that would be either electronically screened on the mainline or stopped at the static scale (Figure 9).

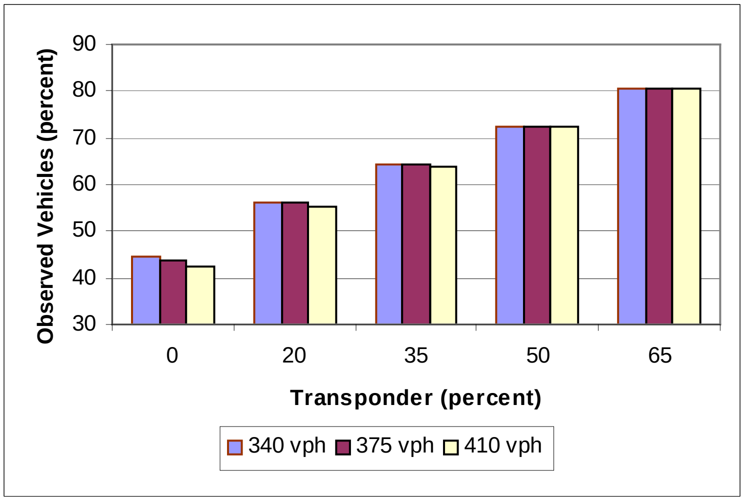


Figure 9: Percent of vehicles screened, manually and electronically

With a sufficient percentage of vehicles participating in Oregon's electronic screening program, the Woodburn Port of Entry will be able to process, (i.e. screen vehicles, both electronically and manually for safety, regulatory compliance, and weight) a substantially higher percentage of the truck traffic. By increasing capacity, electronic screening extends the design life of the facility.

3.2 DETAILED TEST #7 MEASURE 2.3.2 NUMBER AND LENGTH OF SERVICE INTERRUPTIONS (AS MEASURED IN UNOBSERVED BYPASSES)

As participation in the electronic screening program increases, the number of unobserved bypasses will decrease. Commercial vehicle enforcement personnel consider the elimination of unobserved bypasses as a major benefit of electronic screening. Because it is the objective of the Oregon Department of Transportation to screen all vehicles that pass by the Woodburn Port of Entry, a one percent unobserved bypass rate is not acceptable. As the following table illustrates, those unobserved bypasses that are the direct result of the weigh station operating beyond capacity will be eliminated with sufficient transponder rates.

Table 3 Unobserved bypasses

	340 Vehicles Per Hour	375 Vehicles Per Hour	410 Vehicles Per Hour
Unobserved Bypasses %			
@ 0% Transponder Rate	1	3	6
@ 20% Transponder Rate	0	0	2
@ 35% Transponder Rate	0	0	1
@ 50% Transponder Rate	0	0	0
@ 65% Transponder Rate	0	0	0

As with fuel consumption and travel time savings, the efficient design and operation of Woodburn minimizes the number of unobserved bypasses. One would expect a traditional weigh station, with a single static scale and without a ramp WIM bypass design, would experience a much higher percentage of unobserved bypasses in these traffic volume scenarios.

3.3 DETAILED TEST #7, MEASURE 2.4.1 PREDICT TRAVEL TIME SAVINGS PER VEHICLE

The bar chart in Figure 10 summarizes time savings for bypass vehicles in each scenario. For all scenarios, time savings for electronically screened vehicles fell within a range of 1.43 minutes at 410 vehicles per hour and a 20 percent transponder rate to 1.31 minutes at 410 vehicles per hour and a 65 percent transponder rate.

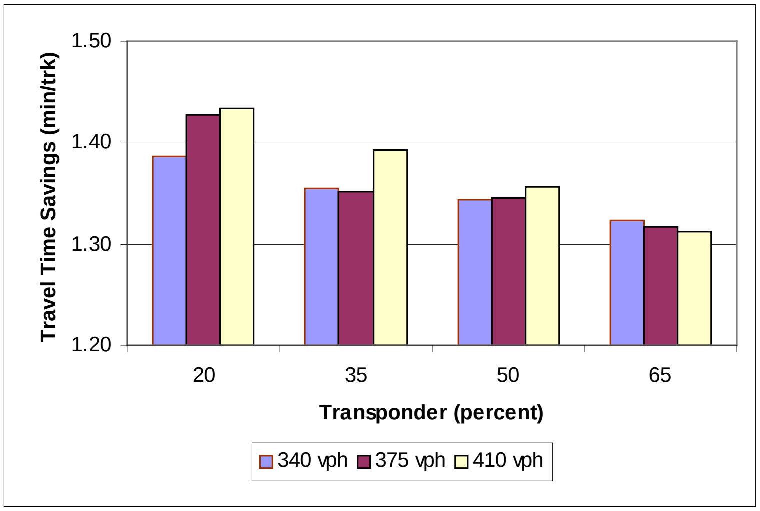


Figure 10: Time savings Realized by Electronically Screened Vehicles

Reduced travel time is an incentive for trucks to participate in an electronic screening program. There is no singularly accepted estimate for the value of time saved for commercial vehicles. If one accepts the estimate put forth by Waters, Wong, and Meagle (7), and adjusted for inflation using the consumer price index, the value of time saved in 1998 dollars is $34.00 per hour and the value of one pass for an electronically screened vehicle in the scenarios examined, would range from $.74 to $.81.

As more trucks participate in electronic screening, the overall efficiency of the weigh station increases. As a result, time and fuel consumption savings for participating trucks in comparison to non-participating trucks decreases. As more vehicles bypass the weigh station electronically, the queue and therefore the delay within the weigh station subsides. Combining the time-savings for the pull in and bypass vehicles, estimated travel time savings per hour are quite significant. Using the 340 vehicles per hour scenario as an example, the cumulative time savings for all trucks passing the weigh station within any given hour, ranges from 1 hour and 42 minutes with the transponder rate at 20 percent, to five hours and 23 minutes with the transponder rate at 65 percent.

3.4 DETAILED TEST #9, MEASURE 2.5.1 ESTIMATE CHANGES IN FUEL USE

The CORSIM simulation model is used to predict the fuel consumption at Woodburn. For the scenarios selected, the CORSIM weigh station model indicates that electronic screening systems reduce relative fuel consumption for the electronically screened vehicles.

The fuel consumption values drawn from the CORSIM simulation model were reported in relative terms. The relative fuel savings for the 12 scenarios that were simulated,are illustrated on the following graph.

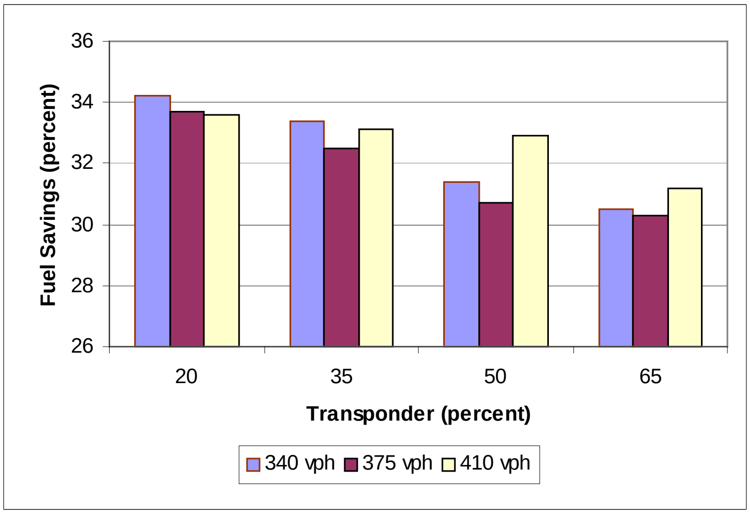


Figure 11: Relative Fuel Savings for Electronically Screened Vehicles

CORSIM fuel consumption rates are synthesized from passenger vehicle fuel tests. Therefore, the direct reporting of CORSIM's fuel consumption output was not recommended. Instead, the fuel consumption values drawn from the CORSIM simulation model were reported in relative terms. In the CORSIM model, the mainline and weigh station segments have common beginning and ending points, (.*See Figure 7*). The fuel savings are reported in terms of percentage of fuel saved by the vehicle passing along the mainline segment (electronically screened) with a the vehicle of equal dimensions passing along the weigh station segment. So, looking at Figure 11, the first bar in the chart represents the percent of fuel saved by a bypassing truck in a scenario in which there are 340 vehicles per hour and 20 percent of the vehicles are equipped with transponders.

To assess the value of electronic screening in terms of fuel savings at Woodburn, it is more helpful to convert savings back to volume of fuel. It was estimated that for a weigh station with attributes like Woodburn's, a truck passing through the weigh station segment will consume, on average, .one half gallon of fuel. The estimate is based on the motor carrier fuel consumption tests conducted as part of the evaluation of Advantage I-75 Mainline Automated Clearance System. The fuel test was based on guidelines set forth by the Society for Automotive Engineers.

For the scenarios examined, fuel savings per pass ranged from .1525 gallons (30..5 percent * .5 gallons) to .171 gallons (34.2 percent * .5 gallons) for electronically screened vehicles.

4. CONCLUSIONS AND RECOMMENDATIONS.

4.1 CONCLUSIONS

The simulation findings indicate that electronic screening will reduce travel time and fuel consumption for trucks participating in the electronic screening programs, or transponder equipped trucks. Findings also indicate that electronic screening will decrease the occurrence of unobserved bypasses resulting from full queues and increase the percentage of trucks being screened for safety and compliance. The effectiveness of electronic screening will be situational. Several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures will determine the degree to which the electronic screening program meets its objectives.

4.1.1 Recommendations- Continued Application of the Simulation Model

One of the advantages of the weigh station simulation model developed in Arena is that the Oregon Department of Transportation is not limited to the analysis of the scenarios selected for this report. The Oregon Department of Transportation (ODOT) staff was given user copies of the Woodburn model that can be run on any personal computer with the Windows 95 operating system. (see Appendix III, User's Manual). With the Arena Viewer, users are able to alter input parameters such as traffic level, transponder rate, and number and length of inspections, to perform "what if" scenarios. ODOT can also analyze the impact that changes in operational procedure and/or staffing levels would have on the functionality of the weigh station. For example, using the Arena model, ODOT could examine the impact of changing the threshold weight for the bypass lane or closing the ramp bypass lane entirely. If, for example, the Oregon Department of Transportation were to close the ramp bypass lane, electronically screened vehicles would realize greater time savings benefits relative to vehicles that were not participating in the program.

To demonstrate the impact of closing the bypass lane, we simulated a closed bypass ramp for the last scenario, 410 vehicles per hour and a 65 percent transponder rate. For this scenario, the average travel time savings for electronically screened vehicles was predicted to be 1.31 minutes per vehicle. With the ramp bypass lane closed, the average travel time savings is predicteded to increase to 2.0 minutes per vehicle.

In the scenario described above, closing the ramp bypass lane would also serve the objectives of ODOT’s motor vehicle enforcement objectives. At the time of data collection, the ramp bypass lane allowed vehicles weighing less than 75 percent of the legal limit to bypass the static scale and return to the mainline. By bringing all vehicles to a stop at the static scale, the Woodburn staff would have the opportunity to visually check all vehicles not participating in the electronic screening. The ramp bypass lane serves the purpose of reducing congestion within the weigh station and thus minimizing unobserved bypasses, while maintaining weight screening on all vehicles that enter the weigh station. With enough vehicles participating in the program, electronic screening will give ODOT more flexibility in setting operational procedures. The simulation model will assist ODOT in assessing the impact of proposed changes in procedures.

Although closing the ramp bypass lane would result in the most dramatic changes in travel time savings for participating vehicles and would allow for a visual check of all vehicles, it is more likely that operational procedures would change incrementally. The simulation package gives the end user the ability to vary the percentage of vehicles and determine the threshold weight that would bring the greatest number of vehicles to the static scale without resulting in unobserved bypasses.

For this evaluation of weigh station efficiency, the Arena Viewer software "packed" with the Woodburn model is considered a deliverable equal in and of itself. Not only does the simulation provide a robust medium for evaluation but the powerful animation capability makes it possible to demonstrate the functionality of the weigh station and the impact of electronic screening to a broader audience.

5. REFERENCES

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9. Center for Transportation Research and Education *Advantage I-75 Mainline Automated Clearance System: Final Evaluation Report.* August 1998

APPENDIX

Truck Bypass Form

Weigh Station Name:

Traffic Direction: (circle) North South

Observer Name:

Date:

Session Start Time: ________

Point One-Point Three Mainline Distance: ______________ (ft.)

Minute	Number of Truck Bypasses		Minute	Number of Truck Bypasses
0			30	
1			31	
2			32	
3			33	
4			34	
5			35	
6			36	
7			37	
8			38	
9			39	
10			40	
11			41	
12			42	
13			43	
14			44	
15			45	
16			46	
17			47	
18			48	
19			49	
20			50	
21			51	
22			52	
23			53	
24			54	
25			55	

26			56	
27			57	
28			58	
29			59	

Mainline Bypass Speed Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		
Observation Time	Bypass Speed (mph)		Observation Time	Bypass Speed (mph)

Vehicle Approach Speed Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		Obs. Point: 1 2 3
Observation Time	Approach Speed (mph)		Observation Time	Approach Speed (mph)

Vehicle Approach Speed Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		Obs. Point: 1 2 3
Observation Time	Approach Speed (mph)		Observation Time	Approach Speed (mph)

Static Scale Service Time Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		
Observation Time	Service Time (seconds)		Observation Time	Service Time (seconds)

Static Scale Service Time Form

Weigh Station Name:

Traffic Direction: (circle one) North South

Observer Name:

Date:

Observation Time	Service Time (seconds)		Observation Time	Service Time (seconds)

Vehicle Arrival/Identification Form Page One:

Weigh Station Name:

Traffic Direction: (circle one) North South

Observation Point: (circle one) 1 2 3 4

Date:

Session Start Time: ____________

Observer Name:

Recorder Name:

Weather Conditions:

Point _____ -Point _____ Distance: _____

Minute		Vehicle Identification and Arrival Time (Seconds)									
0	ID.										
	Secs.										
1	ID.										
	Secs.										
2	ID.										
	Secs.										
3	ID.										
	Secs.										
4	ID.										
	Secs.										
5	ID.										
	Secs.										
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12	ID.										
	Secs.										
13	ID.										
	Secs.										
14	ID.										
	Secs.										
15	ID.										
	Secs.										
16	ID.										
	Secs.										
17	ID.										
	Secs.										

Developing a traffic model for a weigh station was a new application of CORSIM. Through trial and error, we were finally successful at developing a weigh station model that enabled us to evaluate the impact of electronic screening in terms of fuel consumption savings at the Woodburn weigh station. We started modeling the Woodburn weigh station in the version 4.01 of CORSIM, and ended up completing the project with the latest version of CORSIM; version 4.2. The 4.2 version, of course, eliminated some of the problems with the earlier version. It, however, introduces a new minor problem. This section briefly describes some of our difficulties in modeling the Woodburn weigh station in CORSIM.

CORSIM 4.01 - Incompatible Fuel Tables

In our first attempt, we used FRESIM and NETSIM, the two components of CORSIM, to model the traffic operations at the Woodburn weigh station. The entire mainline section was modeled in FRESIM. The off-ramp, bypass lane, scale lanes, and on-ramp were modeled in NETSIM. Figure I.1 shows the model. FRESIM is shown in gray and NETSIM in black. The static scale delay was simulated by assigning pretimed traffic signals at the scales.

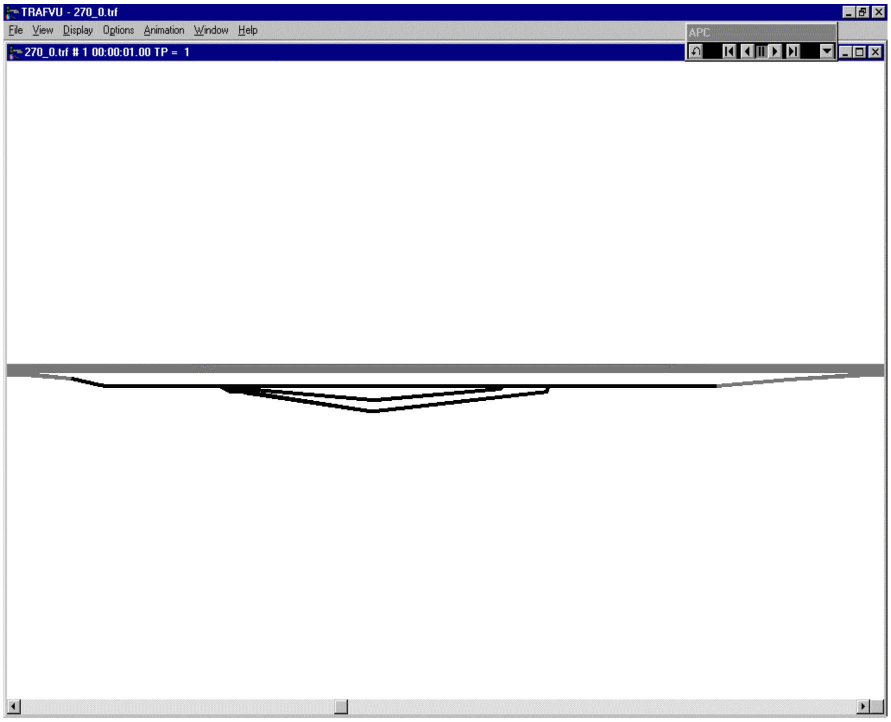

Figure I.1 Woodburn Weigh Station Model 1

In the 4.01 version of CORSIM, NETSIM and FRESIM obtain fuel consumption values from different acceleration tables. It was mentioned earlier in the report that fuel savings are obtained by comparing the fuel consumption results for the mainline segment with that of the weigh station segment, that is, comparing fuel consumption obtained from FRESIM and NETSIM. Therefore, incompatible source of parameters in CORSIM's acceleration table made it impossible to make any meaningful comparison.

