Mobility Monitoring in Your Community: Interactive Workshop

This DVD contains electronic copies of materials to perform this training.
The following are included on the DVD.

Slides:
PowerPoint® workshop slides (5-5571-01 Mobility Monitoring Workshop Slides, Final.ppt)

Handouts used throughout the workshop:
For Lesson 4 interactive exercise, participants choose from one of three different maps to "identify the needs and opportunities" based on community input. The three maps are medium-sized community, small community with relief route, and small community without a relief route.

There are three attached documents that provide a background on each map via feedback from stakeholders (Medium-sized community, feedback from stakeholders.doc; Small community, relief route, feedback from stakeholders.doc; and Small community, no relief route, feedback from stakeholders.doc).

The three maps are also on the attached DVD. Past workshops have used these maps printed at 38 inches by 38 inches and laminated to allow the participants to mark them up with markers and then erase them. The maps are provided in three camera-ready (full-size) typical formats on the attached DVD. The formats are EPS (Encapsulated Postscript), PNG (Portable Network Graphic), and PSD (Photoshop® drawing). The three maps are also shown on the DVD in JPG (full-size) and PDF (small-size for simple viewing) format.

Lesson 7 is based upon Step 4: Analyze the Data. Workshop participants work through an example problem, and it is contained on this DVD (Analyze the data, exercise.doc). For the exercise, this handout is printed off, and the numbers in the boxes with the darker line around them are deleted in the file and then copies are made. An electronic copy of the answer key is also provided (Analyze the data, answer key.doc), and it provides answers for the deleted values that the participants fill in.

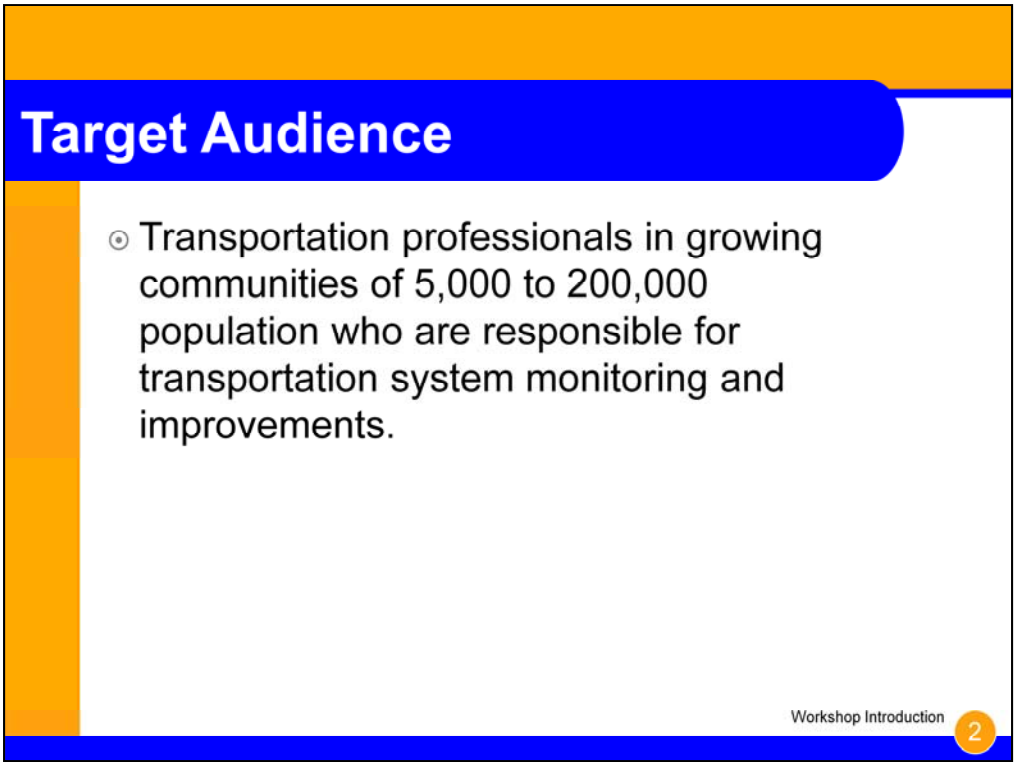
A workshop evaluation form is also included on the DVD (Workshop evaluation form.doc).

Duration: 25 minutes

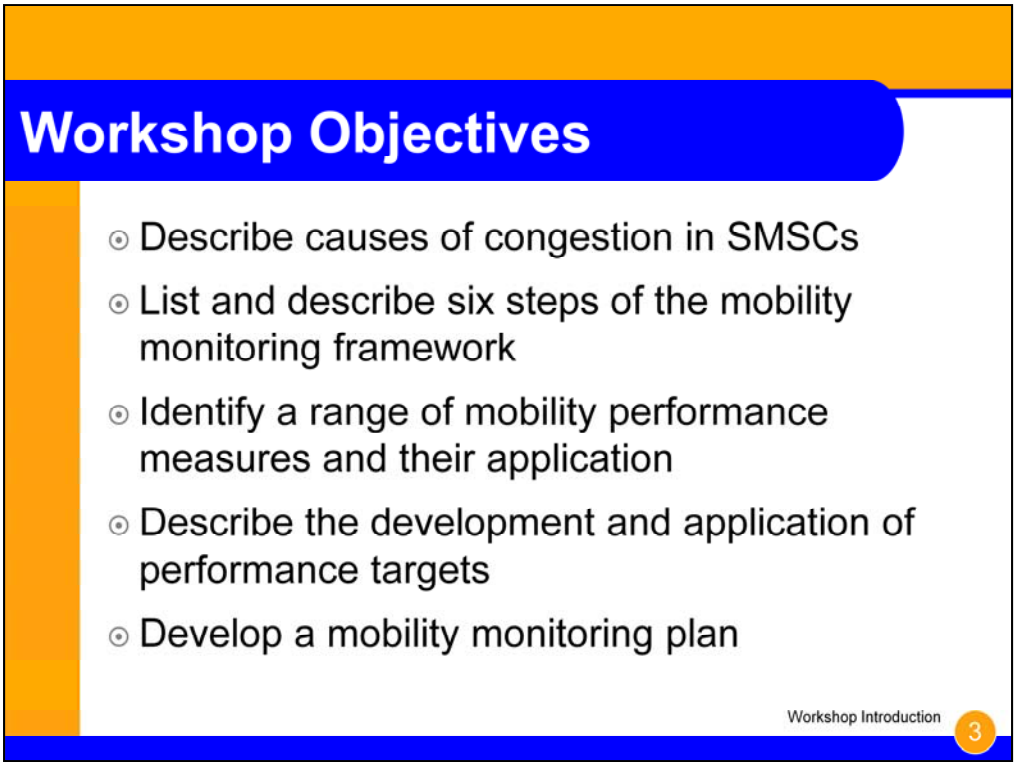
Time: 9:15 – 9:40 am

Time Allocation:

Lecture	10 minutes
Introductions	15 minutes



The target audience for this workshop are transportation professionals in communities of 5,000 to 200,000 population growing communities who are responsible for transportation system monitoring and improvements. This might include state department of transportation personnel (District Engineer, Director of Transportation Planning, Director of Operations, Area Engineers, or other area office or district staff), city engineers/planners, county engineers/planners, metropolitan planning organization staff, council of governments staff, or regional mobility authority representatives.



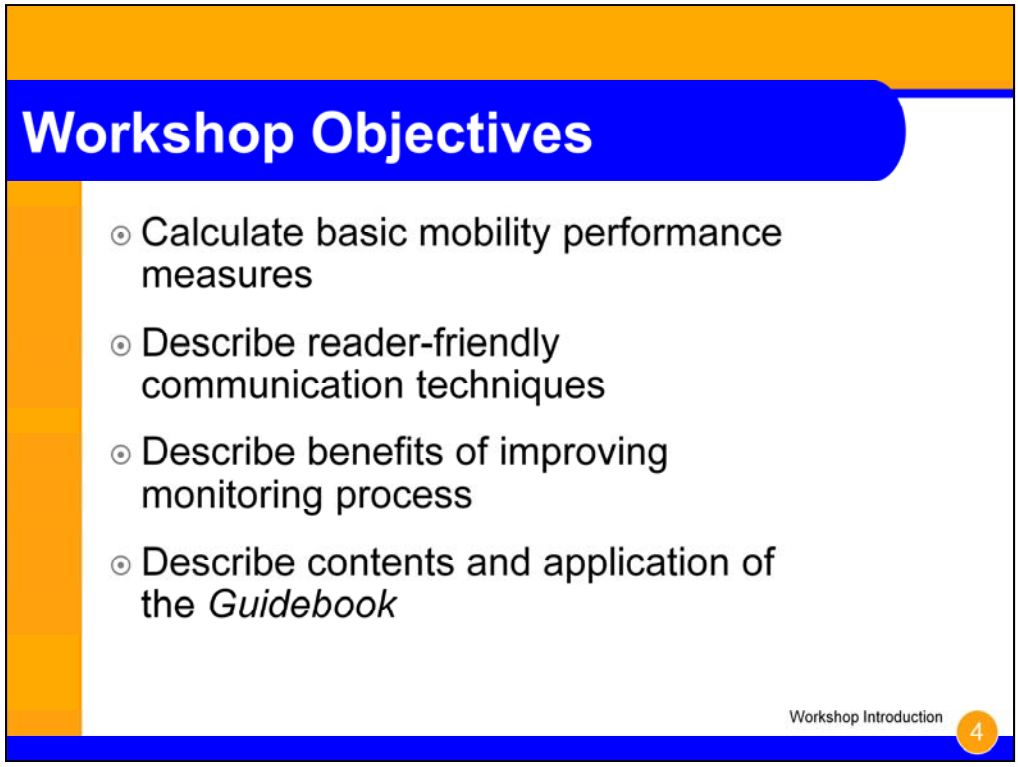
The objective of this workshop is to instruct participants on how to measure, document, and report mobility changes based upon the products of TxDOT project 0-5571.

Project 0-5571 was a one-year research project conducted by the Texas Transportation Institute that concluded in August 2007. Researchers developed a *Guidebook for Mobility Monitoring in Small to Medium-Sized Communities* and other documents to assist transportation professionals in measuring, documenting, and reporting mobility changes.

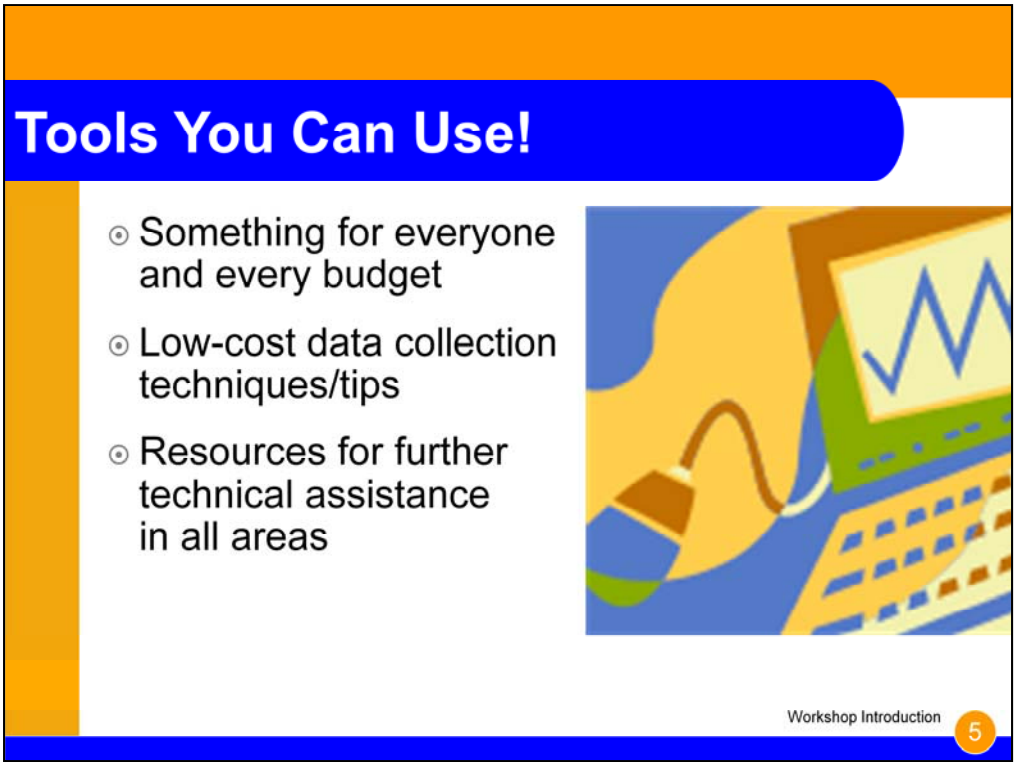
Research project 0-5571 included data collection in Bryan-College Station, Texas and Huntsville, Texas to apply and fine-tune the framework presented in this workshop.

By example, the following illustrates one common need for establishing baseline mobility conditions in growing communities:
Many growing communities have rapid development on the outskirts of town. Commonly this is where land is cheaper. A developer might want to place a “big-box” development on such a parcel of land where existing infrastructure is inadequate (i.e., two-lane roadway). They might claim that trip generation will be low and mitigation won’t be needed. Transportation agencies with objective and frequent monitoring data could indicate to them what types of changes they have seen in other parts of their community. The objective baseline mobility data are of value for such discussions.

The instructor then states the workshop objectives on this slide and the following slide.

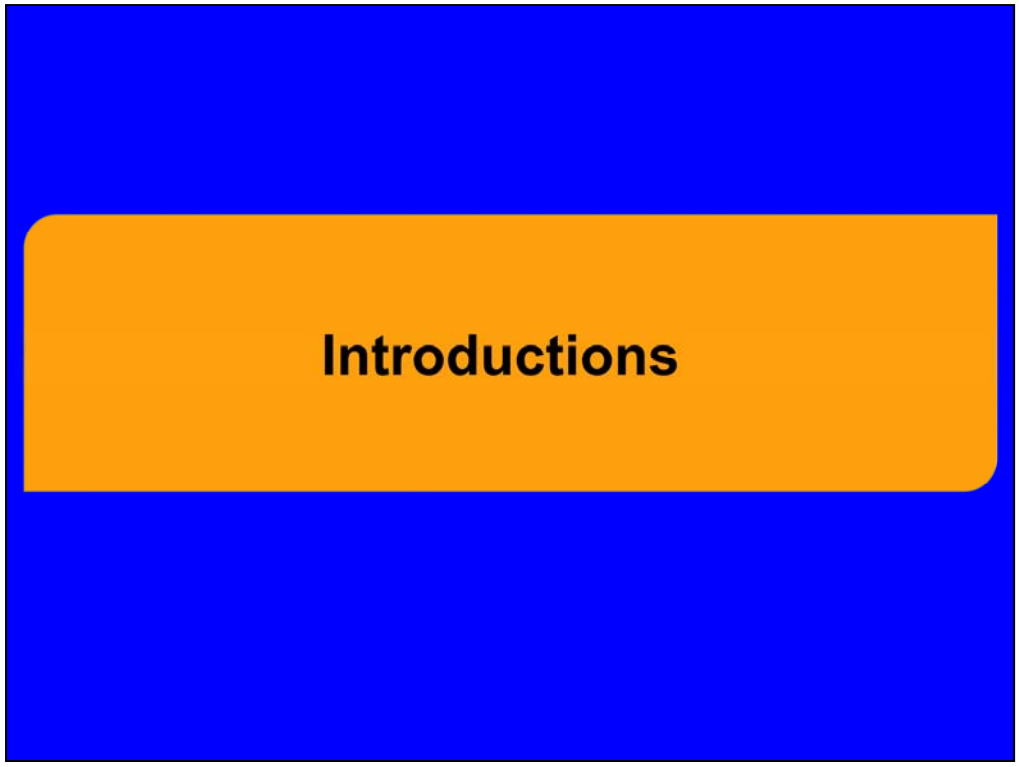


Verbally state the workshop objectives.



Time and financial resources are often limited. This is particularly true in SMSCs. Throughout this workshop, we will remain cognizant of this reality, and we will provide something for everyone, and every budget. This will include low-cost data collection techniques and expert tips. We'll also provide you with further technical assistance in all areas of monitoring including data collection, data reduction, data analysis, communication techniques, unit costs, etc.

For example, one cost-saving travel time data collection tip is to use existing staff and pen-and-paper techniques rather than higher-priced technologies. We'll discuss further advantages and disadvantages later in the workshop.



Instructors introduce themselves and provide a response to the following questions as part of their introductions.

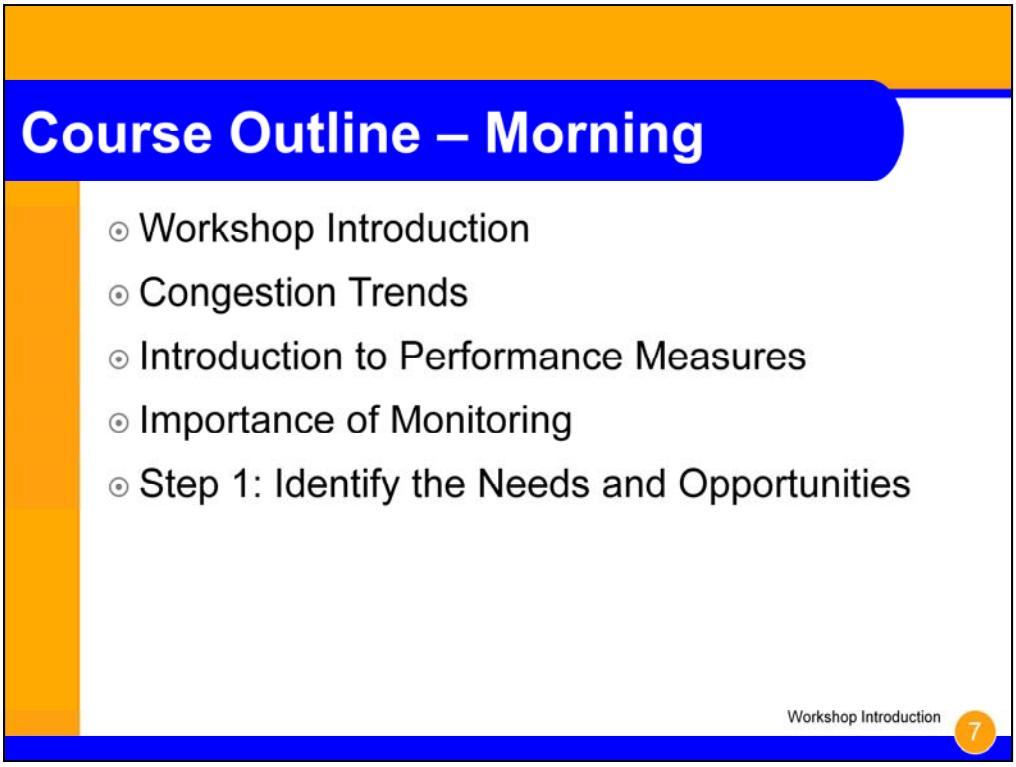
- What agency do the instructors work for?
- Experience in current position?
- Experience in mobility/performance monitoring, and prioritizing improvements?
- Current tasks and responsibilities?

Instructor asks everyone to introduce themselves and answer the following questions.

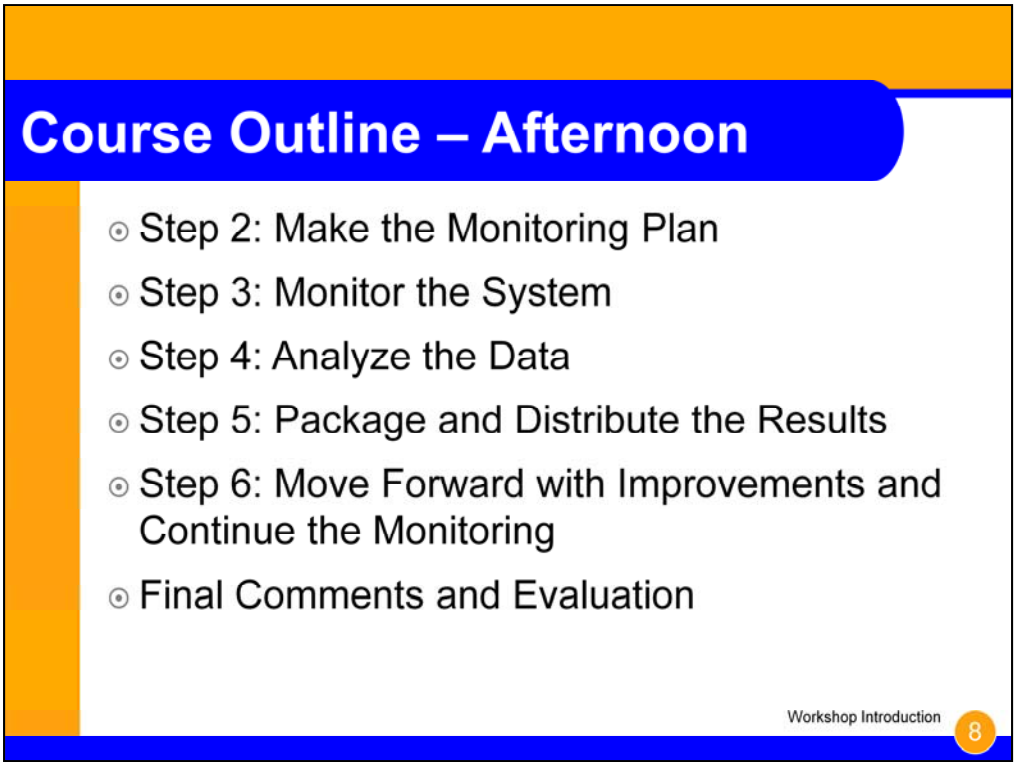
- What agency do you work for?
- Experience in current position?
- Experience in mobility/performance monitoring, and prioritizing improvements?
- Current tasks and responsibilities?
- Learning objective they would like to satisfy today

The instructor should also ask each person to list a learning priority for the course. Instructors will document the learning priorities on a flip chart.

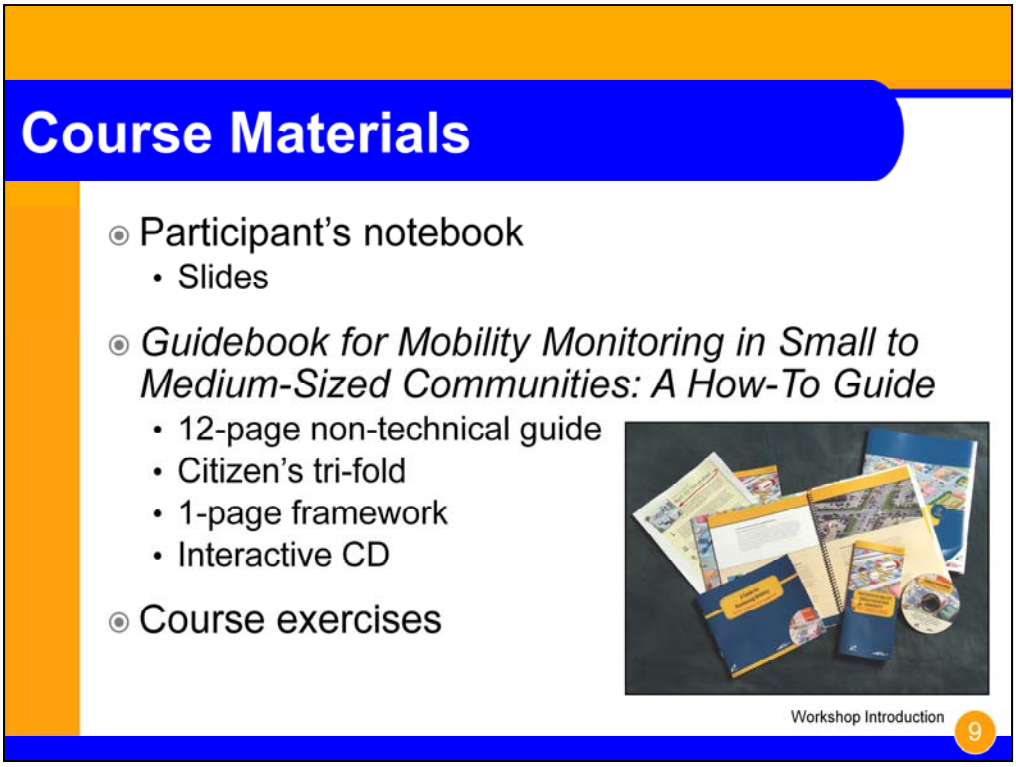
The instructor should encourage each participant to take no more than about 30 seconds to introduce themselves and address the questions above.



Instructor states the morning course outline.



Instructor states the afternoon course outline.



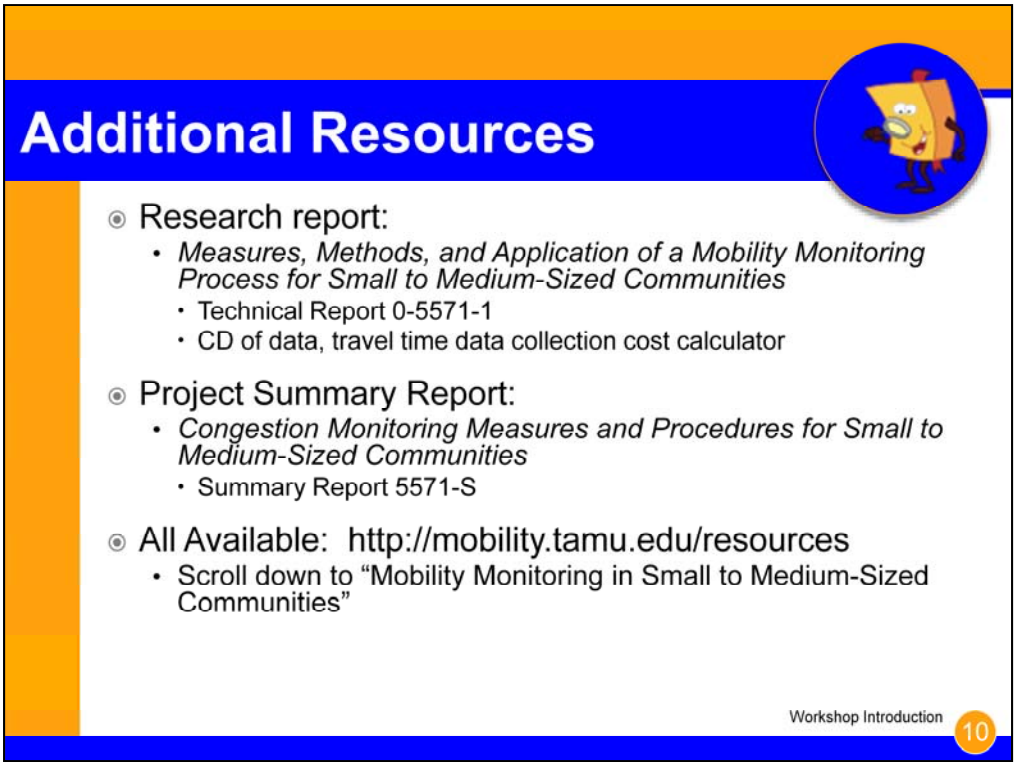
There are three primary course materials.

1. The participant's notebook which contains each of the slides presented in the workshop. Tabs are included in the participant's notebooks 3-ring binder to assist in negotiating the materials.

2. The 84-page *Guidebook for Mobility Monitoring in Small to Medium-Sized Communities: A How-To Guide.* The *Guidebook* is written for a technical audience, yet breaks up the monitoring effort into manageable portions by prompting the user with questions for each section. It includes full-color style and a case study example from a fictitious city (Fender Falls). The pocket in the back of the *Guidebook* includes a 12-page guide for mobility monitoring in small to medium-sized communities for non-technical audiences. A tri-fold brochure is also included for targeting citizens. Finally, an interactive CD is included that includes all these materials in PDF form as well as PDFs of the full final report and summary report. The interactive CD also contains the case study from the *Guidebook*, which allows the user to drill forward and backward through the Fender Falls case study.

The instructor describes the *Guidebook*, including the layout and format of the document. Instructor introduces the case study and character of "Bookster" who is found throughout the *Guidebook* and associated materials.

3. Course exercise materials will be supplied throughout the course.



Instructor describes additional resources available, including the research report and Project summary Report. Instructor identifies the primary research objective to develop and test a framework for congestion monitoring in SMSCs, including economical (low-cost) monitoring techniques and the normal range of improvements for SMSCs. Instructor indicates that these additional resources document successful completion of that objective as well as the full research results.

The final research report includes a summary of project details, unit costs for travel time data collection, communication techniques to technical and non-technical audiences, and all the data from the case studies on a CD.

The Project Summary Report is a 2-page summary report that hits the highlights of the work.

The final report and the Project Summary Report are available on the CD in the *Guidebook.*

All resources are available on the Internet site shown.

We ask that all participants mind the start and end times so that we can provide a timely workshop. We have scheduled breaks and lunch, and we ask that you please return ready to begin at these times. We also ask that you please turn off your cell phones if you have not already done so.

Finally, this workshop is meant to be an opportunity to learn about mobility monitoring techniques appropriate to small and medium-sized communities. Your active interaction and participation throughout the workshop is encouraged. Shared experiences will benefit everyone in the room.

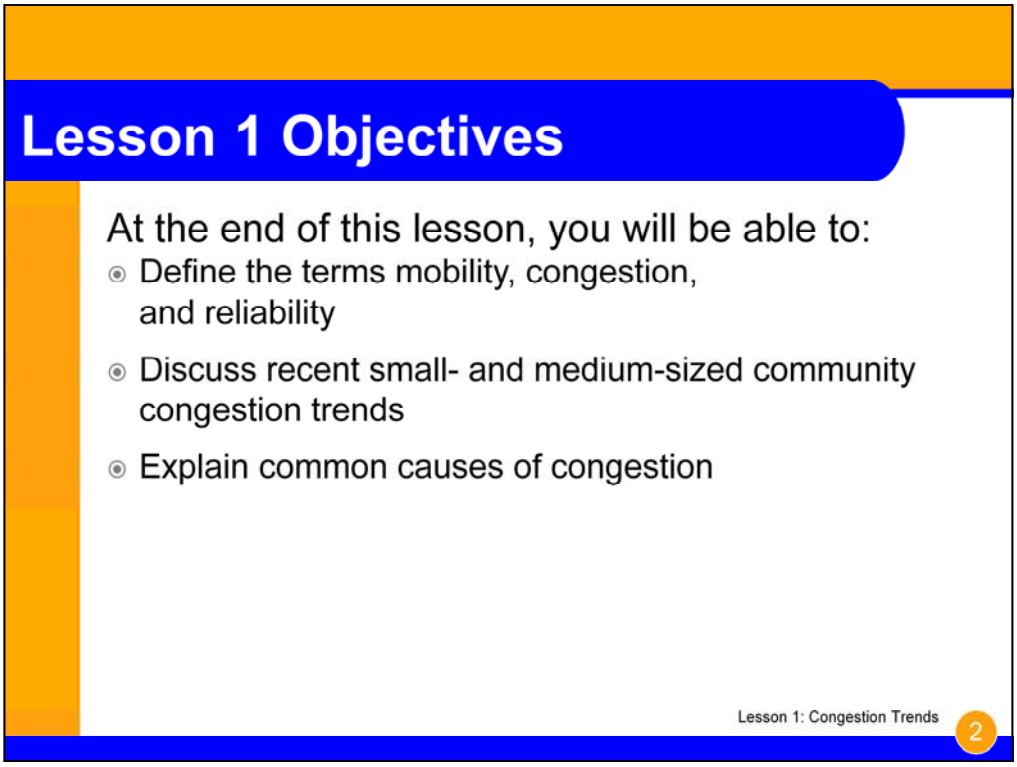
Instructors ask if there are any questions before going on to Lesson 1.

Duration: 15 minutes

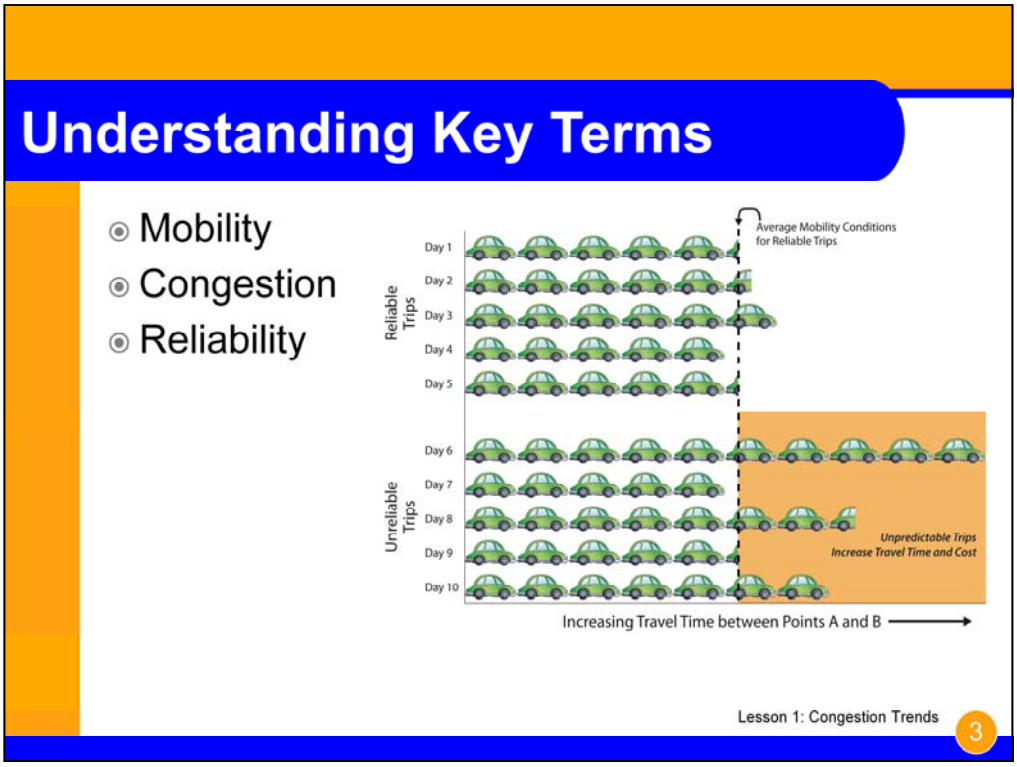
Time: 9:40 – 9:55 am

Time Allocation:

Lecture	10 minutes
Discussion	5 minutes



Verbally state the lesson objectives for the participants.



