4.0. DATA COLLECTION AND ASSESSMENT

4.1. Data Collection

In order to fully assess the performance of ramp meters, staff will need to collect data. Data collection is not only needed to ensure that ramp meters are providing desired benefits, but also to justify the use of public funds used to purchase and deploy these systems. Both qualitative data (e.g., observations, agency and public feedback, etc.) and quantitative data (e.g., speeds, crashes, queue length, etc.) will be needed to analyze ramp metering impacts during peak periods and to ensure that these systems are operating as intended.

Since the results of data collection will be used to make operational and program-level decisions, NDOT and RTC must take great care in making sure that collected data are of superior quality. High quality data will lead to better conclusions and therefore will contain more value to agency decision makers. High quality data collection systems are necessary to collect high quality data and NDOT/RTC should analyze the possibilities for improving data collection efforts as funding and policy permits. However, data collection efforts must fall in line with agency budgets. Where possible the quickest, least costly means should be used to collect data, as long as the objectives of data collection are fully satisfied. Data collection should begin with an analysis of the data archived in the FAST system, and after this, a determination of the data that still need to be collected should be made.

4.1.1. Collection Periods

As previously stated, qualitative and quantitative data will need to be collected before and after ramp meters are deployed and subsequently turned on. These data are needed to assess the performance of ramps meters and to ensure that these systems are operating as intended. Every effort should be made to collect before data before ramp meters are turned on.

4.1.1.1. Before (baseline)

Data need to be collected before ramp meters are set into operation to establish the baseline from which the impacts of ramp meters will be analyzed. The types of data that need to be collected will depend on the types of analysis that will be conducted. Generally speaking the following types of data are needed when assessing the performance of ramp meters:

- Traffic volumes and speeds
- Travel times (if feasible)
- Ramp queue length and frequencies
- Crash records
- Driver and system observations

The collection of before data should focus on the proposed local metered segments, the metered freeway corridor, metered ramps, and adjacent arterials. As the ramp metering system grows to include additional ramps or freeway corridors, “before” data should be collected in the appropriate corridor prior to each expansion of the system.

4.1.1.2. After

NDOT/RTC should also collect data after ramp meters have been deployed and turned on to complete the assessment of ramp meter performance. Typically, the collection of “after data” occurs several times during the first year of operation (See Section 5.1 for more details), and annually thereafter. The data collected in the “after” phase should be compared against data

collected in the “before” phase to assess what significant changes, if any, have occurred in the data due to the operation of ramp meters.

4.2. Data Collection Locations

Determining the location where data need to be collected is essential to assessing the full impact of newly deployed ramp meters. Focusing evaluation and monitoring efforts on the metered ramps alone will likely only capture a portion of the effects ramp metering has on traffic flow. Some motorists may divert from using a newly metered ramp to other upstream and downstream ramps because they do not want to wait at the ramp meter.

When collecting data for a ramp meter evaluation, NDOT and RTC should focus their efforts on locations that are most likely to be affected by metering. These locations, which are discussed below, include:

- Ramps
- Freeways
- Adjacent Arterials
- Freeway/ Ramp merge area

4.2.1. Freeways

Conditions on the metered segments of area freeways should be monitored to determine the impacts ramp metering has on vehicle speeds, throughput, and crashes. Ramp meter research has shown that ramp meters can increase vehicle speeds by up to 25 mph and throughput by up to 25 percent while reducing crashes by up to 40 percent. .

4.2.2. Ramps

Conditions on the ramp will need to be monitored to determine if queue storage at ramp meters is adequate and that metering operations are not resulting in excessive delay or improper driver behavior

4.2.3. Ramp/Arterial Intersection

When monitoring conditions on the ramp, it is also recommended that conditions at the ramp/arterial intersection be monitored. If ramp meters do not release vehicles fast enough, queues may build at the ramp meter and may back up into the ramp/arterial intersection. This will adversely affect operations on the arterial.

4.2.4. Merge Areas

Ramp metering has the potential to significantly improve traffic operations at and immediately upstream of entrance ramp merge areas. This is because ramp metering restricts excessive demand from entering the freeway and breaks up platoons. Ramp metering allows vehicles to enter the freeway facility in regulated intervals allowing released vehicles to enter the freeway facility in a controlled, smooth manner. Crash analysis should focus on specific high collision locations within the metered segment, such as ramp merge areas. However, crash analysis should not be limited to merge areas. As mentioned above, ramp metering can result in reduced crash rates throughout the metered corridor.

