Validation Report

Minnesota, SPS-5
Task Order 15, CLIN 2
November 11 and 12, 2008

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1 Executive Summary

A visit was made to the Minnesota 0500 on November 11 and 12, 2008 for the purposes of conducting a validation of the WIM system located on US 2 at 21 miles west of Bemidji. The SPS-5 is located in the righthand, westbound lane of a four-lane divided facility. The posted speed limit at this location is 65 mph. At the time of installation, all four lanes were instrumented for WIM. The LTPP lane is designated as lane number 4 by the controller. The validation procedures were in accordance with LTPP's SPS WIM Data Collection Guide dated August 21, 2001.

This is a new WIM data location for the SPS-5. It was determined by others that the site originally selected to provide data did not have the same truck traffic stream. This is the third validation visit to this location. The site was installed in August 2006 by International Road Dynamics Inc..

This site demonstrates the ability to produce research quality loading data under the observed conditions. The classification data is also currently of research quality for Traffic Monitoring Guide Classes.

The site is instrumented with quartz piezo WIM and iSINC electronics. It is installed in asphalt concrete.

The validation used the following trucks:

1) 5-axle tractor-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 77,440 lbs., the "golden" truck.
2) 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 63,900 lbs., the "partial" truck.

The validation speeds ranged from 54 to 65 miles per hour. The pavement temperatures ranged from 28 to 38 degrees Fahrenheit. The desired speed range was achieved during this validation. The desired 30 degree Fahrenheit temperature range was not achieved.

Table 1-1 - Post-Validation results – 270500 – 12-Nov-2008

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-0.4 ± 7.9%	Pass
Tandem axles	±15 percent	-0.2 ± 5.4%	Pass
GVW	±10 percent	-0.2 ± 4.6%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

Prepared: ea *Checked: bko*

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

avoidance by trucks in the sensor area. The upper threshold of the WIM index was not exceeded and 27 of the calculated indices are below the lower threshold limits.

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

Prepared: ea *Checked: bko*

Upon our arrival at the site, we found the system parameters were not the same as we left them at the conclusion of our last validation on August 28, 2007. We have no information on the rationale or reason for the parameter adjustments.

This site needs three years of data to meet the goal of five years of research quality data assuming that a complete year of data is received for 2008.

2 Corrective Actions Recommended

It is possible that the recommendation from the previous validation to replace and re-calibrate the leading WIM sensor has occurred. It was not necessary to shock the sensor to get it to function. **Additionally, different calibration factors were in place upon our arrival.**

This visit observed the same low resistance value on the leading WIM sensor which was seen on the last Validation visit. In addition a low back-up battery condition was also observed on this visit.

The leading WIM sensor should continue to be monitored. The battery condition should be monitored and the battery replaced and/or the charging circuit evaluated at the next maintenance visit.

3 Post Calibration Analysis

This final analysis is based on test runs conducted November 12, 2008 from mid-morning through early afternoon at test site 270500 on US 2. This SPS-5 site is at milepost 98.0 on the westbound, righthand of a four-lane divided facility. No auto-calibration was used during test runs. The two trucks used for the calibrations and for the subsequent validation included:

1. 5-axle tractor-trailer with a tractor having an air suspension and trailer with a standard rear tandem and air suspension loaded to 77,440 lbs., the “golden” truck.
2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 63,900 lbs., the “partial” truck.

Each truck made a total of 20 passes over the WIM scale at speeds ranging from approximately 54 to 65 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 28 to 38 degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was not achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 3-1.

The statistics in Table 3-1 indicate that the loading data meets the conditions for research quality data.

Table 3-1 - Post-Validation Results – 270500 – 12-Nov-2008

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-0.4 ± 7.9%	Pass
Tandem axles	±15 percent	-0.2 ± 5.4%	Pass
GVW	±10 percent	-0.2 ± 4.6%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

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The test runs were conducted during the mid to late morning hours under cloudy conditions, resulting in a narrow range of pavement temperatures. The runs were conducted at various speeds to determine the effects of these variables on the performance of the WIM scale. To investigate these effects, the data set was split into three speed groups and one temperature group. The distribution of runs by speed and temperature is illustrated in Figure 3-1. This figure indicates that the desired distribution of speed and temperature combinations was not achieved for this set of validation runs due to limits on the temperature range.

The three speed groups were divided as follows: Low speed – 54 to 57 mph, Medium speed – 58 to 62 mph and High speed – 63 + mph. The one temperature group was created with the runs between 28 to 38 degrees Fahrenheit called Medium temperature.

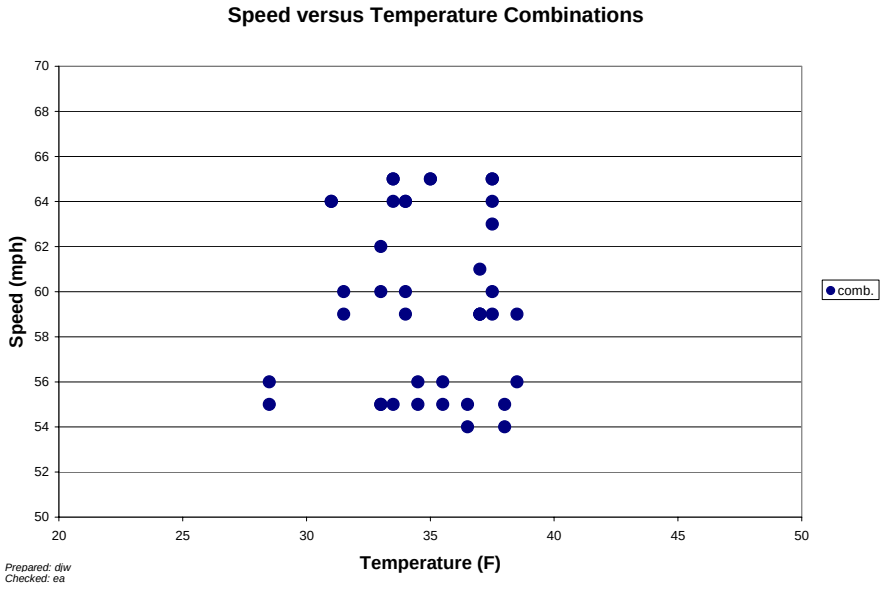

Figure 3-1 - Post-Validation Speed-Temperature Distribution – 270500 – 12-Nov-2008

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.

It can be seen from Figure 3-2 that the equipment estimates GVW with reasonable accuracy at all speeds. Variability in error is consistent throughout the entire speed range.

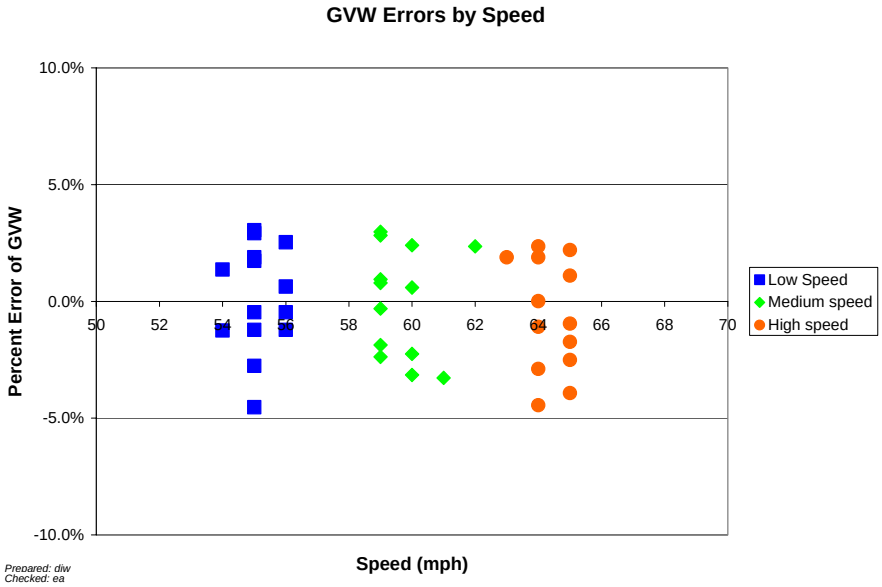

Figure 3-2 - Post-Validation GVW Percent Error vs. Speed – 270500 – 12-Nov-2008

Figure 3-3 shows the relationship between temperature and GVW percentage error. It can be seen from the figure that the equipment estimates GVW with reasonable accuracy at the observed temperatures.

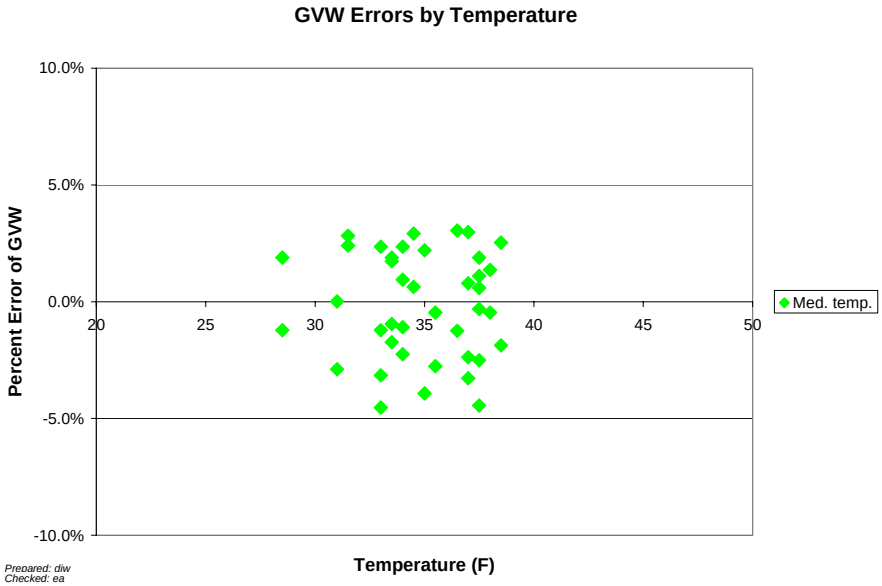

Figure 3-3 - Post-Validation GVW Percent Error vs. Temperature – 270500 – 12-Nov-2008

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. There is no apparent relationship between speed and axle spacing measurements.

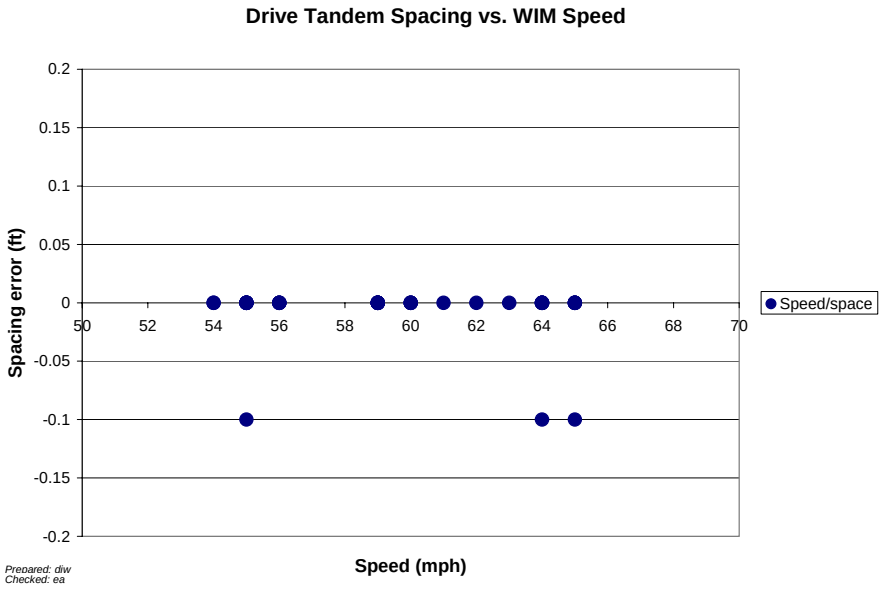

Figure 3-4 - Post-Validation Spacing vs. Speed – 270500 – 12-Nov-2008

3.1 Temperature-based Analysis

The one temperature group was created with the runs between 28 to 38 degrees Fahrenheit called Medium temperature.

Table 3-2 - Post-Validation Results by Temperature Bin – 270500 – 12-Nov-2008

Element	95% Limit	Medium Temperature 28 to 38 °F
Steering axles	±20 %	-0.4 ± 7.9%
Tandem axles	±15 %	-0.2 ± 5.4%
GVW	±10 %	-0.2 ± 4.6%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft

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As it can be seen in Table 3-2 the equipment slightly underestimates all weights at the observed temperature range.

Figure 3-5 is the distribution of GVW Errors versus Temperature by Truck graph. From the graph it can be seen that the golden truck GVW (squares) is generally underestimated. The partial truck GVW (diamonds) tends to be overestimated. There is greater scatter for the golden truck (squares) than the partial truck (diamonds).

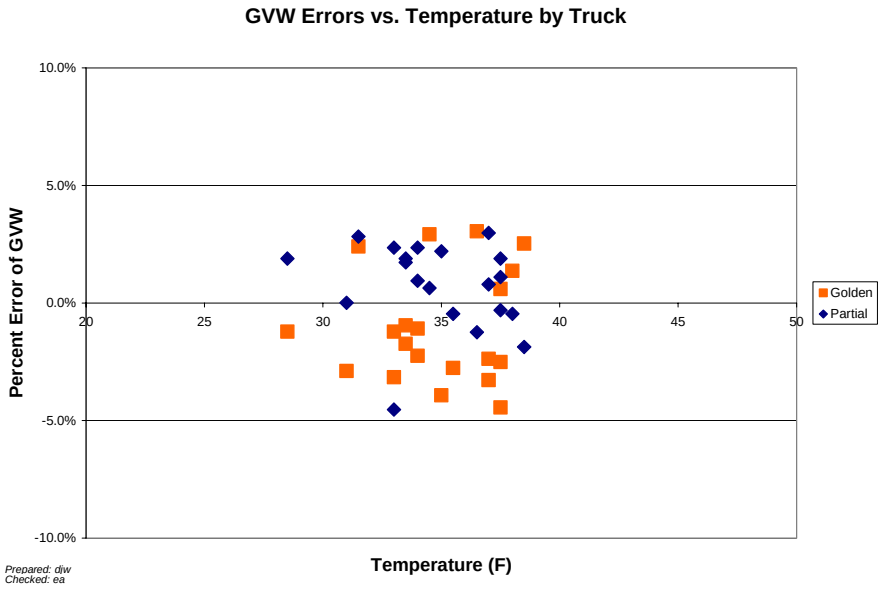

Figure 3-5 - Post-Validation GVW Percent Error vs. Temperature by Truck – 270500 – 12-Nov-2008

Figure 3-6 shows the relation between steering axle errors and temperature. 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 vehicles. As it can be seen in Figure 3-6, steering axle errors are estimated with reasonable accuracy at the observed temperature range.

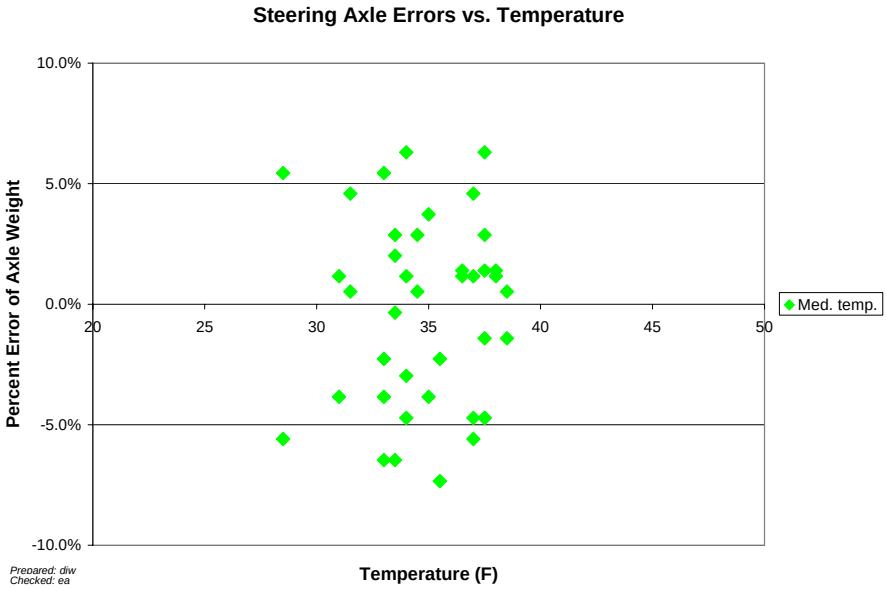

Figure 3-6 - Post-Validation Steering Axle Error vs. Temperature by Group – 270500 – 12-Nov-2008

3.2 Speed-based Analysis

The three speed groups were created using 54 to 57 mph for Low speed, 58 to 62 mph for Medium speed and 63+ mph for High speed.