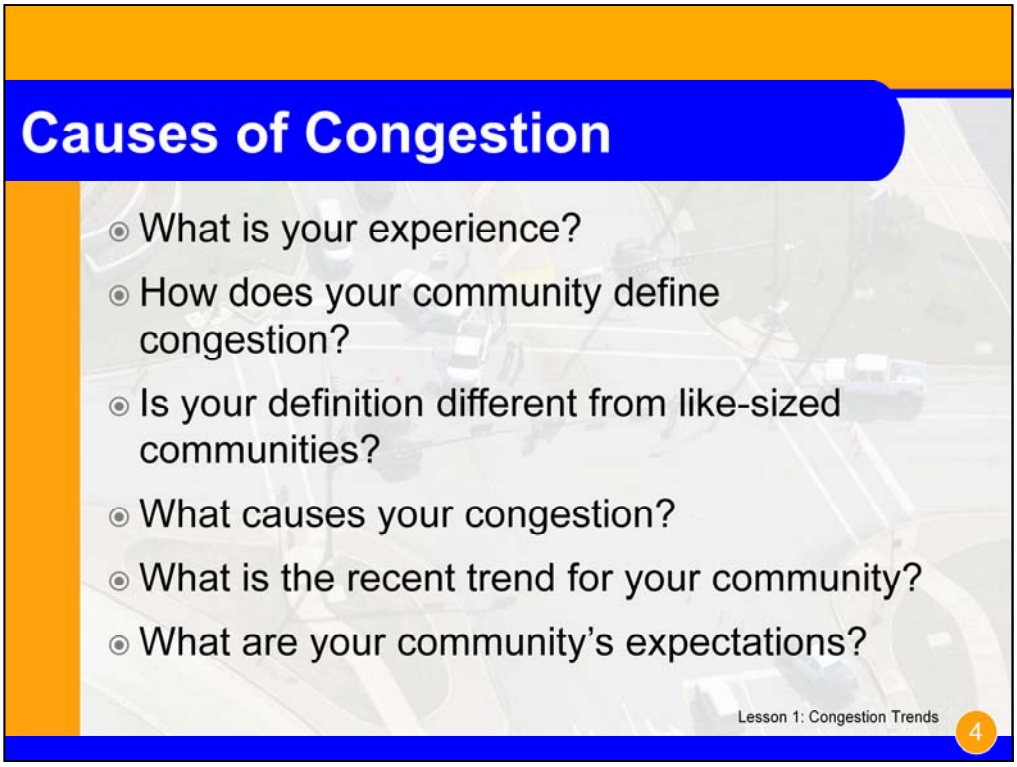
Open by asking a the participants to tell their definition. Listen to confirm, correct, or augment the participants' responses.

Mobility – Ability to reach a destination in a satisfactory time and cost.

Congestion – Inability to reach a destination in a satisfactory time due to slow travel speeds (which increases operating costs for the trip and time costs for driver and passengers).

Reliability – level of consistency in transportation service (hour-to-hour or day-to-day).

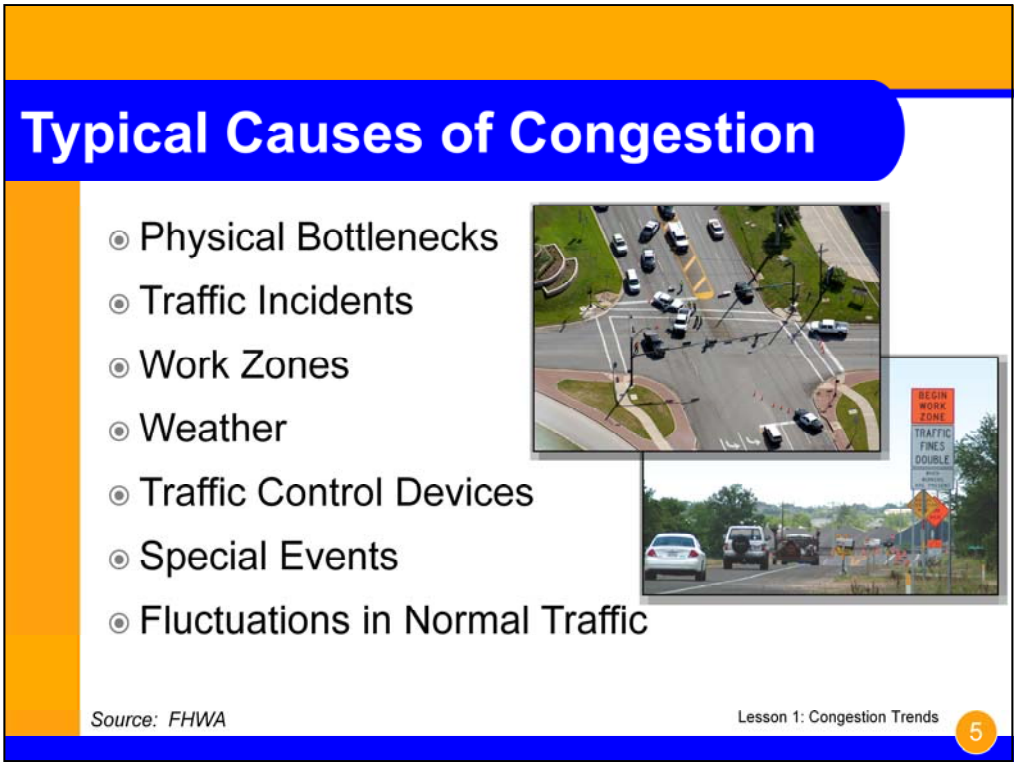
(See *Guidebook* page 3 for graphics).



Engage the participants by asking them these questions.

Use a flipchart or whiteboard to capture their statements.

Use tick marks or other indications for multiple like-responses.

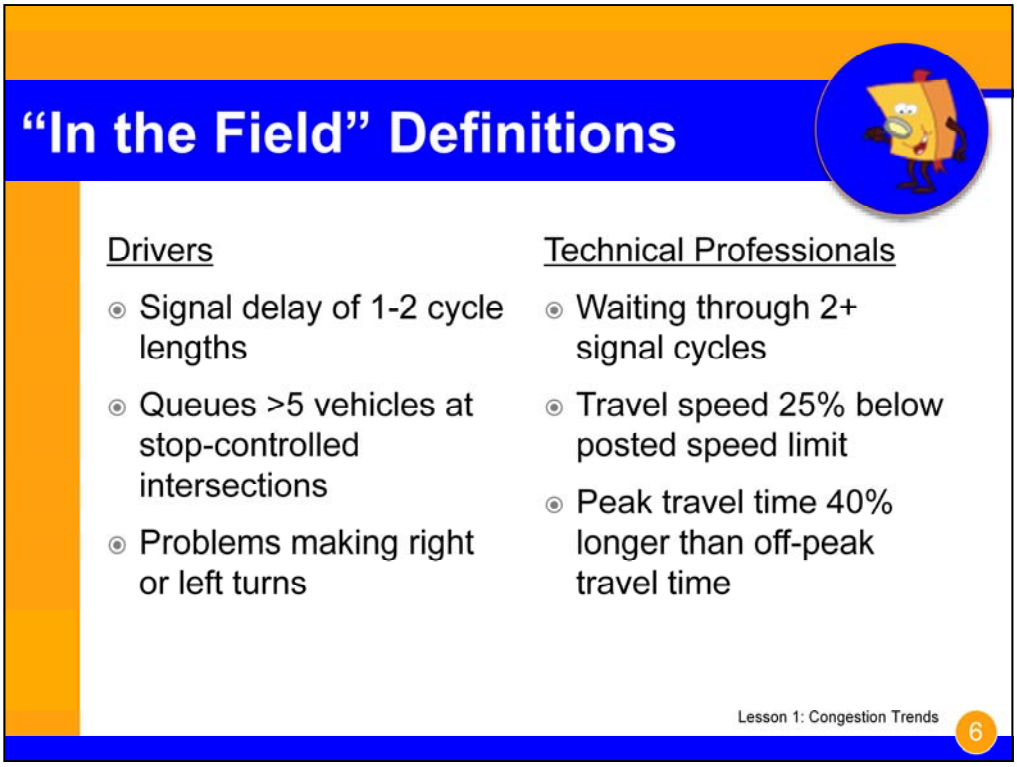


Researchers identified this list of causes.

Physical Bottlenecks—Limited capacity of the roadway, including physical constraints (lane configurations) at intersections;
Traffic Incidents—Events that disrupt the normal flow of traffic, usually by physical impedance in the travel lanes;
Work Zones—Construction activities on the roadway that result in physical changes to the highway environment;
Weather—Environmental conditions can lead to changes in driver behavior that affect traffic flow;
Traffic Control Devices—Excess demand for the control device to handle properly;
Special Events—A special case of demand fluctuations whereby traffic flow in the vicinity of the event will be radically different from "typical" patterns; and
Fluctuations in Normal Traffic—Day-to-day variability in demand leads to some days with higher traffic volumes than others.

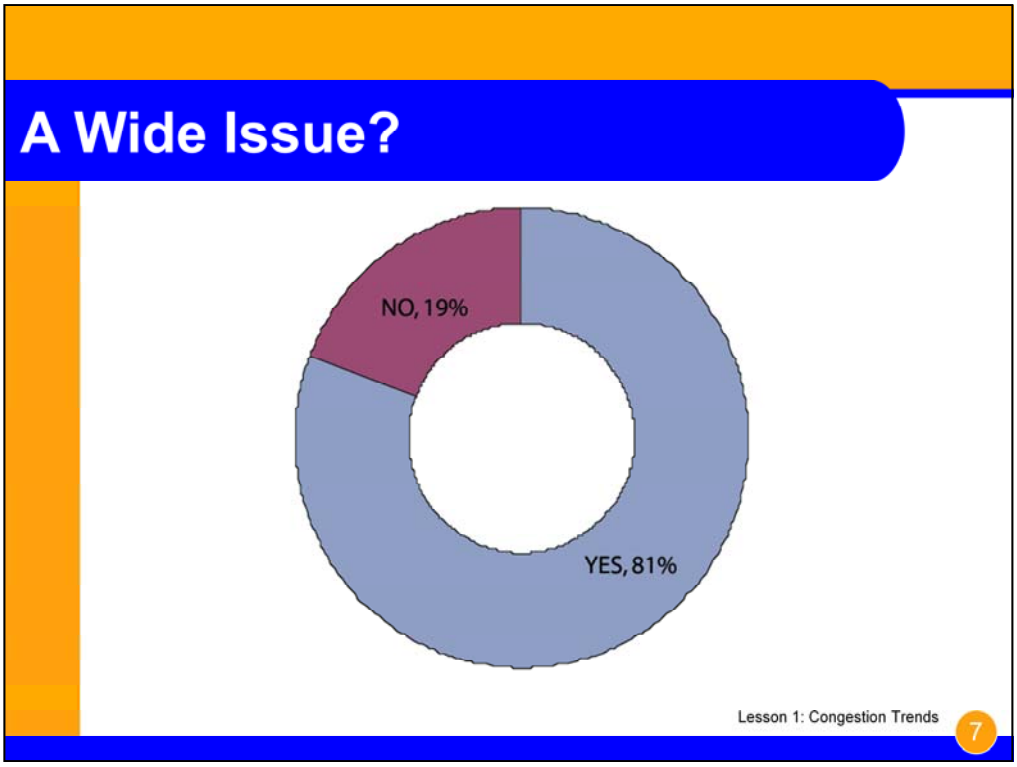
Instructors ask the participants if they can think of other causes that are not listed on this slide.

Source:
Traffic Congestion and Reliability: Trends and Advanced Strategies for Congestion Mitigation. Produced by Cambridge Systematics with Texas Transportation Institute. Sponsored by Federal Highway Administration, Washington DC. September 1, 2005. Available: http://ops.fhwa.dot.gov/congestion_report/congestion_report_05.pdf.



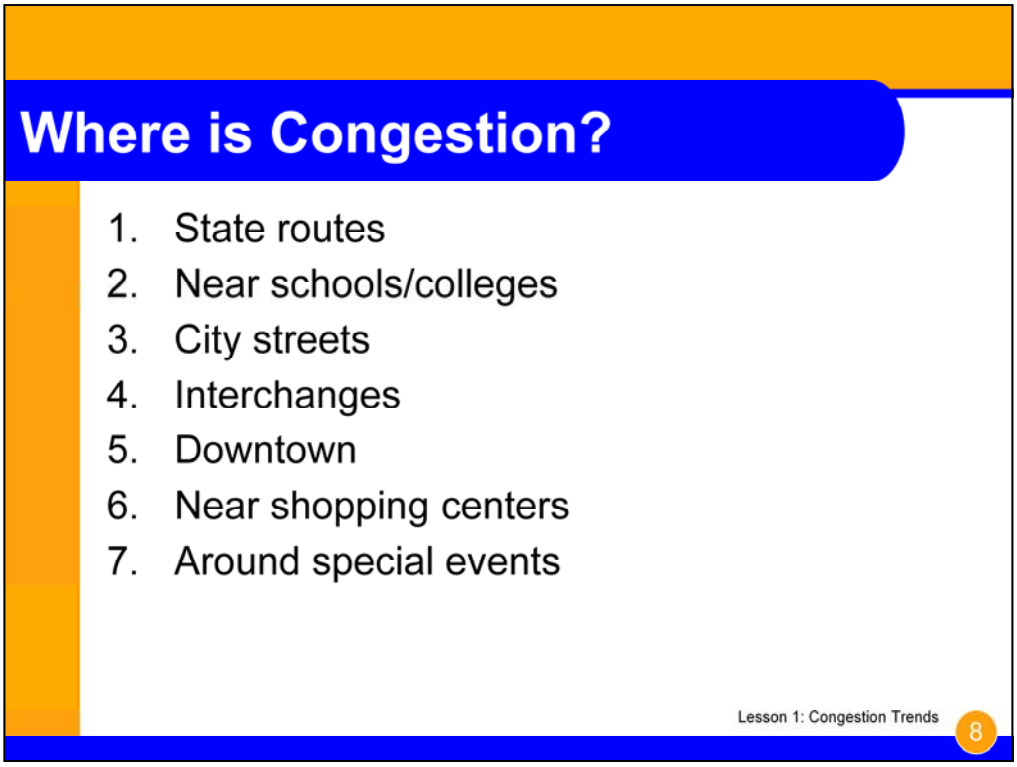
In cooperation with the Texas Municipal League, Texas SMSC were surveyed in 2007. Twenty-six responses were received.
The next few slides relate some of the high points from this survey.

Respondents were asked to relate their community's definition of congestion, shown on the left side under "Drivers." They were also asked to give a technical definition used in their community, shown on the right side under "Technical Professionals." The values shown on the right side represent the median response.



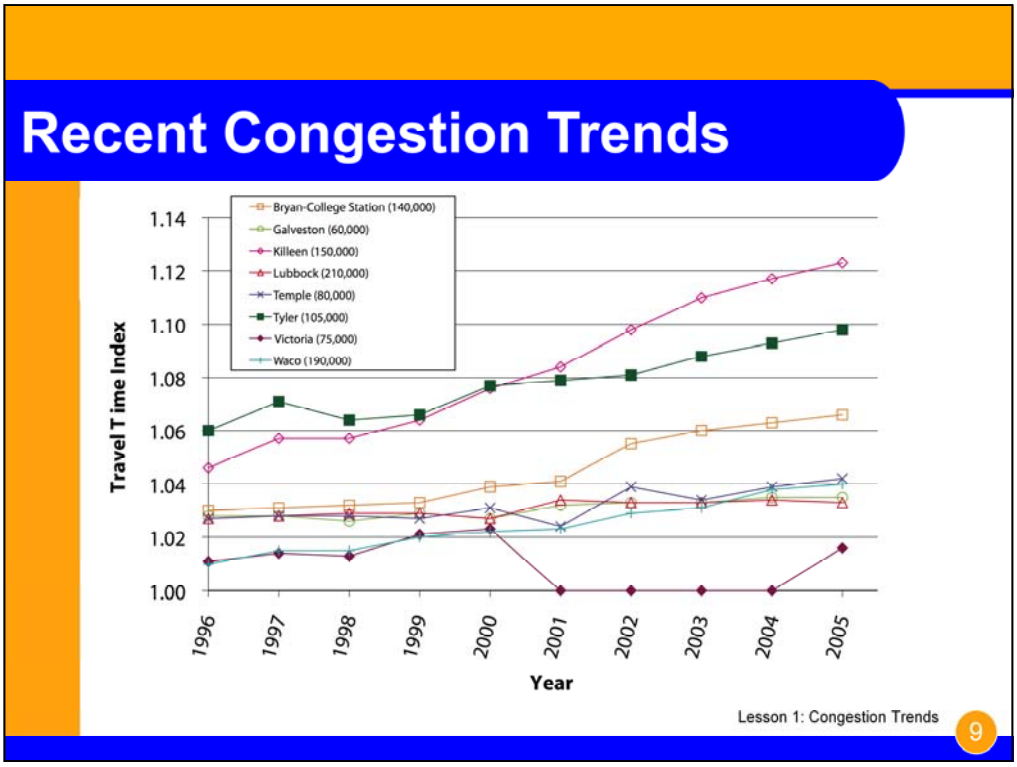
80% of the respondents indicated their community experiences congestion today.

Instructors should relate the results from the recent discussion to this slide to validate responses.



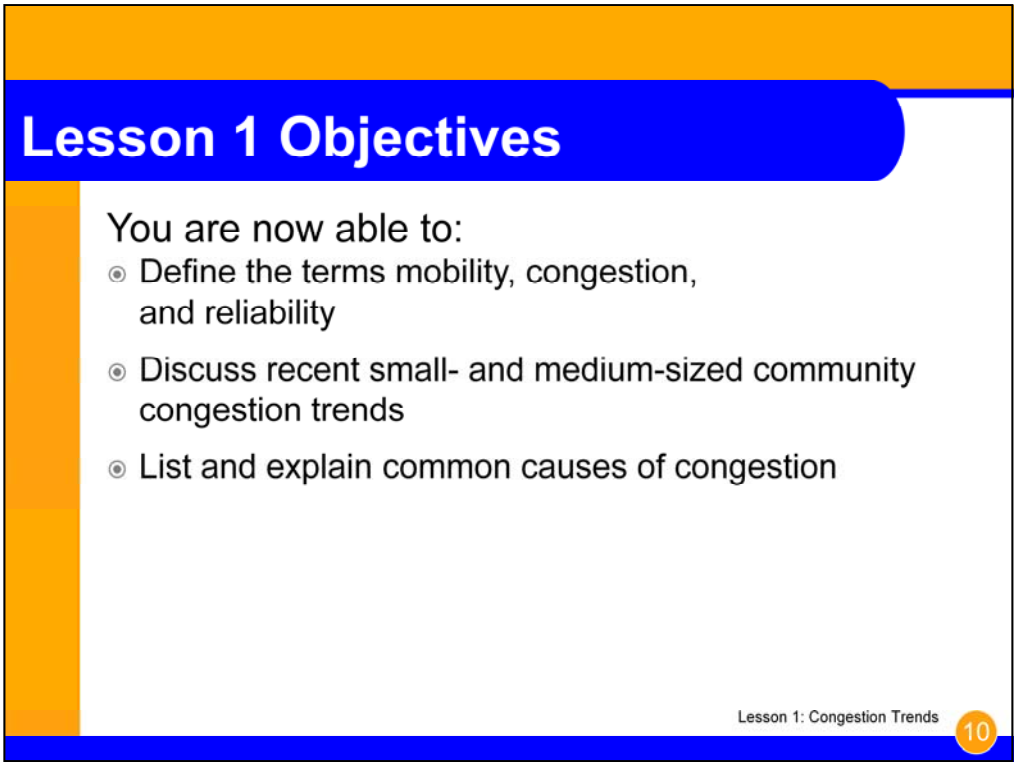
These locations are ranked in decreasing order. The top 5 responses had more than 50% of the respondents indicating congestion occurred at those locations.

Instructors may relate the other locations and their rank based on questions from participants or relating back to earlier comments:
8) Truck stops
9) Near government facilities
10) Edge of downtown
11) Hospitals
12) Other locations
12) Near other business centers
13) Near industrial facilities

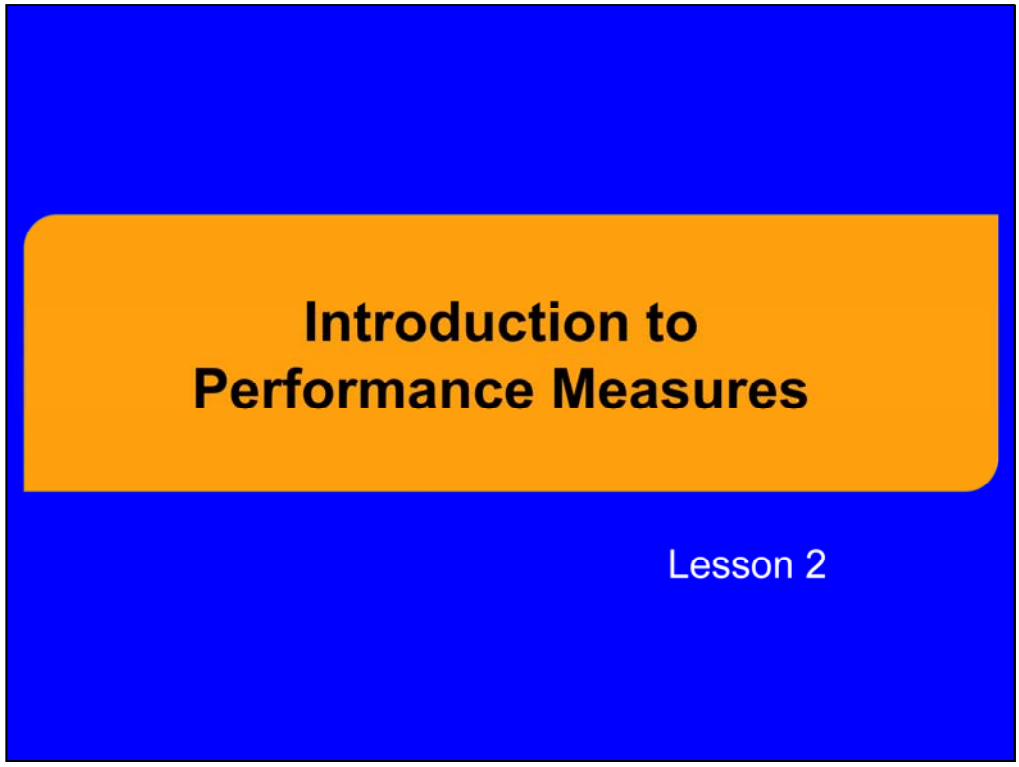


This graphic shows how congestion is growing in selected small to medium-sized communities in Texas.

Instructor encourages participants to refer to “Appendix” tab for full-page graphic and additional survey results.



Restate the Lesson 1 objectives, and ask the participants if they have any questions before moving on to the next lesson.

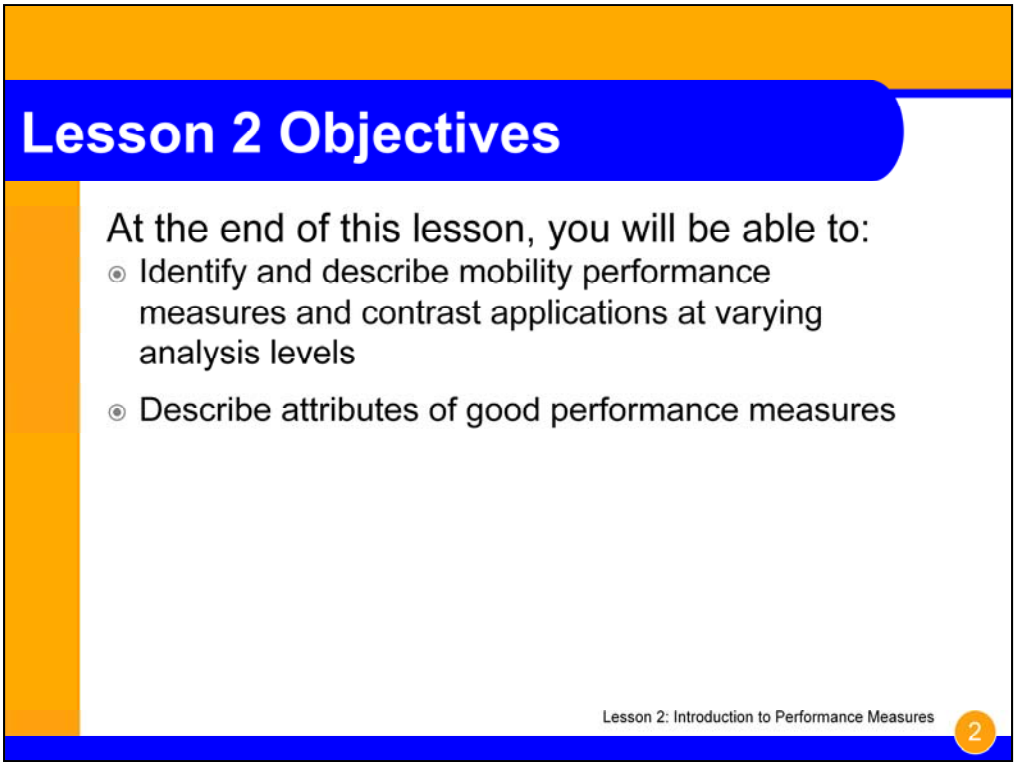


Duration: 20 minutes

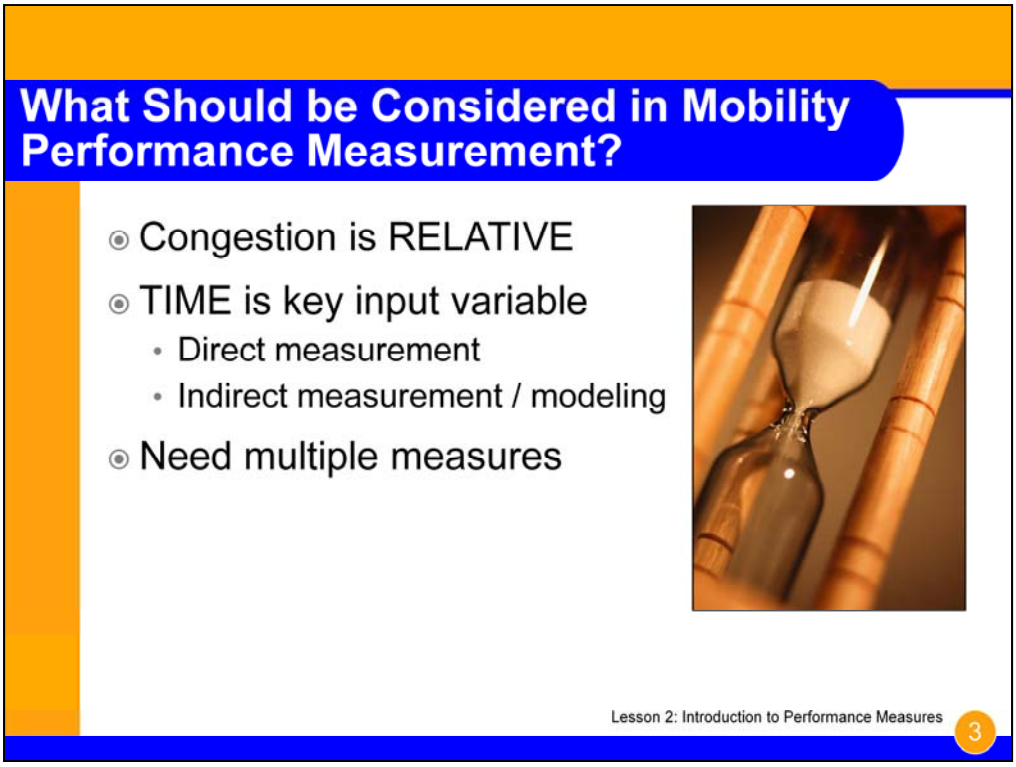
Time: 9:55 – 10:15 am

Time Allocation:

Lecture	10 minutes
Discussion	10 minutes



Verbally state the Lesson 2 objectives.



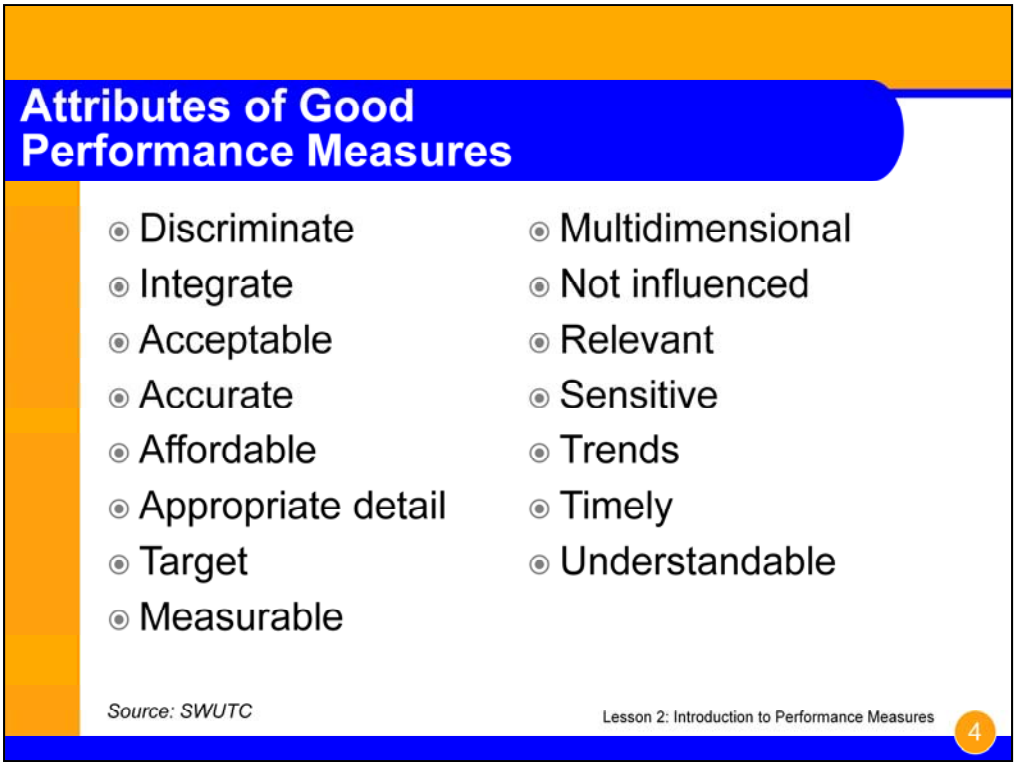
As mentioned previously, mobility is the ability to reach a destination in a satisfactory time and cost. However, what is "satisfactory" will differ from city to city. Traffic congestion is "relative." A motorist in Houston might tolerate waiting 3-4 cycles at a traffic signal. However, a motorist in Tyler might not tolerate a trip where thy were stopped at a traffic signal for more than 2 cycles. We all despise the traffic congestion problem but our definition of congestion will vary depending on where we live and possibly even the roadway we drive on.

One thing all travelers have in common is time. We are all wary of how long it takes us to make the trip we are taking. Our internal database tells us how long we need to allow ourselves to complete a certain trip on a certain facility at a certain time of the day. Since time is such a critical input to our lives and our travel, it makes sense that travel time ought to be a key input variable to the performance measures we use to monitor our mobility.

Direct measurement includes collecting data with continuous probe vehicles or instrumented cars. Indirect measurement includes data collected by such things as continuous in-pavement equipment. This type of data require additional processing to obtain travel time information

We may also need more than one performance measure to completely explain a situation. If someone told you to go pick up a package for them, you would ask what kinds of package, how large is it, how much it weighs etc. These are all measures that help to paint the picture of what you will need to pick up the package. The same is true in mobility performance measurement. One measure, alone, may not tell you everything you need to know about a situation. But, several measures together, may give you a much clearer picture of the situation on a particular roadway or on your entire roadway system.