4.3. Data Needs and Tools

Specific types of data are needed to evaluate the impacts of ramp meters, depending on the previously agreed-upon performance measures. In general, traffic data should be collected at

metered ramps and along the metered corridors both before and after meters are turned on and become operational. Data should be collected during the proposed metering periods on non-holiday weekdays (i.e., Monday thru Friday). If resources are very limited, data for Tuesday-Thursday should be used in the analysis. Ideally, however, data should be collected for every day of the week that the meters will be operated and analysis should look at daily stratification as well as aggregation over all weekdays.

Since the initial set of ramp meters along US 95 have already been turned on, it is no longer possible to collect data for the before period at these locations. It may be possible to evaluate the performance of these ramp meters because some data was collected before metering started. Results may not be as robust because limited data was collected.

4.3.1. Traffic Volume

Traffic volume is defined as the number of vehicles observed or predicted to pass over a given point or section of a lane or roadway during a given time. Volume is typically used to track historical trends and to predict the future occurrence of congestion on specified freeway sections. In terms of measuring the performance of ramp meters, analysis of traffic volumes at upstream and downstream locations along the mainline and on ramps in the corridor can provide useful insights regarding the efficiency of the freeway and changing traffic patterns in the corridor.

4.3.2. Mainline Vehicle Speeds

Mainline vehicle speeds are frequently used to describe traffic operations because it is a measure most drivers experience directly and can easily understand. Speed measurements are typically taken for individual vehicles at specific locations and averaged to characterize the traffic stream as a whole. Measured speeds can be compared to optimum values to estimate how the freeway is operating when ramp meters are operational.

4.3.3. Travel Times

Travel time data measures the time it takes a vehicle to travel a certain distance, usually the length of the metered corridor. Travel time data are usually collected before and after the freeway facility is deployed with ramp meters. The differences in travel times between the before and after situations can then be compared to determine the affects of ramp metering.

Travel time data for the freeway and individual ramps can be obtained using a number of methods. The simplest, and most commonly used, is referred to by a variety of names including the "floating car" and "maximum car" techniques. Both refer to the use of a test vehicle making a series of trips along a stretch of freeway or ramp and measuring travel times.

Travel times can also be estimated or calculated based on other traffic measurements, such as speed or volume and lane occupancy.

4.3.4. Crash Records

A comparison of crash records before and after ramp meters are installed can be made to determine if there are any significant reductions in crash rates on the mainline, on ramps, or in the merge areas. Of specific interest to ramp meter evaluations are crashes recorded as “rear-end,” “lane change,” or “sideswipe”. In many cases, ramp metering has the potential to reduce rear-end collisions by reducing or eliminating stop-and-go driving behavior on both the mainline and merge areas. Similarly, the staggered release of metered vehicles smoothes the flow of vehicles merging with freeway traffic, which may result in a reduction in sideswipe or lane change crashes at the ramp/freeway merge area and at the back of a mainline queue.

4.3.5. Ramp Queues and Driver Behavior

To a large part, the success of ramp metering depends on the ability to smooth the flow of traffic onto the freeway while adequately serving demand to the ramp. Part of ramp meter monitoring should focus on queues that form on ramps as a result of ramp meter operations. When demand exceeds the metering flow rate, and storage on the ramp cannot contain the excess demand, traffic may back up on the adjacent arterial, causing traffic and safety problems. Ramp metering approaches must consider whether and how ramp queues may be managed. Before and after analysis of ramp queue observations can indicate whether or not ramp meters are negatively affecting operations on the ramp or if queues are spilling onto the adjacent arterial.

Whenever new traffic control devices are installed, such as ramp meters, it is a good idea to monitor driver behavior, either through closed circuit television cameras deployed in the field and in sight of ramp meters, or manually, to assess drivers' ability to conform to the traffic control device. When ramp meters are deployed, drivers may unintentionally or intentionally ignore the traffic control device. In either case, ignoring the ramp meter may confuse other drivers on the ramp, which in turn, may result in similar driving behavior. Ignoring the ramp meter indication may also defeat the purpose of ramp meters which is to smooth the flow of traffic entering the freeway facility.

An assessment of ramp queuing and driver behavior should be made through observations made by personnel stationed in the field or viewing images from closed circuit television cameras. If personnel observe queues that spill back into the arterial and affect arterial traffic operations, operators should adjust metering rates or the parameters that are used in ramp meter algorithms in an effort to quickly resolve queue related problems. Similarly, if drivers are not obeying the ramp meter, metering rates may have to be adjusted to reduce driver frustration, or ramp meter compliance may need to be actively enforced.

4.3.6. Archiving Data

Data collected during the ramp meter evaluation should be archived in the FAST data archive so it can be used in other, future evaluations. This helps to lower the cost of performance monitoring efforts over time and provides more and better information for managing and operating ramp meters.