Table 3-3 - Post-Validation Results by Speed Bin – 270500 – 12-Nov-2008

Element	95% Limit	Low Speed 54 to 57 mph	Medium Speed 58 to 62 mph	High Speed 63+ mph
Steering axles	±20 %	-0.5 ± 8.1%	-0.2 ± 8.2%	-0.3 ± 9.6%
Tandem axles	±15 %	0.2 ± 5.5%	0.0± 4.9%	-0.8 ± 6.2%
GVW	±10 %	0.2 ± 4.9%	0.0 ± 5.1%	-0.6 ± 5.2%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.0 ft	0.0 ± 0.1 ft

Prepared: ea *Checked: bko*

From Table 3-3 it can be seen that steering axles are underestimated at all speeds. In addition, tandem axles and GVW also tend to be underestimated at the higher speeds. Variability in error is consistent throughout the entire speed range.

From Figure 3-7 it can be seen that the golden truck (squares) tends towards underestimation from low to high speed. The partial truck (diamonds) tends towards overestimation from low to high speeds. Variability in error is consistent throughout the entire graph. The consistent variability is from a combination of errors from both trucks not similar patterns and variability for the two trucks used.

Figure 3-7 - Post-Validation GVW Percent Error vs. Speed by Truck – 270500 – 12-Nov-2008

Figure 3-8 shows the relationship between steering axle errors and speed. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for auto-calibration. This site does not use auto-calibration. The steering axles in this graph are

associated only with Class 9 vehicles. As it can be seen by the graph, the equipment estimates steering axle errors with reasonable accuracy with a slight upward trend from low to high speeds. Variability in error is similar throughout the entire speed range.

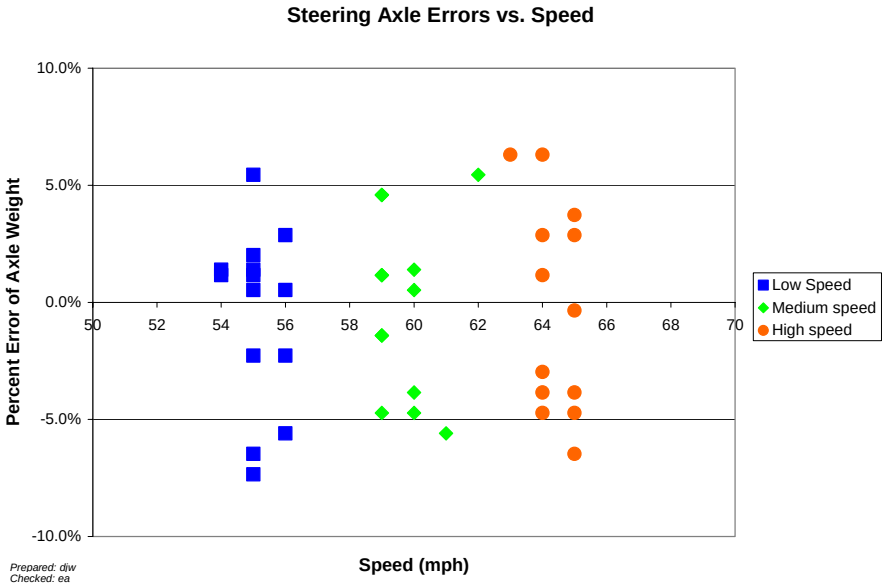

Figure 3-8 - Post-Validation Steering Axle Percent Error vs. Speed by Group – 270500 – 12-Nov-2008

3.3 Classification Validation

This LTPP installed site uses the FHWA 13-bin classification scheme and the LTPP ETG mod 3 classification algorithm. Classification 15 has been added to define unclassified vehicles.

The classification validation is intended to find gross errors in vehicle classification, not to validate the installed algorithm. A sample of three hours (28 trucks) was collected at the site. Video was taken at the site to provide ground truth for the evaluation. Based on the sample it was determined that there are zero percent unknown vehicles and zero 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 3-4 has the classification error rates by class. The overall misclassification rate is zero percent.

Table 3-4 - Truck Misclassification Percentages for 270500 – 12-Nov-2008

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

Prepared: ea *Checked: bko*

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 3-5 - Truck Classification Mean Differences for 270500 – 12-Nov-2008

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

Prepared: ea *Checked: bko*

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 (UNK) 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 vehicles of that type might actually exist. N/A means no vehicles of the class were recorded by either the equipment or the observer.

A limited investigation of the precision and bias of the speeds reported by the equipment was undertaken. The values were within the expected tolerances.

3.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 criteria 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 3-6 - 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

Prepared: ea *Checked: bko*

4 Pavement Discussion

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 on August 14, 2008 were processed through the LTPP SPS WIM Index software, version 1.1. This WIM scale is installed on a flexible pavement.

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 Regional Support Contractor 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

Prepared: als *Checked: jrn*

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 below the lower index limits are presented in italics and values above the upper index limits are presented in bold.

Table 4-2 - WIM Index Values – 270500 –14-Aug-2008

Profiler Passes			**Pass 1**	**Pass 2**	**Pass 3**	**Pass 4**	**Pass 5**	**Ave.**
Center	LWP	LRI (m/km)	*0.489*	0.553	*0.475*	*0.435*	0.506	*0.492*
		SRI (m/km)	*0.442*	0.633	*0.414*	*0.211*	*0.442*	*0.428*
		Peak LRI (m/km)	0.547	0.553	0.557	0.562	0.588	0.561
		Peak SRI (m/km)	*0.537*	0.875	*0.516*	*0.328*	0.794	*0.610*
	RWP	LRI (m/km)	0.552	0.549	0.568	0.610	0.600	0.576
		SRI (m/km)	0.500	*0.460*	0.505	0.572	0.572	0.522
		Peak LRI (m/km)	0.704	0.685	0.685	0.698	0.692	0.693
		Peak SRI (m/km)	*0.592*	*0.621*	*0.644*	0.806	0.796	*0.692*
Left Shift	LWP	LRI (m/km)	0.568	0.558	0.530			0.552
		SRI (m/km)	*0.372*	*0.367*	*0.346*			*0.362*
		Peak LRI (m/km)	0.637	0.624	0.621			0.627
		Peak SRI (m/km)	*0.465*	*0.413*	*0.458*			*0.445*
	RWP	LRI (m/km)	0.532	0.570	0.587			0.563
		SRI (m/km)	0.506	0.555	0.561			0.541
		Peak LRI (m/km)	0.564	0.584	0.623			0.590
		Peak SRI (m/km)	*0.672*	*0.702*	*0.702*			*0.692*
Right Shift	LWP	LRI (m/km)	0.567	0.581	0.584			0.577
		SRI (m/km)	0.556	0.564	0.598			0.573
		Peak LRI (m/km)	0.592	0.590	0.603			0.595
		Peak SRI (m/km)	*0.681*	*0.745*	*0.741*			*0.722*
	RWP	LRI (m/km)	0.667	0.659	0.660			0.662
		SRI (m/km)	0.551	0.685	0.763			0.666
		Peak LRI (m/km)	0.832	0.791	0.767			0.797
		Peak SRI (m/km)	*0.590*	0.754	0.835			*0.726*

Prepared: als *Checked: jrn*

From Table 4-2 it can be seen that 27 of the indices computed from the profiles are below the lower threshold values. All remaining values are between the upper and lower threshold values. Based on these results, it is unlikely that the roughness at the site would be expected to interfere with the successful validation of the scale.

The profile data evaluated was collected after the site installation. There is no profile evaluation for conditions prior to that visit since the system was newly installed or prior to the previous validation.

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, traverse 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 iSINC electronics. The sensors are installed in asphalt concrete 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. Most sensors and system components were found to be within operating parameters.

The leading WIM sensor has a low resistance value similar to the previous visit; however it was not necessary to shock the sensor to obtain readings during this visit.

During the electrical checks of the system, the back-up battery was found to be below acceptable operating tolerances. The operation of the charging circuit for the battery should be investigated.

5.2 Calibration Process

Upon our arrival at the site, we found the system parameters were not the same as we left them at the conclusion of our last Validation on August 28, 2007. Apparently the site has had equipment maintenance work or factor adjustments made remotely between our last Validation visit and this one.

The equipment required two iterations of the calibration process between the initial 40 runs and the final 40 runs.

The operating system weight compensation parameters that were in place prior to the Pre-Validation are in Table 5-1.

Table 5-1 - Initial System Parameters - 270500 - 11-Nov-2008

Speed Bin	Left Sensor 1/3	Right Sensor 2/4
65 kph	3597	3330
80 kph	3659	3388
96 kph	3640	3700
112 kph	3549	3286
125 kph	3455	3199

Prepared: ea *Checked: bko*

5.2.1 Calibration Iteration 1

As a result of the Pre-Validation, where there was consistent underestimation throughout the speed range, the compensation factors were adjusted as shown in Table 5-2.

Table 5-2 - Calibration 1 - Change in Parameters - 270500 - 12-Nov-2008

Speed Bins	Left Sensor 1/3	Change	Right Sensor 2/4	Change
65 kph	3597	N/A	3330	N/A
80 kph	3844	5.1%	3559	5.1%
96 kph	3933	8.1%	3641	8.1%
112 kph	3831	8.0%	3548	8.0%
125 kph	3455	N/A	3199	N/A

Prepared: ea *Checked: bko*

Table 5-3 - Calibration Iteration 1 - Results – 270500 – 12-Nov-2008 (08:58 AM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	1.8 ± 11.1%	Pass
Tandem axles	±15 percent	1.5 ± 5.0%	Pass
GVW	±10 percent	1.6 ± 4.6%	Pass
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	Pass

Prepared: ea *Checked: bko*

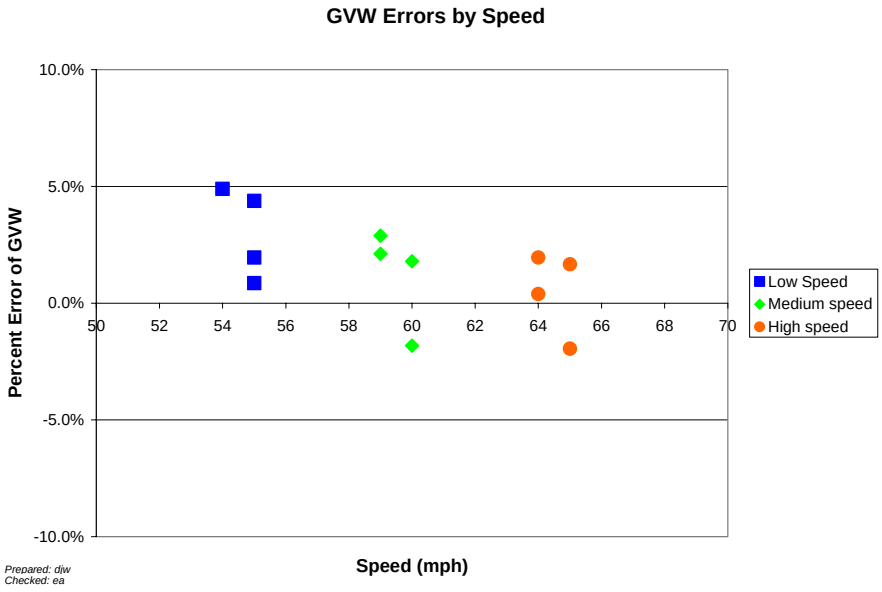

Figure 5-1 - Calibration Iteration 1 - GVW Percent Error vs. Speed Group – 270500 – 12-Nov-2008 (08:58 AM)

5.2.2 Calibration Iteration *2*

As a result of the first calibration, where the changes to the compensation factors in the first iteration did not bring the entire set of errors "equally" and therefore produced the observed trend with speed, a second calibration iteration was performed. The compensation factors were adjusted as shown in Table 5-4.

Table 5-4 - Calibration 2 - Change in Parameters - 270500- 12-Nov-2008

Speed Bins	Left Sensor 1/3	Change	Right Sensor 2/4	Change
65 kph	3597	N/A	3330	N/A
80 kph	3731	-2.9%	3454	-2.9%
96 kph	3884	-1.2%	3596	-1.2%
112 kph	3811	-1.5%	3529	-1.5%
125 kph	3455	N/A	3199	N/A

Prepared: ea *Checked: bko*

Table 5-5 - Calibration Iteration 2 Results – 270500 – 12-Nov-2008 (09:54 AM)

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	0.1 ± 7.3%	Pass
Tandem axles	±15 percent	0.5 ± 5.8%	Pass
GVW	±10 percent	0.5 ± 5.1%	Pass
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.0 ft	Pass

Prepared: ea *Checked: bko*

As shown in Table 5-5 and Figure 5-2, the calibration produced the desired results. No additional calibration iterations of the equipment were required.

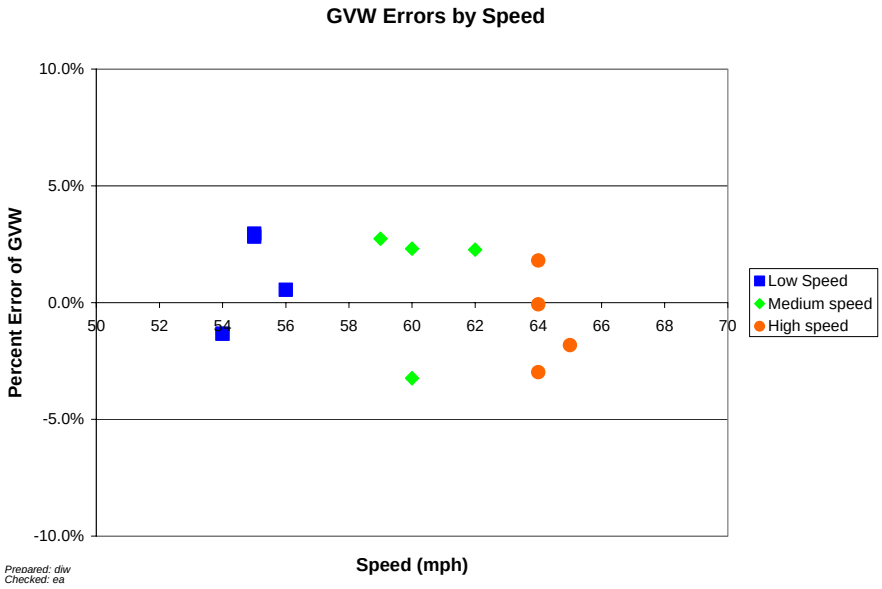

Figure 5-2 - Calibration Iteration 2 GVW Percent Error vs. Speed Group – 270500 – 12-Nov-2008 (09:54 AM)

5.3 Summary of Traffic Sheet 16s

This site has validation information from previous visits as well as the current one in the tables below. Table 5-6 has the information for TRF_CALIBRATION_AVC for Sheet 16s submitted prior to this validation as well as the information for the current visit. The Sheet 16s shown are only for this contractor's validation visits.

Table 5-6 - Classification Validation History – 270500 – 12-Nov-2008

Date	Method	Mean Difference				Percent Unclassified
		Class 9	Class 8	Other 1	Other 2	
11/12/2008	Manual	0	0	CL 5: 0	CL 6: 0	0
11/11/2008	Manual	0	UNK	CL 5: -25	CL 6: -25	0
8/29/2007	Manual	0	0			0
8/28/2007	Manual	0	-50			0
12/13/2006	Manual	0	0			0
12/12/2006	Manual	0	0			0

\Prepared: ea *Checked: bko*

Table 5-7 has the information for TRF_CALIBRATION_WIM for Sheet 16s submitted prior to this validation as well as the information for the current visit. The Sheet 16s available are only for this contractor's validation visits.

