Amended Assessment Report for
Michigan, SPS 2

Visit date: April 21, 2004

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1 Executive Summary

A visit was made to the Michigan SPS-2 site on April 21, 2004 for the purposes of conducting an assessment of the WIM system located on US route 23 at milepost 2.23, 0.7 miles north of the Stearns Road interchange. The LTPP lane is the driving lane in the northern direction and is identified as lane number 1 by the WIM controller. This is an amended report following the receipt of data from the Regional Support Contractor on August 4, 2004.

This site is not recommended for validation. This recommendation is based on the high WIM Index values reflected throughout the site.

The site is instrumented with Kistler quartz WIM sensors and a PAT DAW-190 WIM controller.

The equipment is in working order.

Sufficient data was collected to provide a Sheet 16 for classification verification at this site. There are no unclassified vehicles. This is below the percentage of 2% defined as the criteria for research data. Truck classes 10 and 13 had an error rate exceeding 2% of matches. The algorithm for classification should be reviewed and the classification verification repeated at the next assessment or validation. **The State representative stated that after the submission of the preliminary assessment report dated May 7 2004, the classification algorithm has been rechecked and corrected.**

The pavement condition appears 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.

A review of the speed information collected on-site indicates that the range of truck speeds to be covered during an evaluation is 45 to 55 mph. The posted speed limit on site is 70 mph for cars and 55 mph for trucks. Due to the variance in the posted speed limit for cars and trucks, it may not be feasible to set the lowest of the three speeds in the range.

This site has 9 years of classification and weight data, which has been submitted. The site was last calibrated on August 18, 1993 as per the May 2004 upload. **Based on available calibration information and review of the data submitted through last year, this site does not meet the need for 5 years of research quality classification and weight data**.

2 Corrective Actions Recommended

The classification algorithm has to be rechecked and readjusted in order to reduce the classification errors mentioned in the previous section. **The state agency representative stated that after the submission of the preliminary assessment report dated May 7 2004, the classification algorithm has been rechecked and corrected**.

It is recommended that grinding or pavement replacement should be done prior to validation since the profile data indicated that the sensor accuracy might be influenced by the roughness of the pavement.

3 Equipment inspection and diagnostics

The site is instrumented with two half-lane Kistler quartz WIM sensors, installed in a staggered configuration. A 6- foot by 6-foot loop sensor is installed directly preceding the leading WIM sensor and an identical loop sensor is installed between the WIM sensors. The first loop sensor is not currently being used by the WIM system, and was installed to provide classification data should either of the WIM sensors fail. The second loop sensor is used for vehicle presence detection. The quartz WIM sensors are used for weight, speed and spacing. The WIM system utilizes a PAT America DAW-190 WIM Controller for signal processing, data storage, user interface and remote operation.

A complete electrical check of all support service components including the power service equipment and telephone service was performed. All support equipment is operating properly.

An electronic check of all WIM components was performed. All in-road sensors and WIM controller components are working properly.

A visual inspection of all system components, including in-road sensors, cabinet, pull boxes, drainage, power and telephone service panels and conduit was conducted. All components are in good physical condition.

4 Classification Verification with test truck recommendations

The agency uses the 13-bin FHWA classification scheme, slightly modified to correctly classify the large number of state specific Class 10 and 13 vehicles that cross over the WIM location. The Class 10s as classified by the agency are dump trucks with dump trailers and the Class 13s are tractors with a semi-trailer, semi-trailer combination with 3-axle dump semi's.

A sample of 100 trucks was collected at the site. Also, 13 hours of April 21, 2004 was downloaded from the equipment at the site. One hour of video was taken at the site to provide ground truth for the evaluation.

Twenty-three minutes of video was collected for pavement interaction studies.

Based on a 100 percent sample it was determined that there are no unknown vehicles or 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. The following are the classification error rates by class:

Table 1 Truck Misclassification Percentages for 260200 – 21 April 2004

Class	Percent Error	Class	Percent Error	Class	Percent Error
4	N/A	5	0	6	0
7	0				
8	0	9	0	10	38
11	0	12	N/A	13	33

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 above 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 2 Truck Classification Mean Differences for 260200 – 21 April 2004

Class	Mean Difference	Class	Mean Difference	Class	Mean Difference
4	N/A	5	0	6	0
7	0				
8	0	9	0	10	-38
11	0	12	N/A	13	50

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

A review of the site data both collected on site and historical data indicated that Class 9s and Class 5s constitute at least 10 percent of the truck population. However, Class 5s are only slightly above 10 percent. Based on this information in addition to the air-suspension 3S2, the second vehicle used for evaluation should be a Class 9. Due to the length of the truck turn around no additional vehicle should be used. Since this site is

equally loaded and unloaded using one fully loaded and one partially loaded Class 9 is recommended for the validation.

5 Profile Evaluation

The Regional Support Contractor submitted the profile data to this office on August 4, 2004.

The WIM site is a section of pavement that is 305 m long with the WIM scale located at 274.5 m 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. The Long Range Index (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 Short Range Index (SRI) incorporates a shorter section of pavement profile beginning 2.7 m prior to the WIM scale and ending 0.5 m after the scale.

Profile data collected at the SPS WIM location by Stantec Inc. on July 7, 2004 were processed through the LTPP SPS WIM Index software. This WIM scale is installed on a portland cement concrete pavement. The results are shown in Table 3.

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 done 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).

Table 3 shows the computed index values for all 11 profiler passes for this WIM site. The average values over the passes at each path were also calculated when three or more passes are completed. These are shown in the right most column of the table. Values above the index limits are presented in italics.

Table 3 Long Range Index (LRI) and Short Range Index (SRI)

Profiler Passes			**Pass 1**	**Pass 2**	**Pass 3**	**Pass 4**	**Pass 5**	**Ave.**
Center	LWP	LRI (m/km)	*1.432*	*1.496*	*1.461*	*1.467*	*1.497*	***1.471***
		SRI (m/km)	*1.927*	*1.621*	*1.642*	*2.223*	*1.881*	***1.859***
	RWP	LRI (m/km)	*1.540*	*1.579*	*1.497*	*1.561*	*1.486*	***1.533***
		SRI (m/km)	*1.746*	*1.613*	*1.624*	*1.617*	*1.570*	***1.634***
Left Shift	LWP	LRI (m/km)	*1.891*	*1.946*	*1.941*			***1.926***
		SRI (m/km)	*2.987*	*3.531*	*3.343*			***3.287***
	RWP	LRI (m/km)	*1.413*	*1.429*	*1.470*			***1.437***
		SRI (m/km)	*1.323*	*1.593*	*1.521*			***1.479***
Right Shift	LWP	LRI (m/km)	*1.391*	*1.560*	*1.408*			***1.453***
		SRI (m/km)	*2.028*	*2.513*	*2.077*			***2.206***

Profiler Passes			**Pass 1**	**Pass 2**	**Pass 3**	**Pass 4**	**Pass 5**	**Ave.**
	RWP	LRI (m/km)	*1.497*	*1.590*	*1.502*			***1.530***
		SRI (m/km)	*1.612*	*1.760*	*1.538*			***1.637***

All the passes have exceeded the WIM Index value of 0.789 m/km as can be seen in the table. When all values are less than 0.789 it is presumed unlikely that pavement conditions will significantly influence sensor output. Values above that level may or may not influence the reported weights and potentially vehicle spacing. **Based on the profile data analysis, the Michigan SPS-2 WIM site does not meet the requirements for WIM site locations since all values are higher than the index limits.** The recommended remediation options are grinding or pavement replacement.

Figure 15-1 and Figure 15-2 show the typical WIM index values in the left and right wheel path respectively within the critical section of the site. These figures are generated through the LTPP's WIM Index software. The lighter (green) line is the SRI value computed at each point along the WIM section. The darker (red) line is the LRI value computed at each point along the WIM section. A horizontal line is drawn at 0.789 to mark the threshold limit. The scale location is at approximately 275 m based on the directions for LTPP's profiling of WIM sections. If the site has a single weigh sensor, it is located at 275 m. If there are multiple weigh sensors, the middle of the array is a 275 m. As can be noted in the figures, the high index values are not limited to the immediate sensor area, but are throughout the WIM section.

6 Distress survey and any applicable photos

A visual inspection of the pavement 425 feet in advance of the WIM area and 75 feet following the WIM area was conducted. No pavement distress that would affect the performance of the WIM scales was discovered. Figure 13-1 and Figure 13-2 show the condition of the pavement in the downstream and upstream direction respectively.

7 Vehicle-pavement interaction discussion

There is no visible change in the motion of trucks that can be discerned as they cross or leave the sensor area. Daylight cannot be readily seen between the tires and any of the sensors indicating that the tires were fully touching the sensors. All traffic appears to travel along the center of the lane.

8 Speed data with speed range recommendations for evaluation

Based on the data collected on site the 15th and 85th percentile speeds for Class 9s are 55 and 60 mph respectively. The upper end of the range exceeds the posted speed limit of 55 mph for trucks. This range does not vary significantly for other truck classes. As a result the recommended speeds for test trucks in an evaluation are 50 and 55 mph in order to comply with the posted speed limit and have at least two target speeds even though the data indicated that only a few trucks were traveling below 55 mph. Use of a third speed

of 45 mph is probably implausible due to site conditions. A final determination will need to be made prior to any validation of this site.

Measurements of speeds on-site indicated that the equipment is currently measuring speeds with a bias of 0.0 mph and an associated standard deviation of 0.8 mph.

The review of drive axle spacings for Class 9 vehicles indicates that this is not affecting the measurements of length and therefore vehicle classification. The equipment is reporting the drive axle spacing of a Class 9 to be an average of 4.25 feet with a standard deviation of 0.10 feet.

9 Traffic Data review: Overall Quantity and Sufficiency

As of April 21, 2004 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. The precision requirements are shown in Table 4. A record of a calibration visit for August 18, 1993 was provided. Review of the data indicates that no information is available on the precision or bias of the weight data.

Table 4 Precision and Bias Requirements for Weight Data

Pooled Fund Site	95 Percent Confidence Limit of Error
Single Axles	± 20 percent
Axle groups	± 15 percent
Gross Vehicle Weight	± 10 percent
Vehicle Speed	±1 mph (2 kph)
Axle Spacing	± 0.5 ft (150 mm)

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

The amount and coverage for the site is shown in Table 5. The value for months is a measure of the seasonal variation in the data. The indicator of coverage indicates whether day of week variation has been accounted for on an annual basis. As can be seen from the table all years except 1993 and 1997 for classification and weight data and 1994 for classification data have a sufficient quantity to be considered complete years of data. **Together with the previously gathered calibration information it can be seen that at least 5 additional years of research quality data are needed to meet the goal of a minimum of 5 years of research classification and weight data**. Without statistics on

data quality from the on-site checks, the data can be considered no more than nominally of research quality if it is internally consistent from and between calibrations. As there is no data provided for the periods immediately following the reported validation, even that assessment cannot be made for this site.

