Validation Report

Michigan SPS-1

Task Order 14, CLIN 2
July 11, 2006

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1 Executive Summary

A visit was made to the Michigan SPS-1 on July, 11, 2006 for the purposes of conducting a validation of the WIM system located on US Route 127 located approximately 2.6 miles north of M-21. The validation procedures were in accordance with LTPP's SPS WIM Data Collection Guide dated August 21, 2001.

The site is instrumented with quartz piezo WIM sensors and an IRD/PAT Traffic WIM controller.

The agency is utilizing a slightly modified version of the FHWA 13-bin classification scheme. Classification 15 has been added to record the number of unclassified vehicles.

The LTPP Lane is installed in the southbound driving lane and is identified as Lane 4 in the controller. This validation is the second validation effort performed at this site. This site was initially validated on December 7, 2005.

The site is located within an area of five year old PCC pavement. This is a correction to the information provided in the original report for this site, where we indicated that the pavement was new.

This site meets all LTPP precision requirements except speed. That is not considered sufficient to disqualify the site as having research quality data. The classification data is of research quality.

This site meets the overall classification requirement of less than two percent unclassified. However, it does not meet the less than two percent trucks misclassified criteria.

The vehicles that were misclassified were two Class 5 vehicles identified as Class 4 because of long axle spacings (24.9 feet and 23.5 feet), and a Class 3 identified as a Class 5 because of a heavy trailer that resulted in a GVW of 15.3 kps. With the anticipated changes to the classification requirements that will not include Class 3 through 5 vehicles, this site meets the less than two percent misclassified criteria.

The validation used the following trucks:

1) 3S2 with a tractor having an air suspension tandem and a trailer with a standard tandem and air suspension, loaded to 77,180 lbs.
2) 3S2 with a tractor having an air suspension tandem and a trailer with a split tandem and air suspension, loaded to 65,340 lbs.

The validation speeds ranged from 39 to 60 miles per hour. The site is currently posted with a speed limit of 70 miles per hour for cars and 55 miles per hour for trucks. Since the agency had already identified that the 85th percentile speed for trucks was in excess to the posted speed limit, the Agency received approval from the Motor Carrier

Enforcement Group to run the test trucks at speeds greater than the posted speed limit, so long as the test trucks matched the speeds being driven by the surrounding traffic.

The pavement temperatures ranged from 79 to 96 degrees Fahrenheit. Of these only four were below 90 degrees.

Table 1-1 Post-Validation results – 260100 – 11-Jul-2006

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	3.5 ± 6.7%	Pass
Single axles	±20 percent	0.5 ± 9.4%	Pass
Tandem axles	±15 percent	-1.2 ± 4.1%	Pass
Gross vehicle weights	±10 percent	-0.6 ± 3.5%	Pass
Speed	**±1 mph [2 km/hr]**	**0.3 ± 1.4 mph**	**Fail**
Axle spacing	± 0.5 ft [150 mm]	0.0 ± 0.0 ft	Pass

The pavement condition appeared to be satisfactory for conducting a performance evaluation. There were no distresses that would influence truck motions significantly. A visual survey determined that there is no discernable bouncing or avoidance by trucks in the sensor area.

If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 1-2 Results Based on ASTM E-1318-02 Test Procedures

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

By direction of the COTR, given the values for Single axle mean error (0.5%), Tandem axle mean error (-1.2%) and GVW mean error (-0.6%) after the initial 40 test runs were conducted, only one of the two typical validation run sets was conducted. For the purposes of this report, the data set was identified as the Post-Calibration run set. The results are illustrated and discussed in Section 3.

2 Corrective Actions Recommended

There are no corrective measures recommended for this site at this time under the assumption that LTPP will only recognize misclassification of heavy vehicles (FHWA Classes 6 and higher).

3 Post Calibration Analysis

This final analysis is based on test runs conducted July 11, 2006 from early afternoon to late afternoon at test site 260100 on US Route 127. This SPS-1 site is located 2.6 miles north of M-21 on the southbound, right hand lane of a divided four-lane facility. No auto-calibration was used during test runs. The two trucks used for initial calibration and for the subsequent testing included:

1) 3S2 with a tractor having an air suspension tandem and a trailer with a standard tandem and air suspension, loaded to 77,180 lbs.
2) 3S2 with a tractor having an air suspension tandem and a trailer with a split tandem and air suspension, loaded to 65,340 lbs.

Each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 39 to 60 miles per hour. Pavement surface temperatures recorded during the test runs ranged from about 79 to 96 degrees Fahrenheit. The computed values of 95% confidence limits of each statistic for the total population are in Table 3-1.

As shown in Table 3-1 the site meets and passed all LTPP performance criteria for research quality data for weight and spacing. It did not meet the requirements for speed which is not considered sufficient to disqualify the site as having research quality data.

It should be noted, that since the axle spacing measurements (which are dependant on accurate speed measurements) did meet the performance requirements, it is likely that the failure of speed measurements is the result of errors in the speed values that were obtained by radar and to which the WIM equipment output was compared.

Table 3-1 Post-Validation Results - 260100 – 11-Jul-2006

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	3.5 ± 6.7%	Pass
Single axles	±20 percent	0.5 ± 9.4%	Pass
Tandem axles	±15 percent	-1.2 ± 4.1%	Pass
Gross vehicle weights	±10 percent	-0.6 ± 3.5%	Pass
Speed	**±1 mph [2 km/hr]**	**0.3 ± 1.4 mph**	**Fail**
Axle spacing	± 0.5 ft [150 mm]	0.0 ± 0.0 ft	Pass

The test runs were conducted primarily during the afternoon hours, resulting in narrow range of pavement temperatures. The runs were also conducted at various speeds to determine the effects of these variables on the performance of the WIM scale. To investigate these effects, the dataset was split into 3 speed groups and left in one

temperature group. The distribution of runs by speed and temperature is illustrated in Figure 3-1. The figure indicates that the desired distribution of speed and temperature combinations was not achieved for this set of validation runs. Due to very little change in air temperature during the test runs, pavement temperature did not vary significantly. The temperature change that did occur followed a rain storm.

The speed groups were divided as follows: Low speed – 39 to 45 mph, Medium speed – 46 to 51 mph and High speed - 52+ mph. All test runs were combined into the Medium temperature group, from 79 to 96 degrees Fahrenheit.

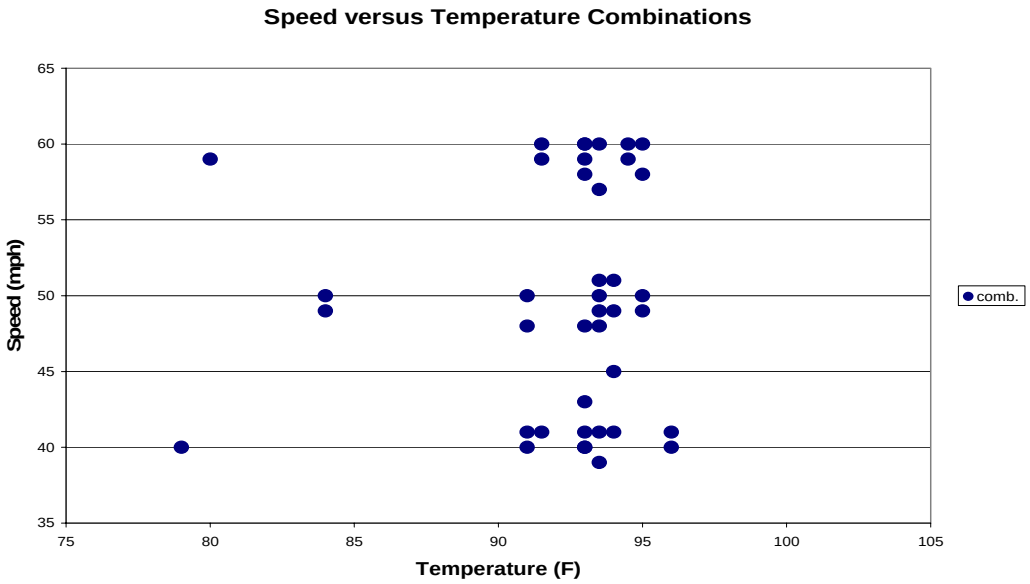

Figure 3-1 Post-Validation Speed-Temperature Distribution – 260100 – 11-Jul-2006

A series of graphs was developed to investigate visually any sign of a relationship between speed or temperature and the scale performance.

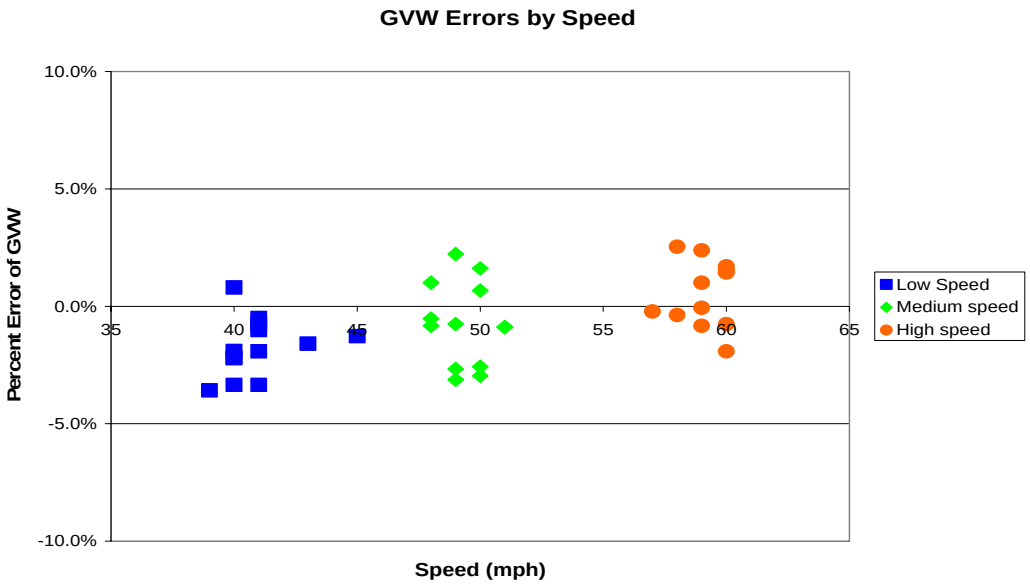

Figure 3-2 shows the GVW Percent Error vs. Speed graph for the population as a whole. From the figure, it can be seen that the GVW error estimate of the WIM equipment progresses from an underestimation at lower speeds toward an overestimation as speeds reach the higher end of the test range. The scatter of the percent error appears to be consistent over the entire speed range.