Table 5-7 - Weight Validation History – 270500 – 12-Nov-2008

Date	Method	Mean Error and (SD)		
		GVW	Single Axles	Tandem Axles
11/12/2008	Test Trucks	-0.2 (2.3)	-0.4 (3.9)	-0.2 (2.7)
11/11/2008	Test Trucks	-6.2 (2.3)	-6.6 (3.4)	-6.2 (2.6)
8/29/2007	Test Trucks	-2.6 (2.7)	-2.4 (4.6)	-2.3 (4.5)
8/28/2007	Test Trucks	-4.2 (2.9)	-4.8 (4.0)	- 3.5 (4.6)
12/13/2006	Test Trucks	3.0 (1.5)	-0.2 (3.3)	4.6 (1.8)
12/12/2006	Test Trucks	-0.6 (3.1)	-4.3 (5.2)	1.6 (5.4)

Prepared: ea *Checked: bko*

5.4 Projected Maintenance/Replacement Requirements

This site is scheduled for semi-annual maintenance under the installation contract. The leading WIM sensor should continue to be monitored. The battery condition should be monitored and the battery replaced or the charging system evaluated at the next maintenance visit.

6 Pre-Validation Analysis

Upon our arrival at the site, we found the system parameters were not the same as we left them at the conclusion of our last validation on August 28, 2007. Apparently the site has had equipment maintenance work or factor adjustments made remotely between our last Validation visit and this one.

The factors in place at the end of our last Validation visit and those found prior to validation are shown below.

Table 6-1 - Calibration Factor Change – 270500 – Since 28-Aug-2007

	Left Sensors 1/3		Right Sensors 2/4	
	11-Nov-2008	28-Aug-2007	11-Nov-2008	28-Aug-2007
65 kph	3597	3436	3330	3436
80 kph	3659	3495	3388	3495
95 kph	3640	3477	3700	3477
110 kph	3549	3390	3286	3390
125 kph	3455	3300	3199	3300

Prepared: ea *Checked: bko*

This Pre-Validation analysis is based on test runs conducted November 11, 2008 during the late morning and afternoon at test site 270500 on US 2. This SPS-5 site is located at milepost 98.0 on the westbound, righthand of a four-lane divided facility. No auto-calibration was used during test runs. The two trucks used for initial validation included:

1. 5-axle tractor semi-trailer combination with a tractor having an air suspension and trailer with standard rear tandem and an air suspension loaded to 77,090 lbs., the “golden” truck.

2. 5-axle tractor semi-trailer with a tractor having an air suspension and a trailer with a standard rear tandem and an air suspension loaded to 64,280 lbs., the "partial" truck.

For the initial validation each truck made a total of 21 passes over the WIM scale at speeds ranging from approximately 52 to 65 miles per hour. The desired speed range was achieved during this validation. Pavement surface temperatures were recorded during the test runs ranging from about 27 to 42 degrees Fahrenheit. The desired 30 degree Fahrenheit temperature range was not achieved. The computed values of 95% confidence limits of each statistic for the total population are in Table 6-2.

Table 6-2 indicates that due to bias in combination with GVW error, the conditions for research quality loading data were not met.

Table 6-2 - Pre-Validation Results – 270500 – 11-Nov-2008

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-6.6 ± 6.9%	Pass
Tandem axles	±15 percent	-6.2 ± 5.2%	Pass
GVW	**±10 percent**	**-6.2 ± 4.7%**	**Fail**
Axle spacing	± 0.5 ft [150mm]	0.0 ± 0.1 ft	Pass

Prepared: ea *Checked: bko*

The test runs were conducted from late-morning to mid-afternoon hours under cloudy skies, resulting in a reasonable range of pavement temperatures. The runs were 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 three speed groups and two temperature groups. The distribution of runs within these groupings is illustrated in Figure 6-1. The figure indicates that the desired distribution of speed and temperature combinations was not achieved for this set of validation runs due to the limited temperature range.

The three speed groups were divided into 52 to 57 mph for Low speed, 58 to 62 mph for Medium speed and 63+ mph for High speed. The two temperature groups were created by splitting the runs between those at 27 to 34 degrees Fahrenheit for Low temperature and 35 to 42 degrees Fahrenheit for High temperature.

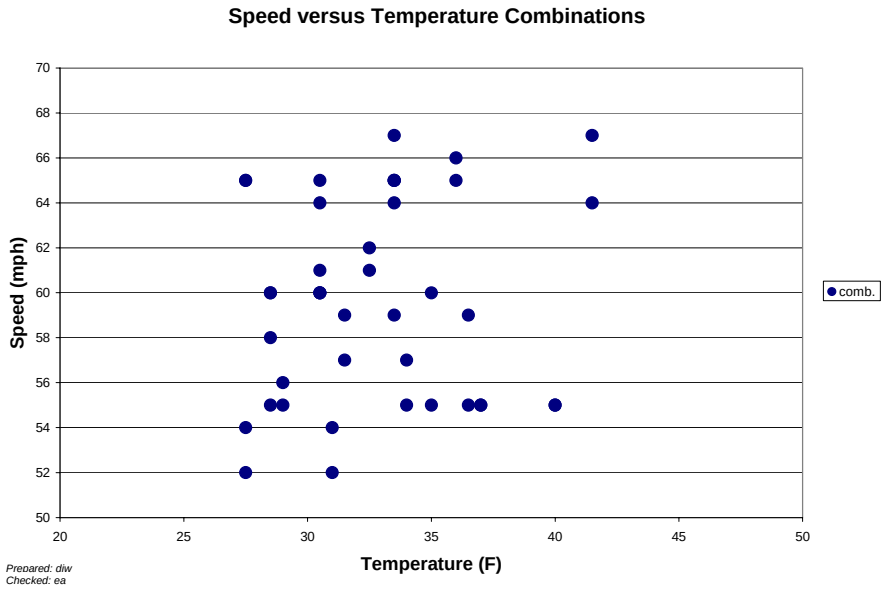

Figure 6-1 - Pre-Validation Speed-Temperature Distribution – 270500 – 11-Nov-2008

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

Figure 6-2 shows the GVW Percent Error vs. Speed graph for the population as a whole. It can be seen in Figure 6-2 that the equipment underestimates GVW errors at all speeds. Variability in error is consistent throughout the entire speed range.

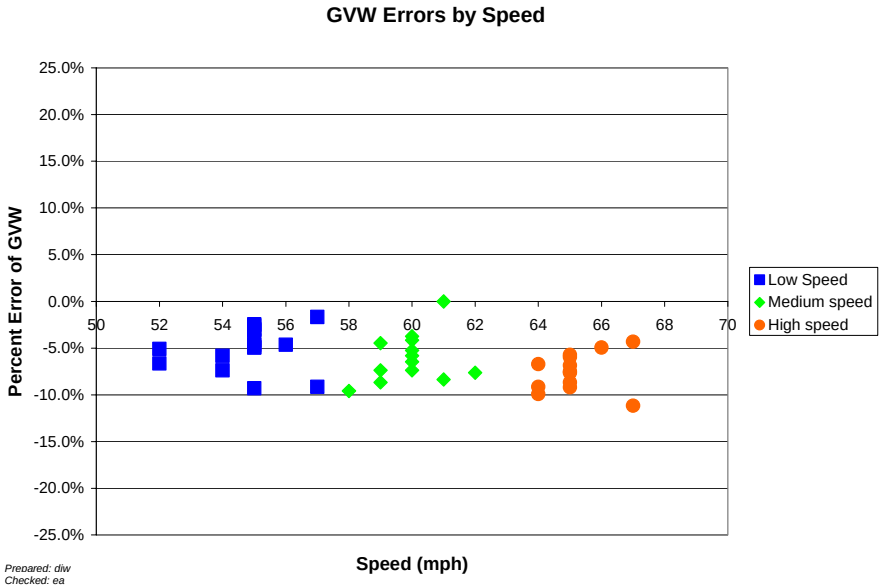

Figure 6-2 - Pre-Validation GVW Percent Error vs. Speed – 270500 – 11-Nov-2008

Figure 6-3 shows the relationship between temperature and GVW percentage error. Figure 6-3 shows that GVW errors are underestimated at both the low and high temperatures. Variability in error is consistent.

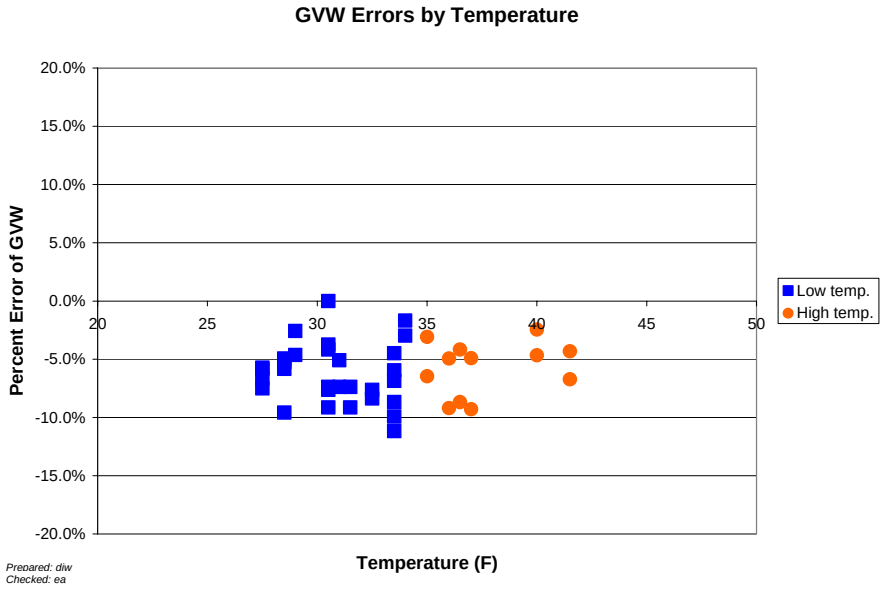

Figure 6-3 - Pre-Validation GVW Percent Error vs. Temperature – 270500 – 11-Nov-2008

Figure 6-4 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. Figure 6-4 indicates that the errors in tandem spacing were not affected by changes in speed.

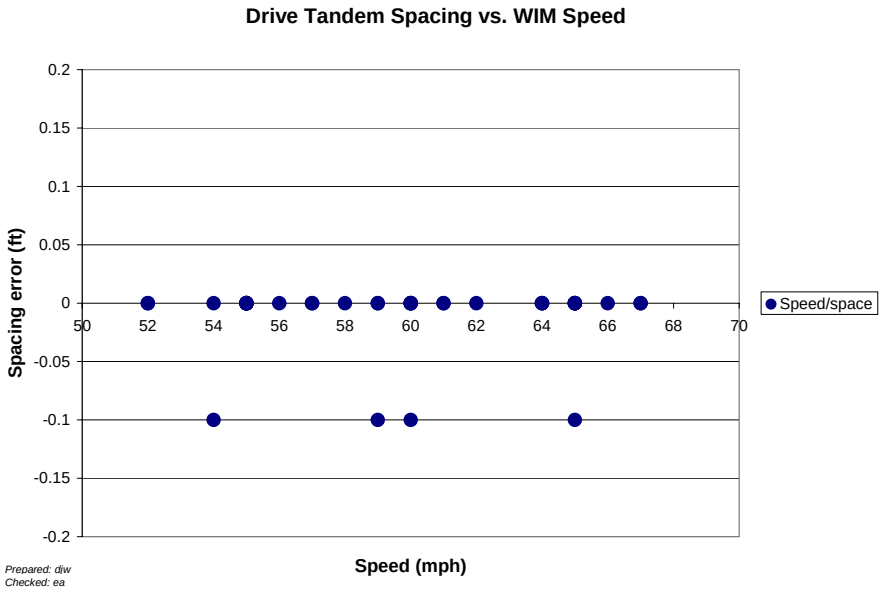

Figure 6-4 - Pre-Validation Spacing vs. Speed - 270500 – 11-Nov-2008

6.1 Temperature-based Analysis

The two temperature groups were created by splitting the runs between those at 27 to 34 degrees Fahrenheit for Low temperature and 35 to 42 degrees Fahrenheit for High temperature.

Table 6-3 - Pre-Validation Results by Temperature Bin – 270500 – 11-Nov-2008

Element	95% Limit	Low Temperature 27 to 34 °F	High Temperature 35 to 42 °F
Steering axles	±20 %	-6.7 ± 6.3%	-6.4 ± 9.4%
Tandem axles	±15 %	-6.4 ± 5.2%	-5.7 ± 5.3%
GVW	±10 %	-6.5 ± 4.8%	-5.7 ± 5.1%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.0 ft

Prepared: ea *Checked: bko*

From Table 6-3 it is shown that the equipment produces an overestimation of all weights at low and high temperatures.

Figure 6-5 shows the distribution of GVW Errors versus Temperature by Truck. Figure 6-5 shows the tendency of the equipment to overestimate GVW errors of both trucks. Variability in error is consistent throughout the temperature range.

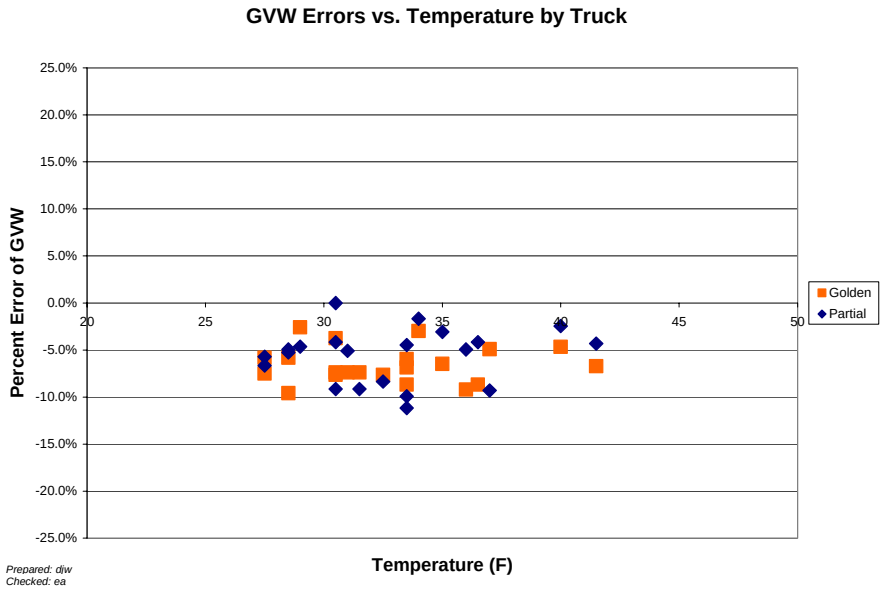

Figure 6-5 - Pre-Validation GVW Percent Error vs. Temperature by Truck – 270500 – 11-Nov-2008

Figure 6-6 shows the relation between steering axle errors and temperature. This graph is included due to the frequent use of steering axle weights of Class 9 vehicles for auto-calibration. This site does not use auto-calibration. The steering axles in this graph are associated only with Class 9 vehicles. The graph illustrates the tendency of the equipment to underestimate steering axle weights in the observed temperature range.

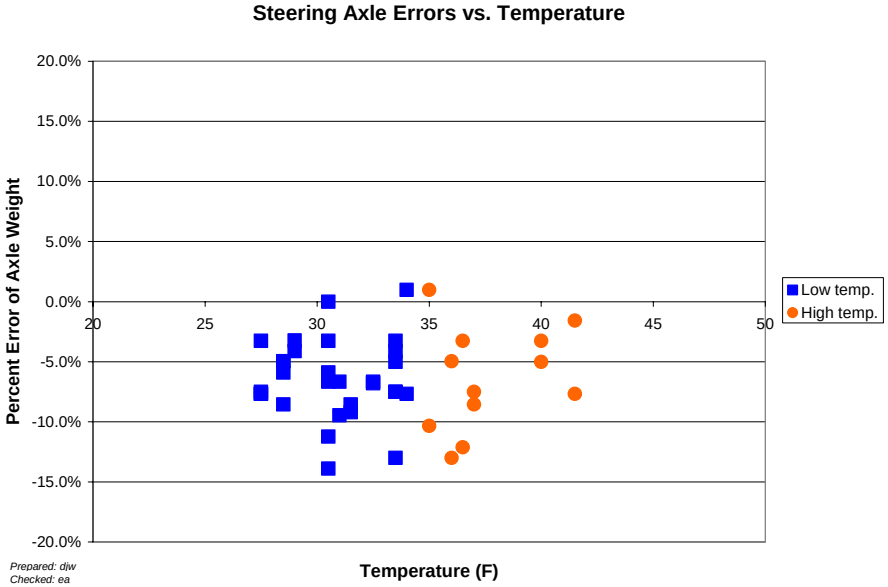

Figure 6-6 - Pre-Validation Steering Axle Error vs. Temperature by Group – 270500 – 11-Nov-2008

6.2 Speed-based Analysis

The speed groups were divided as follows: Low speed – 52 to 57 mph, Medium speed – 58 to 62 mph and High speed – 63+ mph.