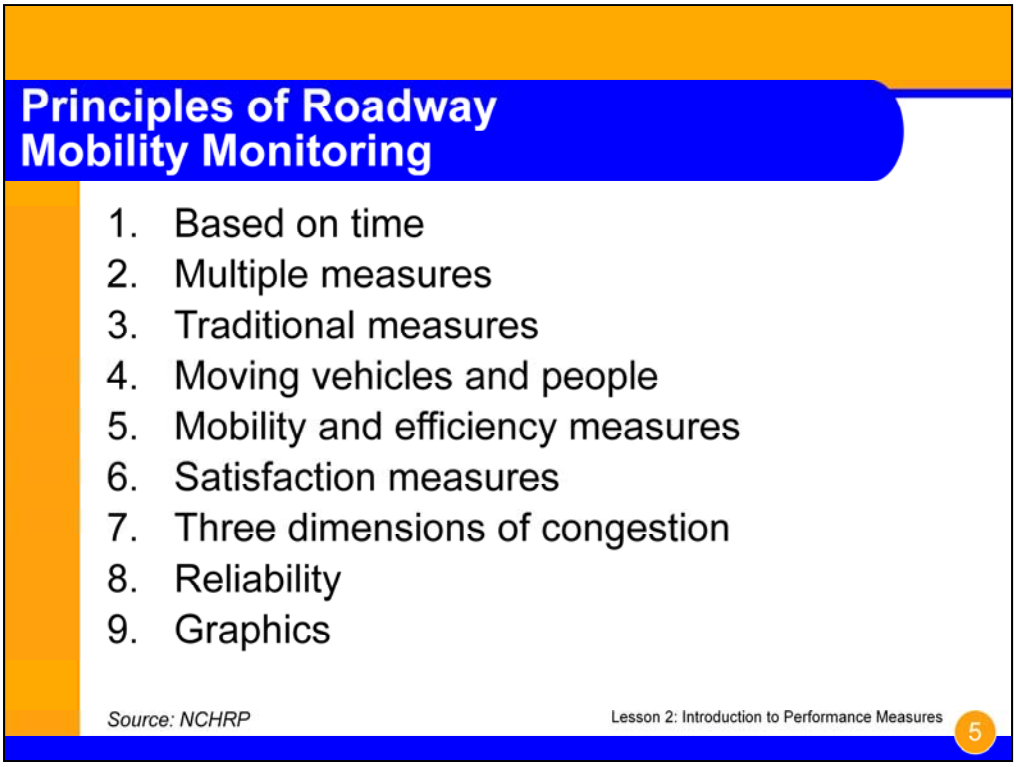
Why would you need multiple mobility measures to paint a clear picture? Suppose that you measured 5,000 minutes of delay in a corridor during the peak-period. Three years later, the delay in the corridor was 6,000 minutes. Is this necessarily worse? Not if we are moving a lot more vehicles on that roadway now than 3 years prior. So if we had 5,000 minutes of delay for 2,500 vehicles (2 minutes per vehicle) and now have 6,000 minutes for 4,000 vehicles (1.5 minutes per vehicle) the average driver is experiencing 25% less delay than they did 3 years prior even though the traffic volumes have risen 60% during the same time. Thus, it is critical to have more than one performance measure or data elements to give an accurate description of what is truly happening in your monitoring program.



What measures do you select for your monitoring program? Some key attributes of performance measures are listed here. Every measure may not include all of these attributes because of budget constraints. However, this does provide a starting point for identifying and selecting the measures that are appropriate for your monitoring program. Thee attributes are shown in Table 1 of the *Guidebook* on page 15.

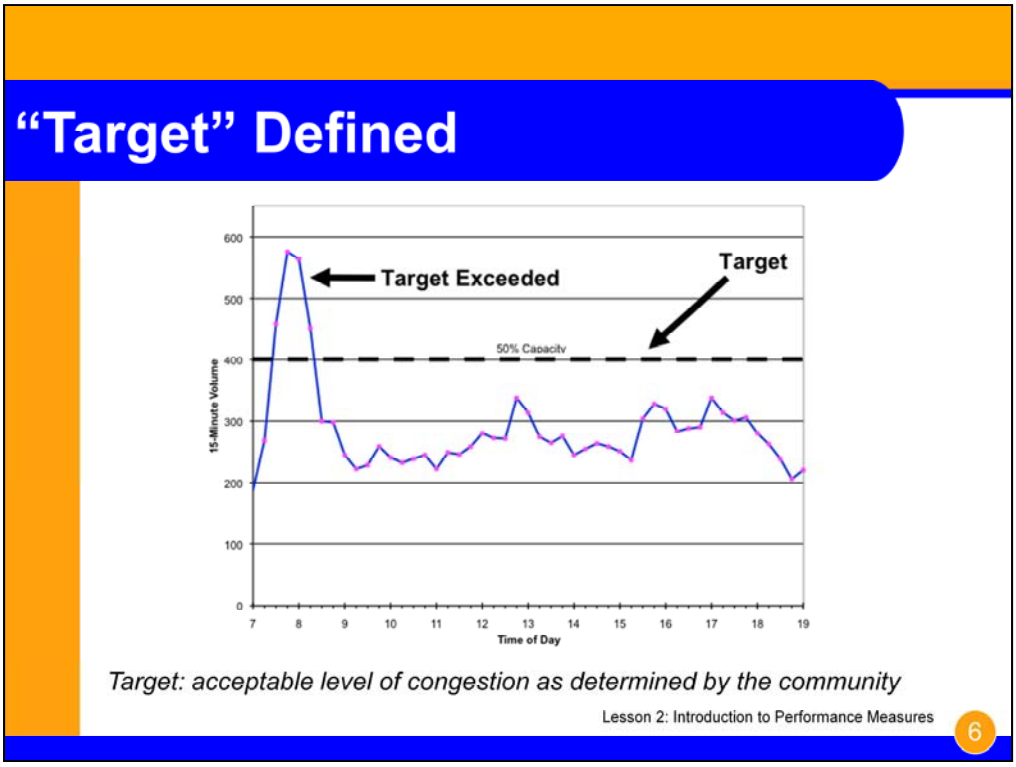
1. **Discriminate** – Must be able to differentiate between the individual components that are affecting your system's performance
2. **Integrate** – Must be able to integrate the sustainability aspects of environmental, social, and economic sustainability
3. **Acceptable** – The general community must assist in identifying and developing the performance measures
4. **Accurate** – Must be based on precise information, of known quality and origin.
5. **Affordable** – Must be based on readily available data or data that can be obtained at reasonable cost.
6. **Appropriate level of detail** – Must be specified and used at the appropriate aggregation level for the questions it is intended to answer
7. **Have a target** – Must have a benchmark against which to compare it
8. **Measurable** – data must be available, and the tools need to exist to perform the required calculations
9. **Multidimensional** – Must be able to be used over time frames, at different geographic areas, with different scales of aggregation, and in the context of multimodal issues
10. **Not influenced** – Must not be affected by exogenous factors that are difficult to control for, or that the planner is not even aware of
11. **Relevant** – Must be compatible with overall goals and objectives
12. **Sensitive** – Must detect a certain level of change that occurs in the transportation system
13. **Show trends** – Must be able to evaluate over time and provide early warnings about problems
14. **Timely** – Must be based on timely information that is capable of being updated at regular intervals
15. **Understandable** – Must be easy to interpret, even by the community at large.

Source:
Zietsman, J., and L.R. Rilett. "Sustainable Transportation: Conceptualization and Performance Measures." Southwest Region University Transportation Center Report 167403. College Station, Texas. March 2002.Available: http://swutc.tamu.edu/



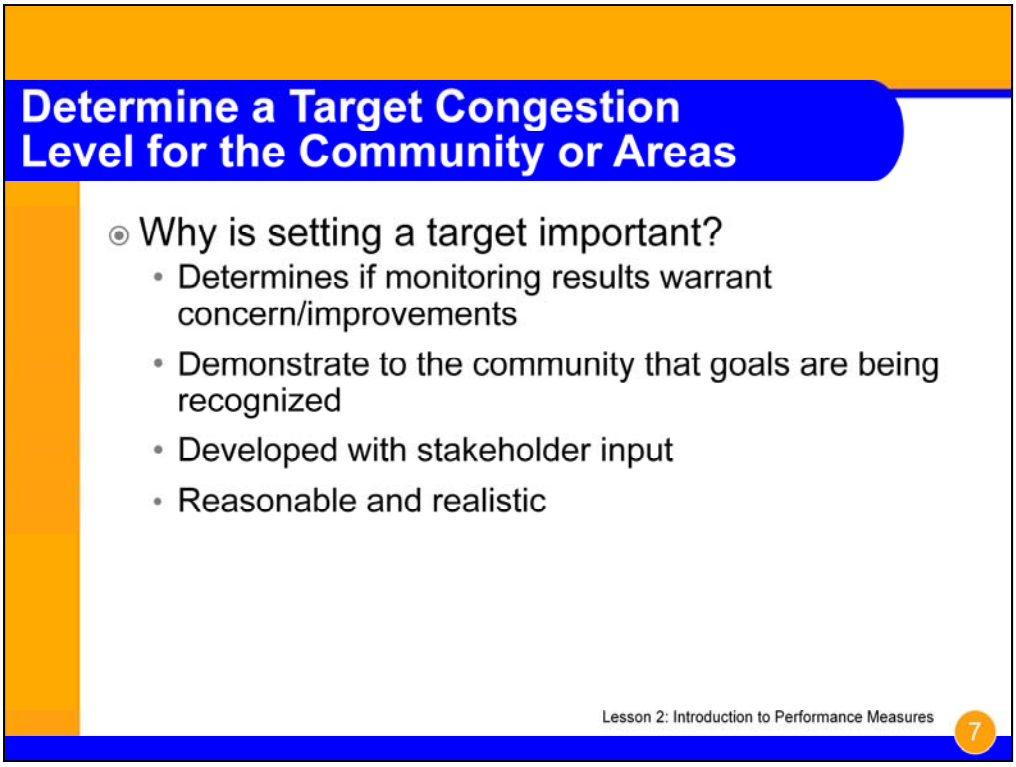
Research has documented 9 basic principles for roadway mobility monitoring. These attributes are shown in Table 2 of the *Guidebook* on page 16.
Principle 1 – Mobility performance measures must be based upon travel time. Travel times are easily understood by both practitioners and the public. Travel times are applicable to both traveler experience and the facility performance.
Principle 2 – Multiple measures should be used to report congestion performance.
Principle 3 – Traditional Highway Capacity Manual-based performance measures such as volume-to-capacity ratio and level of service should not ignored but should serve as supplementary, not primary, measures of performance in most cases.
Principle 4 – Both vehicle-based and person-based performance measures are useful and should be developed, depending on the application. Person-based measures provide a "mode-neutral" way of comparing alternatives.
Principle 5 – Both mobility (outcome) and efficiency (output) performance measures are required for congestion performance monitoring. Efficiency measures should be chosen so that improvements in their values can be linked to positive changes in mobility measures.
Principle 6 – Customer satisfaction measures should be included with quantitative mobility measures for monitoring congestion "outcomes".
Principle 7 – Three dimensions of congestion should be tracked with congestion-related performance measures (source of congestion, temporal aspects, and spatial detail).
Principle 8 – The measurement of reliability is a key aspect of roadway performance measurements, and reliability metrics should be developed and applied. Use of continuous data is the best method for developing reliability metrics, but abbreviated methods should also be explored.
Principle 9 – Communication of performance measures should be done with graphics that resonate with a variety of technical and nontechnical audiences.

Source:
"Guide to Effective Freeway Performance Measurement." Research Results Digest 312. National Cooperative Highway Research Program. Washington, D.C., February 2007.Available: http://trb.org/news/blurb_detail.asp?id=7444



A congestion "target" is the acceptable level of congestion as determined by the community. The term "target" is often used for mobility analyses recognizing that it may be financially difficult to eliminate all congestion.

This graphic shows an example of a target (in terms of capacity) for a link of roadway for a 15-minute volume. The left-most arrow shows where the target is exceeded, while the right-most arrow indicates a dashed line that represents the target value throughout the day.



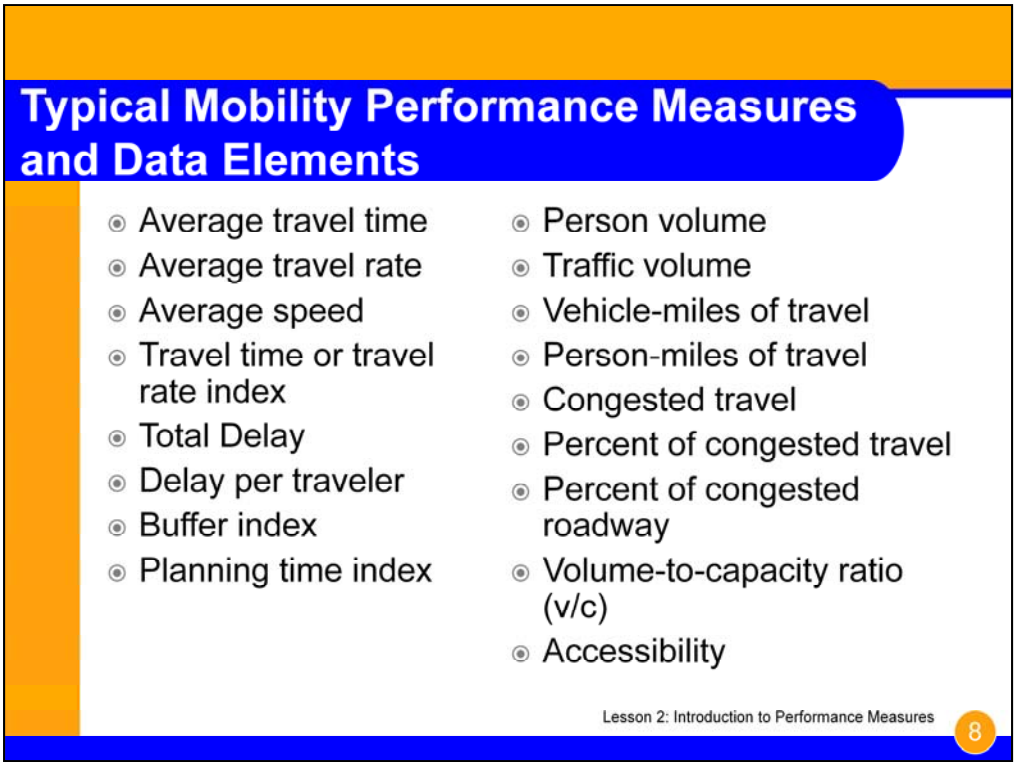
Targets for performance measures are important for knowing whether your monitoring results (e.g., travel times, speeds, or indices) warrant concern and the need for improvements. Obtain broad range of citizen input for targets.

The target values represent the crucial link between: 1) the vision that your community has for its transportation system, land uses, and its “quality of life” issues, and 2) the improvement strategies, programs, and projects that government agencies and private sector interests will implement.

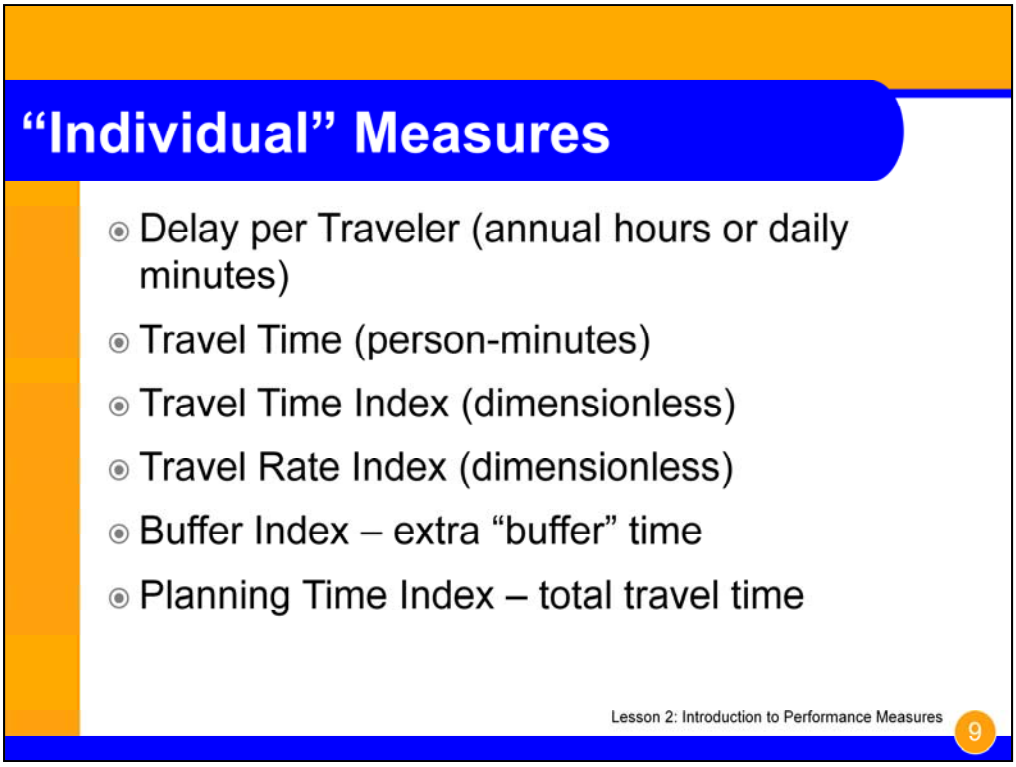
Target values are determined from input from citizens, business owners, decision-makers, and transportation professionals. Target values must be reasonable and realistic.

The instructor asks the participants how they would define congestion in their community. With that information, the instructor asks the participants what they believe would be the target for congestion in their community, using the appropriate measure.

Instructor can discuss responses in light of responses from Lesson 2 (Introduction to Performance Measures).

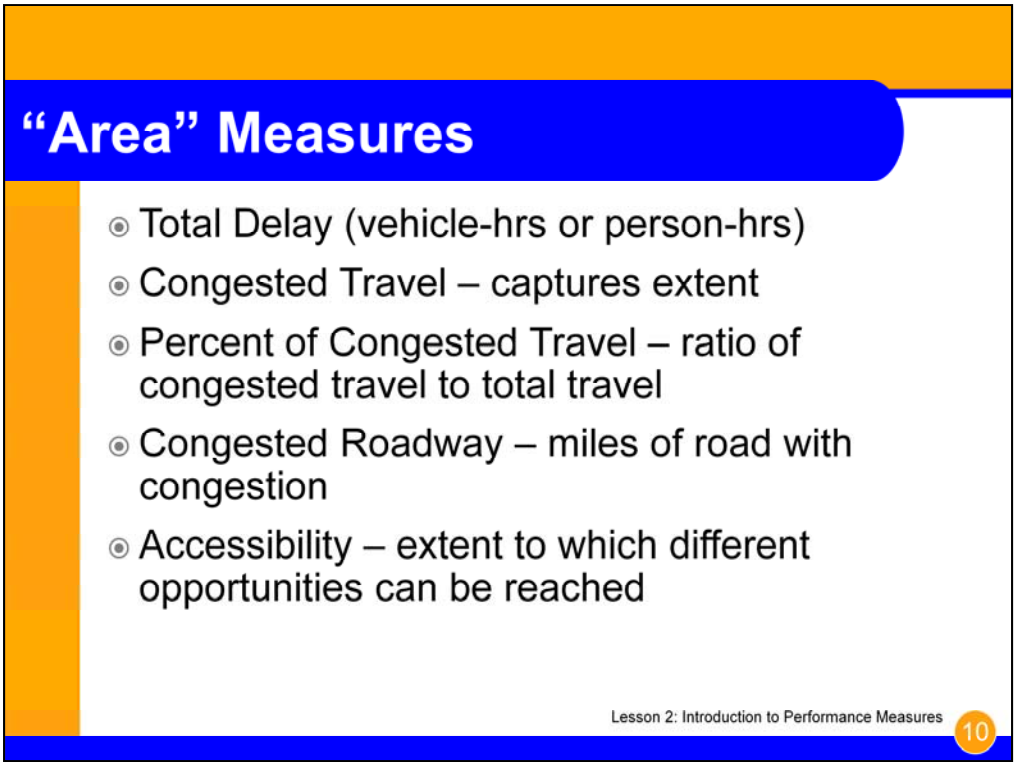


Shown are 16 typical mobility performance measures. These measures are shown on pages 18-19 of the *Guidebook*.
The measures in the left hand column are all based on some aspect of time.
The measures on the right reflect such things as the amount of traffic, persons, or facilities affected by congestion.
Some of these measures reflect the effects of congestion on the individual traveler and some reflect the situation for an entire corridor or region.

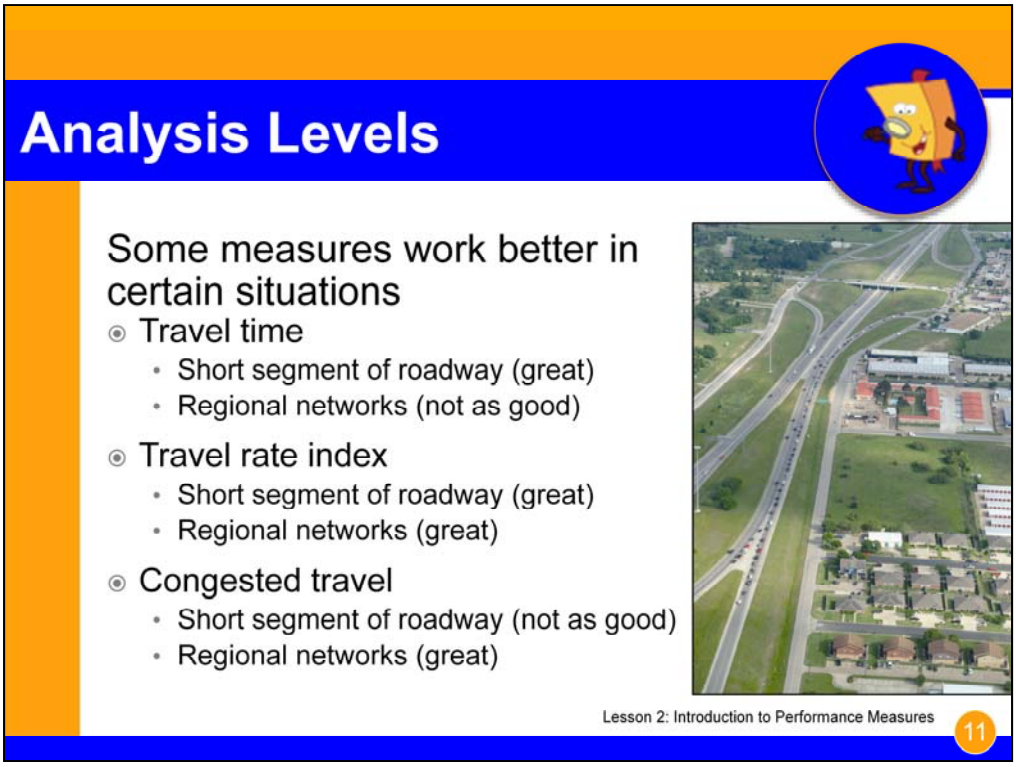


Equations for these measures (and the next slide) are shown on page 18 of the *Guidebook*.

1. **Delay per Traveler** – can be used to reduce the travel delay value to a figure that is more useful in communicating with non-technical audiences. These figures normalize the impact of mobility projects that handle much higher person-demand than alternative routes.
2. **Travel Time** – is the time required to traverse a segment or complete a trip. Times may be measured directly using field studies.
3. **Travel Time Index** – is a dimensionless quantity that compares travel conditions in the peak period to travel conditions during free-flow or posted speed limit conditions. The TTI reflects travelers' perceptions of travel time on the roadway, transit facility, or other transportation network element. This comparison can be based on the travel time increases relative to free-flow conditions (or the posted speed limit) and compared to the target conditions. Thus, the same index formula can be applied to various system elements with different free-flow or posted speeds. A TTI of 1.20 means that it takes 20% longer to complete a peak-period trip than it does to complete the same trip under free-flow or posted speed limit conditions.
4. **Travel Rate Index** – The TRI is identical to the TTI except that is does not include incident conditions. Continuous data streams allow for the direct measurement of a TTI that includes incidents. For some applications, incident conditions would not be included. For example, when test vehicle travel time runs are performed along a section of roadway, those runs that are affected by incident conditions are normally removed. This approach provides an estimate of the non-incident travel time along the roadway. Such conditions would be reported as a TRI rather than TTI.
5. **Buffer Index** – is a measure of trip reliability that expresses the amount of extra "buffer" time needed to be on time for 95 percent of trips (e.g., late for work one day a month). Indexing the measures provides a time- and distance-neutral measure, but the actual minute values could be used by an individual traveler for a particular trip length or specific origin-destination pair. Continuous data sources are necessary to estimate the Buffer Index.
6. **Planning Time Index** – represents the total travel time that should be planned when an adequate buffer time is included. The planning time index differs from the buffer index in that it includes typical delay as well as unexpected delay. Thus, the planning time index compares near-worst-case travel time to a travel time in light or free-flow traffic. For example, a planning time index of 1.60 means that for a 15-minute trip in light traffic, the total time that should be planned for the trip is 24 minutes (15 min x 1.60). The planning time index is useful because it can be directly compared to the travel time index on similar numeric scales.



1. **Total Delay** – the delay for a transit or roadway segment is the sum of time lost due to congestion. Delay can be expressed as a value relative to free-flow travel or relative to the posted speed limit. Total delay on a roadway or in an urban area is calculated as the sum of individual segment delays. This quantity is used as an estimate of the impact of improvements on transportation systems.
2. **Congested Travel** – is a measure that captures the extent of congestion. It estimates the extent of the system that is affected by congestion
3. **Percent of Congested Travel** – is an extension of the congested travel measure. It also measures the extent of congestion but is computed as a ratio of the congested segment person-hours of travel to the total person-hours of travel.
4. **Congested Roadway** – is another measure of the extent of congestion. It is the sum of the mileage of roadways that operate slower than free-flow or posted speed limit conditions.
5. **Accessibility** – is a measure that often accompanies mobility measures. It quantifies the extent that different opportunities can be realized. This measure might describe accessibility to jobs, a transit station, or other land use or trip attractors of interest.



The number of measures required for comprehensive monitoring depends on the type of analysis being performed, and it depends on what you are ultimately communicating and to whom. In general, measures that relate to the trip experience of an individual driver resonate well with all audiences. These measures tell them what they experience on the roadway. Measures that capture what is occurring at the regional or areawide level are useful because they can be used to identify how areawide congestion is changing over time.

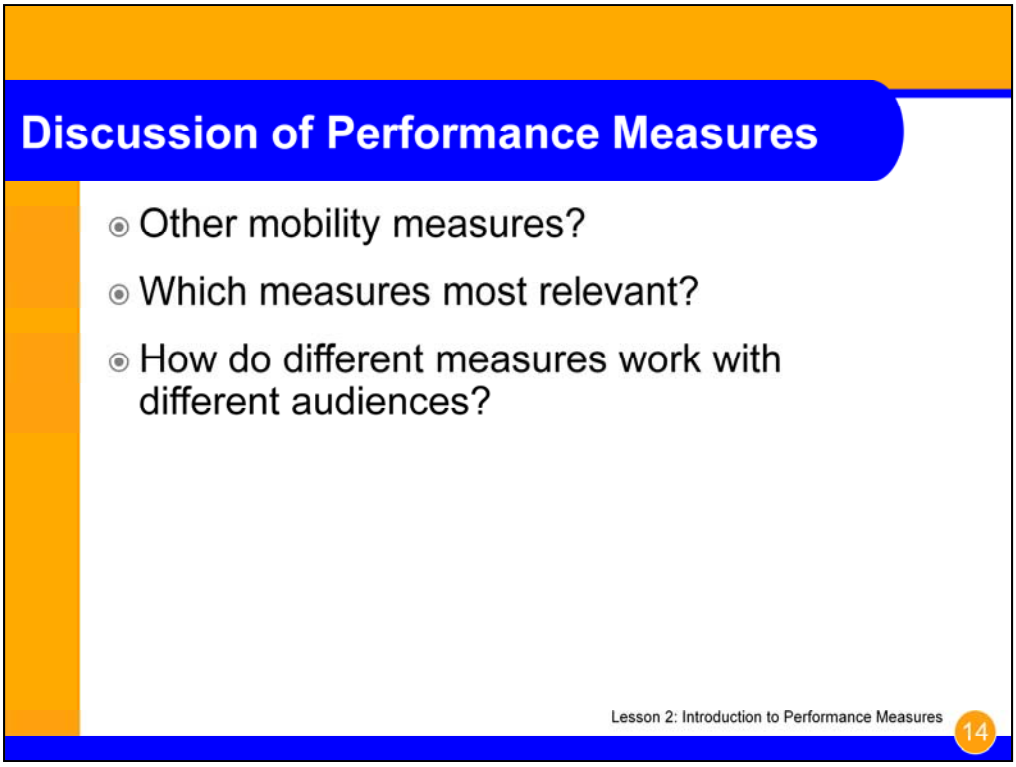
The individual measures may be useful when discussing an individual corridor or segment of roadway. They can also be used to tell the entire traveling public what affect congestion has on the average trip in a region or on a network. This is the case with a measure such as travel rate index or delay per traveler. However, an area measure such as congested travel doesn't convey much meaning when analyzing a segment of roadway. It is extremely useful when monitoring the situation on an entire roadway network.

Analysis Types

- Land development impact
  - Travel time, travel rate, delay per traveler, travel time index, buffer index, total delay
- Prioritization of improvements
  - Delay per traveler, travel time index, buffer index, total delay

Instructor reviews how different measures relate best to different types of analyses (pg 21). Instructors refer to Table 5 of the *Guidebook* on page 21 for additional examples.

Measures that relate to the trip experience of the individual driver resonate will with all audiences. Measures that capture what is occurring at the regional or areawide level are useful because they can be used to identify how areawide congestion is changing over time.



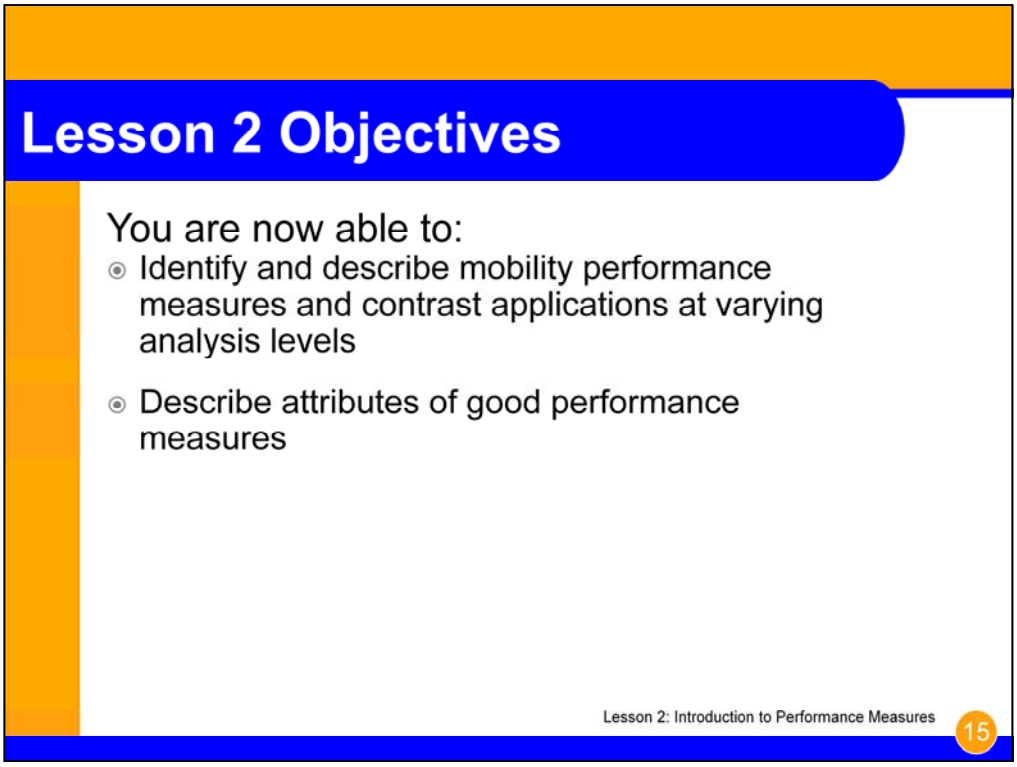
The instructor asks the audience if they can think of other possible mobility measures not discussed in the slides.

The instructor asks which performance measures discussed, or others, would be most relevant in their monitoring program.

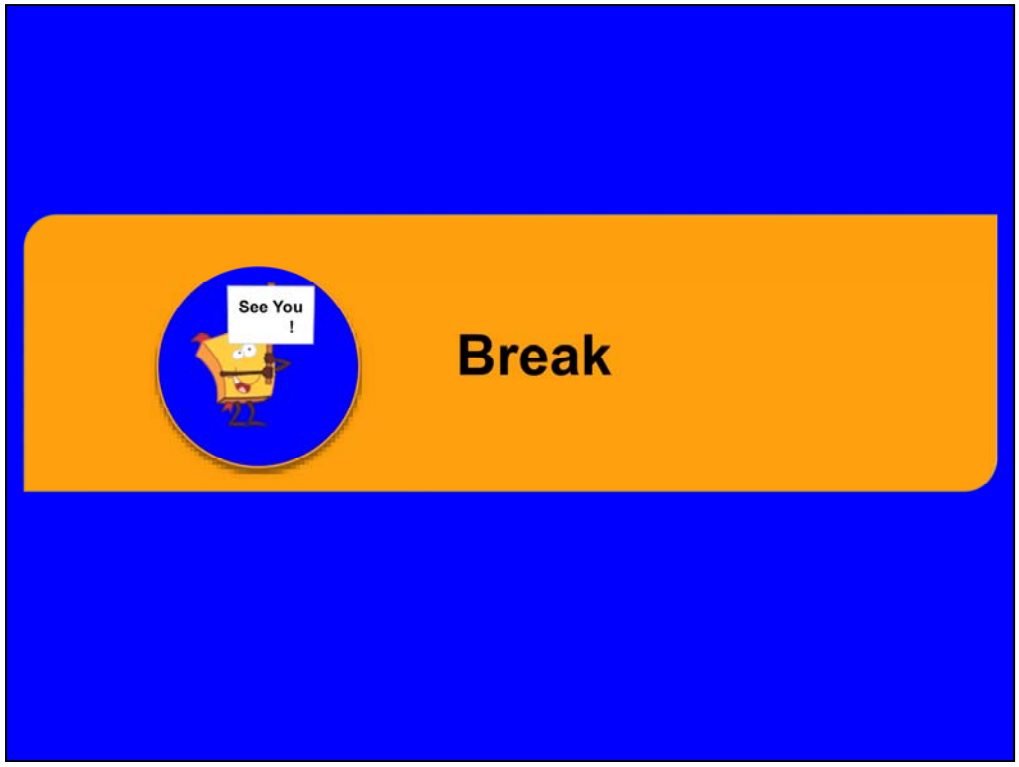
The instructor asks the audience why and how different measures work for different audiences.