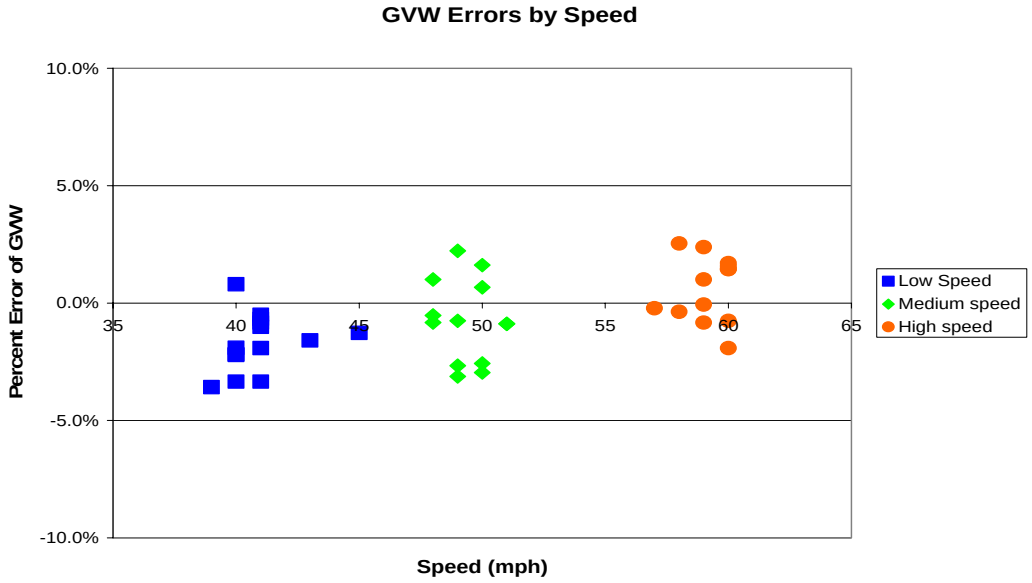

Figure 3-2 Post-Validation GVW Percent Error vs. Speed – 260100 – 11-Jul-2006

Figure 3-3 shows the relationship between temperature and GVW percentage error. The graph illustrates that there does not appear to be a significant relationship between GVW error and pavement temperature although there is a minor underestimation at the lower temperatures.

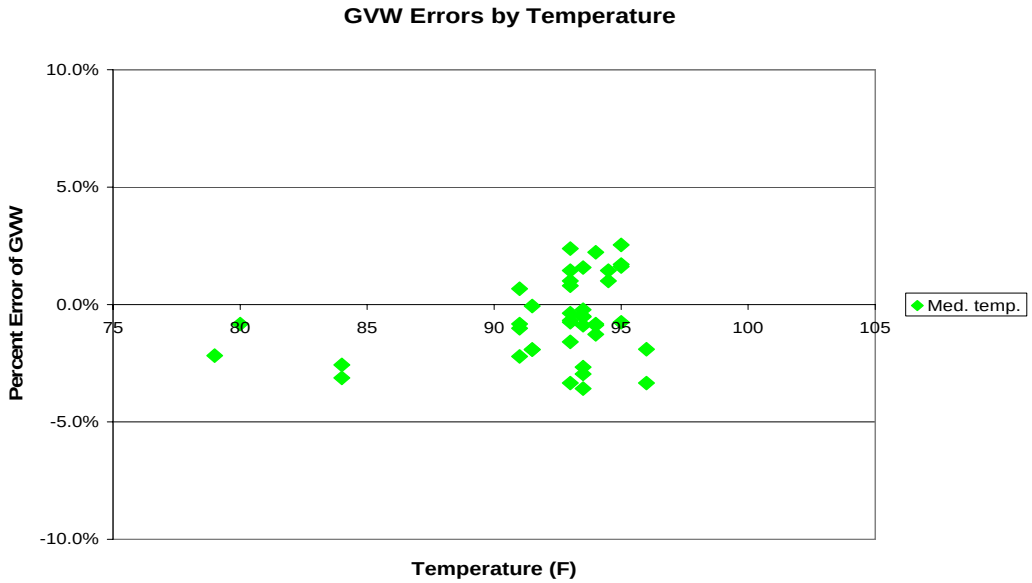

Figure 3-3 Post-Validation GVW Percent Error vs. Temperature – 260100 – 11-Jul-2006

Figure 3-4 shows the relationship between the drive tandem spacing errors in feet and speeds. This graph is used as a potential indicator of classification errors due to failure to correctly identify spacings on a vehicle. Since the most common reference value is the drive tandem on a Class 9 vehicle, this is the spacing evaluated and plotted for validations.

Axle spacing errors appear to be consistent throughout the test truck speed range and are limited to maximums of about 0.1 feet. Vehicles speeds appear to have no effect on the error of measured axle spacing. Based on the consistency of spacing errors, the speed difference between the radar gun used to capture vehicle speeds and the reported WIM speeds, is more likely to be measurement error in the radar gun technique.

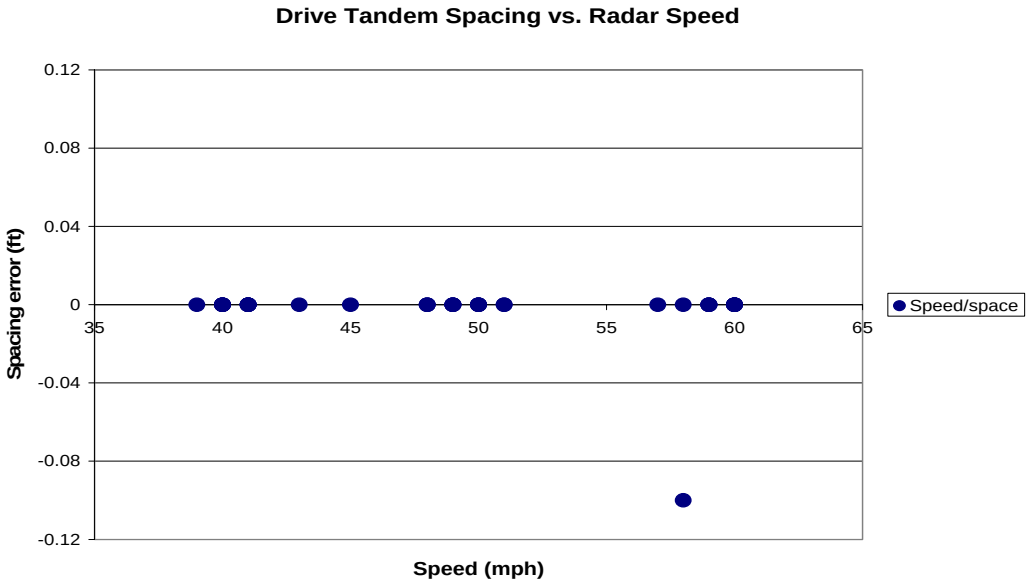

Figure 3-4 Post-Validation Spacing vs. Speed - 260100 – 11-Jul-2006

3.1 Temperature-based Analysis

Due to the limited range of temperatures during the period of testing, the site could not be evaluated for temperature effects.

3.2 Speed-based Analysis

The speed groups were divided as follows: Low speed – 39 to 45 mph, Medium speed – 46 to 51 mph and High speed - 52+ mph.

Table 3-2 Post-Validation Results by Speed Bin – 260100 – 11-Jul-2006

Element	95% Limit	Low Speed 39 to 45 mph	Medium Speed 46 to 51 mph	High Speed 52+ mph
Steering axles	± 20 %	2.2 ± 7.4%	2.8 ± 4.7%	5.7 ± 7.1%
Single axles	± 20 %	-1.2 ± 10.1%	1.0 ± 7.9%	1.6 ± 10.3%
Tandem axles	± 15 %	-1.9 ± 3.5%	-1.6 ± 4.3%	0.1 ± 4.1%
GVW	± 10 %	-1.7 ± 2.7%	-0.7 ± 3.8%	0.6 ± 3.0%
Speed	± 1 mph	0.1 ± 1.9 mph	0.4 ± 1.4 mph	0.0 ± 0.1 mph
Axle spacing	± 0.5 ft	0.0 ± 0.0 ft	0.0 ± 0.0 ft	0.0 ± 0.1 ft

From Table 3-2 it appears that the mean error for steering axles is greater than the mean error for single, tandem and GVW weights at all speeds and the scatter for single axle error is significantly greater than the scatter for steering, tandem and GVW error. For single, tandem and GVW weights, the equipment appears to underestimate at low speeds and move toward an overestimation as speed increases, while steering axle weights are overestimated at all speeds.

Figure 3-5 illustrates the tendency of the WIM equipment to report fairly consistent GVW weights for both trucks over the entire speed range, moving from a slight underestimation at low speeds to a slight overestimation at high speeds.

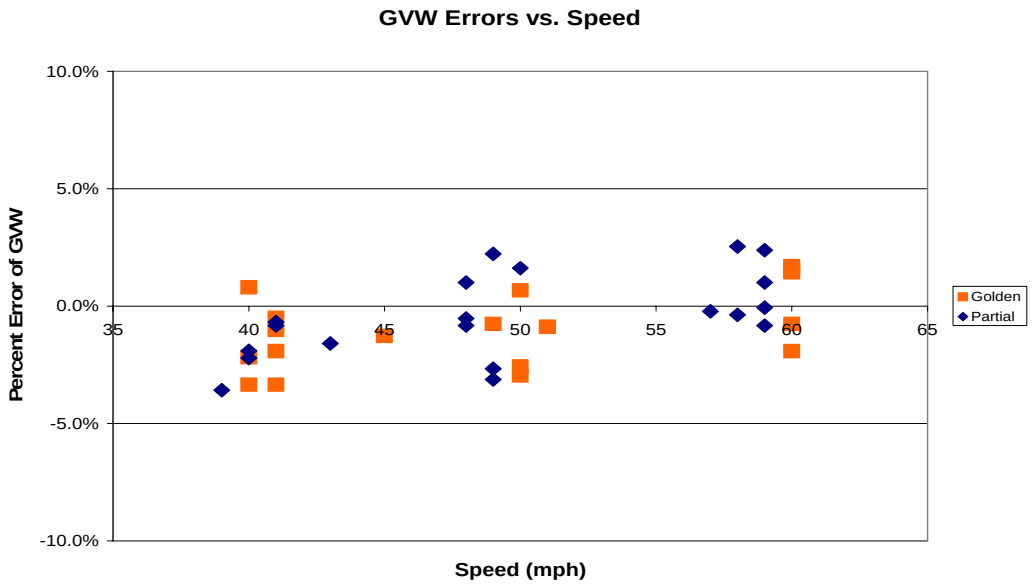

Figure 3-5 Post-Validation GVW Percent Error vs. Speed by Truck – 260100 – 11-Jul-2006

Figure 3-6 shows the relation between steering axle errors and speed. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 trucks. Figure 3-6 shows how the WIM equipment generally overestimates the steering axle weights. Variability of the error is generally constant throughout the entire speed range.