Table 6-4 - Pre-Validation Results by Speed Bin – 270500 – 11-Nov-2008

Element	95% Limit	Low Speed 52 to 57 mph	Medium Speed 58 to 62 mph	High Speed 63+ mph
Steering axles	±20 %	-5.4 ± 6.9%	-7.3 ± 6.4%	-7.4 ± 8.4%
Tandem axles	±15 %	-4.9 ± 5.2%	-6.4 ± 4.4%	-7.6 ± 4.8%
GVW	±10 %	-5.0 ± 4.8%	-6.6 ± 4.2%	-7.5 ± 4.4%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft

Prepared: ea *Checked: bko*

In Table 6-4 it is shown that the equipment produces an underestimation of all weights at all speeds. Variability is similar throughout the speed range.

Figure 6-7 shows the tendency of the equipment to underestimate GVW errors of both trucks. Variability in error is consistent through the temperature range.

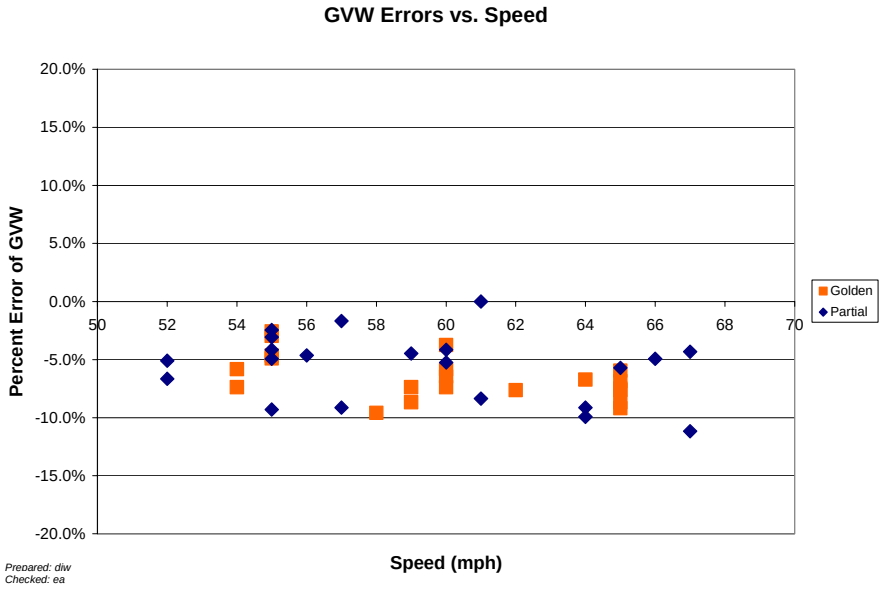

Figure 6-7 - Pre-Validation GVW Percent Error vs. Speed Group - 270500 –11-Nov-2008

Figure 6-8 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 vehicles. It can be seen in Figure 6-8 that the equipment underestimates GVW errors at all speeds with a downward trend from low to high speeds. Variability in error is consistent throughout the entire speed range.

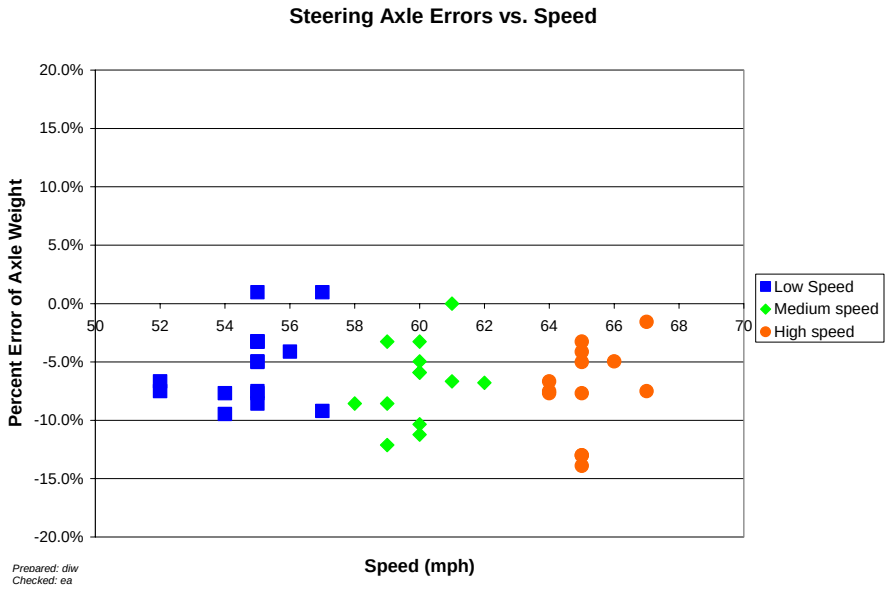

Figure 6-8 - Pre-Validation Steering Axle Percent Error vs. Speed Group - 270500 – 11-Nov-2008

6.3 Classification Validation

This LTPP installed site uses the FHWA 13-bin classification scheme and the LTPP ETG mod 3 classification algorithm. Classification 15 has been added to define unclassified vehicles.

The classification validation is intended to find gross errors in vehicle classification, not to validate the installed algorithm. A sample of three hours (32 trucks) was collected at the site. The classification identification is to identify gross errors in classification, not validate the classification algorithm. Video was taken at the site to provide ground truth for the evaluation. Based on the sample it was determined that there are zero percent unknown vehicles and zero 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 6-5 has the classification error rates by class. The overall misclassification rate is 17.1 percent. The large value for misclassification can be attributed to the small sample size. It represents errors in classifying three of the thirty-two observed trucks. In the case of the Class 5s, two were classified as Class 8 by the equipment and the one Class 6 was interpreted as a Class 4.

Table 6-5 - Truck Misclassification Percentages for 270500 – 11-Nov-2008

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	100	5	25	6	25
7	N/A				
8	100	9	0	10	N/A
11	N/A	12	N/A	13	N/A

Prepared: ea *Checked: bko*

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 a re 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 6-6 - Truck Classification Mean Differences for 270500 – 11-Nov-2008

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	UNK	5	- 25	6	- 25
7	N/A				
8	UNK	9	0	10	N/A
11	N/A	12	N/A	13	N/A

Prepared: ea *Checked: bko*

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 (UNK) are those identified by the equipment but no vehicles of the type were seen the observer. There is no way to tell how many vehicles of that type might actually exist. N/A means no vehicles of the class were recorded by either the equipment or the observer.

A limited investigation of the precision and bias of the speeds reported by the equipment was undertaken. The values were not within the expected tolerances. The observed bias and variability are thought to be more strongly related to radar speed precision than errors in the WIM equipment.

6.4 Evaluation by ASTM E-1318 Criteria

The ASTM E-1318 criteria 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 6-7 - 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%	98%	Pass

Prepared: ea *Checked: bko*

6.5 Prior Validations

The last validation for this site was performed on August 29, 2007. It was the second validation of the site. The site was producing research quality data. Figure 6-9 shows the GVW Percent Error vs. Speed for the post validation runs. The site was validated with two trucks. The "Golden" truck was loaded to 75,160 lbs. The "partial" truck which had air suspension on both tandems was loaded to 67,890 lbs.

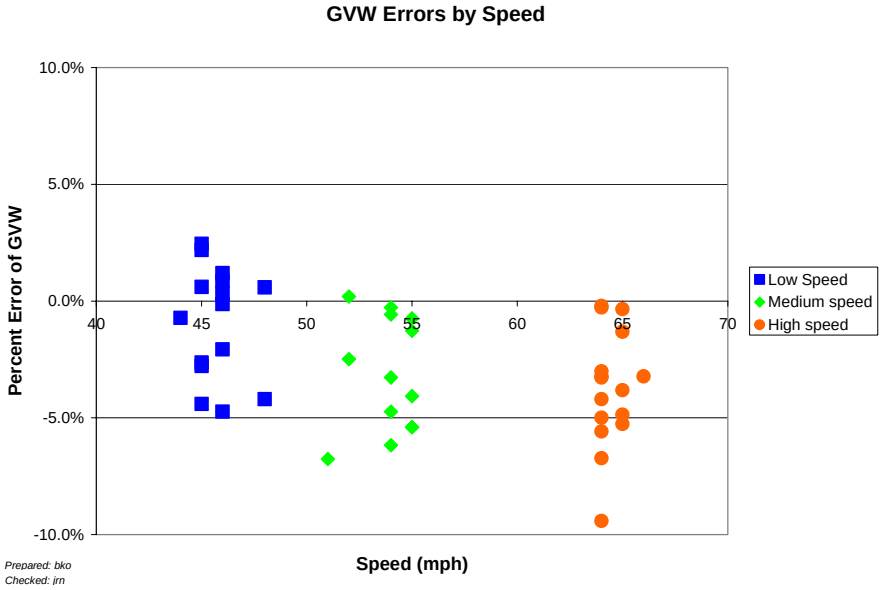

Figure 6-9 - Last Validation - GVW Percent Error vs. Speed – 270500 – 28-Aug-2007

Table 6-8 shows the overall results from the last validation. Compared to the initial Pre-Validation results in Table 6-2 which shows a failed condition for GVW, Table 6-8 shows smaller underestimation of all weights with a passing condition for GVW.

Table 6-8 - Last Validation - Final Results – 270500 – 28-Aug-2007

SPS-1, -2, -5, -6 and -8	95 %Confidence Limit of Error	Site Values	Pass/Fail
Steering axles	±20 percent	-0.7 ± 8.3%	Pass
Tandem axles	±15 percent	-2.3 ± 9.0%	Pass
Gross vehicle weights	±10 percent	-2.6 ± 5.4%	Pass
Axle spacing	± 0.5 ft [150 mm]	0.0 ± 0.1 ft	Pass

Prepared: ea *Checked: bko*

Table 6-9 has the results at the end of the last validation by temperature. As the temperature ranges do not overlap comments on changes due to temperature are not appropriate. Through this validation the equipment has been observed at temperature from 13 to 89 degrees Fahrenheit.

Table 6-9 - Last Validation - Results by Temperature Bin – 270500 – 28-Aug-2007

Element	95% Limit	Low Temperature 57 to 65 °F	Medium Temperature 66 to 77 °F	High Temperature 78 to 90 °F
Steering axles	±20 %	0.7 ± 9.1%	0.6 ± 9.3%	-2.7 ± 6.7%
Tandem axles	±15 %	-1.3 ± 10.5%	-1.7 ± 9.6%	-3.2 ± 8.6%
GVW	±10 %	-2.1 ± 5.9%	-1.6 ± 5.7%	-3.7 ± 5.2%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft

Prepared: ea *Checked: bko*

Table 6-10 has the results of the prior Post Validation by speed groups. The Pre-Validation results show a greater underestimation as compared to Table 6-10 and larger variability.

Table 6-10 - Last Validation - Results by Speed Bin – 270500 – 28-Aug-2007

Element	95% Limit	Low Speed 44 to 50 mph	Medium Speed 51 to 59 mph	High Speed 60+ mph
Steering axles	±20 %	1.3 ± 7.5%	-1.0 ± 9.4%	-2.4 ± 8.2%
Tandem axles	±15 %	-1.2 ± 7.2%	-2.7 ± 10.8%	-3.0 ± 9.7%
GVW	±10 %	-0.9 ± 5.1%	-3.2 ± 5.3%	-3.7 ± 5.3%
Axle spacing	± 0.5 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft	0.0 ± 0.1 ft

Prepared: ea *Checked: bko*

7 Data Availability and Quality

As of November 11, 2008 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 this installation is shown in Table 7-1. The value for months is a measure of the seasonal variation in the data. Coverage indicates whether day of week variation has been accounted for on an annual basis. As can be seen from the table only 2007 has a sufficient quantity to be considered complete year of data. **In the absence of previously gathered validation information it can be seen that at least three additional years of research quality data are needed, assuming that a complete year of data is received for 2008, to meet the goal of a minimum of 5 years of research weight data.**

Table 7-1 - Amount of Traffic Data Available 270500 – 11-Nov-2008

Year	Classification Days	Months	Coverage	Weight Days	Months	Coverage
2006	51	2	Full Week	54	2	Full Week
2007	338	12	Full Week	351	12	Full Week
2008	179	6	Full Week	182	6	Full Week

Prepared: ea *Checked: bko*

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 8s, and Class 5s constitute more than 10 percent of the truck population. Based on the data collected following this validation 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 Regional Support Contractor 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.

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 4-15) 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 – 270500 – 12-Nov-2008

Characteristic	Class 9	Class 5	Class 8
Percentage Overweights	0%	0%	0%
Percentage Underweights	0%	4.3%	11.8%
Unloaded Peak	36,000		
Loaded Peak	80,00		
Peak		8,000	20,000

Prepared: ea *Checked: bko*

The expected percentage of unclassified vehicles is 3.8 percent. This is based on the percentage of unclassified vehicles in the post-validation data download.

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 period.