The latest version of CORSIM (version 4.2) has been enhanced. Both FRESIM and NETSIM now use the same acceleration and environmental tables. This upgraded version of CORSIM enabled us to measure the fuel savings using this model design, shown in Figure I.1, to measure fuel savings at the Woodburn weigh station.

CORSIM 4.01 – Problems with Transition Nodes and Truck Classifications

Prior to obtaining the newly released version 4.2, we modeled the middle section of the mainline in NETSIM to eliminate the incompatibility problem of acceleration source data. The mainline sections prior to and following the weigh station were modeled in FRESIM. Figure I.2 shows the area modeled in NETSIM in black and the area modeled in FRESIM in gray. The static scale delay was simulated by assigning pretimed traffic signals at the scales.

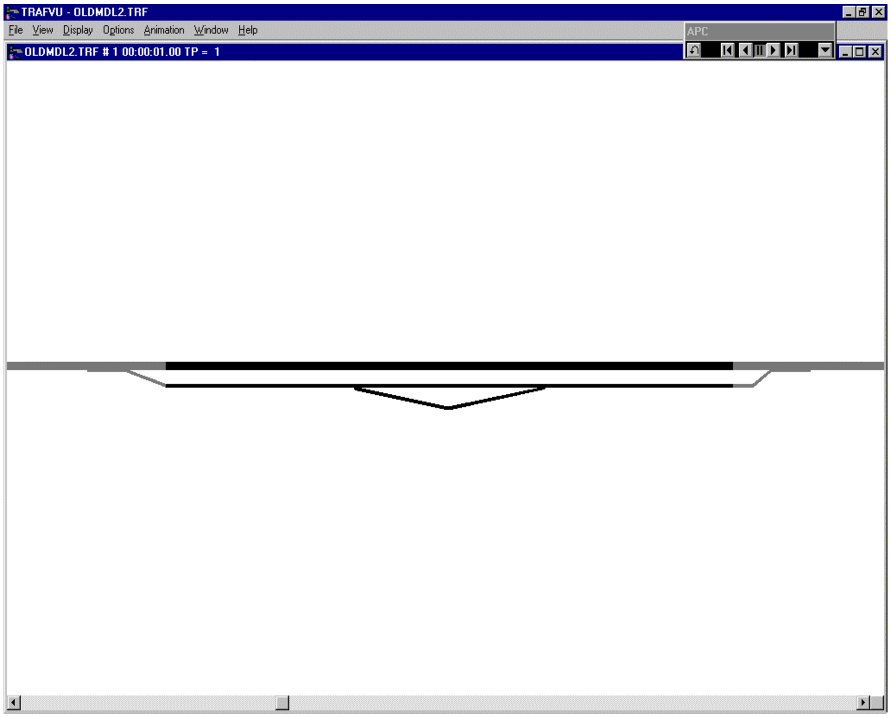

Figure I.2 Woodburn Weigh Station Model 2

This model solved the problem of incompatibility. However, we detected two new problems. FRESIM and NETSIM networks are connected by a node called transition. The transition nodes allow a seamless movement of vehicles between the two components of CORSIM. The first problem detected was that trucks began to disappear at the transition node located at the end of the off ramp. We first noticed that the queue was not extending beyond the transition node to the freeway off ramp. Trucks seemed to be stacking up on top of each other at this point. Obviously, this is contrary to existing conditions and does not accurately simulate the weigh station environment.

The second observed problem relates to CORSIM's inablity to keep the same truck classification in FRESIM and NETSIM. NETSIM models all truck as single unit trucks. The desired truck vehicle fleet generated in FRESIM is composed of medium loaded, heavy loaded, and double-bottom trucks. The trucks entering the weigh station appear as semi trailers. Once the trucks enter the NETSIM portion of the model these vehicles perform as single unit vehicles. The performance of the truck fleet is essential for the correct measurement of the fuel consumption at weigh stations, particularly, the acceleration from a stopped condition at the static scale to freeway speed. This is at which pull-in vehicles would be expected to use a considerably greater amount of fuel than bypass vehicles. Since the scale area was modeled in NETSIM, the performance measurements were inconsistent with the truck vehicle fleet (i.e., a single unit truck will not use as much fuel as a heavily loaded semi trailer to achieve freeway speed from a stopped condition). This problem has been corrected in the 4.2 version of CORSIM.

CORSIM 4.01 – Poor Visual Animation

The third model was built to mitigate the three stated problems. We built the entire network (mainline and weigh station) in FRESIM. The static scale delay was simulated by giving the scale the attributes of a ramp meter rather than an unsignalized intersection. As shown in Figure I.3, the discontinuity of the weigh station and mainline components presented a poor visual animation. The latest version of CORSIM was released while we were in process of improving the model design. Although the new version solved the current problem, it introduced a new, albeit minor, problem.

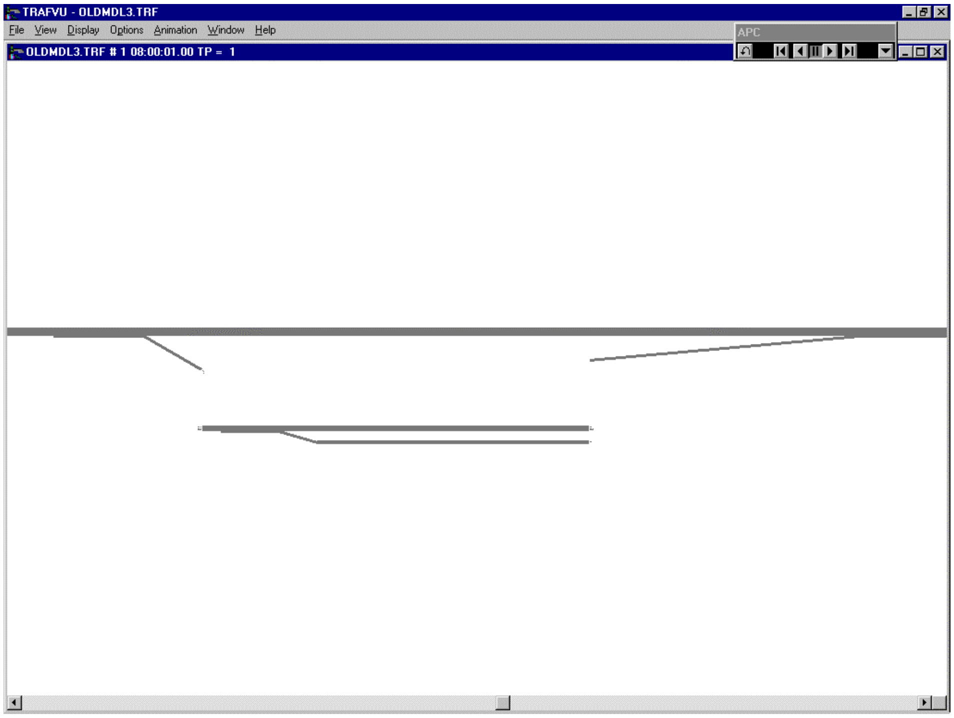

Figure I.3 Woodburn Weigh Station Model 3

CORSIM 4.2 – Inability to Change Seed Numbers

We used our basic design, shown in Figure I.1, to simulate the Woodburn weigh station in the new version of CORSIM. We discovered that the new verision of CORSIM was unable to change seed numbers. Instead, unable to recognize new seed numbers, CORSIM changed the user-assigned seed number back to it's default number. Being able to change the seed numbers in a multiple simulation run is essential for establishing confidence intervals for the obtained results. This incapability of the new CORSIM led us to use a longer simulation run period (10 hours) to at least achieve a more stable average result.

Woodburn Weigh Station Simulation Model

User's Manual

Center for Transportation Research and Education

Iowa State University

Ames, Iowa

October 1997

1. Introduction

As the evaluator of the Oregon Green Light deployment, the Center for Transportation Research and Education (CTRE) was given the task of quantifying the impact of electronic screening in terms of travel time and fuel consumption savings for motor carriers and enhanced efficiency of the weigh station. To conduct our evaluation, we developed simulation models that provide for visual animation of traffic operations approaching, through, and after a weigh station. The simulation provides a robust medium for evaluation as it can quantify the benefits of electronic screening under a variety of operating policy alternatives and display the operation of the system under each alternative using high fidelity animation. The animation allows a broad audience to better understand the analysis and the effect of electronic screening on weigh station throughput.

The simulation model consists of two modules, a weigh station and a mainline module. This user's manual describes the weigh station module which examines the number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses) and determines the travel time saved by allowing compliant trucks to be screened electronically at mainline speed. The mainline module will measure the reduction in fuel consumption resulting from an increase in the number of trucks equipped with transponders participation.

The weigh station simulation design is based on the existing geometry and functionality of a given weigh station, yet is flexible enough to accommodate the potential modifications of the weigh station policy and procedure. It allows a user to change the model's parameters to perform "what-if" analysis.

The weigh station module is specifically designed to simulate traffic operations in and around a weigh station facility. It simulates truck movement through a weigh station, the weighing of the trucks, and inspection. One of the most important parts of this module is the inclusion of the decision making logic that is associated with the electronic screening system's assignment of bypass or pull-in flags to the approaching trucks. Figure 1 presents an overview of the implemented electronic screening bypass and pull-in logic.

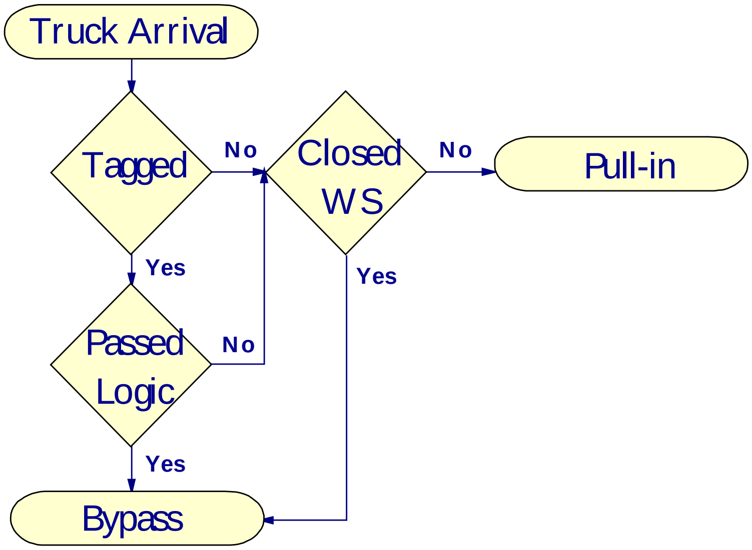

Figure 1. Electronic Screening System Bypass/Pull-in Logic

The simulation generates each entity (a truck) in the simulation and attributes the entity with vehicle characteristics. For example, if the user decides to test the implication of having 10 percent of the population of trucks equipped with transponders, the program randomly allocates transponders to 10 percent of the entities. Other attributes are assigned following a discrete or continuous probability function. These attributes could include such vehicle characteristics as classification, axle spacing, and axle weights. When electronic screening is deployed in a network or a corridor of weigh stations, the simulation also has the ability to take into account information regarding the vehicle which was written to the transponder during prior interrogation.

The decision making engine is triggered when a transponder-equipped truck passes the Advanced Vehicle Identificatin (AVI) reader site, located on the mainline. The transponder data (prior information written to the transponder) as well as weigh-in-motion (WIM) data (e.g., axle weights and spacing), which initially were assigned to each truck, are recorded by the roadside reader. If a truck successfully satisfies all the conditions stated in the logic, it is awarded a bypass flag. If not, it must enter the upcoming weigh station (pull-in). All trucks that are not assigned a transponder must also enter the weigh station.

The allowable weight criteria and the bridge formula are the two main components of the decision making processor. Given a truck's axle weights and spacing information from the WIM, these components determine the truck's compliance with weight regulations.

The logic used by the simulation has been verified and the results of the simulation have been validated by comparing the travel time collected in the field to those generated by the simulation without the availability of electronic screening.

The weigh station simulation module is a microscopic, stochastic model with a powerful animation capability. The simulation module is built in Arena[1] simulation language. The "Pack and Go" feature of Arena enables the end-users to view the model's animation and outputs using Arena Viewer software. The Arena Viewer software, runs the "packed" model on any personal computer running Windows 95.

No prior computer programming skill is required to use this simulation model. This manual intends to assist users to run the simulated models with a minimal amount of effort. Inquiries and suggestions may be forwarded to:

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kmb@iastate.edu

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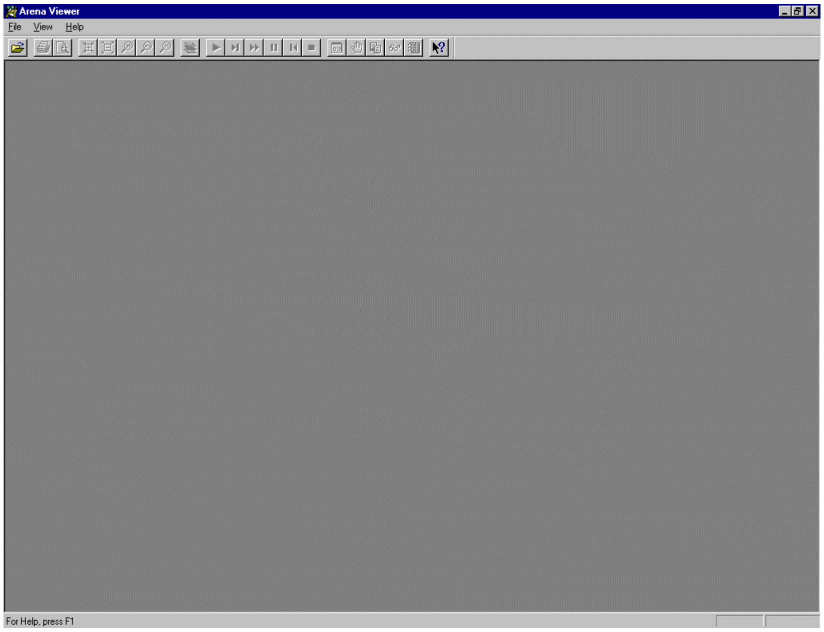
[1] Systems Modeling Corporation, *Arena User's Guide*. Sewickley, PA, 1996.

2. Installation

Arena Viewer software runs the weigh station simulation module on the Windows 95 platform. Arena Viewer is provided in eight diskettes. Insert Disk 1 into the disk drive a: and, using the Windows *Start/Run* command, run the a:/setup program. Follow the instructions on the screen.

To run Arena Viewer, select the Windows' *Start/Programs/Arena Viewer* menu command. Figure 2 shows the first screen after the Arena Viewer is open. This is the basic Arena Viewer window which consists of a menu bar and the toolbars at the top and a status bar along the bottom. The icons, included in toolbars, are the shortcuts of the main menu commands. Placing the mouse cursor over an icon highlights its function. The status bar provides a brief description of the specific function currently being performed.



For Help, press F1

Figure 2. Arena Viewer Basic Window and Toolbars

3. Getting Started

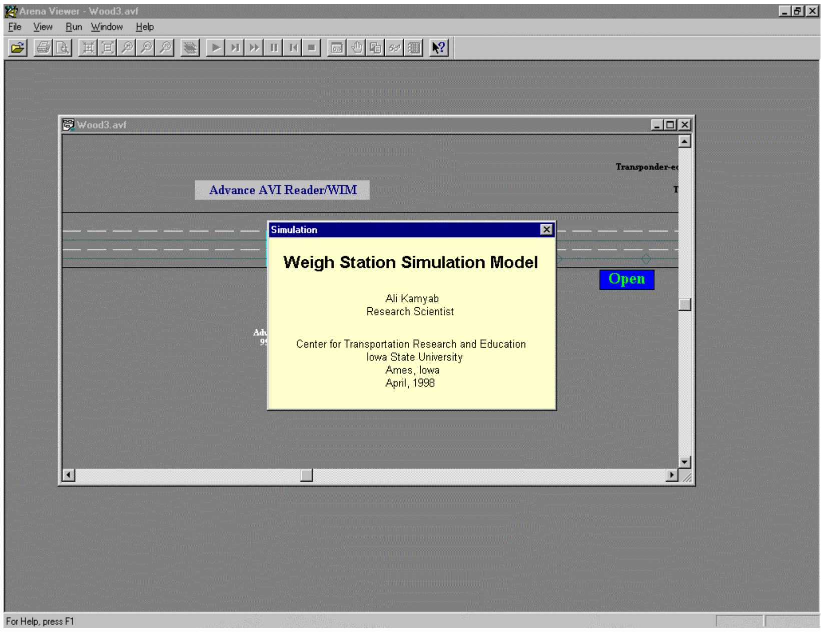
The weigh station simulation module consists of two files: an *avf* file containing animation portion of the model and the program (*p*) file containing data. These two files together (saved in the same folder) enable the Arena Viewer to animate the model and calculate the output results.

To run the simulation model the following step should be taken:

1. Click on *File/Open* from Arena Viewer's main menu (or use the Open toolbar button).
2. Double-click on the folder containing the two simulation files.
3. Select *Woodburn.avf*.
4. Click the Open button.

Figure 3 shows the first screen after the model opens. The simulation title page will close after a few seconds.

5. Explode (maximize) the opened simulation window.
6. Press the shortcut key "a" (will be explained in Table 3) to zoom the Advance AVI/WIM Reader site in the opened window.
7. Click the Go button on the Run toolbar to start the simulation run.



