WIM System Field Calibration and Validation Summary Report

Maine SPS-5
SHRP ID – 230500

Validation Date: November 30, 2010
Submitted: 12/17/2010

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1 Executive Summary

A WIM validation was performed on November 30 and December 1, 2010 at the Maine SPS-5 site located on route I-95 at milepost 200.1, .25 miles north of Bennoch Road interchange.

This site was installed on May 23, 2007. The in-road sensors are installed in the northbound lane. The site is equipped with quartz WIM sensors and IRD iSINC WIM controller. The LTPP lane is identified as lane 1 in the WIM controller. From a comparison between the report of the most recent validation of this equipment on October 15, 2008 and this validation visit, it appears that a change has occurred during this time to the basic operating condition of the equipment.

The equipment is not in working order. However, electronic checks of all WIM sensors determined that they were operating within tolerances. The loop sensors and support services appeared to be working properly. Further equipment discussion is provided in Section 3.

During the on-site pavement evaluation, no distresses that would affect the performance of the WIM scales were noted. Observations of trucks passing over the site did not detect any motions by the trucks that would affect WIM system accuracies. Further pavement condition discussion is provided in Section 4.

Based on the criteria contained in the LTPP Field Operations Guide for SPS WIM Sites, Version 1.0 (05/09), this site is not providing research quality loading data. The summary results of the validation are provided in Table 1.1 below.

Table 1-1 – Pre-Validation Results – 30-Nov-10

Parameter	95% Confidence Limit of Error	Site Values	Pass/Fail
Steering Axles	±20 percent	8.5 ± 7.6%	Pass
Tandem Axles	±15 percent	8.2 ± 5.3%	Pass
Tridem Axles	±15 percent	17.8 ± 6.7%	FAIL
Axle Groups	±15 percent	10.6 ± 5.7%	FAIL
GVW	±10 percent	10.3 ± 7.0%	FAIL
Vehicle Length	±3 percent (2.1 ft)	0.4 ± 1.3 ft	Pass
Axle Length	± 0.5 ft [150mm]	-0.3 ± 0.3 ft	Pass

Truck speeds were manually collected for each test run by a radar gun and compared with the speed reported by the WIM equipment. For this site, the error in speed measurement was -1.2 ± 1.8 mph, which is greater than the ±1.0 mph tolerance established by the LTPP Field Operations Guide for SPS WIM Sites. However, since the site is measuring axle spacing length with a mean error of -0.3 feet, and the speed and axle spacing measurements are based on the distance between the axle detector sensors, it can be concluded that the distance factor is set correctly.

This site is providing research quality vehicle classification data for heavy trucks (Class 6 – 13). The heavy truck misclassification rate of 0.0% is within the 2.0% acceptability criterion for LTPP SPS WIM sites. The overall misclassification rate of 1.0% from the 100 truck sample (Class 4 – 13) was due to the 1 cross-classification of a Class 5 vehicle that was identified as Class 3 vehicle by the equipment.

There were two test trucks used for the post-validation. They were configured and loaded as follows:

- The *Primary* truck was a Class 9 vehicle with air suspension on the tractor and trailer tandems, and standard (4 feet) tandem spacings. It was loaded with concrete blocks loaded along the trailer.

- The *Secondary* truck was a Class 10 vehicle with air suspension on the tractor tandem, air on the trailer tridem, standard tandem spacing on the tractor and standard tridem spacing on the trailer. The Secondary truck was loaded with concrete blocks loaded along the trailer.

Prior to the validation, the test trucks were weighed and measured, cold tire pressures were taken, and photographs of the trucks, loads and suspensions were obtained (see Section 7). Axle length (AL) was measured from the center hub of the first axle to the center hub of the last axle. Overall length (OL) was measured from the edge of the front bumper to the edge of the rear bumper. The test trucks were re-weighed at the conclusion of the validation. The average post-validation test truck weights and measurements are provided in Table 1-2.

Table 1-2 – Pre-Validation Test Truck Measurements

Test Truck	Weights (kips)						Spacings (feet)						
	GVW	Ax1	Ax2	Ax3	Ax4	Ax5	1-2	2-3	3-4	4-5	5-6	AL	OL
1	76.9	11.3	16.0	16.0	16.8	16.8	17.0	4.3	29.5	4.1		54.9	67.3
2	66.4	9.8	13.3	13.3	10.0	10.0	17.4	4.4	37.8	4.4	4.4	68.4	73.1

The posted speed limit at the site is 65 mph. During the testing, the speed of the test trucks ranged from to 52 to 64 mph, a variance of 12 mph.

During test truck runs, pavement temperature was collected using a hand-held infrared temperature device. The post-validation pavement surface temperatures varied from 31.0 to 39.3 degrees Fahrenheit, a range of 8.3 degrees Fahrenheit. The partly cloudy weather conditions prevented the desired 30 degree range in temperatures.

A review of the LTPP Standard Release Database 24 shows that there are 25 consecutive months of level "E" WIM data for this site. This site requires at least 3 additional years of data to meet the minimum of five years of research quality data. However, considering that the December 2010 validation shows that the site does not provide research quality data at present, the 2009 and 2010 data should be reviewed to ascertain when the system ceased to provide research quality data.

2 WIM System Data Availability and Pre-Visit Data Analysis

To assess the quality of the current data, a pre-visit analysis was conducted by comparing a two-week data sample from October 25, 2010 (Data) to the most recent Comparison Data Set (CDS) from October 16, 2008. The assessments performed prior to the site visits are used to develop reasonable expectations for the validation. The results of further investigations performed as a result of the analyses are provided in Section 5 of this report.

2.1 LTPP WIM Data Availability

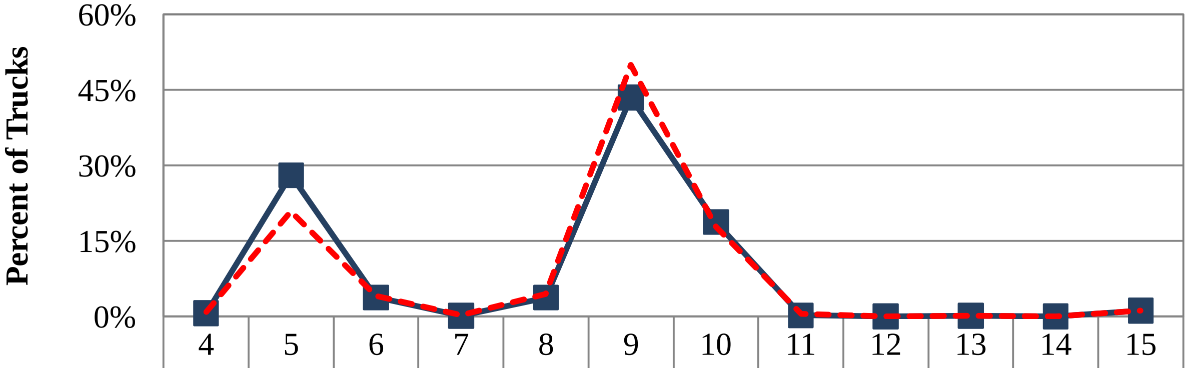
A review of the LTPP Standard Release Database 24 shows that there are 25 consecutive months of level "E" WIM data for this site. This site requires 3 additional years of data to meet the minimum of five years of research quality data. The data does not meet the 210-day minimum requirement for the 2007 and 2009 calendar years, however, the continuous data for the last 6 months of 2007 and the first 7 months of 2009 provide more than 210 days data for each of the two 12-month periods, and therefore provide for two periods in which 210 days of WIM data has been collected. Table 2-1 provides a breakdown of the available data for years 2008 and 2009.

Table 2-1 – LTPP Data Availability

Year	Total Number of Days in Year	Number of Months
2007	158	6
2008	365	12
2009	200	7

2.2 Classification Data Analysis

The traffic data was analyzed to determine the expected truck distributions. This analysis provides a basis for the classification distribution study that was conducted on site. Figure 2-1 provides a comparison of the truck type distributions for the two datasets. The figure indicates an increase in the number of Class 5 trucks and a decrease in the number of Class 9 trucks between the October 2008 and October 2010 data sets.



	4	5	6	7	8	9	10	11	12	13	14	15
Data	0.6%	28.0%	3.8%	0.2%	3.7%	43.5%	18.7%	0.2%	0.0%	0.1%	0.0%	1.1%
CDS	0.9%	20.9%	4.1%	0.2%	4.4%	50.0%	17.8%	0.5%	0.0%	0.1%	0.0%	1.2%

Figure 2-1 – Comparison of Truck Distribution

Table 2-2 provides statistics for the truck distributions at the site for the two periods represented by the two datasets. The table shows that according to the most recent data, the most frequent truck types crossing the WIM scale are Class 9 (43.5%) and Class 5 (28.0%). It also indicates that 1.1 percent of the vehicles at this site are unclassified. Table 2-2 also provides data for vehicle Classes 14 and 15. Class 14 vehicles are vehicles that are reported by the WIM equipment as having irregular measurements and cannot be classified properly, such as negative speeds from vehicles passing in the opposite direction of a two-lane road. Class 15 vehicles are unclassified vehicles.

Table 2-2 – Truck Distribution from W-Card

Vehicle Classification	CDS		Data		Change
	Date				
	10/16/2008		10/25/2010		
4	87	0.9%	56	0.6%	-0.3%
5	2016	20.9%	2419	28.0%	7.2%
6	394	4.1%	326	3.8%	-0.3%
7	19	0.2%	13	0.2%	0.0%
8	427	4.4%	323	3.7%	-0.7%
9	4824	50.0%	3750	43.5%	-6.5%
10	1720	17.8%	1616	18.7%	0.9%
11	46	0.5%	18	0.2%	-0.3%
12	2	0.0%	1	0.0%	0.0%
13	8	0.1%	9	0.1%	0.0%
14	0	0.0%	0	0.0%	0.0%
15	112	1.2%	96	1.1%	0.0%

From the table it can be seen that the number of Class 9 vehicles has decreased by 6.5 percent from October 2008 and October 2010. The decrease in the number of heavier trucks may be attributed to seasonal variations in truck distributions. During the same time period, the number of Class 5 trucks increased by 7.2 percent. These differences may be attributed to small sample size used to develop vehicle class distributions, decreased use of the roadway for local deliveries, cross-classifications of type 3 and 5 vehicles, as well as natural variations in truck volumes.

2.3 Speed Data Analysis

The traffic data received from the Phase II Contractor was analyzed to determine the expected truck speed distributions. This will provide a basis for the speed of the test trucks during validation testing. The CDS distribution of speeds is shown in Figure 2-2.