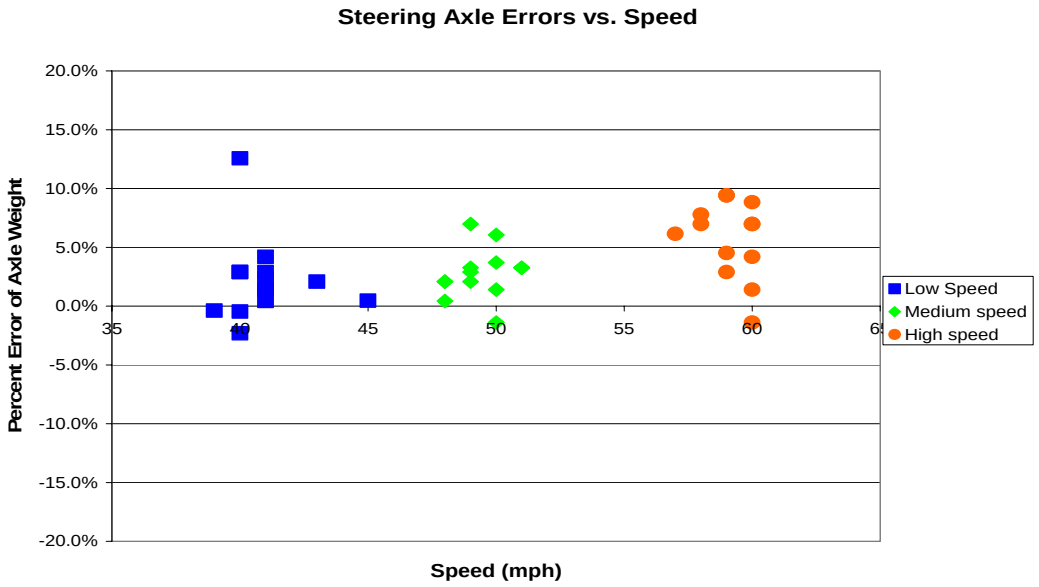

Figure 3-6 Post-Validation Steering Axle Percent Error vs. Speed by Group - 260100 – 11-Jul-2006

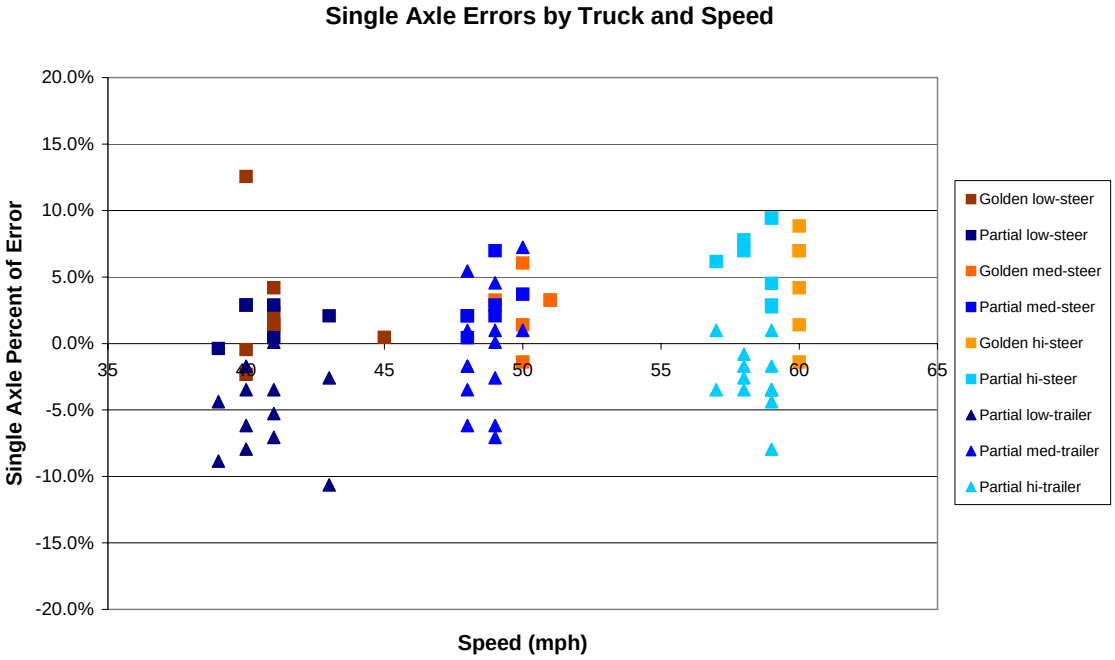

Figure 3-7 Post-Validation Single Axle Percent Error vs. Speed by Group by Truck - 260100 – 11-Jul-2006

Figure 3-7 shows the relationship of all single axles versus speed. The variability is somewhat larger when all single axles are considered. However, the trend of increasing errors with increasing speeds still exists.

3.3 Classification Validation

The agency uses a variant of the FHWA 13-bin classification scheme. Classification 15 has been added to record the number of unclassified vehicles.

A sample of 100 trucks was collected at the site. Video was taken at the site to provide ground truth for the evaluation. Based on a 100 percent sample it was determined that there are 0 percent unknown vehicles and 0 percent unclassified vehicles.

The second check is the ability of the algorithm to correctly distinguish between truck classes with no more than 2% errors in such classifications. Table 3-3 has the classification error rates by class. The overall misclassification rate is 4.9 percent and is attributed to single Class 3, 4 and 5 misclassifications. The vehicles that were misclassified were two Class 5 vehicles identified as Class 4 because of long axle spacings (24.9 feet and 23.5 feet), and a Class 3 identified as a Class 5 because of a heavy trailer that resulted in a GVW of 15.3 kips. With the anticipated changes to the classification requirements that will not include Class 3 through 5 vehicles, this site meets the less than two percent misclassified criteria.

Table 3-3 Truck Misclassification Percentages for 260100 - 11-Jul-2006

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	100	5	18	6	0
7	0				
8	0	9	0	10	0
11	N/A	12	N/A	13	0

The misclassification percentage is computed as the probability that a pair containing the class of interest does NOT include a match. Thus if there are eight pairs of observations with at least one Class 9 and only six of them are matches, the error rate is 25 percent. The percent error and the mean differences reported below do not represent the same statistic. It is possible to have error rates greater than 0 with a mean difference of zero.

Table 3-4 Truck Classification Mean Differences for 260100 - 11-Jul-2006

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	Unknown	5	-6	6	0
7	0				
8	0	9	0	10	0
11	N/A	12	N/A	13	0

These error rates are normalized to represent how many vehicles of the class are expected to be over or under-counted for every hundred of that class observed by the equipment. Thus a value of 0 means the class is identified correctly on average. A number between –1 and –100 indicates at least that number of vehicles either missed or not assigned to the class by the equipment. It is not possible to miss more than all of them or one hundred out of one hundred. Numbers 1 or larger indicate at least how many more vehicles are assigned to the class than the actual "hundred observed". Classes marked Unknown are those identified by the equipment but no vehicles of the type were seen by the observer. There is no way to tell how many more are reported than actually present in the population. N/A means no vehicles of the class were recorded by either the equipment or the observer.

3.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 standard for a successful validation of Type I sites is 95% of the observed errors within the limits for allowable errors for each of the relevant statistics. If this site had been evaluated using ASTM E-1318-02 it would have met the conditions for a Type I site exclusive of wheel loads. LTPP does not validate WIM performance with respect to wheel loads.

Table 3-5 Results of Validation Using ASTM E-1318-02 Criteria

Characteristic	Limits for Allowable Error	Percent within Allowable Error	Pass/Fail
Single Axles	± 20%	100%	Pass
Axle Groups	± 15%	100%	Pass
GVW	± 10%	100%	Pass

4 Pavement Discussion

In determining the site location, the Agency utilized the services of the Regional Support Contractor to perform a pavement smoothness analysis over all four lanes in the area of the present WIIM installation.

The pavement condition did not appear to influence truck movement across the sensors.

4.1 Profile analysis

The WIM site is a section of pavement that is 305 meters long with the WIM scale located at 274.5 meters from the beginning of the test section. An ICC profiler was used to collect longitudinal profiles of the test section with a sampling interval of 25 millimeters.

Profile data collected at the SPS WIM location by Stantec Consultants on June 2, 2006 were processed through the LTPP SPS WIM Index software, version 1.1. While the profile files indicate that this WIM scale is installed on a flexible pavement, a review of the photos and on-site confirmation show that the pavement type around on this section is rigid.

A total of 11 profiler passes were conducted over the WIM site. Since the issuance of the LTPP directive on collection of longitudinal profile data for SPS WIM sections, the requirements have been a minimum of 3 passes in the center of the lane and one shifted to each side. For this site the RSC has completed 5 passes at the center of the lane, 3 passes shifted to the left side of the lane, and 3 passes shifted to the right side of the lane. Shifts to the sides of the lanes were made such that data were collected as close to the lane edges as was safely possible. For each profiler pass, profiles were recorded under the left wheel path (LWP) and the right wheel path (RWP).

The SPS WIM Index software, version 1.0 was developed with four different indices: LRI, SRI, Peak LRI and Peak SRI. The LRI incorporates the pavement profile starting 25.8 m prior to the scale and ending 3.2 m after the scale in the direction of travel. The SRI incorporates a shorter section of pavement profile beginning 2.74 m prior to the WIM scale and ending 0.46 m after the scale. The LRI and SRI are the index values for the actual location of the WIM scale. Peak LRI is the highest value of LRI, within 30 m prior to the scale. Peak SRI indicates the highest value of SRI that is located between 2.45 m prior to the scale and 1.5 m after the scale. Also, a range for each of the indices was developed to provide the smoothness criteria. The ranges are shown in Table 4-1. When all of the values are below the lower thresholds, it is presumed unlikely that pavement smoothness will significantly influence sensor output. When one or more values exceed an upper threshold there is a reasonable expectation that the pavement smoothness will influence the outcome of the validation. When all values are below the upper threshold but not all below the lower threshold, the pavement smoothness may or may not influence the validation outcome.

Table 4-1 Thresholds for WIM Index Values

Index	Lower Threshold (m/km)	Upper Threshold (m/km)
LRI	0.50	2.1
SRI	0.50	2.1
Peak LRI	0.50	2.1
Peak SRI	0.75	2.9

Table 4-2 shows the computed index values for all 11 profiler passes for this WIM site. The average values over the passes in each path were also calculated when three or more passes were completed. These are shown in the right most column of the table. Values above the upper index limits are presented in bold while values below the lower index limits are presented in italics.

From Table 4-2 it can be seen that most of the indices computed from the profiles are between the upper and lower threshold values. These results indicate that the pavement smoothness may or may not influence the sensor output. However, since the validation of the equipment was successful, no pavement remediation is recommended at this time.