Table 5 Amount of Traffic Data Available

Year	Class Days	Months	Coverage	Weight Days	Months	Coverage
1993	7	2	Weekdays and Weekend	47	2	Complete Week
1994	140	12	Weekdays and Weekend	348	12	Complete Week
1995	225	9	Complete Week	235	9	Complete Week
1996	315	12	Complete Week	318	12	Complete Week
1997	140	5	Complete Week	149	5	Complete Week
1998	286	10	Complete Week	301	10	Complete Week
2000	343	12	Complete Week	347	12	Complete Week
2001	359	12	Complete Week	365	12	Complete Week
2002	306	11	Complete Week	283	10	Complete Week

To evaluate the consistency of the existing data and determine its probable quality a series of reports and graphs have been generated. They include the SPS Summary report, vehicle distribution graphs, GVW distributions both over all years and by month within years, average daily steering axle weights for Class 9 vehicles, and ESAL graphs.

Based on this review it is recommended that November 1993 weight data be omitted from the database and further investigation be done for July 1995 Classification data April 1998 classification and weight data and all 2002 weight data. The investigation should be done in the context of all years and types of data.

9.1 SPS Summary Report

The overall report is the SPS Summary Report. This report uses sets of benchmark data based on calibration information or consistent, rational data patterns. The report shows the trend in some basic statistics at the site over time. It provides a numeric equivalent to the graphs typically run for the comparison evaluation process. It includes the number of days of data and statistics associated with Class 9 vehicles. They include the average volumes, average ESALs, the average steering axle weight and mean loaded and unloaded weight on a monthly basis. Class Days and Percent Class 9s are generated from classification data submissions. All other values come from the weight data submissions. Counts derived from weight data are available for all months. Steering axle and weight statistics are only present when that data was loaded through LTPP's new traffic analysis software, since it is the only software that calculates them. The data is separated into blocks that depend on when the site was validated. Where there is no validation record an initial time point has been picked at which continuous data exists and that data is used as the basis for comparison. Excluded months have no data.

Table 6 SPS Summary Report

Michigan 0200

North Lane 1

Comparison Date Weight - 01-January-1994 Classification - 02-December-1994

Month-Year	Class Days	Percent Class 9s	Weight Days	Average No. Class 9s	Avg.ESALs Per Class 9	Average Class 9 Steering	Mean Loaded Weight	Mean Unloaded Weight
Comparison values		20.0		1379	0.33	6,950	77,765	34,055
NOV 1993	4	12.8	19	1309	0.33	6,903	56,273	22,561
DEC 1993	3	18.5	28	1413	1.04	9,177	77,619	33,443
JAN 1994	4	17.0	30	1131	1.27	9,823	77,314	33,591
FEB 1994	5	17.0	26	1431	1.42	10,092	78,065	33,774
MAR 1994	7	18.4	31	1655	1.51	10,213	81,116	33,920
APR 1994	8	16.2	30	1567	1.62	10,380	81,482	33,931
MAY 1994	7	17.6	31	1655	1.66	10,515	81,821	34,056
JUN 1994	6	15.4	29	1707	1.67	10,609	82,015	34,083
JUL 1994	6	13.2	25	1347	1.65	10,576	82,000	34,033
AUG 1994	8	16.6	31	1763	1.60	10,519	81,937	34,114
SEP 1994	7	17.8	30	1738	1.52	10,425	81,643	33,878
OCT 1994	25	17.5	26	1736	1.36	10,221	81,108	33,463
NOV 1994	27	17.7	28	1669	1.33	10,175	81,093	33,430
DEC 1994	30	16.3	31	1499	1.36	10,269	78,290	33,640
JAN 1995	29	16.9	29	1516	1.35	10,152	77,870	33,598
FEB 1995	26	17.8	22	1744	1.43	10,291	78,229	33,897
MAR 1995	23	17.0	23	1710	1.54	10,520	81,495	33,869
APR 1995	26	15.5	26	1629	1.59	10,592	81,698	33,829
MAY 1995	26	15.3	29	1595	1.63	10,678	81,925	33,807
JUN 1995	26	15.6	29	860	1.59	10,616	81,773	33,765
JUL 1995	12	7.2						
OCT 1995			16	1648	1.28	10,150	81,282	33,535
NOV 1995	28	15.9	30	1653	1.32	10,252	78,266	33,938
DEC 1995	29	14.1	31	1364	1.03	9,426	73,771	33,668
JAN 1996	31	18.8	31	1539	1.42	10,094	78,213	33,882
FEB 1996	29	19.3	29	1681	1.66	10,524	81,997	34,211
MAR 1996	22	17.0	28	1542	1.55	10,086	81,787	33,951
APR 1996	29	12.0	30	1076	1.37	8,543	81,550	29,457
MAY 1996	23	16.2	25	1260	1.48	9,426	77,783	33,735
JUN 1996	27	16.0	28	1673	1.11	9,332	69,722	33,776
JUL 1996	28	12.8	30	1174	1.04	9,098	70,126	29,652
AUG 1996	22	13.4	9	2134	1.23	10,361	77,972	34,139
SEP 1996	25	19.9	26	2147	1.37	10,523	78,267	34,163
OCT 1996	18	21.9	23	1802	1.32	10,404	78,132	33,984
NOV 1996	30	19.5	29	1957	1.29	10,414	78,056	34,045
DEC 1996	31	17.0	30	1632	1.33	10,560	78,178	34,216
JAN 1997	25	22.1	31	1769	1.43	10,656	78,271	34,644
FEB 1997	28	20.7	28	1936	1.65	11,023	82,042	35,041
MAR 1997	28	19.2	30	1822	1.71	11,178	82,392	35,140
APR 1997	28	21.4	29	2184	1.78	11,197	85,002	35,039
MAY 1997	31	19.3	31	2025	1.79	11,237	85,052	35,103
JAN 1998	30	24.1	31	1647	1.08	8,547	70,035	33,619
FEB 1998	23	22.9	26	1853	1.09	9,967	73,348	34,129
MAR 1998	31	22.9	31	2194	0.97	10,000	70,291	34,044
APR 1998	27	18.4	29	1468	1.00	9,676	70,334	34,152
JUL 1998	31	15.6	31	2123	1.24	10,123	74,177	33,633
AUG 1998	29	20.0	31	2533	1.15	10,160	77,383	33,785
SEP 1998	28	20.6	30	2586	1.11	10,117	74,214	33,725
OCT 1998	29	21.6	31	2429	1.10	10,103	74,319	33,581
NOV 1998	27	18.4	30	1970	1.12	10,137	74,380	33,683
DEC 1998	31	18.4	31	1967	1.12	10,123	74,380	33,767
JAN 2000	30	21.2	31	2069	1.30	10,203	78,002	33,933
FEB 2000	12	21.0	12	2037	1.20	10,204	77,463	34,203
MAR 2000	31	22.0	31	2333	1.26	10,219	77,753	34,215

Michigan 0200
North Lane 1

Comparison Date Weight - 01-January-1994 Classification - 02-December-1994

Month-Year	Class Days	Percent Class 9s	Weight Days	Average No. Class 9s	Avg.ESALs Per Class 9	Average Class 9 Steering	Mean Loaded Weight	Mean Unloaded Weight
Comparison values		20.0		1379	0.33	6,950	77,765	34,055
APR 2000	29	18.5	30	1662	1.27	10,218	77,827	34,178
MAY 2000	29	19.2	29	2030	1.21	10,205	77,336	34,524
JUN 2000	30	19.8	30	2459	1.22	10,215	77,502	34,500
JUL 2000	31	15.7	31	1966	1.35	10,224	78,167	33,875
AUG 2000	30	19.3	31	2478	1.18	10,169	77,537	33,975
SEP 2000	30	19.1	30	2219	1.16	10,165	77,386	33,904
OCT 2000	31	21.5	31	2474	1.14	10,168	77,459	34,014
NOV 2000	30	20.2	30	2204	1.15	10,167	77,492	34,079
DEC 2000	30	17.3	31	1804	1.19	10,205	77,697	34,223
JAN 2001	31	20.8	31	2087	1.12	10,185	77,210	34,402
FEB 2001	28	20.8	28	2133	1.18	10,209	77,254	34,662
MAR 2001	30	20.3	31	2193	1.20	10,221	77,650	34,755
APR 2001	29	19.3	30	2153	1.26	10,220	77,952	34,716
MAY 2001	31	20.4	31	2366	1.27	10,216	77,975	34,481
JUN 2001	30	18.8	30	2397	1.29	10,208	78,095	34,411
JUL 2001	31	16.2	31	2120	1.34	10,239	78,303	34,162
AUG 2001	31	19.4	31	2577	1.27	10,187	78,181	34,257
SEP 2001	28	18.9	30	2190	1.28	10,217	78,186	34,266
OCT 2001	31	20.2	31	2221	1.21	10,198	77,683	34,552
NOV 2001	30	18.7	30	2094	1.17	10,177	77,693	34,459
DEC 2001	29	16.4	31	1756	1.20	10,173	77,611	34,514
JAN 2002	30	21.2						
FEB 2002	26	20.5	28	2140	0.73	8,725	69,074	33,820
MAR 2002	31	19.5	31	2067	0.76	8,713	69,329	33,816
APR 2002	29	20.1	30	2253	0.96	9,160	70,217	34,098
MAY 2002	31	20.0	31	2294	0.99	9,263	73,164	34,143
JUN 2002	30	18.1	30	2315	1.08	9,423	73,770	34,164
JUL 2002	29	16.9	29	2196	1.05	9,338	73,677	33,927
AUG 2002	28	17.4	31	2334	0.96	9,260	73,203	33,942
SEP 2002	30	19.1	30	2212	0.93	9,173	70,353	33,870
OCT 2002	30	20.9	31	2361	0.78	8,945	69,367	33,743
NOV 2002	12	19.4	12	2073	0.72	8,800	69,024	33,698

From the table it appears that in the classification data the percent of Class 9s gradually increased till the end of 1995 except in July 1995 where the percent dropped significantly. Afterwards the percent returned to pre-July 1995 levels and remained almost stable except in April, July and August 1996. In the weight data the average number of Class 9s gradually increased till March 1996 except in June 1995 where the amount dropped significantly. Afterwards the amount decreased slightly in April, May and July 1996. From late 1996 on, the average volumes have been gradually increasing but tend to fluctuate between 1,800 and 2,300. The average ESALs per Class 9 was outside the expected range in November 1993. The ESAL distribution reflects seasonality in weights. It may reflect equipment changes or calibration due to three distinct average levels. The average steering axle weights were essentially the same till 2001 except in the spring of 1996, 1998 and entire 2002 when the averages dropped significantly. The mean loaded weight was essentially stable for all the years except November 1993 and 2002 when the averages decreased significantly. The mean unloaded weights were essentially the same for all the years except November 1993. The average steering axle weights, the mean loaded and unloaded weights in November 1993

were out of the expected range. Thus, it is recommended to remove the November 1993 weight data from the database.