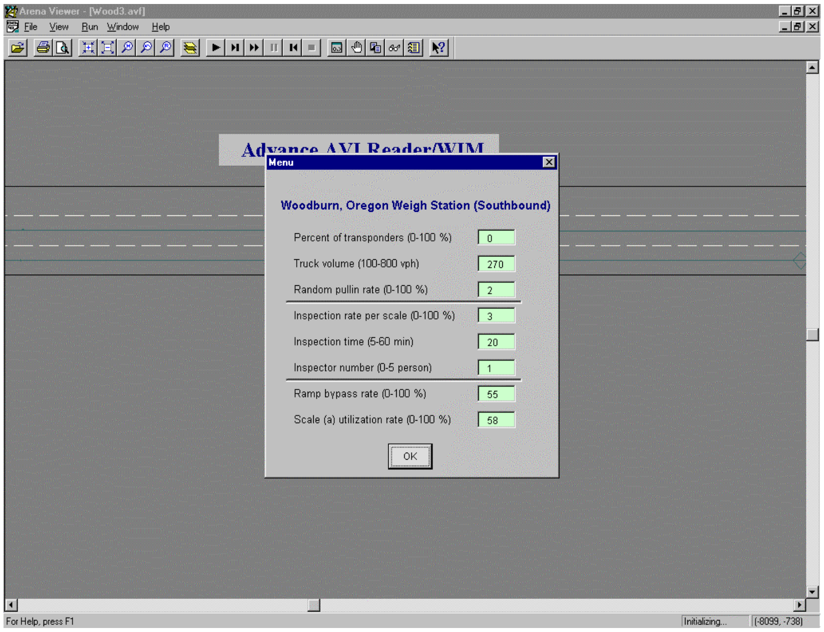
Weigh Station Simulation Model

Ali Kamyab
Research Scientist

Center for Transportation Research and Education
Iowa State University
Ames, Iowa
April, 1998

Figure 3. Simulation Title Page

As soon as the Go button is clicked, the users are presented with a menu, shown in Figure 4. This menu allows users to change the default values of the model's parameters, within the specified limits, before starting a run. Click the OK button to start the simulation run or change any of the parameters before clicking the OK button to run a new scenario.



Woodburn, Oregon Weigh Station (Southbound)

Percent of transponders (0-100 %) 0
Truck volume (100-800 vph) 270
Random pullin rate (0-100 %) 2
Inspection rate per scale (0-100 %) 3
Inspection time (5-60 min) 20
Inspector number (0-5 person) 1
Ramp bypass rate (0-100 %) 55
Scale (a) utilization rate (0-100 %) 58

Figure 4. Simulation Model Menu

The status of each simulated truck is represented by its assigned color in the model. For example, a blue colored truck indicates that it carries a transponder. As it passes the AVI/WIM roadside reader, its color changes to green or red indicating a bypass or pull-in flag assignment. A complete list of the assigned colors is included in Table 1.

Table 1. Colors of Animated Trucks

Color	Assignment
White	Non transponder-equipped truck
Blue	Transponder-equipped truck
Green	Bypass truck
Red	Pull-in truck

Tables 2 and 3 include shortcut keys which can be used while the simulation model is running. The shortcut keys, listed in Table 2, can be used to interrupt the simulation run or change the animation speed. For example, in order to interrupt the model execution before the end of the simulation press the Esc key, or click the Pause button on the Run toolbar. To resume the simulation, click the Go button again.

Table 2. Arena Viewer Shortcut Keys

Key	Function
Esc	Interrupt or pause the simulation
+ or -	Zoom in or out from the current view
Arrow keys	Pan from the current view
<	Slow down the animation
>	Speed up the animation

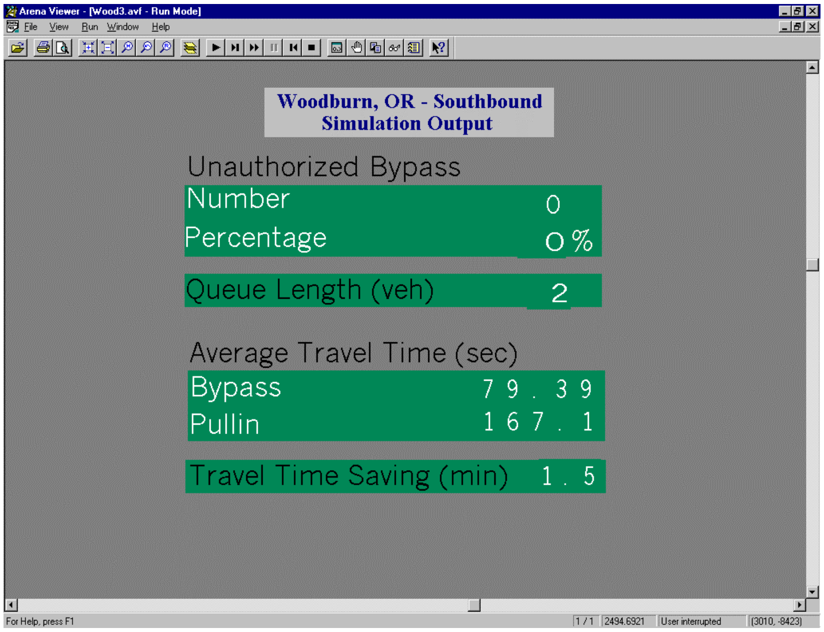
The keys included in Table 3 are specific to the weigh station module. These keys automatically zoom and pan to a specific view. Note that these keys are case sensitive.

Table 3. Weigh Station Simulation Module Shortcut Keys

Key	View
A	Advance AVI/WIM
F	Weigh station off-ramp
W	Inside weigh station
N	Weigh station on-ramp
B	Model overview
O	Results summary
P	Input parameters

When the model run is complete, a dialog appears asking whether a user would like to view the results. Click No to close the dialog box since this data is unlikely to be of much use in the presented form. A likely more useful summary of the results can be viewed by pressing the shortcut key "o" at any time during or after the simulation run, before exiting the Run mode. Figure 5 shows a summary of the results during a simulation run. Click the End button on the Run toolbar to exit the Run mode.

The average CPU time for a two-hour run is about eight minutes on a Pentium computer. The running time can, however, be reduced to three minutes by disengaging the model's animation. This can be done by clicking the Fast-Forward button on the Run toolbar, instead of the Go button, and minimizing the Viewer window.



```
Woodburn, OR - Southbound
Simulation Output

Unauthorized Bypass
Number                          0
Percentage                      0 %

Queue Length (veh)              2

Average Travel Time (sec)
Bypass                     7 9 . 3 9
Pullin                     1 6 7 . 1

Travel Time Saving (min)       1 . 5
```

Figure 5. Simulation Sample Output

The weigh station simulation model is capable of assessing the impact of electronic screening at weigh stations. One of the advantages of this model is its ability to simulate hypothetical scenarios. Part of the electronic screening evaluation goal is to extrapolate the obtained results into the future. Thus performance measures (i.e., delay, unobserved bypasses, trucks checked, etc.) can be projected into the future, illustrating the implications of growth in truck traffic or transponder usage.

4. Additional Model Enhancements

With additional programming, the weigh station simulation module can be enhanced to provide additional options and information to the users. Enhancements could potentially assist users in the planning, design and operation of weight stations. The new output screens can be customized to include the following information.

a. Truck travel time by type between designated points
b. Truck count by type at selected locations
c. Scale utilization rate
d. Inspection utilization rate
e. Truck count by inspection levels
f. Inspected truck count
g. Non-inspected truck count due to lack of parking space and/or inspectors
h. Total closing time due to queue overflow
i. Overweight truck count due to closed weigh station

Enhancement of the model would result in more parameters for the users to set before running the simulation. For example, users would be able to modify the inspection level rates and their associated times. The current version of the Woodburn model includes an option for users to change the number of inspectors to examine the feasibility of the input inspection rate and inspection time. This option could become more meaningful in an enhanced version when the functionality of inspection area is defined more clearly.

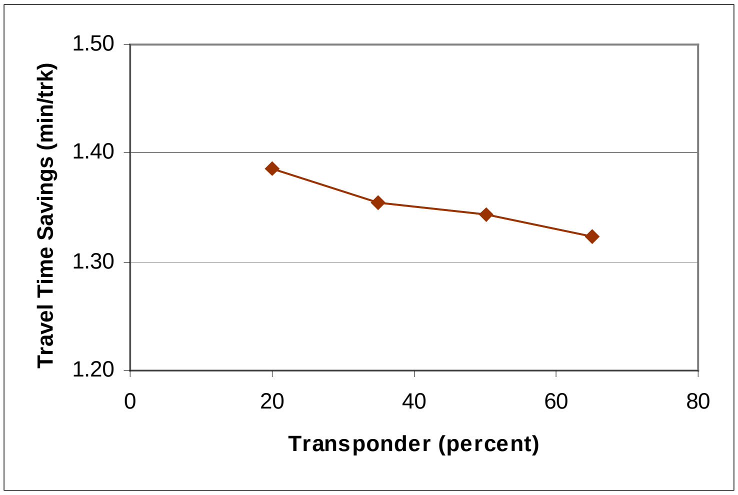
Appendix Four: Simulation Output

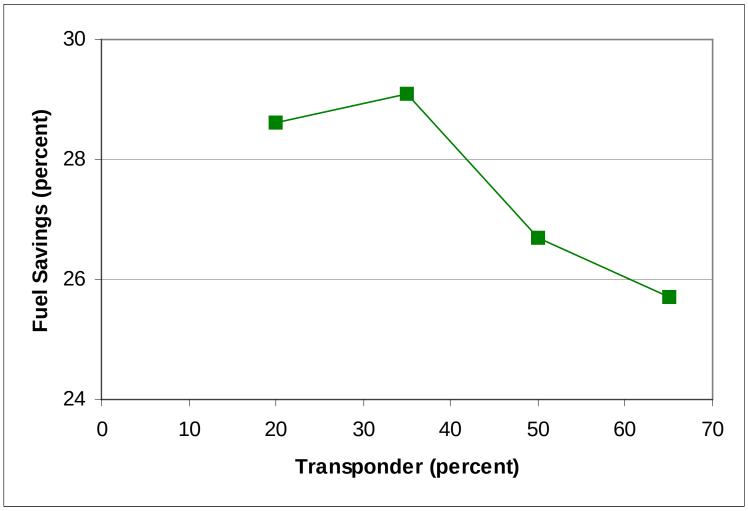
340 Vehicles per Hour-

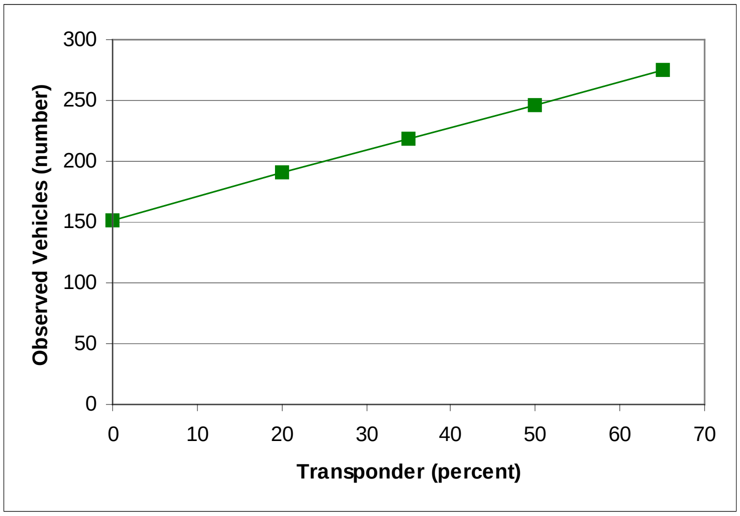
Transponder Rate	Pullin (seconds/truck)	Bypass (seconds/truck)	Travel Time Savings (min/trk)
20%	162.7	79.5	1.39
35%	160.7	79.4	1.36
50%	160.0	79.4	1.34
65%	158.8	79.4	1.32

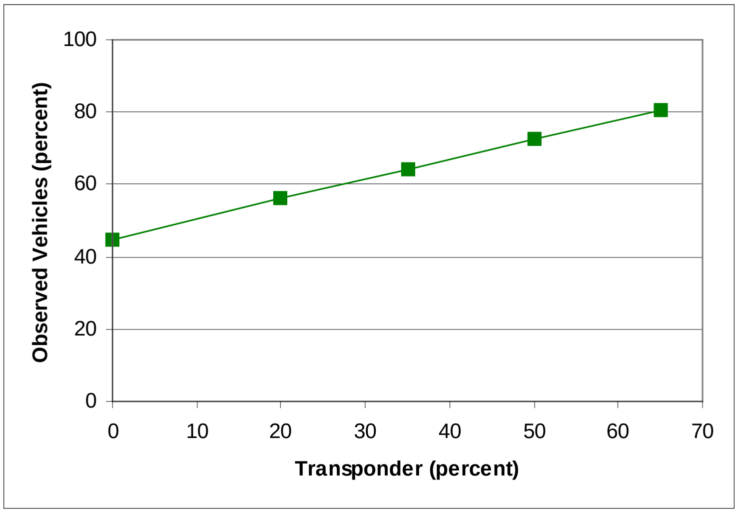
Transponder Rate	Fuel Savings-Mainline Segment v. Weigh Station Segment	Unobserved Bypasses
0%		1
20%	28.6%	0
30%	29.1%	0
50%	26.7%	0
65%	25.7%	0

Transponder Rate	Screened Vehicles- Electronically Screened + Static Scale	
	Number	As Percent of Overall Truck Traffic
0%	151	45%
20%	190	56%
30%	218	64%
50%	247	73%
65%	275	81%


Travel Time Savings (min/trk)
1.50
1.40
1.30
1.20
0
20
40
60
80
Transponder (percent)


Fuel Savings (percent)
30
28
26
24
0
10
20
30
40
50
60
70
Transponder (percent)


Observed Vehicles (number)
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
Transponder (percent)

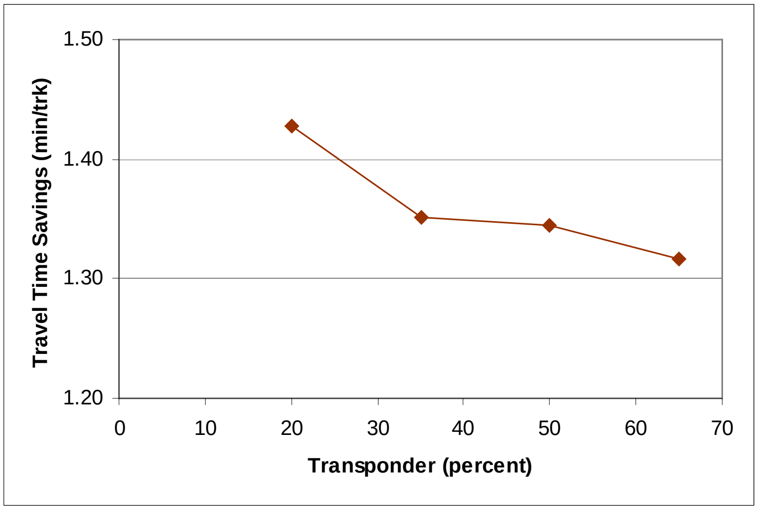

Observed Vehicles (percent)
100
80
60
40
20
0
0
10
20
30
40
50
60
70
Transponder (percent)

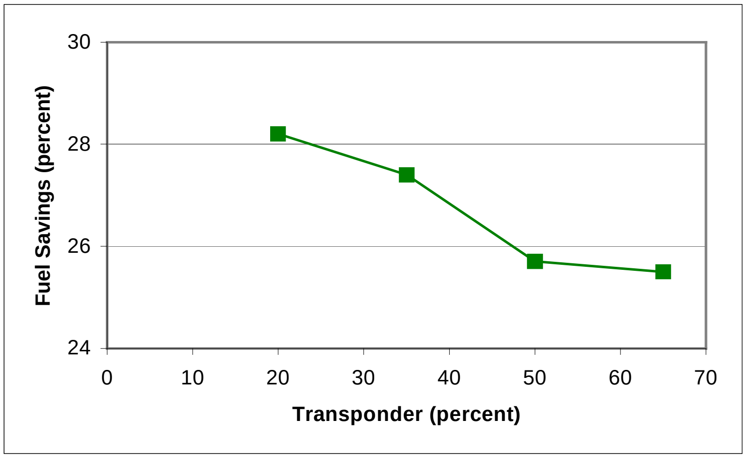
375 Vehicles per Hour-

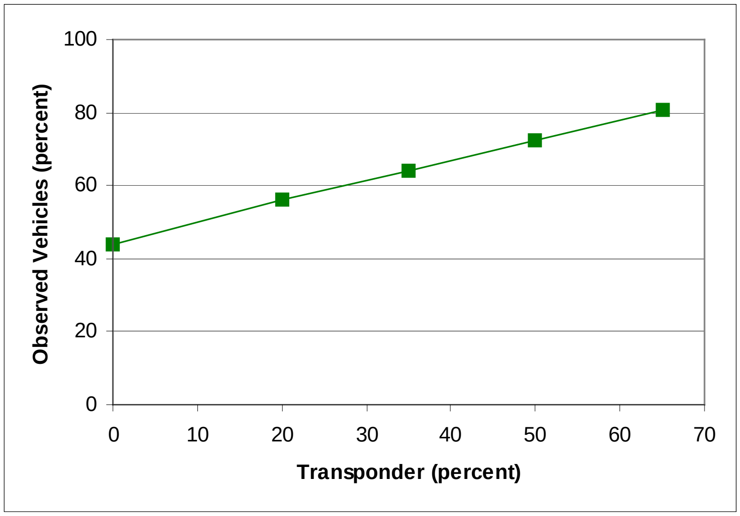
Transponder Rate	Pullin (seconds/truck)	Bypass (seconds/truck)	Travel Time Savings (min/trk)
20%	165.0	79.4	1.43
35%	160.5	79.4	1.35
50%	160.1	79.4	1.34
65%	158.4	79.4	1.32