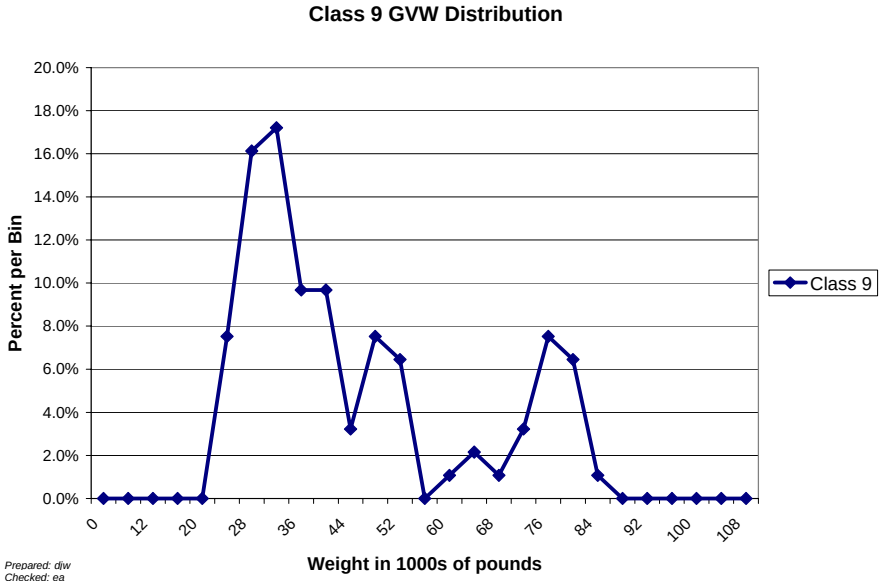

Figure 7-1 - Expected GVW Distribution Class 9 – 270500 – 12-Nov-2008

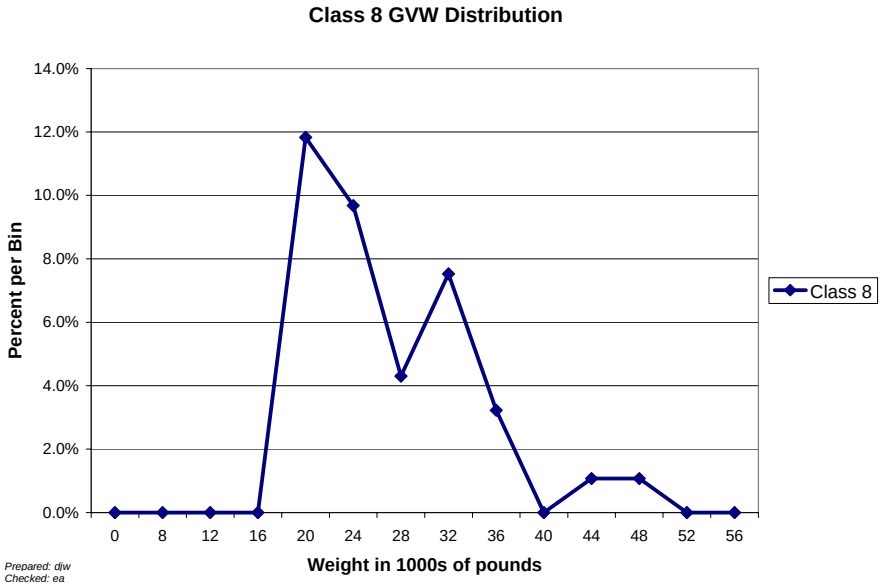

Figure 7-2 - Expected GVW Distribution Class 8 – 270500 – 12-Nov-2008

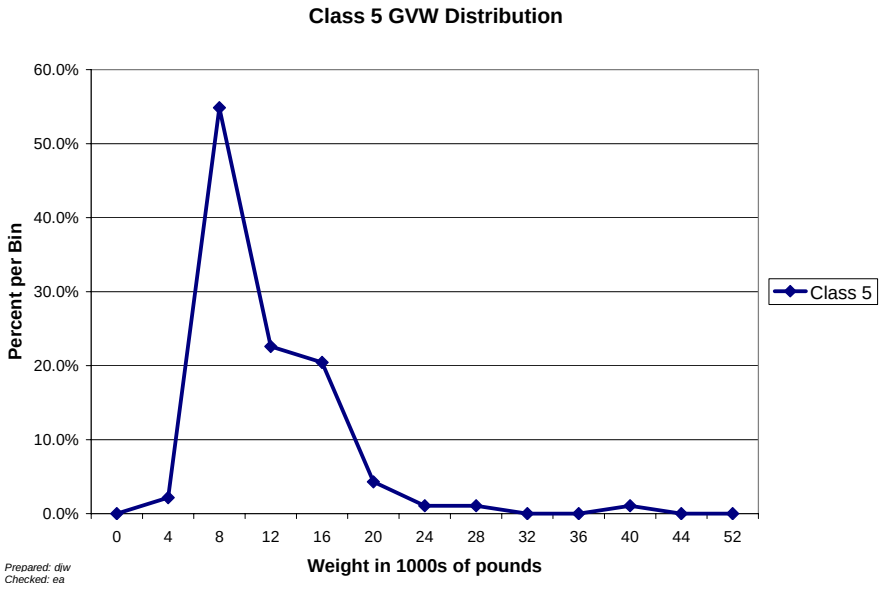

Figure 7-3 - Expected GVW Distribution Class 5 – 270500 – 12-Nov-2008

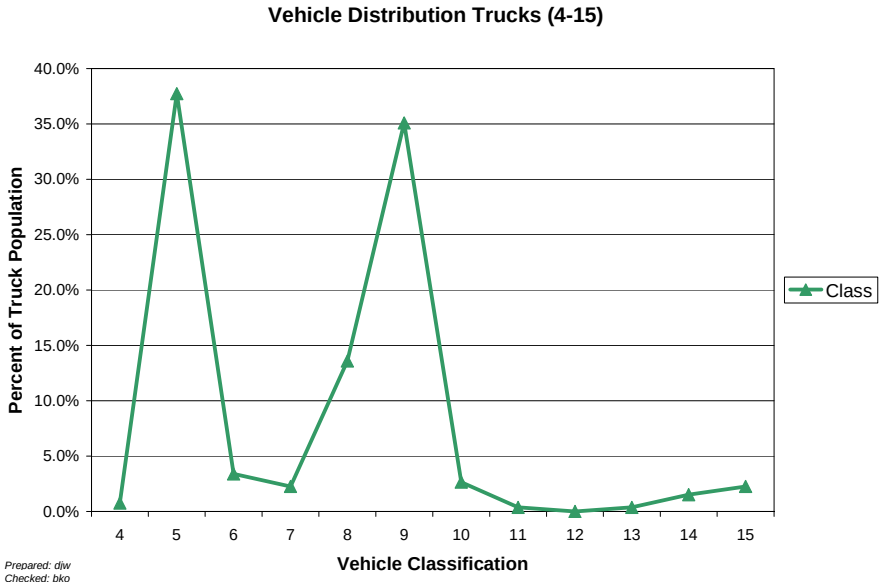

Figure 7-4 - Expected Vehicle Distribution – 270500 – 12-Nov-2008

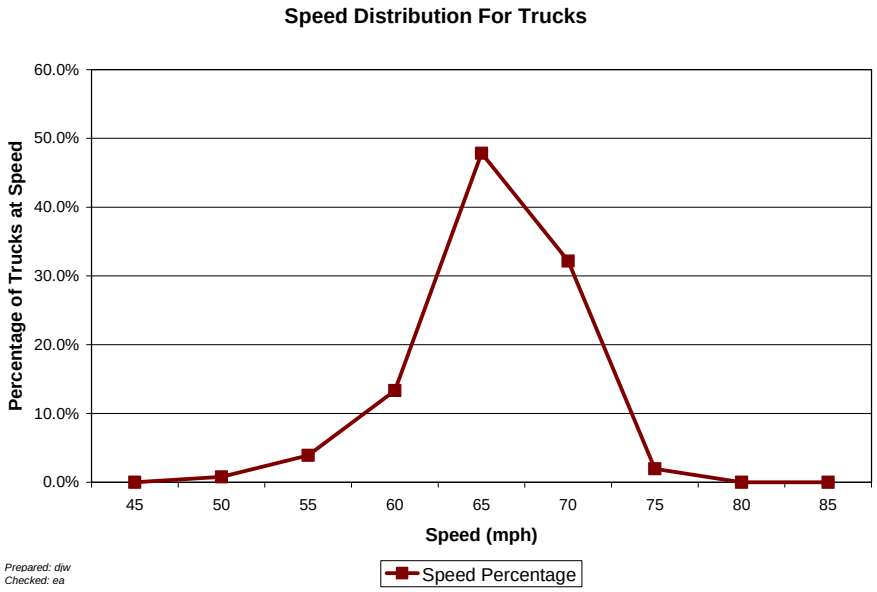

Figure 7-5 - Expected Speed Distribution – 270500 – 12-Nov-2008

8 Data Sheets

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

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

Sheet 20 – Classification Verification – Pre-Validation (1 page)
Sheet 20 – Classification Verification – Post-Validation (1 page)

Sheet 21 – Pre-Validation (3 pages)
Sheet 21 – Calibration Iteration 1 – (1 page)
Sheet 21 – Calibration Iteration 2 – (1 page)
Sheet 21 – Post-Validation (2 pages)

Calibration Iteration 1 Worksheets – (1 page)
Calibration Iteration 2 Worksheets – (1 page)

Test Truck Photographs (6 pages)

LTPP Mod 3 Classification Scheme (1 page)

Final System Parameters (1 page)

9 Updated Handout Guide and Sheet 17

A copy of the handout has been included following page 33. 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(s)

Sheet 16s for the pre-validation and post-validation conditions are attached following the current Sheet 18 information at the very end of the report.

POST-VISIT HANDOUT GUIDE FOR SPS WIM FIELD VALIDATION

STATE: Minnesota

SHRP ID: 270500

Figures

Photos

1. General Information

SITE ID: *270500*

LOCATION: *US 2, 20 miles west of Bemidji, milepost 91.8*

VISIT DATE: *November 11, 2008*

VISIT TYPE: *Validation*

2. Contact Information

POINTS OF CONTACT:

***Validation Team Leader*:** *Dean J. Wolf, 301-210-5105, djwolf@mactec.com*

Highway Agency: *George Cepress, 651-296-0217,*
george.cepress@dot.state.mn.us

Mark Novak, 651-296-2607,
mark.novak@dot.state.mn.us

Graig Gilbertson,
graig.gilbertson@dot.state.mn.us

Ben Worel, 651-779-5522,
ben.worel@dot.state.mn.us

FHWA COTR: *Debbie Walker, 202-493-3068, deborah.walker@fhwa.dot.gov*

FHWA Division Office Liaison: *William Lohr, 651-291-6122,*
william.lohr@fhwa.dot.gov

LTPP SPS WIM WEB PAGE: *http://www.tfhrc.gov/pavement/ltpp/spstraffic/index.htm*

3. Agenda

BRIEFING DATE: *No briefing requested for this visit.*

ON SITE PERIOD: *November 11 and 12, 2008.*

TRUCK ROUTE CHECK: *Completed.*

4. Site Location/ Directions

NEAREST AIRPORT: *Bemidji National Airport*

DIRECTIONS TO THE SITE: *20 miles west of Bemidji on US 2, milepost 91.8*

MEETING LOCATION: *On site beginning at 9:00 a.m.*

WIM SITE LOCATION: *US 2, milepost 91.8; Lat: 47.5302° N; Long: -95.3302° W*

WIM SITE LOCATION MAP: *See Figure 4.1*

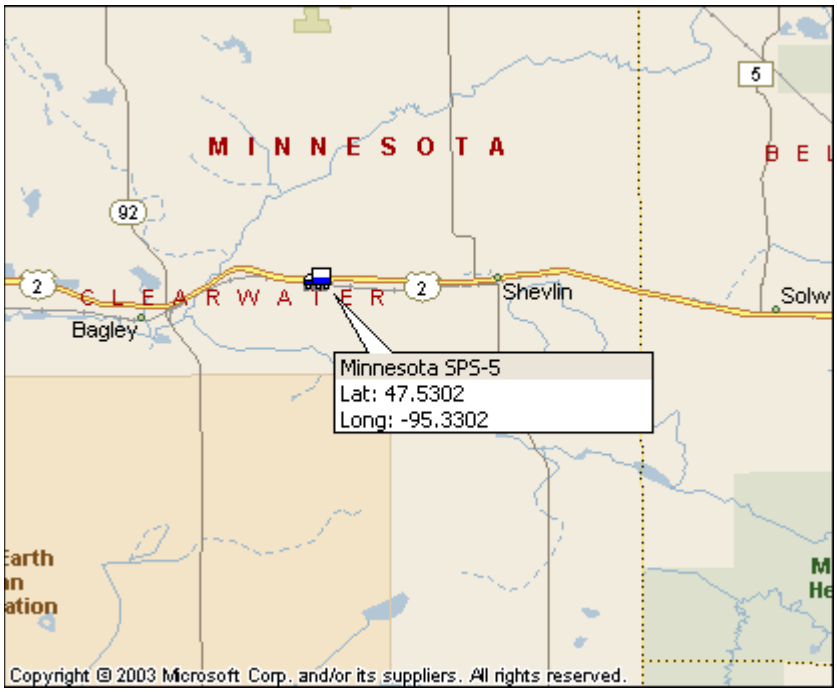

Figure 4-1 – Site 270500 in Minnesota

5. Truck Route Information

ROUTE RESTRICTIONS: *None*

SCALE LOCATION: *Waste Management, 751 Industrial Park Drive, Bemidji, MN*

Figure 5-1 – Truck Scale Location for 270500 in Minnesota

TRUCK ROUTE:

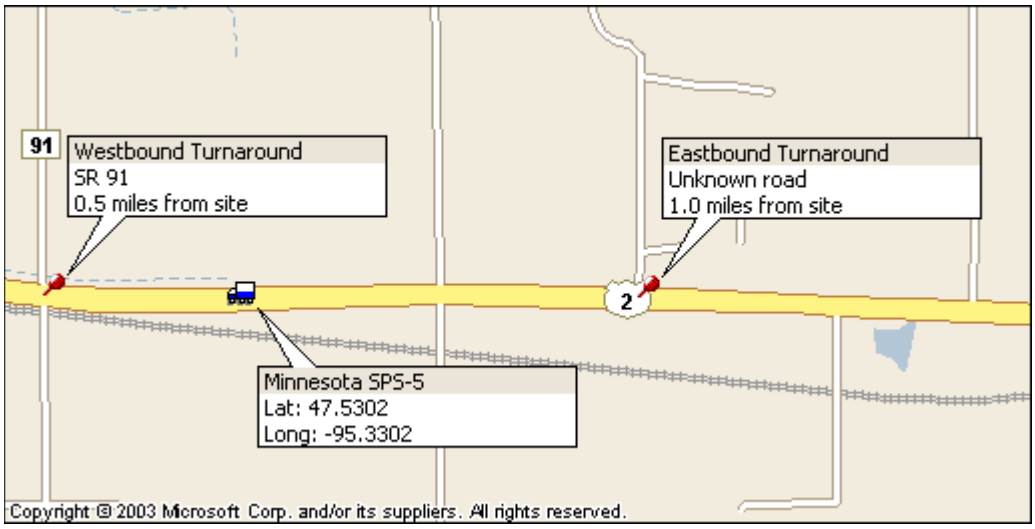

Figure 5-2 – Truck Route for 270500 in Minnesota

EB distance = 1.0 miles
WB distance = 0.5 miles

Total distance = 3.0 miles (5 minutes)

6. Sheet 17 – Minnesota (270500)

1.* ROUTE ___US 2_____ MILEPOST _91.8____ LTPP DIRECTION - N S E W

2.* WIM SITE DESCRIPTION - Grade ___<1___ % Sag vertical Y / N
Nearest SPS section upstream of the site ___unknown ___
Distance from sensor to nearest upstream SPS Section ___unknown ___ ft

3.* LANE CONFIGURATION
Lanes in LTPP direction __2_ Lane width _1_2_ ft

Median -
1 – painted
2 – physical barrier
3 – grass
4 – none

Shoulder -
1 – curb and gutter
2 – paved AC
3 – paved PCC
4 – unpaved
5 – none

Shoulder width __1_2__ ft

4.* PAVEMENT TYPE ___Asphalt_____

5.* PAVEMENT SURFACE CONDITION – Distress Survey (6420070022_SPSWIM_)
Date: _11/11/08_ Filename: 27_0500_Downstream__11_11_08.jpg ___
Date: _11/11/08_ Filename: 27_0500_Upstream_11_11_08.jpg_____

6. * SENSOR SEQUENCE _____loop-quartz piezo-quartz piezo-loop_____

7. * REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __
REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __
REPLACEMENT AND/OR GRINDING __ __ __ / __ __ / __ __ __ __

8. RAMPS OR INTERSECTIONS
Intersection/driveway within 300 m upstream of sensor location Y / N distance _____
Intersection/driveway within 300 m downstream of sensor location Y / N distance _____
Is shoulder routinely used for turns or passing? Y / N

9. DRAINAGE (*Bending plate and load cell systems only)*
1 – Open to ground
2 – Pipe to culvert
3 – None

Clearance under plate ___ ___ . ___ in
Clearance/access to flush fines from under system Y / N

10. * CABINET LOCATION

Same side of road as LTPP lane Y / N Median Y/ N Behind barrier Y / N
Distance from edge of traveled lane _4_7_ ft
Distance from system __5_3__ ft
TYPE _____

CABINET ACCESS controlled by LTPP / STATE / JOINT
Contact - name and phone number _Bob Worel, MnDOT, 651-779-5522_____
Alternate - name and phone number _Roy Czinku, IRD, 306-653-6627_____

11. * POWER

Distance to cabinet from drop ___ __4 ___ ft Overhead / underground / solar / AC in cabinet?
Service provider _____ Phone number _____

12. * TELEPHONE

Distance to cabinet from drop __9_2__ ___ ft Overhead / under ground / cell?
Service provider _____ Phone Number _____

13.* SYSTEM (software & version no.)- _____iSINC_____
Computer connection – RS232 / Parallel port / USB / Other _____

14. * TEST TRUCK TURNAROUND time __5___ minutes DISTANCE __3.0__ mi.