9.2 Vehicle Distribution

The vehicle distribution graphs indicate whether the fleet mix is stable over time and any day of week or seasonal patterns that may exist. The vehicle distribution graphs contain two types of comparisons, one between data types and one over time. The between types comparison is represented by the two columns for every time unit present. The column on the left labeled with a 4 is for classification data. The right hand column of the pair is for weight data. Whether or not the data is equivalent is perhaps more important than the variation over time.

Figure 14-1 shows a typical by week pattern for heavy truck classification data. The individual weeks show essentially the same heavy truck mix. Every vehicle in Classes 6 through 13 that constitutes at least 10 percent of the population is expected to stay within plus or minus 5 percent of the value observed during the two weeks following validation. This range is shown by the darker band inside the lighter band to the right of the weekly data. Weeks that go outside more than plus or minus 10 percent of the expected value will fall above or below the light gray areas of the band. These are weeks that should have been subjected to additional scrutiny prior to accepting the data as reasonable.

For this site, the fleet mix is essentially the same for all the years except July 1995 and April 1998 as shown in Figure 14-3 and Figure 14-4 respectively. The reason for this sudden change in the middle of the year cannot be determined. There was no significant difference in the mix stability graphed for the weight data as shown in Figure 14-2. The corresponding weight data for April 1998 had similar trend as for classification data. There was no weight data for July 1995.

Figure 14-5 shows the typical pattern for vehicle distribution by month by year for the data collected from the classifier versus the data collected by the WIM equipment. As seen from the figure the vehicle distribution appears to exhibit a slight seasonal pattern. It appears that the classifier data is almost the same as the WIM data. Prior to 2000 the WIM data was same if not slightly less than the classifier data for most of the time. In 1995 there is a significant volume of unclassified vehicles as shown in Figure 14-6. The reason for this discrepancy could not be determined although a change in data submission format may have contributed to it.

9.3 GVW Distributions for Class 9s

The Class 9 GVW graph is a generally accepted way to evaluate loading data reported at a site. A typical graph has two peaks, one between 28,000 and 36,000 pounds and the other between 72,000 and 80,000 pounds. The first is the unloaded peak. The second, the loaded peak, reflects the legal weight limit for a 5-axle tractor-trailer vehicle on the interstate highway system. Additionally, it is expected that less than 3 percent of the trucks will be excessively light (less than 12,000 pounds) and less than 5 percent will be significantly overweight (in excess of 96,000 pounds). Data that falls outside of the expected conditions needs a record of validation to verify that the pattern is in fact correct

for the location. Data meeting the expected patterns is not automatically considered to be of research quality, merely rational as bias in scale measurements may shift the peaks in the data from their true values.
The overall assessment of loading patterns is done using a Class 9 GVW graph by year over the available years. In Figure 14-7 and Figure 14-8 the average pattern is shown in the (red) line with squares. From the figures it appears that this site has almost equal proportions of loaded and unloaded vehicles. The peaks are within the expected range except 2002 when the peak-loaded weight is slightly lower than the expected range. From 1994 till 2002 the unloaded peaks appear to be essentially the same whereas the loaded peaks are slightly different. In 1993 the peaks unloaded and loaded peaks were significantly different compared to the rest of the data as shown in Figure 14-7.

To investigate any seasonal variations the Class 9 GVW distributions are graphed by month by year. As shown in Figure 14-9 and Figure 14-10 there appears to be no seasonal variation.

9.4 Axle Distributions

Axle distribution graphs were not needed since the GVW graphs were available for all years.

9.5 ESALs per year

Average ESALs for Class 9 vehicles are a very crude method of identifying loading shifts. Figure 14-11 shows the average Class 9 ESALs per month for this location. To remove the influence of changing pavement structure all ESAL values have been computed with an SN = 5 and a p_t of 2.5. Average ESALs per Class 9 are not used as an indicator of research quality data. As seen from the figure it appears that the average ESALs are not exhibiting a consistent pattern. There is greater seasonality in the earlier years. However, all years have the highest loadings in summer. The trend has been downward over time with a distinct drop in the 2002 data. This may be an artifact of equipment changes or an actual change in weights.

9.6 Average Daily Steering Axle Weight

A frequently used statistic for checking scale calibration and doing auto-calibration of WIM equipment is the weight of the front axle. This value is site specific and should be relatively constant particularly for loaded Class 9s (vehicles in excess of 60,000 lbs). Typically when auto calibration is used this value either cycles repeatedly or with very large truck volumes results in an essentially straight line for the mean. As shown in Figure 14-12 the average is essentially stable. The average of about 10,000 pounds is essentially the same for all years except in spring of 1996 and 1998. There is a drop of about 1,000 pounds in 2002 to 9,000 pounds.

10 Updated handout guide and Sheet 17

A copy of the post-visit handout guide has been included following page 20. It includes a current Sheet 17 with all applicable maps and photographs. There are no significant changes in the information provided.

11 Updated Sheet 18

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

12 Traffic Sheet 16(s) (Classification Verification only)

Sufficient classification information was collected between 8:00 a.m. and 9:00 a.m. on April 21, 2004 to complete a Sheet 16. A copy is attached following the Sheet 18 information.

13 Distress Photographs

Figure 13-1 Pavement Condition in the Downstream Direction at 260200

Figure 13-2 Pavement Condition in the Upstream Direction at 260200

14 Traffic Graphs

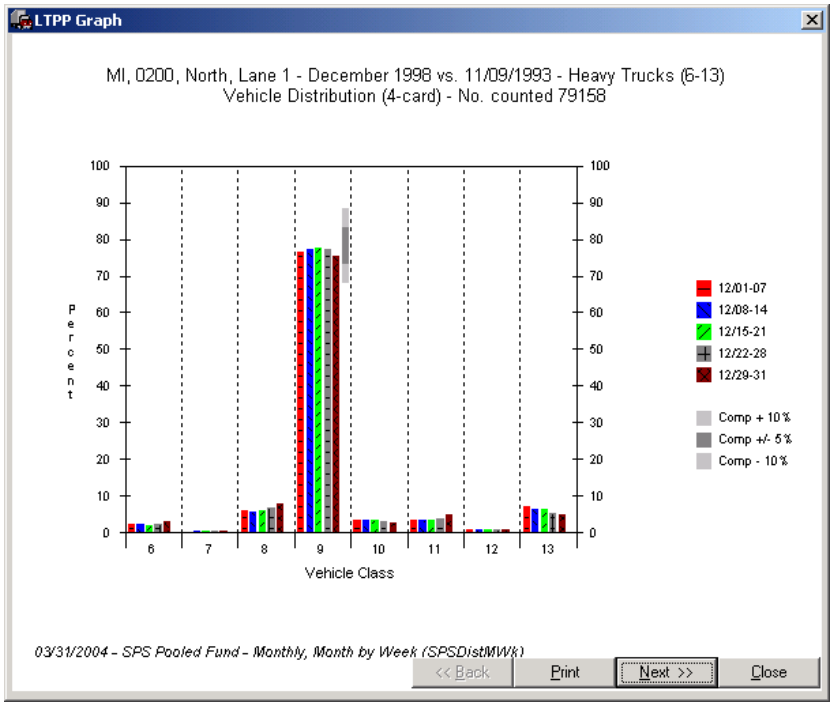


Figure 14-1 Typical Heavy Truck Distribution Pattern for Classification Data for 260200

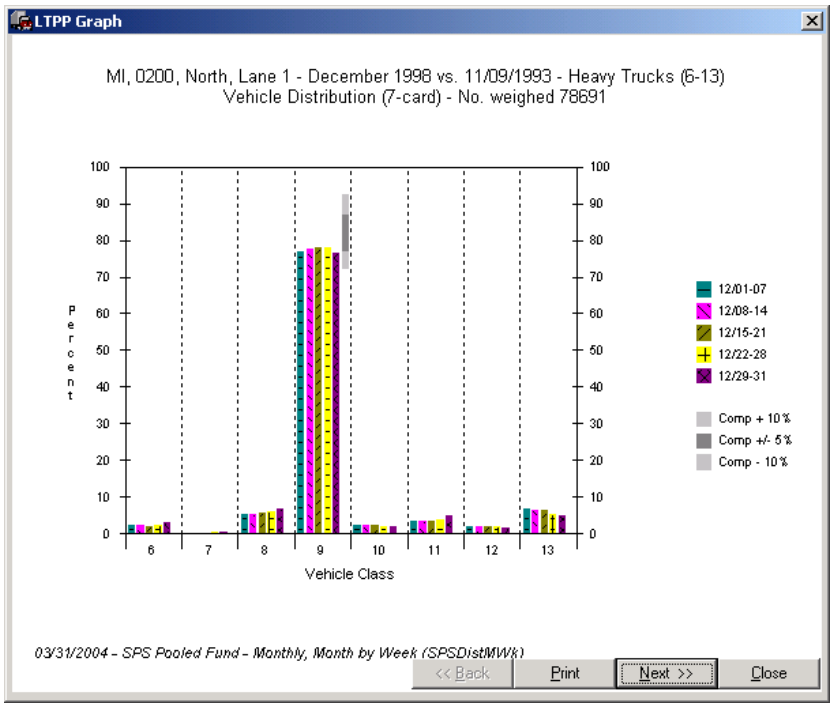


Figure 14-2 Typical Heavy Truck Distribution Pattern for Weight Data for 260200

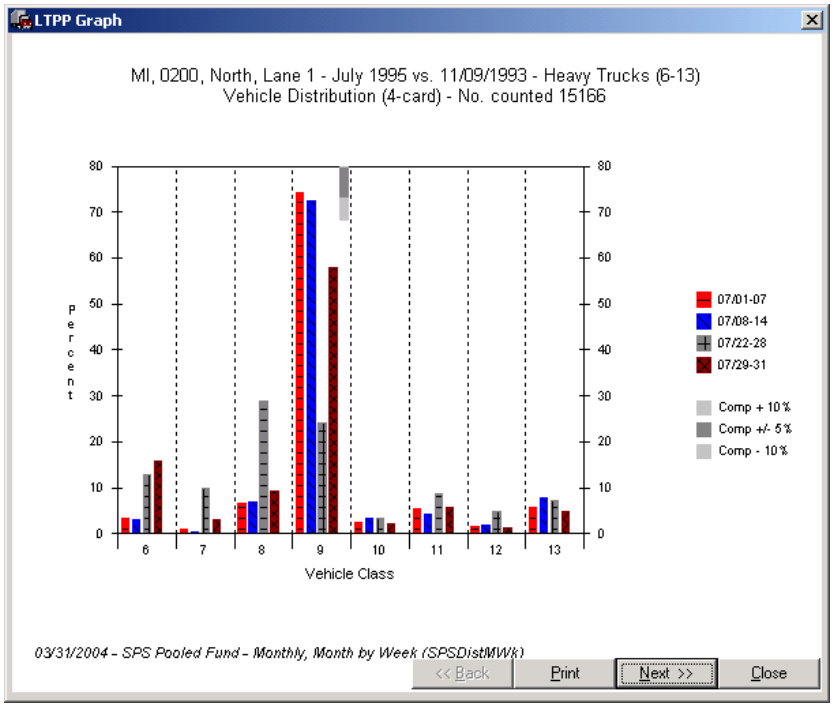


Figure 14-3 Heavy Truck Distribution Pattern for Classification Data - July 1995 for 260200