Table 4-2 WIM Index Values - 260100 –02-Jun-2006

Profiler Passes			Pass 1	Pass 2	Pass 3	Pass 4	Pass 5	Ave.
Center	LWP	LRI (m/km)	0.544	0.562	0.600	0.582	0.565	0.571
		SRI (m/km)	0.630	*0.482*	0.635	0.648	0.594	0.598
		Peak LRI (m/km)	0.686	0.744	0.791	0.741	0.752	0.743
		Peak SRI (m/km)	*0.674*	*0.639*	*0.691*	*0.658*	*0.647*	*0.662*
	RWP	LRI (m/km)	0.809	0.741	0.771	0.805	0.820	0.789
		SRI (m/km)	1.123	0.973	1.226	1.286	1.316	1.185
		Peak LRI (m/km)	0.895	0.871	0.946	0.954	0.916	0.916
		Peak SRI (m/km)	1.180	1.112	1.311	1.367	1.363	1.267
Left Shift	LWP	LRI (m/km)	0.612	0.578	0.597			0.596
		SRI (m/km)	0.554	0.538	0.619			0.570
		Peak LRI (m/km)	0.672	0.640	0.727			0.680
		Peak SRI (m/km)	0.789	0.791	*0.689*			0.756
	RWP	LRI (m/km)	0.771	0.761	0.795			0.776
		SRI (m/km)	1.044	0.959	1.360			1.121
		Peak LRI (m/km)	1.182	1.196	0.957			1.112
		Peak SRI (m/km)	1.295	1.301	1.507			1.368
Right Shift	LWP	LRI (m/km)	0.672	0.682	0.612			0.655
		SRI (m/km)	0.839	0.824	0.617			0.760
		Peak LRI (m/km)	0.807	0.916	0.853			0.859
		Peak SRI (m/km)	0.911	0.951	*0.713*			0.858
	RWP	LRI (m/km)	0.854	0.903	0.779			0.845
		SRI (m/km)	1.217	1.305	1.266			1.263
		Peak LRI (m/km)	0.977	1.009	0.937			0.974
		Peak SRI (m/km)	1.313	1.379	1.285			1.326

4.2 Distress survey and any applicable photos

During a visual survey of the pavement no distresses that would influence truck movement across the WIM scales were noted.

4.3 Vehicle-pavement interaction discussion

A visual observation of the trucks as they approach, transverse and leave the sensor area did not indicate any visible motion of the trucks that would affect the performance of the WIM scales. Trucks appear to track down the wheel path and daylight cannot be seen between the tires and any of the sensors for the equipment.

5 Equipment Discussion

The traffic monitoring equipment at this location includes quartz piezo WIM sensors and an IRD/PAT Traffic DAW-190 WIM controller. The sensors are installed ten feet apart in a staggered configuration in a Portland concrete cement pavement.

5.1 Pre-Evaluation Diagnostics

A complete electronic and electrical check of all system components including in-road sensors, electrical power, and telephone service were performed immediately prior to the evaluation. All sensors and system components were found to be within operating parameters.

5.2 Calibration Process

The equipment required no iterations of the calibration process.

Due to the mean values of the initial test results, it was decided that a calibration of the equipment would not significantly improve the accuracies of the WIM system so a calibration of the equipment and a subsequent set of validation runs was deemed unnecessary.

5.3 Summary of Traffic Sheet 16s

The equipment at this site was installed in the June 2005. Therefore, Table 5-1 has has the information found in TRF_CALIBRATION_AVC the Sheet 16 submitted for the current visit.

Table 5-1 Classification Validation History - 260100 –11-Jul-2006

Date	Method	Mean Difference				Percent Unclassified
		Class 9	Class 8	Class 13	Other 2	
07/11/2006	Manual	0.0	0.0	0.0		0.0
12/07/2005	Manual	0.0	0.0			0.0
12/06/2005	Manual	0.0	0.0			0.0

Table 5-2 has the information found in TRF_CALIBRATION_WIM for site visits and the Sheet 16 submitted for this validation visit. The December, 2005 visit was the initial LTPP validation visit for this site.

Table 5-2 Weight Validation History - 260100 – 11-Jul-2006

Date	Method	Mean Error and (SD)		
		GVW	Single Axles	Tandem Axles
07/11/2006	Test Trucks	-0.6 (1.7)	0.5 (4.7)	-1.2 (2.1)
12/08/2005	Test Trucks	-2.1 (3.4)	-4.2 (4.0)	-1.7 (4.3)
12/07/2005	Test Trucks	19.8 (7.6)	19.6 (3.6)	19.7 (9.7)

5.4 Projected Maintenance/Replacement Requirements

There is no corrective maintenance action required at this site at this time.

6 Pre-Validation Analysis

By direction of the COTR, given the values for Single axle mean error (0.5%), Tandem axle mean error (-1.2%) and GVW mean error (-0.6%) after the initial 40 test runs were conducted, only one of the two typical validation run sets was conducted. For the purposes of this report, the data set was identified as the Post-Calibration run set.

7 Data Availability and Quality

As of July 11, 2006 this site does not have at least 5 years of research quality data. Research quality data is defined to be at least 210 days in a year of data of known calibration meeting LTPP's precision requirements.

Data that has validation information available has been reviewed in light of the patterns present in the two weeks immediately following a validation/calibration activity. A determination of research quality data is based on the consistency with the validation pattern. Data that follows consistent and rational patterns in the absence of calibration information may be considered nominally of research quality pending validation information with which to compare it. Data that is inconsistent with expected patterns and has no supporting validation information is not considered research quality.

The amount and coverage for the site is shown in Table 7-1. The value for months is a measure of the seasonal variation in the data. The indicator of coverage indicates whether day of week variation has been accounted for on an annual basis. As can be seen from the table, between 1996 and 2005 all years but 1996, 1998 and 1999 for classification and 1996,1999 and 2002 for weight have a sufficient quantity of data to be considered complete years of data. **In the absence of previously gathered validation information for these years it can be seen that at least five additional years of research quality data are needed to meet the goal of a minimum of 5 years of research weight data. Since the site was installed in June 2005, analysis of data from prior years for consideration as research quality data will require validation information for that installation.**

Table 7-1 Amount of Traffic Data Available 260100 –11-Jul-2006

Year	Classification Days	Months	Coverage	Weight Days	Months	Coverage
1996	176	7	Full week	191	7	Full week
1997	339	12	Full week	322	11	Full week
1998	1	1	Weekday(s)	356	12	Full week
1999	127	6	Full week	136	6	Full week
2000	290	11	Full week	301	12	Full week
2001	359	12	Full week	365	12	Full week
2002	348	12	Full week	N/A		
2003	300	10	Full week	298	10	Full week
2004	280	11	Full week	323	11	Full week
2005	333	12	Full week	340	12	Full week

GVW graphs and characteristics associated with them are used as data screening tools. As a result classes constituting more that ten percent of the truck population are considered major sub-groups whose evaluation characteristics should be identified for use in screening. The typical values to be used for reviewing incoming data after a validation are determined starting with data from the day after the completion of a validation.

Class 9s, Class 13s and Class 5s constitute more than 10 percent of the truck population. Based on the data collected from the end of the last calibration iteration the following are the expected values for these populations. The precise values to be used in data review will need to be determined by the RSC on receipt of the first 14 days of data after the successful validation. For sites that do not meet LTPP precision requirements, this period may still be used as a starting point from which to track scale changes.

Predominant Class 13 vehicles at this site range from 7 axles to 11 axles. Typically, the maximum single axle weight for Class 13 vehicles is 20,000 pounds. However, this depends on the type of tires, axle spacings, etc. Generally, an 11-axle vehicle is allowed 13,000 pounds for each axle except for the front axle. The legal gross weight on an 11 axle can be up to 164,000 if it has the proper tire and axle spacing configuration.

Table 7-2 is generated with a column for every vehicle class 4 or higher that represents 10 percent or more of the truck (class 4-20) population. In creating Table 7-2 the following definitions are used:

- Class 9 overweights are defined as the percentage of vehicles greater than 88,000 pounds
- Class 9 underweights are defined as the percentage of vehicles less than 20,000 pounds.
- Class 9 unloaded peak is the bin less than 44,000 pounds with the greatest percentage of trucks.
- Class 9 loaded peak is the bin 60,000 pounds or larger with the greatest percentage of trucks.
- For all other trucks the typical axle configuration is used to determine the maximum allowable weight based on 18,000 pounds for single axles and 34,000 pounds for tandem axles. A ten percent cushion above that maximum is used to set the overweight threshold.
- For all other trucks in the absence of site specific information the computation of under weights assumes the power unit weighs 10,000 pounds and each axle on a trailer 5,000 pounds. Ninety percent of the total for the unloaded configuration is the value below which a truck is considered under weight.
- For all trucks other than class 9s that have a bi-modal distribution the unloaded peak is defined to be in a bin less than or equal to half of the allowable maximum weight.
- For all trucks other than class 9s that have a bi-modal distribution the loaded peak is defined to be in a bin greater than or equal to half of the allowable maximum weight.

There may be more than one bin identified for the unloaded or loaded peak due to the small sample size collected after validation. Where only one peak exists, the Peak rather

than a loaded or unloaded peak is identified. This may happen with single unit trucks. It is not expected to occur with combination vehicles.

Table 7-2 GVW Characteristics of Major sub-groups of Trucks - 260100 – 11-Jul-2006

Characteristic	Class 13	Class 9	Class 5
Percentage Overweights	4.0%	0.0%	0.0
Percentage Underweights	0.0%	0.0%	0.0
Unloaded Peak	52,000 lbs	36,000 lbs	
Loaded Peak	156,000 lbs	84,000 lbs	
Peak			12,000 lbs

The expected percentage of unclassified vehicles is 1.4%. This is based on the percentage of unclassified vehicles in the post-validation data download. The Class 15 trucks at this site are largely one or two trailer truck combinations with short trailer axle spacings (less than 3.9 feet).

The graphical screening comparison figures are found in Figure 7-1 through Figure 7-5. These are based on data collected immediately after the validation and may not be wholly representative of the population at the site. They should however provide a sense of the statistics expected when SPS comparison data is computed for the post-validation Sheet 16.