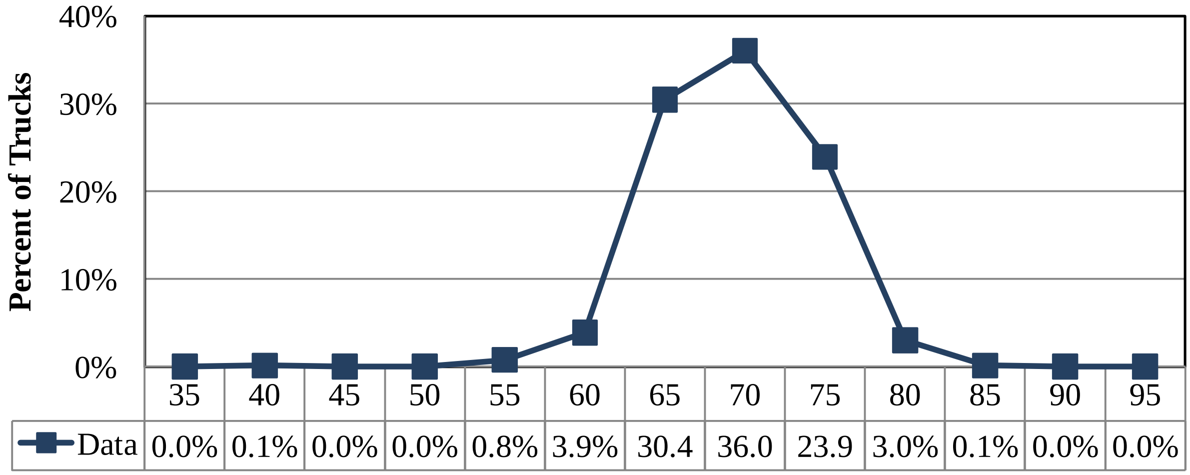


Figure 2-2 – Truck Speed Distribution – 25-Oct-10

As shown in Figure 2-2, the majority of the trucks at this site are traveling between 65 and 75 mph. The posted speed limit at this site is 65 and the 85th percentile speed for trucks at this site is 72 mph. The coverage of truck speeds for the validation will be 55 and 65 mph. Since the 85th percentile speeds for trucks is above the posted speed limit, the post-visit applied calibration will be used to develop compensation factors for speed points from 65 to 70 mph.

2.4 GVW Data Analysis

The traffic CDS data received from the Regional Support Contractor was analyzed to determine the expected Class 9 GVW distributions. Figure 2-3 shows a comparison between GVW plots generated using a two-week W-card sample from October 2010 and the Comparison Data Set from October 2008.

As shown in Figure 2-3, there is a shift to the left for the loaded peak between the October 2008 Comparison Data Set (CDS) and the October 2010 two-week sample W-card dataset (Data). The new loaded peak is also not well-defined. The results indicate that there may have been a change in the pavement condition or sensor deterioration.

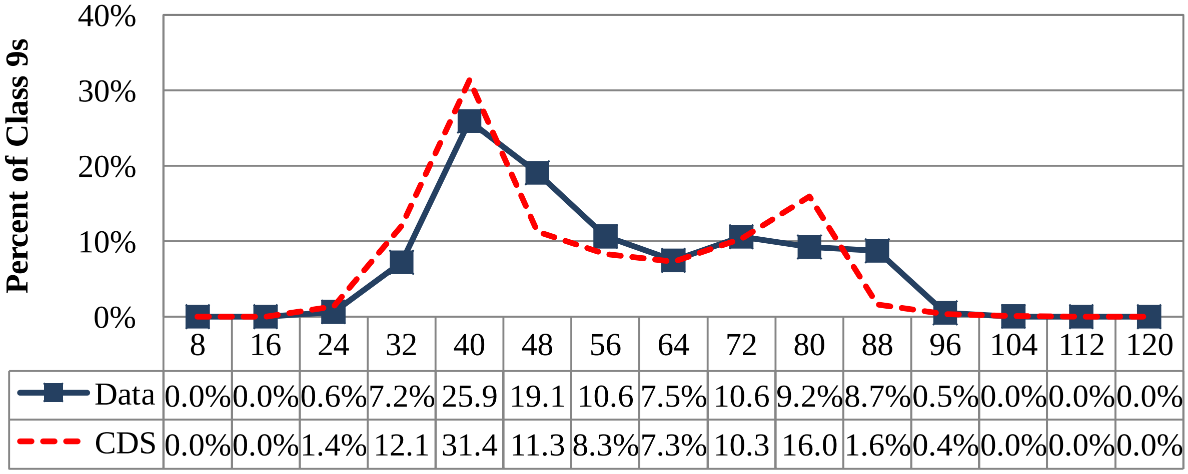


Figure 2-3 – Comparison of Class 9 GVW Distribution

Table 2-3 is provided to show the statistical comparison between the Comparison Data Set and the current dataset.

Table 2-3 – Class 9 GVW Distribution from W-Card

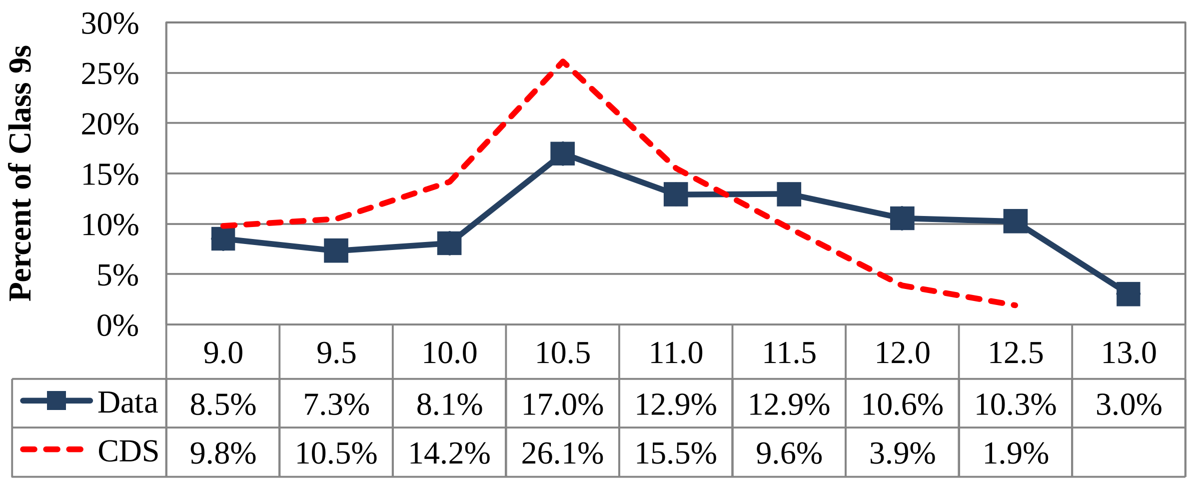
GVW weight bins (kips)	CDS		Data		Change
	Date				
	10/16/2008		10/25/2010		
8	0	0.0%	0	0.0%	0.0%
16	0	0.0%	0	0.0%	0.0%
24	66	1.4%	23	0.6%	-0.8%
32	581	12.1%	269	7.2%	-4.9%
40	1511	31.4%	970	25.9%	-5.4%
48	543	11.3%	713	19.1%	7.8%
56	401	8.3%	398	10.6%	2.3%
64	350	7.3%	279	7.5%	0.2%
72	498	10.3%	396	10.6%	0.2%
80	768	16.0%	345	9.2%	-6.7%
88	78	1.6%	327	8.7%	7.1%
96	17	0.4%	19	0.5%	0.2%
104	2	0.0%	1	0.0%	0.0%
Average =	49.4		51.9		2.5

As shown in the table, the number of unloaded class 9 trucks in the 32 to 40 kips range decreased by 5.4 percent and the number of loaded class 9 trucks in the 72 to 80 kips range decreased by 6.7 percent. The number of overweight trucks increased during this time period by 7.3 percent and the overall GVW average for this site increased from 49.4 kips to 51.9 kips.

2.5 Class 9 Front Axle Weight Data Analysis

The CDS data received from the Regional Support Contractor was analyzed to determine the expected average front axle weight of Class 9 trucks. This will provide a basis for the evaluation of the quality of the data by comparing the observed average front axle weight with the expected average front axle weight average for Class 9 trucks of 10.3 kips.

Figure 2-4 shows a comparison between Class 9 front axle weight plots generated by using the two week W-card sample from October 2010 and the Comparison Data Set from October 2008.



	9.0	9.5	10.0	10.5	11.0	11.5	12.0	12.5	13.0
Data	8.5%	7.3%	8.1%	17.0%	12.9%	12.9%	10.6%	10.3%	3.0%
CDS	9.8%	10.5%	14.2%	26.1%	15.5%	9.6%	3.9%	1.9%	

Figure 2-4 – Distribution of Class 9 Front Axle Weights

It can be seen in the figure that although the greatest percentage of trucks having front axle weights averaging 10.5 kips has remained consistent, the percentage of trucks at this weight have decreased between the October 2008 Comparison Data Set (CDS) and the October 2010 dataset (Data). The number of trucks with front axle weights greater than 10.5 kips has increased and the number of trucks with front axle weights less than 10.5 kips has decreased.

Table 2-4 provides the Class 9 front axle weight distribution data for the October 2008 Comparison Data Set (CDS) and the October 2010 dataset (Data).

Table 2-4 – Class 9 Front Axle Weight Distribution from W-Card

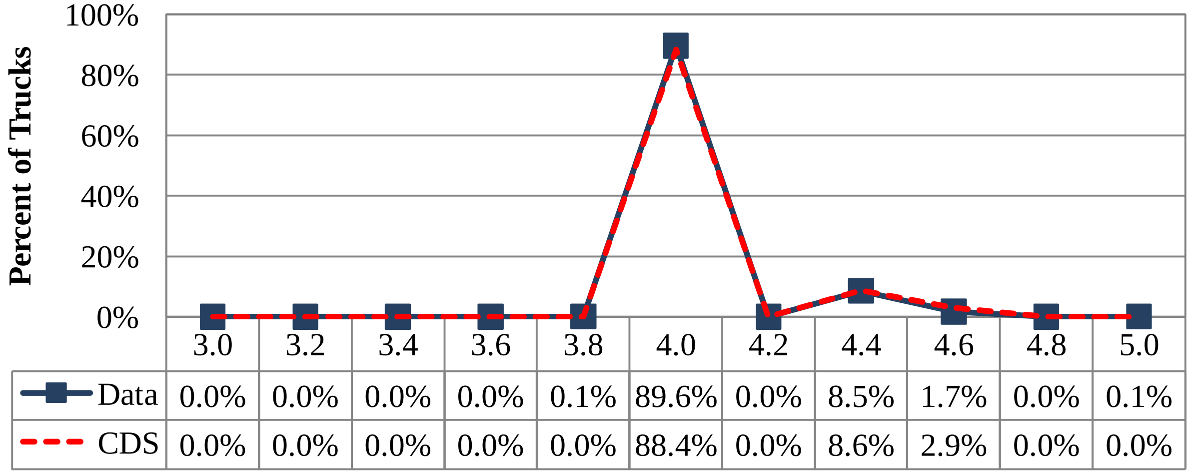
F/A weight bins (kips)	CDS		Data		Change
	Date				
	10/16/2008		10/25/2010		
9.0	392	8.2%	345	9.4%	1.2%
9.5	471	9.8%	313	8.5%	-1.3%
10.0	505	10.5%	269	7.3%	-3.2%
10.5	681	14.2%	296	8.1%	-6.1%
11.0	1254	26.1%	622	17.0%	-9.2%
11.5	744	15.5%	474	12.9%	-2.6%
12.0	461	9.6%	475	12.9%	3.3%
12.5	186	3.9%	387	10.6%	6.7%
13.0	93	1.9%	376	10.3%	8.3%
13.5	15	0.3%	111	3.0%	2.7%
Average =	10.5		11.0		0.4

The table shows that the average front axle weight for Class 9 trucks has increased by 0.4 kips, or 4.2 percent. According to the current data, the majority of the Class 9 front axle weights are between 10.5 and 11.5 kips and the average front axle weight for Class 9 trucks is 11.0 kips.