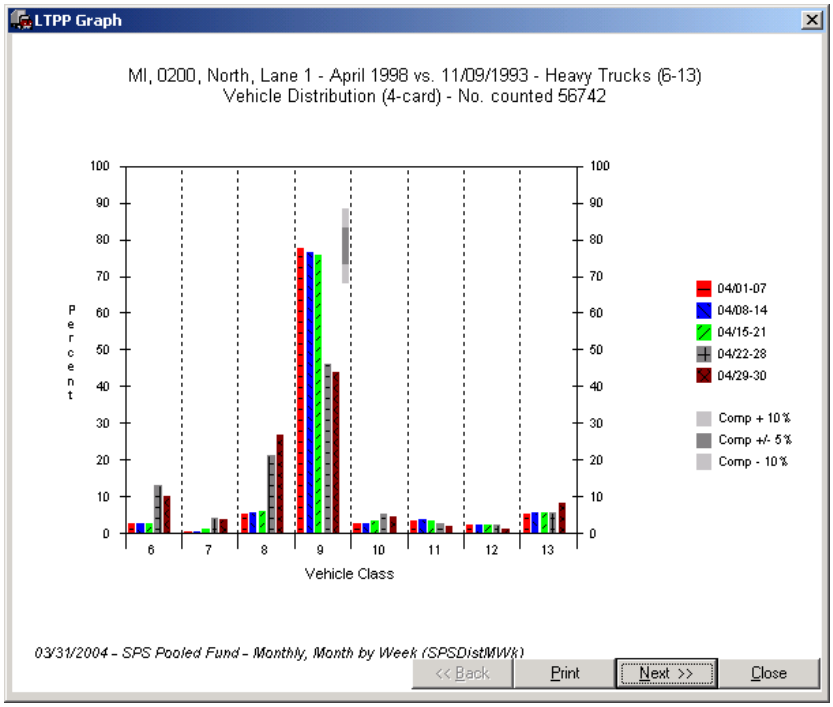


Figure 14-4 Heavy Truck Distribution Pattern for Classification Data - April 1998 for 260200