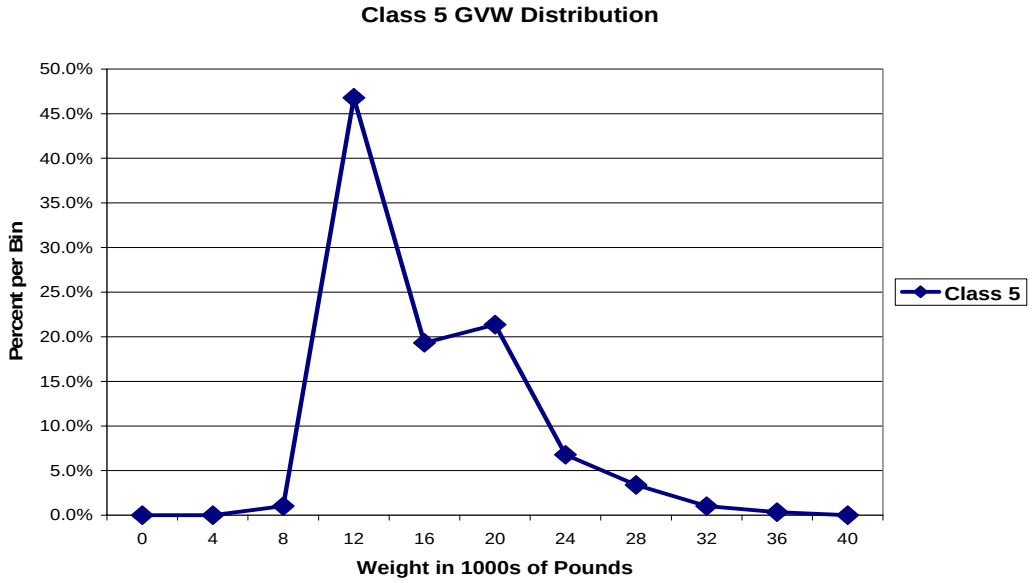

Figure 7-1 Expected GVW Distribution Class 5 – 260100 – 11-Jul-2006

Figure 7-2 Expected GVW Distribution Class 9 – 260100 – 11-Jul-2006

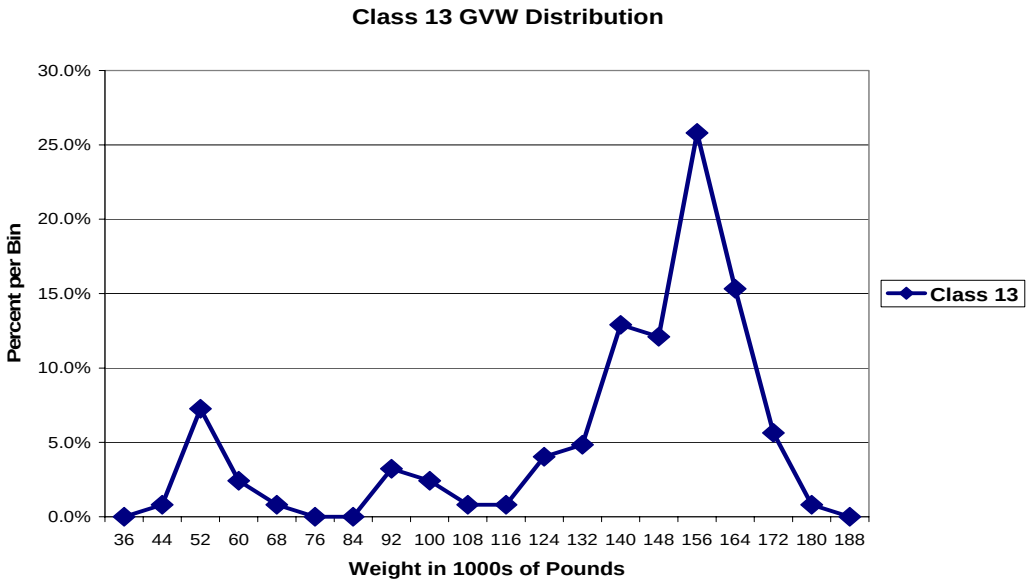

Figure 7-3 Expected GVW Distribution Class 13 – 260100 – 11-Jul-2006

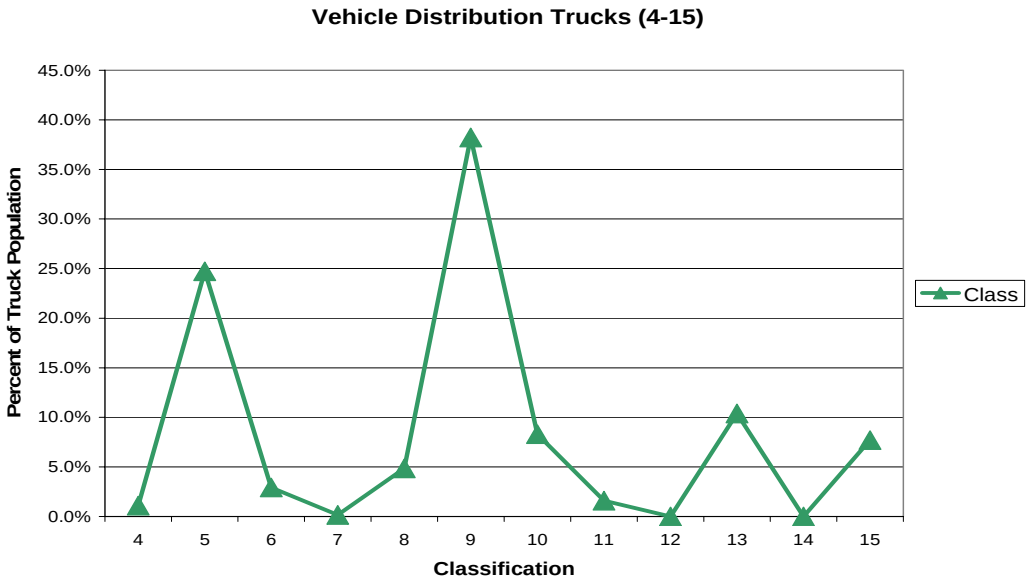

Figure 7-4 Expected Vehicle Distribution - 260100 – 11-Jul-2006

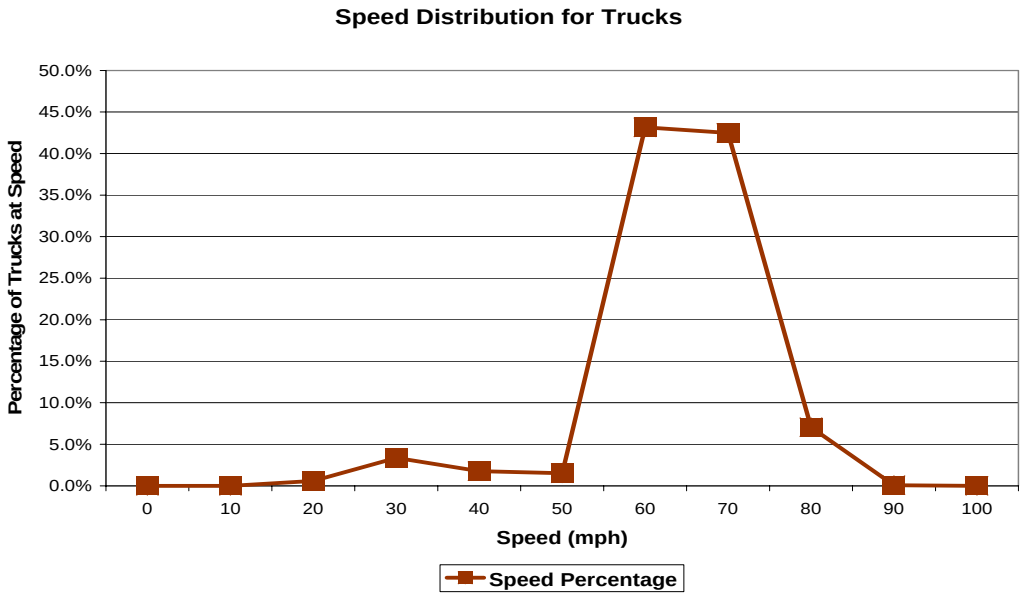

Figure 7-5 Expected Speed Distribution - 260100 – 11-Jul-2006

8 Data Sheets

The following is a listing of data sheets incorporated in Appendix A.

Sheet 19 – Truck 1 – 3S2 loaded air suspension (4 pages)
Sheet 19 – Truck 2 – 3S2 loaded air suspension (4 pages)

Sheet 20 – Speed and Classification verification – Post-Validation (3 pages)

Sheet 21 – Post-Validation (3 pages)

Test Truck Photographs – (6 pages)

Michigan Modified FHWA 13 bin Classification Scheme (1 page)

Final Site Factors (1 page)

9 Updated Handout Guide and Sheet 17

A copy of the handout has been included following page 19. It includes a current Sheet 17 with all applicable maps and photographs. There are no significant changes in the information provided.

10 Updated Sheet 18

A current Sheet 18 indicating the contacts, conditions for assessments and evaluations has been attached following the updated handout guide.

11 Traffic Sheet 16

The Sheet 16 for the Post-Validation conditions is attached following the current Sheet 18 information at the very end of the report.

APPENDIX A

Sheet 19	* STATE_CODE	26
LTPP Traffic Data	* SPS PROJECT ID	0100 10199
*CALIBRATION TEST TRUCK # 1	* DATE	7/11/06

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PART I.

1.* FHWA Class 9 2.* Number of Axles 5

AXLES - units - lbs / 100s lbs / kg

	3. Empty Truck Axle Weight	4.* Pre-Test Average Loaded Axle Weight	5.* Post-Test Average Loaded Axle Weight	6.* Measured D)irectly or C)alculated?
A		10840	10660	D / C
B		17250	17140	D / C
C		17250	17140	D / C
D		16020	16030	D / C
E		16020	16030	D / C
F				D / C

GVW (same units as axles)

7. a) Empty GVW _____

*b) Average Pre-Test Loaded weight 77370
*c) Post Test Loaded Weight 77000
*d) Difference Post Test – Pre-test -370

GEOMETRY

8 a) * Tractor Cab Style - Cab Over Engine / Conventional b) * Sleeper Cab? (Y) / N

9. a) * Make: Peterbilt b) * Model: 379

10.* Trailer Load Distribution Description:

evenly distributed bag fertilizer

11. a) Tractor Tare Weight (units): _____

b). Trailer Tare Weight (units): _____

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12.* Axle Spacing – units m / feet and inches / feet and tenths

A to B 19.5' B to C 4.3' C to D 35.8'

D to E 4.0' E to F _____

Wheelbased (measured A to last) _____ Computed _____

13. *Kingpin Offset From Axle B (units) 2.1' (_____)
(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	11R22.5	2 leaf
B	11R22.5	air
C	11R22.5	air
D	275/80R 22.5	air
E	295/75R 22.5	air
F		

16. Cold Tire Pressures (psi) – from right to left

Steering Axle	Axle B	Axle C	Axle D	Axle E

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PART II

Table 1. Axle and GVW computations - pre-test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI- VII		VII- VIII		VIII- IX		IX`		X	
										XI	
Avg.											