2.6 Class 9 Tractor Tandem Spacing Data Analysis

The CDS data received from the Regional Support Contractor was analyzed to determine the expected average tractor tandem spacing. This will provide a basis for the evaluation of the accuracy of the equipment distance and speed measurements by comparing the observed average tractor tandem spacing with the expected average tractor tandem spacing of 4.25 feet.

The class 9 tractor tandem spacing plots in Figure 2-5 are provided to indicate possible shifts in WIM system distance and speed measurement accuracies.



	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0
Data	0.0%	0.0%	0.0%	0.0%	0.1%	89.6%	0.0%	8.5%	1.7%	0.0%	0.1%
CDS	0.0%	0.0%	0.0%	0.0%	0.0%	88.4%	0.0%	8.6%	2.9%	0.0%	0.0%

Figure 2-5 – Comparison of Class 9 Tractor Tandem Spacing

As seen in the figure, the Class 9 tractor tandem spacing for the October 2008 Comparison Data Set and the October 2010 Data are nearly identical.

Table 2-5 shows the Class 9 axle spacings between the second and third axles for the power unit.

Table 2-5 – Class 9 Axle 3 to 4 Spacing from W-Card

Tandem 1 spacing bins (feet)	CDS		Data		Change
	Date				
	10/16/2008		10/25/2010		
3.0	0	0.0%	0	0.0%	0.0%
3.2	0	0.0%	0	0.0%	0.0%
3.4	0	0.0%	0	0.0%	0.0%
3.6	0	0.0%	0	0.0%	0.0%
3.8	2	0.0%	3	0.1%	0.0%
4.0	4255	88.4%	3351	89.6%	1.2%
4.2	0	0.0%	0	0.0%	0.0%
4.4	415	8.6%	319	8.5%	-0.1%
4.6	142	2.9%	65	1.7%	-1.2%
4.8	0	0.0%	0	0.0%	0.0%
5.0	1	0.0%	2	0.1%	0.0%
Average =	4.0		4.0		0.0

From the table it can be seen that the spacing of the tractor tandems for Class 9 trucks at this site is between 3.8 and 4.6 feet. The average tractor tandem spacing is 4.0 feet, which is below the expected average of 4.25 feet. Further analyses are performed during the validation and post-validation analysis.

2.7 Data Analysis Summary

Historical data analysis involved the comparison of the most recent Comparison Data Set (October 2008) based on the last calibration with the most recent two-week WIM data sample from the site (October 2010). Comparison of vehicle class distribution data indicates a 6.5 percent decrease in the number of Class 9 vehicles. Analysis of Class 9 weight data indicates that front axle weights have increased by 4.2 percent and average Class 9 GVW has increased by 5.1 percent for the October 2010 data. The data indicates an average truck tandem spacing of 4.0 feet, which is below the expected average of 4.25 feet.

3 WIM Equipment Discussion

From a comparison between the report of the most recent validation of this equipment on October 15, 2008 and this validation visit, it appears that a change has occurred during this time to the basic operating condition of the equipment.

3.1 Description

This site was installed on May 23, 2007 by International Road Dynamics. It is instrumented with quartz weighing sensors and IRD iSINC WIM Controller. As the installation contractor, IRD also performs routine equipment maintenance and data quality checks of the WIM data.

3.2 Physical Inspection

Prior to the pre-validation test truck runs, a physical inspection of all WIM equipment and support services equipment was conducted. No deficiencies were noted. Photographs of all system components were taken and are presented in Section 7.

3.3 Electronic and Electrical Testing

Electronic and electrical checks of all system components were conducted prior to the pre-validation test truck runs. Dynamic and static electronic checks of the in-road sensors were performed with no deficiencies noted. All values for the WIM sensors and inductive loops were within tolerances. Electronic tests of the power and communication devices indicated that they were operating normally.

3.4 Equipment Troubleshooting and Diagnostics

During the Pre-Validation test truck runs, the WIM system reported vehicle weight measurements with right wheel weights at nearly 50% of left wheel weights for tandem axles as shown in Figure 3-1.

(57374) LANE #1 CLASS 9 GVW 64.3 kips LENGTH 72 ft
SPEED 71 mph MAX GVW 80.0 kips Mon Nov 29 2010 20:58:56 (1912)

AXLE	SEPARATION (ft)	LEFT WT (kips)	RIGHT WT (kips)	TOTAL WT (kips)	ALLOWABLE (kips)
1		4.3	6.3	10.6	20.0
2	17.4	9.9	5.6	15.4	17.0
3	4.5	9.9	5.6	15.5	17.0
4	31.5	7.2	4.2	11.5	20.0
5	10.2	6.6	4.6	11.2	20.0

STATUS: Weight Difference
STATUS: Unequl Axls Detcted

Figure 3-1 - Vehicle Record

It was believed that the problem was related to a faulty sensor on the right side of either the leading or trailing sensor.

During troubleshooting, the right wheel weights suddenly and inexplicably increased to be within reasonable balance with the left wheel weights. However, the tridem axle weights continued to be overestimated by a much higher degree than steering or tandem axle weights. The cause for this discrepancy could not be determined in the field, but it is believed that it was related to the compensation by the equipment for the loss of detection of Sensor #2 by the equipment.

The diagnostic function for the equipment was used to determine that Sensor #2 inputs were not being detected and processed by the equipment as evidenced by the vehicle diagnostic record shown in Figure 3-2.

```
(60633) LANE #1    ***** DIAGNOSTIC *****  Wed Dec  1 2010 06:54:52 (2044)
 Axle |  Loop  Detune  |  Fr Ov  |   Tire  |      Axle Sensor (ticks)
         (tick) (Norm)                          #1   #2   #3   #4
 1                                              35    0   38   41
 2     3962                                     34    0   35   41
 3     3974                                     32    0   35   40
 4       0                                    28    0   29   33
 5       0                                    28    0   30   32
```

Figure 3-2 – Vehicle Diagnostic Record

Note that the steering axle weights shown in Figure 3-1 were not affected with underestimating the right wheel weights. However, there was a marked difference between the left and right wheel loads of single axles. It was determined that this was because the single wheels of the steering axle do not cross Sensor #2.

Further troubleshooting actions were undertaken to attempt to localize the cause of the fault. Electronic readings for Sensor #2 were taken again, with similar results to the first test, where all readings were normal.

With the assistance of Bruce Myers with IRD, Sensor #2 was disabled, removing it from the system configuration. Although the “Unequal Axles Detected” fault was no longer present, the inconsistency in tandem and tridem axle group measurement continued.

3.5 Recommended Equipment Maintenance

It is recommended that the problems associated with the inconsistent weight measurements of tandem and tridem axle group weights and the failure of the equipment to detect inputs from the #2 WIM sensor be further investigated to determine if the problem is with the controller or with the sensor.

4 Pavement Discussion

4.1 Pavement Condition Survey

During a visual distress survey of the pavement conducted from the shoulder, no areas of pavement distress that may affect the accuracy of the WIM sensors were noted.

4.2 Profile and Vehicle Interaction

Profile data was collected on November 10, 2010 by the North Atlantic Regional Support Contractor using a high-speed profiler, where the operator measures the pavement profile over the entire one-thousand foot long WIM Section, 900 feet prior to WIM scales and 100 feet after the WIM scales. Each pass collects International Roughness Index (IRI) values in both the left and right wheel paths. For this site, 11 profile passes were made, 5 in the center of the travel lane and 6 that were shifted to the left and to the right of the center of the travel lane.

From a pre-visit review of the IRI values for the center, right, and left profile runs, the highest IRI value within the 1000 foot WIM section is 95 in/mi and is located approximately 751 feet prior to the WIM scale. The highest IRI value within the 400 foot approach section was 94 in/mi and is located approximately 473 feet prior to the WIM scale. This area of pavement was closely investigated during the validation visit, and truck dynamics in this area were closely observed. There were no distresses observed that would influence truck dynamics in the WIM scale area.

Additionally, 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 center of the lane.

4.3 LTPP Pavement Profile Data Analysis

The IRI data files are processed using the WIM Smoothness Index software. The indices produced by the software provide an indication of whether or not the pavement roughness may affect the operation of the WIM equipment. The recommended thresholds for WIM Site pavement smoothness are provided in Table 4-1.

Table 4-1 – Recommended WIM Smoothness Index Thresholds

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

When all values are less than the lower threshold shown in Table 4-1, it is unlikely that pavement conditions will significantly influence sensor output. Values between the threshold values may or may not influence the accuracy of the sensor output and values above the upper threshold would lead to sensor output that would preclude achieving the research quality loading data.

The profile analysis was based on four different indices: Long Range Index (LRI), which represents the pavement roughness starting 25.8 m prior to the scale and ending 3.2 m after the scale in the direction of travel; Short Range Index (SRI), which represents the pavement roughness beginning 2.74 m prior to the WIM scale and ending 0.46 m after the scale; Peak LRI – the highest value of LRI within 30 m prior to the scale; and Peak SRI – the highest value of SRI between 2.45 m prior to the scale and 1.5 m after the scale. The results from the analysis for each of the indices for the right wheel path (RWP) and left wheel path (LWP) values for the 3 left, 3 right and 5 center profiler runs are presented in Table 4-2.

Table 4-2 – WIM Index Values

Profiler Passes			**Pass 1**	**Pass 2**	**Pass 3**	**Pass 4**	**Pass5**	**Avg**
Left	LWP	LRI (m/km)	0.608	0.542	0.621			0.590
		SRI (m/km)	*0.481*	0.563	0.586			0.543
		Peak LRI (m/km)	1.068	0.996	0.915			0.993
		Peak SRI (m/km)	0.661	0.851	0.675			0.729
	RWP	LRI (m/km)	0.590	0.665	0.626			0.627
		SRI (m/km)	*0.419*	0.551	*0.473*			*0.481*
		Peak LRI (m/km)	0.830	0.818	0.831			0.826
		Peak SRI (m/km)	*0.693*	0.822	*0.668*			*0.728*
Center	LWP	LRI (m/km)	*0.426*	*0.439*	*0.478*	*0.480*	*0.414*	*0.456*
		SRI (m/km)	*0.384*	*0.424*	0.518	0.522	*0.426*	*0.462*
		Peak LRI (m/km)	0.690	0.587	0.662	0.690	0.636	0.657
		Peak SRI (m/km)	*0.740*	0.837	0.945	0.932	0.755	0.864
	RWP	LRI (m/km)	0.654	0.725	0.727	0.711	0.684	0.704
		SRI (m/km)	0.565	0.588	0.685	0.610	0.577	0.612
		Peak LRI (m/km)	0.668	0.738	0.738	0.721	0.706	0.716
		Peak SRI (m/km)	0.817	0.804	0.775	*0.741*	0.859	0.784
Right	LWP	LRI (m/km)	0.773	0.721	0.733			0.742
		SRI (m/km)	0.820	0.703	0.699			0.741
		Peak LRI (m/km)	0.775	0.728	0.744			0.749
		Peak SRI (m/km)	0.891	0.789	0.769			0.816
	RWP	LRI (m/km)	0.745	0.740	0.669			0.718
		SRI (m/km)	0.673	0.757	0.815			0.748
		Peak LRI (m/km)	0.777	0.772	0.702			0.750
		Peak SRI (m/km)	0.840	0.914	1.051			0.935

From Table 4-2 it can be seen that most of the indices computed from the profiles are between the upper and lower threshold values, with the remaining values under the lower threshold. The highest values, on average, are the Peak LRI values in the left wheel path of the left shift passes.