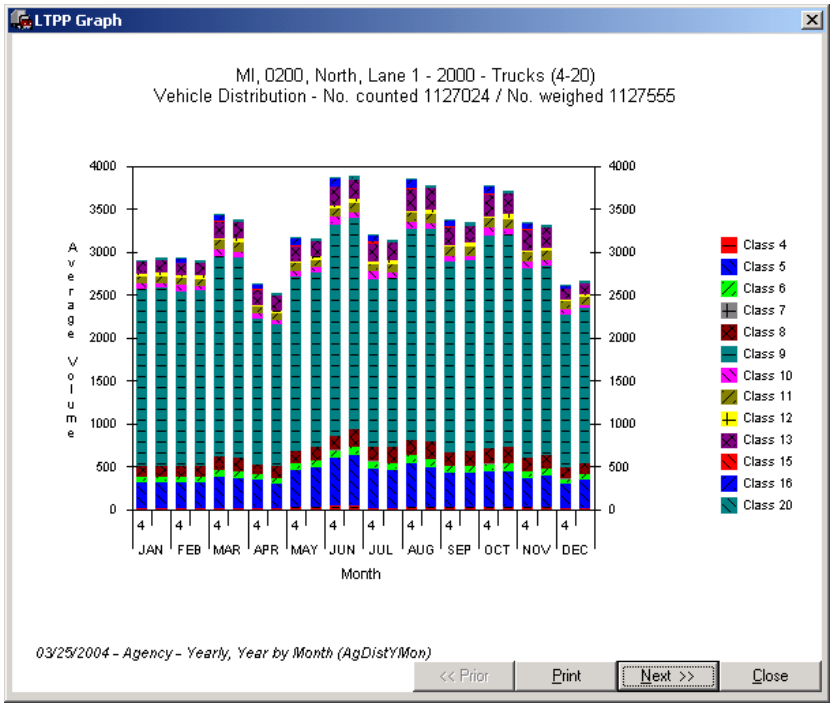


Figure 14-5 Truck Distribution by Month for the Year 2000 for 260200

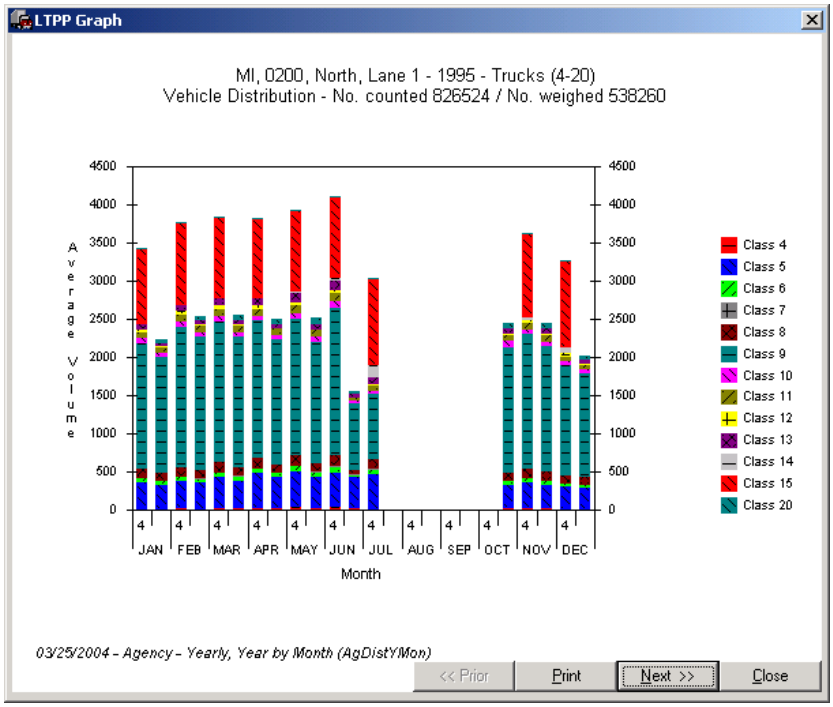


Figure 14-6 Truck Distribution by Month for the Year 1995 for 260200

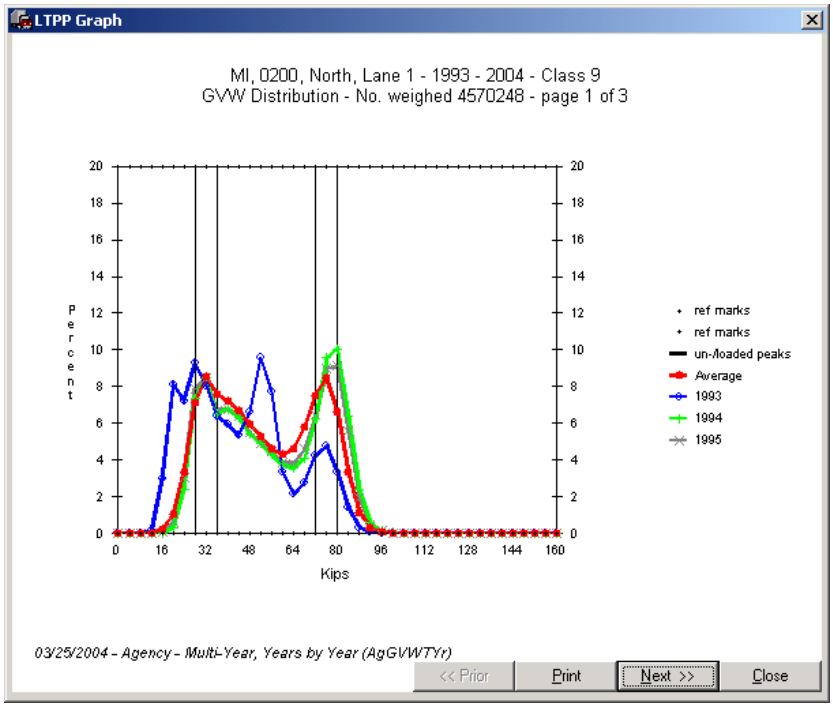


Figure 14-7 Class 9 GVW Distribution - 1993 to 1995 for 260200

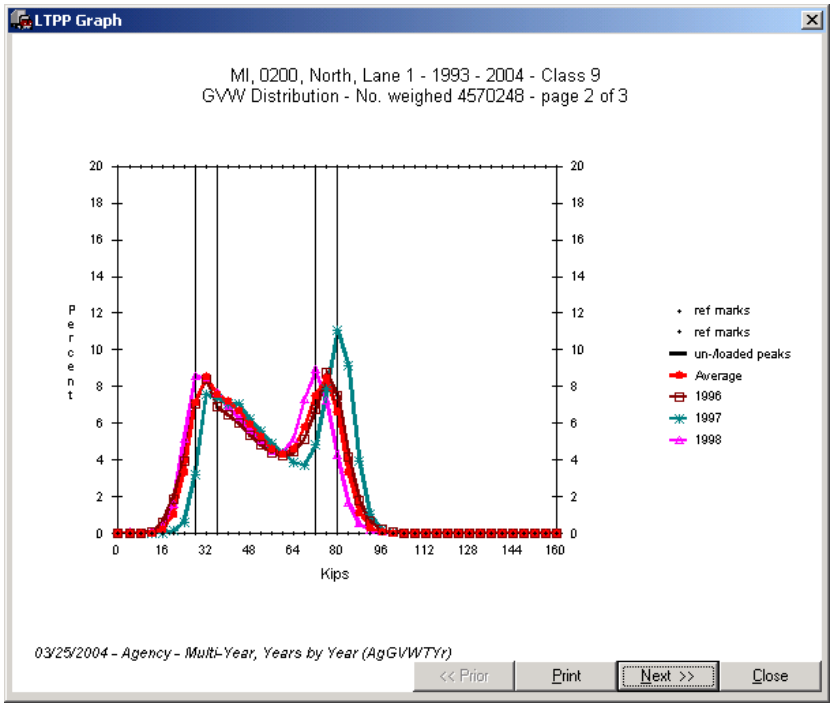


Figure 14-8 Class 9 GVW Distribution - 1996 to 1998 for 260200

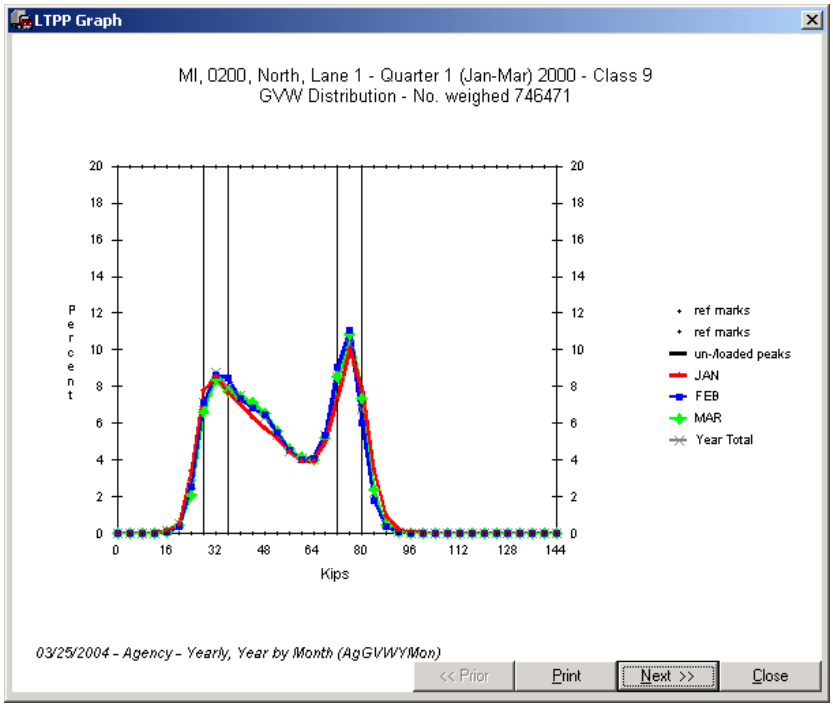


Figure 14-9 Class 9 GVW Distribution - January to March 2000 for 260200

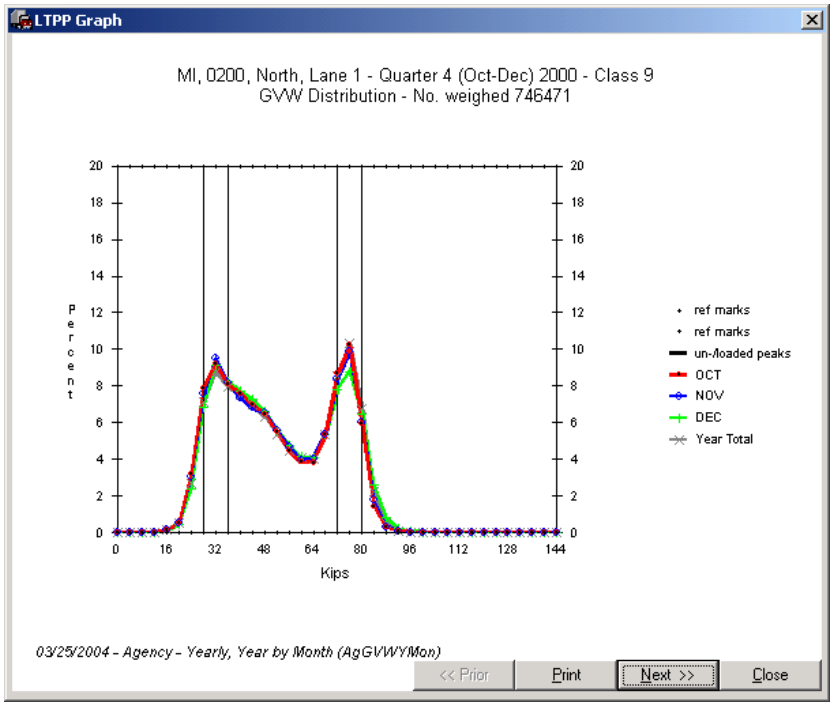


Figure 14-10 Class 9 GVW Distribution - October to December 2000 for 260200

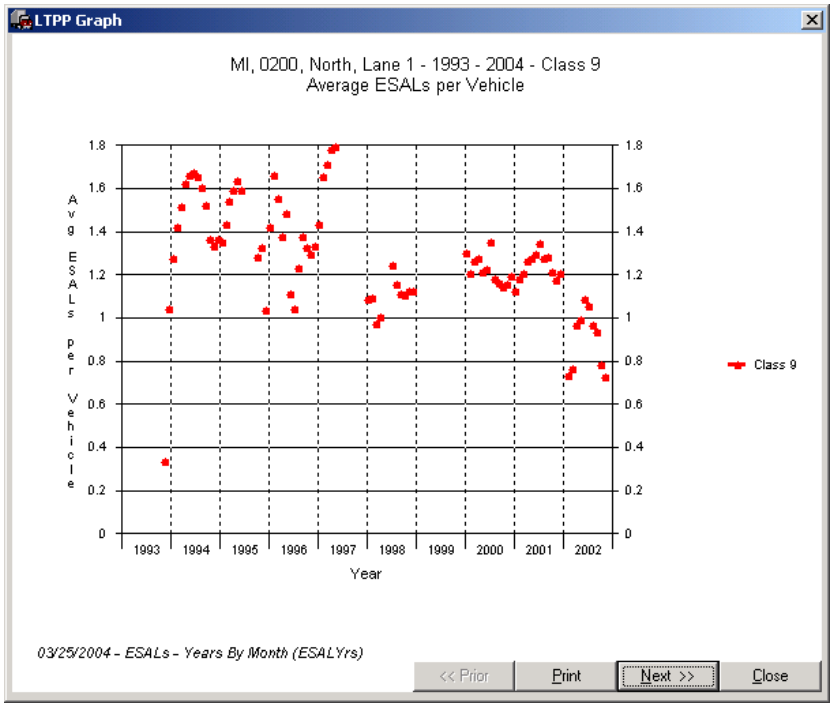


Figure 14-11 Average Class 9 ESALs for site from 1993 to 2002 for 260200

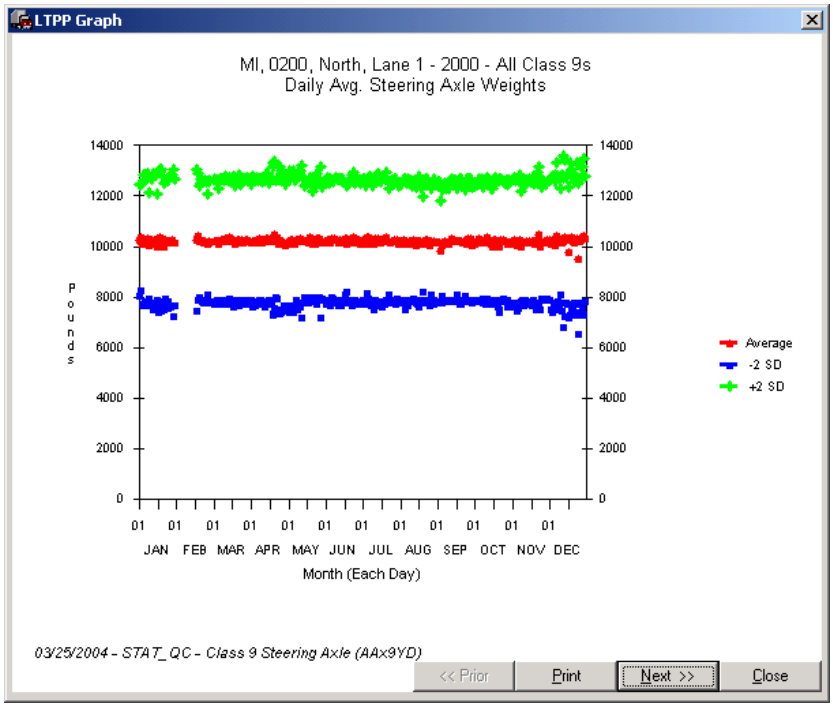


Figure 14-12 Average Daily Class 9 Steering Axle Weight – 2000 for 260200

15 WIM Index Graphs

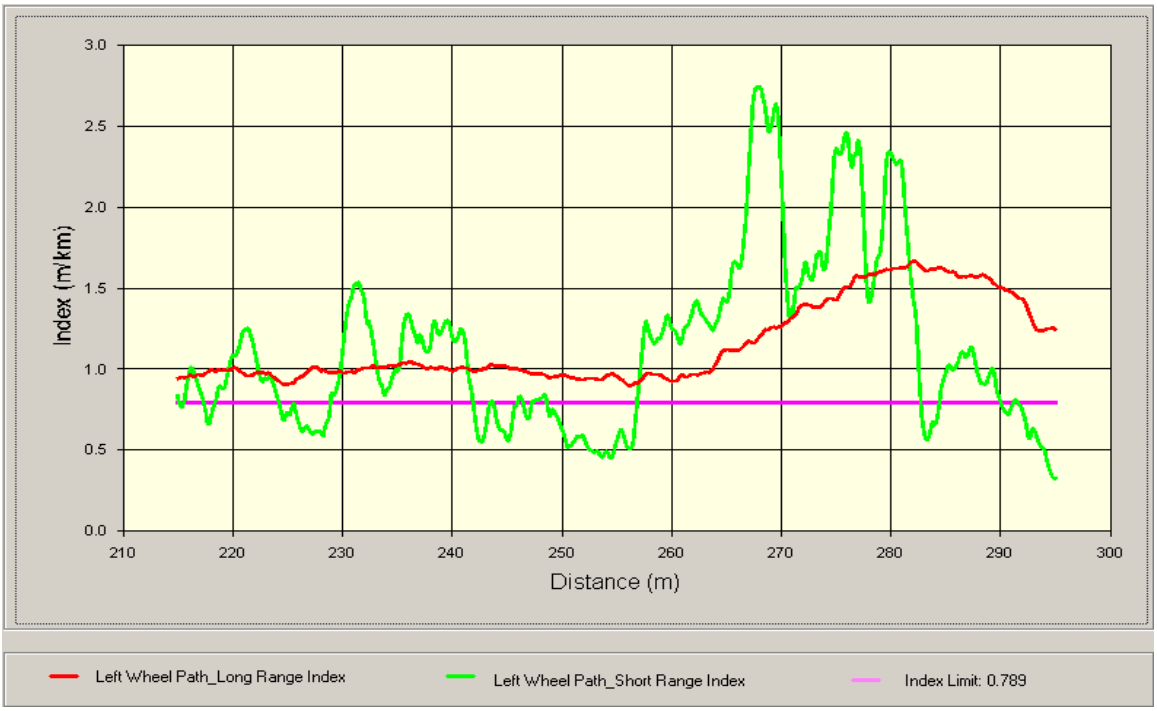


Figure 15-1 Typical WIM Index Data in the Left Wheel Path at 260200 – 7 July 2004