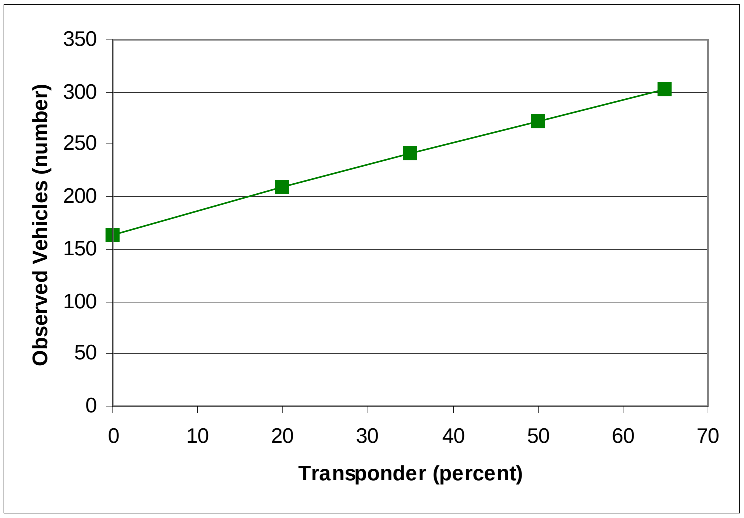
Transponder Rate	Fuel Savings-Mainline Segment v. Weigh Station Segment	Unobserved Bypasses
0%		3
20%	28.2	0
30%	27.4	0
50%	25.7	0
65%	25.5	0

Transponder Rate	Screened Vehicles- Electronically Screened + Static Scale	
	Number	As Percent of Overall Truck Traffic
0%	164	44%
20%	210	56%
30%	241	64%
50%	272	73%
65%	303	81%


1.50
1.40
1.30
1.20
Travel Time Savings (min/trk)
0
10
20
30
40
50
60
70
Transponder (percent)


30
28
26
24
Fuel Savings (percent)
0
10
20
30
40
50
60
70
Transponder (percent)


100
80
60
40
20
0
Observed Vehicles (percent)
0
10
20
30
40
50
60
70
Transponder (percent)

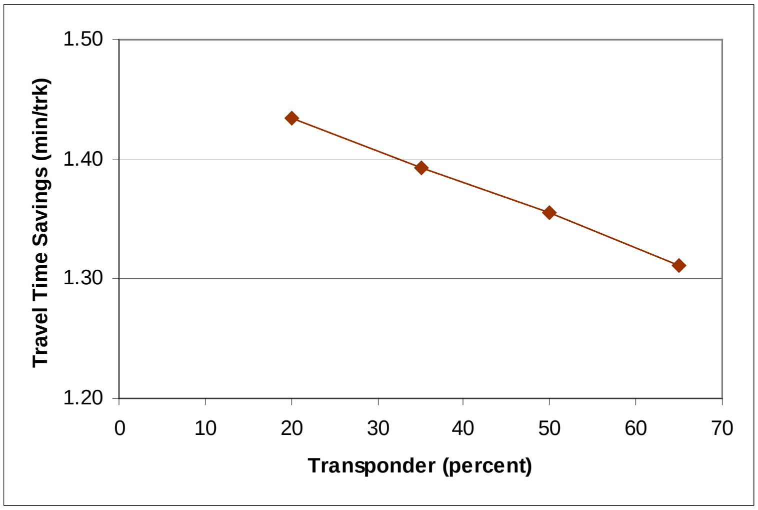


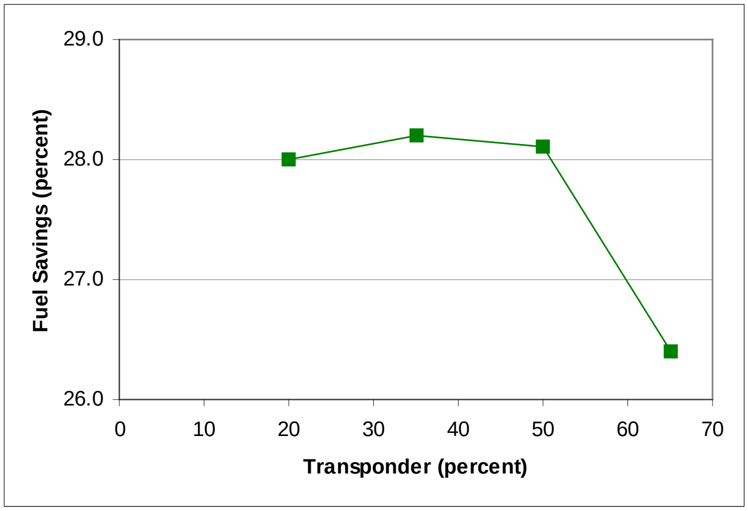
410 Vehicles per Hour-

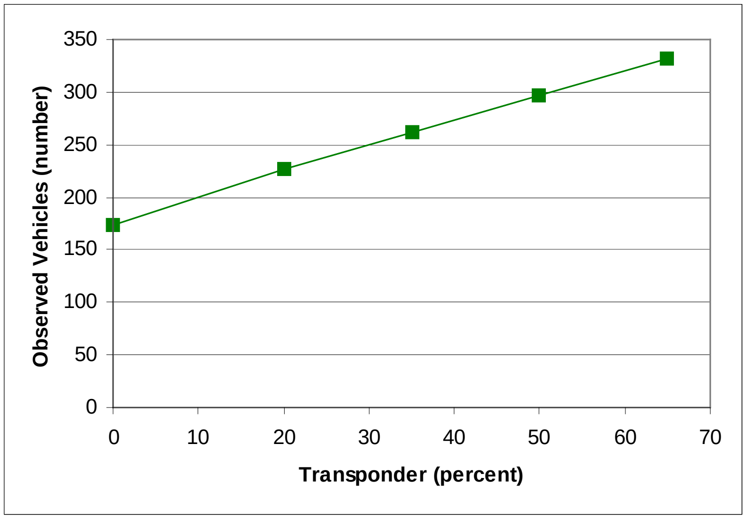
Transponder Rate	Pullin (seconds/truck)	Bypass (seconds/truck)	Travel Time Savings (min/trk)
20%	165.6	79.6	1.43
35%	163.2	79.6	1.39
50%	161.0	79.6	1.36
65%	158.2	79.5	1.31

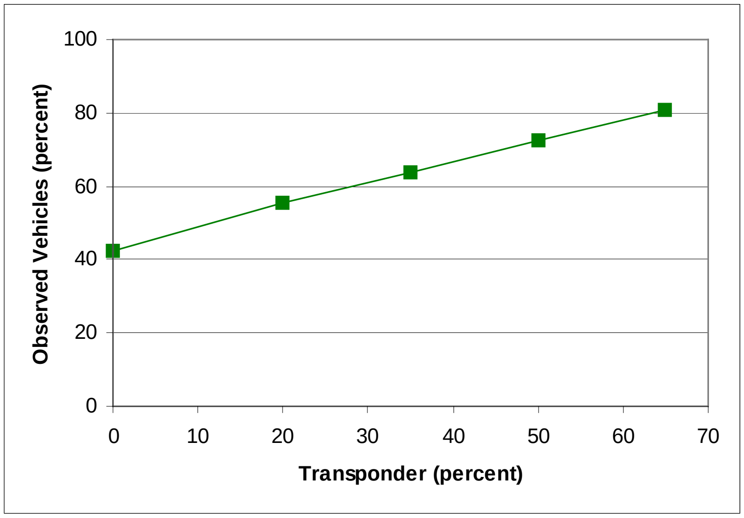
Transponder Rate	Fuel Savings-Mainline Segment v. Weigh Station Segment	Unobserved Bypasses
0%		6
20%	28.0%	2
30%	28.2%	1
50%	28.1%	0
65%	26.4%	0

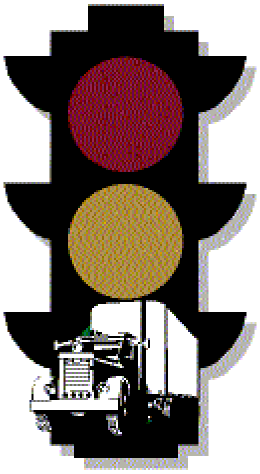
Transponder Rate	Screened Vehicles- Electronically Screened + Static Scale	
	Number	As Percent of Overall Truck Traffic
0%	173	42%
20%	227	55%
30%	262	64%
50%	297	73%
65%	331	81%




29.0
28.0
27.0
26.0
Fuel Savings (percent)
0
10
20
30
40
50
60
70
Transponder (percent)


350
300
250
200
150
100
50
0
Observed Vehicles (number)
0
10
20
30
40
50
60
70
Transponder (percent)


100
80
60
40
20
0
Observed Vehicles (percent)
0
10
20
30
40
50
60
70
Transponder (percent)



Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLAN 8

System Availability

Bill McCall

Center for Transportation Research and Education

Iowa State University

Ames, IA 50010

Conducted by sub-contract for Oregon State University
Transportation Research Institute
Transportation Research Report No. 00-017

June 2000

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

TABLE OF CONTENTS

1 INTRODUCTION

This result of conducting Detailed Test Plan 8 provides an assessment of the system's availability to both the motor carrier and the weighmasters for an established time period. The Green Light System is very complex and extensive. Exhibit 1-1, Functional Architecture for Oregon Green Light, illustrates the architecture of mainline electronic screening including national interoperability. The architecture has been updated to reflect minor changes. The availability of the system to motor carriers and weighmasters is dependent on each of the databases and connecting links functioning correctly. System availability to motor carriers and weighmasters begins with the roadside subsystem. Exhibit 1-2, Roadside Subsystem Architecture, illustrates this subsystem. The roadside architecture has been updated to include minor changes. System availability to motor carriers and weighmasters depends on each of the elements within the subsystem and connecting links functioning correctly.

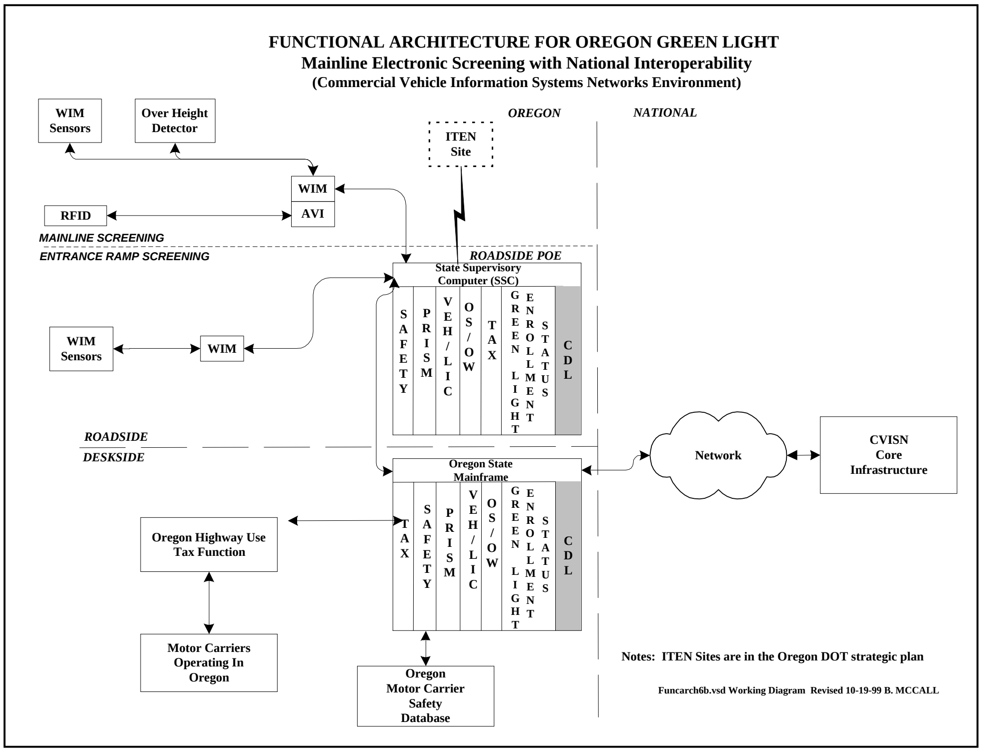


Exhibit 1-1, Functional Architecture for Oregon Green Light

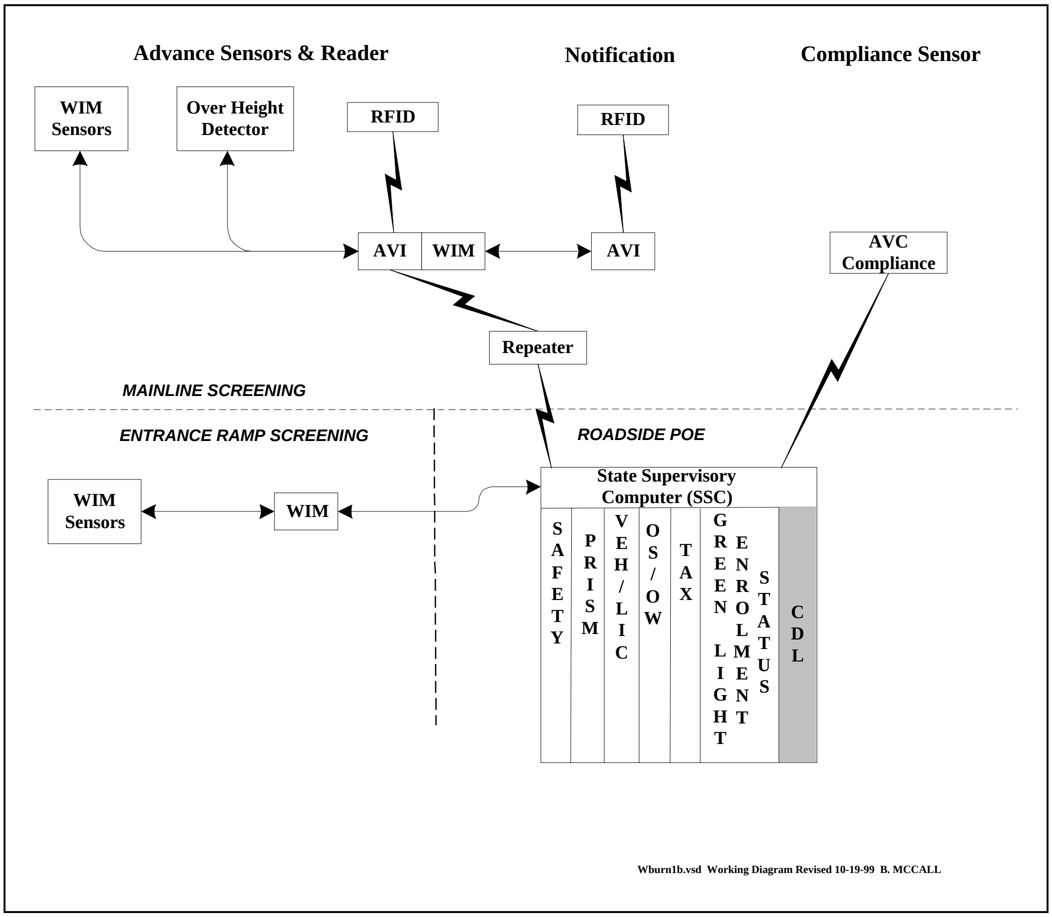


Exhibit 1-2, Roadside Architecture

The scope of this evaluation will include the observation and quantification of “trouble” reports reported motor carriers, the Oregon Department of Transportation (ODOT), and the system integrator, International Road Dynamics (IRD). ODOT assumed the role of transponder administrator in March 2000. The transponder administrator role includes distributing and maintaining the Dedicated Short Range Communications (DSRC) tags.

In addition, ODOT conducts first level failure analysis, First level failure analysis includes checking the physical condition of the tag and battery condition. If the first level failure analysis does not identify the cause of failure, the tag is returned to the manufacture for failure analysis and repair or replacement. IRD is responsible for maintenance of the roadside subsystem for the duration of the operational test.

2 SCOPE

This evaluation will document statewide electronic screening system availability in terms of the percent of time that the roadside system (Automated Vehicle Identification, Weigh in Motion Scale, Automated Vehicle Classification, the connection to state supervisory computer system, and headquarters databases) is available to the weighmasters, and; the percent of distributed transponders functioning for motor carriers as intended. Therefore, the availability of electronic screening to motor carriers and weighmasters is the sum of the time that the transponder is functional and the time that roadside system is functional. In addition to the quantitative analysis, CTRE will also attempt to document the causes for electronic screening system failure and the corrective action taken.

For the second part of this evaluation, the research team will focus on system availability for a specific subgroup of carriers, long combination vehicles (LCV), at a single weigh station. CTRE will track the experience of these long combination vehicles at the Farewell Bend POE, site 2, located on Interstate 84 near the Idaho border. See Exhibit 5-1 for the location of the Farewell Bend POE. The Multi-Jurisdiction Automated Preclearance System (MAPS) that included the states of Idaho, Oregon, Utah, and Washington became a part of NORPASS. Oregon has resigned from NORPASS. However, Oregon continues to work with the states of Idaho and Utah to provide preclearance to LCV's.

The long combination vehicle operators are of interest for two primary reasons. First, long combination vehicles are exceptional in that they do not fit within the State's size restrictions. Their automated exception status will provide a test of the flexibility of the preclearance system. This systems evaluation will allow participants to begin to measure effectiveness of Green Light program.