4.4 Recommended Pavement Remediation

No pavement remediation is recommended.

5 Statistical Reliability of the WIM Equipment

The following section provides summaries of data collected during the pre-validation as well as information resulting from the classification and speed studies. All analyses of test truck data and information on necessary equipment adjustments are provided.

5.1 Pre-Validation

The first set of test runs provides a general overview of system performance prior to any calibration adjustments for the given environmental, vehicle speed and other conditions.

The 42 pre-validation test truck runs were conducted on November 30, 2010, beginning at approximately 6:54 AM and continuing until 3:55 PM.

The two test trucks consisted of:

- A Class 9 truck, loaded with concrete blocks loaded along the trailer, and equipped with air suspension on truck and trailer tandems and with standard tandem spacings on both the tractor and trailer.
- A Class 10, 6-axle truck, loaded with concrete blocks loaded along the trailer, and equipped with air suspension on the tractor, air suspension on the trailer, with a standard tandem spacing on the tractor and a standard tridem spacing on the trailer.

The test trucks were weighed prior to the pre-validation and were re-weighed at the conclusion of the pre-validation. The average test truck weights and measurements are provided in Table 5-1.

Table 5-1 - Pre-Validation Test Truck Weights and Measurements

Test Truck	Weights (kips)						Spacings (feet)						
	GVW	Ax1	Ax2	Ax3	Ax4	Ax5	1-2	2-3	3-4	4-5	5-6	AL	OL
1	76.9	11.3	16.0	16.0	16.8	16.8	17.0	4.3	29.5	4.1		54.9	67.3
2	66.4	9.8	13.3	13.3	10.0	10.0	17.4	4.4	37.8	4.4	4.4	68.4	73.1

Test truck speeds varied by 12 mph, from 52 to 64 mph. The measured pre-validation pavement temperatures varied 8.3 degrees Fahrenheit, from 31.0 to 39.3. The partly cloudy weather conditions prevented the desired 30 degree temperature range. Table 5-2 provides a summary of the pre-validation results.

Table 5-2 – Pre-Validation Overall Results – 30-Nov-10

Parameter	95% Confidence Limit of Error	Site Values	Pass/Fail
Steering Axles	±20 percent	8.5 ± 7.6%	Pass
Tandem Axles	±15 percent	8.2 ± 5.3%	Pass
Tridem Axles	±15 percent	17.8 ± 6.7%	FAIL
Axle Groups	±15 percent	10.6 ± 5.7%	FAIL
GVW	±10 percent	10.3 ± 7%	FAIL
Vehicle Length	±3 percent (2.1 ft)	0.4 ± 1.3 ft	Pass
Axle Length	± 0.5 ft [150mm]	-0.3 ± 0.3 ft	Pass

Truck speed was manually collected for each test run using a radar gun and compared with the speed reported by the WIM equipment. For this site, the average error in speed measurement over all speeds was -1.2 ± 1.8 mph, which is greater than the ±1.0 mph tolerance established by the LTPP Field Guide. However, since the site is measuring axle spacing length with a mean error of -0.3, and the speed and axle spacing measurements are based on the distance between the axle detector sensors, it can be concluded that the distance factor is set correctly and that the speeds being reported by the WIM equipment are within acceptable ranges.

5.1.1 Statistical Speed Analysis

Statistical analysis was conducted on the test truck run data to investigate whether a relationship exists between speed and WIM equipment weight and distance measurement accuracy. The posted speed limit at this site is 65 mph. The test runs were divided into three speed groups - low, medium and high speeds, as shown in Table 5-3 below.

Table 5-3 – Pre-Validation Results by Speed – 30-Nov-10

Parameter	95% Confidence Limit of Error	Low	Medium	High
		52.0 to 56.0 mph	56.1 to 60.1 mph	60.2 to 64.0 mph
Steering Axles	±20 percent	8.2 ± 4.0%	8.9 ± 8.1%	8.6 ± 11.3%
Tandem Axles	±15 percent	8.9 ± 6.5%	8.3 ± 5.6%	7.3 ± 4.7%
Tridem Axles	±15 percent	17.0 ± 10.5%	18.6 ± 7.7%	17.7 ± 5.2%
Axle Groups	±15 percent	12.9 ± 8.5%	13.5 ± 6.6%	12.5 ± 4.9%
GVW	±10 percent	10.4 ± 7.5%	10.5 ± 5.8%	9.8 ± 9.2%
Vehicle Length	±3 percent (2.1 ft)	0.3 ± 1.4 ft	0.4 ± 1.4 ft	0.4 ± 1.4 ft
Vehicle Speed	± 1.0 mph	-1.2 ± 1.9 mph	-1.1 ± 1.8 mph	-1.2 ± 2.1 mph
Axle Length	± 0.5 ft [150mm]	-0.3 ± 0.3 ft	-0.2 ± 0.3 ft	-0.2 ± 0.2 ft

From the table, it can be seen that the WIM equipment does not estimate weights with reasonable accuracy or precision. The range of errors for each weight parameter appears to be independent of speed, and all the weight of all weight parameters is overestimated across the range of speeds.

To aid in the speed analysis, several graphs were developed to illustrate the possible effects of speed on GVW, single axle, and axle group weights, and axle and overall length distance measurements, as discussed in the following sections.

5.1.1.1 GVW Errors by Speed

As shown in Figure 5-1, the equipment overestimated GVW at all speeds. The range in error is slightly greater at the lower and higher speeds when compared with the medium speeds.

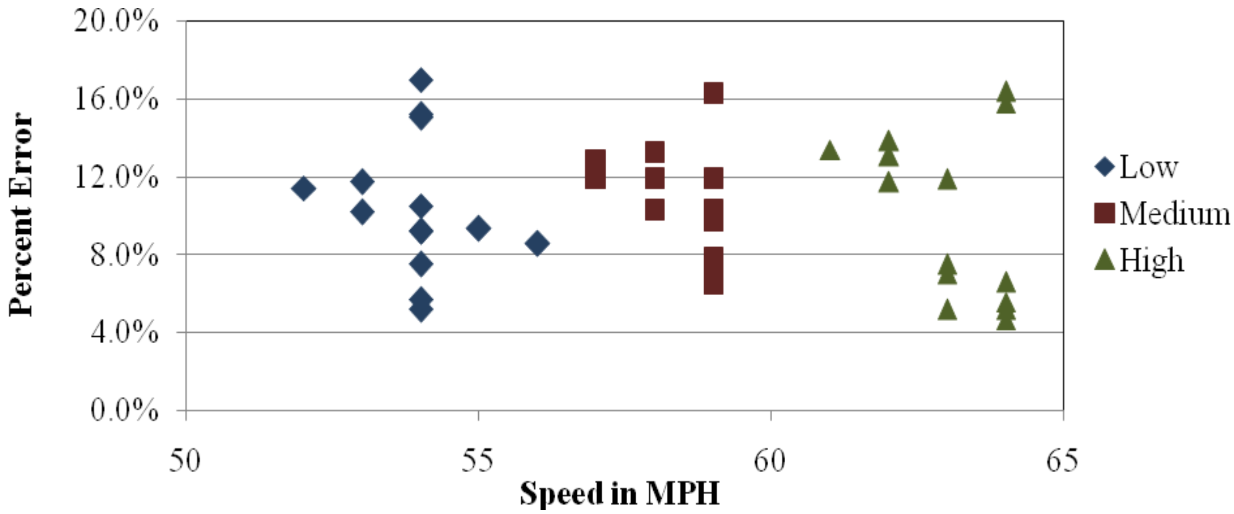


Figure 5-1 – Pre-Validation GVW Error by Speed – 30-Nov-10

5.1.1.2 Steering Axle Weight Errors by Speed

As shown in Figure 5-2, the equipment overestimates steering axle weights at all speeds. The range in error appears to be increase as speed increases.

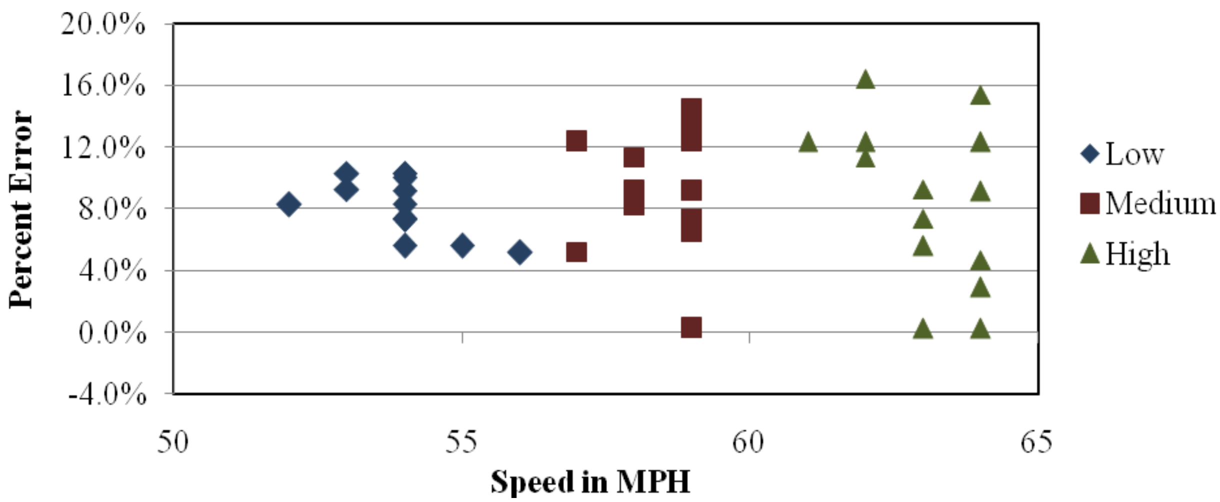


Figure 5-2 – Pre-Validation Steering Axle Weight Errors by Speed – 30-Nov-10

5.1.1.3 Tandem Axle Weight Errors by Speed

As shown in Figure 5-3, the equipment overestimates tandem axle weights at all speeds. The range in error is greater at the lower and higher speeds when compared with the medium speeds.