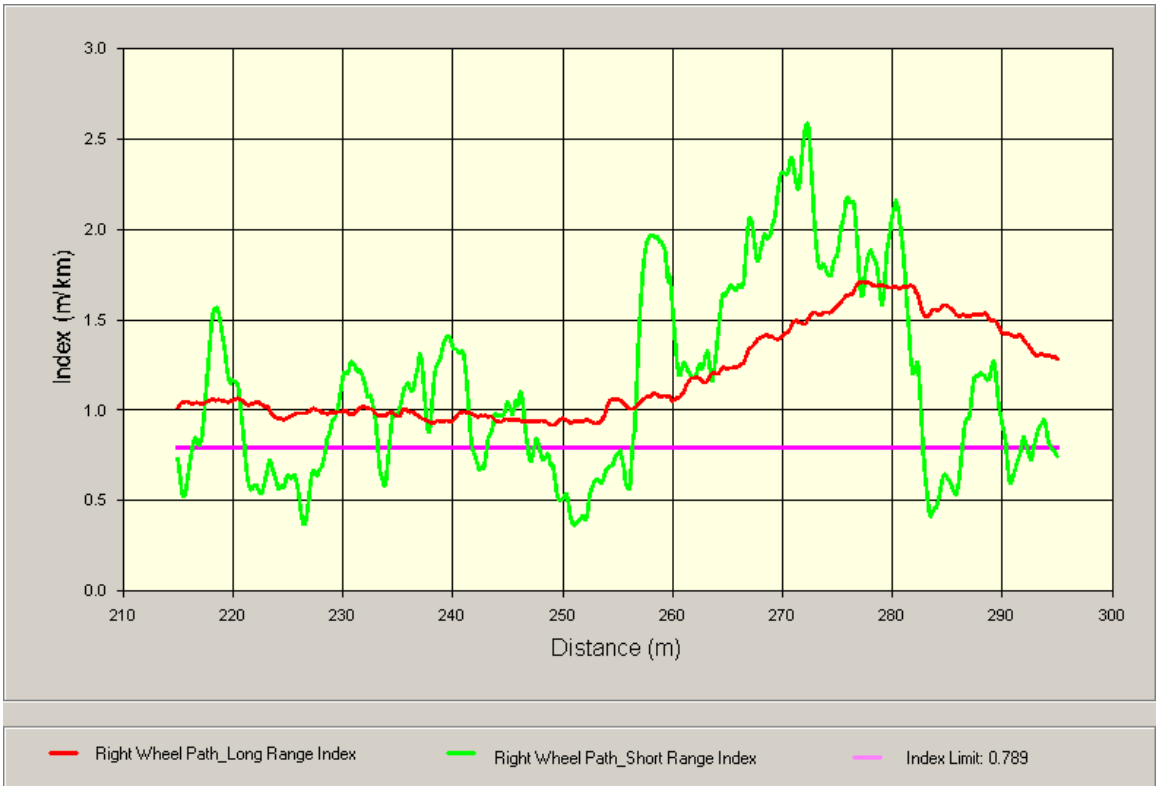


Figure 15-2 Typical WIM Index Data in the Right Wheel Path at 260200 – 7 July 2004

POST VISIT HANDOUT GUIDE FOR SPS WIM FIELD ASSESSMENT

STATE: Michigan

SHRP ID: 0200

Figures

1. General Information

SITE ID: *260200*

LOCATION: *US 23 North at M.P. 2.23*

VISIT DATE: *April 21, 2004*

VISIT TYPE: *Assessment*

2. Contact Information

POINTS OF CONTACT:

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

Highway Agency: *Tom Hynes, 517-322-5711, hynest@mdot.state.mi.us*

James Kramer, 517-322-1716, kramerj2@michigan.gov

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

FHWA Division Office Liaison: *Ryan Rizzo, 517-702-1842, ryan.rizzo@fhwa.dot.gov*

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

3. Agenda

BRIEFING DATE: *None Requested.*

ON SITE PERIOD: *April 21, 2004 beginning at 9:00 a.m.*

TRUCK ROUTE CHECK: *Completed. See truck route.*

4. Site Location/ Directions

NEAREST AIRPORT: *Detroit Metropolitan Wayne County Airport, Detroit, MI*

DIRECTIONS TO THE SITE: *0.7 mi. North of Stearns Road.*

MEETING LOCATION: *On site beginning at 9:00 a.m.*
WIM SITE LOCATION: *US 23 North at M.P. 2.23 (Latitude: 41.752^0 and Longitude: -83.701^0)*

WIM SITE LOCATION MAP: *See Figure 4.1*

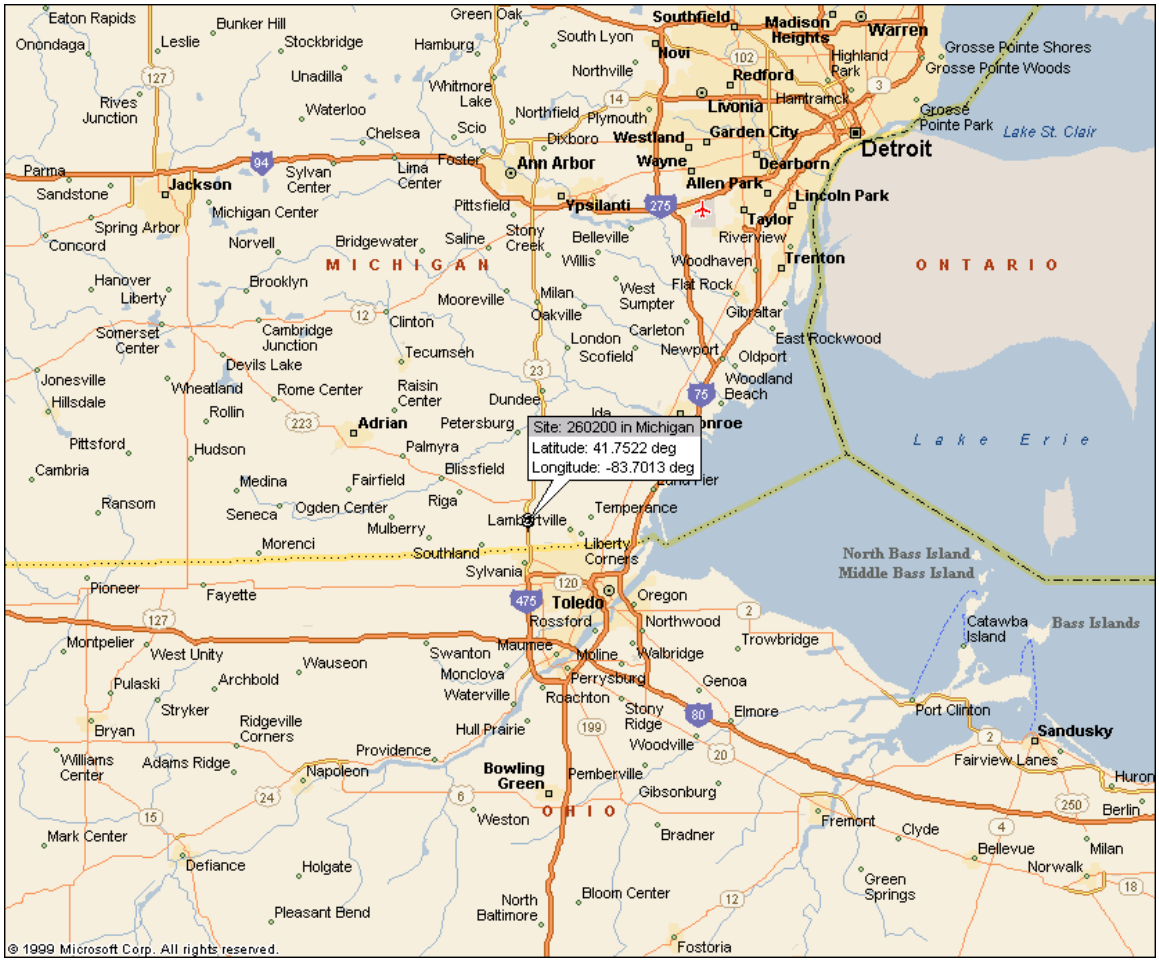


Figure 4.1: Site 260200 in Michigan

5. Truck Route Information

ROUTE RESTRICTIONS: *None.*

SCALE LOCATION: *23RD Fuel Stop, SR 23 at Stearns Road, Ottawa Lake, MI (1 mile from site), Operator – Christie Mulligan, 734-856-4674, 24 hours a day, 7 days a week, $8.00 per weight.*

TRUCK ROUTE:

- *North: 0.63 miles to exit 3 on US 23 (Consear Road)*
- *South: 0.69 miles to exit 1 on US 23 (Stearns Road)*
- *Length of truck turnaround is 1.32 miles*