15. PHOTOS FILENAME

Power source	27_0500_Power_Meter_11_11_08.jpg
	27_0500_Power_Service_11_11_08.jpg
Phone source	27_0500_Telephone_Pedestal_11_11_08.jpg
Cabinet exterior	27_0500_Cabinet_Exterior_11_11_08.jpg
Cabinet interior	27_0500_Cabinet_Interior_11_11_08.jpg
Weight sensors	27_0500_Leading_WIM_Sensor_11_11_08.jpg
	27_0500_Trailing_WIM_Sensor_11_11_08.jpg
Loop sensors	27_0500_Leading_Loop_Sensor_11_11_08.jpg
	27_0500_Trailing_Loop_11_11_08.jpg
Classification sensors	_____
Other sensors	_____

Description _____
Downstream direction at sensors on LTPP lane
27_0500_Downstream_11_11_08.jpg
Upstream direction at sensors on LTPP lane
27_0500_Upstream_11_11_08.jpg

COMMENTS _____ all amenities in Bemidji, approximately 21 miles east of the site _____

_____ GPS – Lat: 47.5302 N; Long: -95.3302 W _____

_____ LTPP lane is lane 4 _____

COMPLETED BY __Dean J. Wolf_____

PHONE _301-210-5105_____ DATE COMPLETED _1_1_ /_1_1_ / _2_0_0_8_

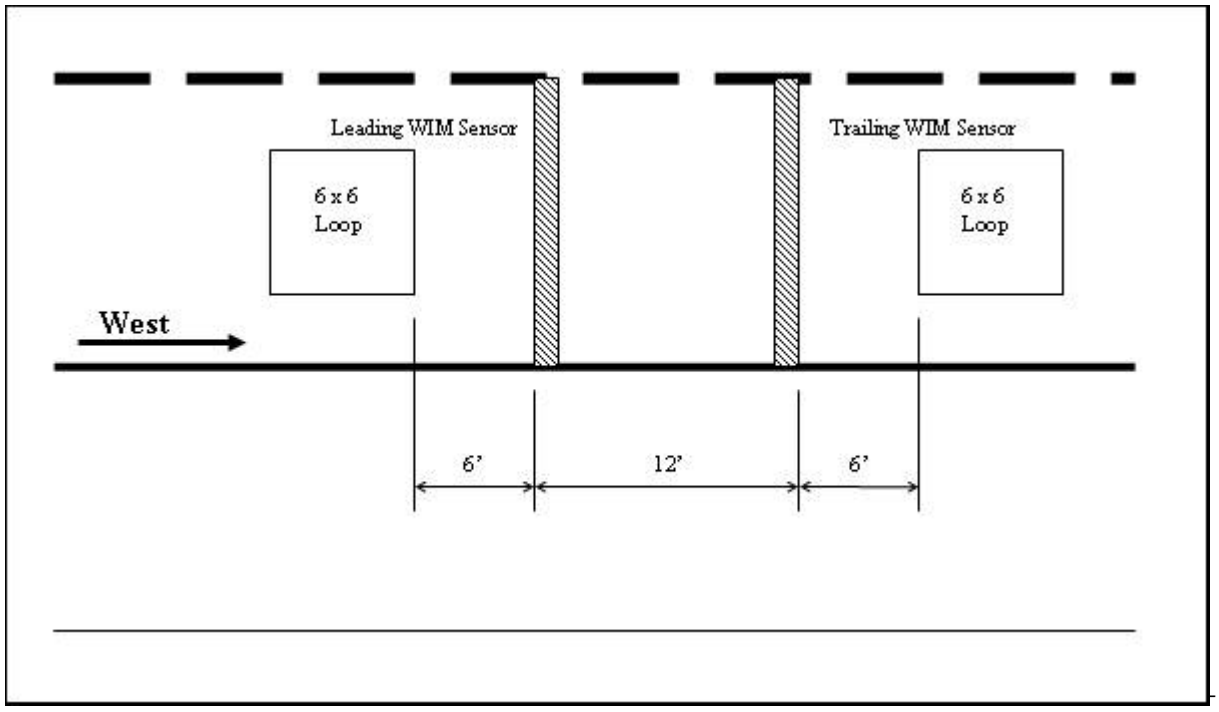

Figure 6-1 - Sketch of Equipment Layout at SPS-5 in Minnesota

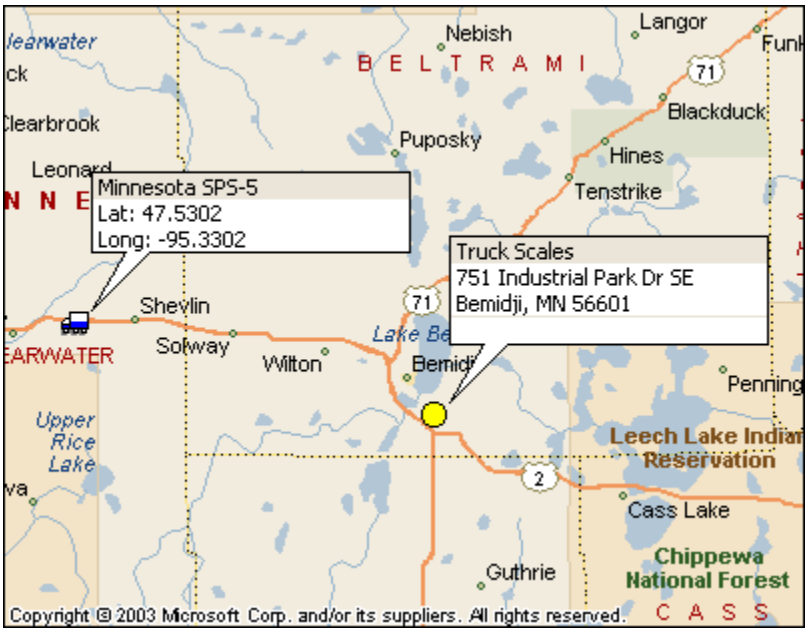

Figure 6-2 – Site map of SPS-5 in Minnesota

Photo 1 - 27_0500_Upstream_11_11_08.jpg

Photo 2 - 27_0500_Downstream_11_11_08.jpg

Photo 3 - 27_0500_Power_Meter_11_11_08.jpg

Photo 4 - 27_0500_Power_Service_11_11_08.jpg

Photo 5 - 27_0500_Telephone_Pedestal_11_11_08.jpg

Photo 6 - 27_0500_Cabinet_Exterior_11_11_08.jpg

Photo 7 - 27_0500_Cabinet_Interior_11_11_08.jpg

Photo 8 - 27_0500_Leading_WIM_Sensor_11_11_08.jpg

Photo 9 - 27_0500_Trailing_WIM_Sensor_11_11_08.jpg

Photo 10 - 27_0500_Leading_Loop_Sensor_11_11_08.jpg

Photo 11 - 27_0500_Trailing_Loop_11_11_08.jpg

SHEET 18	STATE CODE [27]
LTPP MONITORED TRAFFIC DATA	SPS PROJECT ID [0 5 0 0]
WIM SITE COORDINATION	DATE: (mm/dd/yyyy) 11/11/2008

Rev. 05/15/07

1. DATA PROCESSING –
   a. Down load –
      - ☐ State only
      - ☐ LTPP read only
      - ☒ LTPP download
      - ☐ LTPP download and copy to state

   b. Data Review –
      - ☐ State per LTPP guidelines
      - ☐ State – ☐ Weekly ☐ Twice a Month ☐ Monthly ☐ Quarterly
      - ☒ LTPP

   c. Data submission –
      - ☐ State – ☐ Weekly ☐ Twice a month ☐ Monthly ☐ Quarterly
      - ☒ LTPP

2. EQUIPMENT –
   a. Purchase –
      - ☐ State
      - ☒ LTPP

   b. Installation –
      - ☒ Included with purchase
      - ☐ Separate contract by State
      - ☐ State personnel
      - ☐ LTPP contract

   c. Maintenance –
      - ☒ Contract with purchase – Expiration Date _5 years from installation_
      - ☐ Separate contract LTPP – Expiration Date _____
      - ☐ Separate contract State – Expiration Date _____
      - ☐ State personnel

   d. Calibration –
      - ☐ Vendor
      - ☐ State
      - ☒ LTPP

   e. Manuals and software control –
      - ☒ State
      - ☐ LTPP

   f. Power –
      i. Type –
         - ☐ Overhead
         - ☒ Underground
         - ☐ Solar

      ii. Payment –
         - ☒ State
         - ☐ LTPP
         - ☐ N/A

g. Communication –

i. Type –
- ☒ Landline
- ☐ Cellular
- ☐ Other

ii. Payment –
- ☒ State
- ☐ LTPP
- ☐ N/A

3. PAVEMENT –

a. Type –
- ☐ Portland Concrete Cement
- ☒ Asphalt Concrete

b. Allowable rehabilitation activities –
- ☐ Always new
- ☐ Replacement as needed
- ☐ Grinding and maintenance as needed
- ☒ Maintenance only
- ☐ No remediation

c. Profiling Site Markings –
- ☐ Permanent
- ☒ Temporary

4. ON SITE ACTIVITIES –

a. WIM Validation Check - advance notice required _2__ ☐ days ☒ weeks

b. Notice for straightedge and grinding check - __4_ ☐ days ☒ weeks

i. On site lead –
- ☒ State
- ☐ LTPP

ii. Accept grinding –
- ☒ State
- ☐ LTPP

c. Authorization to calibrate site –
- ☒ State only
- ☐ LTPP

d. Calibration Routine –
- ☒ LTPP – ☐ Semi-annually ☒ Annually
- ☐ State per LTPP protocol – ☐ Semi-annually ☐ Annually
- ☐ State other – _____

e. Test Vehicles
   i. Trucks –
      1st – Air suspension 3S2 ☐ State ☒ LTPP
      2nd – 3S2 different weight/suspension ☐ State ☒ LTPP
      3rd – _____ ☐ State ☐ LTPP
      4th – _____ ☐ State ☐ LTPP
   ii. Loads – ☐ State ☒ LTPP
   iii. Drivers – ☐ State ☒ LTPP

f. Contractor(s) with prior successful experience in WIM calibration in state:

   IRD

g. Access to cabinet
   i. Personnel Access –
      ☐ State only
      ☒ Joint
      ☐ LTPP
   ii. Physical Access –
      ☒ Key
      ☐ Combination

h. State personnel required on site – ☐Yes ☒No

i. Traffic Control Required – ☐Yes ☒No

j. Enforcement Coordination Required – ☐Yes ☒No

5. SITE SPECIFIC CONDITIONS –
   a. Funds and accountability – _____
   b. Reports – _____
   c. Other – _____
   d. Special Conditions – _____

6. CONTACTS –
   a. Equipment (operational status, access, etc.) –

      Name: Roy Czinku Phone:(306) 653-6627

      Agency: IRD

b. Maintenance (equipment) –

Name: Roy Czinku Phone:(306) 653-6627

Agency: IRD

c. Data Processing and Pre-Visit Data –

Name: Basel Abukhater Phone:(716) 632-0804

Agency: IRD

d. Construction schedule and verification –

Name: _____ Phone:_____

Agency: _____

e. Test Vehicles (trucks, loads, drivers) –

Name: Brian Phone:(218) 766-9365

Agency: Fast Lane Trucking

f. Traffic Control –

Name: _____ Phone:_____

Agency: _____

g. Enforcement Coordination –

Name: _____ Phone:_____

Agency: _____

h. Nearest Static Scale

Name: Waste Management Location:751 Industrial Park Dr. SE Bemidji, MN

Phone: (218) 751-1668

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [27] *SHRP SECTION ID [0500]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [11/11/2008]

2. * TYPE OF EQUIPMENT CALIBRATED ___ WIM ___ CLASSIFIER _X_ BOTH

3. * REASON FOR CALIBRATION
   ___ REGULARLY SCHEDULED SITE VISIT ___ RESEARCH
   ___ EQUIPMENT REPLACEMENT ___ TRAINING
   ___ DATA TRIGGERED SYSTEM REVISION ___ NEW EQUIPMENT INSTALLATION
   _X_ OTHER (SPECIFY) ___LTPP Validation

4. * SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   ___ BARE ROUND PIEZO CERAMIC ___ BARE FLAT PIEZO ___ BENDING PLATES
   ___ CHANNELIZED ROUND PIEZO ___ LOAD CELLS _X_ QUARTZ PIEZO
   ___ CHANNELIZED FLAT PIEZO _X_ INDUCTANCE LOOPS ___ CAPACITANCE PADS
   ___ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER ___IRD/ PAT Traffic

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:
   ___ TRAFFIC STREAM -- ___STATIC SCALE (Y/N) _X_ TEST TRUCKS

   ___ NUMBER OF TRUCKS COMPARED __ 2__ NUMBER OF TEST TRUCKS USED

   __ 21__ PASSES PER TRUCK

   TYPE PER FHWA 13 BIN SYSTEM
   SUSPENSION: 1 - AIR; 2 - LEAF SPRING
   3 - OTHER (DESCRIBE)

TRUCK	TYPE	SUSPENSION
1	9	1
2	9	1
3		

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---
   DYNAMIC AND STATIC GVW -6.2 STANDARD DEVIATION 3.1
   DYNAMIC AND STATIC SINGLE AXLES -6.8 STANDARD DEVIATION 3.7
   DYNAMIC AND STATIC DOUBLE AXLES -6.6 STANDARD DEVIATION 3.7

8. 3 ____ NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED

9. DEFINE THE SPEED RANGES USED (MPH) _____ ___ 55 60 65 __ __ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) 3549 / 3286

11.** IS AUTO-CALIBRATION USED AT THIS SITE? (Y/N) N
   IF YES, LIST AND DEFINE AUTO-CALIBRATION VALUE: _____
   _____
   _____

CLASSIFIER TEST SPECIFICS***

12.*** METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
   ___ VIDEO _X_ MANUAL ___ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT _X_ TIME __ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:
   *** FHWA CLASS 9 ____ 0 FHWA CLASS _5_ ____ ____ -25
   *** FHWA CLASS 8 ____ UNK FHWA CLASS _6_ ____ ____ -25
   FHWA CLASS ___ ____ ____ _____
   FHWA CLASS ___ ____ ____ _____
   *** PERCENT "UNCLASSIFIED" VEHICLES: ____ 0.0

PERSON LEADING CALIBRATION EFFORT: Dean J. Wolf, MACTEC
CONTACT INFORMATION: 301-210-5105 rev. November 9, 1999

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [__ __ __ __] *STATE CODE [27] *SHRP SECTION ID [0500]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [11/12/2008]

2. * TYPE OF EQUIPMENT CALIBRATED ___ WIM ___ CLASSIFIER _X_ BOTH

3. * REASON FOR CALIBRATION
   ___ REGULARLY SCHEDULED SITE VISIT ___ RESEARCH
   ___ EQUIPMENT REPLACEMENT ___ TRAINING
   ___ DATA TRIGGERED SYSTEM REVISION ___ NEW EQUIPMENT INSTALLATION
   _X_ OTHER (SPECIFY) ___LTPP Validation_____

4. * SENSORS INSTALLED IN LTPP LANE AT THIS SITE (CHECK ALL THAT APPLY):
   ___ BARE ROUND PIEZO CERAMIC ___ BARE FLAT PIEZO ___ BENDING PLATES
   ___ CHANNELIZED ROUND PIEZO ___ LOAD CELLS _X_ QUARTZ PIEZO
   ___ CHANNELIZED FLAT PIEZO _X_ INDUCTANCE LOOPS ___ CAPACITANCE PADS
   ___ OTHER (SPECIFY) _____

5. EQUIPMENT MANUFACTURER ___IRD/ PAT Traffic_____

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:
   ___ TRAFFIC STREAM -- ___STATIC SCALE (Y/N) _X_ TEST TRUCKS

   ___ NUMBER OF TRUCKS COMPARED __ 2__ NUMBER OF TEST TRUCKS USED

   __ 20__ PASSES PER TRUCK

	TRUCK	TYPE	SUSPENSION
TYPE PER FHWA 13 BIN SYSTEM	1	9	1
SUSPENSION: 1 - AIR; 2 - LEAF SPRING	2	9	1
3 - OTHER (DESCRIBE)	3		

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---

DYNAMIC AND STATIC GVW	-0.2	STANDARD DEVIATION 2.3
DYNAMIC AND STATIC SINGLE AXLES	-0.4	STANDARD DEVIATION 3.9
DYNAMIC AND STATIC DOUBLE AXLES	-0.2	STANDARD DEVIATION 2.7

8. 3 ____ NUMBER OF SPEEDS AT WHICH CALIBRATION WAS PERFORMED

9. DEFINE THE SPEED RANGES USED (MPH) _____ ___ 55 60 65 __ __ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) 3811 / 3529

11.** IS AUTO-CALIBRATION USED AT THIS SITE? (Y/N) N
   IF YES, LIST AND DEFINE AUTO-CALIBRATION VALUE: _____
   _____
   _____

CLASSIFIER TEST SPECIFICS***

12.*** METHOD FOR COLLECTING INDEPENDENT VOLUME MEASUREMENT BY VEHICLE CLASS:
   ___ VIDEO _X_ MANUAL ___ PARALLEL CLASSIFIERS

13. METHOD TO DETERMINE LENGTH OF COUNT _X_ TIME __ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:

*** FHWA CLASS 9	0	FHWA CLASS 5	0
*** FHWA CLASS 8	0	FHWA CLASS 6	0
		FHWA CLASS 10	0
		FHWA CLASS ___	

   *** PERCENT "UNCLASSIFIED" VEHICLES: 0.0

PERSON LEADING CALIBRATION EFFORT: Dean J. Wolf, MACTEC
CONTACT INFORMATION: 301-210-5105 rev. November 9, 1999

APPENDIX A

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT_ID	0500
*CALIBRATION TEST TRUCK # 1	* DATE	11/11/08

Rev. 08/31/01

PART I.