3 MEASURES OF EFFECTIVENESS AND HYPOTHESIS

The evaluation measures used to make an assessment of the Green Light system are stated below:

- **Observe Overall System Availability to Weighmasters and Motor Carriers**
- **Observe System Availability to Long Combination Vehicles at Farewell Bend Weigh Station.**

The following hypothesis is given in support of the two measures and will be tested according to accepted statistical techniques should it be necessary to utilize them:

- **The overall system availability will be approximately 95%.**
- **The system availability for long combination vehicles at Farewell Bend will be approximately 95%.**

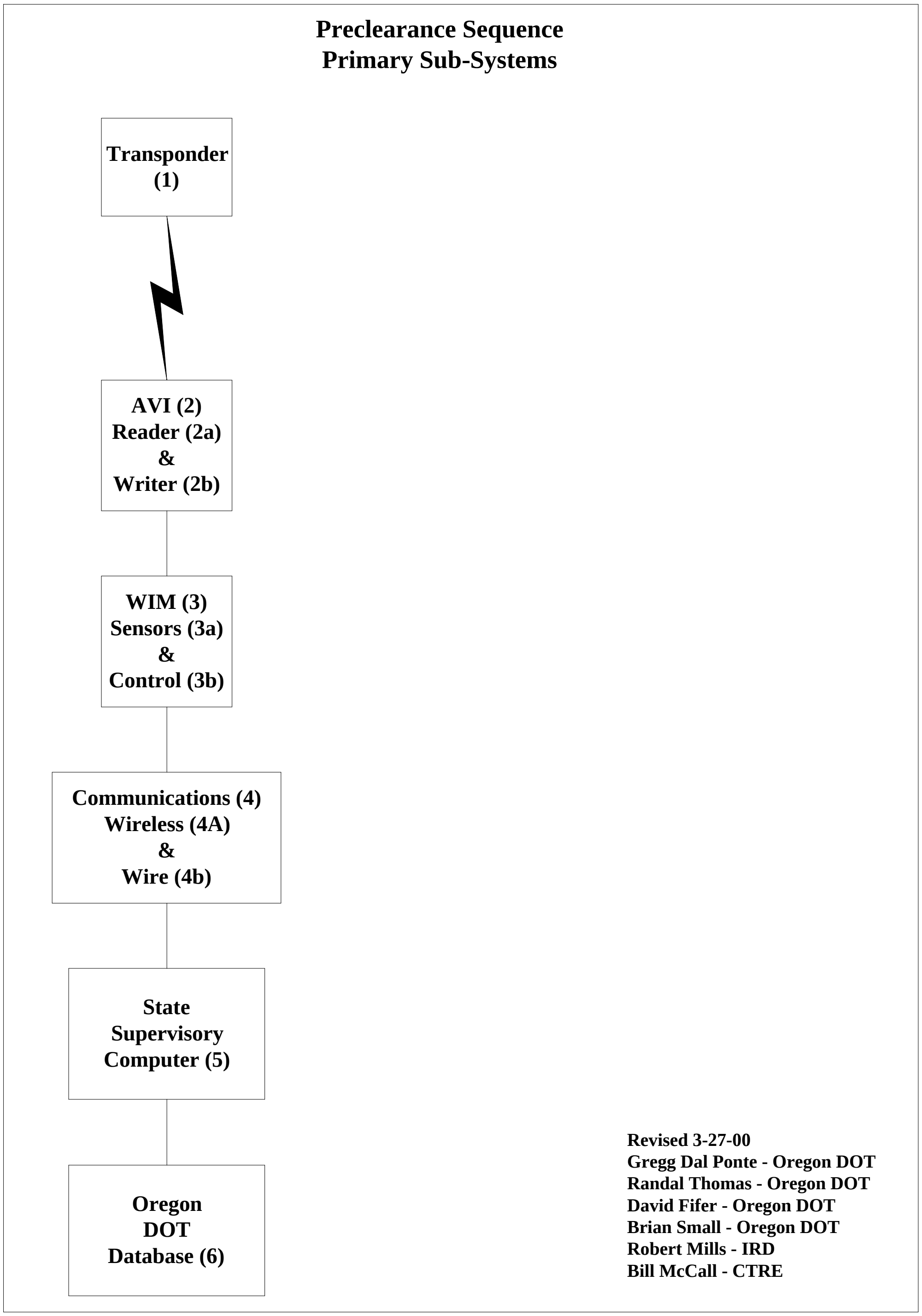
4 DATA SOURCES AND AVAILABILITY

The evaluation was organized according to preclearance sequence primary trouble categories. The evaluation is based on the ODOT, motor carriers, and IRD following trouble reporting communication channels and service requests and corrective actions processes. The results are recorded in the trouble report master log. The following paragraphs will provide discussion on each of the elements.

The preclearance system is divided into the sub-systems shown in Exhibit 4-1, Preclearance Sequence Sub-Systems. This evaluation includes the transponder, automated vehicle identification (AVI) and weigh-in-motion (WIM) sub-systems. The communications, state supervisory computer, and ODOT databases are grouped.

Service requests follow the structure shown in Exhibit 4-2, Service Request Communication Structure. Exhibit 4-2 includes the relationship among the elements in the structure. For example, the relationship between motor carriers and the ITS Specialist – ODOT is a service relationship.

Solutions to service requests follow the structure shown in Exhibit 4-3, Solutions to Service Requests Communications Structure. The ITS Specialist communicates the solution to the Motor Carrier, System Integrator, and Field Offices Motor Carrier Enforcement Officer (MCEO) and registration function depending on the problem identified in the service request. For example, the solution to service request submitted by the MCEO involving a Motor Carrier will be reported to the MCEO, Motor Carrier, and System Integrator. The driver failing to receive and in cab notification is an example.



Preclearance Sequence
Primary Sub-Systems

Revised 3-27-00
Gregg Dal Ponte - Oregon DOT
Randal Thomas - Oregon DOT
David Fifer - Oregon DOT
Brian Small - Oregon DOT
Robert Mills - IRD
Bill McCall - CTRE

Exhibit 4-1, Preclearance Sequence Primary Sub-Systems

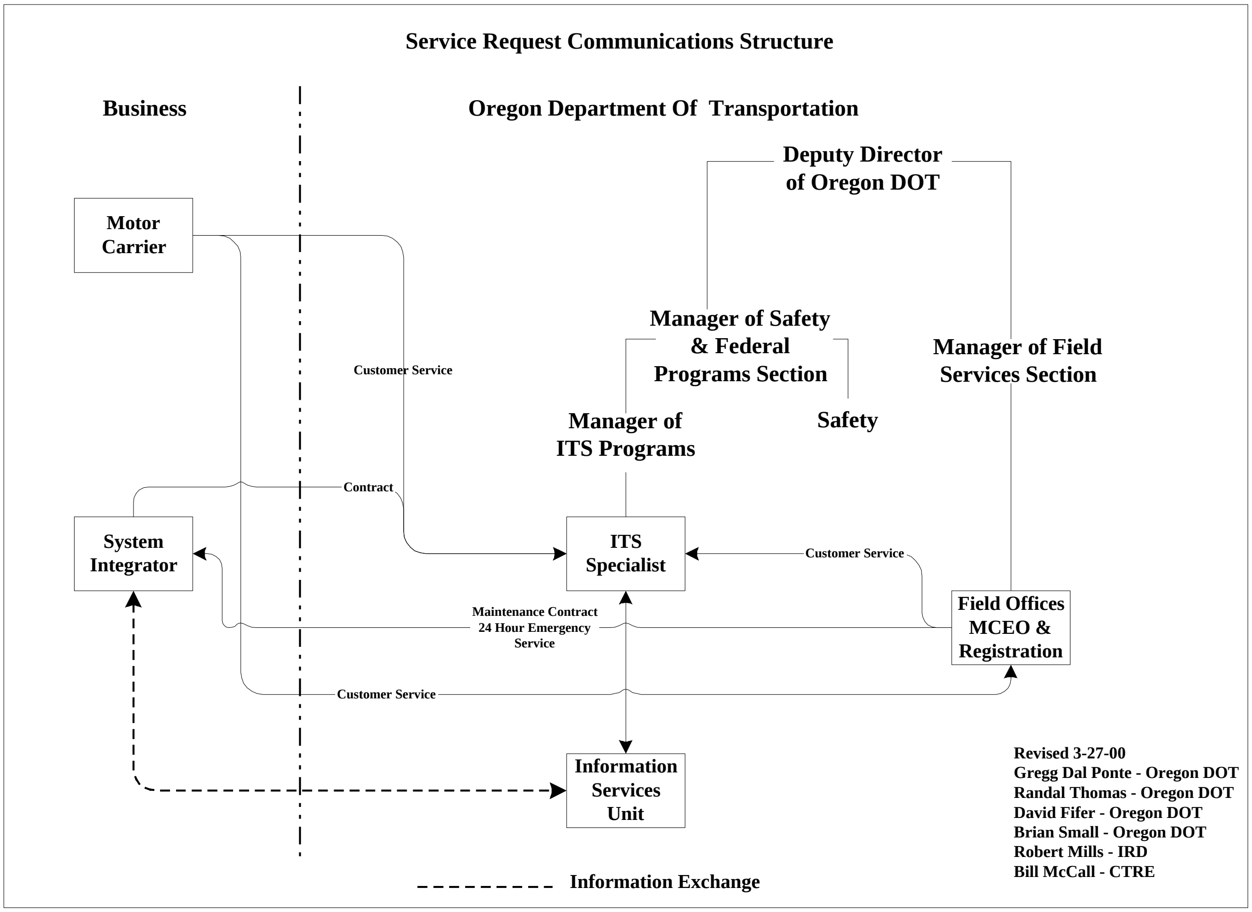


Exhibit 4-2, Service Request Communication Structure

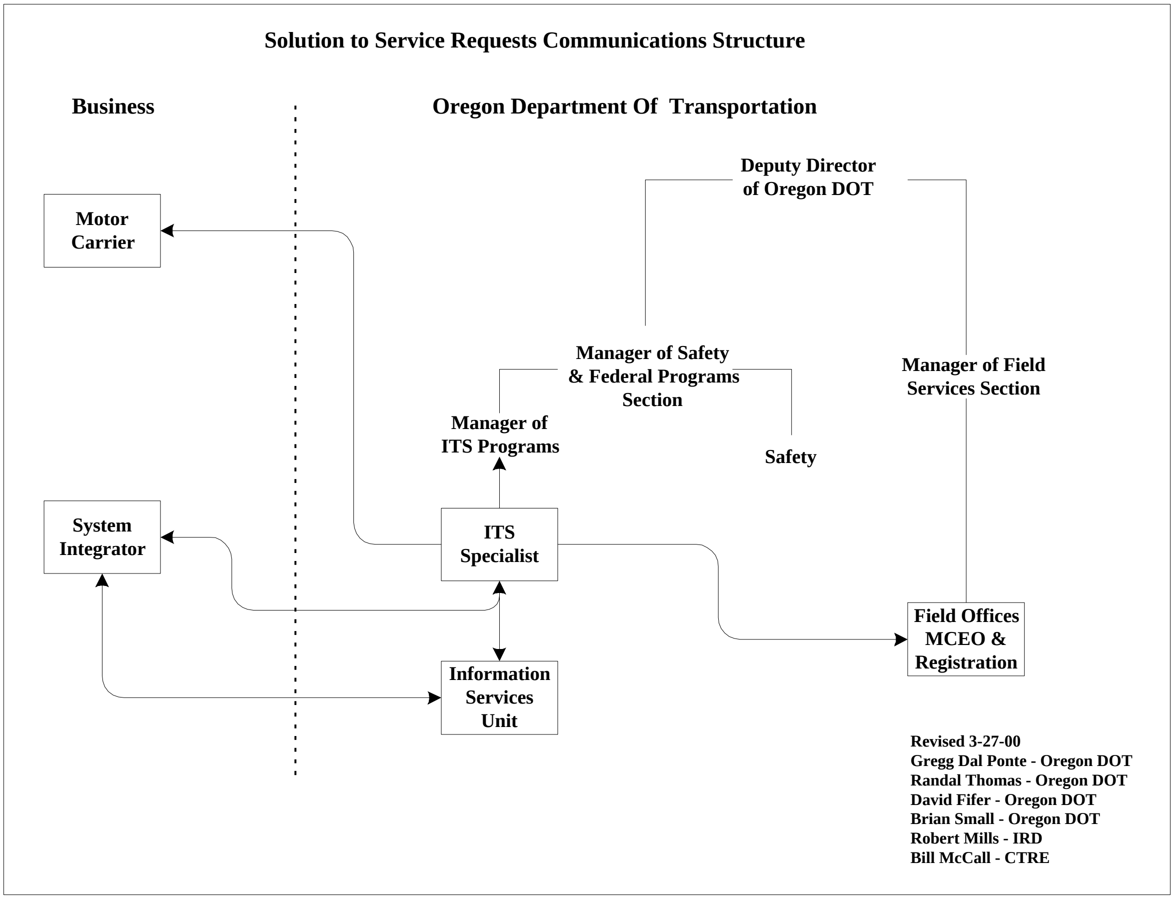


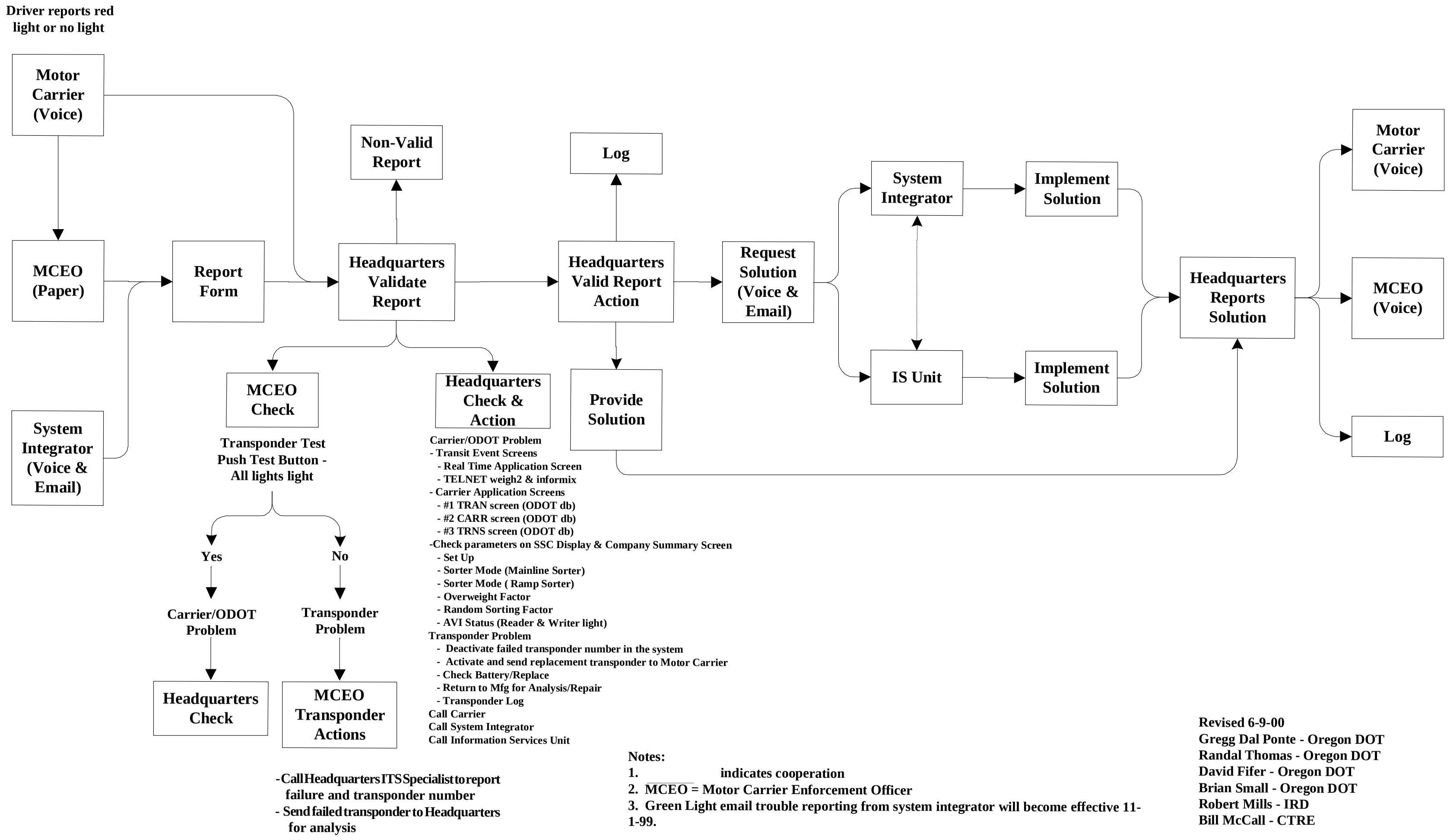
Exhibit 4-3, Solution to Service Requests Communications Structure

The request for service and corrective action follows the process flow shown in Exhibit 4-4, Service Request and Corrective Action Process Flow. Examples of records listed in cases when the Motor Carrier Enforcement Officer (MCEO) replaces a transponder and in cases when the Headquarters Check is conducted are in Appendix A.

The request for service and corrective action requires a log be maintained. An example of the log is shown in Exhibit 4-5, Trouble Report Master Log. The current log is in Appendix B. A list of the error codes used in the Log is in Appendix C.

