Guidelines[1] for Traffic Counts Used for Forecasts Certified for Roadway Design

11/18/2016, updated 8-24-17, 1-30-2018, 5-8-2018,10-29-2018, 6-1-2020

These guidelines are intended to address count quantity, quality, and form for estimating traffic demands needed for roadway design.

This document was also written to address the frequently asked question posed by those who don't want to read and understand the referenced manual. It answers the questions (1) "What counts does Modeling & Forecasting want to see in order to produce traffic certified for design and in what format?"

It assumes the reader knows something about traffic counting already. Refer to "Ohio Design Traffic Forecasting Manual Volume 1: Traffic Forecasting Background - Chapter 3 Traffic Monitoring Data" for a more comprehensive discussion about traffic counts.

It is intended that this document may be updated more frequently than the Traffic Forecasting Manual and would contain updates and answers to frequently asked questions which potentially could take precedence over the contents of the manual.

It is worth noting that these are guidelines per the definition of the word guideline in the footnote and not hard and fast rules. Common sense should prevail. If there are good reasons not to follow these guidelines, document it and move on. At the same time, if the guidelines are not followed and ODOT Modeling & Forecasting is asked to certify those forecasts, the certification may be delayed as new traffic counts are taken to satisfy the request or disclaimers will be noted in the transmittal.

Note: This document does not address agreement on counts between project stakeholders.

Examples of counts used for certified traffic for projects may be found on the section's web page:

http://www.dot.state.oh.us/Divisions/Planning/SPR/ModelForecastingUnit/Pages/CertifiedTraffic.aspx

[1] Guideline definition:
A general rule, principle, or piece of advice.

Basic Requirements Bullet Point:

1) Turning movement counts for intersections:
   a) Summarize by *car and truck*[2] in 15-minute intervals, should be counted for a minimum of 8 hours and capture the peak hour (4 hours, typically 6-10 AM and 2-6 PM or 3-7 PM in Cincinnati/Dayton, Cleveland, and Columbus metropolitan planning areas).
   b) Forty eight (48) hour machine counts (see 2) are recommended[3], one (1) on each of the intersecting roads (outside of the intersection queuing area if possible). So, a 4 legged intersection would have up to two machine counters to capture the mainline and cross street, though adjacent intersections might utilize the same machine count if there are no major traffic generators between them.
   c) Where the traffic peak is midday, 12 hour turn movement counts are required, 6 AM - 6 PM.
   d) For routes estimated to carry less than 1000 annual average vehicles per day, b) may be waived.
   e) Preferred format for submittals is shown later in the count format sections.
2) Machine Counts:
   a) Machine counts are defined as traffic counts made by anything other than a human.
   b) For locations already counted within the previous two years in relatively stable areas, the existing machine counts may be used.
   c) At a minimum, machine counts are hourly, directional (cover both directions), classification (car/truck) counts covering a contiguous 24 to 48 hour period where applicable.
   d) In addition to the machine counts recommended to supplement turning movement counts as described under item 1 above, machine counts should be conducted at other critical locations within the project area.
   e) For path 3, 4, & 5 projects, permanent automatic traffic recorder (ATR) installations may be discussed at early coordination meetings and if determined feasible, will be installed through ODOT Traffic Monitoring Section of Office of Technical Services contracts. ATRs collect traffic data continuously and indefinitely.
   f) In addition to count summaries in Excel readable format, electronic count data files should be submitted for ODOT traffic monitoring section's use and therefore should be submitted in the count equipment format per the Machine Count Electronic File Format shown later.
3) When forecast requests include truck factors, truck counts must be summarized at a minimum by hour, preferably by 15-minute periods.
4) Conduct counts during typical weekdays (Tuesday-Thursday) unless designing to accommodate unique, area specific, conditions such as weekend or amusement park traffic.
5) If the request is for design designations on local roads (non-state), then include machine counts.
6) Provide a Map showing count location(s).
7) Queue counts are recommended if it is known that the queue backs up beyond the previous intersection. See 9) under Other Notes:

[2] Cars are FHWA class 1-3, Trucks are 4-13 See FHWA vehicle class definitions:
https://www.dot.state.oh.us/Divisions/Planning/TechServ/traffic/Reports/Scheme_F_Report/SchemeF.pdf
[3] Use some common sense and do what makes the most sense for the project at hand, see page 6.