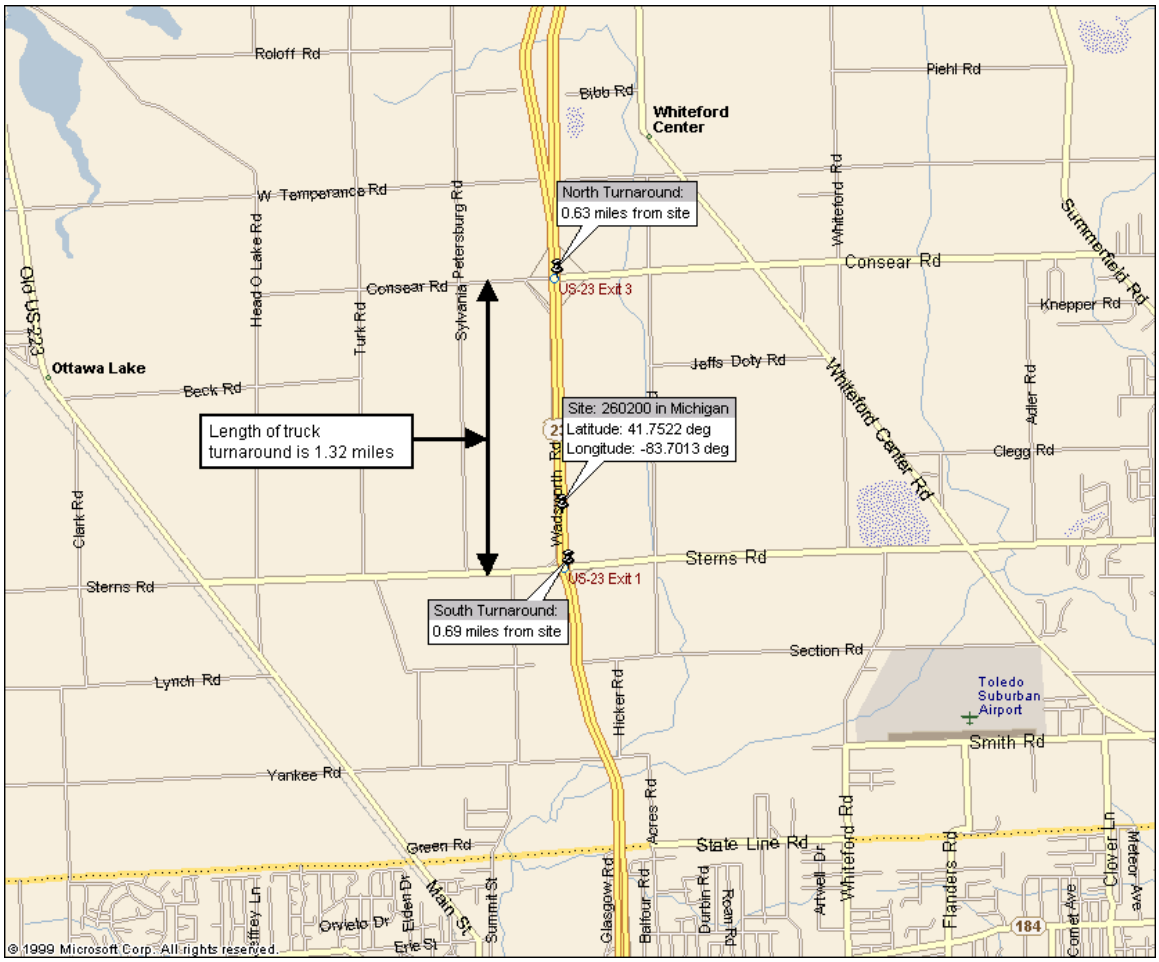


Figure 5.1: Truck Route of 260200 in Michigan

6. Sheet 17 – Michigan (260200)

1.* ROUTE ___US 23_____MILEPOST _2.23____LTPP DIRECTION - N S E W

2.* WIM SITE DESCRIPTION - Grade ___<_1____ % Sag vertical Y / N
Nearest SPS section upstream of the site ___ _260221__ ___
Distance from sensor to nearest upstream SPS Section ___ _66.9__ ___ ___ 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__ _0__ ft

4.* PAVEMENT TYPE _____Cement Concrete_____

5.* PAVEMENT SURFACE CONDITION – Distress Survey
Date _____4-21-04_____Distress Photo Filename
_Downstream_TO_5_26_35A_0200_04_21_04.JPG_____
Date _____4-21-04_____Distress Photo Filename
_Upstream_TO_5_26_35A_0200_04_21_04.JPG_____
Date _____Distress Photo Filename _____

6. * SENSOR SEQUENCE _____Loop – Kistler Quartz – Loop – Kistler Quartz

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 _3_ _1_ ft

Distance from system __ _3_ _6_ ft

TYPE _____M_____

CABINET ACCESS controlled by LTPP / STATE / JOINT?

Contact - name and phone number __James Kramer (517) 322-5711 ___

Alternate - name and phone number _Bob Brenner (517) 322-1673 _____

11. * POWER

Distance to cabinet from drop ___ _217__ ___ ft Overhead / underground / solar / AC in cabinet?

Service provider _____ Phone number _____

12. * TELEPHONE

Distance to cabinet from drop ___ _217__ ___ ft Overhead / under ground / cell?

Service provider _____ Phone Number _____

13.* SYSTEM (software & version no.)- _____DAW 190 _____

Computer connection – RS232 / Parallel port / USB / Other _____

14. * TEST TRUCK TURNAROUND time ___6____ minutes DISTANCE _2.6__ mi

15. PHOTOS FILENAME

Power source Power_Source_TO_5_26_35A_0200_04_21_04.JPG

Phone source Phone_ Source_TO_5_26_35A_0200_04_21_04.JPG

Cabinet exterior Cabinet_Exterior_TO_5_26_35A_0200_04_21_04.JPG _____

Cabinet interior Cabinet_Interior_TO_5_26_35A_0200_04_21_04.JPG _____

Weight sensors Leading_Weight_Sensor_TO_5_26_35A_0200_04_21_04.JPG _

Classification sensors Trailing_Weight_Sensor_TO_5_26_35A_0200_04_21_04.JPG __

Other sensors _____

Description _____

Downstream direction at sensors on LTPP lane _

Downstream_TO_5_26_35A_0200_04_21_04.JPG _____

Upstream direction at sensors on LTPP lane _

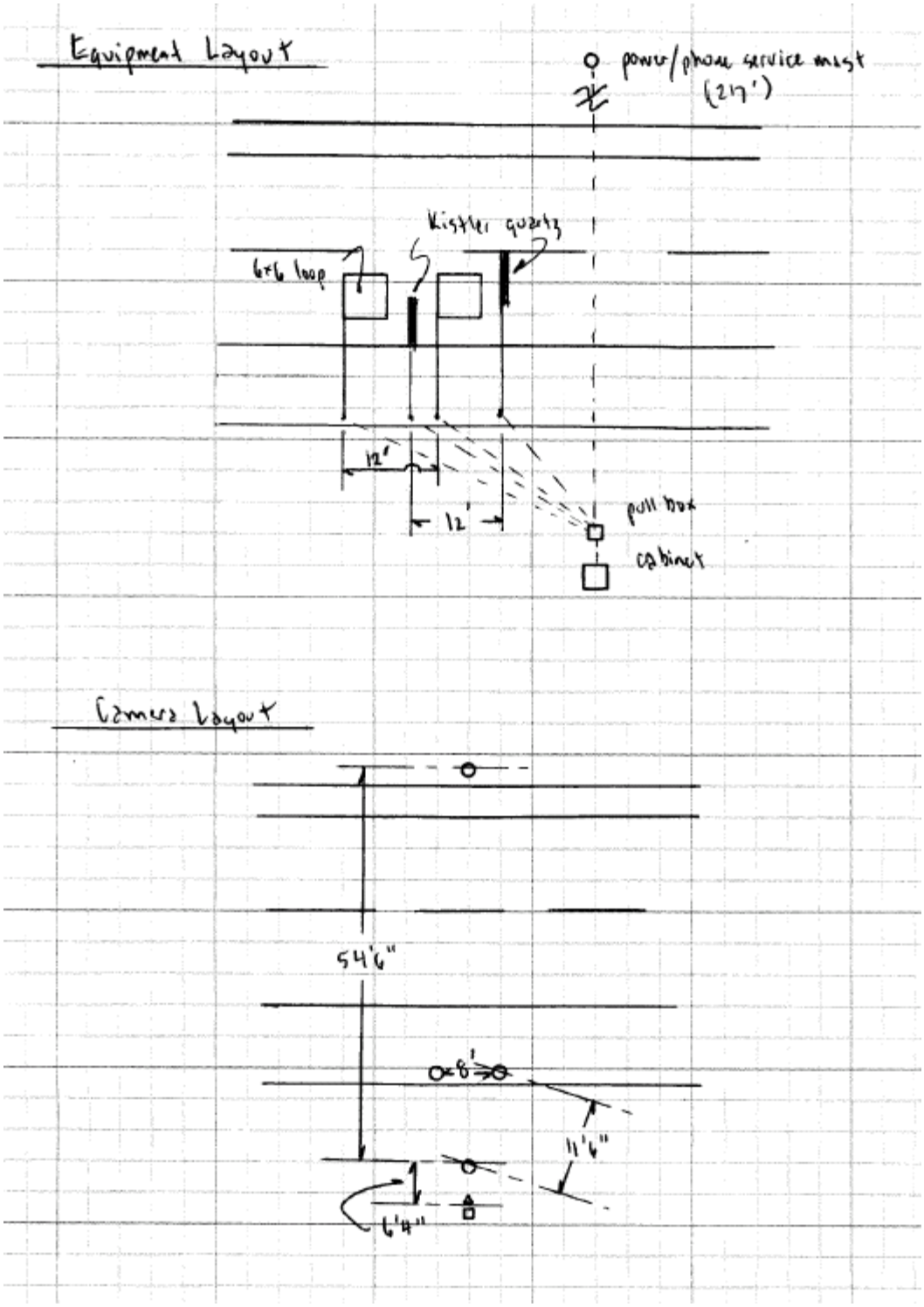
Upstream_TO_5_26_35A_0200_04_21_04.JPG _____

COMMENTS __ _____
_____GPS Coordinates: Latitude: 41.752^0 and Longitude: -83.701^0 _____
_____
_____Speed Limit is 70 mph for cars and 55 mph for trucks_____
_____
_____Closest Amenities: _____
_____Exit 5 – Gas, MacDonald's, Burger King_____
_____Exit 17 – various hotels, restaurants, gas etc._____
_____
_____
_____Test Truck Recommendations: _____
_____Types of Trucks: Two Class 9s _____
_____Truck 1: Class 9, 72,000 to 80,000 legal limit on gross and axles, air_____
suspension; _____
_____Truck 2: Class 9, 45,000 to 55,000 lbs_____
_____
_____ Expected Speeds: 45, 50 and 55 mph due to high percentage of trucks
running above speed limit a 2-speed regime should be considered for safety. _____
_____
_____
_____
_____