Exhibit 4-4, Service Request and Corrective Action Process Flow

Service Request & Corrective Action Process Flow



Notes:
1. ________ indicates cooperation
2. MCEO = Motor Carrier Enforcement Officer
3. Green Light email trouble reporting from system integrator will become effective 11-1-99.

Revised 6-9-00
Gregg Dal Ponte - Oregon DOT
Randal Thomas - Oregon DOT
David Fifer - Oregon DOT
Brian Small - Oregon DOT
Robert Mills - IRD
Bill McCall - CTRE

Green Light Administration

Trouble Report Master Log (Accepted Sites)

Report # codes: Ashland S.B. (SBA); Ashland POE (ASH); Booth Ranch (BOO); Brightwood E.B. (EBB); Brightwood W.B. (WBB); Cascade Locks POE (CCL); Emigrant Hill (EMH); Farewell Bend POE (FAB); Juniper Butte N.B. (NBJ); Juniper Butte S.B. (SBJ); Klamath Falls POE (KFA); Klamath Falls S.B. (SBK); LaGrande (EBL); Lowell (LOW); Olds Ferry (OFY); Rocky Point (ROK); Umatilla (UMA); Wilbur (WIL); Woodburn N.B. (NBW); Woodburn POE (WOO); Wyeth (WBW)

Pending - On-going problem, solution still in progress

Report #	Report Type	Report Description	Reported By	Report Date	Solution Date	Down Time (hours)	Received By	Notes/Resolution
WOO 1	Ramp	Sorter not working properly - when set to credential weight, it only sends trucks > 80K. It should be set at 60K.	MCEO	10/25/99	10/25/99	2	ITS Specialist	IRD remotely adjusted parameters of the sorter software
ASH 1	AVI	Motor Carrier received a red light, however the system indicated "WBLOWM," a bypass code	MCEO	11/2/99	11/2/99	0	ITS Specialist	ITS Specialist reviewed the carrier history, and determined that this was an isolated event.
ASH 2	AVI	Motor did not receive an in cab signal	MCEO	11/4/99	11/4/99	0	ITS Specialist	ITS Specialist reviewed the event history for this truck and found that it was at the Woodburn N.B. Weigh Station during the time of the report, NOT at Ashland.

Exhibit 4-5, Example Trouble Report Log

5 PRECLEARANCE SYSTEM LOCATION ACCEPTANCE AND TRANSPONDERS ISSUED

Table 5-1, Site Acceptance and Availability Log provides a list of all the location preclearance will be deployed, the date sites were accepted as operational, and accepted site availability. LaGrande, Ashland SB, and Olds Ferry are open about 34 to 40 hours per week. To calculate hours since acceptance, 37 hours per week is used. All other accepted sites are open 24 hours per day seven days a week. Exhibit 5-1, Green Light Preclearance Sites shows the location of sites.

The number of transponders issued by March 1, 2000 was 4800. 800 motor carriers were participating in Green Light as of March 1, 2000. The number of transponders issued as of April 13, 2000 is 10100. 922 motor carriers are participating in Green Light as of April 13, 2000.

GREEN LIGHT PROGRAM

Site Acceptance and Availability Log

SITE NUMBER	SITE NAME	ACCEPTANCE DATE	HOURS SINCE ACCEPTANCE	DOWN TIME HOURS	HOURS OF AVAILABILITY	% AVAILABILITY
4	Ashland N.B. (POE)	8/1/99	6216	56	6160	99%
5	Ashland S.B.	8/1/99	1628	0	1628	100%
11	Booth Ranch					
20	Brightwood E.B.					
19	Brightwood W.B.					
17	Cascade Locks (POE)					
8	Emigrant Hill					
2	Farewell Bend (POE)	11/1/99	4008	3	4005	100%
12	Juniper Butte N.B.					
13	Juniper Butte S.B.					
14	Klamath Falls N.B. (POE)					
15	Klamath Falls S.B.					
7	LaGrande	10/1/99	1190	72	1118	94%
16	Lowell					
3	Olds Ferry	8/1/99	1628	0	1628	100%
21	Rocky Point					
6	Umatilla (POE)	10/1/99	4752	24	4728	99%
10	Wilbur					
9	Woodburn N.B.					
1	Woodburn S.B. (POE)	2/1/99	10560	153	10407	99%
18	Wyeth					

Table 5-1, Sites Acceptance and Availability Log

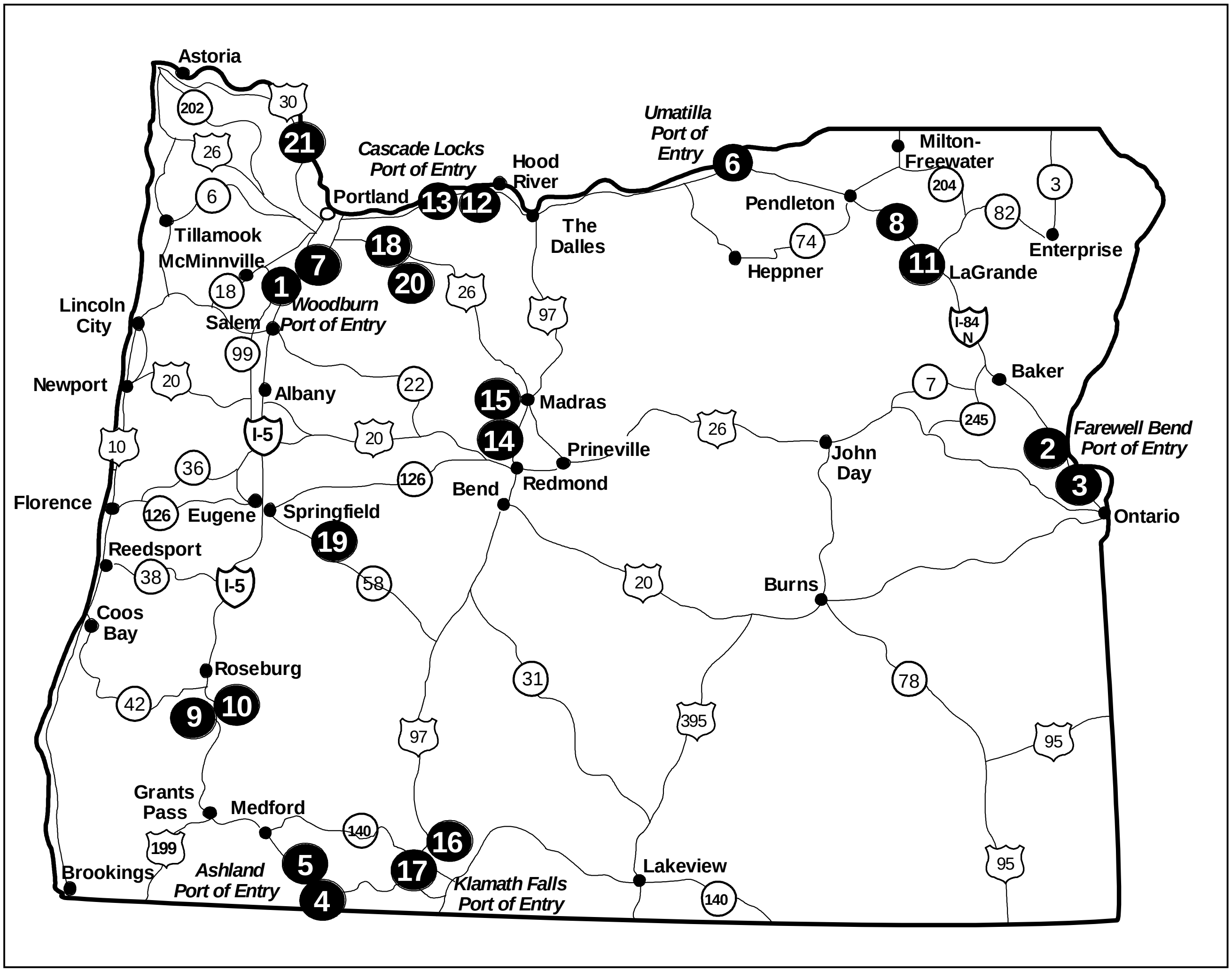


Exhibit 5-1, Green Light Preclearance Sites

6 DATA ANALYSIS

This section will include an assessment of the transponder availability and roadside system availability. The basic data collection sources are the Trouble Report Master Log. Trouble reports and corrective action reports prepared as a deliverable by the Transponder Administrator, the system integrator, International Road Dynamics, and ODOT and recorded in the Trouble Report Master Log. An example is shown in Exhibit 4-5. The Log includes the Report Number, Report Type, Report Description, Reported By, Report Date, Solution Date, Down Time, Received By, and Notes/Resolution. Down Time is defined as an event that interferes with the preclearance process. For example, a driver not receiving the correct in-cab notification or a motor carrier enforcement officer not receiving data enabling the officer to support the preclearance process.

The evaluation was designed to take place for a two-year period after the roadside systems were accepted. However, the deployment of the Green Light preclearance was delayed. Therefore, evaluation cannot be completed as planned. However, based on the data collected for the seven sites that are operational at the writing of this report the following evaluation of the project can be made.

6.1 ASSESSMENT OF TRANSPONDER AVAILABILITY

The transponder availability was to be determined by subtracting downtime from total hours in the two-year period (17520 hours) and then dividing by total hours. A summary of overall transponder availability was to be made by aggregating individual transponder availability. Based on the limited data available observations will be made regarding transponder availability.

6.2 ASSESSMENT OF ROADSIDE SUBSYSTEM AVAILABILITY

The roadside system availability was to be determined by subtracting downtime from total hours in the two-year period (17520 hours) and then dividing by total hours. A summary of overall roadside system availability was to be made by aggregating individual system availability. The roadside system availability is determined by subtracting downtime from total number of hours the site was available following site acceptance. The availability of all roadside sub-systems is determined by aggregating individual roadside subsystem availability. Based on the limited data available observations will be made regarding roadside system availability

6.3 ASSESS TOTAL SYSTEM AVAILABILITY FOR LONG COMBINATION VEHICLES AT FAREWELL BEND

The roadside system availability at Farewell Bend for long combination vehicles was to be determined by subtracting downtime from total hours in the two-year period (17520 hours) and then dividing by total hours. A summary of overall roadside system availability was to be made by aggregating individual system availability. The roadside system availability is determined by subtracting downtime from total number of hours the site was available following site acceptance. Exhibit 6-1, Farewell Bend LCV Log presents the data available regarding LCV activity at Farewell Bend. Based on the limited data available observations will be made regarding roadside system availability at Farewell Bend. System availability data will be extracted from the overall system availability data, using the LCV unit tag numbers.

Farewell Bend LCV Log						
Date	Total LCV approaching FB (FAB)	Transponder Equipped	Enrolled in Green Light	Green Light Bypass	Green Light Report	Report Reason Code
April 30 thru May 6, 2000	328	81	46	32	14	HELP, Inc transponder

Exhibit 6-1, Farewell Bend LCV Log

7 RESULTS

The evaluation measures used to make an assessment of the Green Light system are stated below:

- **Observe Overall System Availability to Weighmasters and Motor Carriers**
- **Observe System Availability to Long Combination Vehicles at Farewell Bend Weigh Station.**

The following hypothesis is given in support of the two measures. It is not possible conduct a statistical valid analysis because the data is not available for the full two-year test period.

- **The overall system availability will be approximately 95%.**
- **The system availability for long combination vehicles at Farewell Bend will be approximately 95%.**

Table 5-1, Site Acceptance and Availability Log contains data supporting the observations.

Regarding the hypothesis that overall system availability will be approximately 95%, the observation can be made that based on a limited number of sites (7) being available for less than two years the overall system availability may be approximately 99%.

Total hours since acceptance = 29982
Total down time hours = 309
Total hours of availability = 29673

Regarding the hypothesis that the system availability for long combination vehicles at Farewell Bend will be approximately 95%, the observation can be made that based on the site being available for a relatively short time the system availability may be approximately 100**%**.

8 CONCLUSIONS

Although the seven sites currently in operation have not been functioning for two years, the trend certainly indicates the system will be available at least 95% of the time.

APPENDIX A

Examples of screens and databases

supporting the Service Request and Corrective Action Process

Real Time Application Screen

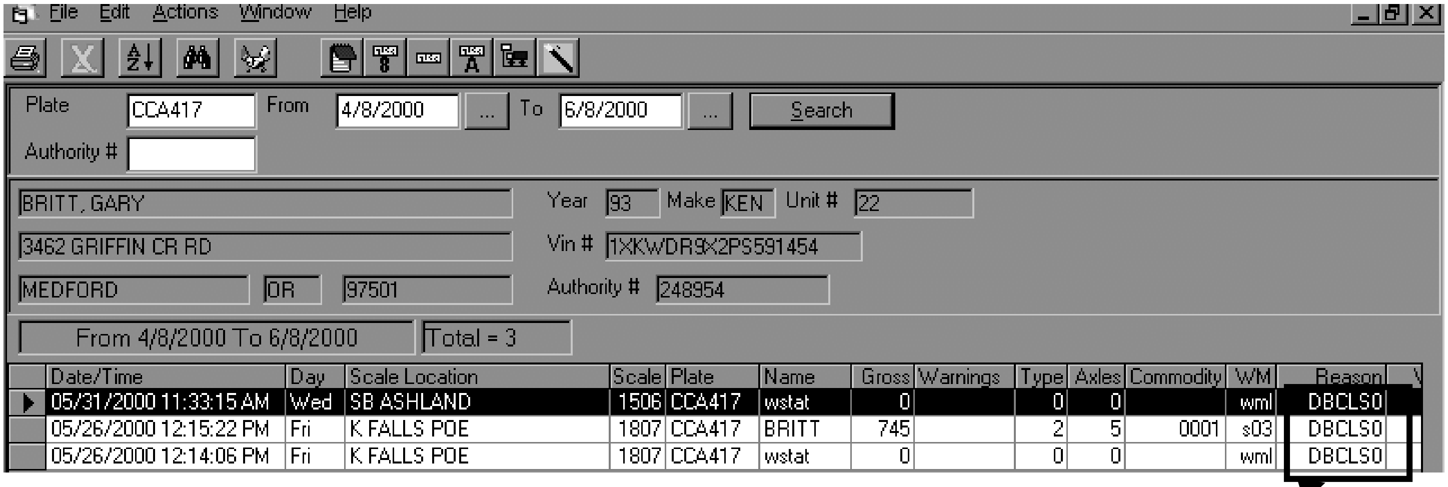


Plate CCA417
From 4/8/2000
To 6/8/2000
Authority #

BRITT, GARY
3462 GRIFFIN CR RD
MEDFORD OR 97501

Year 93
Make KEN
Unit # 22
Vin # 1XKWDR9X2PS591454
Authority # 248954

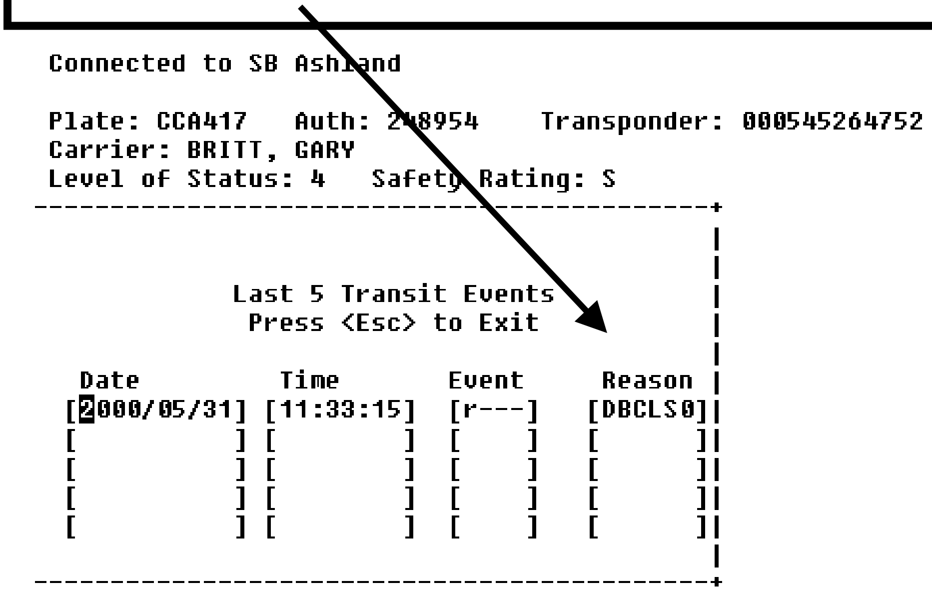
From 4/8/2000 To 6/8/2000
Total = 3

Date/Time	Day	Scale Location	Scale	Plate	Name	Gross	Warnings	Type	Axles	Commodity	WM	Reason
05/31/2000 11:33:15 AM	Wed	SB ASHLAND	1506	CCA417	wstat	0		0	0		wml	DBCLS0
05/26/2000 12:15:22 PM	Fri	K FALLS POE	1807	CCA417	BRITT	745		2	5	0001	s03	DBCLS0
05/26/2000 12:14:06 PM	Fri	K FALLS POE	1807	CCA417	wstat	0		0	0		wml	DBCLS0

Verifies red light signals at multiple sites. Note the reason code

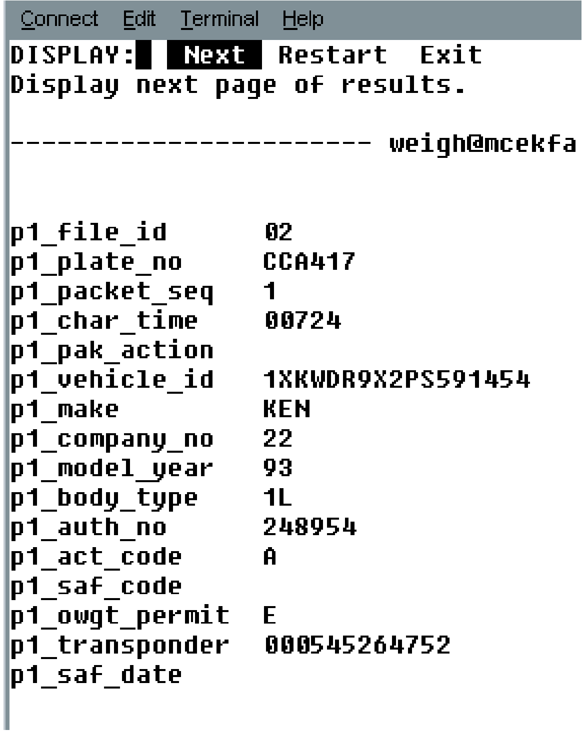
TELNET Screens

weigh2 – Each Green Light site can be individually accessed to show the most recent five transit events for a particular truck. Again, note the reason code.