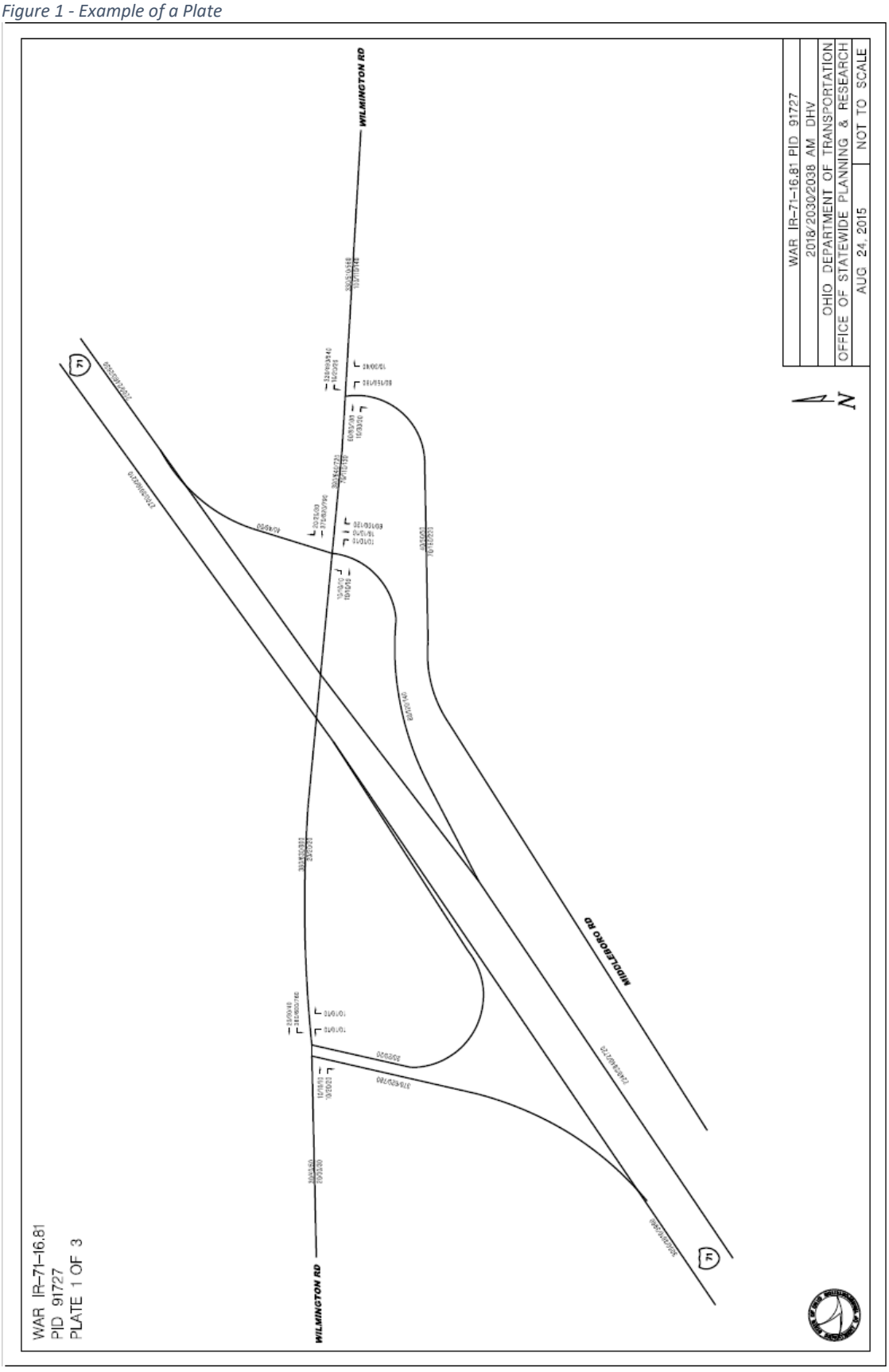
Other Notes:

1) Slip ramps are not usually included in counts obtained thru TIMS. So, for projects including slip ramps, please include counts on the slip ramps.
2) Age of Count - In general, up to date counts should be used (counted in the same year as the request for forecast and same day for multiple adjacent locations). If counts are more than 3 years old new counts are recommended. Although there could be exceptions in very stable rural areas, rule of thumb is to get new counts.
3) When counting for TIS's it is recommended that 8 hour minimums are followed so that ADT may be more accurately estimated from the count.
4) It is recommended that counts be reviewed and checked before submissions to avoid delays caused by re-counting.
5) For each forecast time period requested, include one or more "plates"[4] containing the period counts and AADT for the entire project area (see Plates below). Include in accompanied documentation details on how the AADT was estimated including references to existing documents and specific factors used such as TD and Seasonal factors other counts, data from routes with similar characteristics, etc.
6) Interstate counts are usually estimated by adding and subtracting ramp counts from nearby ATRs, particularly at high volume locations where laying counters is difficult.
7) For areas within Metropolitan Planning Organizations (MPO) planning areas, MPOs often have counts available. So, check with the MPO.
8) Unless otherwise approved for purposes of accommodating unique traffic patterns (recreational route, tourist attraction, etc.), special event traffic dates must be avoided.
   a) Examples of events or dates to avoid:
      weekends,
      Fridays,
      holiday travel days,
      the week before Christmas,
      the week after Christmas,
      the week of thanksgiving,
      the day of a snowstorm,
      roadway construction,
      designated construction detour route,
      Routes affected by County or State Fair traffic during the event