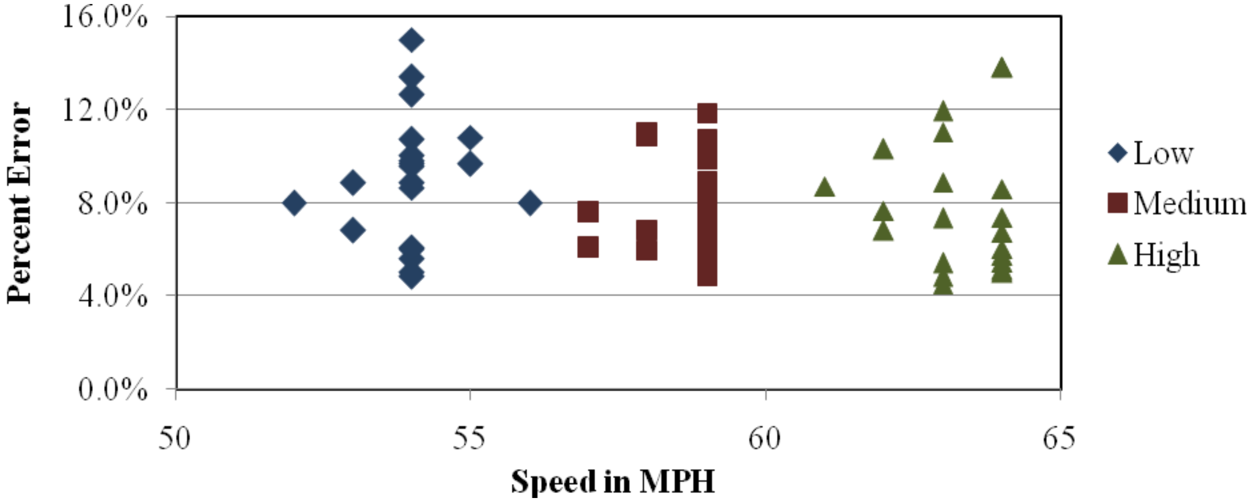


Figure 5-3 – Pre-Validation Tandem Axle Weight Errors by Speed – 30-Nov-10

5.1.1.4 Tridem Axle Weight Errors by Speed

As shown in Figure 5-4, the equipment overestimates tridem axle weights with similar accuracy at all speeds. Note that this overestimation is much greater than the overestimations of steering or tandem axle weights. The range in error appears to be consistent throughout the entire speed range.

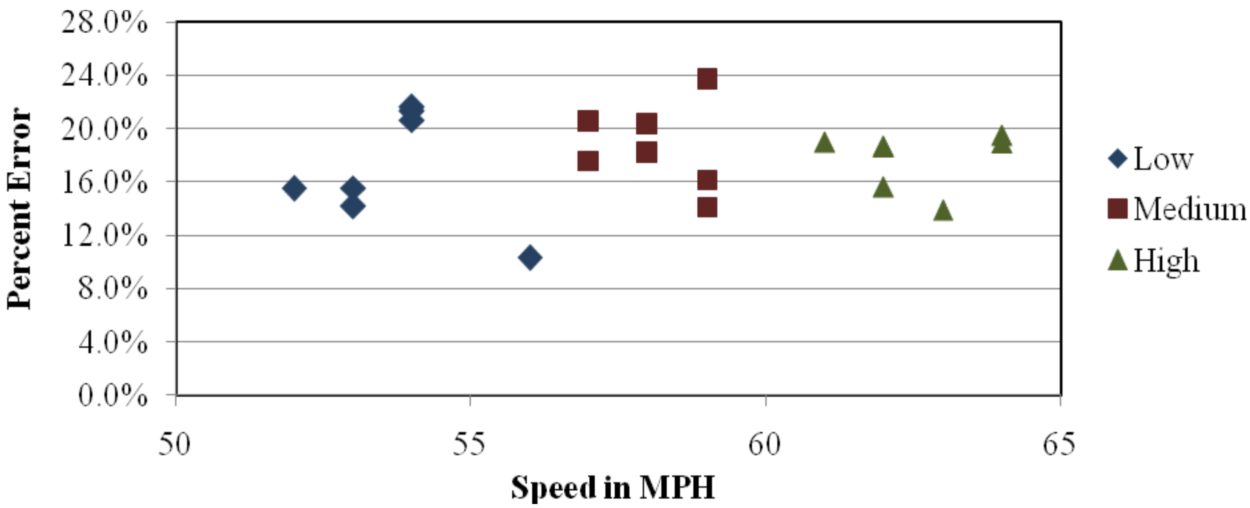


Figure 5-4 – Pre-Validation Tridem Axle Weight Errors by Speed – 30-Nov-10

5.1.1.5 Axle Group Weight Errors by Speed

As shown in Figure 5-5, the difference in the overestimation of tandem and tridem axle weights creates a significant range in axle group weight measurements error when observed collectively, although the range in error appears to be consistent throughout the entire speed range.

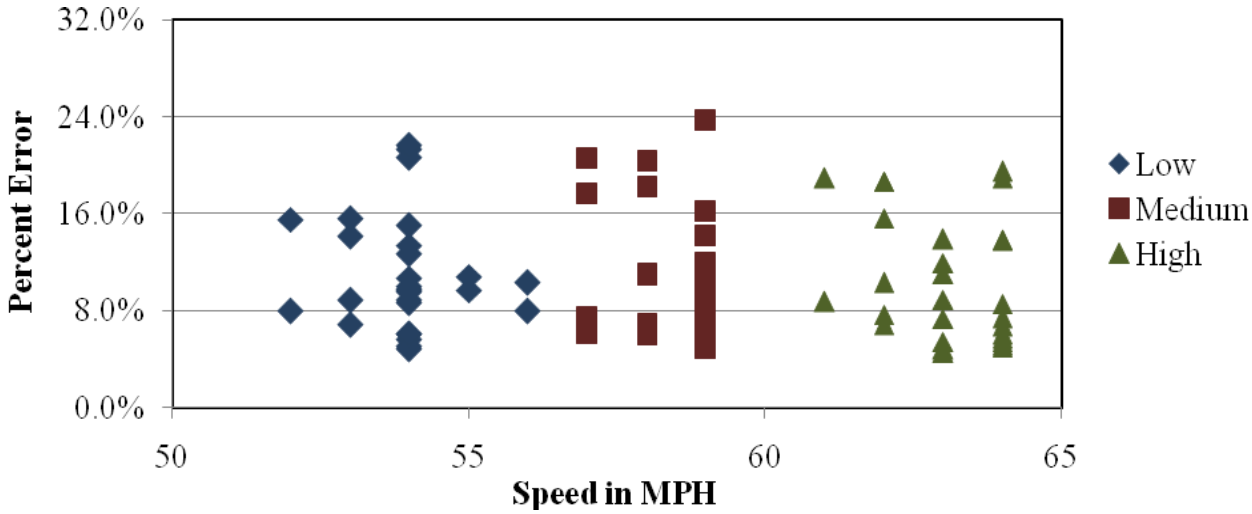


Figure 5-5 – Pre-Validation Axle Group Weight Errors by Speed – 30-Nov-10

5.1.1.6 GVW Errors by Speed and Truck Type

When the GVW error for each truck type is analyzed as a function of speed, it can be seen that the WIM equipment overestimates the GVW of the Secondary truck by a greater degree due to the addition of the tridem axle group. Distribution of errors is shown graphically in Figure 5-6.

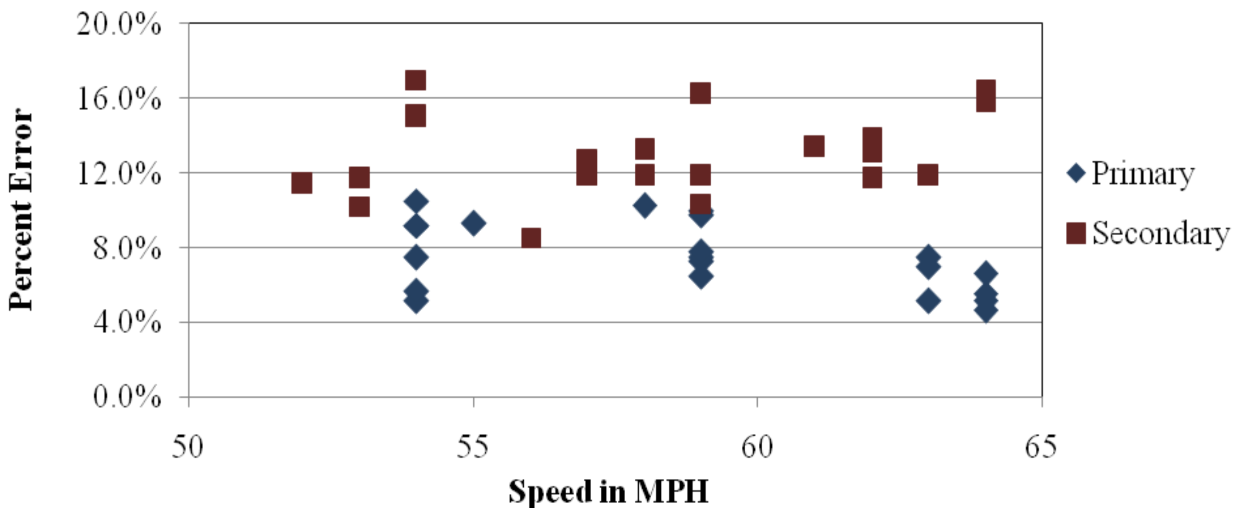


Figure 5-6 – Pre-Validation GVW Errors by Truck and Speed – 30-Nov-10

5.1.1.7 Axle Length Errors by Speed

For this site, the error in axle length measurement was consistent at all speeds. The range in axle length measurement error ranged from -0.6 feet to 0.0 feet. Distribution of errors is shown graphically in Figure 5-7.

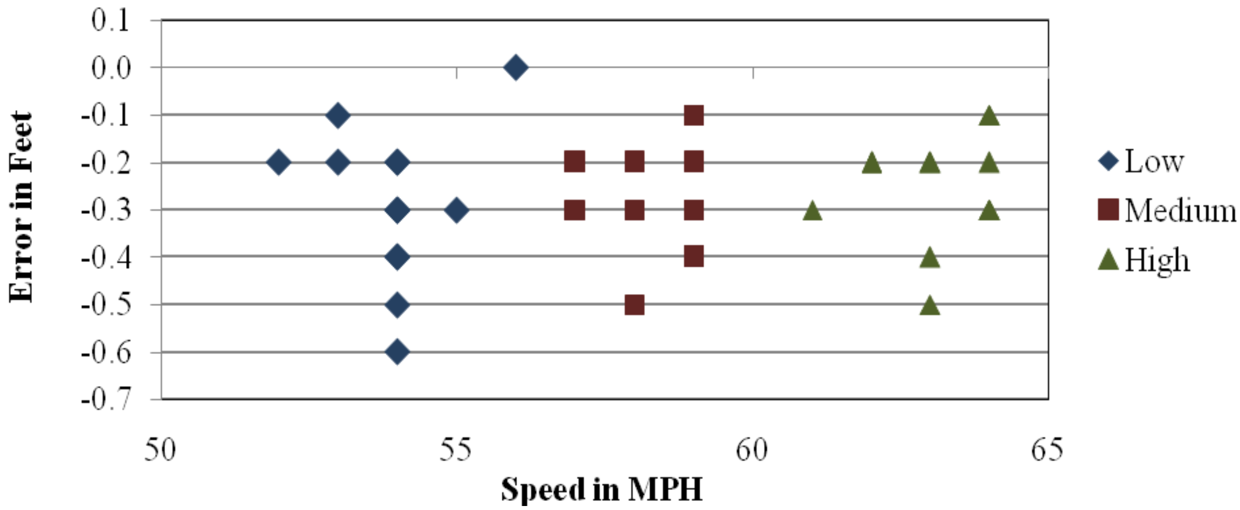


Figure 5-7 – Pre-Validation Axle Length Errors by Speed – 30-Nov-10

5.1.1.8 Overall Length Errors by Speed

For this system, the WIM equipment measured overall vehicle length with reasonable accuracy at all speeds, with an error range of -1.1 to 1.7 feet. Distribution of errors is shown graphically in Figure 5-8.