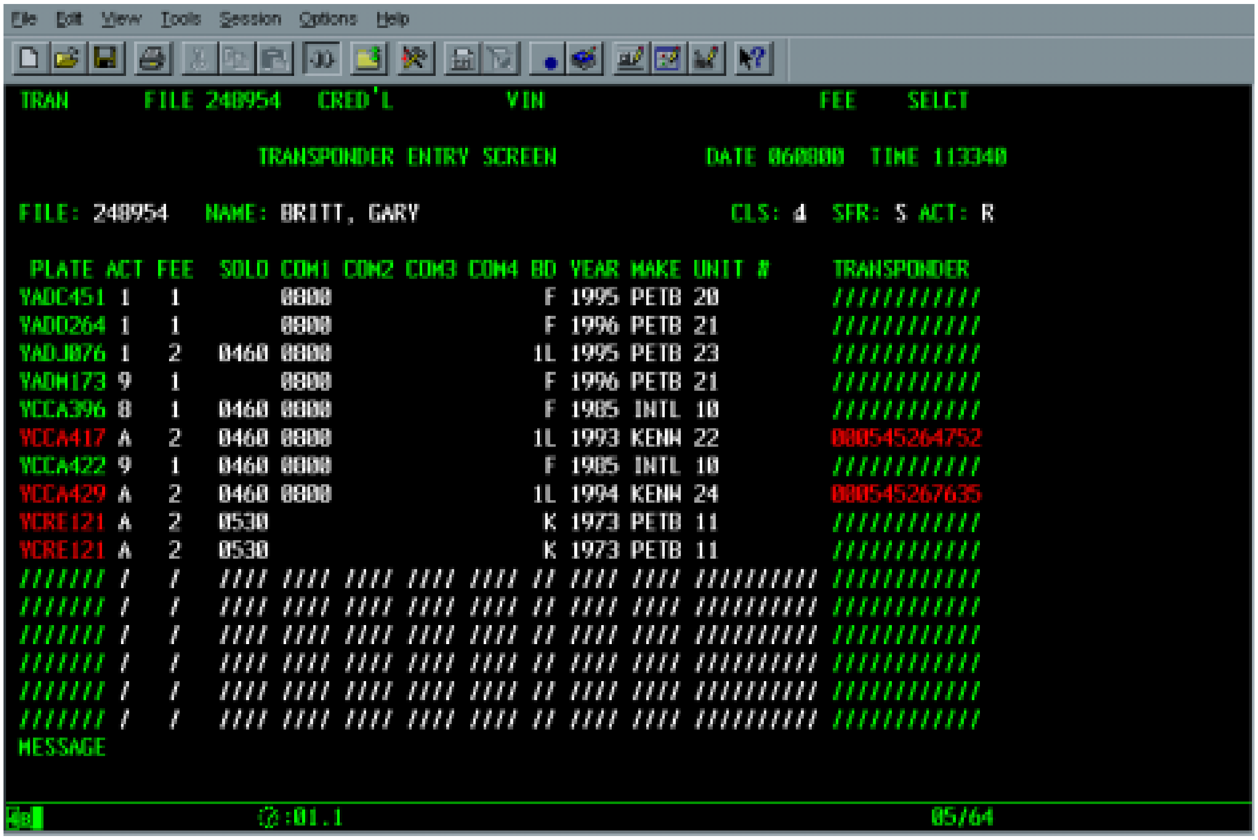
```
 Connected to SB Ashland

 Plate: CCA417   Auth: 248954    Transponder: 000545264752
 Carrier: BRITT, GARY
 Level of Status: 4   Safety Rating: S
---------------------------------------------+
                                             |
                                             |
             Last 5 Transit Events           |
              Press <Esc> to Exit            |
                                             |
   Date         Time       Event     Reason  |
  [2000/05/31] [11:33:15]  [r---]   [DBCLS0]|
  [          ] [        ]  [    ]   [      ]|
  [          ] [        ]  [    ]   [      ]|
  [          ] [        ]  [    ]   [      ]|
  [          ] [        ]  [    ]   [      ]|
                                             |
---------------------------------------------+
```

Informix– Each Green Light site computer can be individually accessed to verify truck specific information is properly downloaded to that respective site.



```
DISPLAY:  Next  Restart  Exit
Display next page of results.

----------------------- weigh@mcekfa


p1_file_id       02
p1_plate_no      CCA417
p1_packet_seq    1
p1_char_time     00724
p1_pak_action
p1_vehicle_id    1XKWDR9X2PS591454
p1_make          KEN
p1_company_no    22
p1_model_year    93
p1_body_type     1L
p1_auth_no       248954
p1_act_code      A
p1_saf_code
p1_owgt_permit   E
p1_transponder   000545264752
p1_saf_date
```

Corrected Database (TRNS) Carrier Information screen

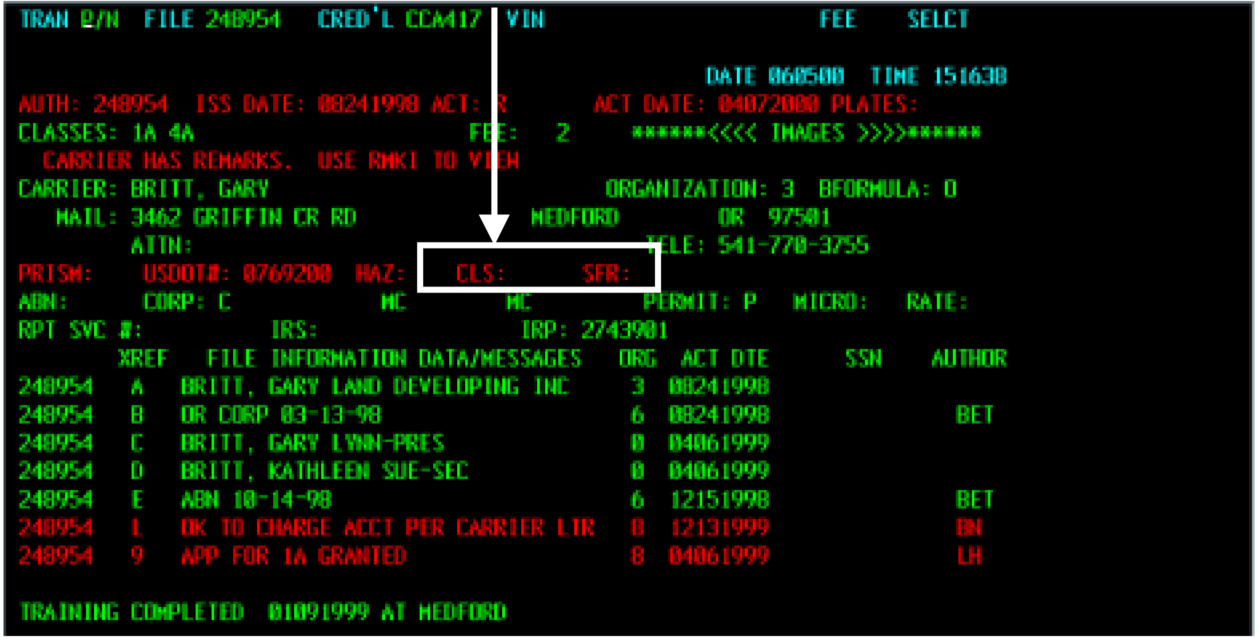


```
TRAN      FILE 240954   CRED'L        VIN                        FEE     SELCT

                   TRANSPONDER ENTRY SCREEN          DATE 060000  TIME 113340

FILE: 240954   NAME: BRITT, GARY                       CLS: 4  SFR: S ACT: R

 PLATE ACT FEE  SOLO COM1 COM2 COM3 COM4 BD YEAR MAKE UNIT #     TRANSPONDER
YADC451 1   1        0800                     F 1995 PETB 20         ////////////
YADD264 1   1        0800                     F 1996 PETB 21         ////////////
YADJ076 1   2   0460 0800                    1L 1995 PETB 23         ////////////
YADH173 9   1        0800                     F 1996 PETB 21         ////////////
YCCA396 8   1   0460 0000                     F 1985 INTL 10         ////////////
YCCA417 A   2   0460 0800                    1L 1993 KENW 22         000545264752
YCCA422 9   1   0460 0000                     F 1985 INTL 10         ////////////
YCCA429 A   2   0460 0800                    1L 1994 KENW 24         000545267635
YCRE121 A   2   0530                          K 1973 PETB 11         ////////////
YCRE121 A   2   0530                          K 1973 PETB 11         ////////////
/////// /   /   //// //// //// //// //// // //// //// ////////// ////////////
/////// /   /   //// //// //// //// //// // //// //// ////////// ////////////
/////// /   /   //// //// //// //// //// // //// //// ////////// ////////////
/////// /   /   //// //// //// //// //// // //// //// ////////// ////////////
/////// /   /   //// //// //// //// //// // //// //// ////////// ////////////
/////// /   /   //// //// //// //// //// // //// //// ////////// ////////////
MESSAGE

                   :01.1                                       05/64
```

The "RED" highlighted fields indicate active plates/registration.
The "GREEN" highlighted fields indicate inactive plates/registration.
The /////// (any color) indicate blank fields.

Database Carrier Information (CARR) screen prior to correction

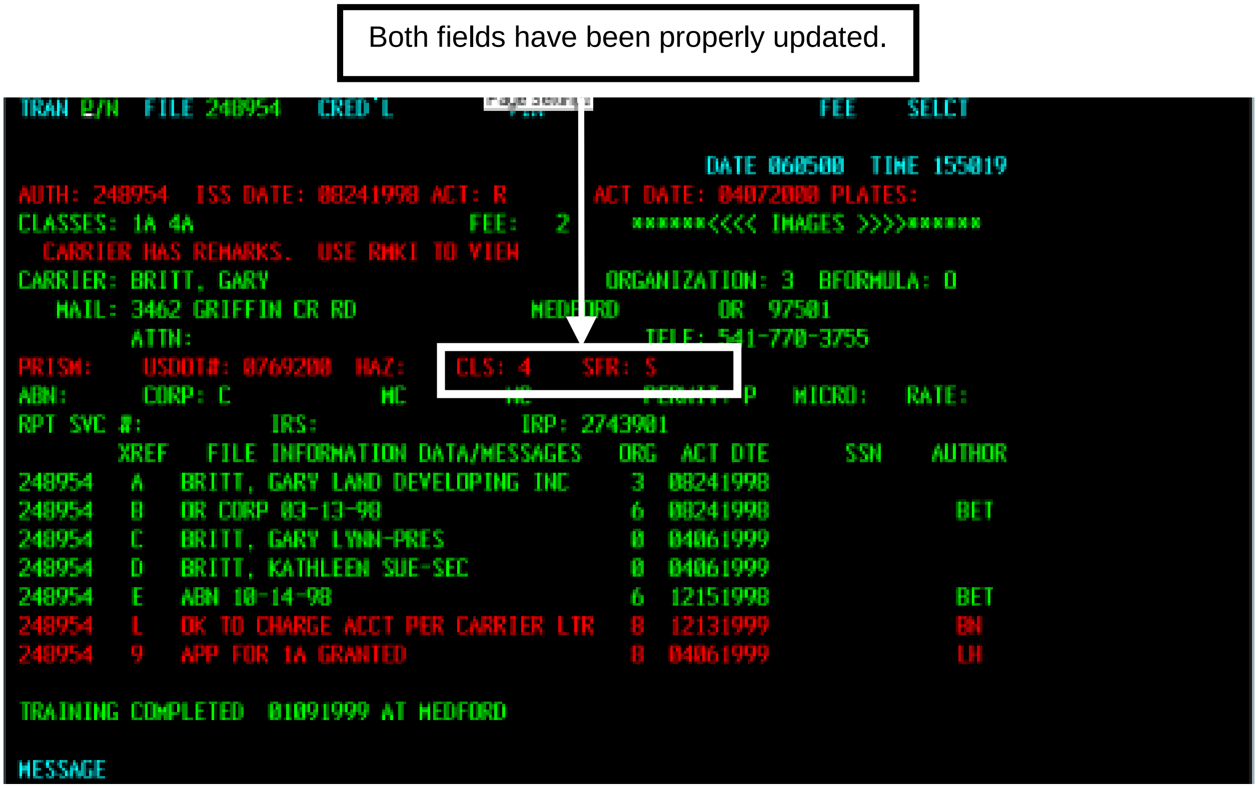
Both the CLS (Carrier Level of Service) and the SFR (Safety Fitness Rating) are blank. Please refer to the Report & Bypass Reason Codes chart for interpretation of these fields.



```
TRAN Q/N  FILE 248954   CRED'L CCA417  VIN                      FEE    SELCT

                                                       DATE 060500  TIME 151630
AUTH: 248954  ISS DATE: 08241998 ACT: R      ACT DATE: 04072000 PLATES:
CLASSES: 1A 4A                        FEE:   2     ******<<<< IMAGES >>>>******
  CARRIER HAS REMARKS.  USE RMKI TO VIEW
CARRIER: BRITT, GARY                            ORGANIZATION: 3  BFORMULA: 0
   MAIL: 3462 GRIFFIN CR RD               MEDFORD        OR  97501
         ATTN:                                TELE: 541-770-3755
PRISM:    USDOT#: 0769200  HAZ:   CLS:      SFR:
ABN:      CORP: C             MC        MC        PERMIT: P   MICRO:   RATE:
RPT SVC #:          IRS:                IRP: 2743901
        XREF   FILE INFORMATION DATA/MESSAGES   ORG  ACT DTE      SSN    AUTHOR
248954   A   BRITT, GARY LAND DEVELOPING INC     3  08241998
248954   B   OR CORP 03-13-98                    6  08241998               BET
248954   C   BRITT, GARY LYNN-PRES               0  04061999
248954   D   BRITT, KATHLEEN SUE-SEC             0  04061999
248954   E   ABN 10-14-98                        6  12151998               BET
248954   L   OK TO CHARGE ACCT PER CARRIER LTR   8  12131999               BN
248954   9   APP FOR 1A GRANTED                  8  04061999               LH

TRAINING COMPLETED  01091999 AT MEDFORD
```

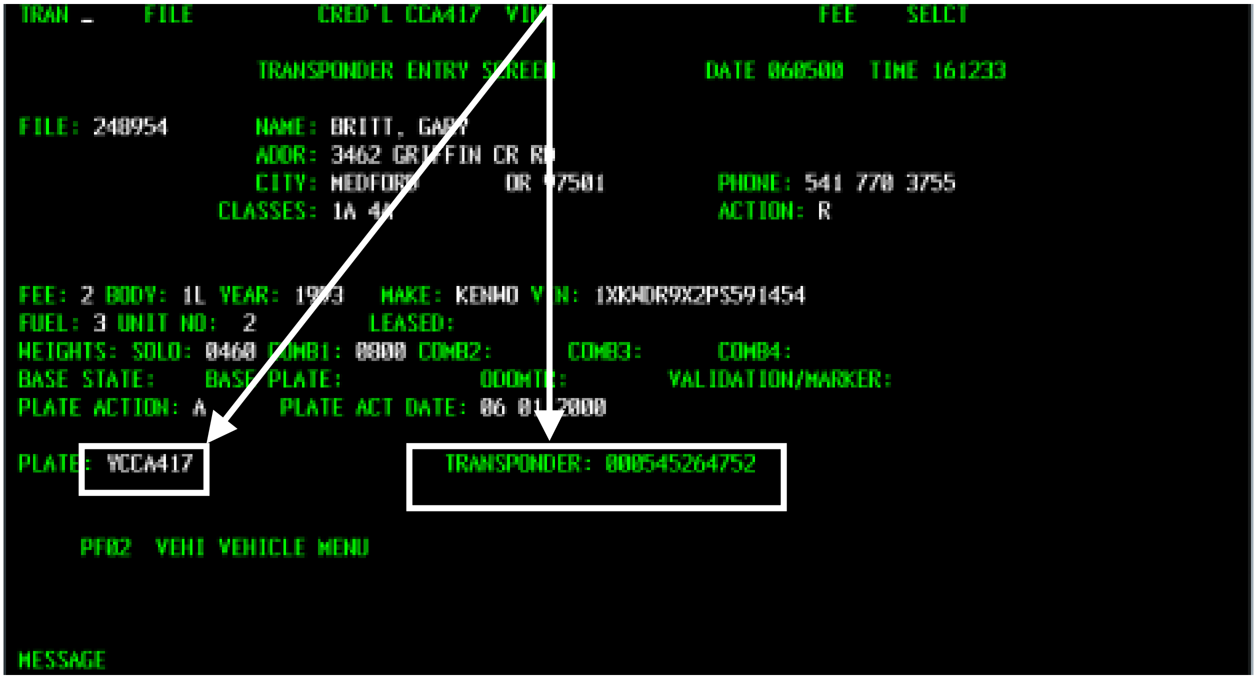
Corrected Database (CARR) Carrier Information screen

Both fields have been properly updated.