The instructor asks for the targets that might be used in their monitoring programs for their city size.

Finally, the instructor asks what actions the audience would take when targets are exceeded.

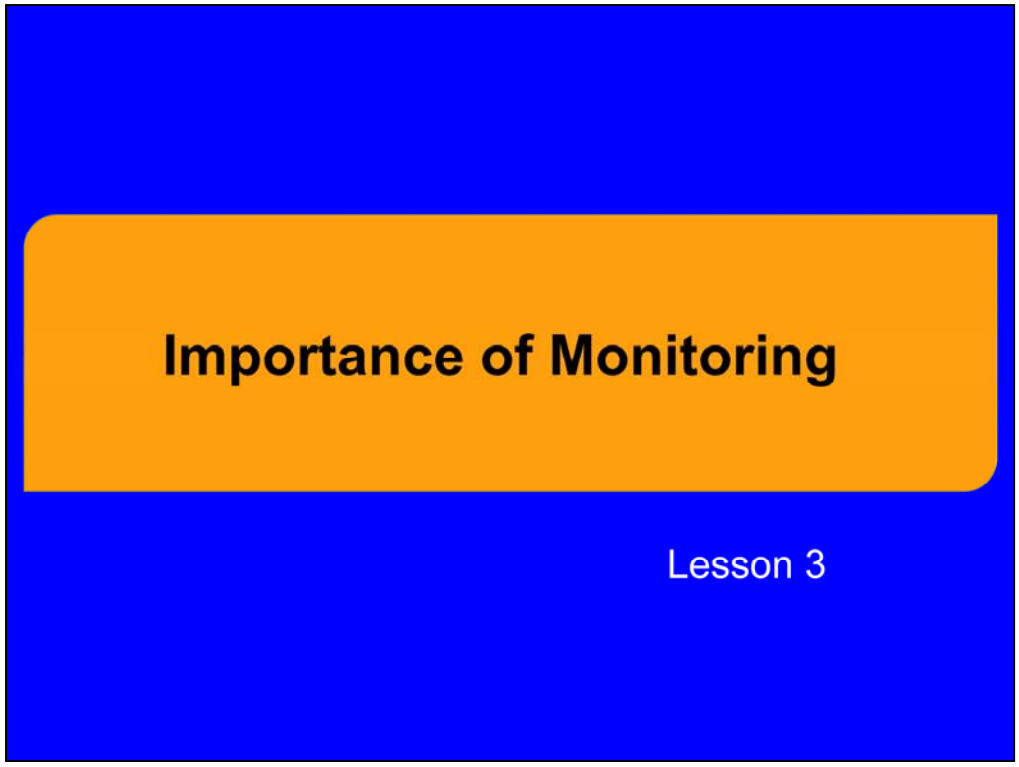


Restate the Lesson 2 objectives, and ask the participants if they have any questions before moving to the break.



Duration: 15 minutes

Time: 10:15 to 10:30 am

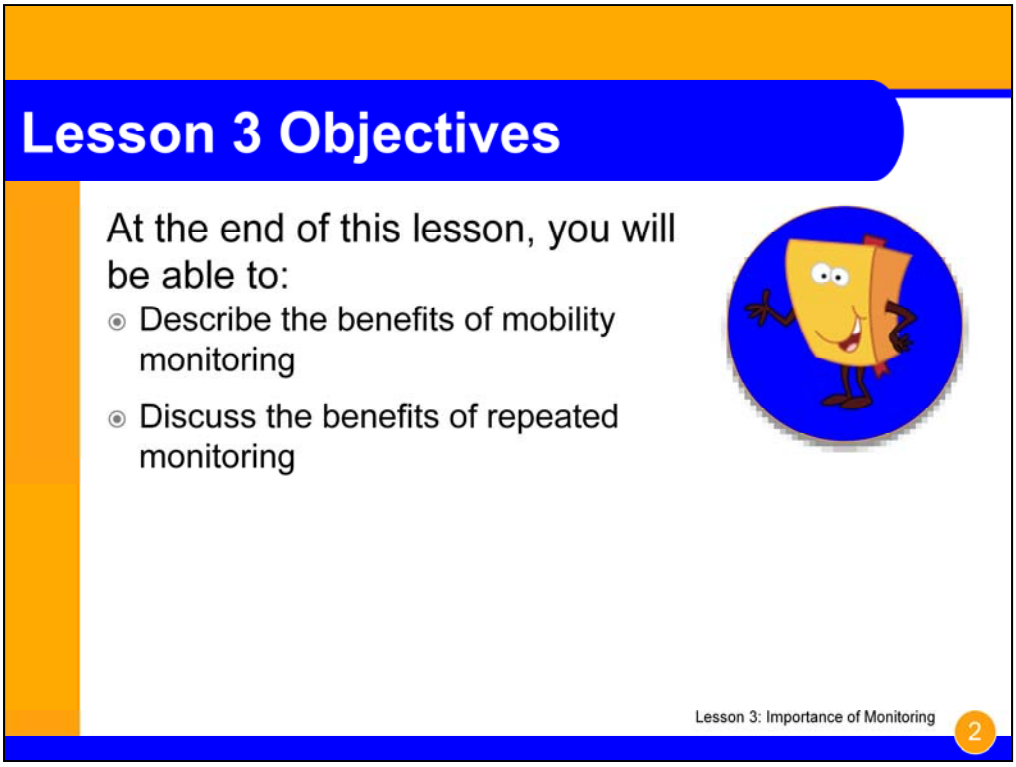


Duration: 15 minutes

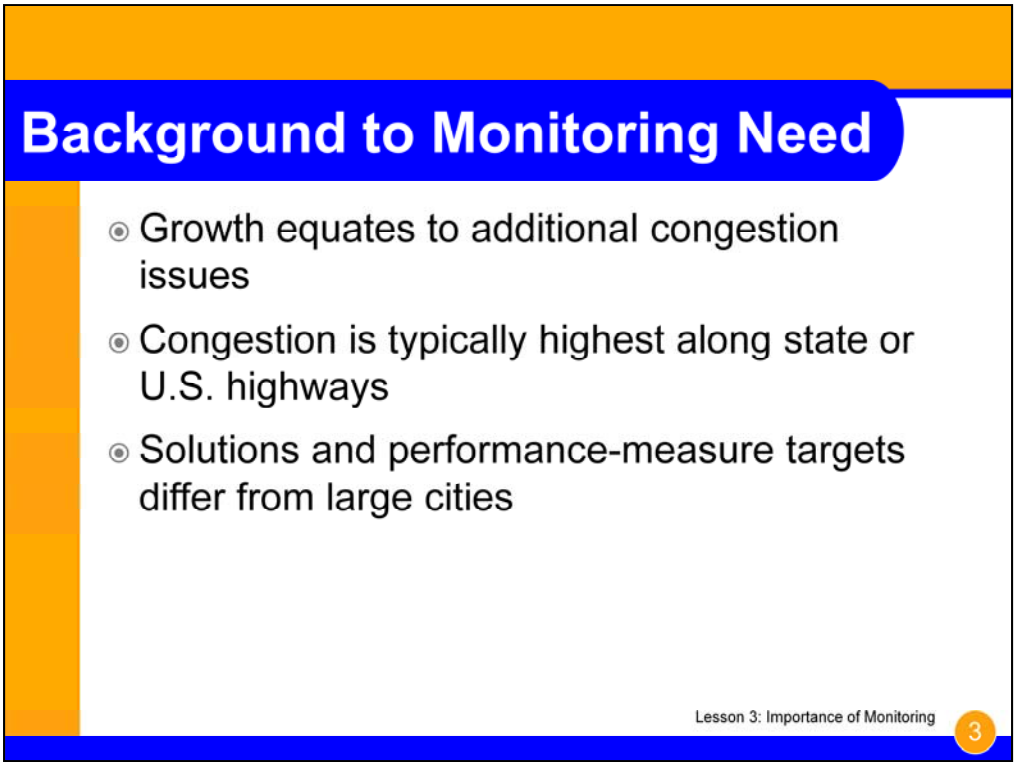
Time: 10:30 to 10:45 am

Time Allocation:

Lecture	10 minutes
Discussion	5 minutes



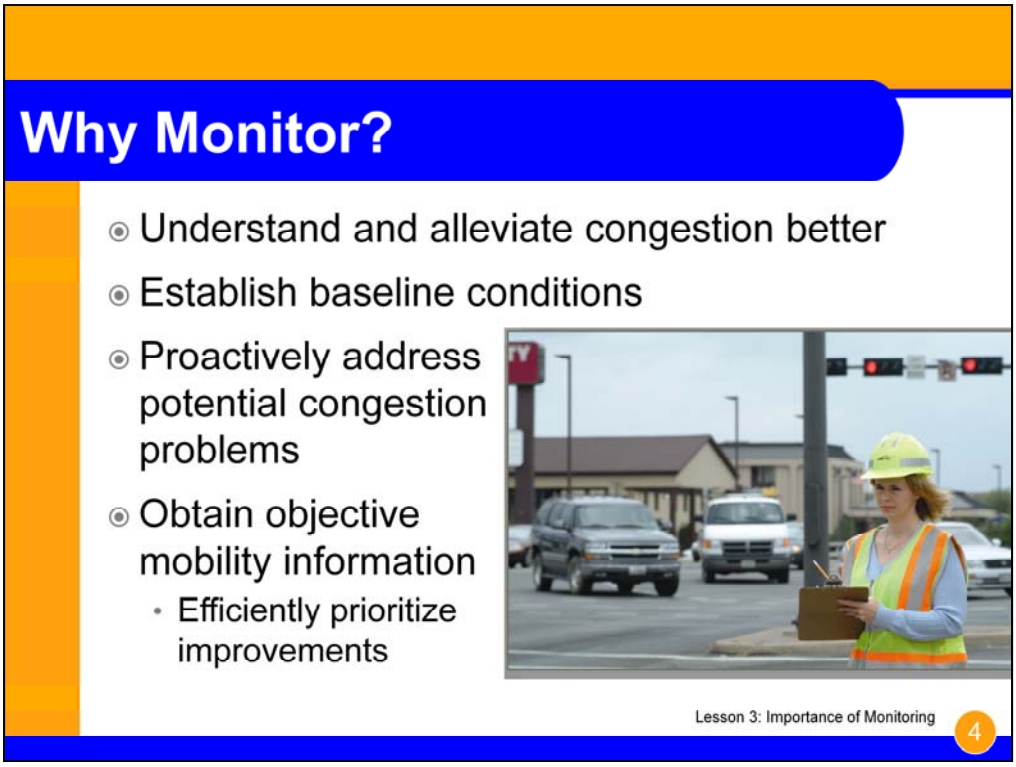
Verbally state the Lesson 3 objectives for the participants.



Transportation professionals in many growing small to medium-sized communities (SMSCs) struggle with congestion issues.

Congestion in these communities is often highest along state or U.S. highways that also serve significant amounts of local travel.

Potential solutions and performance-measure targets are much different for small communities than those identified in the literature for urban areas.



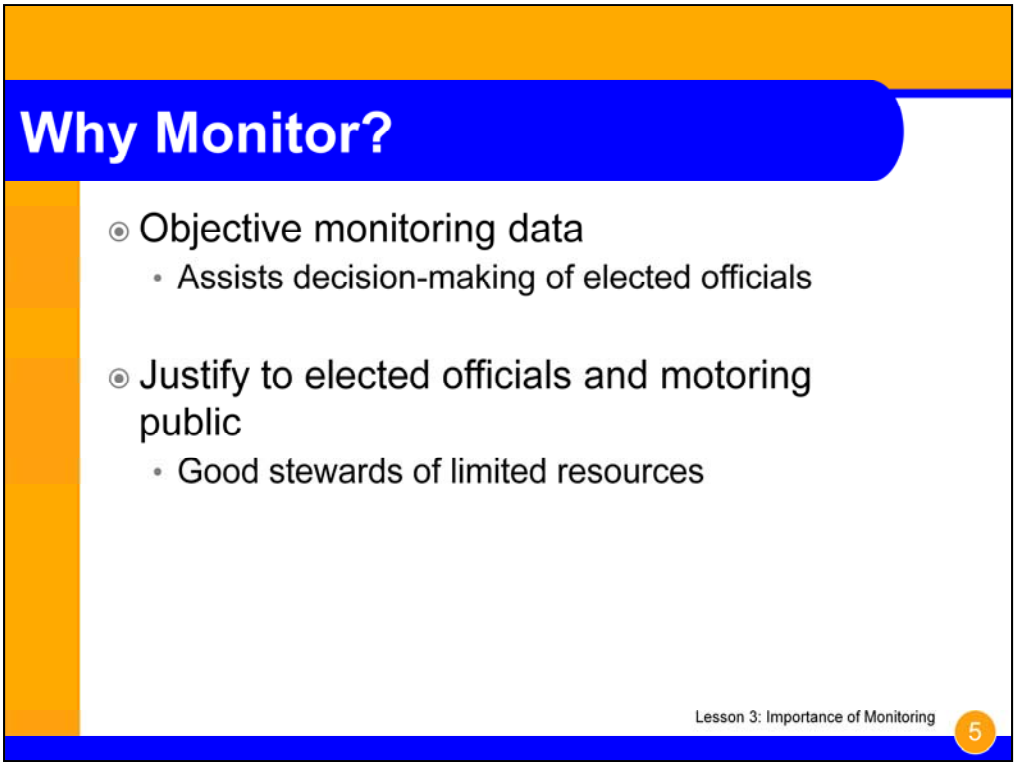
This leads to the question, “Why monitor?”

There are several reasons, but primarily it is that monitoring provides a means to SMSCs to better understand and alleviate congestion before it gets worse.

In locations where monitoring has not been performed, the initial monitoring will establish baseline conditions for future trend analysis.

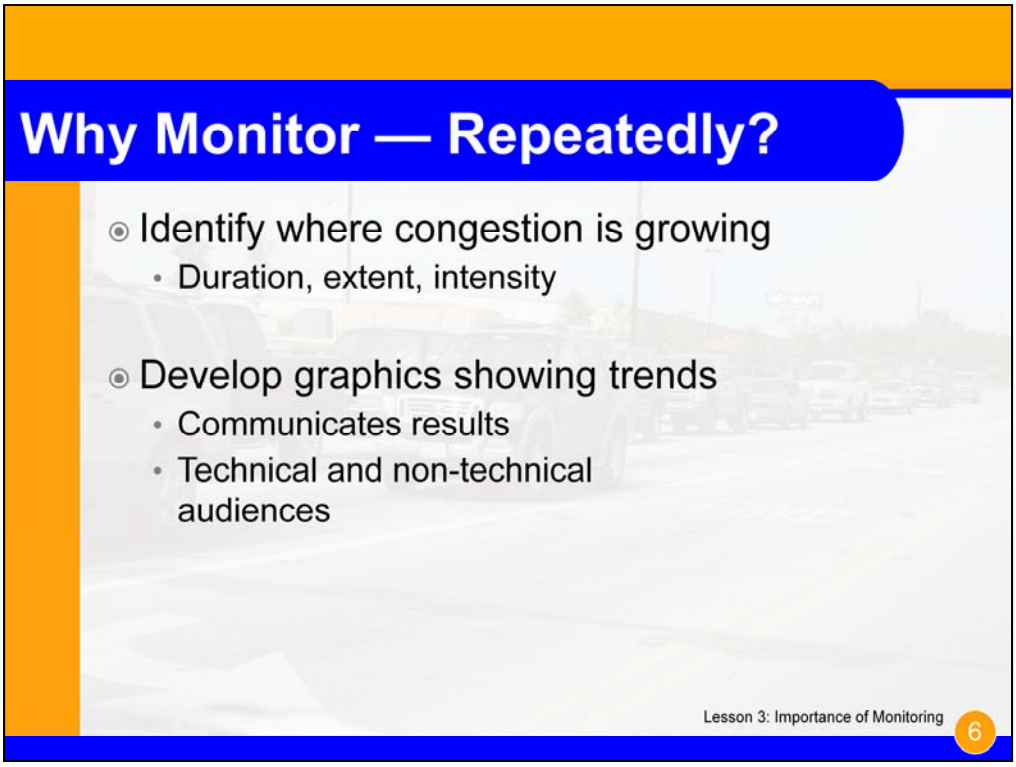
The process of monitoring mobility identifies congested locations and time periods, along with low-cost improvements that can alleviate congestion before it becomes a large-scale problem. Monitoring provides a proactive solution to the growing congestion problem.

Objective mobility information provides a way to effectively communicate performance and identify the location for, and the type of, needed improvements.



In addition, monitoring mobility provides objective congestion information to assist transportation professionals in identifying locations for improvement, identifying the type of improvement, and objective information that can assist decision-making of elected officials for project selection.

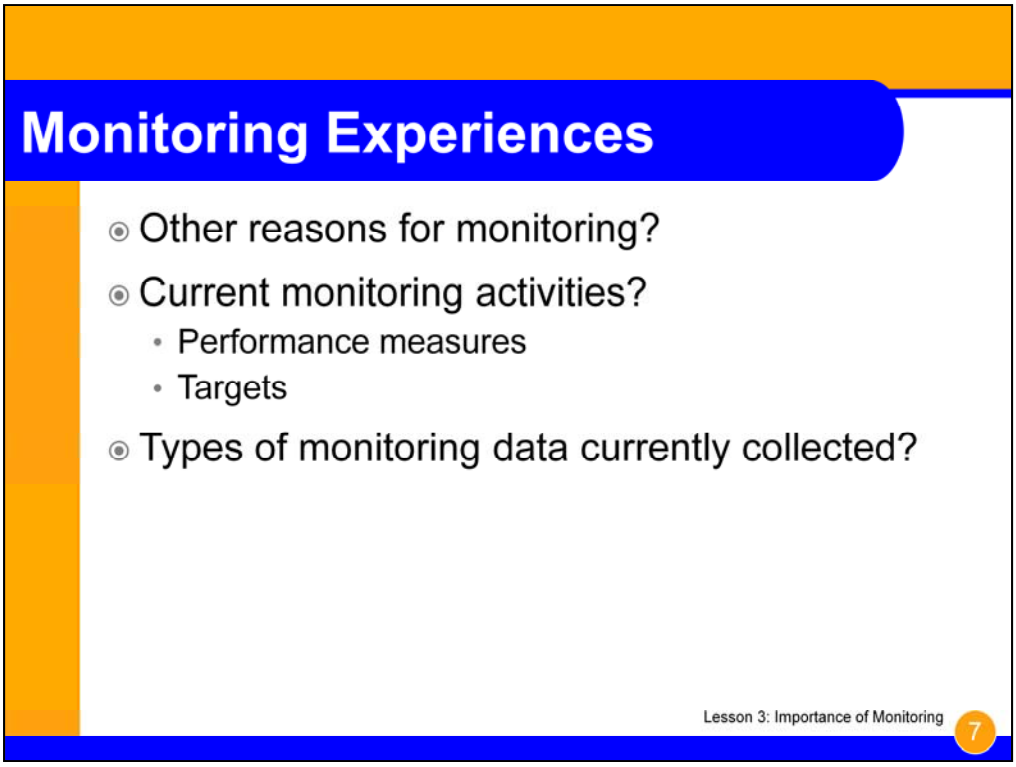
Monitoring also provides justification to elected officials and the motoring public that transportation agencies are being good stewards of their limited resources because mobility-improving decisions will be made based upon objective data. Such data also assist decision-making of technical staff and elected officials.



Repeated monitoring is where benefits can really be observed. Repeated monitoring, every 6 months or annually, allows for trend analysis. It allows the analyst to identify where congestion is growing. The duration, extent, and intensity of congestion can be followed by comparing the monitoring results.

Definitions of congestion dimensions:
Duration is the amount of time during the day that the travel speed (or travel time) indicates congested travel along a roadway, parts of the system, or the entire system.
Extent is described by estimating the number of people or vehicles affected by congestion and by the geographic distribution of congestion. It may be measured by person-miles of travel or person-trips that occur during congestion periods. The percent, route-miles, or lane-miles of the transportation system affected by the congestion may be used to measure the geographic extent of mobility problems.
Intensity (or severity) of congestion that affects travel is a measure from an individual traveler's perspective. In concept, it is measured as the difference between the desired condition and the conditions being analyzed (e.g., travel rate index).

Trend analysis lends itself to the creation of graphics to communicate the monitoring results to technical and non-technical audiences. Communication methods will be further discussed in Lesson 8.

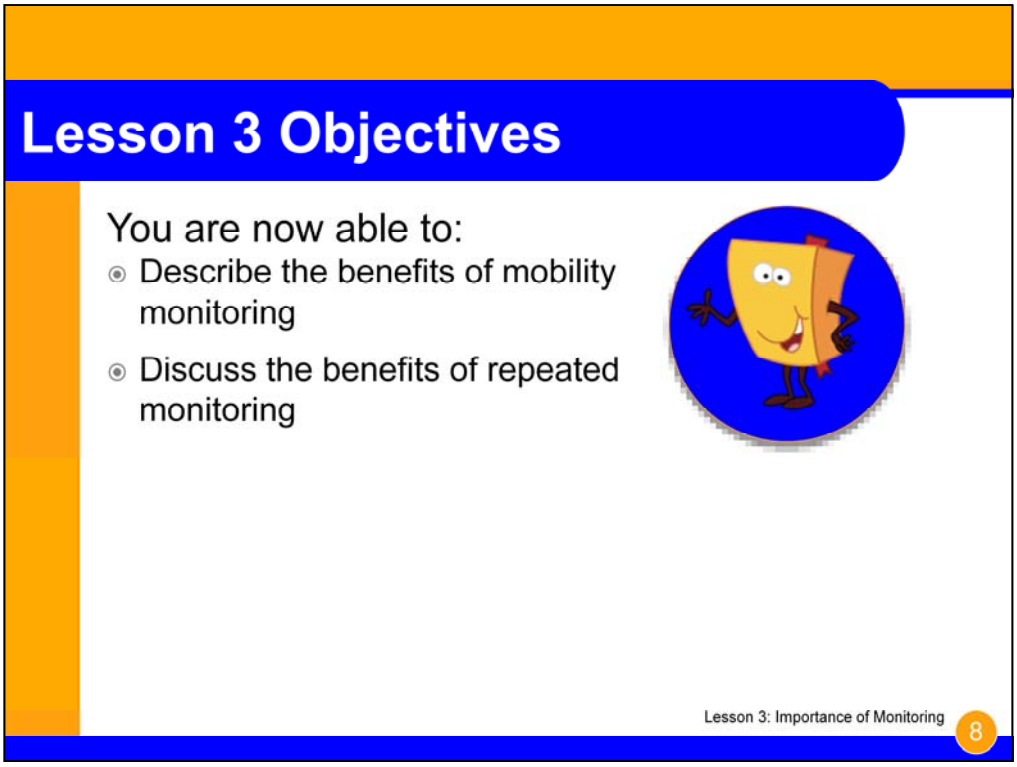


The instructor asks participant feedback on:

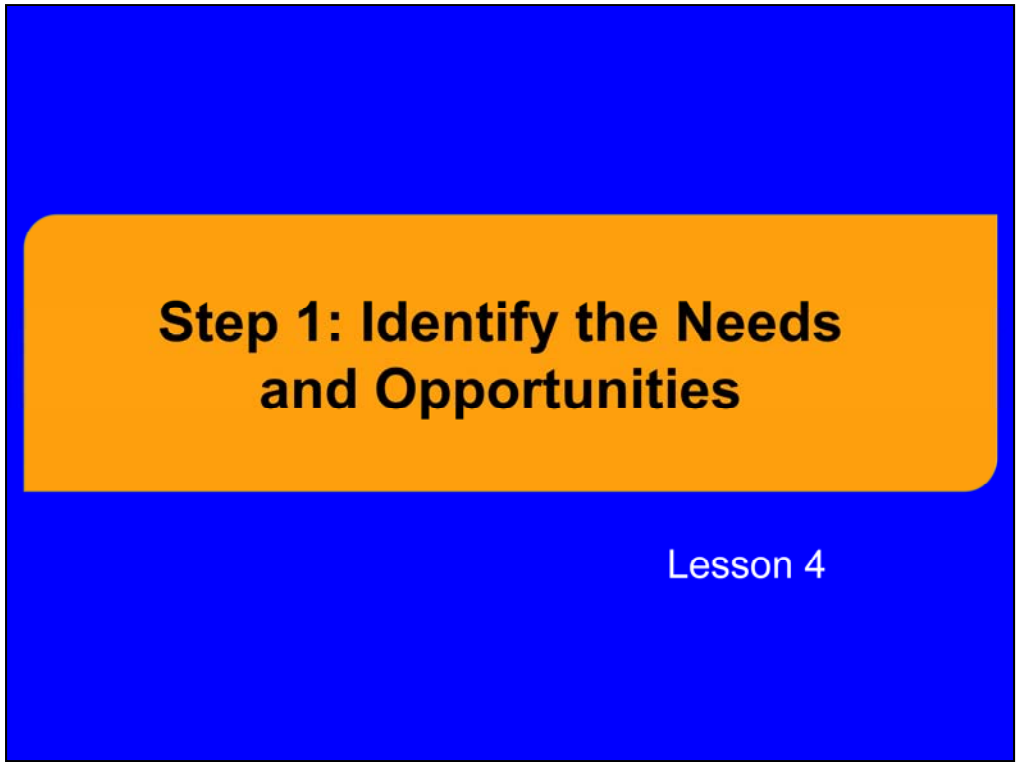
- Additional reasons for monitoring.
- Any current monitoring activities by communities represented here?

If current monitoring activities are identified, the instructor asks:

- What performance measures are used?
- Have targets been established?
- What types of monitoring data are collected?



Restate the Lesson 3 objectives, and ask the participants if they have any questions before moving to the next lesson.

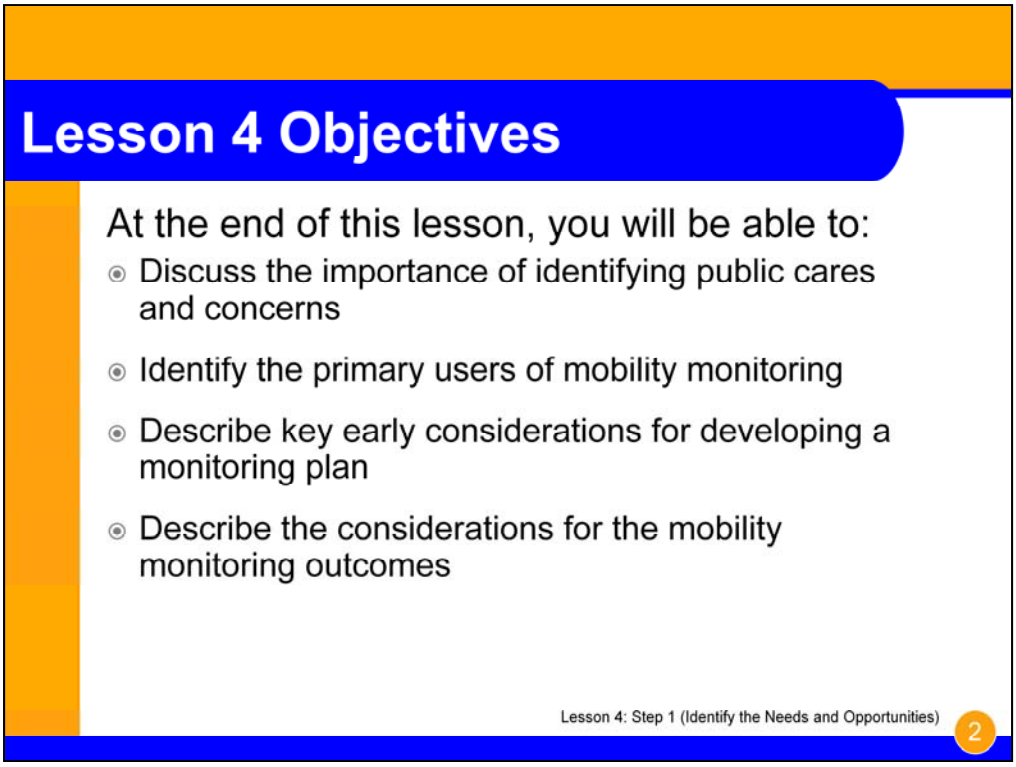


Duration: 45 minutes

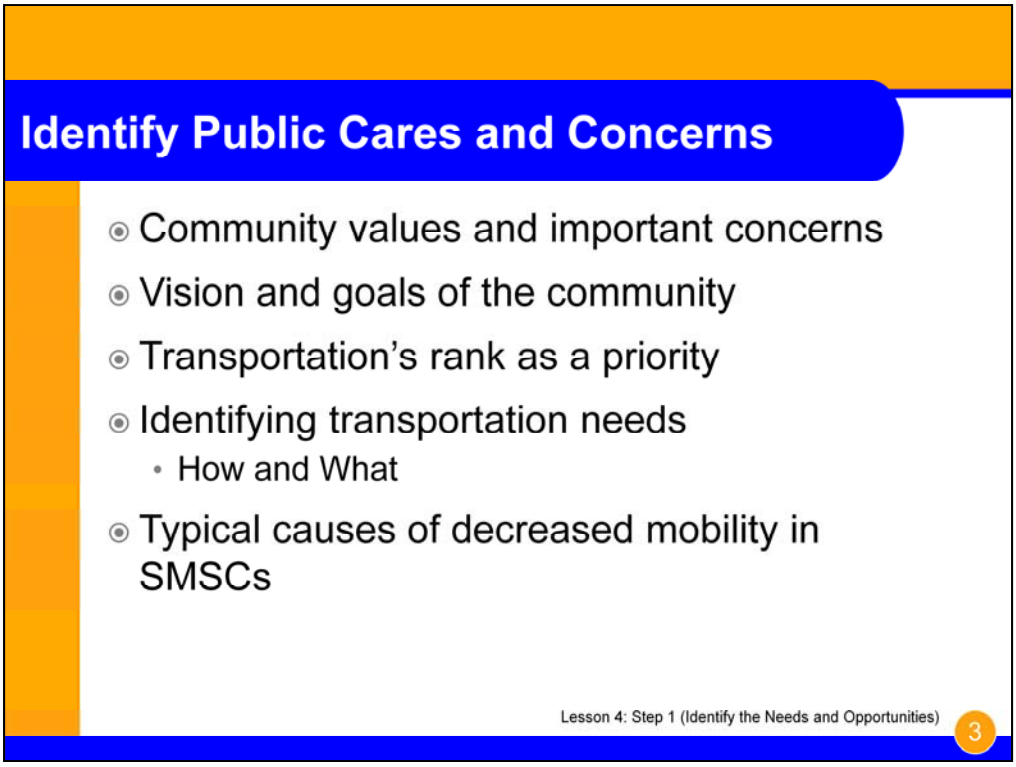
Time: 10:45 to 11:30 am

Time Allocation:

Lecture	15 minutes
Exercise	30 minutes



Verbally state the Lesson 4 objectives for the participants.



Instructors will encourage participants to respond to these questions from their communities. Below is guidance on where these answers might be found for a community, and typical responses.

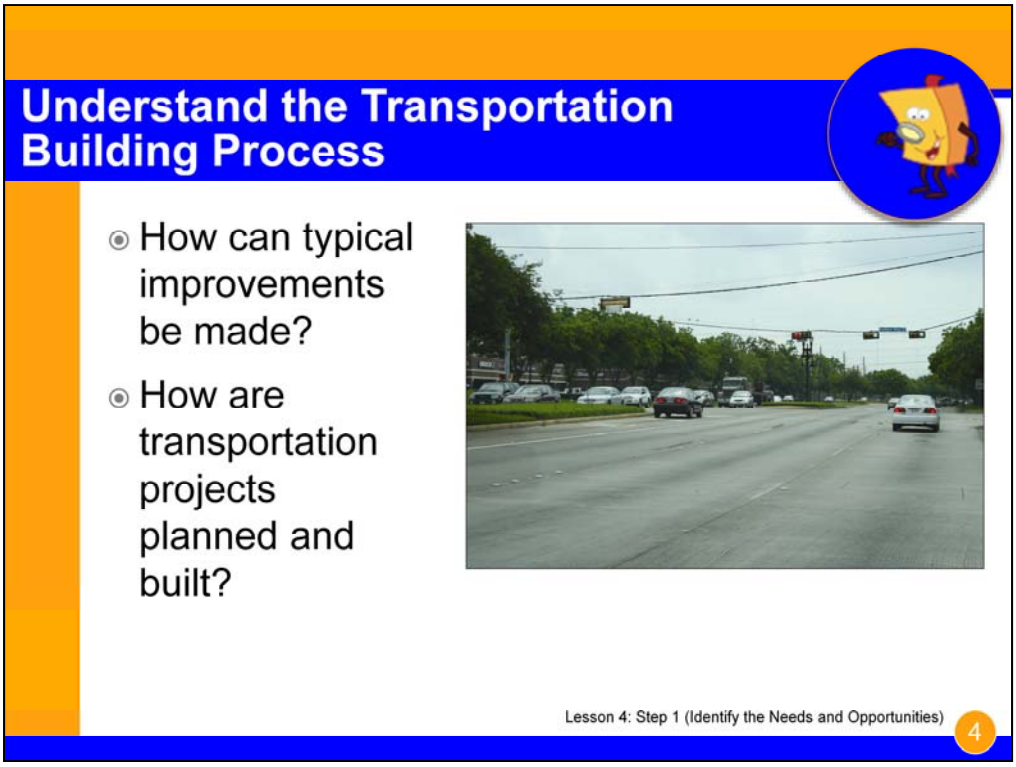
Because increasing demands on infrastructure are frequently growing faster than available budgets to address problems, it is critical to ensure that public service professionals are focused on issues that are perceived as problems in the community. Simply watching the local print or television media can provide a cursory indication of community values and important concerns. Community surveys on transportation/traffic, managing growth/development, education/schools, economy/jobs, public safety/crime, and housing will also provide an indication.