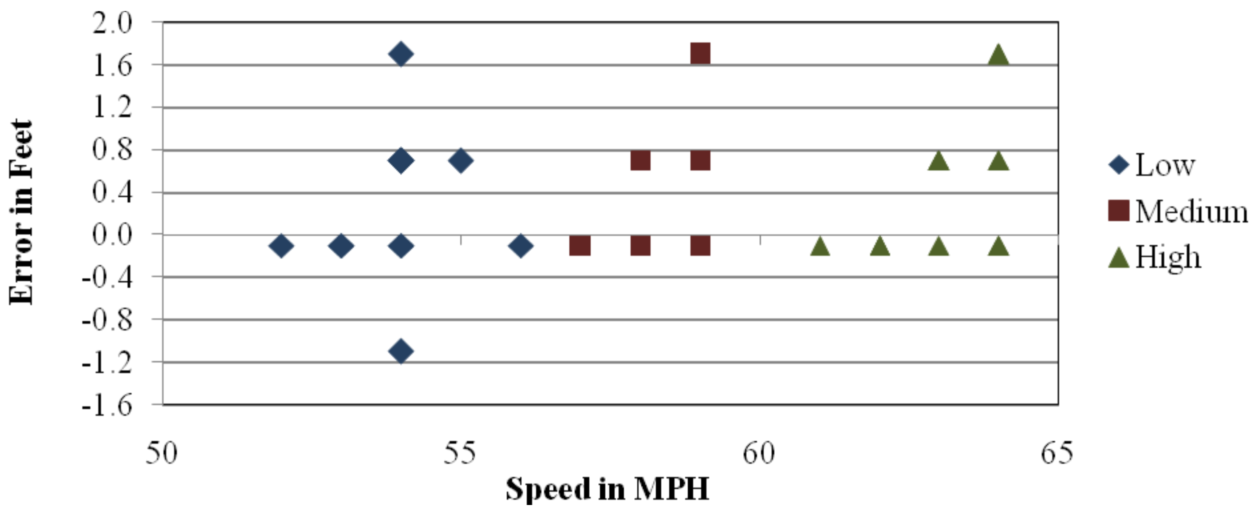


Figure 5-8 – Pre-Validation Overall Length Error by Speed – 30-Nov-10

5.1.2 Statistical Temperature Analysis

Statistical analysis was performed for the test truck run data to investigate whether there is a relation between pavement temperature and WIM equipment weight and distance measurement accuracy. The range of pavement temperatures only varied 8.3 degrees, from 31.0 to 39.3 degrees Fahrenheit. Consequently, the pre-validation test runs are being reported under one temperature group as shown in Table 5-4.

Table 5-4 – Pre-Validation Results by Temperature – 30-Nov-10

Parameter	95% Confidence Limit of Error	Medium
		31.0 to 39.3 degF
Steering Axles	±20 percent	8.5 ± 7.6%
Tandem Axles	±15 percent	8.2 ± 5.3%
Tridem Axles	±15 percent	17.8 ± 6.7%
Axle Groups	±15 percent	10.6 ± 5.7%
GVW	±10 percent	10.3 ± 7%
Vehicle Length	±3 percent (2.1 ft)	0.4 ± 1.3 ft
Vehicle Speed	± 1.0 mph	-1.2 ± 1.8 mph
Axle Length	± 0.5 ft [150mm]	-0.3 ± 0.3 ft

To aid in the analysis, several graphs were developed to illustrate the possible effects of temperature on GVW, single axle, and axle group weights.

5.1.2.1 GVW Errors by Temperature

From Figure 5-9 through Figure 5-13, it can be seen that the equipment overestimates all weights across the range of temperatures observed in the field. Tridem axle weights were overestimated by a much greater degree. Due to the limited temperatures range, a correlation between temperature and weight estimates could not be investigated.

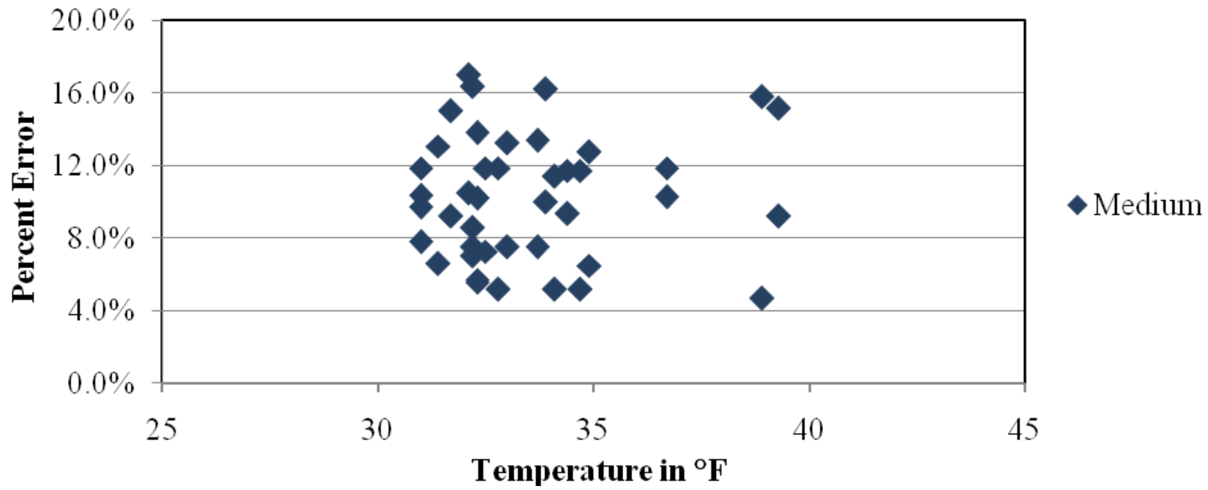


Figure 5-9 – Pre-Validation GVW Errors by Temperature – 30-Nov-10

5.1.2.2 Steering Axle Weight Errors by Temperature

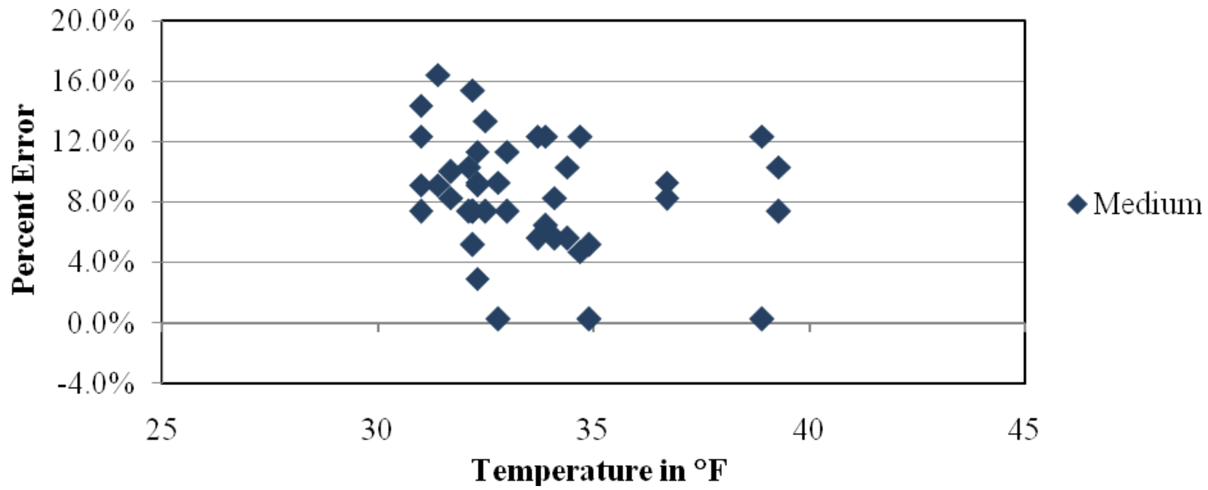


Figure 5-10 – Pre-Validation Steering Axle Weight Errors by Temperature – 30-Nov-10

5.1.2.3 Tandem Axle Weight Errors by Temperature

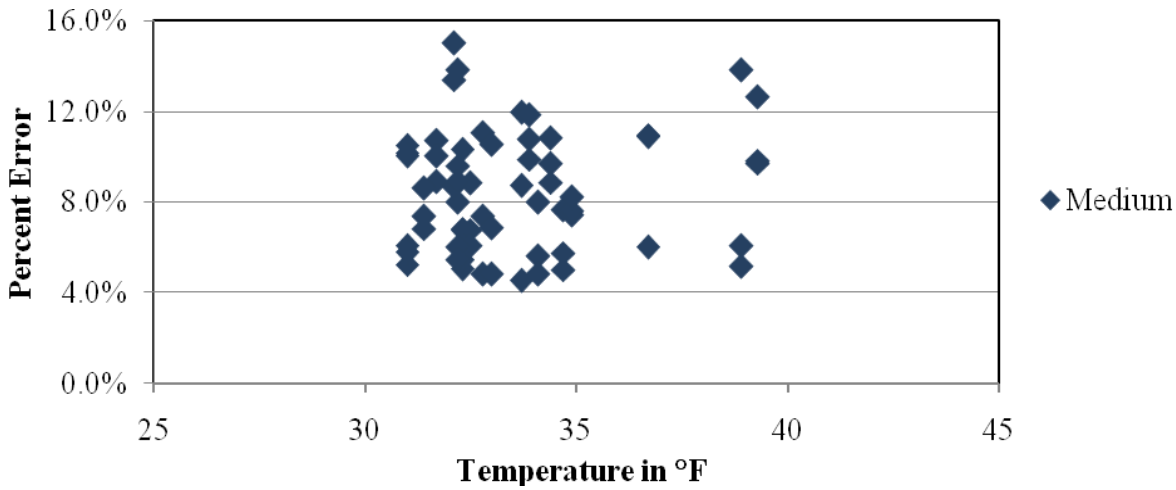


Figure 5-11 – Pre-Validation Tandem Axle Weight Errors by Temperature – 30-Nov-10

