Appendix C –

Compendium of
Data Quality Control Criteria

Appendix C. COMPENDIUM OF DATA QUALITY CONTROL CRITERIA

C.1 CASE STUDY: LOCAL AGENCY DATA SHARING DELAWARE VALLEY REGIONAL PLANNING COMMISSION (DVRPC)

C.1.1 INTRODUCTION

This case study discusses the quality control systems used for traffic data in the State of Vermont. Vermont has 3,900 road centerline miles on Federal aid routes and 10,200 road centerline miles on local roads. The Vermont Agency of Transportation (VTrans) Traffic Research Unit uses a combination of permanent in-house staff and summer temporary employees to collect traffic count data on Federal aid routes and on local roads.

C.1.2 CONTINUOUS TRAFFIC COUNTS

VTrans is currently operating 60 continuous volume counters, 21 WIM, and 2 continuous vehicle classification counters.

C.1.3 SHORT-TERM TRAFFIC COUNTS

The coverage count program includes 2,200 short-term ATR counts on Federal aid routes and 2,400 short-term ATR counts on local roads. The counts are done on either a three or a six-year cycle, depending on the route. Each year VTrans collects around 500 week long ATR counts on Federal aid routes, including interstate ramps and other grade separated ramps, and 400 weeklong ATR counts on local roads. Counts performed on the Federal aid routes are typically vehicle classification and speed while the local road counts are volume only.

VTrans conducts 12-hour manual turning movement counts at 1,300 intersections over a four-year period. Either counts are done on a two or four-year cycle, with about 450 counts annually. VTrans is in the process of implementing a bicycle and pedestrian manual count program. VTrans collected trip generation data over the past several years and has submitted 675 counts to ITE to be considered for the ITE Trip Generation Manual. VTrans intends to continue to collect trip generation data on an every other year basis, alternating with the bicycle/pedestrian count program.

C.1.4 TRAFFIC MONITORING SYSTEM

VTrans currently uses an Oracle-based consultant-designed traffic monitoring system to manage traffic count data but is planning to implement a new system. Various off-the-shelf products are under consideration, as well as possibly another consultant designed system.

C.1.5 QA/QC PROCEDURES

The VTrans Traffic Research Unit does not have a formal QA/QC program but does have quality checks built into the data collection and data review procedures as described briefly herein.

Field Procedures – Continuous Traffic Counter (CTC)

VTrans field technicians check the CTC sites on a monthly basis while downloading data at the site. The field technician checks batteries and hardware as well as verifies that the counters are recording correctly.

Office Procedures – Continuous Traffic Counter (CTC)

Monthly traffic is reviewed for daily directional distribution. If the percent of traffic in the lower volume direction is less than 48% the data is reviewed more closely for a potential problem.

Using an Excel based routine that pulls data from the Traffic Monitoring System, graphs are produced on

a monthly basis that show a particular day of the week, for each occurrence of that day of the week over the month. For example, Sundays are reviewed and differences between Sundays may indicate where the counter has stopped working on any one lane, or where there has been a period of resonation shown by surges in the volume.

Monthly reports are generated that compare the current year's average daily volumes with last year's average daily volumes. Differences of more than 10% are reviewed more closely.

Field Procedures – WIM

On a monthly basis, the WIM Technician visually inspects each WIM site and runs diagnostic reports. VTrans relies largely on auto calibration to maintain calibration at the WIM sites but on occasion has used a test vehicle or portable scales to recalibrate the systems.

Office Procedures – WIM

WIM counts are converted to volume counts and compared alongside the other CTC counts (see above).

Field Procedures – Short-Term ATR

As each count is set out, the Field Technician checks to see that the recorder is collecting data and thatthe data is accurate. When the count is picked-up, the field technician downloads and reviews the data on a laptop computer and resets the count as needed.

Office Procedures – Short-Term ATR

Each ATR count is reviewed individually. The minimum duration is 48-hours of weekday data. The estimated AADT is compared to historical volumes to ensure that it is not unreasonable. The following table shows specific quality checks performed on vehicle classification counts.

TABLE C-3 QUALITY CHECKS FOR VEHICLE CLASSIFICATION COUNTS

Checks	Criteria requiring additional review
Class 14s	>5% for the count as a whole
Directional ADT	DAY SPLIT > 53% for the count as a whole
Cycles	> 2%
Cars	<70%
Pickups	>22%
uses	> 1%
8s vs. 9s	8s > 9s, N/A for local streets, weekdays only
Multi trailers	CL 11-13 > 1%
Med vs. Heavy	med < heavy (med - heavy < 0)
Sat % ADTT	> 75% of weekday ADTT
Sun % ADTT	> 75% of weekday ADTT
Peak hr trucks	> weekday ADTT
Misclassification	Class 3s can be misclassified as 5s – look for high class 5s; High cycles can indicate problems with classes 2-5

Source: Vermont Agency of Transportation

Vehicle classification data is also reviewed for daily directional distribution by vehicle classification. Differences of greater than 10% indicate a potential problem requiring additional review.