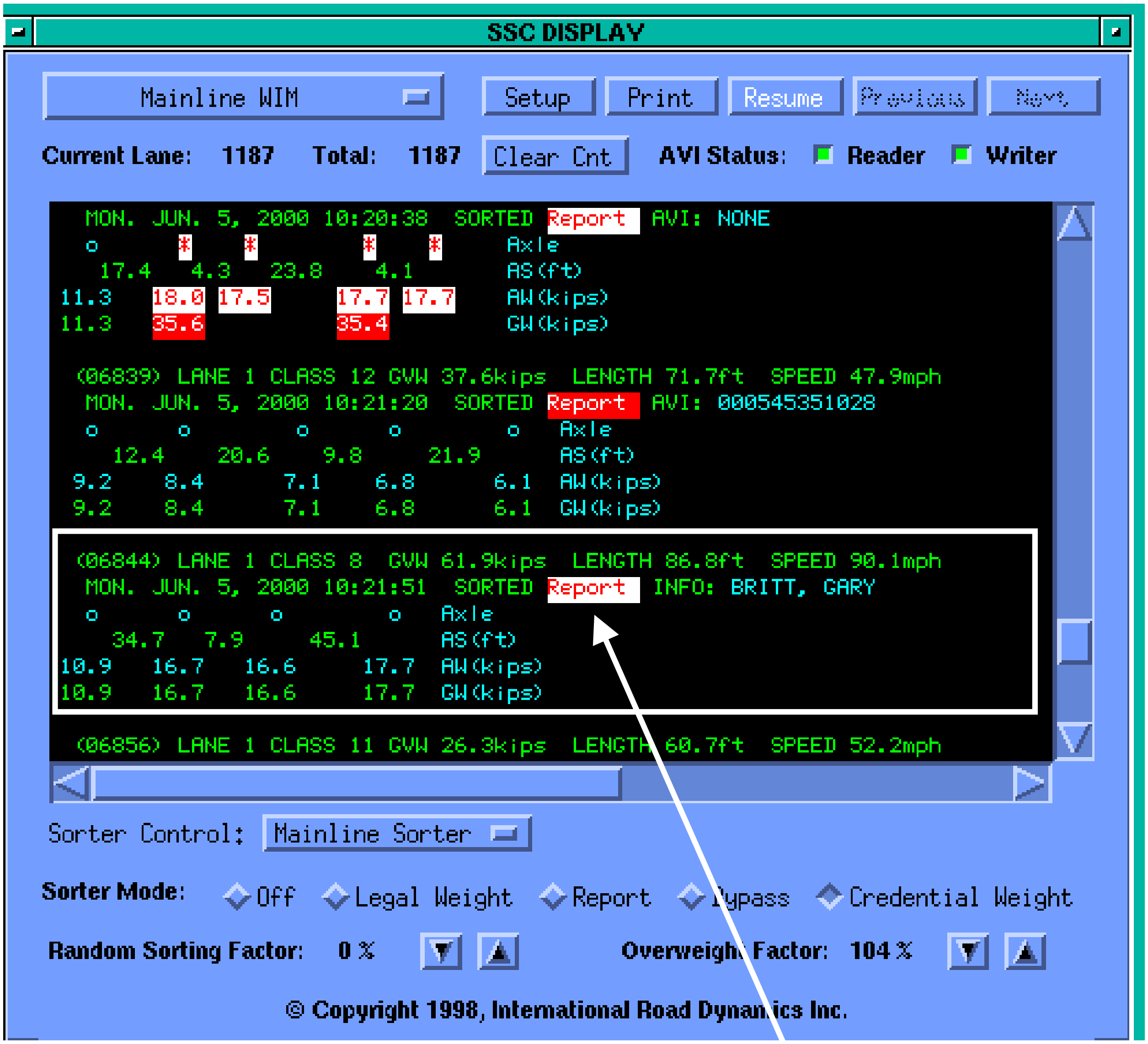


```
TRAN Q/N  FILE 248954   CRED'L                                  FEE    SELCT

                                                          DATE 060500  TIME 155019
AUTH: 248954  ISS DATE: 08241998 ACT: R      ACT DATE: 04072000 PLATES:
CLASSES: 1A 4A                         FEE:   2     ******<<<< IMAGES >>>>******
  CARRIER HAS REMARKS.  USE RMKI TO VIEW
CARRIER: BRITT, GARY                          ORGANIZATION: 3  BFORMULA: 0
   MAIL: 3462 GRIFFIN CR RD              MEDFORD        OR   97501
         ATTN:                                   TELE: 541-770-3755
PRISM:    USDOT#: 0769200  HAZ:   CLS: 4    SFR: S
ABN:      CORP: C            MC                         P   MICRO:   RATE:
RPT SVC #:          IRS:               IRP: 2743901
        XREF   FILE INFORMATION DATA/MESSAGES   ORG  ACT DTE      SSN    AUTHOR
248954   A   BRITT, GARY LAND DEVELOPING INC     3  08241998
248954   B   OR CORP 03-13-98                    6  08241998               BET
248954   C   BRITT, GARY LYNN-PRES               0  04061999
248954   D   BRITT, KATHLEEN SUE-SEC             0  04061999
248954   E   ABN 10-14-98                        6  12151998               BET
248954   L   OK TO CHARGE ACCT PER CARRIER LTR   8  12131999               BN
248954   9   APP FOR 1A GRANTED                  8  04061999               LH

TRAINING COMPLETED  01091999 AT MEDFORD

MESSAGE
```

Carrier Information Screen (TRAN) to verify that a Transponder has been assigned/issued to that plate



```
TRAN _    FILE          CRED'L CCA417  VIN                        FEE    SELCT

                   TRANSPONDER ENTRY SCREEN          DATE 060500  TIME 161233

FILE: 240954       NAME: BRITT, GARY
                   ADDR: 3462 GRIFFIN CR RD
                   CITY: MEDFORD       OR 97501         PHONE: 541 770 3755
                CLASSES: 1A 4A                          ACTION: R


FEE: 2 BODY: 1L YEAR: 1993   MAKE: KENWD VIN: 1XKWDR9X2PS591454
FUEL: 3 UNIT NO:  2         LEASED:
WEIGHTS: SOLO: 0460 COMB1: 0800 COMB2:      COMB3:      COMB4:
BASE STATE:    BASE PLATE:           ODOMTR:        VALIDATION/MARKER:
PLATE ACTION: A      PLATE ACT DATE: 06 01 2000

PLATE: YCCA417                  TRANSPONDER: 000545264752


     PF02  VEHI VEHICLE MENU



MESSAGE
```



Current Lane: 1187 Total: 1187

AVI Status: 🟩 Reader 🟩 Writer

```
  MON. JUN. 5, 2000 10:20:38  SORTED Report  AVI: NONE
  o      *    *        *    *      Axle
   17.4   4.3   23.8     4.1       AS(ft)
11.3   18.0 17.5      17.7 17.7    AW(kips)
11.3   35.6           35.4         GW(kips)

 (06839) LANE 1 CLASS 12 GVW 37.6kips  LENGTH 71.7ft  SPEED 47.9mph
  MON. JUN. 5, 2000 10:21:20  SORTED Report  AVI: 000545351028
  o      o        o      o        o    Axle
    12.4    20.6    9.8     21.9       AS(ft)
 9.2    8.4       7.1    6.8       6.1  AW(kips)
 9.2    8.4       7.1    6.8       6.1  GW(kips)

 (06844) LANE 1 CLASS 8  GVW 61.9kips  LENGTH 86.8ft  SPEED 90.1mph
  MON. JUN. 5, 2000 10:21:51  SORTED Report  INFO: BRITT, GARY
  o      o      o         o    Axle
    34.7   7.9     45.1        AS(ft)
10.9   16.7   16.6      17.7   AW(kips)
10.9   16.7   16.6      17.7   GW(kips)

 (06856) LANE 1 CLASS 11 GVW 26.3kips  LENGTH 60.7ft  SPEED 52.2mph
```

Sorter Control: Mainline Sorter

Sorter Mode: ◇ Off ◇ Legal Weight ◇ Report ◇ Bypass ◇ Credential Weight

Random Sorting Factor: 0 %

Overweight Factor: 104 %

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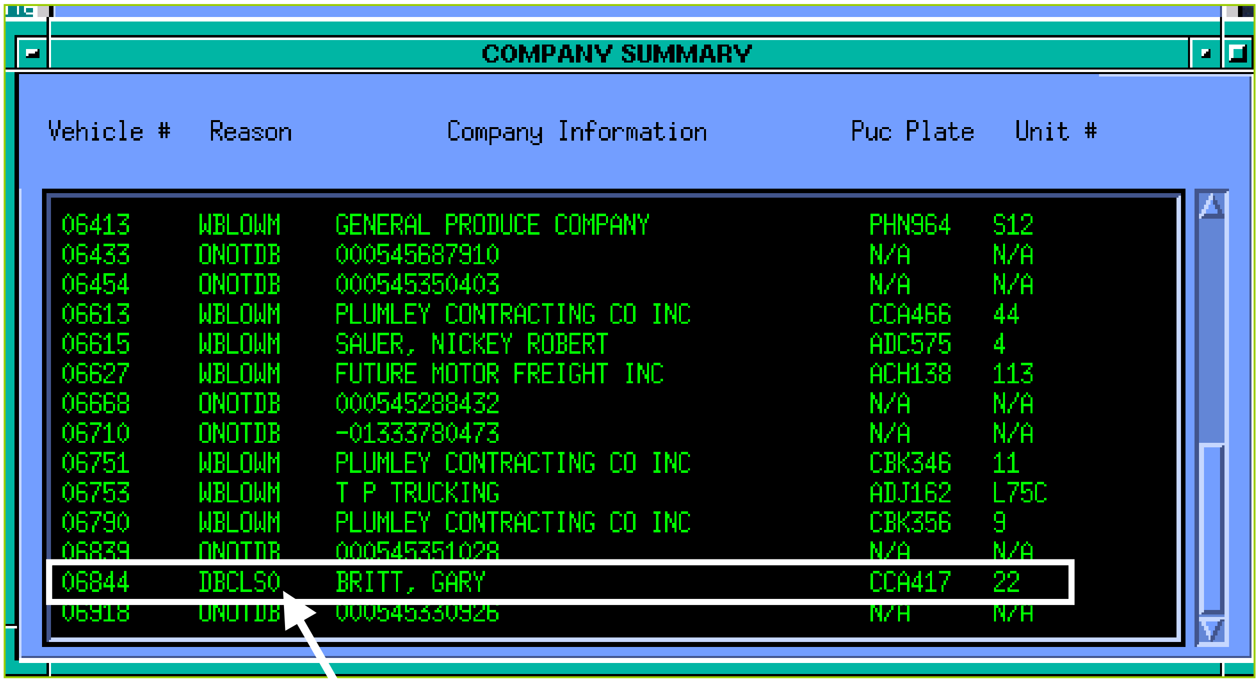
This is a “real time” example of trouble shooting using the SSC Display in conjunction with the Company Summary screen. As you can see, the SSC Display indicates that Gary Britt received a red light signal to report to the weigh station.



Vehicle #	Reason	Company Information	Puc Plate	Unit #
06413	WBLOWM	GENERAL PRODUCE COMPANY	PHN964	S12
06433	ONOTDB	000545687910	N/A	N/A
06454	ONOTDB	000545350403	N/A	N/A
06613	WBLOWM	PLUMLEY CONTRACTING CO INC	CCA466	44
06615	WBLOWM	SAUER, NICKEY ROBERT	ADC575	4
06627	WBLOWM	FUTURE MOTOR FREIGHT INC	ACH138	113
06668	ONOTDB	000545288432	N/A	N/A
06710	ONOTDB	-01333780473	N/A	N/A
06751	WBLOWM	PLUMLEY CONTRACTING CO INC	CBK346	11
06753	WBLOWM	T P TRUCKING	ADJ162	L75C
06790	WBLOWM	PLUMLEY CONTRACTING CO INC	CBK356	9
06839	ONOTDB	000545351028	N/A	N/A
06844	DBCLSO	BRITT, GARY	CCA417	22
06918	ONOTDB	000545330926	N/A	N/A

The Company Summary screen displays the specific reason for the red light sort decision. In this case the “DBCLSO” (Database has a blank or invalid Carrier Level of Service Code) indicates that there is a database problem. The ITS Specialist was able to recognize and correct this problem immediately as it happened by updating the Carrier information in the ODOT database.

APPENDIX B

Green Light Administration

Trouble Report Master Log (Accepted Sites)

Report # codes: Ashland S.B. (SBA); Ashland POE (ASH); Booth Ranch (BOO); Brightwood E.B. (EBB); Brightwood W.B. (WBB); Cascade Locks POE (CCL); Emigrant Hill (EMH); Farewell Bend POE (FAB); Juniper Butte N.B. (NBJ); Juniper Butte S.B. (SBJ); Klamath Falls POE (KFA); Klamath Falls S.B. (SBK); LaGrande (EBL); Lowell (LOW); Olds Ferry (OFY); Rocky Point (ROK); Umatilla (UMA); Wilbur (WIL); Woodburn N.B. (NBW); Woodburn POE (WOO); Wyeth (WBW)

Pending - On-going problem, solution still in progress

Report #	Report Type	Report Description	Reported By	Report Date	Solution Date	Down Time (hours)	Received By	Notes/Resolution
WOO 1	Ramp	Sorter not working properly - when set to credential weight, it only sends trucks > 80K. It should be set at 60K.	MCEO	10/25/99	10/25/99	2	ITS Specialist	IRD remotely adjusted parameters of the sorter software
ASH 1	AVI	Motor Carrier received a red light, however the system indicated "WBLOWM," a bypass code	MCEO	11/2/99	11/2/99	0	ITS Specialist	ITS Specialist reviewed the carrier history, and determined that this was an isolated event.
ASH 2	AVI	Motor did not receive an in cab signal	MCEO	11/4/99	11/4/99	0	ITS Specialist	ITS Specialist reviewed the event history for this truck and found that it was at the Woodburn N.B. Weigh Station during the time of the report, NOT at Ashland.
EBL 1	WIM	Excessive number of "OMANIP" error codes	MCEO	12/9/99	12/12/99	72	ITS Specialist	The problem was with the axle-sensors missing axle hits. IRD configured the sensors out of their current set-up as a short term fix (this will sacrifice some accuracy, but will remain within acceptable threshold limits). These sensors will get replaced during scheduled road maintenance in the Spring of 2000.
ASH 3	AVI	Motor Carrier continually receives red lights at the POE, yet receives green lights at the SB side.	MCEO	12/15/99	12/15/99	0	ITS Specialist	ITS Specialist reviewed the event history of this truck, and site, and found that only 1 green light has been issued. This seems to be happening to this carrier only. Thus the problem may be placement of the transponder.

APPENDIX C

REPORT REASON CODES CHART

Report Categories	Code	Description/Meaning
MANIPULATION	OMANIP	WIM Manipulation Error
	OSPCHG	Excessive Speed change (Accel or Decel)
	O2SLOW	Vehicle travelling too slowly
	O2CLOS	Vehicle too close in front or behind
	ONUMAX	Invalid number of axles
WEIGHT	WAFRNT	Overweight front axle
	WAXn	Overweight single axle (n = position of overweight axle)
	WTAn	Overweight tandem axle (n = position of overweight axle)
	WTRIn	Overweight tridem (n = position of overweight axle)
	WSTRIn	Overweight short tridem, fitting into tandem definition (n = position of overweight axle)
	WCNOP	Overweight combination, without permit
	WCPSTD	Overweight combination, with permit, violating statute
	WCPEXT	Overweight combination, with permit, violating permit
OVERHEIGHT	HOVER	Overheight
SAFETY	SFLAG	Safety Flag set
	STHRES	Safety Inspection Threshold flag
DATABASE	ONOTRN	AVI does not find transponder
	ONOTDB	Transponder number not found within database
	OCRIER	Invalid carrier authority
	OPLATE	Invalid plate not found within database
	DBCLSv	Blank or Invalid Carrier Service Code (v = **Carrier Level Of Status**) ***NOTE 1***
	DBSFTv	Blank or "U" Safety Rating Code (v = **Safety Rating** value) ***NOTE 2***
	DBSRCv	H Report Inspection Status Code (v = **Safety Risk** value) ***NOTE 3***
OTHER	XVNUM	Computer-to-Computer "Packet Collision" or Packet numbering fault
	ORWIND	WIM Independent Mode

NOTE 1: The value "Carrier Level Of Status" is interpreted as shown below.

0, or Blank	No status within Greenlight Transponder Program.
1	Basic Partner, 50% or less of fleet is transponder-equipped.
2	Basic Partner, >50% of fleet is transponder-equipped.
3	Trusted Carrier Partner, <50% of fleet is transponder equipped.
4	Trusted Carrier Partner, >50% of fleet is transponder equipped.

NOTE 2: The value "Safety Rating" is interpreted as:

S	Satisfactory Safety Rating
C	Conditional Safety Rating
U	Unsatisfactory Safety Rating

NOTE 3: The value "Safety Risk" is interpreted as:

H	High Safety Risk
M	Moderate Safety Risk
L	Low Safety Risk

BYPASS REASON CODES CHART

Code	Description/Meaning
OBWIND	WIM Independent Mode
WBLOWM	Vehicle is below maximum gross weight
OBYPAS	Vehicle is OK to bypass
OBNTSL	Vehicle is not in sort classes or sort lanes
OBEMPT	Empty vehicle to bypass