Table 2. Raw Axle and GVW measurements

Axles	Meas.	Pre-test Weight			Post-test Weight
A	I				
A + B	II				
A + B + C	III				
A + B + C + D	IV				
A + B + C + D + E (1)	V				
B + C + D + E	VI				
C + D + E	VII				
D + E	VIII				
E	IX				
A + B + C + D + E (2)	X				
A + B + C + D + E (3)	XI				

Table 3. Axle and GVW computations - post -test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI- VII		VII- VIII		VIII- IX		IX`		X	
										XI	
Avg.											

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Table 4 . Axle and GVW computations -

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI- VII		VII- VIII		VIII- IX		IX`		X	
										XI	
Avg.											

Table 5. Raw data – Axle scales – pre-test - day 1 - 7/11/06

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10820	17280	17280	16010	16010		77400
2	10840	17230	17230	16020	16020		77340
3	10860	17230	17230	16020	16020		77360
Average	10840	17250	17250	16020	16020		77370

Table 6. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Table 7. Raw data – Axle scales – post-test - day 1 - 7/11/06

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	10660	17140	17140	16030	16030		77000
2							
3							
Average	10660	17140	17140	16030	16030		77000

Measured By WJC Verified By DJW

Sheet 19	* STATE CODE	26
LTPP Traffic Data	* SPS PROJECT ID	0100 | 0199
*CALIBRATION TEST TRUCK # 2	* DATE	07 | 11 | 2006

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PART I.

1.* FHWA Class 09 2.* Number of Axles 5

AXLES - units - lbs / 100s lbs / kg

	3. Empty Truck Axle Weight	4.* Pre-Test Average Loaded Axle Weight	5.* Post-Test Average Loaded Axle Weight	6.* Measured D)irectly or C)alculated?
A		12330	12160	D / C
B		15390	15330	D / C
C		15390	15330	D / C
D		11190	11200	D / C
E		11190	11200	D / C
F				D / C

GVW (same units as axles)

7. a) Empty GVW _____

*b) Average Pre-Test Loaded weight 65470
*c) Post Test Loaded Weight 65220
*d) Difference Post Test – Pre-test -250

GEOMETRY

8 a) * Tractor Cab Style - Cab Over Engine / Conventional b) * Sleeper Cab? (Y) / N

9. a) * Make: Peterbilt b) * Model: 379

10.* Trailer Load Distribution Description:

evenly distributed bag fertilizer

11. a) Tractor Tare Weight (units): _____

b). Trailer Tare Weight (units): _____

Sheet 19	* STATE_CODE	26
LTPP Traffic Data	* SPS PROJECT ID	0100
*CALIBRATION TEST TRUCK # 2	* DATE	7/11/06

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12.* Axle Spacing – units m / feet and inches / feet and tenths

A to B 20.3' B to C 4.3' C to D 28.7'

D to E 10' E to F _____

Wheelbased (measured A to last) _____ Computed _____

13. *Kingpin Offset From Axle B (units) 1.5' (_____)
(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	11R22.5	2 leaf
B	11R22.5	air
C	11R22.5	air
D	11R22.5	air
E	11R22.5	air
F		

16. Cold Tire Pressures (psi) – from right to left

Steering Axle	Axle B	Axle C	Axle D	Axle E

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LTPP Traffic Data	* SPS PROJECT ID	9100
*CALIBRATION TEST TRUCK # 2	* DATE	7/4/06

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PART II

Table 1. Axle and GVW computations - pre-test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI-VII		VII-VIII		VIII-IX		IX`		X	
										XI	
Avg.											

Table 2. Raw Axle and GVW measurements

Axles	Meas.	Pre-test Weight			Post-test Weight
A	I				
A + B	II				
A + B + C	III				
A + B + C + D	IV				
A + B + C + D + E (1)	V				
B + C + D + E	VI				
C + D + E	VII				
D + E	VIII				
E	IX				
A + B + C + D + E (2)	X				
A + B + C + D + E (3)	XI				

Table 3. Axle and GVW computations - post -test

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI-VII		VII-VIII		VIII-IX		IX`		X	
										XI	
Avg.											

Sheet 19	* STATE_CODE	26
LTPP Traffic Data	* SPS PROJECT ID	0100
*CALIBRATION TEST TRUCK # 2	* DATE	7/11/06

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Table 4 . Axle and GVW computations -

Axle A		Axle B		Axle C		Axle D		Axle E		GVW	
I		II -I		III -II		IV -III		V -IV		V	
V -VI		VI-VII		VII-VIII		VIII-IX		IX`		X	
										XI	
Avg.											

Table 5. Raw data – Axle scales – pre-test - day 1 7/11/06

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	12320	15460	15400	11170	11170		65460
2	12360	15370	15390	11180	11190		65460
3	12320	15390	15390	11190	11190		65480
Average	12330	15390	15390	11180	11190		65470

Table 6. Raw data – Axle scales –

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1							
2							
3							
Average							

Table 7. Raw data – Axle scales – post-test - day 1 - 7/11/06

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	12160	15330	15330	11200	11200		65220
2							
3							
Average	12160	15330	15330	11200	11200		65220

Measured By WJC Verified By JdW

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LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 1 of* 3	* DATE	07/11/2006

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pre-validation

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
60	9	4360	59	9	58	9	4848	58	9
60	5	4368	60	5	66	9	4870	65	9
55	5	4392	55	5	61	13	4884	61	13
59	9	4399	57	9	59	9	4901	60	9
58	10	4401	57	10	55	6	4906	54	6
60	13	4432	60	13	59	9	4918	58	9
56	9	4483	56	9	59	9	4933	60	9
56	5	4499	55	5	62	9	4963	62	9
60	5	4514	60	5	57	5	4973	58	5
61	10	4533	61	10	61	10	5017	61	10
60	9	4543	58	9	57	9	5020	56	9
70	3	4563	71	3	56	9	5026	55	9
62	10	4584	62	10	63	9	5038	63	9
63	9	4606	64	9	62	9	5057	62	9
58	10	4613	57	18	53	13	5072	52	13
66	3	4625	66	3	53	9	5074	52	9
67	3	4645	67	3	54	13	5081	53	13
47	13	4683	46	13	60	9	5082	59	9
63	9	4718	61	9	62	9	5103	62	9
54	9	4745	54	9	57	7	5108	56	9
57	8	4752	58	8	59	9	5119	59	9
57	4	4755	57	5	64	13	5130	63	13
60	9	4783	58	9	60	5	5135	59	9
61	10	4810	60	10	60	9	5159	59	9
61	7	4814	60	7	61	9	5171	60	9

Recorded by WJC Direction S Lane 4 Time from 9:24 AM to 10:19

① S called a 4 (passing)

Verified

Sheet 20	* STATE_CODE	26
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 2 of* 3	* DATE	07/11/2006

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pre-validation

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
65	6	5174	65	6	59	9	5826	59	9
60	10	5186	59	10	57	9	5855	57	9
61	5	5212	61	5	62	9	5899	60	9
62	4	5233	61	5	58	9	5921	58	9
65	5	5303	65	3	56	5	5953	55	5
60	9	5327	59	9	57	5	5956	56	9
63	13	5329	63	13	59	5	5964	59	5
61	3	5419	61	3	60	9	6036	59	9
60	8	5427	59	8	55	10	6038	54	10
56	5	5430	55	5	62	5	6040	61	5
62	6	5503	61	6	62	6	6048	60	6
59	13	5522	58	13	58	5	6051	57	9
55	9	5531	55	9	63	9	6060	62	9
57	5	5561	57	5	57	13	6065	57	13
61	9	5625	61	9	59	5	6113	58	5
59	9	5630	59	9	57	10	6130	55	10
61	9	5681	60	9	63	13	6149	63	13
59	13	5730	58	13	59	10	6161	59	10
57	9	5739	56	9	55	10	6198	54	10
53	9	5741	52	9	56	9	6327	55	9
57	5	5750	56	5	60	13	6339	59	13
57	13	5780	56	13	55	9	6345	54	9
58	9	5801	56	9	60	9	6359	60	9
56	13	5804	56	13	57	13	6370	57	13
66	6	5816	65	6	57	5	6371	56	5

Recorded by WJC Direction S Lane 4 Time from 10:15 to 11:35

① 5 called a 4 (passing)
① 3 called a 5 (axles)

verified

Sheet 20	* STATE_CODE	26
LTPP Traffic Data	*SPS PROJECT_ID	0100
Speed and Classification Checks * 3 of* 3	* DATE	07/11/2006

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pre-validation

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
54	10	6380	55	10					
56	13	6387	56	13					
58	6	6411	57	6					
53	13	6417	53	13					

Recorded by WJC Direction S Lane 4 Time from 11:15 to 11:30

5 called 4 - 2
3 called 5 - 1

verified SPC

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LTPP Traffic Data	*SPS PROJECT_ID	0100
WIM System Test Truck Records 1 of 3	* DATE	/ /

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pre-validation

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A right / left weight.	Axle B right / left weight.	Axle C right / left weight.	Axle D right / left weight.	Axle E right / left weight.	Axle F right / left weight.	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
93	40	1	1	13:20:21	8367	41	6.9 / 5.2	7.4 / 9.1	7.9 / 9.1	7.8 / 8.1	7.3 / 8.10		72.8	19.5	4.3	36.0	4.1	
93	43	2	1	13:22:56	8467	43	6.3 / 6.2	8.2 / 8.3	8.0 / 9.6	5.1 / 5.2	5.1 / 6.9		69.3	20.3	4.3	28.7	10	
93	48	2	2	13:32:22	8634	49	6.6 / 5.9	8.4 / 8.0	8.2 / 8.6	5.4 / 6.6	5.6 / 5.9		66.0	20.3	4.3	28.6	10	
94.5	60	1	2	13:40:27	8777	60	5.9 / 5.8	8.3 / 8.8	8.4 / 8.8	7.4 / 7.8	7.3 / 7.8		78.3	19.5	4.3	35.8	4	
94.5	59	2	3	13:42:58	8825	59	6.4 / 5.0	8.2 / 8.2	7.0 / 8.0	5.3 / 6.2	5.3 / 5.4		66.0	20.2	4.3	28.6	10	
93	40	1	3	13:51:30	8989	40	5.4 / 5.1	8.1 / 8.4	7.8 / 8.9	8.2 / 7.9	7.4 / 7.4		74.6	19.5	4.3	35.8	4.1	
93	41	2	4	13:53:30	9028	41	6.3 / 6.3	8.1 / 8.1	7.6 / 8.9	5.3 / 5.5	5.2 / 5.4		69.9	20.3	4.3	28.7	10	
93	50	1	4	14:01:36	9182	50	5.3 / 5.4	8.0 / 8.2	8.2 / 8.2	7.6 / 7.6	7.7 / 8.5		81.9	19.5	4.3	35.9	4	
93	48	2	5	14:03:33	9216	49	6.7 / 5.6	8.6 / 8.7	8.4 / 8.9	5.5 / 5.8	5.8 / 5.2		65.0	20.2	4.3	28.5	9.9	
93	60	1	5	14:11:11	9360	60	5.9 / 5.6	8.6 / 9.1	8.7 / 8.6	8.5 / 8.7	8.1 / 7.4		78.3	19.4	4.3	35.8	4	
93	58	2	6	14:13:04	9399	59	6.5 / 6.4	8.1 / 8.8	8.3 / 8.8	5.6 / 5.4	5.3 / 5.5		65.1	20.2	4.2	28.5	10	
93	41	1	6	14:22:54	9572	40	5.8 / 5.2	7.9 / 9.0	7.9 / 8.9	7.6 / 8.3	7.6 / 9.0		76.4	19.4	4.3	35.8	4.1	
91	40	2	7	14:29:03	9609	41	6.3 / 6.5	7.9 / 6.9	9.3 / 8.9	5.4 / 5.6	5.2 / 5.3		63.9	20.4	4.3	28.7	10	
91	50	1	7	14:31:34	9739	49	5.7 / 5.8	8.3 / 8.6	7.9 / 8.1	8.0 / 8.3	6.9 / 7.1		77.7	19.4	4.3	35.8	4	
91	48	2	8	14:33:53	9780	49	6.4 / 6.1	8.7 / 8.9	8.1 / 8.0	5.4 / 5.6	5.6 / 5.2		64.8	20.3	4.3	28.6	10	
91	60	1	8	14:41:49	9932	60	5.8 / 5.4	8.3 / 8.9	8.8 / 8.8	8.3 / 8.8	7.6 / 7.6		76.6	19.4	4.3	35.9	4.1	