[4] Plates:

Plates are diagrams or drawings (not to scale) that show the requested peak period and ADT counted traffic. An example of a plate is shown in figure 1 on the next page. See website for MICROSTATION standard template.

Figure 1 - Example of a Plate



9) Queue Counts

Traffic count data provides the number of vehicles that physically cross a point, or pass through an intersection, within a certain interval of time. In oversaturated conditions, it is likely that traffic count data does not reflect the true demand. In such cases, queue counts can be used to supplement traffic count data. Queue counts provide information regarding the number of vehicles within the queue at a specified location, which equates to the unmet demand after a certain time interval.

Queue counts are a special data request for Certified Design Traffic projects. The methodology for collecting queue count data will vary by project, although a typical approach is to measure the queue size at the end of every 15-minute interval at the beginning of the downstream traffic signal's red phase. The need for queue count data, and the methodology used to obtain it, will be determined at the **Early Coordination Meeting**.

Table 1 illustrates an example set of queue count data. At the end of every 15-minute interval, the observer counts the number of vehicles in the queue that have not passed the count location the first time the signal turns red. The count location would be the approach stop bar at a signalized intersection. If a queue already exists prior to the start of the count, the starting queue should be captured as well. The queue size in vehicles could also be estimated by determining the length of the queue, in feet, and assuming approximately 20 feet per vehicle. It will sometimes be necessary to track the end of a queue through multiple upstream intersections. In such cases, the total queue size can be estimated by summing the available vehicle storage on links that are full, plus the queue size at the last upstream intersection.

Table 1 - *Example 15-minute Interval Queue Count Data*

Time Interval End	Count Location	Queue Size
4:15 PM		 (7 veh)
4:30 PM		 (15 veh)
4:45 PM		 (10 veh)
5:00 PM		 (3 veh)

As shown in Table 2, difference in queue counts between periods are added to the volume counts to obtain the true demand volume at the end of each 15-minute interval. The unmet demand for the full hour is equal to the queue size at the end of the hour. The ratio of the approach demand volume and counted approach volume can be used to factor individually counted turn movements to obtain demand turn movements for that period.

Table 2 - *Counted Volumes versus Demand Volumes*

Time Interval	(1) Counted Approach Volume (veh)	(2) Queue Size (veh) at End of Interval	(3) Queue Size (veh) at the End of Preceding Interval	(4) = (2) - (3) Unmet Demand (veh)	(5) = (1) + (4) Approach Demand Volume (veh)
4:00 - 4:15 PM	221	7	0	7	228
4:15 - 4:30 PM	261	15	7	8	269
4:30 - 4:45 PM	238	10	15	(-5)	233
4:45 - 5:00 PM	190	3	10	(-7)	183
Total	910	35	32	3	913

Rationale for Traffic Count Guidelines for Design Traffic Forecasts

Purpose

The purpose of these guidelines is to facilitate traffic forecasts for roadway construction planning and design, reduce delays caused by count discrepancies, and provide for more accurate estimates of average annual daily traffic.

It was deemed necessary to provide traffic count guidelines to eliminate the submission of counts which are found to be unusable for developing traffic forecasts for design. It is not always clear from initial inspection that submitted counts are unusable. Unusable counts create delays and frequently puts analysts in the position of making judgement calls that adversely affect design just to maintain a timeline. Designers almost always require that ODOT forecasters provide AADT along with peak hour estimates. That means that partial day counts submitted are used as the basis for AADT estimates when no other recent count source exists for the roadway in question. In the absence of any other count data at the same location, estimates of AADT from a few hours count in the morning and in the evening is unreliable and frequently poor results have been obtained from attempts to use these submittals.

Please note that these are "guidelines", not absolute rules or standards. They are not meant to cover every situation and therefore readers are encouraged to let common sense prevail in circumstances where following these guidelines doesn't make sense. If data collection costs make planning a roadway improvement cost prohibitive, then maybe it doesn't make sense. Use common sense and document rationale in cases where the guidelines are not followed.