Cities and counties typically have mission statements, visions, and related strategic goals that can provide insight into the value placed on transportation in the community. For example, something like "safe and efficient mobility" is a typical goal in a city's comprehensive plan.

Ongoing monitoring process will rely on goals and objectives related to transportation in promoting the need for mobility monitoring in the community. If transportation is not a high priority and/or there are other more critical or pressing issues at the moment, that information is equally useful.

Several transportation needs will be identified by answering the prior questions—needs that come from both transportation professionals and other stakeholders such as the general public. Needs can be identified by speaking to professionals at transportation agencies.

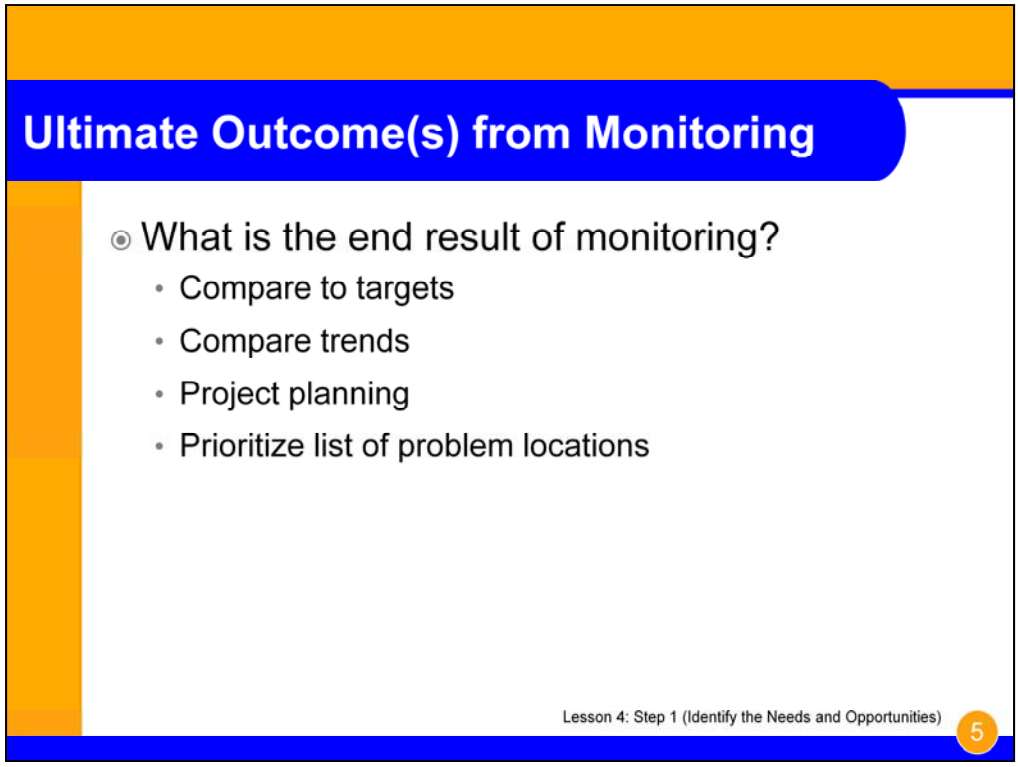
Your community is growing, leading to increased congestion. Some typical causes of increased congestion in a SMSC include:
• rapid development;
• inadequate roadway capacity;
• increased traffic control (signals);
• current and increased truck traffic through or within the community;
• inadequate bicycle and pedestrian facilities;
• inadequate transit;
• special events;
• work zones; and
• lack of development regulatory controls or municipal ordinances.



Instructors will encourage participants to respond to these questions from their communities. Below is guidance on where these answers might be found, and typical responses.

The ultimate outcome of the mobility monitoring effort is identifying locations needing mobility improvement projects. Relatively low-cost projects such as signal timing improvements can typically be done within existing municipal budgets. Moderate-cost improvements such as widening projects, median installations, or intersection improvements may be expensive enough to require you to plan and prioritize them in competition with other projects in the jurisdiction (state, city, or county). Keep in mind the importance of elected officials as project champions, and that mobility monitoring provides objective information for project decision-makers.

Planning and constructing new-location roads is a long process. It can take 10 years or more to complete the steps of planning, design, environmental clearance, right-of-way acquisition, and construction. The project prioritization process provides the opportunity for input from all stakeholders including the public. If your community is located within an urbanized area's metropolitan planning area, transportation projects are planned and built through the MPO process. State roadways that are not located within an MPO's metropolitan planning area are programmed by the state DOT district office in which the project is located.

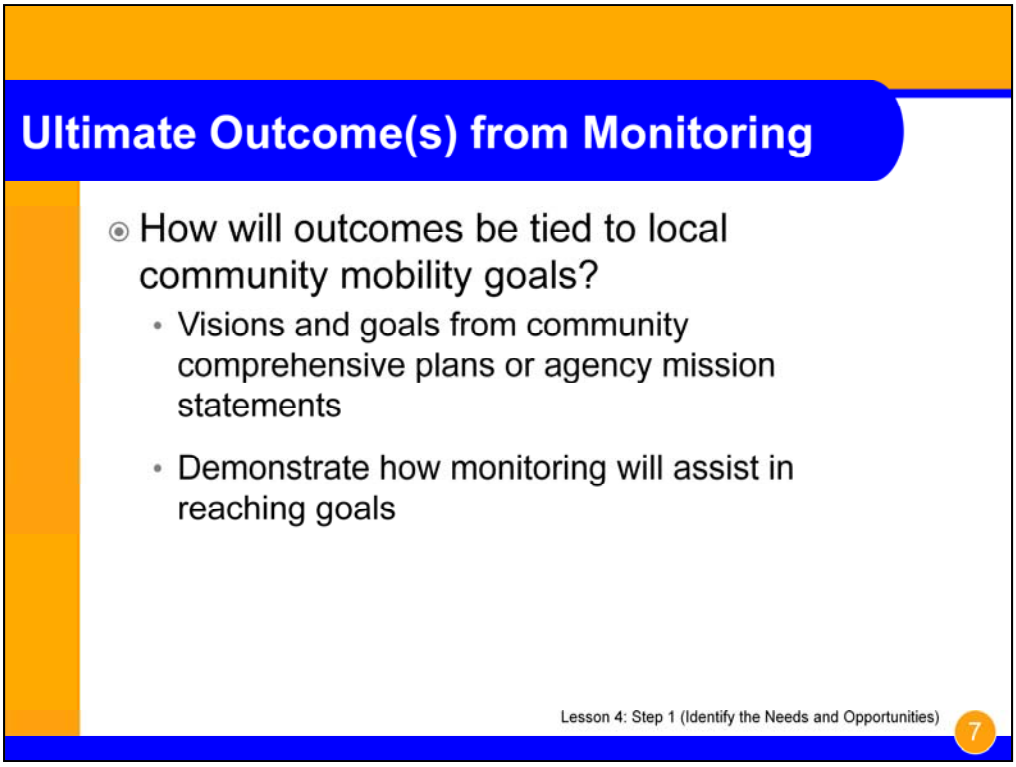


In any planning exercise, it is always helpful to think about the desired outcome at the end of the project. Desired result of the monitoring is to improve mobility by measuring, documenting, and reporting mobility changes so needed improvements can be planned.

Ultimate Outcome(s) from Monitoring

- What should the final press release say?
  - Describe baseline congestion levels
  - Identified congestion time periods
  - Measures used and key statistics
- Provides a clearer vision as you work through the entire framework

Think ahead. What would like your press release to say when you have completed the monitoring? This will provide you a clearer vision as you work through the entire framework.

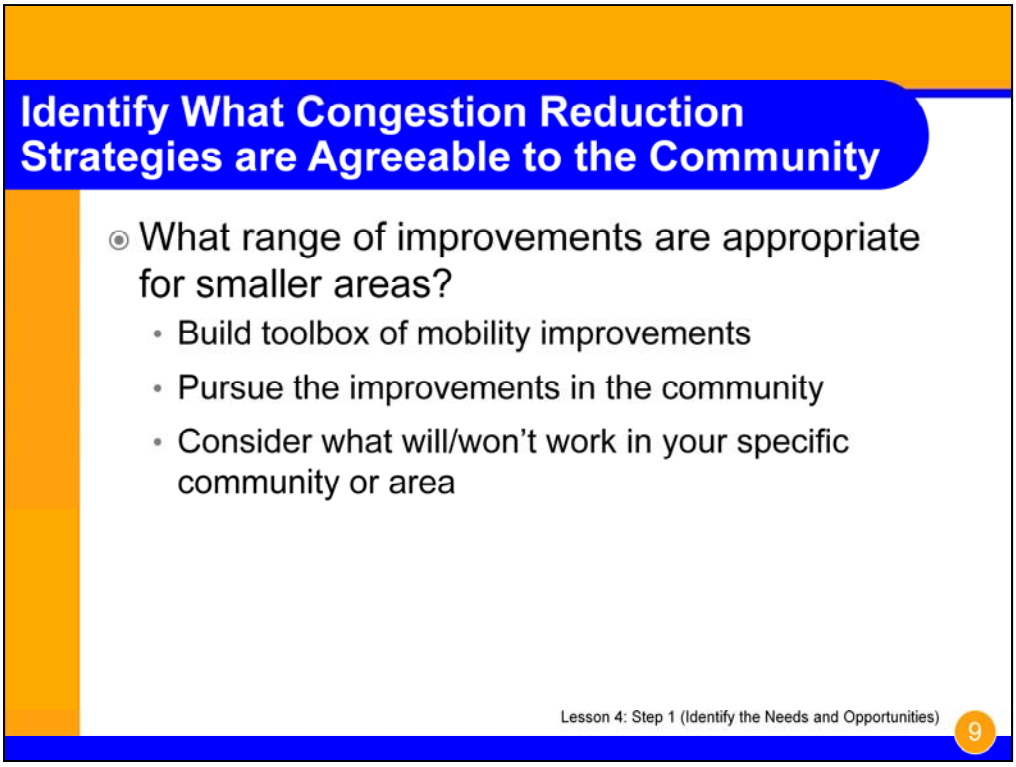


The instructor points out that this consideration provides the opportunity to determine how the findings documented in the final press release will directly tie to your previously accepted mobility goals.

It is important to understand how congestion is defined in your community because congestion differs by city size.

When communities are going through plan updates (e.g., updated city comprehensive plan), there is an opportunity to revisit how those in the community define congestion.

Instructor reflects back to prior definitions and discussion.



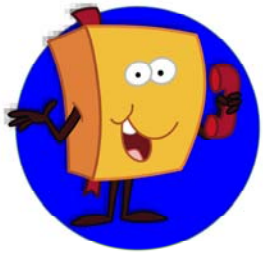
It is important to think about the potential toolbox of improvements early in the process. The toolbox will likely include a combination of projects, plans, and/or policies. Typical improvements in a SMSC might include optimizing traffic signal timings, restriping pavement, widening roadway, implementing low-cost widening projects at intersections, consolidating driveways, installing raised medians, and removing bottlenecks.

Instructors can review *Guidebook* Table 6 (pgs 22-24) with the participants and should note that what might work in one community may not have the same success in another community depending upon available funding, political climate, precedent for past improvements, and the like.

The instructor asks participants to highlight what projects, programs, or policies might be in their "mobility toolbox." The instructor asks if there are some that are not included in Table 6.

Determine the Preferred Method of Communication to the Public and Other Users

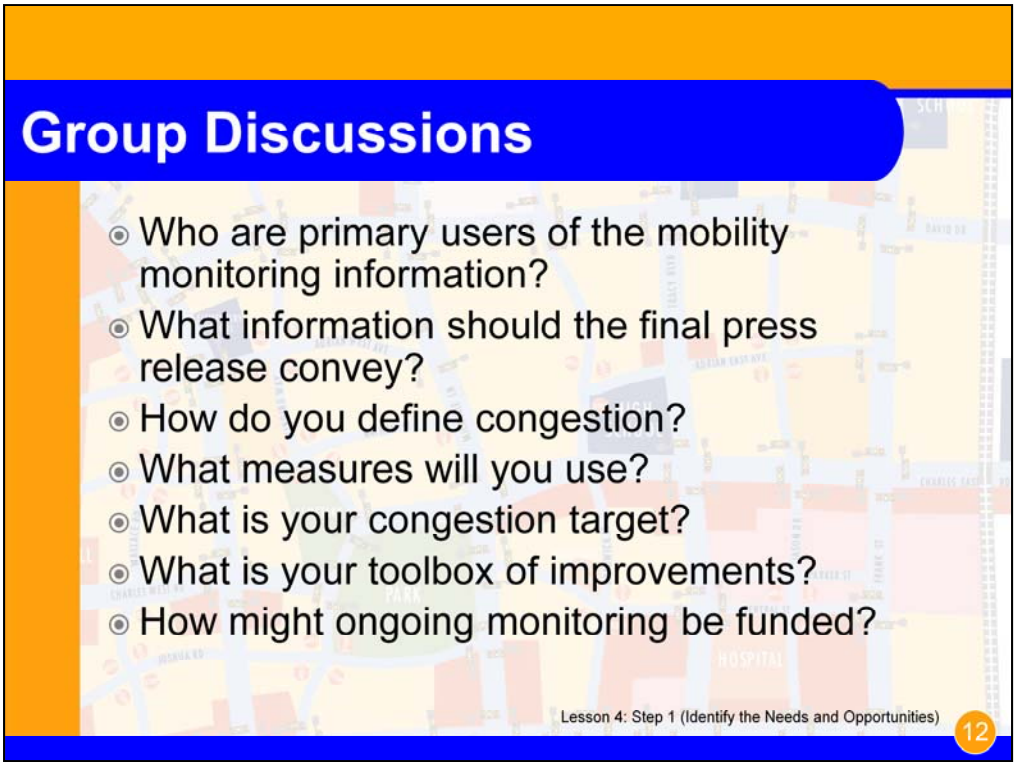
- Most effective communication methods
  - Tables: monitoring results
  - Maps: congestion severity by location
  - Graphics: trends



At this point in the process, it is important to understand what users/uses will require communication tools so you can begin formulating the best methods of presentation to those audiences. Lesson 8 (Step 5: Package and Distribute the Results) will describe specific examples of communication tools.

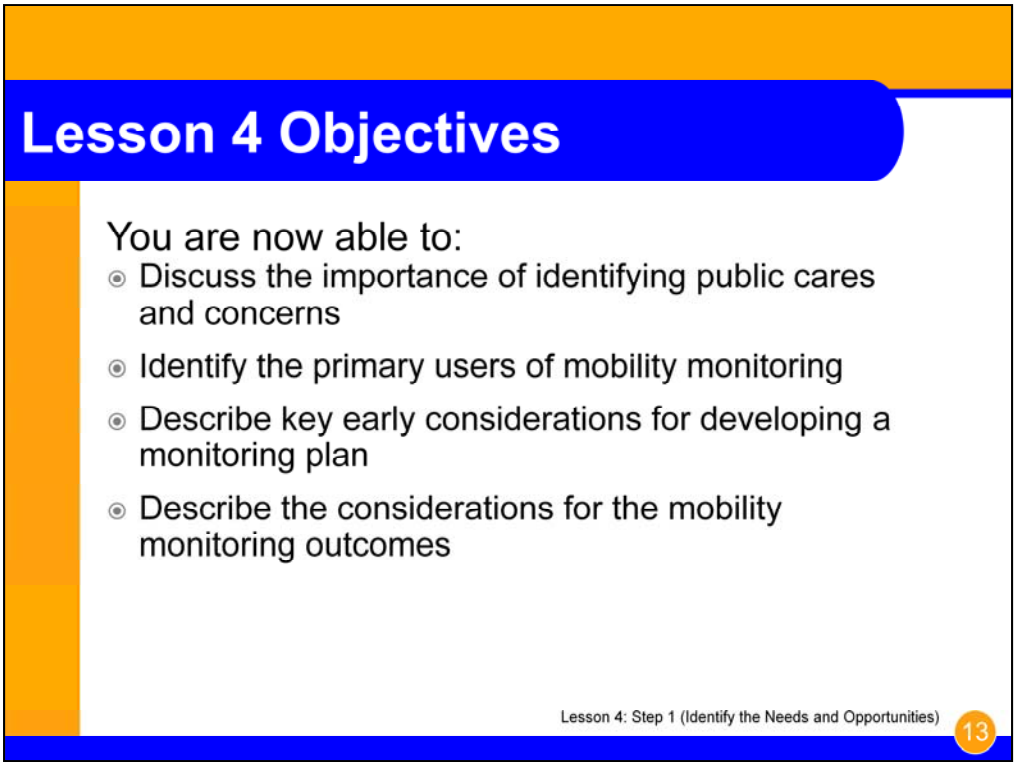
Instructors distribute the appropriate maps (scenarios) for the participants in attendance. Maps are for a small area (with or without a bypass) and a medium-sized area. Instructors review the key transportation elements and the legend with participants to familiarize them with map contents.

Instructors then provide a list of issues and complaints received in each community by transportation professionals from the citizens, motoring public, and elected officials.

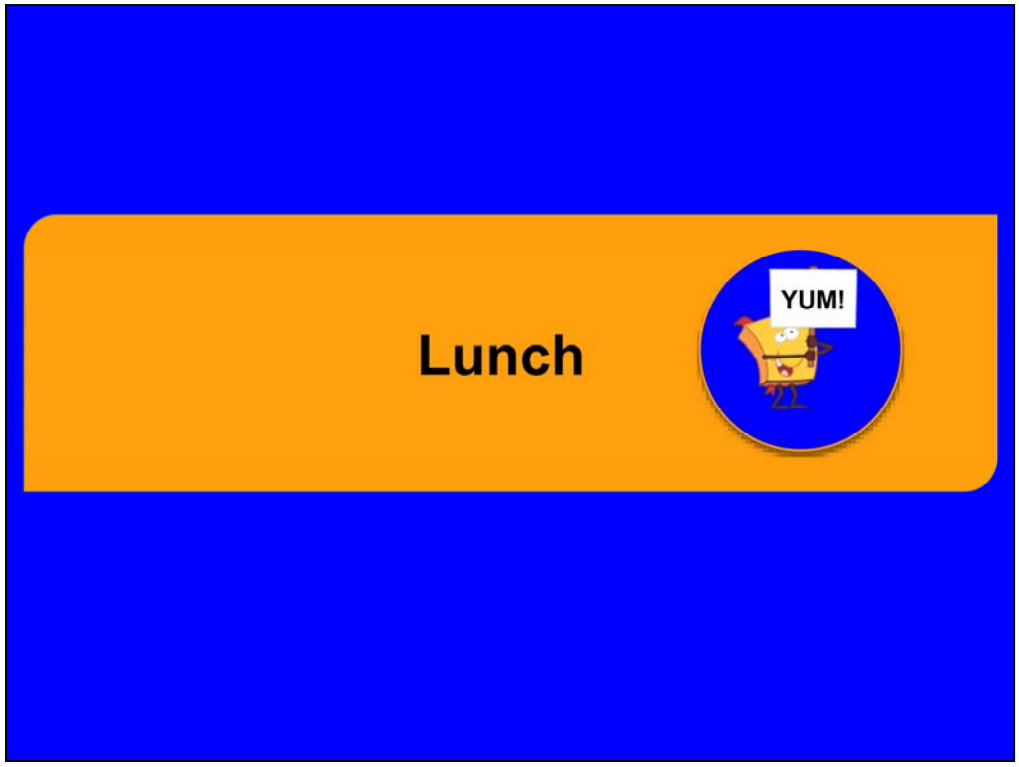


Participants will be encouraged to work in their groups to determine answers for the questions shown on this slide.

After 20 minutes of group work, team leaders of the selected group(s) will present their responses for 10 minutes total.



Restate the Lesson 4 objectives, and ask the participants if they have any questions before adjourning to lunch.



Duration: 75 minutes

Time: 11:30 to 12:45 pm

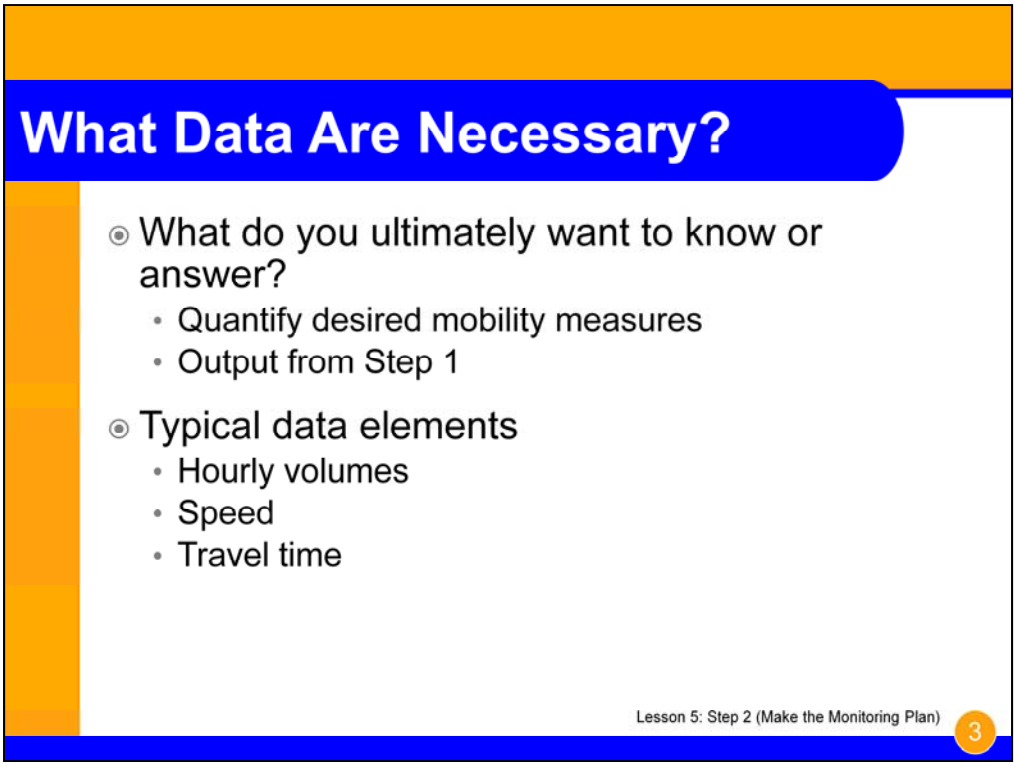
Duration: 45 minutes

Time: 12:45 to 1:30 pm

Time Allocation:

Lecture	15 minutes
Exercise	30 minutes

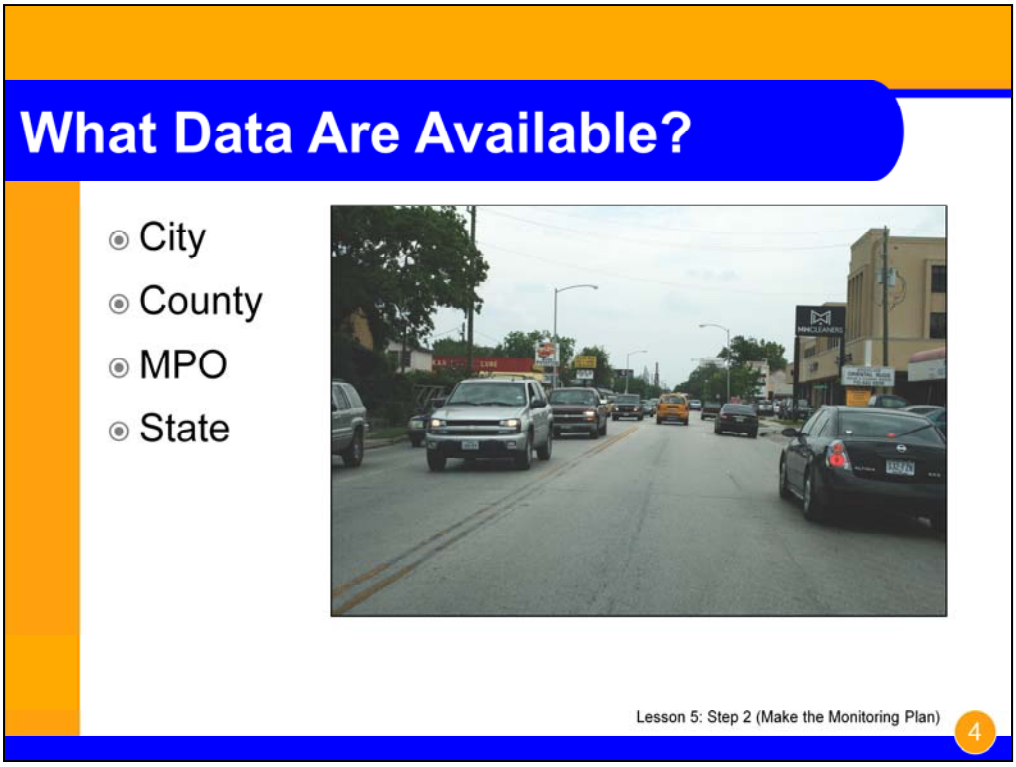
Verbally state the lesson objectives for the participants.



In Step 1 of the framework, you identified what you would like to ultimately know as a result of the monitoring process. You considered what you would like your press release to say at the conclusion of the monitoring. You also considered how the outcomes would be tied to local community mobility goals. In this step, you consider what data are needed to reach those outcomes.

Data, and the measures they support, tell a story over time.

Typical data include hourly volumes (peak and off-peak), speed, and travel time. Other useful data you will want to collect include incident information, weather information, and road work information.

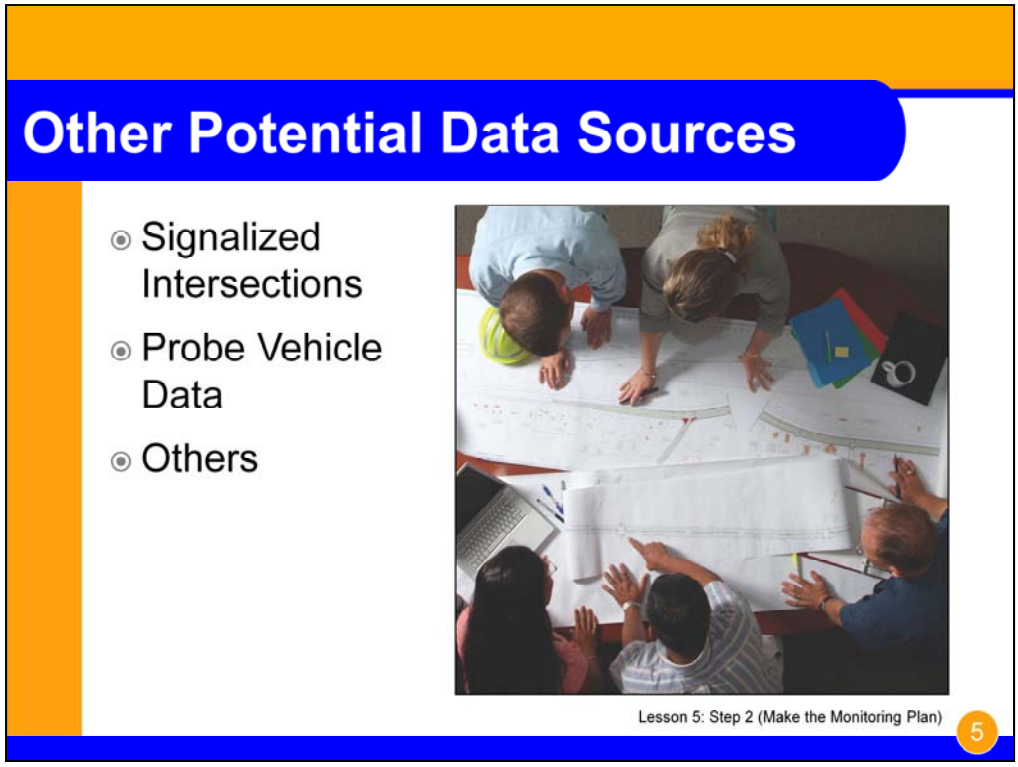


SMSCs require responsible allocation of their limited funds. Remember: collect data once, but use it often. This is particularly important because SMSCs typically will not have dedicated traffic monitoring instrumentation in the field.

State DOTs maintain automatic traffic recorders (ATRs) on state-maintained facilities. Usually only a few in larger areas. State DOTs typically supplement continuous traffic counts with vehicle classification counts. Contact your state DOT to identify available data. State DOTs conduct yearly monitoring and reporting of traffic conditions throughout the state. ATR data support this reporting need, and the largest foundations of traffic data are collected with pneumatic tubes.

It is important to check with state, city, county, and MPO representatives in your community to identify other traffic count data sources that may exist.

Instructors engage the participants in a discussion of available data and data sources.



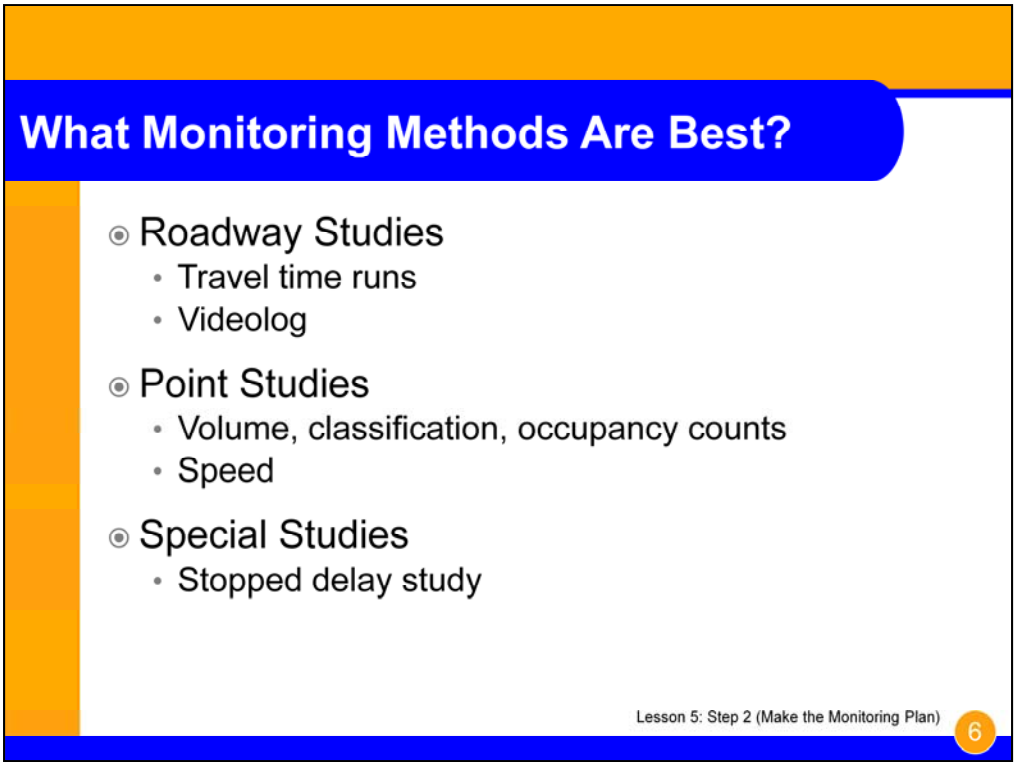
It is important to be opportunistic in looking for other potential data sources.

Signalized intersections in the community are a possible data source. Some signal systems have the ability to save the volume data obtained from the detectors. While it is a “free” data source, you must investigate the quality of the data.

Another example is obtaining travel time data from existing probe vehicles in the traffic stream. Before intelligent transportation systems were implemented in larger cities, many locations used travel time data from fleet buses or municipal fleet vehicles. Obviously there is bias due to the unique operations of the probes (buses drop off and pick up customers), but they can provide an estimate of travel times and can provide a starting point for monitoring in SMSCs.

When considering existing probes, ask:
• Are the data available?
• Are the data stored?
• How aggregate are the data?
• Is there any quality control?
• Are data errors, or suspicious data, noted?
• Can fleet vehicles be trained for monitoring and perform their primary functions?

Instructors will engage participants about other potential data sources that may be available in their communities.