VTrans records speed as well as vehicle classification for most ATR counts, however the speed data files are not loaded into the database but are stored separately in their raw format and are used only occasionally. If the vehicle classification data for a count is rejected, the speed data for the same count is also rejected.

Regarding site location, the field technicians are able to load GPS coordinates directly into the traffic recorder and the coordinates appear in the header of each count file. The coordinates are checked using a GIS application to verify that the count was set in the correct location.

Field Procedures – Manual Turning Movement Counts

The turning movement count program is very well supervised with a Field Technician, as well as a senior temporary employee, circulating among the count staff answering questions, helping to find the correct intersection, verifying that safety measures are in place, filling out field sheets correctly, and providing breaks over the day. A one-day training program is provided at the start of the season.

Office Procedures – Manual Turning Movement Counts

The turning movement counts are reviewed by the Field Technicians at the end of the count season. Information provided on the field sheets is used to enter the street names, orient the count, etc.

C.1.6 LESSONS LEARNED

Using GPS to locate the ATR sites has been very beneficial. The Field Supervision for the turning movement count program has also been very worthwhile, with very few counts rejected over the season and very few safety related problems.

The VTrans Traffic Research Unit does not have a well-documented QA/QC procedure. This is due in large part to having a very experienced staff with quality checking routines in place and little need to refer to documentation. However, as staff members move on it will be more difficult to train new employees in QA/QC without written guidelines. This was made apparent when it was discovered well into the season that a new employee was setting up ATR counts incorrectly and the vehicle classification was inaccurate.

C.2 CASE STUDY #2 NEW YORK STATE DOT (NYSDOT) QA/QC SYSTEMS FOR TRAFFIC DATA

C.2.1 INTRODUCTION

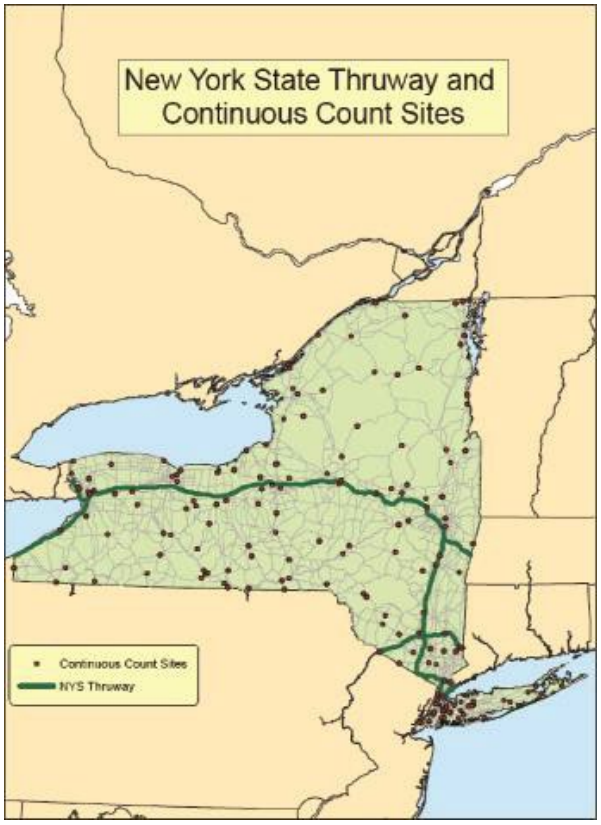
This case study examines the QA/QC systems used by the New York State Department of Transportation (NYSDOT) for traffic data analysis and presents current practices and lessons learned that can benefit other State DOT's traffic monitoring programs. NYSDOT is responsible for managing a State and local highway system of more than 113,000 highway miles and more than 17,400 bridges. This extensive network supports annual travel of over 130 billion vehicle miles. The responsibility for collecting, processing, and disseminating the traffic data at NYSDOT resides with the Highway Data Services Bureau. NYSDOT uses a variety of counters and classifiers with 175 operating continuous count stations used to collect the volume, class, and/or speed data. Twenty-six of those sites collect weigh-in-motion (WIM) data. The following information provides an overview of the use of continuous count stations statewide.