Mainline Segment Counts

Typically, roadways would be designed to meet 30th highest hour of the year traffic conditions. Without continuous traffic data collection over the course of a year, 30th highest hour will be estimated based on statewide traffic count statistics. It is recognized that some locations do not fit statewide averages such as at roadways located at or near theme parks, commercial airports, or other recreational areas.

For more complex projects where there may be large investments considered such as those covering a corridor with multiple intersections or a grid of streets, when feasible, continuous automatic traffic recorders should be installed at key locations a year in advance for use in forecasts certified for design in coordination with the ODOT Office of Technical Services Traffic Monitoring Section.

Mainline roadway counts should be at least 24 contiguous hours. 48 hours is preferred. The count should be vehicle classification counts following FHWA Traffic Monitoring Guide. The count should be summarized by car and truck in 15 minute bins. AADT is estimated from the count using seasonal and day of week adjustment factors derived using averages from permanently installed automatic traffic recorders from all over the state.

Forty-eight hour counts are preferred because, in addition to using the counts for design decisions, this makes the counts usable for other purposes such as augmenting the department's traffic monitoring program for HPMS reporting, historical evaluation of forecast accuracy, updating travel demand models, etc.

Intersection Classification Counts

Intersection classification counts provide turning movements at the intersection and include the vehicle classifications “cars” and “trucks” but could also include pedestrians and bicycles depending on the location and purpose of the count. Cars include the 13 FHWA classes, 1-3. Trucks include FHWA vehicle classes 4-13. FHWA classes are defined in ODOT’s “FHWA Vehicle Classification Scheme F report” or in the traffic monitoring guide (TMG) published by Federal Highway Administration.

When counting for a project which involves only a single intersection, it would be ideal to obtain a contiguous 24 hour classification count on each leg of the intersection. However, our intuition suggests that the extra cost is not usually warranted. Therefore, it is recommended to obtain a 24 hour count on two legs, one on the mainline and one on the cross street for use in expanding partial day counts to represent AADT. This is often done using tube counters. Since the cost difference between 48 hours and 24 hours is usually small for tube counts and 48 hour counts can be used to meet Federal HPMS counting requirements and 48 hours reduces some uncertainty from the effect of daily variation, 48 hours is suggested. However, it is recognized that at high volume locations or high truck volume locations, tubes sometimes break before 48 hours creating higher labor costs from resetting tubes. Therefore, to reduce the cost of re-counting, 24 hour counts are considered acceptable. This provides a daily traffic profile that can then be used to expand the partial day turn movement counts to estimate average daily traffic.

For higher volume, larger intersections, or projects involving multiple intersections, video based or other automated methods which capture all of the intersection turn movements on the same dates are highly recommended. However, when same day counts are impractical, counts within the same week may be useable. If multiple intersections are counted and the counts do not match up where no or few driveways exist to account for the differences between intersections, submitted counts may be rejected and the entire study area may have to be recounted.

Additional Notes

It is probably worth noting that experienced analysts can create estimates from just about any count. The difference is in the level of accuracy and confidence one has in the estimate. For example, if total volumes are reported with only a total daily truck percentage provided, one can assume the hourly distribution of trucks based on the statewide average hourly distribution. If you are doing a safety study for possibility of a roundabout, maybe that’s good enough? However, if you are trying to estimate the length of the left turn bay, perhaps you’ll not want to take that risk. So, the recommendation is to always provide hourly trucks so that the designer will have confidence in the TD and T24. Otherwise, when a forecast is “certified”, it will come with disclaimers.