COMPLETED BY _____Dean J. Wolf_____

PHONE __301-210-5105___DATE COMPLETED _0_ _4_ /_2_ _1_ / _2_ _0_ _0_ _4_

Sketch of equipment layout



Site Map

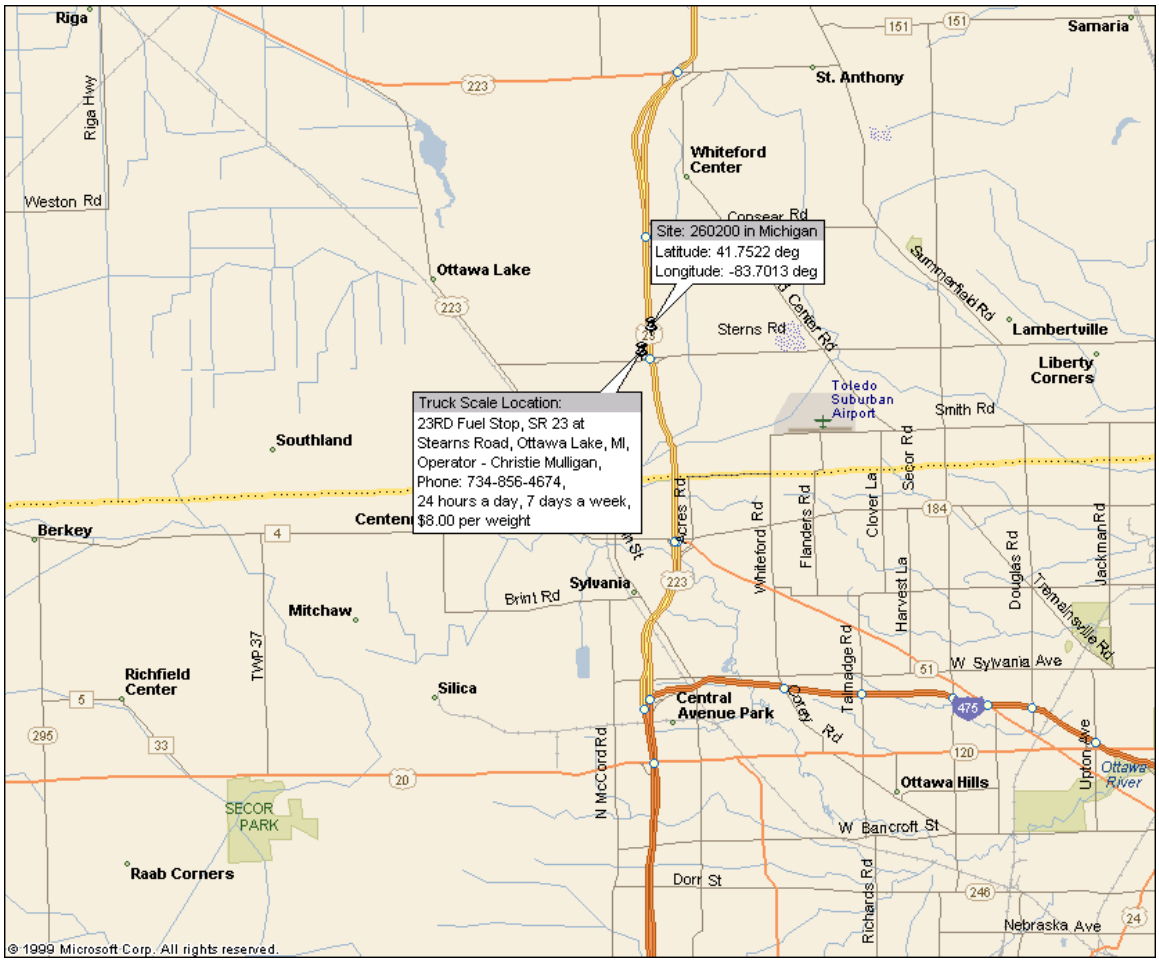


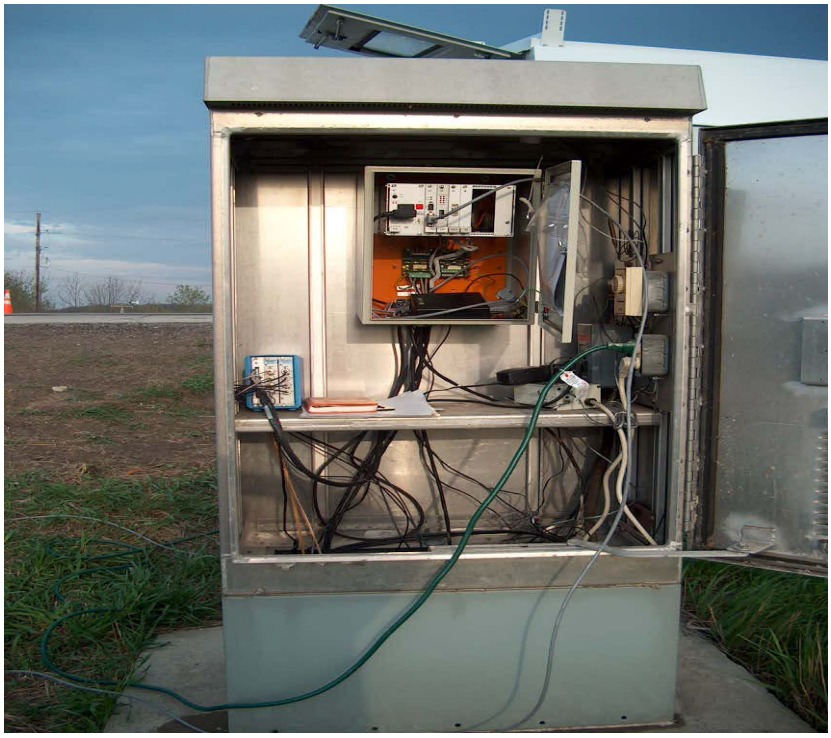
Figure 6.1: Site Map of 260200 in Michigan

Downstream_TO_5_26_35A_0200_04_21_04.JPG (Distress Photo 1)

Upstream_TO_5_26_35A_0200_04_21_04.JPG (Distress Photo 2)

Power_and_Phone_Source_TO_5_26_35A_0200_04_21_04.JPG

Cabinet_Exterior_TO_5_26_35A_0200_04_21_04.JPG



Cabinet_Interior_TO_5_26_35A_0200_04_21_04.JPG

Leading_Weight_Sensor_TO_5_26_35A_0200_04_21_04.JPG

Trailing_Weight_Sensor_TO_5_26_35A_0200_04_21_04.JPG

Downstream_TO_5_26_35A_0200_04_21_04.JPG

Upstream_TO_5_26_35A_0200_04_21_04.JPG

SHEET 18	STATE CODE [26]
LTPP MONITORED TRAFFIC DATA	SPS PROJECT ID [_ 0200_]
WIM SITE COORDINATION	DATE: (mm/dd/yyyy) __ 04 / _21__ / __ 2004_ __

Rev. 05/25/04

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 _____
      - □ 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 ___7_ ■ days □ weeks

   b. Notice for straightedge and grinding check - ___2__ □ 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 – _____ ☐ 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:

_____PAT/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: _____Jim Kramer _____ Phone: (517) 322-1736

      Agency: _____

b. Maintenance (equipment) –

Name: _____Jim Kramer _____ Phone:(517) 322-1736

Agency: _____

c. Data Processing and Pre-Visit Data –

Name: ____Jim Kramer _____ Phone: (517) 322-1736 Agency:

_____

d. Construction schedule and verification –

Name: ____Jim Kramer ____ Phone:(517) 322-1736 _

Agency: _____

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

Name: _____ Phone: _____

Agency: _____

f. Traffic Control –

Name: _____ Phone: _____

Agency: _____

g. Enforcement Coordination –

Name: _____ Phone: _____

Agency: _____

h. Nearest Static Scale

23RD Fuel Stop, SR 23 at Stearns Road, Ottawa Lake, MI (1 mile from site), Operator – Christie Mulligan, 734-856-4674, 24 hours a day, 7 days a week, $8.00 per weight

SHEET 16 **LTPP MONITORED TRAFFIC DATA** **SITE CALIBRATION SUMMARY**	*STATE ASSIGNED ID [_0_ _3_ _1_ _5_] *STATE CODE [_2_ _6_] *SHRP SECTION ID [_0_ _2_ _0_ _0_]

SITE CALIBRATION INFORMATION

1. * DATE OF CALIBRATION (MONTH/DAY/YEAR) [_0_ _4_ / _2_ _1_ / _2_ _0_ _0_ _4_]

2. * TYPE OF EQUIPMENT CALIBRATED __ WIM _XX_ CLASSIFIER ___ BOTH

3. * REASON FOR CALIBRATION
   ____ REGULARLY SCHEDULED SITE VISIT ____ RESEARCH
   ____ EQUIPMENT REPLACEMENT ____ TRAINING
   ____ DATA TRIGGERED SYSTEM REVISION ____ NEW EQUIPMENT INSTALLATION
   _XX___ OTHER (SPECIFY) _____SITE ASSESSMENT _____

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 ____ QUARTZ PIEZO
   ____ CHANNELIZED FLAT PIEZO ____ INDUCTANCE LOOPS ____ CAPACITANCE PADS
   _XX___ OTHER (SPECIFY) _____ Loop – Kistler Quartz – Loop – Kistler Quartz _____

5. EQUIPMENT MANUFACTURER _____PAT DAW_____

WIM SYSTEM CALIBRATION SPECIFICS**

6.**CALIBRATION TECHNIQUE USED:
   ____ TRAFFIC STREAM -- ____STATIC SCALE (Y/N) ____ TEST TRUCKS

   __ __ __ NUMBER OF TRUCKS COMPARED __ __ __ NUMBER OF TEST TRUCKS USED

   __ __ __ PASSES PER TRUCK

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

7. SUMMARY CALIBRATION RESULTS (EXPRESSED AS A PERCENT)
   MEAN DIFFERENCE BETWEEN ---
   DYNAMIC AND STATIC GVW ___ ___ ___ . __ STANDARD DEVIATION __ __ . __
   DYNAMIC AND STATIC SINGLE AXLES ___ ___ ___ . __ STANDARD DEVIATION __ __ . __
   DYNAMIC AND STATIC DOUBLE AXLES ___ ___ ___ . __ STANDARD DEVIATION __ __ . __

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

9. DEFINE THE SPEED RANGES USED (MPH) _____ _____ _____ _____ _____ _____ _____ _____
   _____ _____ _____ _____ _____ _____ _____ _____ _____ _____

10. CALIBRATION FACTOR (AT EXPECTED FREE FLOW SPEED) ___ ___ ___ . ___ ___

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

CLASSIFIER TEST SPECIFICS***

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

13. METHOD TO DETERMINE LENGTH OF COUNT ____ TIME _XX___ NUMBER OF TRUCKS

14. MEAN DIFFERENCE IN VOLUMES BY VEHICLES CLASSIFICATION:
   *** FHWA CLASS 9 ____ __0__ ____ FHWA CLASS ____ ____ ____ ____ ____
   *** FHWA CLASS 8 ____ __0__ ____ FHWA CLASS ____ ____ ____ ____ ____
   FHWA CLASS ____ ____ ____ ____ ____
   FHWA CLASS ____ ____ ____ ____ ____
   *** PERCENT "UNCLASSIFIED" VEHICLES: ____ __0__ ____

PERSON LEADING CALIBRATION EFFORT: _____Dean J. Wolf _____
CONTACT INFORMATION: _____301-210-5105_____ rev. November 9, 1999