1.* FHWA Class 9 2.* Number of Axles 5 Number of weight days _____

AXLES - units - (lbs) / 100s lbs / kg

GEOMETRY

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

9. a) * Make: KENWORTH b) * Model: _____

10.* Trailer Load Distribution Description:

palletized shingles

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

b). Trailer Tare Weight (units): _____

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

A to B 19.3 B to C 4.4 C to D 33.4

D to E 4.0 E to F _____

Wheelbase (measured A to last) _____ Computed 61.1

13. *Kingpin Offset From Axle B (units) +4.0 (_____)

(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	275R 24.5	4 FULL LEAF
B	275R 24.5	AIR
C	275R 24.5	AIR
D	275R 24.5	AIR
E	275R 24.5	AIR
F	_____	_____

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK #_1_	* DATE	11/11/08

Rev. 08/31/01

PART II

Day 1

*b) Average Pre-Test Loaded weight 77140
*c) Post Test Loaded Weight 77030
*d) Difference Post Test – Pre-test -110

Table 5. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11200 ✓	14920 ✓	14920 ✓	18030 ✓	18030 ✓		77100
2	11320 ✓	14910 ✓	14910 ✓	18020 ✓	18020 ✓		77180
3							
Average	11260	14915	14915	18025	18025		77140

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

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11240 ✓	14870 ✓	14870 ✓	18040 ✓	18040 ✓		77060
2	11300 ✓	14830 ✓	14830 ✓	18020 ✓	18020 ✓		77000
3							
Average	11270	14850	14850	18030	18030		77030

Measured By AW Verified By SA. Weight date 11/11/08

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK #_1_	* DATE	11/12/08

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 77510

*c) Post Test Loaded Weight 77370

*d) Difference Post Test – Pre-test -140

Table 5.2. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11440 ✓	15010 ✓	15010 ✓	18030 ✓	18030 ✓		77520
2	11460 ✓	15000 ✓	15000 ✓	18020 ✓	18020 ✓		77500
3							
Average	11450	15005	15005	18025	18025		77510

Table 6.2. Raw data – Axle scales –

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

Table 7.2 Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11420 ✓	14940 ✓	14940 ✓	18040 ✓	18040 ✓		77380
2	11440 ✓	14920 ✓	14920 ✓	18040 ✓	18040 ✓		77360
3							
Average	11430	14930	14930	18040	18040		77370

Measured By [signature] Verified By [signature] Weight date 11/12/08

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 2	* DATE	11/11/08

Rev. 08/31/01

PART I.

1.* FHWA Class 9 2.* Number of Axles 5 Number of weight days _____

AXLES - units - (lbs) / 100s lbs / kg

GEOMETRY

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

9. a) * Make: PETERBUILT b) * Model: _____

10.* Trailer Load Distribution Description:

palletized shingles

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

b). Trailer Tare Weight (units): _____

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

A to B 19.9 B to C 4.3 C to D 33.7

D to E 4.1 E to F _____

Wheelbase (measured A to last) _____ Computed 62

13. *Kingpin Offset From Axle B (units) +.7 (_____)

(+ is to the rear)

SUSPENSION

Axle	14. Tire Size	15.* Suspension Description (leaf, air, no. of leaves, taper or flat leaf, etc.)
A	295R 22.5	2 FULL LEAF
B	295R 22.5	AIR
C	295R 22.5	AIR
D	295R 22.5	AIR
E	295R 22.5	AIR
F	_____	_____

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 2	* DATE	11/11/08

Rev. 08/31/01

PART II

Day 1

*b) Average Pre-Test Loaded weight 64330

*c) Post Test Loaded Weight 64220

*d) Difference Post Test – Pre-test -110

Table 5. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11700 ✓	13780 ✓	13780 ✓	12510 ✓	12510 ✓		64280
2	11880 ✓	13820 ✓	13820 ✓	12430 ✓	12430 ✓		64380
3							
Average	11790	13800	13860	12470	12470		64330

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

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11790 ✓	13660 ✓	13660 ✓	12450 ✓	12450 ✓		64000
2	11780 ✓	13890 ✓	13890 ✓	12440 ✓	12440 ✓		64440
3							
Average	11790	13775	13775	12445	12445		64220

Measured By dw Verified By [signature] Weight date 11/11/08

Sheet 19	* STATE_CODE	27
LTPP Traffic Data	* SPS PROJECT ID	0500
*CALIBRATION TEST TRUCK # 2	* DATE	11/12/06

Rev. 08/31/01

Day 2

7.2 *b) Average Pre-Test Loaded weight 63950

*c) Post Test Loaded Weight 63840

*d) Difference Post Test – Pre-test -110

Table 5.2. Raw data – Axle scales – pre-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11740 ✓	13500 ✓	13500 ✓	12600 ✓	12600 ✓		63940
2	11760 ✓	13500 ✓	13500 ✓	12600 ✓	12600 ✓		63960
3							
Average	11750	13500	13500	12600	12600		63950

Table 6.2. Raw data – Axle scales –

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

Table 7.2 Raw data – Axle scales – post-test

Pass	Axle A	Axle B	Axle C	Axle D	Axle E	Axle F	GVW
1	11560 ✓	13210 ✓	13210 ✓	12840 ✓	12840 ✓		63660
2	11600 ✓	13370 ✓	13370 ✓	12840 ✓	12840 ✓		64020
3							
Average	11580	13290	13290	12840	12840		63840

Measured By _____ Verified By _____ Weight date 11/12/06

Sheet 20	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
Speed and Classification Checks * 1 of* 1	* DATE	11/11/2008

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
62	5	47489	62	5	64	9	48606	64	9
70	9	47499	70	589	65	6	48627	66	6
63	5	47512	64	5	64	4	48660	64	6
64	9	47526	64	9	67	5	48676	67	5
64	8	47528	64	5	58	9	48696	60	9
64	5	47541	65	5	64	9	48700	64	9
64	9	47634	65	9	64	9	48526	64	9
64	9	47658	63	9					
65	9	47696	65	9					
64	9	47795	64	9					
63	9	47832	66	9					
68	6	47841	69	6					
65	9	47947	65	9					
70	5	47973	70	5					
62	8	47983	62	5					
62	9	48369	62	9					
69	9	48381	69	9					
70	5	48428	70	5					
64	6	48438	65	6					
67	9	48439	67	9					
62	9	48476	62	9					
62	9	48482	63	9					
68	9	48505	69	9					
66	9	48525	66	9					
64	9	48544	64	9					

Recorded by MARK E Direction (W) Lane 4 Time from 955PM to 1130 AM
1217 PM 142 PM

Sheet 20	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
Speed and Classification Checks * 1 of* 2	* DATE	1/12/2008

Rev. 08/31/2001

WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs Class
70	5	52671	70	5	62	9	54160	62	9
69	10	52672	69	10	64	5	54168	65	5
68	8	52693	68	8	60	9	54174	60	9
62	9	52737	62	9					
64	9	52782	65	9					
65	9	52822	65	9					
59	5	52842	58	5					
66	4	52854	66	4					
64	6	52887	63	6					
65	9	52976	65	9					
58	6	52995	59	6					
62	5	53001	63	5					
66	9	53045	66	9					
65	10	53062	65	10					
57	10	53156	58	10					
67	5	53170	67	5					
67	6	53849	67	6					
70	9	53871	70	9					
64	9	53905	64	9					
65	9	53938	65	9					
60	5	53955	60	5					
61	5	53988	61	5					
64	6	54008	64	6					
60	10	54075	61	10					
64	9	54154	64	9					

Recorded by MARK B Direction W Lane 4 Time from 10:28 AM to 12:07 PM
2:04 PM 3:21 PM

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 1 of 3	* DATE	11/11/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
27.5	55	1	1	10:10	47542	54	51/53	71/68	66/72	87/83	87/88		72.6	19.4	4.4	33.4	4.1	
27.5	52	2	1	10:10	47545	52	57/58	56/73	59/69	46/68	45/75		60.0	20.1	4.3	33.9	4.1	
28.5	56	1	2	10:14	47565	58	47/56	79/67	65/69	79/87	72/87		69.7	19.4	4.4	33.3	4.0	
28.5	54	2	2	10:14	47567	55	57/55	54/76	56/72	48/66	45/80		61.1	20.1	4.3	33.8	4.1	
30.5	62	1	3	10:19	47595	60	49/51	72/69	67/71	85/82	81/88		71.4	19.3	4.3	33.3	4.0	
30.5	61	2	3	10:19	47599	61	45/54	52/70	54/65	41/45	39/49		51.5	20.0	4.3	33.8	4.1	
31.5	54	1	4	10:24	47629	54	50/52	68/71	67/69	82/83	88/84		71.4	19.4	4.3	33.3	4.0	
31.5	52	2	4	10:24	47630	52	50/60	59/71	60/69	49/68	47/76		61.0	20.1	4.3	33.7	4.1	
31.5	59	1	5	10:29	47661	59	46/55	74/68	74/67	79/84	79/85		71.4	19.3	4.3	33.3	4.0	
31.5	56	2	5	10:29	47662	57	53/54	52/76	54/70	45/66	41/73		58.4	20.1	4.3	33.8	4.1	
32.5	63	1	6	10:34	47687	62	50/55	76/66	71/68	82/79	78/87		71.2	19.4	4.4	33.3	4.0	
32.5	61	2	6	10:34	47690	61	58/52	56/71	56/67	46/66	42/76		58.9	20.0	4.3	33.8	4.1	
37	56	1	7	10:59	47818	55	52/51	70/71	67/70	91/83	89/80		73.3	19.4	4.4	33.3	4.0	
37	55	2	7	11:00	47819	55	55/54	53/74	57/72	44/64	47/70		58.3	20.0	4.3	33.8	4.1	
28.5	61	1	8	11:04	47855	60	50/56	74/70	72/69	83/84	82/86		72.6	19.4	4.4	33.5	4.0	
28.5	60	2	8	11:04	47856	60	53/59	59/69	60/70	52/68	45/75		60.9	20.0	4.3	33.8	4.1	

Recorded by MARK E

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 2 of 3	* DATE	11/1/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
27.5	65	1	9	11:10	47883	65	48/56	74/66	68/67	83/88	74/88		71.3	19.5	4.4	33.4	4.1	
27.5	66	2	9	11:10	47884	65	61/53	56/74	58/71	49/65	45/73		60.6	20.1	4.3	33.8	4.1	
29	52	1	10	11:14	47922	55	53/56	76/70	72/72	93/86	90/85		75.1	19.4	4.4	33.3	4.0	
29	55	2	10	11:15	47924	56	56/57	57/74	60/72	50/66	47/74		61.3	20.0	4.3	33.8	4.1	
30.5	61	1	11	11:20	47964	60	51/55	79/67	74/68	88/84	86/88		74.2	19.3	4.4	33.4	4.0	
30.5	63	2	11	11:20	47966	60	56/58	59/75	60/70	50/69	45/72		61.6	20.0	4.3	33.7	4.1	
30.5	65	1	12	11:25	47992	65	48/49	69/69	68/66	86/82	87/87		71.2	19.4	4.3	33.3	4.1	
30.5	65	2	12	11:26	47993	64	57/53	54/66	56/72	44/66	43/72		58.4	20.1	4.3	33.9	4.1	
40	55	1	13	12:35	48379	55	54/53	75/66	72/66	93/82	85/89		73.5	19.4	4.4	33.3	4.0	
40	56	2	13	12:35	48380	55	55/59	60/74	63/72	53/68	48/77		62.7	20.0	4.3	33.8	4.1	
36.5	60	1	14	12:41	48407	59	51/48	72/67	67/69	86/81	85/76		70.4	19.4	4.4	33.3	4.0	
36.5	55	2	14	12:41	48408	55	59/55	58/77	58/73	49/66	47/74		61.6	20.0	4.3	33.8	4.1	
33.5	65	1	15	12:47	48442	65	50/57	74/69	69/68	81/91	81/86		72.5	19.4	4.4	33.5	4.0	
33.5	60	2	15	12:47	48444	59	58/56	57/73	62/71	51/67	46/73		61.4	20.0	4.3	33.8	4.1	
34	55	1	16	12:53	48479	55	52/52	71/74	70/72	92/85	91/89		74.8	19.4	4.4	33.5	4.1	
34	58	2	16	12:53	48481	57	62/57	56/80	58/75	53/70	47/75		63.2	20.1	4.3	33.9	4.1	

Recorded by MARK Z

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 3 of 3	* DATE	1/11/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
35	61	1	17	12:58	48515	60	50/51	71/71	69/73	87/81	84/83		72.1	19.4	4.4	33.4	4.0	
35	55	2	17	12:59	48519	55	62/57	55/71	62/76	48/68	48/77		62.3	20.0	4.3	33.8	4.1	
33.5	65	1	18	13:04	48552	65	51/47	72/63	67/65	85/87	81/87		70.4	19.4	4.4	33.3	4.1	
33.5	64	2	18	13:04	48554	64	56/53	51/76	53/68	44/64	43/73		57.9	20.0	4.3	33.9	4.1	
33.5	65	1	19	13:09	48586	65	50/58	74/67	63/67	81/86	82/84		71.8	19.4	4.4	33.4	4.0	
33.5	67	2	19	13:09	48588	67	56/53	51/75	54/68	43/63	44/65		57.1	20.1	4.3	33.9	4.1	
36	65	1	20	13:15	48612	65	50/48	67/68	66/66	86/80	84/87		70.0	19.4	4.4	33.3	4.0	
36	66	2	20	13:15	48613	66	53/59	57/74	60/66	52/69	47/73		61.1	20.1	4.3	33.7	4.1	
41.5	65	1	21	13:20	48640	64	52/52	70/70	66/69	87/84	85/84		71.9	19.4	4.4	33.4	4.0	
41.5	66	2	21	13:20	48642	67	61/55	55/75	59/71	59/68	59/70		61.5	20.1	4.3	33.9	4.1	

Recorded by MARK Z

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 1 of 1	* DATE	11/12/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight	Axle B weight	Axle C weight	Axle D weight	Axle E weight	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
28.5	55	1	1	8:58	52183	55	57/61	81/76	78/77	94/89	96/100		80.9	19.3	4.3	33.3	4.0	
28.5	55	2	1	8:58	52184	55	60/63	66/75	68/69	60/65	55/71		65.2	20.1	4.3	33.7	4.1	
32	61	1	2	9:03	52209	60	57/61	83/77	79/76	92/86	90/89		78.9	19.3	4.3	33.3	4.0	
32	62	2	2	9:03	52213	59	63/58	62/75	66/73	57/67	57/75		65.3	20.0	4.3	33.8	4.1	
30	66	1	3	9:09	52242	65	53/52	74/73	71/70	94/94	90/88		76.0	19.4	4.3	33.3	4.0	
30	64	2	3	9:09	52243	64	61/61	63/72	65/70	57/69	55/73		65.2	20.1	4.3	33.7	4.1	
34.5	55	1	4	9:14	52261	54	58/63	83/77	78/75	97/94	97/98		81.3	19.4	4.4	33.3	4.0	
34.5	55	2	4	9:14	52262	55	59/64	63/66	67/72	61/68	56/70		64.5	20.1	4.3	33.8	4.1	
30.5	60	1	5	9:18	52295	60	54/52	81/71	74/73	88/92	89/92		76.1	19.3	4.4	33.2	4.0	
30.5	59	2	5	9:18	52296	59	58/63	65/76	69/70	62/66	55/73		65.8	20.0	4.3	33.6	4.1	
30	65	1	6	9:24	52318	65	54/61	79/74	73/73	92/97	87/99		78.8	19.4	4.4	33.4	4.0	
30	64	2	6	9:24	52320	64	62/56	62/75	65/69	56/65	55/77		64.2	20.0	4.3	33.8	4.0	