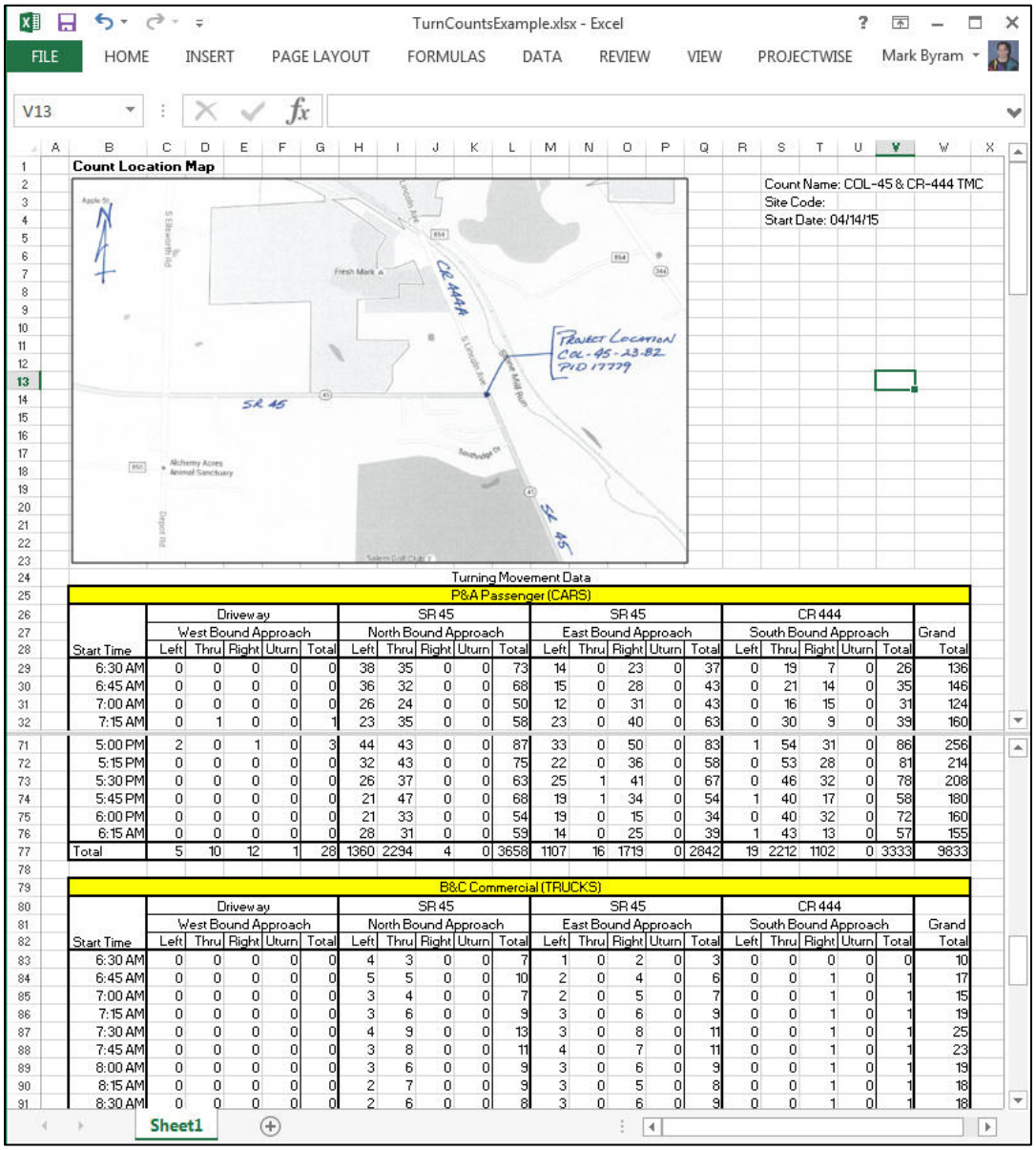
Preferred format for manual turning movement count summaries

At the time of preparing this document, the preferred computer format is Excel spreadsheet vehicle class summarized in 15 minute bins by vehicle classes of Car and Truck(Car=FHWA Class 1-3, Truck=FHWA class 4-13.

Note that totals and subtotals are not really desired as we'll be summarizing them ourselves anyway. In addition, whenever possible provide an electronic file in the format shown in appendix B. Please note that technology may change this before this document is updated again so check with ODOT periodically to make sure this has not changed.

It is recognized that not all traffic count vendor's software will support this but it should be easy to put the summary data into an Excel compatible format.