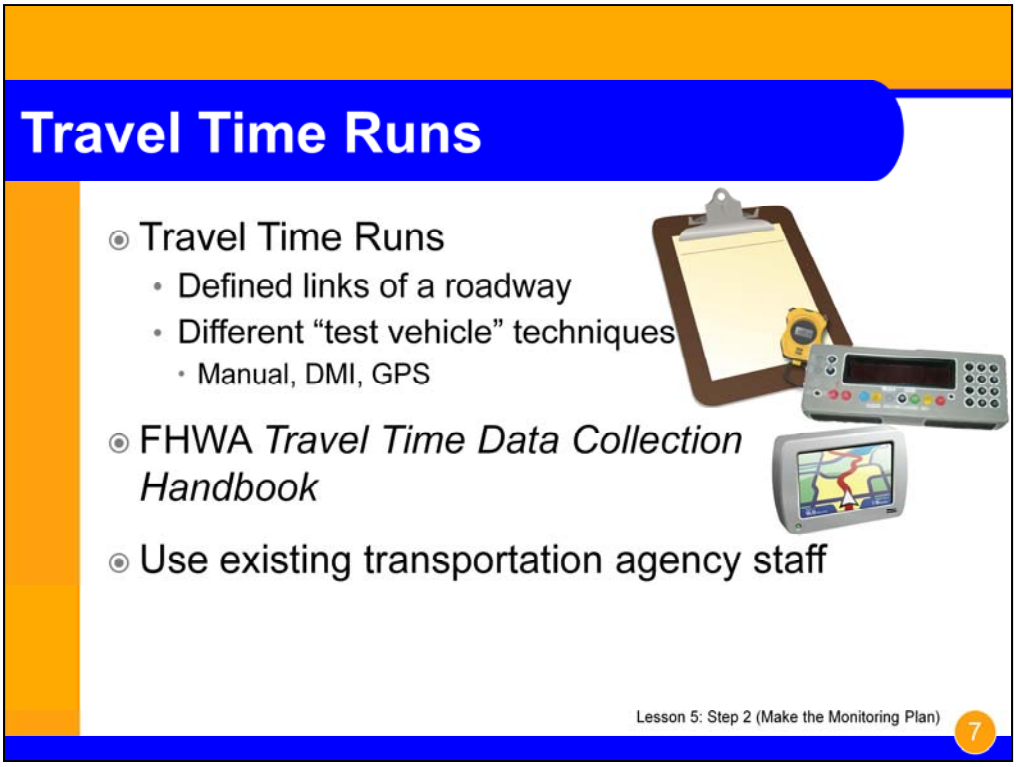


Now that you have decided what type of data are needed and what type of data may already be available, it is time to consider what data collection activities you may need to perform. You probably won't be able to use all existing data. Obtaining a complete mobility monitoring picture in your community will likely include three types of studies:

• **Roadway Studies** — Studies that encompass analysis along an entire roadway (e.g., travel time runs, videolog)

• **Point Studies** — Studies that include data collection at a specific location (e.g., volume counts, classification counts, occupancy counts, speed)

• **Special Studies** — Studies that do not necessarily occur at the "roadway" or "point" level (e.g., stopped delay study)



Travel time runs are a roadway study that provide a way to estimate travel time or speed along your primary roadways. Travel time runs are performed with "test vehicles", and drivers use a data collection vehicle within which an observer records cumulative travel time at predefined checkpoints (i.e., intersections) along the route. There are three levels of instrumentation you can use to measure travel time with a test vehicle:

• **Manual** — manually recording elapsed time at predefined checkpoints using a passenger in the test vehicle

• **Distance Measuring Instrument** — determining travel time along a roadway based upon speed and distance information provided by an electronic DMI connected to the transmission of the test vehicle

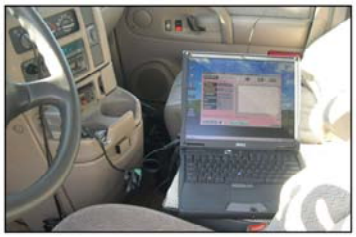
• **Global Positioning System** — determines test vehicle position and speed by using signals from earth-orbiting satellites

Federal Highway Administration's *Travel Time Data Collection Handbook* is a comprehensive resource for travel time data collection. It includes sections on developing a data collection schedule, developing equipment checklists, developing data collection forms, and performing trial runs, as well as many other sections that will assist you.

One way to cut costs is to use transportation agency staff. Employees could use the instrumentation equipment on daily commutes to capture mobility information during the peak periods of the day. With increased use of personal data assistants (PDAs), this may be more viable.

Comparing Travel Time Test Vehicle Data Collection Methods

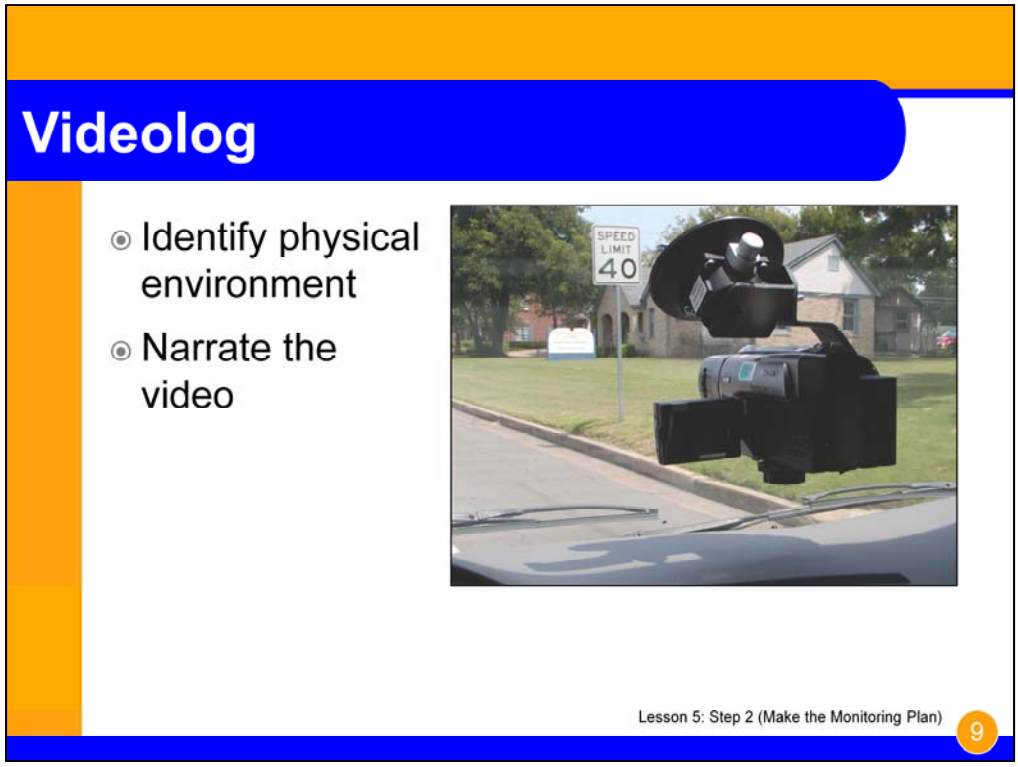
Instrumentation Level	Costs			Level of Data Detail
	Capital	Data Collection	Data Reduction	
Manual:				
Pen and Paper	Low	Moderate	High	Low
Tape Recorder	Low	Low	High	Low
DMI	High	Low	Low	High
GPS	High	Low	Low	High



Lesson 5: Step 2 (Make the Monitoring Plan) 8

This table compares costs and level of data detail for typical instrumentation levels for travel time data collection in SMSCs. Note that while capital costs are initially higher with the DMI an GPS methods, these methods have a lower cost of data collection and reduction to automation capabilities. They also produce more detailed data.

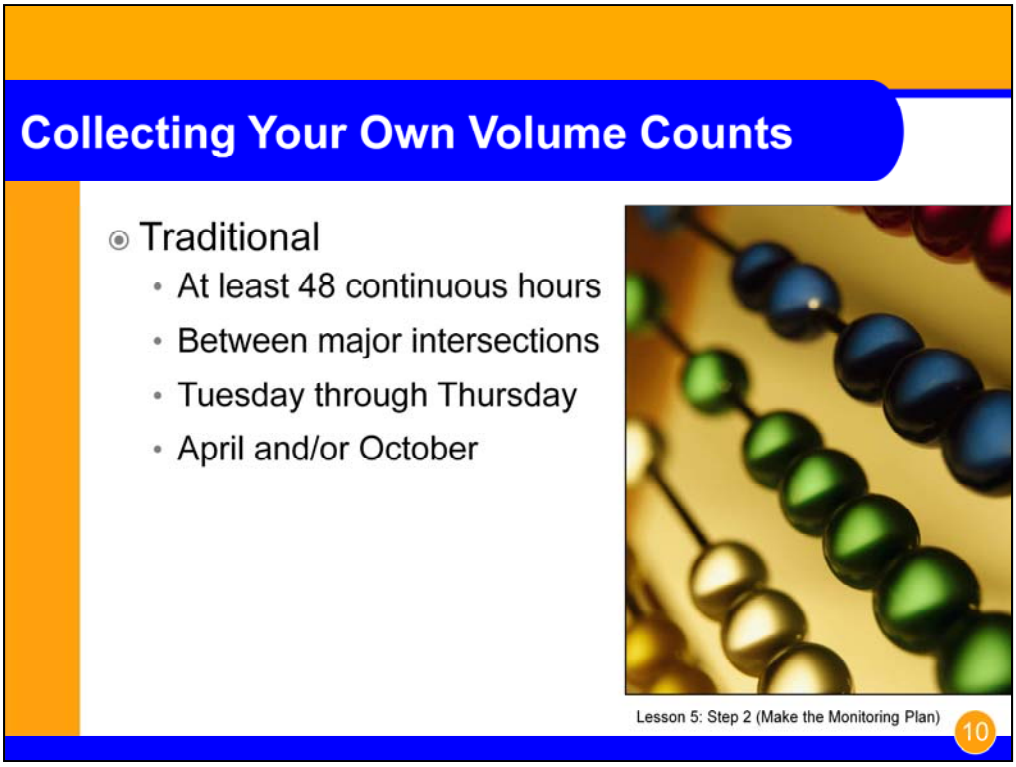
Instructors point out that the full table on the slide is shown as Table 7 on page 32 of the *Guidebook.*



Communities are ever-changing. A videolog is a simple way for you to document the conditions along the roadways when mobility monitoring data are collected. You should take narrated video along all the roadways studied in the monitoring effort.

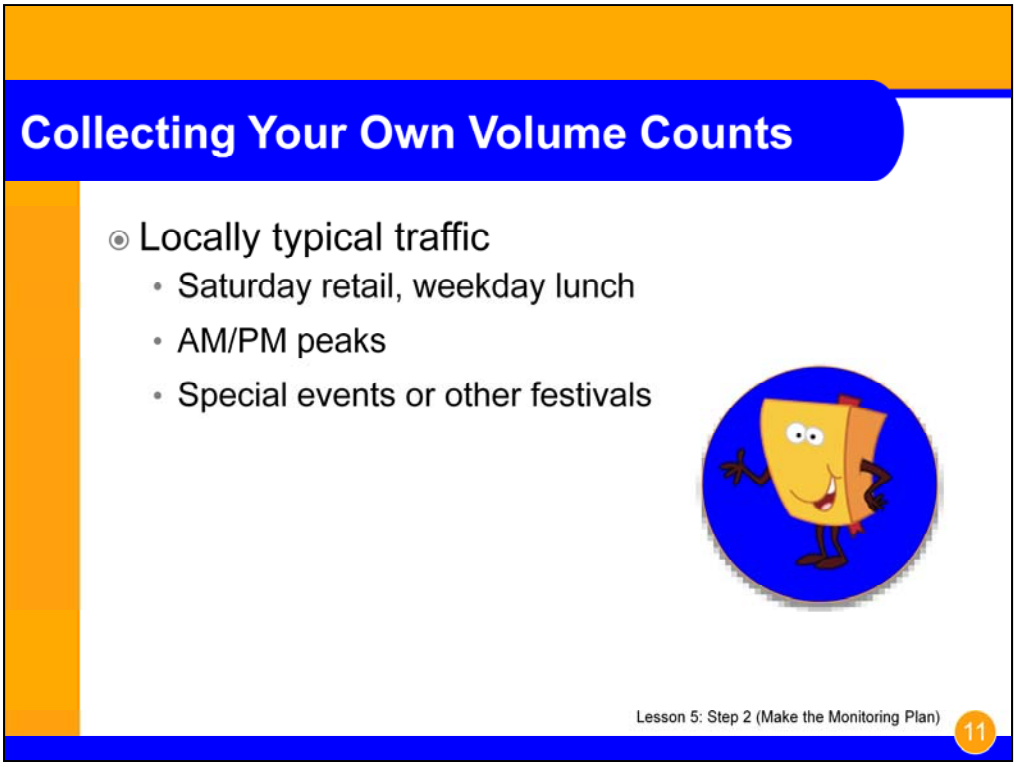
Your video should include narration of the posted speeds, number of lanes, whether there is a median present, signalized intersections, primary cross-streets, primary driveways, land use and existing buildings, work zones, school speed zones, and general roadway geometry.

The photo on this slide shows a typical video camera set-up on the windshield of a vehicle.



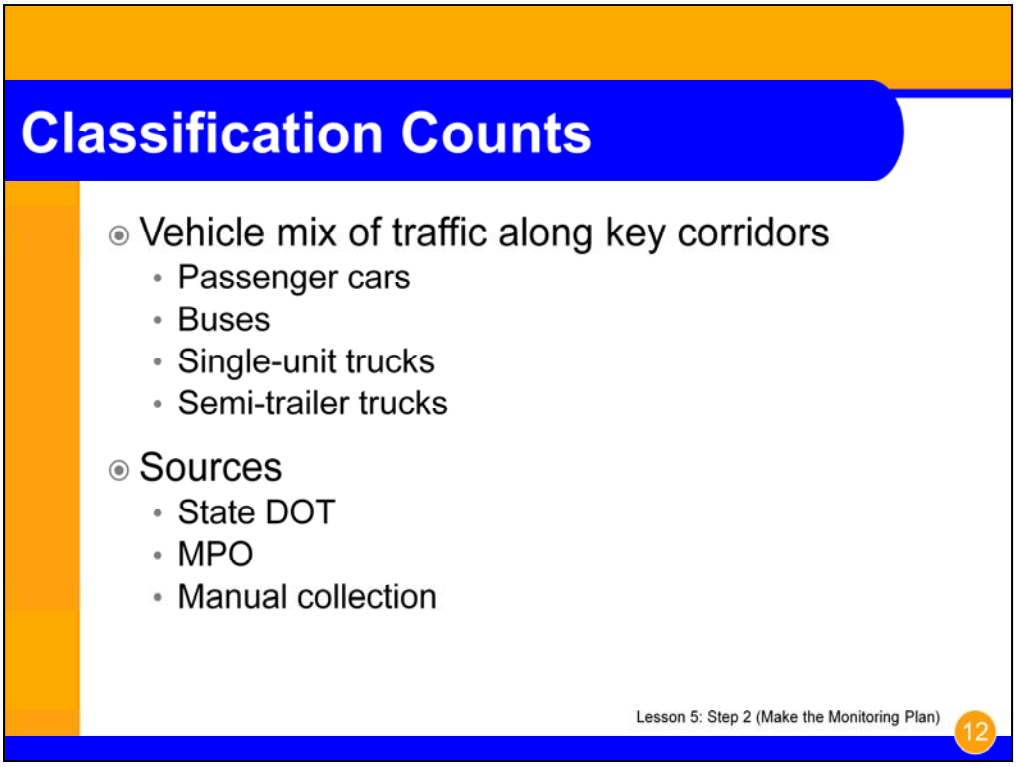
You will probably need to collect some traffic count data above and beyond any existing data. Traditionally, you should collect at least 48 continuous hours of data along the key roadways in the community. Typically you will want to collect volume data along the roadway between the major intersections (e.g., state-maintained, numbered roadways). Tuesday through Thursday provides typical data in a given week, and April and October are the typical months in a given year. Following this guidance will allow you to miss weekends or holidays when traffic patterns are atypical. Collecting in April and October also misses the summer months, and ensures school is in session to provide more representative traffic counts.

Of course, the guidance above is to capture “typical” travel conditions. You may have an interest in performing mobility monitoring for a special event or other festival that occur outside of these typical days or months. This is discussed on the next slide.



The guidance on the prior slide was to capture “typical” travel conditions. You may have an interest in performing mobility monitoring for a special event or other festival that occur outside of these typical days or months.

Instructor lists local suggestions on this slide of times that monitoring in a SMSC might be insightful.

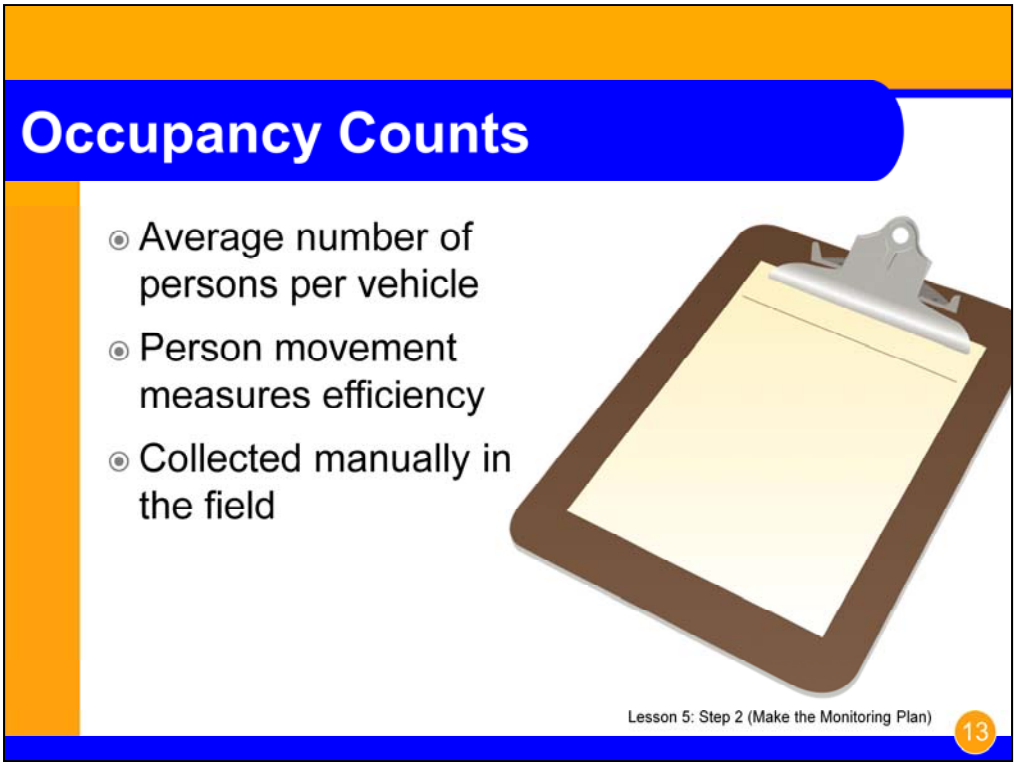


You may be interested in the vehicle mix of traffic along the key roadways you want to monitor. For example, maybe you are interested in how truck traffic has increased. FHWA requires states to report vehicle classification in 13 classes, a majority of which are various large truck configurations. Vehicle classification of most interest in a SMSC would likely be passenger cars (including pickup trucks), buses, single-unit trucks (e.g., UPS trucks), and semi-trailer trucks (e.g., 18-wheelers).

You can likely obtain classification data from the state DOT. If there is a MPO in your region, you should check with staff there, as they sometimes perform classification counts for travel models.

Alternatively, classification data can be collected manually. Clipboards and clickers and/or videotapes that can be reduced in the office.

Instructors ask if classification counts are performed by any of the local agencies. If so, instructors follow-up by asking what the data are currently used for.



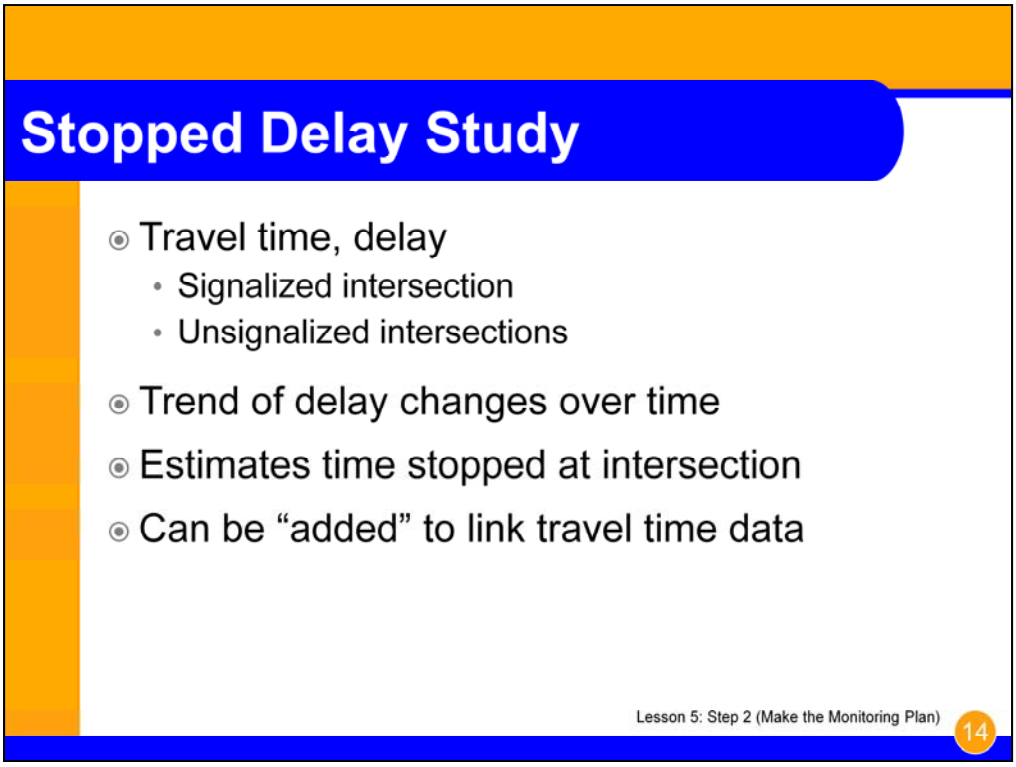
The average vehicle occupancy (AVO) is the average number of persons in a vehicle.

Transportation efficiency and mobility are best communicated in person movement, rather than vehicular movement. You can convert vehicles to persons by multiplying vehicles by average vehicle occupancy. AVO measurement is probably not as critical a measure in a SMSC until a region reaches the Transportation Management Area size (i.e., grater than 200,000 persons).

AVO data can be collected manually in the field – from a safe location, record observational data of the number of persons and vehicles.

As with classification counts, if there is a MPO in your region, you should check with staff there, as they sometimes perform occupancy counts for travel models and related analyses.

Instructors ask if occupancy counts are done locally.



Your travel time data collection effort will ultimately provide travel time and speed information along the key links of interest. In addition, you may have specific turning maneuvers at congested intersections of interest. You can perform a stopped delay study at such intersections.

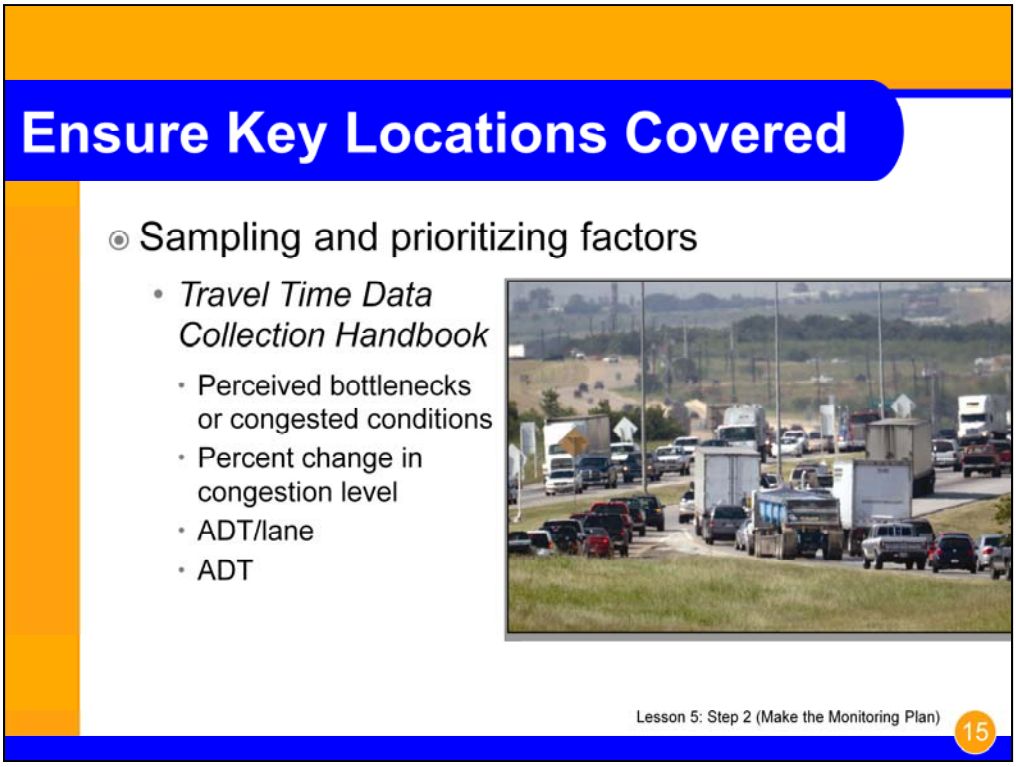
Over time, repeated stopped delay studies will allow you to quantify the delay changes as a result of increased traffic and/or transportation improvements.

You can add this intersection travel time information to the link travel time estimates from each roadway to obtain an estimate of the trip travel time along the entire trip that includes two or more roadway links and intersection(s). A stopped delay study estimates the time motorists spend stopped at an intersection before performing an intersection maneuver. Therefore, if travel time information is available along one roadway (e.g., northbound), and travel time information is available along another intersection roadway (e.g., westbound), the stopped delay could be estimated on the northbound to westbound left-turning maneuver.

You can find more information about intersection studies in the Institute of Transportation Engineer's *Manual of Transportation Studies.*

In some cases, when the stopped delay queue extends through several signals, or simply cannot be counted due to sight restrictions, you can perform travel time runs through the intersection turning movement to obtain a direct measurement of travel time through the intersection.

Instructor asks if stopped delay studies or other intersection studies are done locally.



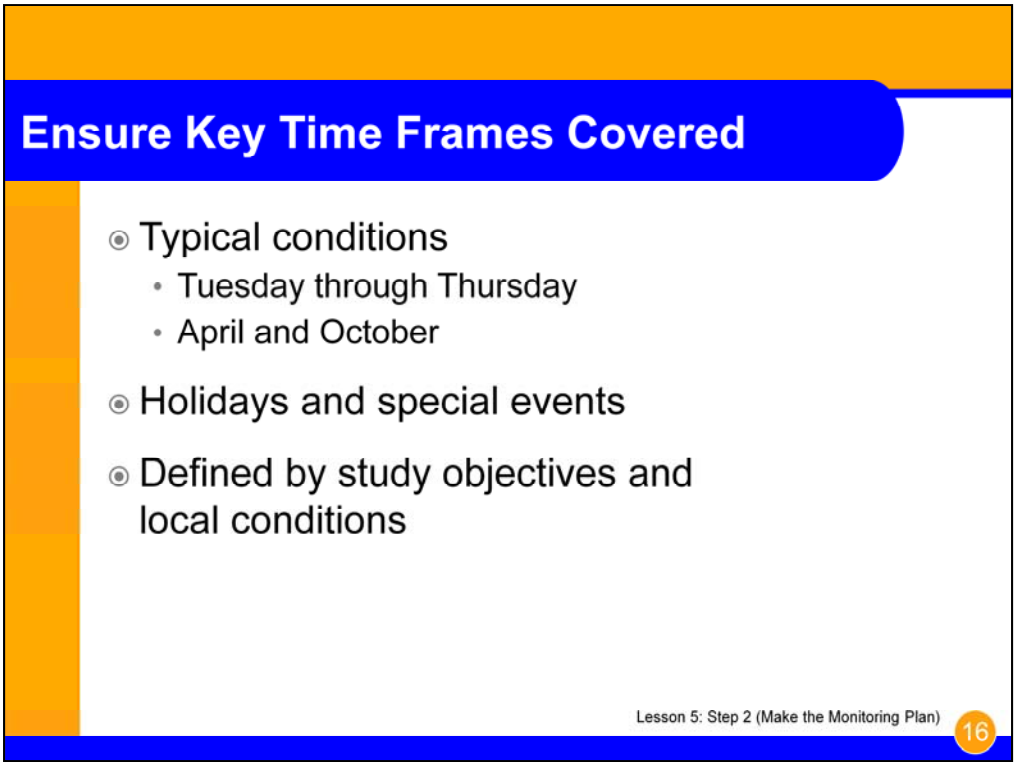
Are key community bottlenecks covered in the monitoring plan?

Through meetings with local peers, and from your own experiences, the primary roadways for monitoring in your community can be identified. If the number of roadways to monitor is cost prohibitive, then sampling should be performed.

The *Travel Time Data Collection Handbook* provides information on how to sample the number of roadways to ensure that reliable, timely data exist for severely congested segments, and that the remaining, less critical segments are sampled on a less frequent basis.

The handbook also suggests that you could use one or more of the following factors for prioritizing your data collection:

- Perceived bottlenecks or congested conditions;
- Percent change in congestion level (if available);
- Average daily traffic volume per lane;
- Average daily traffic volume.



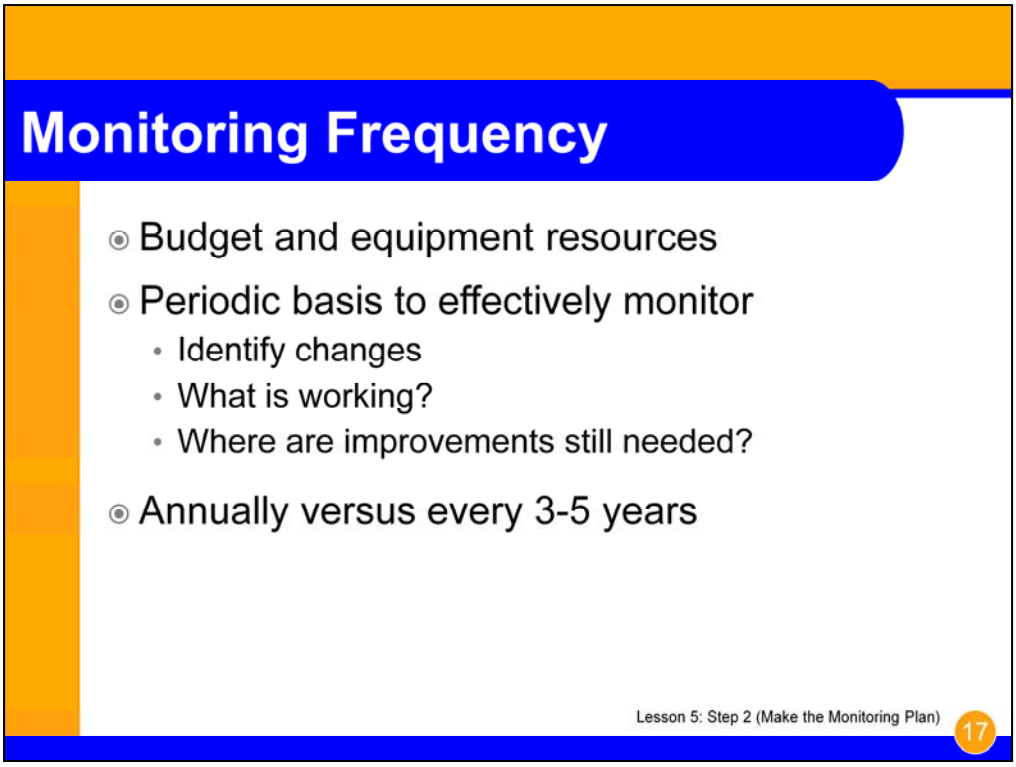
Are key time frames covered in the monitoring plan?

Travel time data are commonly used to represent typical annual conditions, and should be collected during months that have typical or average traffic volume patterns. This is why Tuesday through Thursday are the best weekdays to collect data. This is also why the months of April and October are recommended. Of course, holidays and special events should be avoided if you want to obtain average conditions.

You should match the time periods for data collection to local traffic conditions and congestion patterns for the geographic area under consideration.

The time periods in a day define when travel time data will be collected. Like all other elements of the study scope, the time periods will be determined by your study objectives. For travel time studies that are focused on identifying mobility trends and problems in SMSCs, the following time periods can be considered:

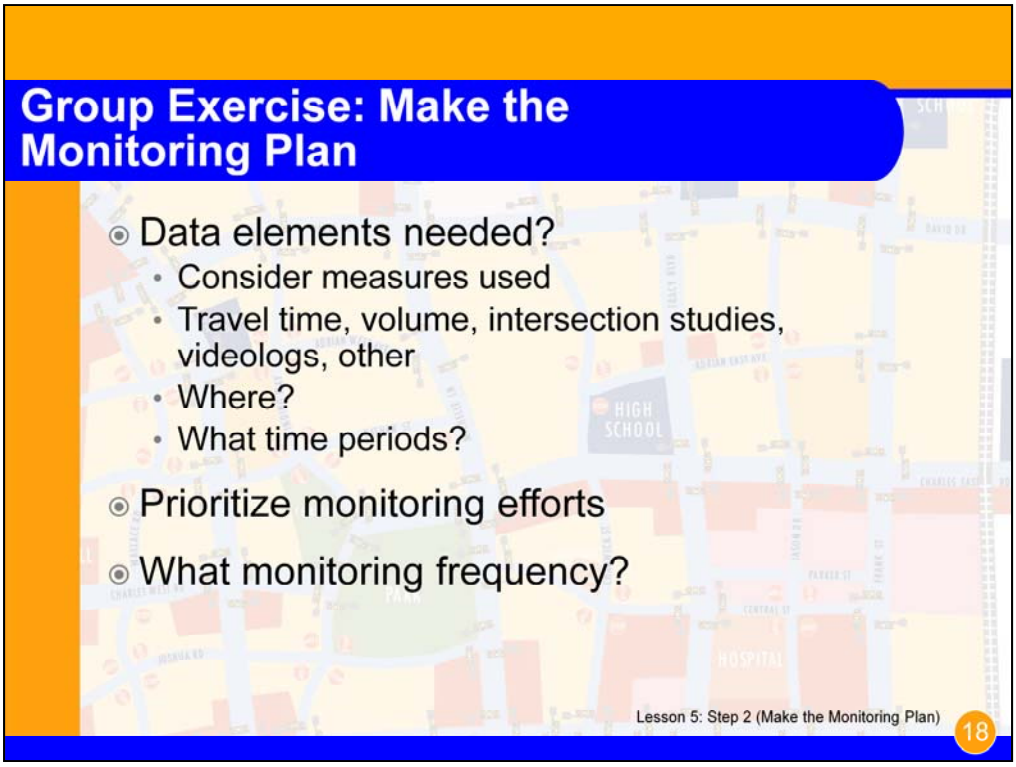
- **Morning Peak Period** — encompasses all congestion during the peak morning commute, typically sometime between the hours of 6 a.m. and 9 a.m.
- **Off-peak Period** — includes periods of free-flow traffic during the middle of the day or late in the evening, typically between 10 a.m. and 11 a.m., 1 p.m. and 3 p.m., or after 7 p.m. For off-peak monitoring, the hours between 11 a.m. to 1 p.m. should be avoided if “lunch hour” traffic is significant. Off-peak travel times are used to establish free-flow conditions for calculating mobility measures.
- **Evening Peak Period** — encompasses all congestion during the peak evening commute, typically sometime between the hours of 4 p.m. and 7 p.m.
- **“Lunch Hour”** — typically includes the hours between 11 a.m. to 1 p.m., and can be the largest traffic period in some communities.
- **Special Events** — includes weekend festivals, fairs, or sporting events. You want to capture data at times when event-goers are arriving or departing en masse.
- **Weekend** — in addition to weekend monitoring due to special events, there may be a need to monitor weekends due to significant retail.