20.1 20.0

Recorded by MARK Z

Checked by

CAL 1

6420070022_SPSWIM_TO_15_27_2.116_0500_~~post-Validation~~_sheet_21

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 1 of 1	* DATE	11/12/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight	Axle B weight	Axle C weight	Axle D weight	Axle E weight	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
36.5	54	1	1	9:54	52460	55	56/60	79/76	74/76	94/91	92/100	LIGHT	79.8	19.4	4.4	33.3	4.0	
36.5	54	2	1	9:54	52463	54	60/58	59/77	58/69	57/67	53/69		63.1	20.1	4.3	33.8	4.1	
31.5	63	1	2	9:59	52489	60	58/57	81/75	75/77	93/94	90/93		79.3	19.4	4.4	33.3	4.0	
31.5	59	2	2	9:59	52492	59	65/62	63/75	69/70	64/69	56/73		65.7	20.0	4.3	33.7	4.1	
31	64	1	3	10:04	52520	64	55/55	80/66	75/68	88/93	83/89		75.2	19.4	4.4	33.2	4.0	
31	64	2	3	10:05	52523	64	62/56	59/72	64/72	68/66	56/72		63.9	20.0	4.3	33.7	4.1	
34.5	55	1	4	10:10	52556	55	54/59	77/77	75/77	97/90	94/95		79.7	19.4	4.4	33.4	4.0	
34.5	56	2	4	10:10	52558	56	63/57	59/80	58/76	52/74	49/75		64.3	20.1	4.3	33.9	4.1	
33	60	1	5	10:15	52572	60	64/59	56/78	69/74	56/74	53/80		75.0	19.4	4.4	33.4	4.0	
33	62	2	5	10:16	52579	62	56/54	78/69	73/71	85/90	82/91		65.4	20.1	4.3	33.8	4.1	
33.5	65	1	6	10:21	52602	65	54/53	75/70	72/71	94/94	92/85		76.1	19.4	4.4	33.3	4.0	
33.5	64	2	6	10:21	52605	64	60/60	57/77	59/73	57/73	52/82		65.1	20.0	4.3	33.7	4.1	

Recorded by MARK Z

Checked by

CAL 2

6420070022_SPSWIM_TO_15_27_2.116_0500~~_Cal_~~_sheet_21

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 1 of 2	* DATE	11/12/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
33	56	1	7	10:26	52639	55	54/53	76/74	72/72	93/85	91/92		76.5	19.4	4.4	33.2	4.0	
33	55	2	7	10:26	52640	55	57/57	54/77	57/76	48/71	47/68		61.0	20.1	4.3	33.9	4.1	
37.5	61	1	8	10:51	52784	60	54/60	78/78	75/77	88/88	88/92		77.9	19.4	4.4	33.4	4.0	
37.5	59	2	8	10:51	52785	59	59/56	56/77	58/75	52/75	47/81		63.7	20.1	4.3	33.8	4.1	
35	65	1	9	10:56	52815	65	56/54	74/69	69/66	88/94	82/91		74.4	19.4	4.4	33.2	4.0	
35	64	2	9	10:57	52817	65	59/62	59/76	59/74	51/76	50/86		65.3	20.1	4.3	33.9	4.1	
35.5	55	1	10	11:01	52836	55	55/51	77/68	72/68	91/93	86/92		75.3	19.3	4.3	33.2	4.0	
35.5	55	2	10	11:02	52840	56	58/56	56/82	54/74	50/75	45/84		63.6	20.1	4.3	33.9	4.1	
34	61	1	11	11:06	52870	60	56/53	74/77	71/76	93/80	88/89		75.7	19.4	4.4	33.4	4.0	
34	59	2	11	11:07	52875	59	61/57	56/78	59/74	51/77	49/82		64.5	20.1	4.3	34.0	4.1	
34	65	1	12	11:12	52896	64	55/56	75/73	75/72	95/86	92/87		76.6	19.4	4.3	33.2	4.0	
34	64	2	12	11:12	52897	64	63/61	57/74	60/75	52/77	50/85		65.4	20.1	4.3	33.9	4.1	
33.5	65	1	13	11:17	52920	65	[illegible]	52/62	79/74	77/73	85/91	84/90	[illegible]	19.4	4.4	33.3	4.0	
33.5	55	2	13	11:17	52921	55	61/58	57/78	62/73	57/73	51/80		65.0	20.0	4.3	33.7	4.1	
38.5	56	1	14	11:22	52953	56	56/59	78/78	75/76	94/92	92/94		79.4	19.4	4.4	33.4	4.0	
38.5	59	2	14	11:22	52954	59	58/57	55/79	59/73	52/72	48/76		62.7	20.1	4.3	33.8	4.1	

Recorded by MARK Z

Checked by

Sheet 21	* STATE_CODE	27
LTPP Traffic Data	*SPS PROJECT_ID	0500
WIM System Test Truck Records 2 of 2	* DATE	1/1/2/2008

Rev. 08/31/2001

Pvmt temp	Radar Speed	Truck	Pass	Time	Record No.	WIM Speed	Axle A weight.	Axle B weight.	Axle C weight.	Axle D weight.	Axle E weight.	Axle F weight	GVW	A-B space	B-C space	C-D space	D-E space	E-F space
37	61	1	15	11:27	52970	61	55/53	77/69	74/69	86/91	82/92		74.9	19.3	4.4	33.3	4.0	
37	59	2	15	11:27	52972	59	61/57	58/80	57/74	54/72	49/82		64.4	20.0	4.3	33.8	4.1	
37.5	66	1	16	11:32	52998	65	55/54	73/67	72/67	90/95	84/98		75.5	19.3	4.3	33.2	4.0	
37.5	65	2	16	11:32	52999	65	60/60	58/80	59/73	51/73	53/79		64.6	20.0	4.3	33.8	4.1	
38	55	1	17	11:37	53026	54	57/59	75/76	73/75	94/93	95/94		78.5	19.3	4.4	33.3	4.0	
38	55	2	17	11:37	53027	55	61/57	57/76	60/73	54/73	48/77		63.6	20.0	4.3	33.8	4.1	
37	61	1	18	11:42	53052	59	56/53	76/70	72/70	88/93	84/103		75.6	19.4	4.4	33.3	4.0	
37	58	2	18	11:42	53054	59	64/58	55/81	60/78	55/77	50/80		65.8	20.1	4.3	33.8	4.1	
37.5	65	1	19	11:48	53088	64	55/54	75/68	75/67	86/89	85/92		74.0	19.4	4.4	33.3	4.0	
37.5	64	2	19	11:48	53090	63	66/58	54/78	58/75	51/76	52/81		65.1	20.1	4.3	33.9	4.1	
28.5	55	1	20	11:53	53115	56	55/53	77/74	73/73	93/84	90/92		76.5	19.4	4.4	33.2	4.0	
28.5	55	2	20	11:53	53116	55	63/60	57/77	62/73	52/74	51/82		65.1	20.1	4.3	33.8	4.1	

Recorded by MARK Z

Checked by

Calibration Worksheet

Site: 270500

Calibration Iteration 1 Date 4/12/08

Beginning factors: 1/3 2/4

Speed Point (mph)	Name	Value	
Overall ~~Overall~~ Distance	axl dis	363	
Front Axle	dynamic compensation	104	
1 – (43)	65 kph	3597	3330
2 – (50)	80 kph	3659	3388
3 – (60)	96 kph (95)	3640	3700
4 – (70)	112 kph (110)	3549	3286
5 – (78)	125 kph	3455	3199

Errors: 43 50 ↙ 55 60 65 ↗ 70 78

	Speed Point 1	Speed Point 2	Speed Point 3	Speed Point 4	Speed Point 5
F/A		-5.4	-8.0	-7.9	
Tandem		-4.9	-7.6	-7.6	
GVW		-5.0	-7.6	-7.5	

Adjustments:

	Raise	Lower	Percentage
Overall	☐	☐	
Front Axle	☐	☐	
Speed Point 1	☐	☐	
Speed Point 2	☑	☐	5.1 %
Speed Point 3	☑	☐	8.1 %
Speed Point 4	☑	☐	8.0 %
Speed Point 5	☐	☐	

End factors: 1/3 2/4

Speed Point (mph)	Name	Value	
Overall	axl dis	363	
Front Axle	dynamic compensation	104	
1 – (43)	65 kph	3597	3330
2 – (50)	80 kph	3844	3559
3 – (60)	96 kph (95)	3933	3641
4 – (70)	112 kph (110)	3831	3548
5 – (78)	125 kph	3455	3199

Calibration Worksheet

Site: 270500

Calibration Iteration 2 Date 11-12-08

Beginning factors: 1/3 2/4

Speed Point (mph)	Name	Value	
Overall			
Front Axle			
1 – (43)	65 kph	3597	3330
2 – (50)	80 kph	3844	3559
3 – (60)	96 kph (95)	3933	3641
4 – (70)	112 kph (110)	3831	3548
5 – (78)	125 kph	3455	3199

Errors: 55 (50) 65 60 70

	Speed Point 1	Speed Point 2	Speed Point 3	Speed Point 4	Speed Point 5
F/A		+4.5	+0.4	+0.4	
Tandem		+2.6	+1.4	+0.3	
GVW		+3.0	+1.2	+0.5	

Adjustments:

	Raise	Lower	Percentage
Overall	☐	☐	
Front Axle	☐	☐	
Speed Point 1	☐	☐	
Speed Point 2	☐	☑	2.9 %
Speed Point 3	☐	☑	1.2 %
Speed Point 4	☐	☑	0.5 %
Speed Point 5	☐	☐	

End factors: 1/3 2/4

Speed Point (mph)	Name	Value	
Overall			
Front Axle			
1 – (43)	65 kph	3597	3330
2 – (50)	80 kph	3731	3454
3 – (60)	96 kph	3884	3596
4 – (70)	112 kph	3811	3529
5 – (78)	125 kph	3455	3199

TEST VEHICLE PHOTOGRAPHS FOR SPS WIM VALIDATION

November 11, 2008

STATE: Minnesota

SHRP ID: 270500

Photo 1 - Truck_1_Tractor_ 27_0500_11_11_08.JPG

Photo 2 - Truck_1_Trailer_27_0500_11_11_08.JPG

Photo 3 - Truck_1_Suspension_1_27_0500_11_11_08.JPG

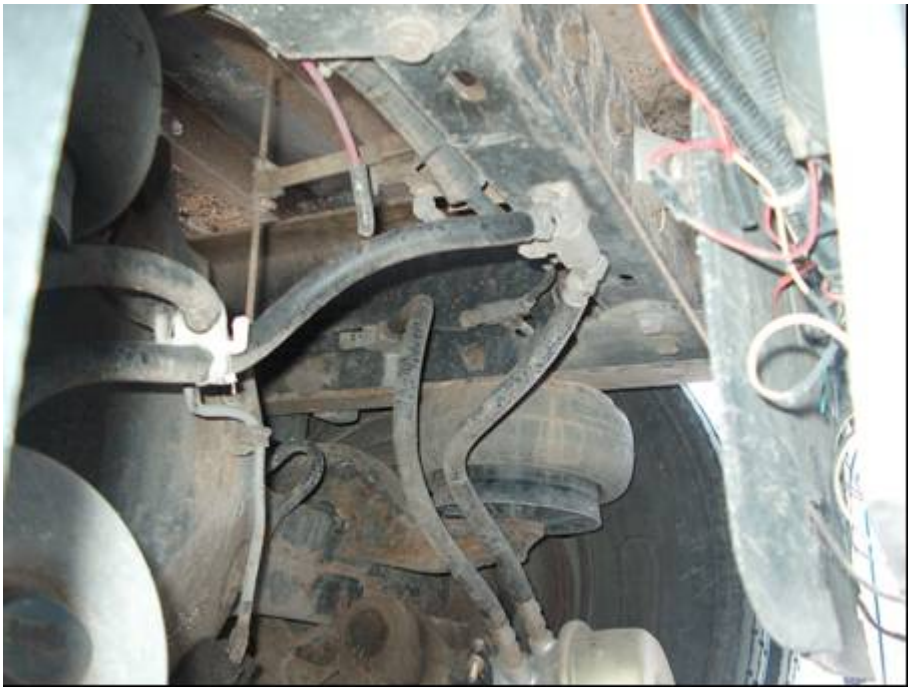

Photo 4 - Truck_1_Suspension_2_27_0500_11_11_08.JPG

Photo 5 - Truck_1_Suspension_3_27_0500_11_11_08.JPG

Photo 6 - Truck_2_Tractor_27_0500_11_11_08.JPG

Photo 7 - Truck_2_Trailer_27_0500_11_11_08.JPG

Photo 8 - Truck_2_Suspension_1_27_0500_11_11_08.JPG

Photo 9 - Truck_2_Suspension_2_27_0500_11_11_08.JPG

Photo 10 - Truck_2_Suspension_3_27_0500_11_11_08.JPG

ETG LTPP CLASS SCHEME, MOD 3

Class	Vehicle Type	No. Axles	Spacing 1	Spacing 2	Spacing 3	Spacing 4	Spacing 5	Spacing 6	Spacing 7	Spacing 8	Gross Weight Min-Max	Axle 1 Weight Min *
1	Motorcycle	2	1.00-5.99								0.10-3.00	
2	Passenger Car	2	6.00-10.10								1.00-7.99	
3	Other (Pickup/Van)	2	10.11-23.09								1.00-7.99	
4	Bus	2	23.10-40.00								12.00 >	
5	2D Single Unit	2	6.00-23.09								8.00 >	2.5
2	Car w/ 1 Axle Trailer	3	6.00-10.10	6.00-25.00							1.00-11.99	
3	Other w/ 1 Axle Trailer	3	10.11-23.09	6.00-25.00							1.00-11.99	
4	Bus	3	23.10-40.00	3.00-7.00							20.00 >	
5	2D w/ 1 Axle Trailer	3	6.00-23.09	6.30-30.00							12.00-19.99	2.5
6	3 Axle Single Unit	3	6.00-23.09	2.50-6.29							12.00 >	3.5
8	Semi, 2S1	3	6.00-23.09	11.00-45.00							20.00 >	3.5
2	Car w/ 2 Axle Trailer	4	6.00-10.10	6.00-30.00	1.00-11.99						1.00-11.99	
3	Other w/ 2 Axle Trailer	4	10.11-23.09	6.00-30.00	1.00-11.99						1.00-11.99	
5	2D w/ 2 Axle Trailer	4	6.00-26.00	6.30-40.00	1.00-20.00						12.00-19.99	2.5
7	4 Axle Single Unit	4	6.00-23.09	2.50-6.29	2.50-12.99						12.00 >	3.5
8	Semi, 3S1	4	6.00-26.00	2.50-6.29	13.00-50.00						20.00 >	5.0
8	Semi, 2S2	4	6.00-26.00	8.00-45.00	2.50-20.00						20.00 >	3.5
3	Other w/ 3 Axle Trailer	5	10.11-23.09	6.00-25.00	1.00-11.99	1.00-11.99					1.00-11.99	
5	2D w/ 3 Axle Trailer	5	6.00-23.09	6.30-35.00	1.00-25.00	1.00-11.99					12.00-19.99	2.5
7	5 Axle Single Unit	5	6.00-23.09	2.50-6.29	2.50-6.29	2.50-6.30					12.00 >	3.5
9	Semi, 3S2	5	6.00-30.00	2.50-6.29	6.30-65.00	2.50-11.99					20.00 >	5.0
9	Truck+FullTrailer (3-2)	5	6.00-30.00	2.50-6.29	6.30-50.00	12.00-27.00					20.00>	3.5
9	Semi, 2S3	5	6.00-30.00	16.00-45.00	2.50-6.30	2.50-6.30					20.00 >	3.5
11	Semi+FullTrailer, 2S12	5	6.00-30.00	11.00-26.00	6.00-20.00	11.00-26.00					20.00 >	3.5
10	Semi, 3S3	6	6.00-26.00	2.50-6.30	6.10-50.00	2.50-11.99	2.50-10.99				20.00 >	5.0
12	Semi+Full Trailer, 3S12	6	6.00-26.00	2.50-6.30	11.00-26.00	6.00-24.00	11.00-26.00				20.00 >	5.0
13	7 Axle Multi's	7	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00			20.00 >	5.0
13	8 Axle Multi's	8	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00		20.00 >	5.0
13	9 Axle Multi's	9	6.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	3.00-45.00	20.00 >	5.0

Spacings in feet
Weights in kips (Lbs/1000)
* Suggested Axle 1 minimum weight threshold if allowed by WIM system's class algorithm programming

System Operating Parameters

Minnesota SPS-5

Lane # 4

	Validation Visit		
	November 12, 2008	November 11, 2008	August 28, 2007
	Calibration factors for Sensor #1/3		
Distance		363	
Dynamic (front axle)	104	104	104
65 kph	3597	3597	3436
80 kph	3731	3659	3495
95 kph	3884	3640	3477
110 kph	3811	3549	3390
125 kph	3455	3455	3300
	Calibration factors for Sensor #2/4		
65 kph	3330	3330	3436
80 kph	3454	3388	3495
95 kph	3596	3700	3477
110 kph	3529	3286	3390
125 kph	3199	3199	3300