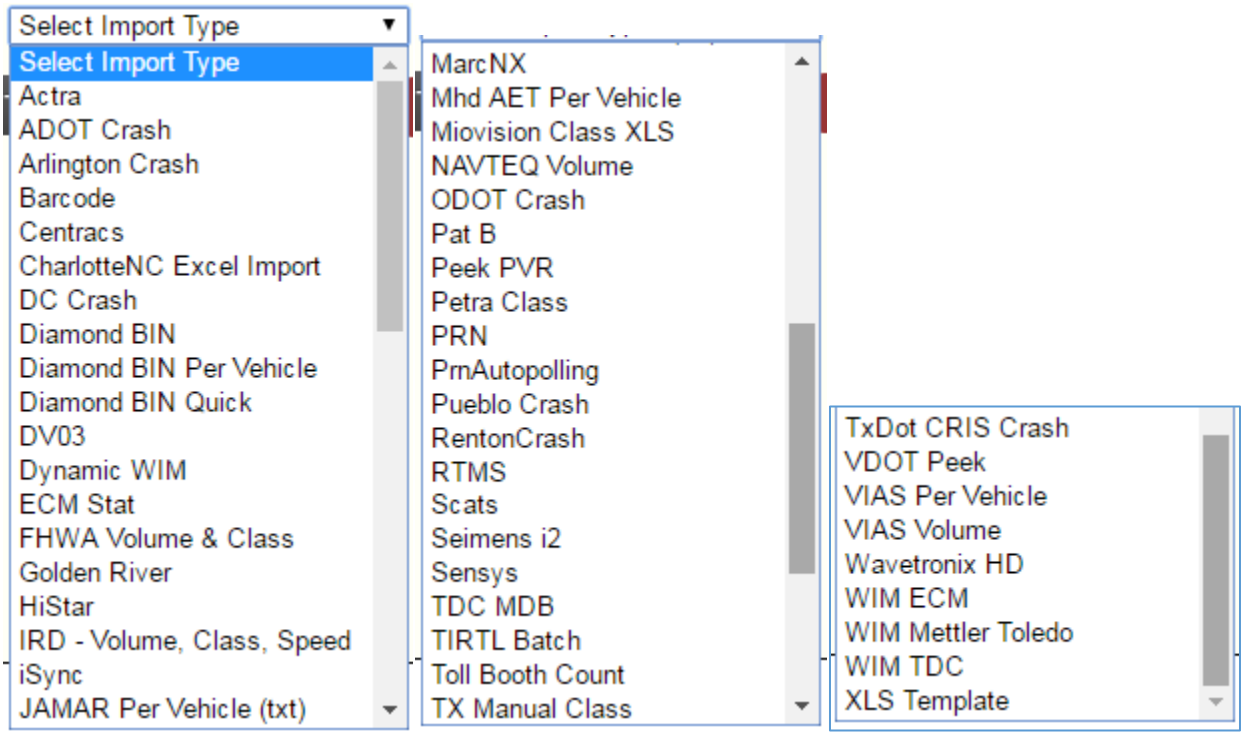
Figure 2 below is an example showing the preferred Excel format. Figure 2



Machine Count Electronic File Format

At the time of preparing this document, Petra is the software used for processing traffic count data. It is advised that people following these guidelines periodically verify with the Traffic Monitoring Section within the Office of Technical Services that this has not changed.

In order to make the counts useable by the department for other purposes, machine counts should be submitted in one of the formats supported by the Petra software in addition to format discussed in the previous section. As of the date these guidelines were created, the following formats are supported:



Example of what we usually don't want.

Missing Trucks by 15 minute count bin so T24 and TD cannot be provided without making lots of assumptions. The count would be rejected and the consultant either has to submit the count summarized with trucks in 15 minute bins or the intersection must be re-counted.

02:15 PM	16	85	9	110	8	10	9	27	5	57	7	69	16	9	6	31	237
02:30 PM	17	76	20	113	6	20	10	36	7	67	15	89	13	17	6	36	274
02:45 PM	11	75	23	109	2	14	11	27	4	74	7	85	36	16	3	55	276
Total	54	306	66	426	19	55	46	120	20	263	36	319	91	56	20	167	1032
03:00 PM	18	66	12	96	11	13	30	54	2	78	3	83	27	42	16	85	318
03:15 PM	27	88	9	124	1	14	6	21	4	90	12	106	15	24	3	42	293
03:30 PM	18	97	17	132	10	10	21	41	4	106	8	118	25	21	5	51	342
03:45 PM	27	95	11	133	4	15	24	43	0	86	18	104	12	13	2	27	307
Total	90	346	49	485	26	52	81	159	10	360	41	411	79	100	26	205	1260

[redacted]

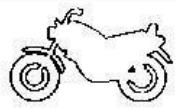
File Name : OH57_at_Seville_392786_03-21-2017
Site Code : Tuesday
Start Date : 3/21/2017
Page No : 2