How frequent should the monitoring be?

This is a function of your budget and equipment resources. To be effective, mobility monitoring must be performed on a periodic basis so changes in mobility can be tracked over time. Re-evaluating mobility provides you the opportunity to identify where mobility is becoming worse or where it may be increasing due to mobility improvements. Annual monitoring would provide an appropriate level of data. Monitoring frequencies greater than 3-5 years may not provide your community enough clarity regarding mobility changes.

Of course, the frequency of the monitoring will go back to your goals and objectives of the monitoring.

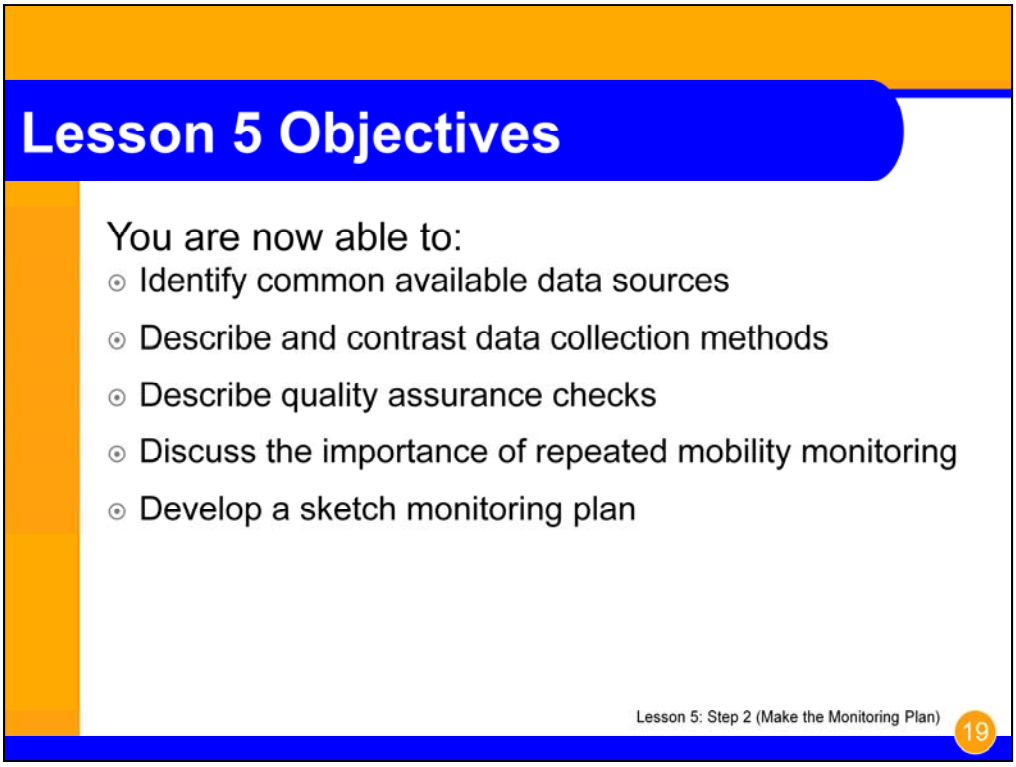


Using the maps introduced in Lesson 4 (Step 1: Identify the Needs and Opportunities), participants will make a monitoring plan for the community. Participants will go into their groups and develop their monitoring plans. Participants will use provided dry erase markers to draw key elements of the data collection plan on the maps. Consideration should be given to locations for data collection as well as time periods to monitor.

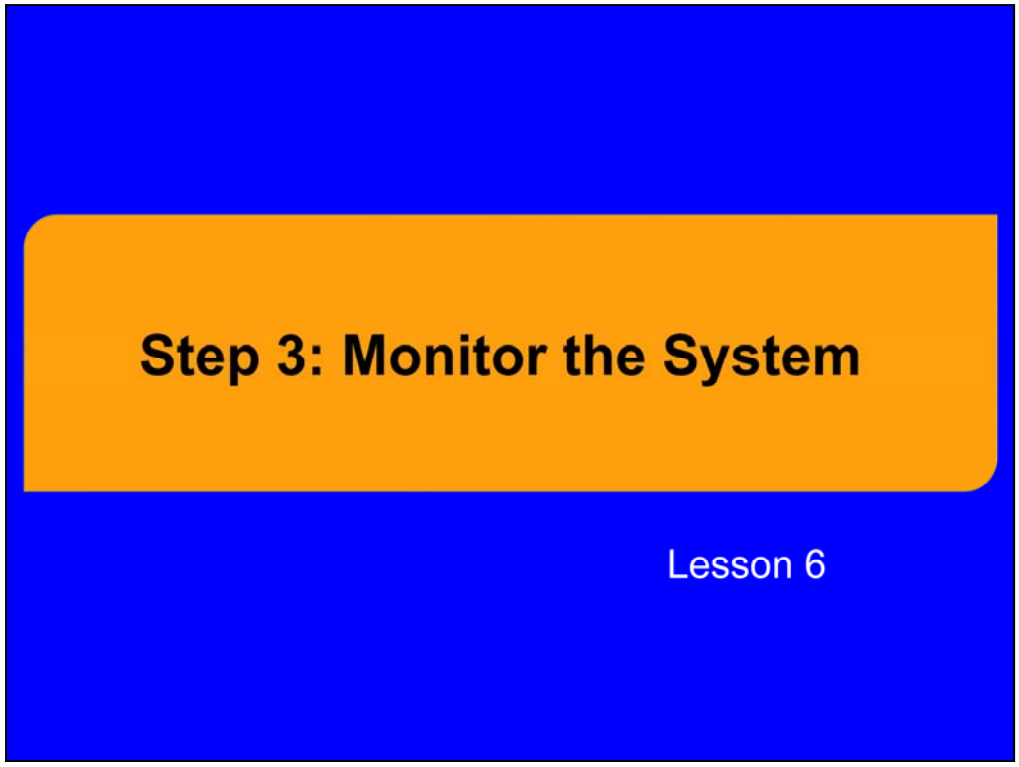
Instructors highlight key elements of the community that might necessitate monitoring (new development, high signal densities, railroad tracks). Instructors refer to the “issues” page circulated as part of Lesson 4 (Step 1: Identify the Needs and Opportunities). These should guide the development of the monitoring plan. The needs and opportunities identified in Lesson 4 (Step 1: Identify the Needs and Opportunities) will influence the monitoring plan as well.

After 20 minutes of group work, team leaders of the selected group(s) will present their monitoring plans for 10 minutes total.

After participants have worked on this exercise, the instructors will discuss the realities of monetary constraints on a monitoring plan. Instructors quiz participants on how much would generally be available for possible monitoring and how that might constrain the amount of data collection possible. Instructors brainstorm with participants about ways they could reduce costs given these constraints.



Restate the lesson objectives, and ask the participants if they have any questions before moving on to Lesson 6.

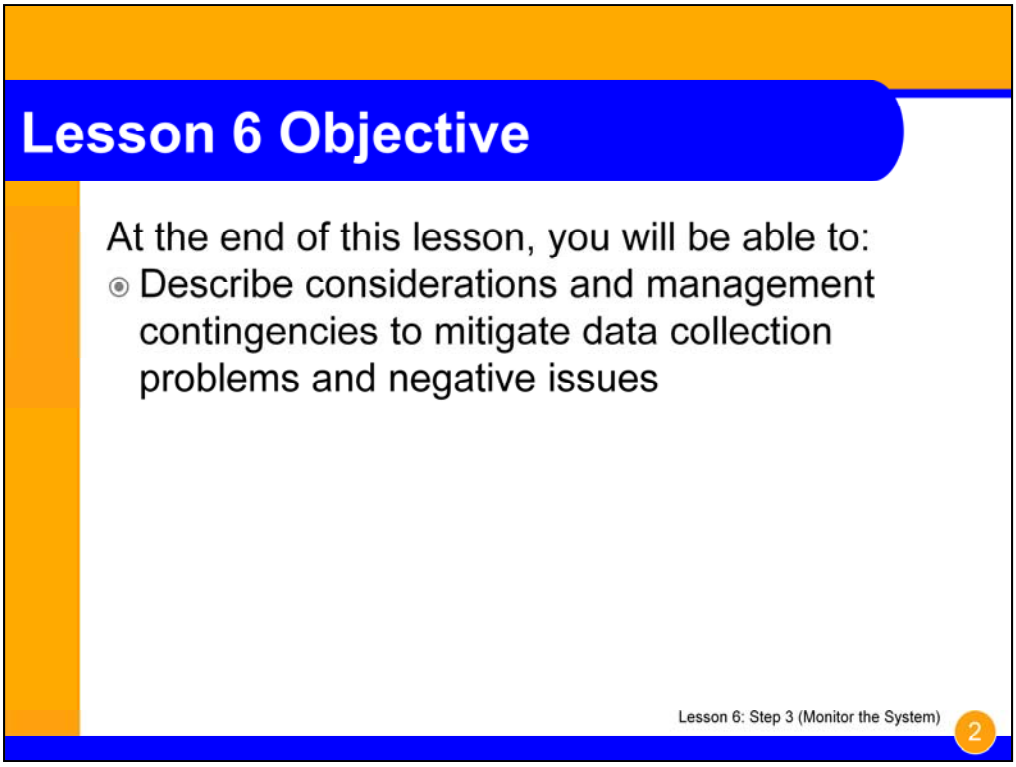


Duration: 15 minutes

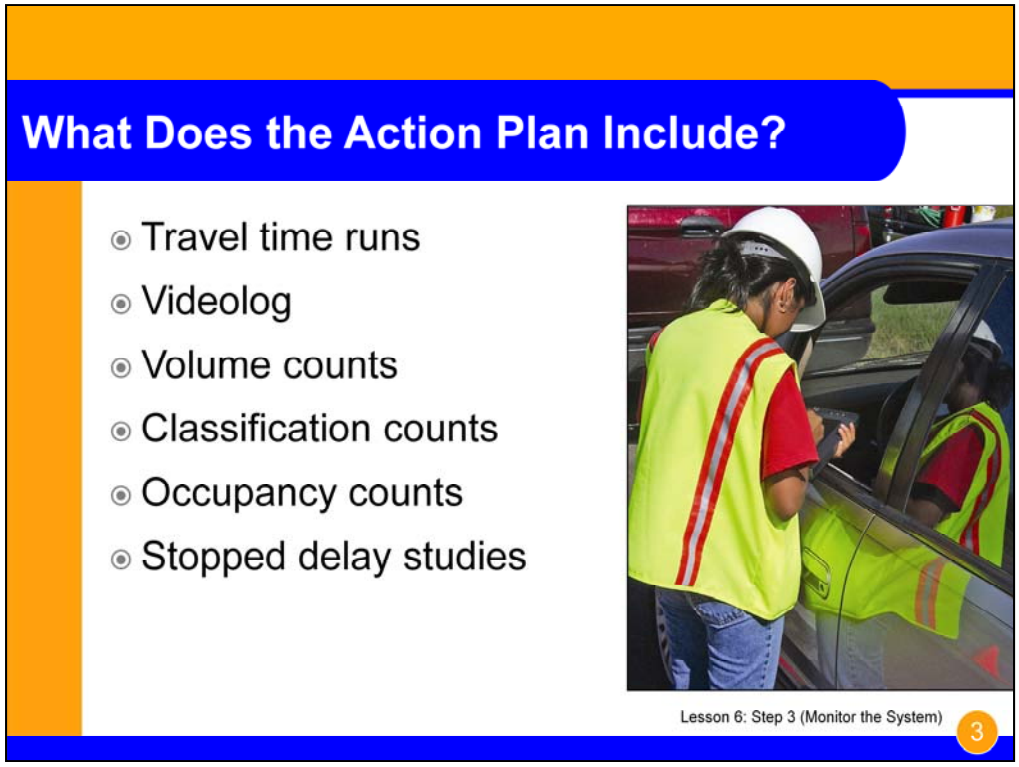
Time: 1:30 to 1:45 pm

Time Allocation:

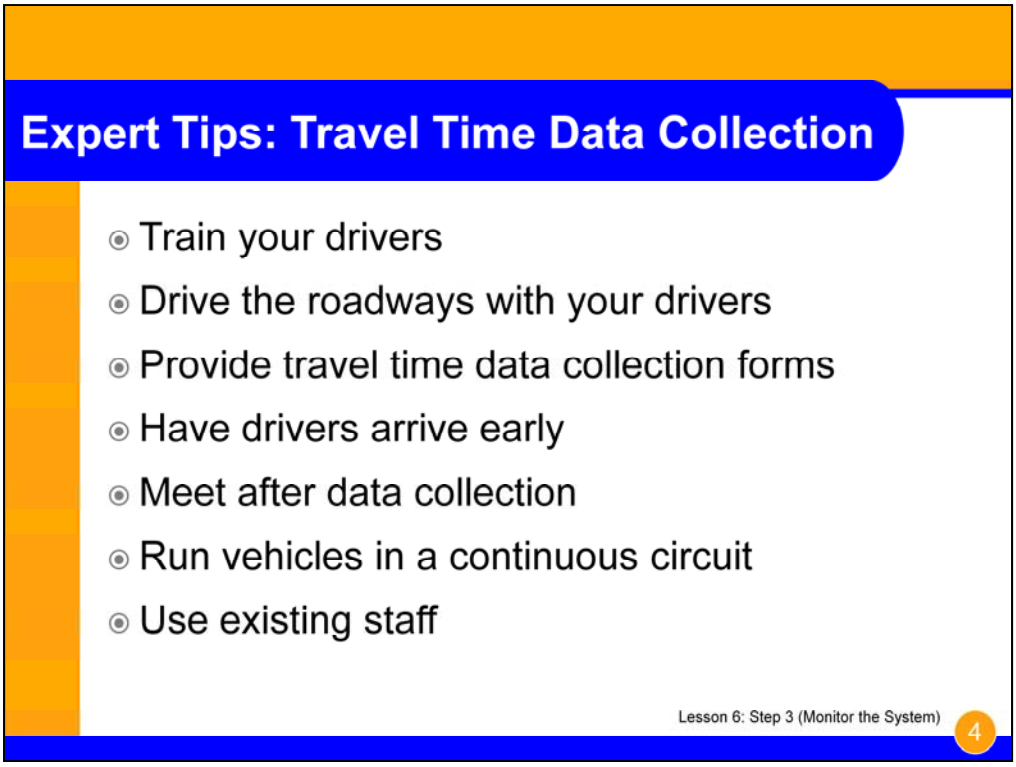
Lecture	10 minutes
Discussion	5 minutes



Verbally state the lesson objective for the participants.



It is now time to implement the data collection as you planned in Lesson 5 (Step 2: Monitor the System). Six typical data collection efforts were described in Step 2 to guide the development of your plan. The data collection efforts are listed on this slide.



The data collection process for your mobility monitoring can be extensive. Here are a few tips to ensure success and help avoid frustration.

- Train your drivers on equipment use and driving technique. Prepare “cheat-sheets” on equipment use and driving technique that they can take with them. Train drivers on completing data collection forms at the end of each run.
- Drive the roadways with your drivers so they know the location of all checkpoints and the turnaround locations.
- Provide travel time data collection forms to your drivers that they can fill out before and after the run to highlight traffic queue, run numbers, run start times, record weather conditions, and make other comments. These forms are invaluable for data reduction. See *Travel Time Data Collection Handbook* for a sample.
- Ensure your data collection personnel arrive early to the site to allow time for equipment setup. Synchronize/check time stamps for each driver (laptops when using GPS or DMI, stopwatches for the manual method).
- Coordinate a location to meet after each period of travel time data collection to share experiences and coordinate how any issues will be consistently resolved. This is also the time for you to get each driver’s data, review it, and back it up (if electronic)
- Run your vehicles in a continuous circuit. As an example, when fiver vehicles are used, three vehicles can start at the end of the roadway in the peak direction, and two vehicles can start in the off-peak direction. The vehicles will turn right to enter the roadway in the peak direction at their assigned headways to perform their travel time runs. When two vehicles queue at an endpoint, the second vehicle should wait two or three minutes before beginning the next run (depending on the length of the roadway and congestion level).
- Use existing transportation agency staff to collect data and cut costs.

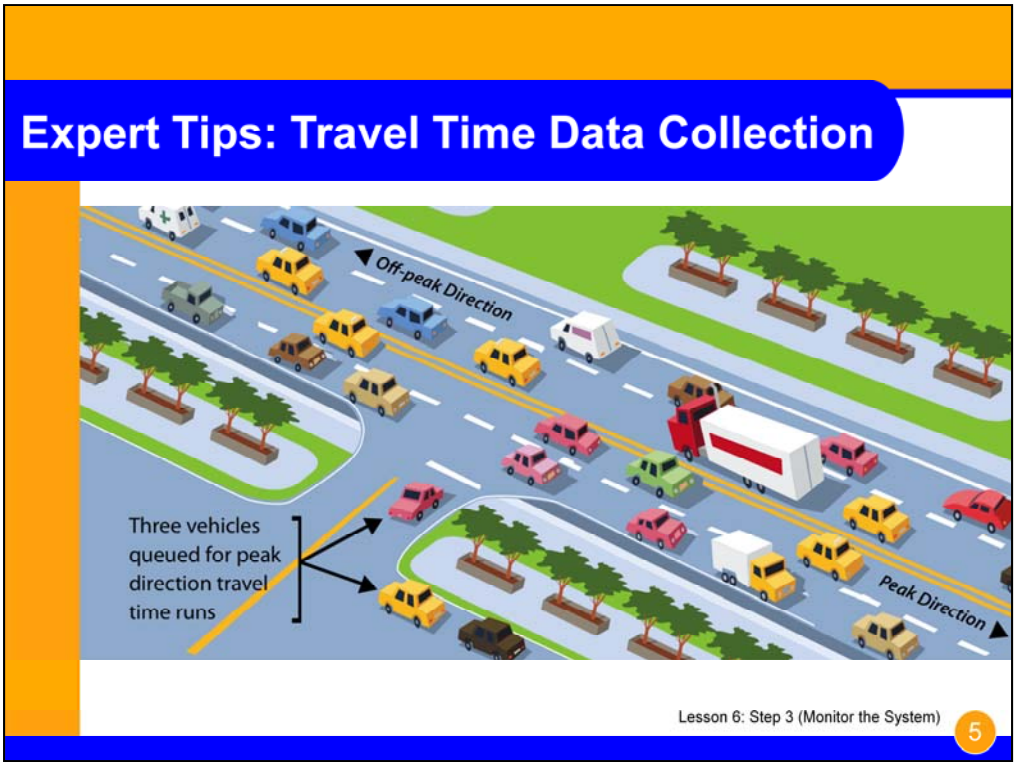
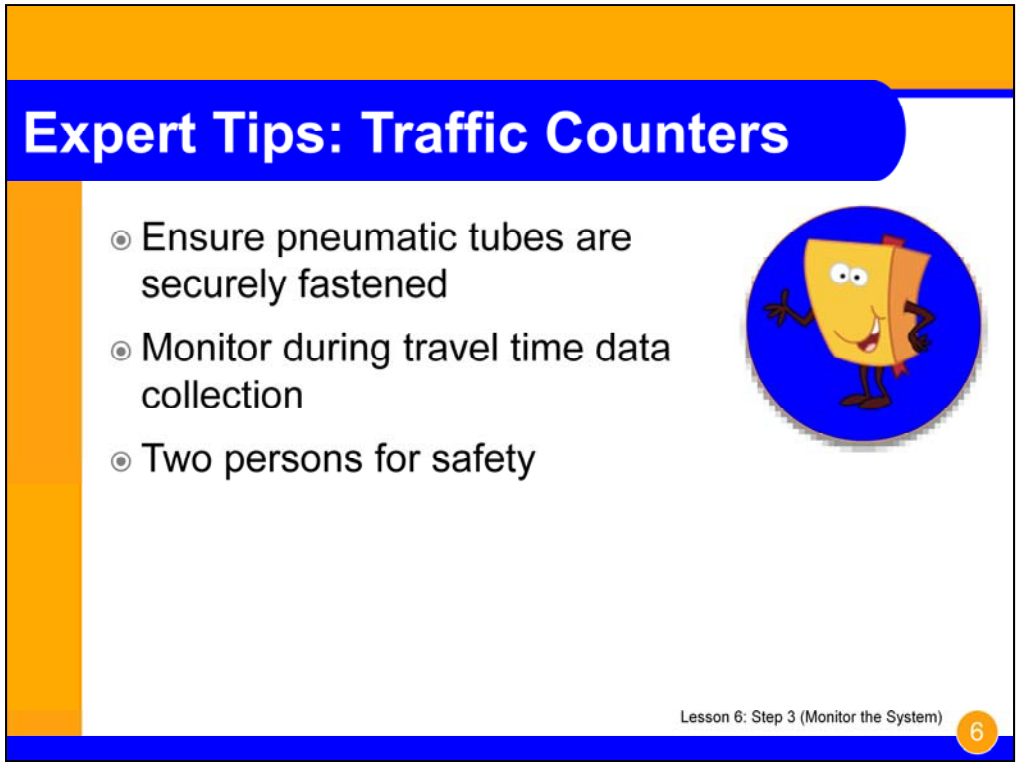


Illustration of travel time study test vehicle deployment at run initiation with three vehicles queued to start in the peak direction.

A “scheduler” can be used to stay in the parking lot and monitor start times of the test vehicles. This ensures vehicles stay on the desired headway. This additional person on each of the corridor will increase the cost of the study.

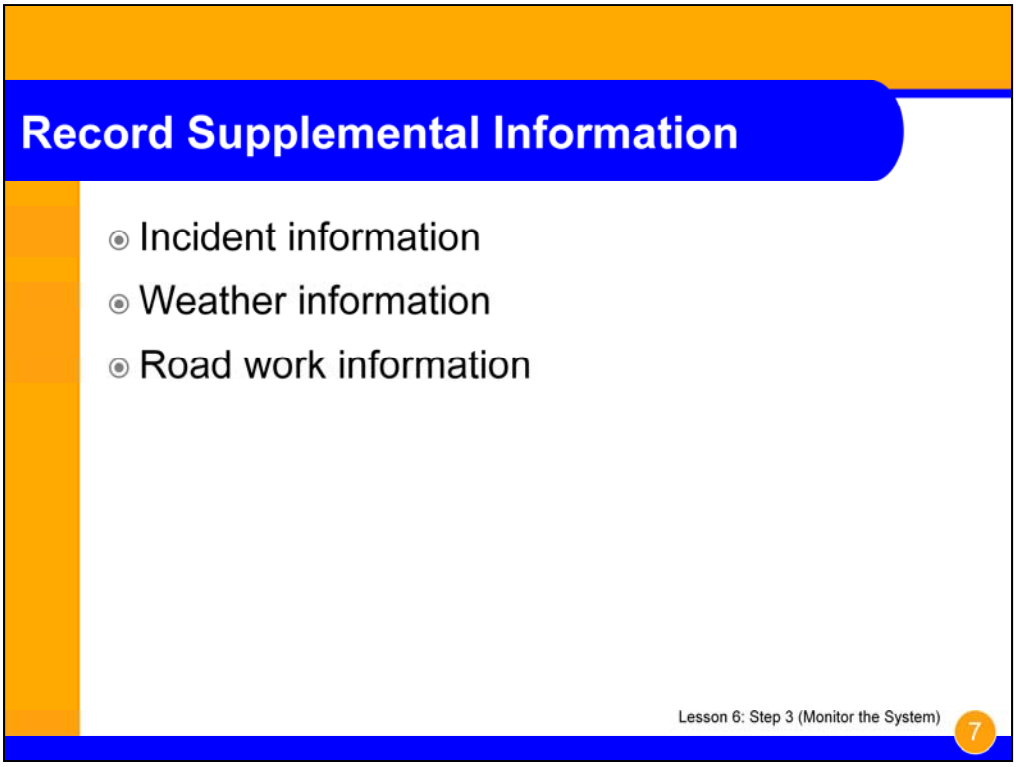
In some cases, a clipboard can be placed at the staging location at either end of the corridor to replace a “scheduler” so the drivers can monitor their own headways. The clipboard would include the time the vehicle leaves the staging area and the driver name.



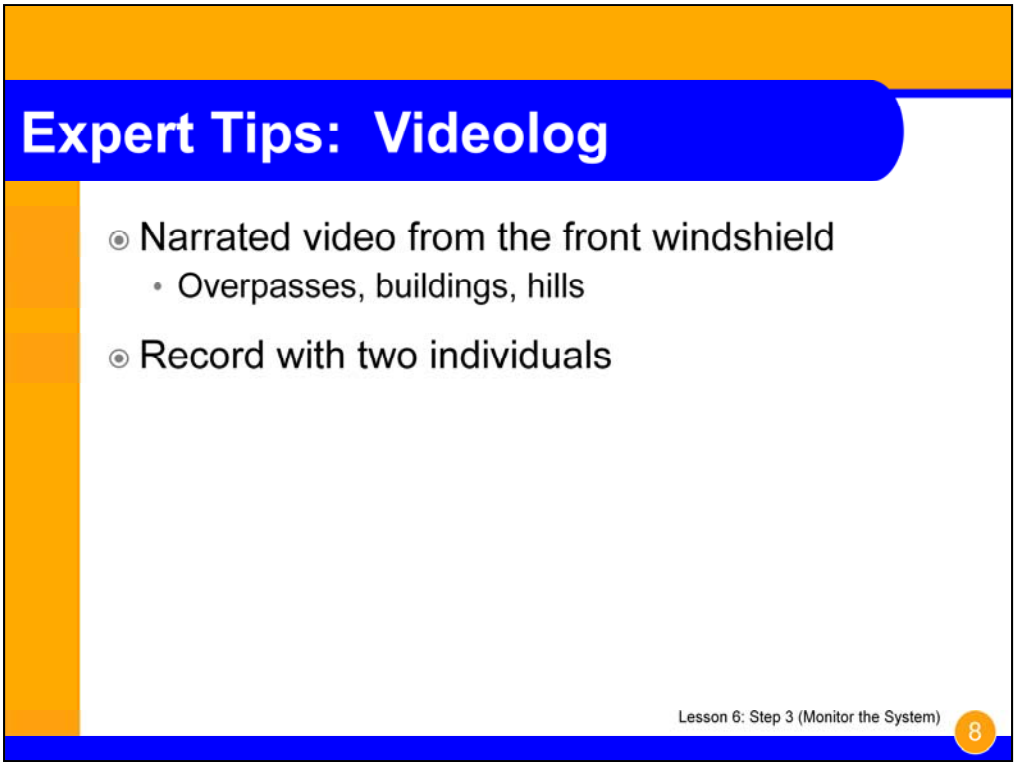
Ensure your pneumatic tubes for volume counts are securely fastened. Use extra tape to ensure tubes are securely fastened.

If you are collecting pneumatic tube counts on the days of your test vehicle runs, inform your drivers to keep an eye on the tubes and notify you if they appear loose or are completely detached.

Always use at least two persons to install traffic counters for safety. One person serves as the hands to secure the tubes, while one person can serve as “the eyes” to monitor the traffic.



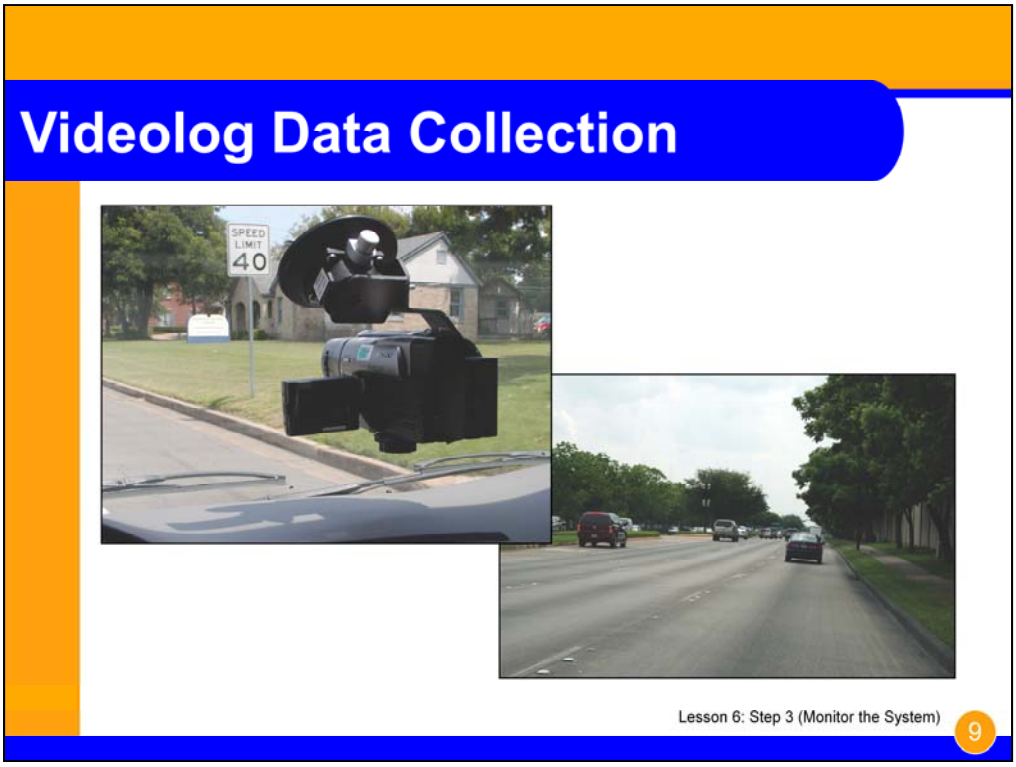
Other useful data elements include incident information, weather information, and road work information, which should be documented for the days and time periods of data collection. Your test vehicle drivers can record this type of information before and/or after each travel time run.



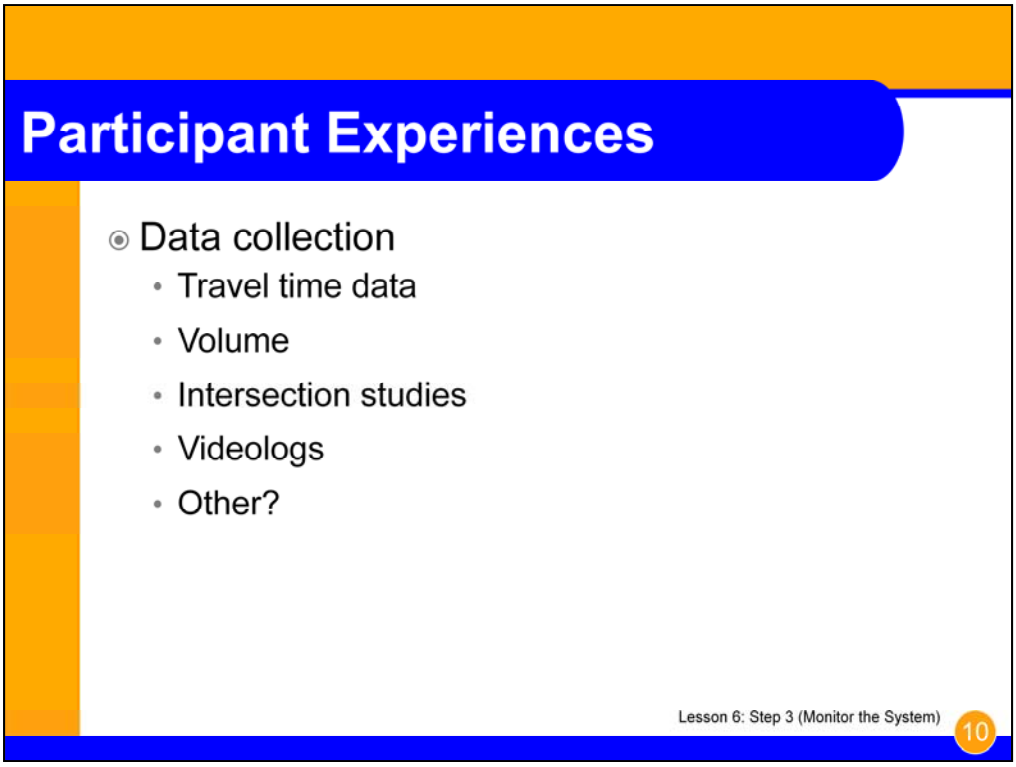
A very useful part of the data collection effort is creating a videolog of the physical environment. This is a narrated video you can take out the front windshield of the vehicle. The physical environment might also provide other vantage points for taking video (e.g., overpasses, pedestrian bridges, buildings, hills). You might want to include key developments or undeveloped properties along the side of the road in your log.

The video is best recorded with two individuals so that the passenger can narrate and record the video. The video camera can be mounted to the vehicle's dashboard.

The video narrator should verbally document cross-streets, roadway geometry, land use, posted speed limits, school speed zones/limits, construction zones/limits, primary driveways, signalized intersection locations, primary cross-street locations, and other features of interest.