C.2.2 NYSDOT CONTINUOUS COUNT STATIONS

The New York State continuous count stations are strategically placed in varying geographical locations, population densities, and roadway functional classes, as well as differing volume groups within these locations. The number of individual continuous count sites in each group can increase with additional sites or decrease with equipment failure or removal. The continuous count sites are grouped by Highway

Performance Monitoring System (HPMS) volume group and urban type (urban, small urban and rural) categories. The vehicle miles traveled (VMT) is estimated through HPMS and as such, it relies on expanded samples and multi-year short count volume measurement adjusted to the current year. Equally important is how bridges and tunnels are considered. Often these represent constriction points within the network and may or may not be a fair representation of overall travel if no other toll or free alternatives exist. Figure C-1 provides an illustration of the New York State Thruway network and the continuous count sites.

FIGURE C-1 NEW YORK STATE THRUWAY AND CONTINUOUS COUNT SITES



Source: New York State Department of Transportation.

C.2.3 WEIGH-IN-MOTION (WIM) STATIONS

Weight data are also collected at several WIM sites throughout the State. NYSDOT uses the following guidance in establishing their WIM sites. Each site should exhibit the following characteristics:

- Free flowing traffic (it is preferred that trucks travel 30 mph or more)
- No daily traffic jams
- No nearby intersections
- Straight and level terrain at the site, including pavement that is in good condition
- At least 100 Class 9s identified in each lane daily

The QA/QC procedures presented in this section provide a high-level overview of these processes, with more detailed information documented in Appendix C of the TMG. Quality control of traffic data at NYSDOT begins with field staff inspections of traffic data collection sites on an annual basis. All physical components of the data collection equipment are checked thoroughly and recorded on a site-specific

spreadsheet by the field staff to ensure that all components are in proper working order. How in-depth the checks are depends upon the level and type of data being collected at the site. The following paragraphs present an overview of the quality checks used at NYSDOT.

C.2.4 VOLUME, CLASSIFICATION, SPEED DATA

In the case of volume data only, a process of assuring that the loops are activating and each vehicle is counted as one vehicle will typically suffice. Sites that collect speed data are checked for accuracy by a radar gun. Sites that collect classification data are checked to make sure that there are no missing, or extra axles on the vehicles. On a normal site inspection, data validation may range from watching just ten vehicles to watching a few hundred vehicles. At a minimum, the test will last until all lanes have been validated.

C.2.5 WEIGHT DATA

Validation of weight data at NYSDOT typically follows these steps:

- Data collected at counter.
- Data automatically polled daily to office PC.
- Data verified for completeness:
- Is there file corruption?
- Are all days retrieved?
- Are all days complete?
- Are all lanes present?
- Initial daily and hourly validity checks performed:
- Is the clock correct to +/- 5 minutes?
- Data imported and stored once per week in polling database.
- Monthly data checks performed.
- Data edited.

There are also a series of office checks and remote checks that are performed for the WIM data collection sites. Additional information on the specific types of validations performed may be found in TMG Appendix D.

C.2.6 EXPERIENCES IMPLEMENTING QA/QC PROCEDURES AT THE DOT

This section provides information about the experiences and significant accomplishments and challenges in implementing QA/QC procedures for traffic data at NYSDOT. Some of the challenges and some system limitations associated with collecting WIM data include the following:

- No vehicle types are collected, only classes
- There is no way available to check lane discipline of the vehicles; vehicles riding the edge of a lane are likely to be classified correctly and weighed incorrectly
- Additional checks such as left/right wheel weights are not available
- No error is given for vehicles changing speed over sensors.

C.2.7 LESSONS LEARNED

Several of the lessons learned in implementing the QA/QC procedures for traffic data at NYSDOT are listed below. These lessons are presented to offer guidance to other State traffic monitoring program managers who are responsible for the collection and quality control of their State's traffic data:

- Each site has its own limitations – an acceptable error at one site is not necessarily acceptable at another site;
- Knowledge of the site layouts and typical traffic is required to decipher the automated check warnings;
- Monitor for data completeness;
- Monitor data from the bottom up: Volume > Class > WIM; and
- General WIM checks can be a good indicator of overall site health, but, they do not give the entire picture.

C.2.8 FUTURE ENHANCEMENTS

The most prominent enhancement to NYSDOT QA/QC procedures is the addition of a comprehensive data system. The traffic monitoring group intends to use a comprehensive data system to QC continuous data of all types using automated checks with parameters tailored to individual sites. This will provide the staff with additional time for a more in-depth analysis of problematic sites that require closer scrutiny of problems.

Current practices also put a lot of emphasis on monthly processing, which means that some errors are not identified until they have been occurring for many weeks. The implementation of a comprehensive data system should allow NYSDOT to analyze more up to date data, and therefore catch problems sooner.

WIM data is currently monitored at a very high level and the WIM data that is disseminated is nearly always raw data. With less time spent converting data, NYSDOT has more time for a thorough review of data on a weekly basis. This will allow technicians to more closely monitor calibrations and provide better data to the customers.