Recorded by WJC

Checked by

Sheet 21	* STATE_CODE 26
LTPP Traffic Data	*SPS PROJECT_ID 0100
WIM System Test Truck Records 2 of 3	* DATE ___/___/_____

Rev. 08/31/2001

pre-validation

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A right / left weight.	Axle B right / left weight.	Axle C right / left weight.	Axle D right / left weight.	Axle E right / left weight.	Axle F right / left weight.	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
93	59	2	9	14:49:[illegible]	9962	59	6.2 / 6.4	8.5 / 8.4	7.3 / 8.1	5.3 / 5.4	5.5 / 5.3		66.9	20.3	4.3	28.9	10	
93	41	1	9	14:51:49	10140	40	5.9 / 5.0	8.0 / 8.1	8.1 / 8.1	6.0 / 8.2	7.6 / 7.8		96.8	19.5	4.3	35.9	4.1	
93.5	39	2	10	14:55:59	10225	41	6.2 / 6.0	7.9 / 7.9	7.8 / 7.5	5.6 / 5.6	5.4 / 5.5		63.0	20.4	4.3	28.8	10	
93.5	51	1	10	15:03:19	10396	51	5.3 / 5.0	8.2 / 8.3	8.1 / 8.1	7.1 / 7.8	7.6 / 7.6		76.5	19.5	4.3	35.9	4.1	
93.5	49	2	11	15:05:59	10443	49	6.4 / 6.1	8.0 / 8.2	7.8 / 8.1	5.1 / 5.8	5.2 / 5.3		63.6	20.3	4.3	28.7	10	
93.5	60	1	11	15:14:26	10641	60	5.9 / 5.6	8.3 / 8.0	8.5 / 8.4	7.5 / 7.9	7.4 / 7.9		78.4	19.5	4.3	35.8	4	
96	57	2	12	15:16:05	10677	57	6.3 / 6.3	8.3 / 8.6	8.3 / 8.4	5.5 / 5.5	5.6 / 5.2		65.2	20.3	4.3	28.7	10.1	
96	41	1	12	15:24:58	10901	40	5.9 / 5.3	8.1 / 8.0	8.1 / 8.1	8.1 / 8.4	8.1 / 8.4		74.6	19.5	4.3	35.9	4.1	
96	40	2	13	15:27:07	10952	40	6.4 / 6.2	7.9 / 8.3	7.8 / 8.3	4.9 / 5.4	5.1 / 5.2		64.1	20.3	4.3	28.7	10	
96	49	1	13	15:35:42	11124	50	5.6 / 5.5	8.1 / 8.2	8.1 / 8.2	8.1 / 8.4	8.0 / 8.2		76.6	19.5	4.3	35.7	4	
95	50	2	14	15:38:01	11187	51	6.6 / 6.1	8.6 / 8.6	8.0 / 8.2	5.7 / 6.1	5.2 / 5.6		66.4	20.3	4.3	28.6	10	
95	60	1	14	15:45:46	11351	60	5.4 / 5.5	8.1 / 8.1	8.1 / 8.9	8.1 / 8.4	8.3 / 8.0		78.5	19.4	4.3	35.9	4	
95	59	2	15	15:48:56	11407	59	6.3 / 6.3	8.3 / 8.4	8.0 / 8.2	5.8 / 5.4	5.9 / 5.0		67.0	20.3	4.3	28.6	10	
95	45	1	15	15:56:15	11586	45	5.6 / 5.3	8.1 / 8.1	8.2 / 8.4	8.2 / 8.2	7.5 / 8.1		76.2	19.5	4.3	35.9	4.1	
94	41	2	16	16:00:01	11656	42	6.3 / 6.1	8.3 / 8.4	7.6 / 7.8	5.5 / 5.8	5.1 / 5.3		64.8	20.3	4.3	28.6	10	
94	51	1	16	16:07:[illegible]	11814	51	5.2 / 5.4	8.1 / 8.1	7.8 / 8.0	8.0 / 8.1	8.0 / 8.1		76.5	19.5	4.3	36.[illegible]	4	

Recorded by WLC

Checked by

Sheet 21	* STATE_CODE 26
LTPP Traffic Data	*SPS PROJECT_ID 0100
WIM System Test Truck Records 3 of 3	* DATE / /

Rev. 08/31/2001

pre-validation

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A right / left weight.	Axle B right / left weight.	Axle C right / left weight.	Axle D right / left weight.	Axle E right / left weight.	Axle F right / left weight.	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
94	49	2	17	16:10:26	11891	49	6.0 / 5.1	6.5 / 5.0	8.0 / 7.4	5.3 / 5.0	5.3 / 5.5		64.8	20.3	4.3	29.7	10	
94	60	1	17	16:16:40	12025	61	5.4 / 5.2	8.2 / 8.5	8.9 / 8.0	8.4 / 8.4	8.8 / 7.7		75.7	19.5	4.3	35.9	4	
91.8	59	2	18	16:20:50	12106	60	6.3 / 6.3	6.4 / 6.8	6.5 / 6.9	5.8 / 6.5	5.6 / 5.2		65.3	20.2	4.3	29.6	10	
91.5	50	1	18	16:3[illegible]	12471	50	5.4 / 5.5	7.9 / 8.5	8.0 / 8.5	6.1 / 7.9	7.3 / 7.6		75.2	19.4	4.3	35.8	4	
84	49	2	19	16:40:[illegible]	12513	50	6.2 / 5.9	8.0 / 6.5	7.2 / 6.8	5.3 / 6.0	5.2 / 5.2		63.3	20.3	4.3	29.7	10	
91.5	41	1	19	16:28:10	12253	41	6.7 / 6.2	7.9 / 8.9	7.9 / 8.7	6.1 / 6.3	7.1 / 8.0		75.7	19.4	4.3	35.8	4.1	
80	59	2	20	16:51:14	12745	60	6.2 / 5.1	9.1 / 6.9	8.7 / 6.3	5.7 / 5.1	5.6 / 4.7		64.8	20.2	4.3	28.6	10	
80	40	1	20	17:06:22	12953	40	5.4 / 5.2	8.9 / 8.6	7.5 / 6.9	7.9 / 8.4	7.5 / 8.3		75.5	19.4	4.3	35.8	4.1	