Groups Printed- Cars - Buses - Trucks

	OH57 From North				CR16 - Seville Road From East				OH57 From South				CR16 - Seville Road From West				
Start Time	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Left	Thru	Right	App. Total	Int. Total
04:00 PM	23	94	16	133	5	7	14	26	4	117	6	127	26	19	7	52	338
04:15 PM	23	78	11	112	4	8	26	38	3	113	11	127	14	10	4	28	305
04:30 PM	37	107	11	155	10	19	26	55	1	86	12	99	41	29	12	82	391
04:45 PM	28	101	11	140	9	19	18	46	3	104	7	114	9	16	2	27	327
Total	111	380	49	540	28	53	84	165	11	420	36	467	90	74	25	189	1361
05:00 PM	30	85	6	121	5	27	35	67	1	129	12	142	29	22	10	61	391
05:15 PM	32	104	17	153	11	11	18	40	1	130	13	144	19	17	3	39	376
05:30 PM	22	118	12	152	12	15	20	47	1	118	14	133	39	22	6	67	399
05:45 PM	34	97	13	144	2	9	19	30	0	107	8	115	29	10	2	41	330
Total	118	404	48	570	30	62	92	184	3	484	47	534	116	71	21	208	1496
06:00 PM	25	73	10	108	4	9	21	34	2	94	10	106	29	14	3	46	294
06:15 PM	19	68	17	104	3	7	20	30	1	72	6	79	17	14	1	32	245
06:30 PM	23	66	9	98	2	8	11	21	1	58	7	66	11	8	5	24	209
06:45 PM	22	56	13	91	4	10	12	26	2	40	6	48	15	9	3	27	192
Total	89	263	49	401	13	34	64	111	6	264	29	299	72	45	12	129	940
07:00 PM	13	53	6	72	9	5	18	32	0	36	2	38	17	15	3	35	177
07:15 PM	15	54	7	76	3	6	11	20	4	40	2	46	9	12	3	24	166
07:30 PM	6	46	11	63	2	6	12	20	0	29	6	35	3	2	5	10	128
07:45 PM	10	39	10	59	0	6	3	9	1	17	3	21	1	10	0	11	100
Total	44	192	34	270	14	23	44	81	5	122	13	140	30	39	11	80	571
Grand Total	877	3598	835	5310	337	663	958	1958	146	3871	336	4353	792	667	205	1664	13285
Apprch %	16.5	67.8	15.7		17.2	33.9	48.9		3.4	88.9	7.7		47.6	40.1	12.3		
Total %	6.6	27.1	6.3	40	2.5	5	7.2	14.7	1.1	29.1	2.5	32.8	6	5	1.5	12.5	
Cars	776	3287	743	4806	320	618	858	1796	128	3565	315	4008	724	628	184	1536	12146
% Cars	88.5	91.4	89	90.5	95	93.2	89.6	91.7	87.7	92.1	93.8	92.1	91.4	94.2	89.8	92.3	91.4
Buses	5	7	1	13	0	2	1	3	1	5	0	6	0	0	0	0	22
% Buses	0.6	0.2	0.1	0.2	0	0.3	0.1	0.2	0.7	0.1	0	0.1	0	0	0	0	0.2
Trucks	96	304	91	491	17	43	99	159	17	301	21	339	68	39	21	128	1117
% Trucks	10.9	8.4	10.9	9.2	5	6.5	10.3	8.1	11.6	7.8	6.2	7.8	8.6	5.8	10.2	7.7	8.4

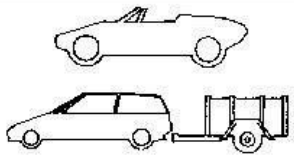
Appendix D - FHWA Vehicle Classification Scheme F Report