5.1.2.4 Tridem Axle Weight Errors by Temperature

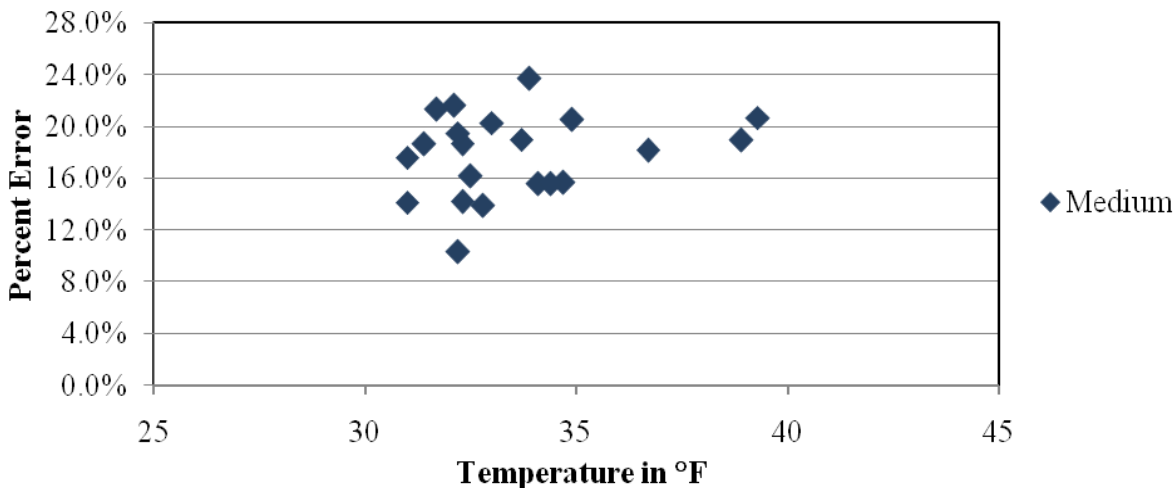


Figure 5-12 – Pre-Validation Tridem Axle Weight Errors by Temperature – 30-Nov-10

5.1.2.5 Axle Group Weight Errors by Temperature

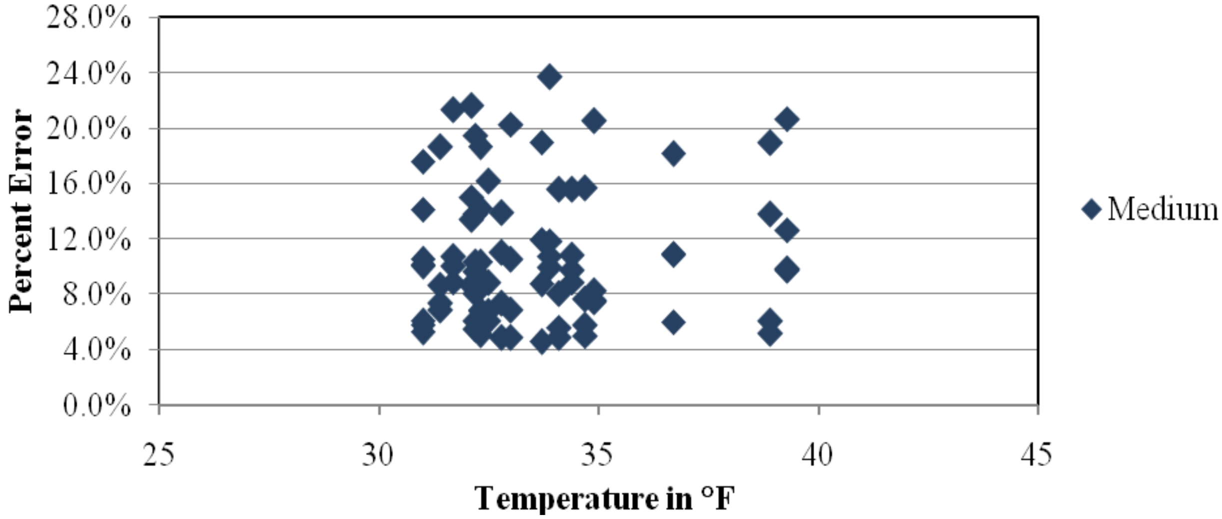


Figure 5-13 – Pre-Validation Axle Group Weight Errors by Temperature – 30-Nov-10

5.1.2.6 GVW Errors by Temperature and Truck Type

Similar to the speed analysis, when the GVW error for each truck is analyzed as a function of temperature, it can be seen that the WIM equipment overestimates the GVW of the Secondary truck by a greater degree due to the addition of the tridem axle group measurement errors. Distribution of errors is shown graphically in Figure 5-14.

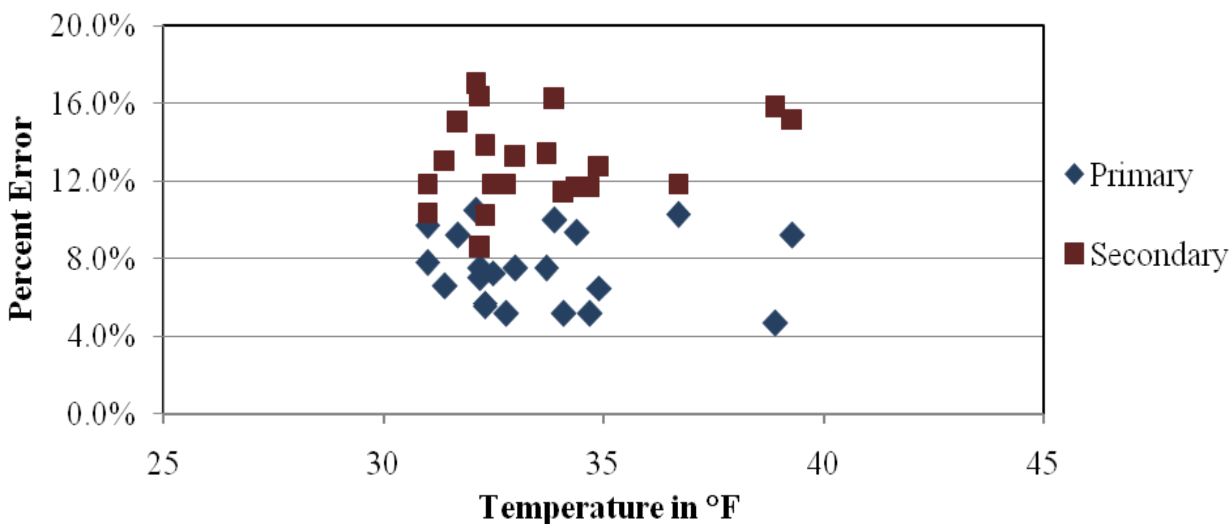


Figure 5-14 – Pre-Validation GVW Error by Truck and Temperature – 30-Nov-10

5.1.3 Classification and Speed Evaluation

The pre-validation classification and speed study involved the comparison of vehicle classification and speed data collected manually with the information for the same vehicles reported by the WIM equipment.

For the pre-validation classification study at this site, a manual sample of 100 vehicles including 100 trucks (Class 4 through 13) was collected. Video was collected during the study to provide a means for further analysis of misclassifications and vehicles whose classifications could not be determined with a high degree of certainty in the field. Table 5-5 illustrates the breakdown of vehicles observed and identified by the WIM equipment for the manual classification study.

Table 5-5 – Pre-Validation Classification Study Results – 30-Nov-10

Class	4	5	6	7	8	9	10	11	12	13
Observed Count	0	10	7	0	3	48	31	1	0	0
WIM Count	0	9	7	0	3	48	31	1	0	0
Observed Percent	0	10	7	0	3	48	31	1	0	0
WIM Percent	0	9	7	0	3	48	31	1	0	0
Misclassified Count	0	1	0	0	0	0	0	0	0	0
Misclassified Percent	N/A	10	0	N/A	0	0	0	0	N/A	N/A
Unclassified Count	0	0	0	0	0	0	0	0	0	0
Unclassified Percent	N/A	0	0	N/A	0	0	0	0	N/A	N/A

Misclassified vehicles are defined as those vehicles that are manually classified by observation as one class of vehicle but identified by the WIM equipment as another class of vehicle. The misclassified percentage represents the percentage of the misclassified vehicles in the manual sample. The misclassifications by pair are provided in Table 5-6.

Table 5-6 – Pre-Validation Misclassifications by Pair – 30-Nov-10

Observed/ WIM	Number of Pairs	Observed/ WIM	Number of Pairs	Observed/ WIM	Number of Pairs
3/5	0	5/9	0	9/5	0
3/8	0	6/4	0	9/8	0
4/5	0	6/7	0	9/10	0
4/6	0	6/8	0	10/9	0
5/3	1	6/10	0	10/13	0
5/4	0	7/6	0	11/12	0
5/6	0	8/3	0	12/11	0
5/7	0	8/5	0	13/10	0
5/8	0	8/9	0	13/11	0

Based on the vehicles observed during the pre-validation study, the misclassification percentage is 0.0% for heavy trucks (6 – 13), which is within the 2.0% acceptability criteria for LTPP SPS WIM sites. The overall misclassification rate for all vehicles (3 – 15) is 1.0%.

As shown in the table, only 1 vehicle was misclassified by the equipment. The single misclassification was a Class 5s identified by the WIM equipment as Class 3. The cause of the misclassification was not investigated in the field.

Unclassified vehicles are defined as those vehicles that cannot be identified by the WIM equipment algorithm. These are typically trucks with unusual trailer tandem configurations and are identified as Class 15 by the WIM equipment. The unclassified vehicles by pair are provided in Table 5-7.

Table 5-7 – Pre-Validation Unclassified Trucks by Pair – 30-Nov-10

Observed/ WIM	Number of Pairs	Observed/ WIM	Number of Pairs	Observed/ WIM	Number of Pairs
3/15	0	7/15	0	11/15	0
4/15	0	8/15	0	12/15	0
5/15	0	9/15	0	13/15	0
6/15	0	10/15	0		

Based on the manually collected sample of the 100 trucks, 0.0% of the vehicles at this site were reported as unclassified during the study. This is within the established criteria of 2.0% for LTTP SPS WIM sites.

For speed, the mean error for WIM equipment speed measurement was -0.8 mph; the range of errors was 2.1 mph.

5.2 Calibration

Due the deficiency in the operation of the WIM equipment, where the signals for Sensor #2 were not being detected or processed by the equipment, and where tridem axle weights were grossly overestimated when compared with other weight estimations, it was determined that the WIM equipment could not be calibrated with reasonable assurance that the calibration would result in the equipment providing consistent research quality data.

The Contracting Officer’s Technical Representative was contacted and informed that the equipment was not working properly and that the validation was being discontinued. No changes to the equipment compensation factors were made during the validation. At the advice of the manufacturer, the input for Sensor #2 was left disabled.

6 Previous WIM Site Validation Information

The information reported in this section provides a summary of the performance of the WIM equipment since it was installed or since the first validation was performed on the equipment. The information includes historical data on weight and classification accuracies as well as a comparison of post-validation results.

6.1 Sheet 16s

This site has validation information from two previous visits as well as the current one as summarized in the tables below. Table 6-1 data was extracted from the most recent previous validation and was updated to include the results of this validation.