Recorded by Wje

Checked by

TEST TRUCK PHOTOS FOR SPS WIM FIELD VALIDATION

STATE: Michigan

SHRP ID: 0100

Truck_1_Tractor_TO_14_26_2.63_0100_07_11_06.jpg

Truck_1_Trailer_TO_14_26_2.63_0100_07_11_06.jpg

Truck_1_Suspension_1_TO_14_26_2.63_0100_07_11_06.jpg

Truck_1_Suspension_2_TO_14_26_2.63_0100_07_11_06.jpg

Truck_1_Suspension_3_TO_14_26_2.63_0100_07_11_06.jpg

Truck_2_Tractor_TO_14_26_2.63_0100_07_11_06.jpg

Truck_2_Trailer_TO_14_26_2.63_0100_07_11_06.jpg

Truck_2_Suspension_1_TO_14_26_2.63_0100_07_11_06.jpg

Truck_2_Suspension_2_TO_14_26_2.63_0100_07_11_06.jpg

Truck_2_Suspension_3_TO_14_26_2.63_0100_07_11_06.jpg

Michigan Dept of Transportation Classification and Weight Parameters for WIM

ass	Vehicle Description	# axles	Spacing 1	Spacing 2	Spacing 3	Spacing 4	Spacing 5	Spacing 6	Spacing 7	Spacing 8	Spacing 9	Spacing 10	Weight Min-Max
1	Motorcycle	2	0.1-6.0										100-3000
2	Car	2	6.0-10.1										1000-8000
3	Truck	2	10.1-16.0										1000-8000
4	Bus	2	21.09-40.0										12000 >
5	2D	2	8.0-21.09										8000 >
2	Car / 1 Axle Trailer	3	6.0-10.1	6.0-30.0									1000-12000
3	Truck / 1 Axle Trailer	3	10.1-16.0	6.0-30.0									1000-15000
4	Bus	3	21.09-40	3.0-7.0									20000 >
5	2D / 1 Axle Trailer	3	8.0-21.09	6.3-30.0									15000-12000
6	3 Axle Single Unit	3	8.0-26.0	2.5-6.3									12000 >
8	Semi 2-1	3	8.0-23.09	11.0-40.0									20000 >
2	Car / 2 Axle Trailer	4	6.0-10.1	6.0-30.0	1.0-11.99								1000-12000
3	Truck / 2 Axle Trailer	4	10.1-16.0	6.0-30.0	1.0-11.99								1000-15000
5	2D / 2 Axle Trailer	4	8.0-23.09	6.3-30.0	1.0-11.99								15000-20000
7	4 Axle Single Unit	4	8.0-23.09	2.5-6.3	2.5-13.0								12000 >
8	Semi 2-2	4	8.0-23.09	11.0-45.0	2.5-11.99								20000 >
8	Semi 3-1	4	8.0-26.00	2.5-6.3	6.1-45.0								20000 >
3	Truck / 3 Axle Trailer	5	10.1-16.0	6.0-30.0	1.0-11.99	1.0-11.99							1000-15000
7	5 Axle Single Unit	5	8.0-23.09	2.5-6.3	2.5-6.3	2.5-6.3							12000 >
9	Semi 3-2	5	8.0-26.0	2.5-6.3	6.0-45.0	2.5-27.0							20000 >
9	Semi 2-3	5	8.0-23.09	11.0-45.0	2.5-6.3	2.5-6.3							20000 >
11	Semi 2-1-2	5	8.0-26.0	11.0-26.0	6.0-20.0	11.0-26.0							12,000 >
10	Semi 3-3	6	8.0-26.0	2.5-6.3	6.1-45.0	2.5-11.99	2.5-11.99						20,000 >
10	Semi 2-4	6	8.0-23.09	11.0-45.0	2.5-6.3	2.5-6.3	2.5-6.3						20,000 >
10	Semi 4-2	6	8.0-26.0	2.5-6.3	2.5-6.3	6.1-46.0	2.5-11.99						20,000 >
12	Semi 3-1-2	6	8.0-26.0	2.5-6.3	11.0-26.0	6.0-24.0	11.0-26.0						12,000 >
10	Semi 3-4	7	8.0-26.0	2.5-6.3	10.0-20.0	6.0-12.0	6.0-12.0	6.0-12.0					20,000 >
10	Semi 3-4	7	8.0-26.0	2.5-6.3	3.5-45.0	2.5-12.0	2.5-6.3	2.5-6.3					20,000 >
13	Semi 3-*-*	7	8.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0					20,000 >
10	Semi 3-5	8	8.0-26.0	2.5-6.3	3.5-45.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3				20,000 >
10	Semi 3-5	8	8.0-26.0	2.5-6.3	10.0-20.0	6.0-12.0	2.5-6.3	2.5-6.3	2.5-6.3				20,000 >
13	Semi 3-*-*	8	8.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0				20,000 >
10	Semi 3-6	9	8.0-26.0	2.5-6.3	3.5-45.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3			20,000 >
10	Semi 3-6	9	8.0-26.0	2.5-6.3	10.0-20.0	6.0-12.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3			20,000 >
10	Semi 4-5	9	8.0-26.0	2.5-6.3	2.5-6.3	6.3-15.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3			20,000>
13	Semi 3-*-*	9	8.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0			20,000 >
10	Semi 3-7	10	8.0-26.0	2.5-6.3	3.5-45.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3		20,000 >
10	Semi 3-7	10	8.0-26.0	2.5-6.3	10.0-20.0	6.0-12.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3		20,000 >
10	Semi 4-6	10	8.0-26.0	2.5-6.3	2.5-6.3	6.3-15.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3		20,000>
10	Semi 5-5	10	8.0-26.0	2.5-6.3	2.5-6.3	2.5-6.3	6.3-15.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3		20,000>
13	Semi 3-*-*	10	8.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0		20,000 >
10	Semi 3-8	11	8.0-26.0	2.5-6.3	3.5-45.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	20,000 >
10	Semi 3-8	11	8.0-26.0	2.5-6.3	10.0-20.0	6.0-12.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	20,000 >
10	Semi 5-6	11	8.0-26.0	2.5-6.3	2.5-6.3	2.5-6.3	6.3-15.0	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	2.5-6.3	20,000>
13	Semi 3-*-*	11	8.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	3.0-45.0	20,000 >

1

```
Weight select:  lbs
Length select:  feet
Speed  select:  mph

Number of Lanes: 4
Station code    : 317
Station name    :  ST JOHNS

Lane  1:
Lane sensor config.    [0-9,A,B]: B
Loop 1 input channel            : 1
Loop 2 input channel            : 0
Piezo 1 Input Channel   [0,1-16]: 1
Piezo 2 Input Channel   [0,1-16]: 2
Piezo 3 Input Channel   [0,1-16]: 0
Piezo 4 Input Channel   [0,1-16]: 0
Distance Piezo 1 - Piezo 2      : 1010
Length of Loop 1                : 600
Loop delay constant     [%]     : 30

Lane  2:
Lane sensor config.    [0-9,A,B]: B
Loop 1 input channel            : 2
Loop 2 input channel            : 0
Piezo 1 Input Channel   [0,1-16]: 3
Piezo 2 Input Channel   [0,1-16]: 4
Piezo 3 Input Channel   [0,1-16]: 0
Piezo 4 Input Channel   [0,1-16]: 0
Distance Piezo 1 - Piezo 2      : 1000
Length of Loop 1                : 600
Loop delay constant     [%]     : 30

Lane  3:
Lane sensor config.    [0-9,A,B]: B
Loop 1 input channel            : 3
Loop 2 input channel            : 0
Piezo 1 Input Channel   [0,1-16]: 5
Piezo 2 Input Channel   [0,1-16]: 6
Piezo 3 Input Channel   [0,1-16]: 0
Piezo 4 Input Channel   [0,1-16]: 0
Distance Piezo 1 - Piezo 2      : 1000
Length of Loop 1                : 600
Loop delay constant     [%]     : 30

Lane  4:
Lane sensor config.    [0-9,A,B]: B
Loop 1 input channel            : 4
Loop 2 input channel            : 0
Piezo 1 Input Channel   [0,1-16]: 7
Piezo 2 Input Channel   [0,1-16]: 8
Piezo 3 Input Channel   [0,1-16]: 0
Piezo 4 Input Channel   [0,1-16]: 0
Distance Piezo 1 - Piezo 2      : 1000
Length of Loop 1                : 600
Loop delay constant     [%]     : 30
```

```
Mode:
Mode:2
Weight select:  lbs
Length select:  feet
Speed  select:  mph
Weight limit front axle  : 1600
Weight limit single axle : 1800
Weight limit tandem axle : 3400
Weight limit triple axle : 3900
Distinction single / multiple axles,
           upper distance:  800
           lower distance:  250
Registration of overloaded vehicles.
Overload threshold             :  0
Reg. Vehicle, lim. front axle :  300
Registr. Vehicle Type (0..15) :  4
Inbalance percentage           :  40
Wheel weight low (inbalance)   :  200
Speed maximum                  :  7000
Axle Detection Timeout         :  1
Max. Detection Timeout         :  1200
Minimum detuning for default vehicle (0-9999): 250
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:5
   DAW190 USA 3.097 Aug 23 2005 08:24:55
   HW Version V5  CT5
   US-Michigan classes
   Available memory: 4 MB
   Axles detected: 13  Axles Stored: 13
   Modem connection.
   Event logging OFF

Event logging ?  (Y/N) : N

Baudrate Direct:  [BPS]:      19200
Baudrate Modem :  [BPS]:      19200

Length in  m  ?  (Y/N) : N
Speed in km/h ?  (Y/N) : N
Weight in kg  ?  (Y/N) : N
Temperature in (F/C/K) : F

Peak limit piezo board 1: 6
Peak limit piezo board 2: 9
Configuration for Temperature compensation curve
Temperature Offset (250-750): 500
```

Kelvin (0-500): 262
Factor (100-9999): 1013
Kelvin (0-500): 276
Factor (100-9999): 990
Kelvin (0-500): 282
Factor (100-9999): 965
Kelvin (0-500): 300
Factor (100-9999): 951
Kelvin (0-500): 308
Factor (100-9999): 954
Kelvin (0-500): 330
Factor (100-9999): 945
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:
Mode:0
Weight select: lbs
Length select: feet
Speed select: mph

Lane 1
Sensitivity Piezo 1 : 1030
Sensitivity Piezo 2 : 970
Sensitivity : 878
Frontaxle Corr-Factor : 1030
Lin 0 kips Corr-Factor : 1000
Speed Corr-Factor 1 : 986
Speed Corr-Factor 2 : 1001
Speed Corr-Factor 3 : 1003
Speed Point 1 : 4500
Speed Point 2 : 5500
Speed Point 3 : 6500

Lane 2
Sensitivity Piezo 1 : 1000
Sensitivity Piezo 2 : 1000
Sensitivity : 839
Frontaxle Corr-Factor : 1035
Lin 0 kips Corr-Factor : 1000
Speed Corr-Factor 1 : 1026
Speed Corr-Factor 2 : 1029
Speed Corr-Factor 3 : 1005
Speed Point 1 : 4500
Speed Point 2 : 5500
Speed Point 3 : 6500

Lane 3
Sensitivity Piezo 1 : 950
Sensitivity Piezo 2 : 1050
Sensitivity : 882
Frontaxle Corr-Factor : 1007
Lin 0 kips Corr-Factor : 1000

```
Speed Corr-Factor 1      : 984
Speed Corr-Factor 2      : 1006
Speed Corr-Factor 3      : 1020
Speed Point 1            : 4500
Speed Point 2            : 5500
Speed Point 3            : 6500

Lane    4
Sensitivity Piezo 1      : 1010
Sensitivity Piezo 2      : 990
Sensitivity              : 820
Frontaxle Corr-Factor    : 1039
Lin 0 kips Corr-Factor   : 1000
Speed Corr-Factor 1      : 1000
Speed Corr-Factor 2      : 1014
Speed Corr-Factor 3      : 1044
Speed Point 1            : 4500
Speed Point 2            : 5500
Speed Point 3            : 6500
Mode:
Mode:
Mode:L
Configuration for Self calibration
Reference type [Class] (1-15):                9
Minimum calibration period (0-8):             1
20% Coarse change (ON/OFF):                   OFF

Calibration factor lane 1 (100-9999):         1000
Calibration factor lane 2 (100-9999):         1000
Calibration factor lane 3 (100-9999):         1000
Calibration factor lane 4 (100-9999):         1000

Mininumum gross weight [LB] (0-655340):       30000
Maximum gross weight [LB] (30000-655340):     70000
Desired front axle [LB] (0-655340):           10000
Minimum front axle [LB] (0-10000):            9800
Maximum front axle [LB] (10000-655340):       10200
Minimum vehicles (1-500):                     50

Self calibration (ON/OFF):                    OFF
Continue (ENTER/N) ?
Calibration changes:

    0   Date: 2005.12.05   22:00   Lane:  4   Factor:   785
    1   Date: 2005.12.06   07:00   Lane:  1   Factor:   856
    2   Date: 2005.12.06   08:00   Lane:  4   Factor:   821
    3   Date: 2005.12.02   09:00   Lane:  1   Factor:  1005
    4   Date: 2005.12.02   19:00   Lane:  1   Factor:   967
    5   Date: 2005.12.03   02:00   Lane:  4   Factor:   941
    6   Date: 2005.12.03   20:00   Lane:  4   Factor:   920
    7   Date: 2005.12.05   02:00   Lane:  1   Factor:   947
    8   Date: 2005.12.05   07:00   Lane:  1   Factor:   973
    9   Date: 2005.12.05   08:00   Lane:  4   Factor:   898
Mode:
Mode:
Mode:
```