1



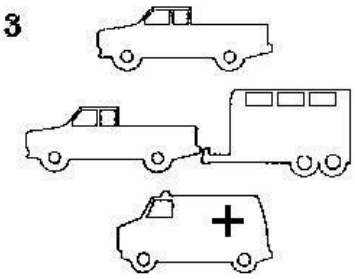
MOTORCYCLES

2



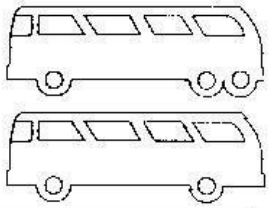
PASSENGER CARS

3



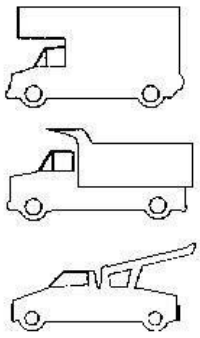
FOUR TIRE, SINGLE UNIT

4



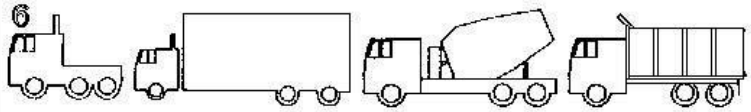
BUSES

5



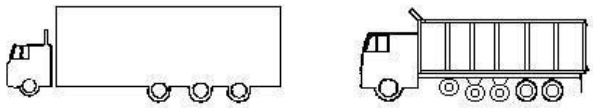
TWO AXLE, SIX TIRE SINGLE UNIT

6



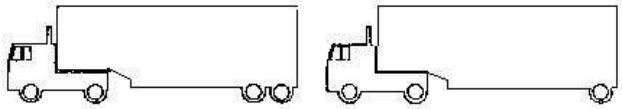
THREE AXLE, SINGLE UNIT

7



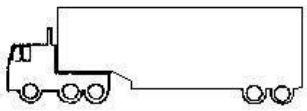
FOUR OR MORE AXLE, SINGLE UNIT

8



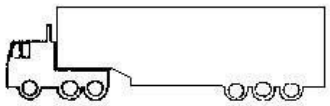
FOUR OR LESS AXLE, SINGLE TRAILER

9



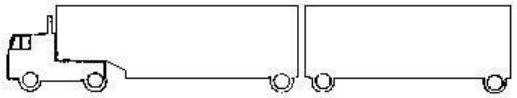
FIVE-AXLE, SINGLE TRAILER

10



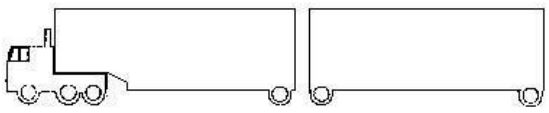
SIX OR MORE AXLE, SINGLE TRAILER

11



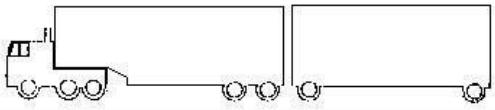
FIVE OR LESS AXLE, MULT-TRAILER

12



SIX AXLE, MULT-TRAILER

13



SEVEN OR MORE AXLE, MULTI-TRAILER

Class 1- **Motorcycles:** All two- or three-wheeled motorized vehicles. Typical vehicles in this category have saddle type seats and are steered by handle bars rather than wheels. This category includes motorcycles, motor scooters, mopeds, motor-powered bicycles, and three-wheeled motorcycles.

Class 2- **Passenger Cars:** All sedans, coupes, and station wagons manufactured primarily for the purpose of carrying passengers and including those passenger cars pulling recreational or other light trailers.

Class 3- **Other Two-Axle, Four-Tire, Single Unit Vehicles:** All two-axle, four-tire, vehicles other than passenger cars. Included in this classification are pickups, panels, vans, and other vehicles such as campers, motor homes, ambulances, hearses, carryalls, and minibuses. Other two-axle, four-tire single unit vehicles pulling recreational or other light trailers are included in this classification.

Class 4- **Buses:** All vehicles manufactured as traditional passenger-carrying buses with two axles and six tires or three or more axles. This category includes only traditional buses (including school buses) functioning as passenger-carrying vehicles. Modified buses should be considered to be trucks and be appropriately classified.

Note: In reporting information on trucks the following criteria should be used:

a. Truck tractor units traveling without a trailer will be considered single unit trucks.

b. A truck tractor unit pulling other such units in a “saddle mount” configuration will be considered as one single unit truck and will be defined only by axles on the pulling unit.

c. Vehicles shall be defined by the number of axles in contact with the roadway. Therefore, “floating” axles are counted only when in the down position.

d. The term “trailer” includes both semi- and full trailers.

Class 5- **Two-Axle, Six-Tire, Single Unit Trucks:** All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having two axles and dual rear wheels.

Class 6- **Three-axle Single unit Trucks:** All vehicles on a single frame including trucks, camping and recreational vehicles, motor homes, etc., having three axles.

Class 7- **Four or More Axle Single Unit Trucks:** All trucks on a single frame with four or more axles.

Class 8- **Four or Less Axle Single Trailer Trucks:** All vehicles with four or less axles consisting of two units, one of which is a tractor or straight truck power unit.

Class 9- **Five-Axle Single Trailer Trucks:** All five-axle vehicles consisting of two units, one of which is a tractor or straight truck power unit.

Class 10- **Six or More Axle Single Trailer Trucks:** All vehicles with six or more axles consisting of two units, one of which is a tractor or straight truck power unit.

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Class 11- **Five or Less Axle Multi-Trailer Trucks:** All vehicles with five or less axles consisting of three or more units, one of which is a tractor or straight truck power unit

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Class 12- **Six-Axle Multi-Trailer Trucks:** All six-axle vehicles consisting of three or more units, one of which is a tractor or straight truck power unit.

Class 13- **Seven or More Axle Multi-Trailer Trucks:** All vehicles with seven or more axles consisting of three or more units, one of which is a tractor or straight truck power unit.

Class 14- **Will be defined by ODOT personnel for special studies.**

Class 15- **Will by default identify any vehicle which does not conform to the classification criteria for Class 1 through Class 14.**