Table 6-1 – Classification Validation History

Date	Misclassification Percentage by Class										Pct Unclass
	4	5	6	7	8	9	10	11	12	13	
14-Aug-07	0	0	0	N/A	0	0	0	N/A	N/A	N/A	0
15-Aug-07	N/A	14	0	N/A	0	0	0	N/A	N/A	N/A	0
14-Oct-08	N/A	0	0	N/A	0	0	0	N/A	N/A	N/A	0
15-Oct-08	67	24	0	N/A	0	0	0	N/A	N/A	N/A	0
30-Nov-10	N/A	10	0	N/A	0	0	0	0	N/A	N/A	0

Table 6-2 data was extracted from the most recent previous validation and was updated to include the results of this validation.

Table 6-2 – Weight Validation History

Date	Mean Error and (SD), %			
	GVW	Single Axles	Tandem	Tridem
14-Aug-07	1.6 (2.8)	3.2 (4.2)	1.3 (3.2)	N/A
15-Aug-07	2.4 (2.0)	4.8 (4.1)	2.0 (2.7)	N/A
14-Oct-08	5.8 (2.7)	5.4 (4.7)	6.3 (2.8)	N/A
15-Oct-08	-1.4 (1.4)	-1.7 (3.1)	-1.1 (2.6)	N/A
1-Dec-10	**10.3 (7.0)**	8.5 (3.8)	8.2 (2.6)	**17.8 ± 6.7%**

The variability of the weight errors appears to have remained reasonably consistent during the period of August 14, 2007 to October 15, 2008. The 2010 validation shows that the equipment overestimates axle weights. Based on the validation results provided in Table 5.2 the system does not provide research quality traffic data. The table also demonstrates the effectiveness of the validations in maintaining the weight estimations within LTPP SPS WIM equipment tolerances.

6.2 Comparison of Past Validation Results

A comparison of the post-validation results from previous visits is provided in Table 6-3.

Table 6-3 – Comparison of Post-Validation Results

Parameter	**95 %Confidence Limit of Error**	**Site Values , Mean Error and (SD), %**		
		15-Aug-07	**14-Oct-08**	**1-Dec-10**
Single Axles	±20 percent	4.8 ± 4.1	5.4 ± 4.7	8.5 ± 3.8
Tandem Axles	±15 percent	2.0 ± 2.7	6.3 ± 2.8	8.2 ± 2.6
Tridem Axels	±15 percent	N/A	N/A	**17.8 ± 6.7**
GVW	±10 percent	2.4 ± 2.0	5.8 ± 2.7	**10.3 ± 7.0**

The information provided in Table 6-3 shows that the December 1, 2010 validation measurements yielded GVW and tridem axle weights that exceeded the 95% confidence limit of error.

According to Table 2.1, “E” WIM data for this site include 1999 data. Considering that the December 2010 validation shows that the site does not provide research quality data, the 2009 and 2010 data should be reviewed to ascertain when the system ceased to provide research quality data.

7 Additional Information

The following information is provided in the attached appendix:

- Site Photographs
  - Equipment
  - Test Trucks
  - Pavement Condition
- Pre-validation Sheet 16 – Site Calibration Summary
- Pre-validation Sheet 20 – Classification and Speed Study

Additional information is available upon request through LTPP INFO at ltppinfo@dot.gov, or telephone (202) 493-3035. This information includes:

- Sheet 17 – WIM Site Inventory
- Sheet 18 – WIM Site Coordination
- Sheet 19 – Calibration Test Truck Data
- Sheet 21 – WIM System Truck Records
- Sheet 22 – Site Equipment Assessment plus Addendum
- Sheet 23 – WIM Troubleshooting Outline
- Sheet 24A/B – Site Photograph Logs
- Updated Handout Guide

WIM System Field Calibration and Validation - Photos

Maine, SPS-5
SHRP ID: 230500

Validation Date: December 1, 2010


Photo 1 – Cabinet Exterior


Photo 2 – Cabinet Interior (Front)


Photo 3 – Cabinet Interior (Back)


Photo 4 – Leading Loop


Photo 5 – Leading WIM Sensor


Photo 6 – Trailing WIM Sensor

Photo 7 – Trailing Loop Sensor

Photo 8 – Solar Panel

Photo 9 – Cellular Modem

Photo 10 – Downstream

Photo 11 – Upstream

Photo 12 – Truck 1

Photo 13 – Truck 1 Tractor

Photo 14 – Truck 1 Trailer and Load

Photo 15 – Truck 1 Suspension 1

Photo 16 – Truck 1 Suspension 2/3

Photo 17 – Truck 1 Suspension 4/5

Photo 18 – Truck 2

Photo 19 – Truck 2 Tractor

Photo 20 – Truck 2 Trailer and Load

Photo 21 – Truck 2 Suspension 1

Photo 22 – Truck 2 Suspension 2/3

Photo 23 – Truck 2 Suspension 4/5

Photo 24 – Truck 2 Suspension 5/6

Traffic Sheet 24B LTPP MONITORED TRAFFIC DATA SITE PHOTO LOG - Test Trucks	STATE CODE:	23
	SPS WIM ID:	230500
	DATE (mm/dd/yyy)	11/30/2010

Item	Description	Filename
1	Tractor, Truck #1	230500_Truck_1_Tractor_11_30_10.jpg
2	Trailer/Load, Truck #1	230500_Truck_1_Trailer_11_30_10.jpg
3	Kingpin Offset, Truck #1	
4	Suspension A, Truck #1	230500_Truck_1_Suspension_1_11_30_10.jpg
5	Suspension B, Truck #1	230500_Truck_1_Suspension_2_3_11_30_10.jpg
6	Suspension C, Truck #1	
7	Suspension D, Truck #1	230500_Truck_1_Suspension_4_5_11_30_10.jpg
8	Suspension E, Truck #1	
9	Suspension F, Truck #1	
10	Tractor, Truck #2	230500_Truck_2_Tractor_11_30_10.jpg
11	Trailer/Load, Truck #2	230500_Truck_2_Trailer_11_30_10.jpg
12	Kingpin Offset, Truck #2	
13	Suspension A, Truck #2	230500_Truck_2_Suspension_1_11_30_10.jpg
14	Suspension B, Truck #2	230500_Truck_2_Suspension_2_3_11_30_10.jpg
15	Suspension C, Truck #2	
16	Suspension D, Truck #2	230500_Truck_2_Suspension_4_5_11_30_10.jpg
17	Suspension E, Truck #2	
18	Suspension F, Truck #2	
19	Tractor, Truck #3	
20	Trailer/Load, Truck #3	
21	Kingpin Offset, Truck #3	
22	Suspension A, Truck #3	
23	Suspension B, Truck #3	
24	Suspension C, Truck #3	
25	Suspension D, Truck #3	
26	Suspension E, Truck #3	
27	Suspension F, Truck #3	
28	Scale	
29		
30		

RECORDED BY: Dean J Wolf

Traffic Sheet 20 LTPP MONITORED TRAFFIC DATA SPEED AND CLASSIFICATION STUDIES	STATE CODE: 23 SPS WIM ID: 230500 DATE (mm/dd/yyyy) 11/30/2010

WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class
72	10	58158	72	10	70	10	58304	71	10
73	6	58164	74	6	70	9	58306	71	9
70	10	58170	70	10	66	5	58316	68	5
73	9	58184	70	9	67	9	58321	68	9
71	8	58185	66	8	70	9	58328	68	9
64	10	58188	67	10	68	10	58331	69	10
69	10	58204	69	10	68	10	58332	69	10
65	6	58214	67	6	67	9	58346	67	9
74	9	58218	72	9	69	9	58369	72	9
65	5	58219	65	5	64	9	58370	67	9
64	9	58221	64	9	60	9	58377	60	9
66	10	58237	68	10	65	10	58378	66	10
65	9	58238	65	9	67	9	58381	65	9
73	9	58240	74	9	60	10	58390	62	10
70	9	58241	71	9	58	10	58401	58	10
71	9	58248	72	9	71	10	58404	72	10
65	9	58252	65	9	66	9	58409	67	9
67	10	58254	68	10	65	10	58414	67	10
72	10	58268	74	10	68	10	58436	70	10
72	10	58270	67	10	68	10	58437	73	10
63	**3**	**58273**	**63**	**5**	70	10	58438	70	10
73	10	58274	80	10	61	9	58440	62	9
65	9	58290	66	9	62	9	59449	63	9
69	9	58291	69	9	70	5	58461	71	5
64	10	5830	65	10	57	5	58462	59	5

Sheet 1 - 0 to 50 Start: 13:10:00 Stop: 14:19:39

Recorded By: djw Verified By: ar

Validation Test Truck Run Set - Pre

Traffic Sheet 20	STATE CODE:	23
LTPP MONITORED TRAFFIC DATA	SPS WIM ID:	230500
SPEED AND CLASSIFICATION STUDIES	DATE (mm/dd/yyyy)	11/30/2010

WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class
62	9	58471	66	9	63	9	58657	66	9
65	10	58475	63	10	75	10	58663	78	10
65	9	58481	66	9	70	9	58712	73	9
61	6	58490	61	6	72	10	58717	73	10
73	10	58496	67	10	64	9	58720	66	9
56	9	58538	61	9	70	5	58735	71	5
64	9	58539	64	9	67	9	58739	68	9
74	5	58540	74	5	67	9	58752	67	9
72	6	58551	73	6	65	10	58790	67	10
72	9	58552	68	9	72	10	58791	74	10
59	9	58557	60	9	65	9	58799	66	9
72	9	58563	73	9	70	9	58817	71	9
72	10	58569	74	10	68	9	58822	70	9
82	5	58581	75	5	64	9	58826	65	9
64	9	58587	65	9	63	9	58827	64	9
73	10	58623	71	10	64	8	58852	65	8
65	6	58628	64	6	62	5	58853	63	5
64	9	58635	67	9	60	11	58887	65	11
66	9	58640	68	9	64	9	58906	65	9
64	9	58641	64	9	66	9	58919	67	9
67	6	58647	68	6	71	9	58935	72	9
60	9	58650	63	9	55	6	58936	54	6
67	8	58651	68	8	71	9	58938	71	9
64	10	58652	67	10	66	10	58943	67	10
64	9	58656	63	9	64	5	58959	63	5

Sheet 2 - 51 to 100 Start: 14:20:00 Stop: 16:02:40

Recorded By: djw Verified By: ar

Validation Test Truck Run Set - Pre

Traffic Sheet 20 LTPP MONITORED TRAFFIC DATA SPEED AND CLASSIFICATION STUDIES	STATE CODE:	23
	SPS WIM ID:	230500
	DATE (mm/dd/yyyy)	1/0/1900

WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class

Sheet 3 - 101 - 150 Start: ____________ Stop: ____________

Recorded By: djw Verified By: ar

Validation Test Truck Run Set - Pre

Traffic Sheet 20 **LTPP MONITORED TRAFFIC DATA** **SPEED AND CLASSIFICATION STUDIES**	STATE CODE: 23 SPS WIM ID: 230500 DATE (mm/dd/yyyy) 1/0/1900

WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class	WIM speed	WIM class	WIM Record	Obs. Speed	Obs. Class

Sheet 4 - 151 to 200 Start: ____________ Stop: ____________

Recorded By: djw Verified By: ar

Validation Test Truck Run Set - Pre