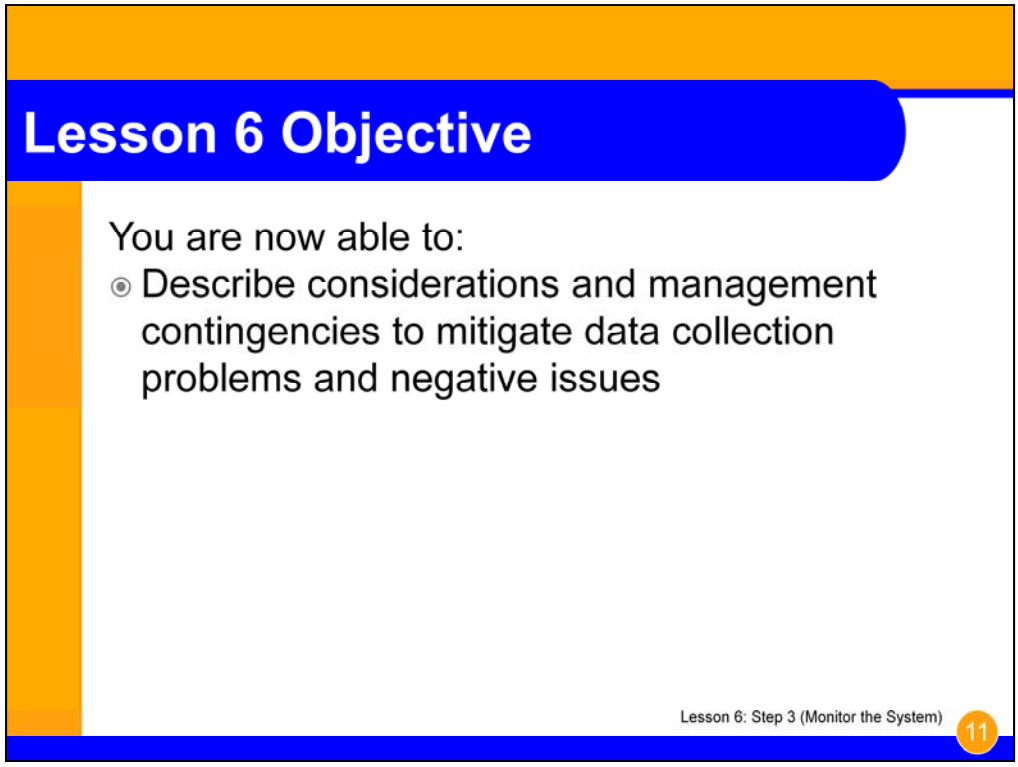
Video camera shown mounted to the windshield and a screen shot of a videolog taken from further down the street.



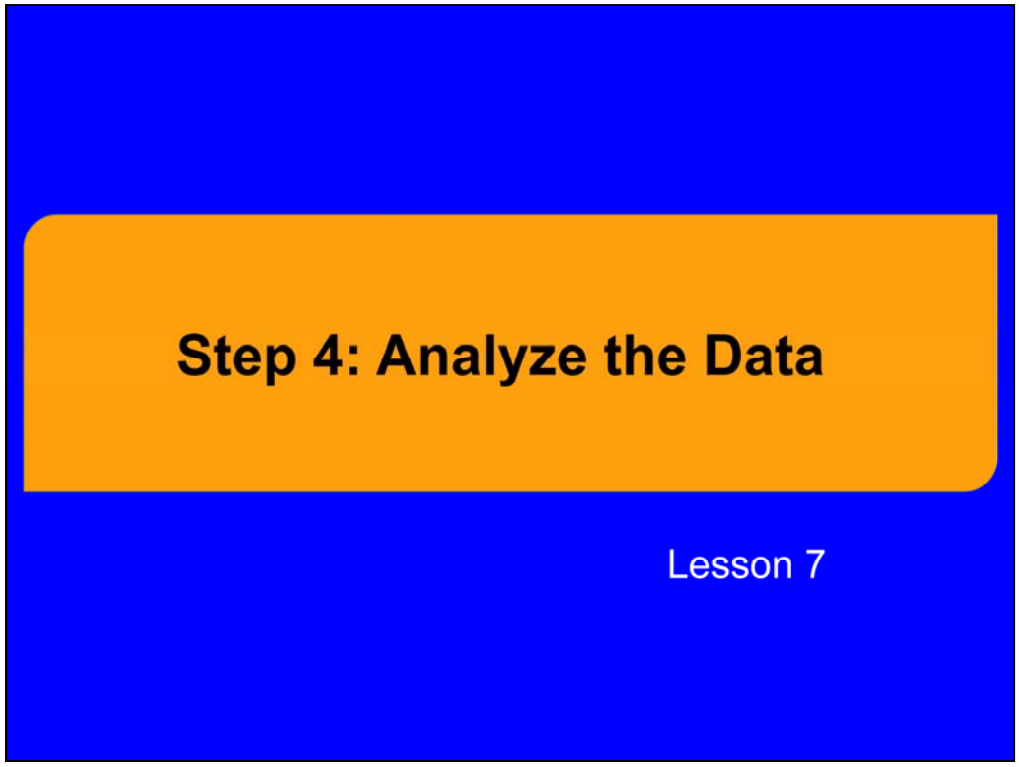
Instructor solicits tips and experiences for data collection from audience members. These tips will be written on a flip-chart by the instructors.

Instructor asks the audience how much these data collection activities generally cost the participants. Instructors ask participants how they generally perform these data collection activities.

After discussing this slide, the instructor asks if there are any final questions on this lesson before moving on to Lesson 9.



Restate the lesson objectives, and ask participants if they have any questions before moving on to Lesson 7.

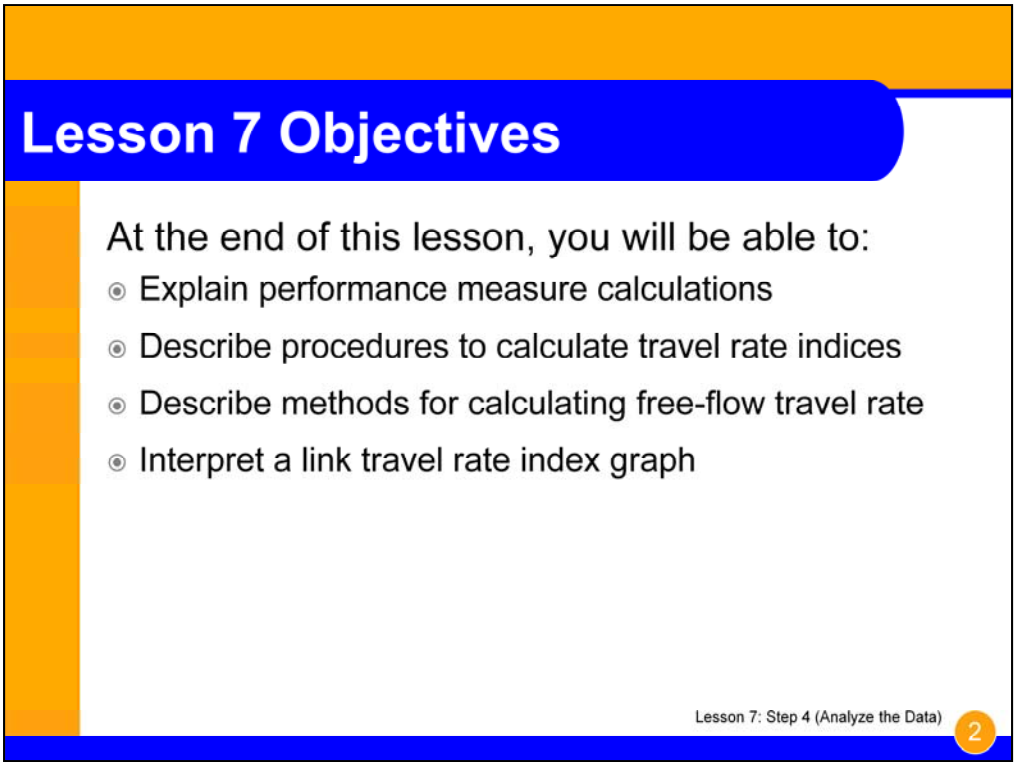


Duration: 55 minutes

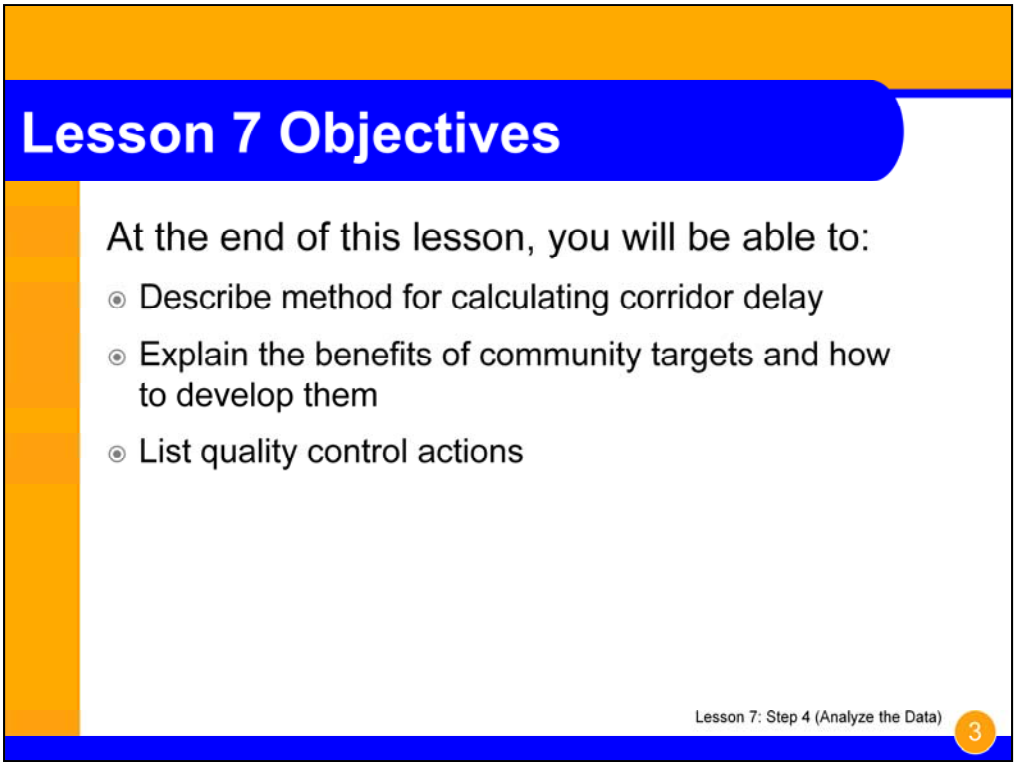
Time: 1:45 to 2:40 pm

Time Allocation:

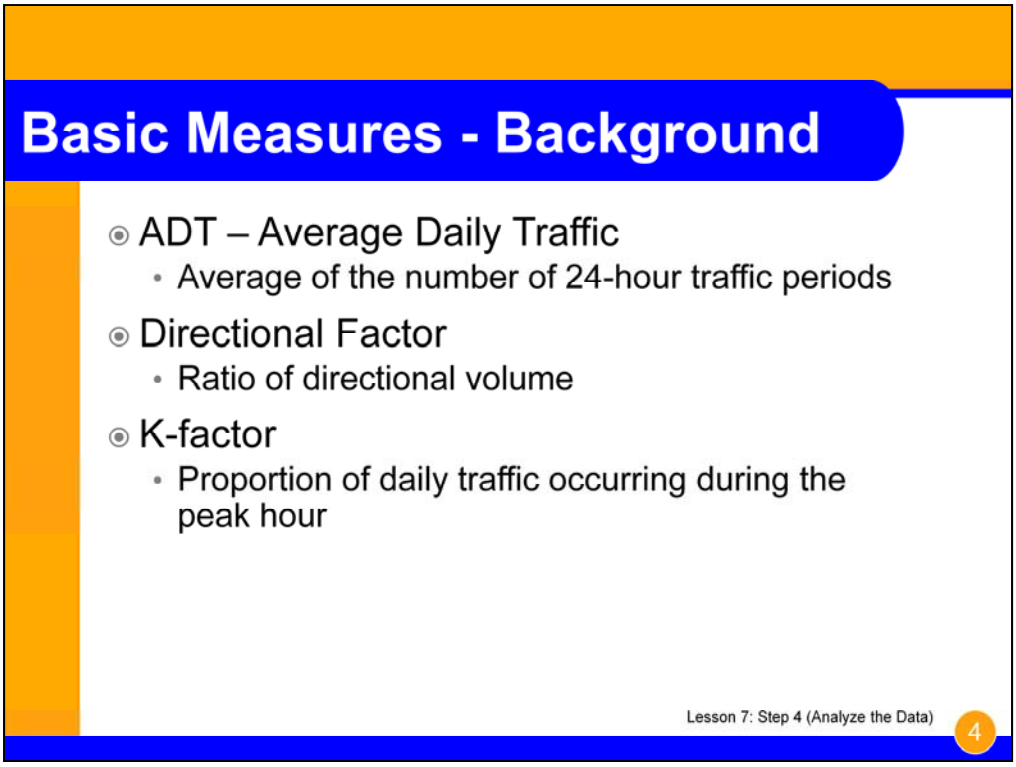
Lecture	30 minutes
Exercise	25 minutes



Verbally state the Lesson 7 objectives.



Verbally state the Lesson 7 objectives.



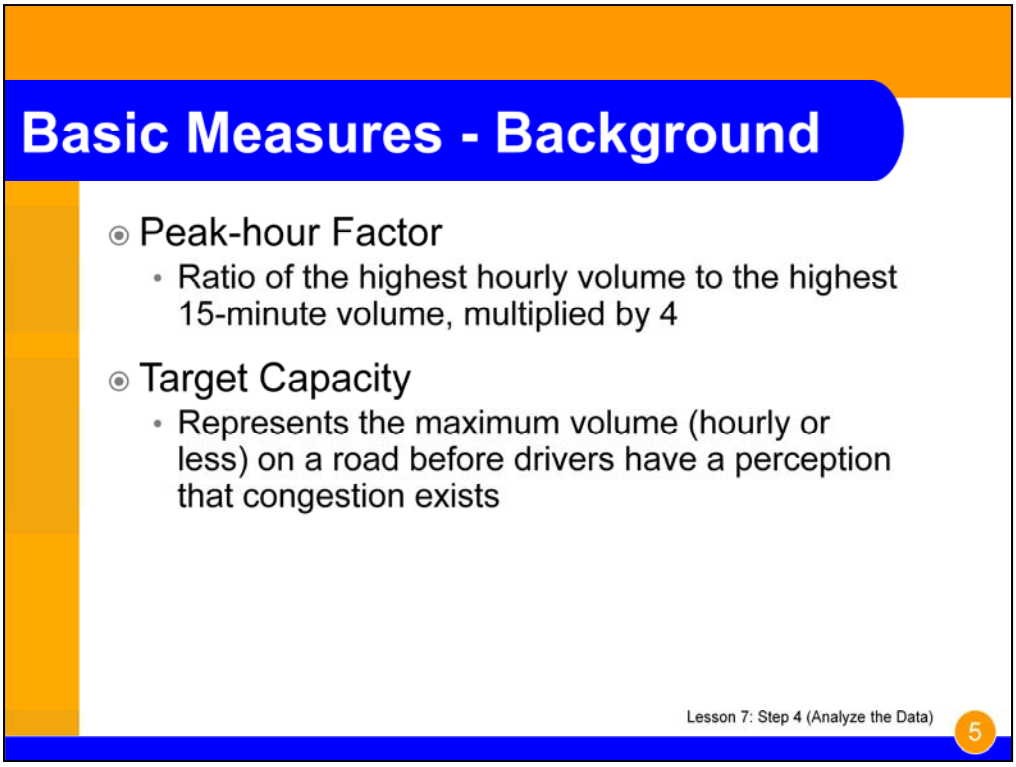
Instructor should remind audience that consistency is critical.

There are a few basic traffic data variables that need to be known and understood before you can proceed with the calculations.

ADT – average of the number of 24-hour traffic periods.

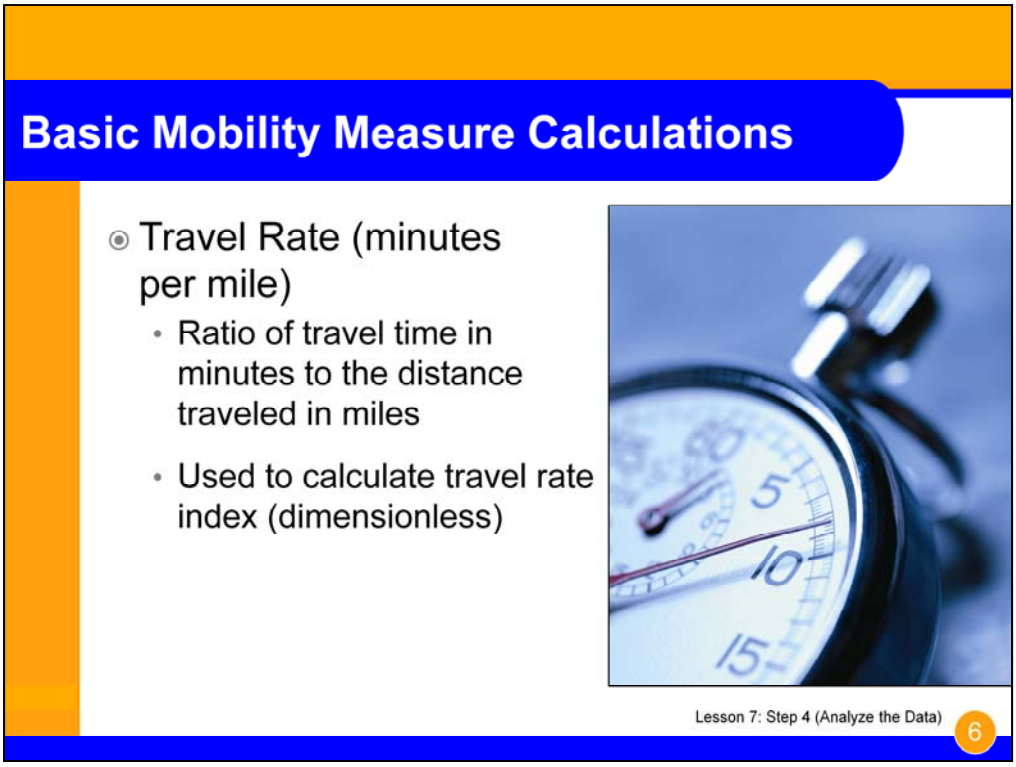
Directional factor – the ratio of the directional volumes. For example, EB volume is divided by sum of the EB and WB volumes to give the EB directional factor.

K-factor – proportion of daily traffic occurring during the peak hour.



Peak-hour factor – ratio of the highest hourly volume to the highest 15-minute volume, multiplied by 4.

Target capacity – represents the maximum volume (hourly or less) on a road before drivers have a perception that congestion exists. See page 45 of the *Guidebook* for example of the following form: (lane capacity [e.g., from HCM]) x (number of lanes in section) x (interval adjustment [necessary if not using hourly data]) x (target capacity factor).

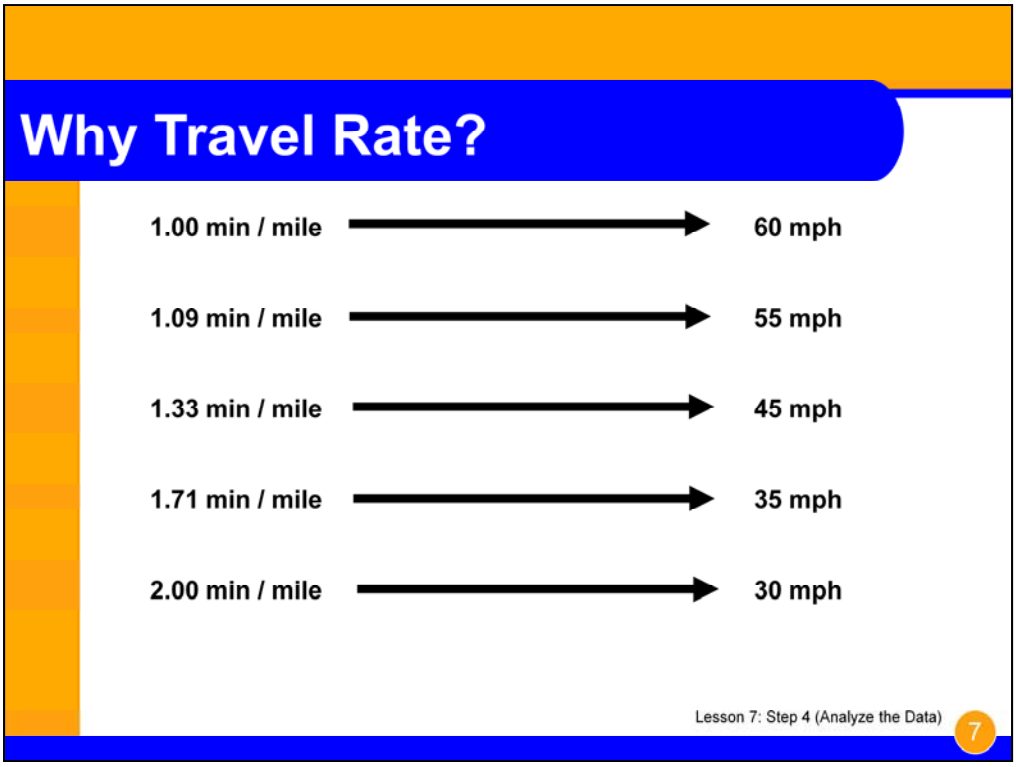


Understanding travel rate is key to being able to calculate a travel rate or travel time index.

Travel rate is the time required to travel a certain distance. This is the reciprocal of speed which is distance over time.

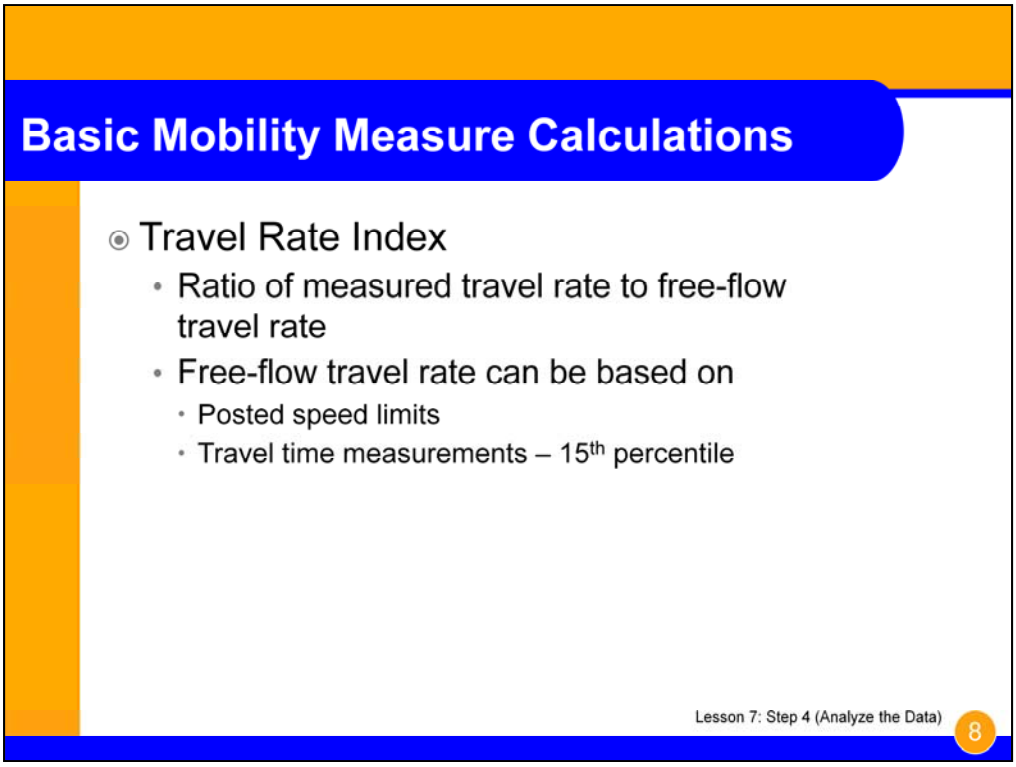
So, a speed of 60 mph equates to a travel rate of 1.0 because in one minute you travel one mile (minutes per mile => [(1 hour/60 miles) x (60 min/1 hour)] = 1.0 minute per mile).

A speed of 30 mph translates to a travel rate of 2.0 because in it takes 2 minutes to travel one mile.



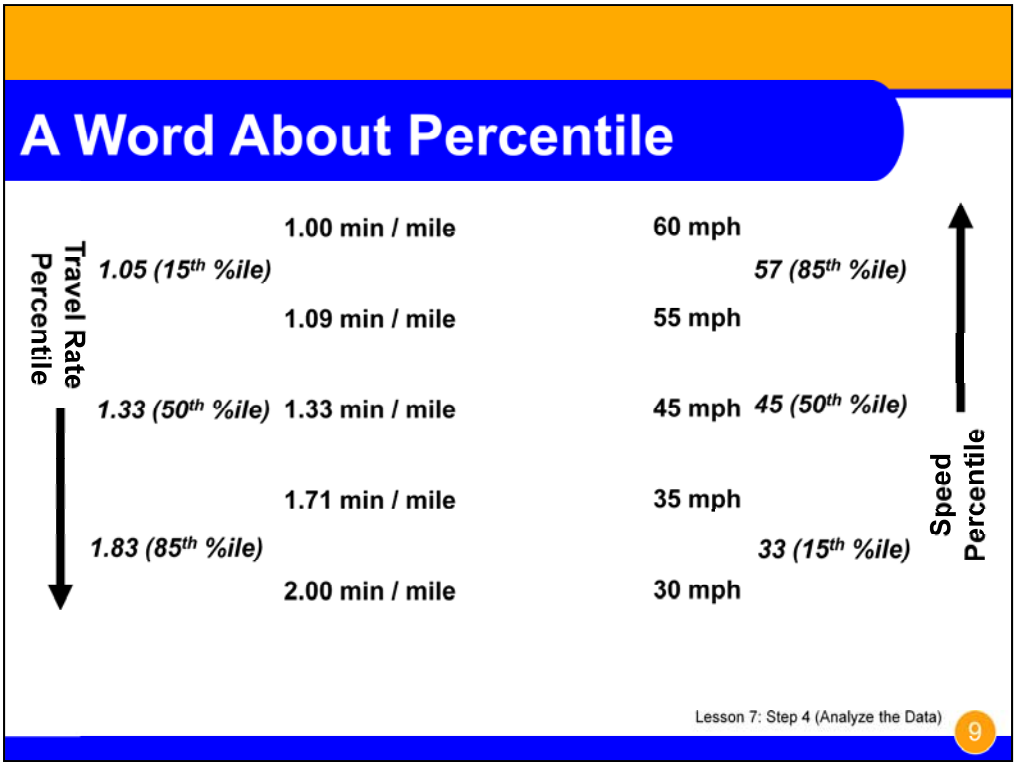
Often there is a question like, “why not just use speed?; that’s what we are used to.” It is important to consider what you are measuring when you do a travel time run. You are obtaining several travel rate estimates over a given distance. Therefore, you are collecting the minutes / mile that it takes you to travel a link or a corridor.

This slide visually relates collected travel time values (left column) with equivalent speeds for a 1-mile link.

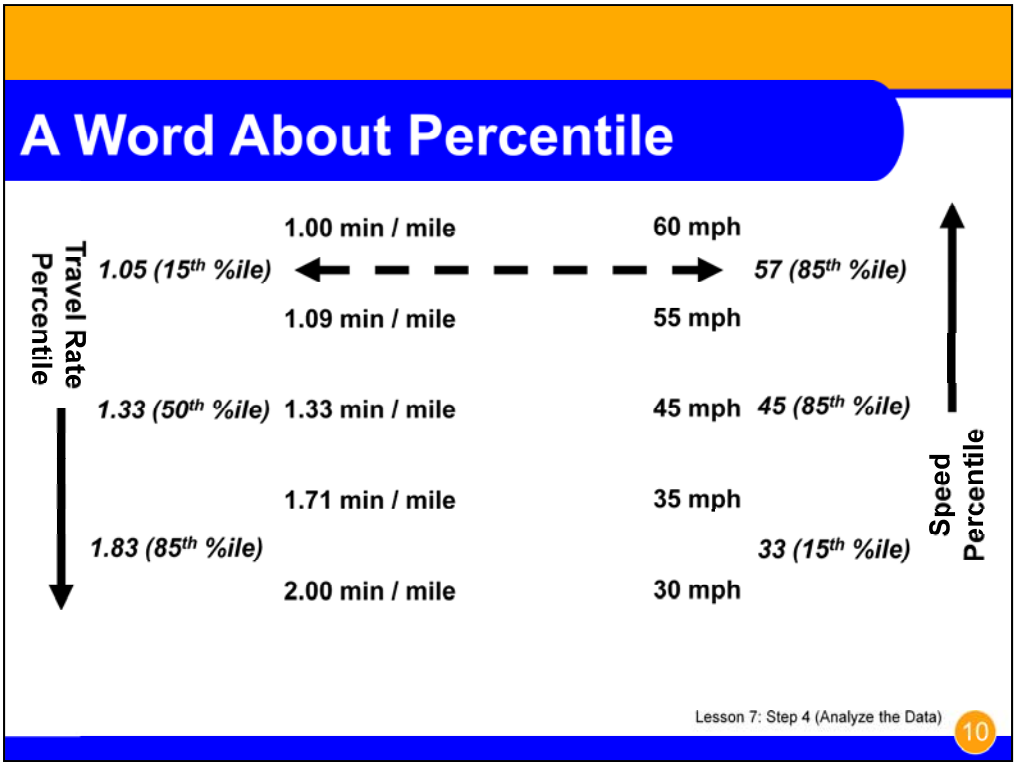


The travel rate index is a ratio of travel rates. The travel rate measured on a roadway is divided by the travel rate of free-flow conditions on the same roadway. The measured travel rate does not include conditions when non-recurring or incident delay is present on the roadway. For the travel rate index, only recurring delay is captured.

The free-flow travel rate can be based on posted speed limit or a statistical percentile of measured data from the roadway. It is important to be careful about the selection of the free-flow travel rate because consistency over time is important in capturing mobility trends (e.g., posted speeds could change).



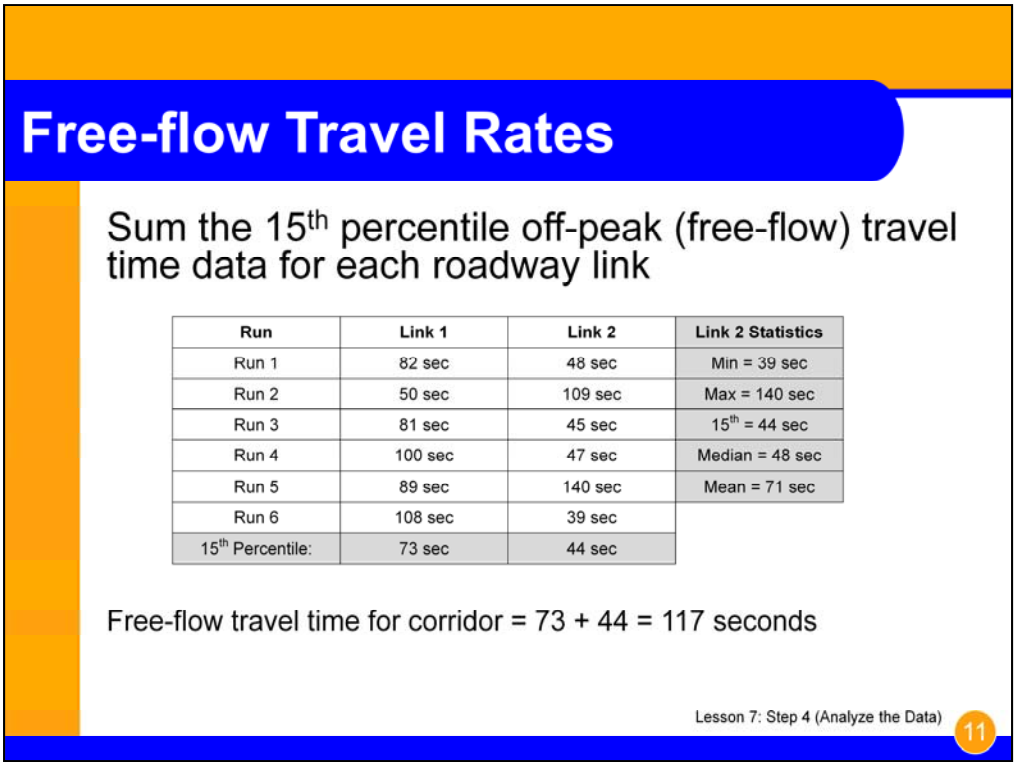
This graphic shows the computed 15th percentile, 50th percentile (median), and 85th percentile travel rate and speed for the observed data.



Often the 15th percentile travel rate is used as the free-flow travel rate.

This graphic shows that the 15th percentile travel rate equates to the 85th percentile speed (see dashed line), which is often identified as “reasonable and prudent” for posted speed definition.

Estimating free-flow speed with the 15th percentile travel rate eliminates one or two (typically) of the fastest recorded times, thus mitigating the “speed racer” effect of one really fast travel time.



These data are from page 47 of the *Guidebook*.

There are many possibilities for calculating the free-flow travel rate. Using posted speed limits can prove difficult along a corridor when the posted speed changes from link to link. Over time, it is possible that Thus, it may be easier to calculate a travel rate for each link, roadway, or even the entire system.

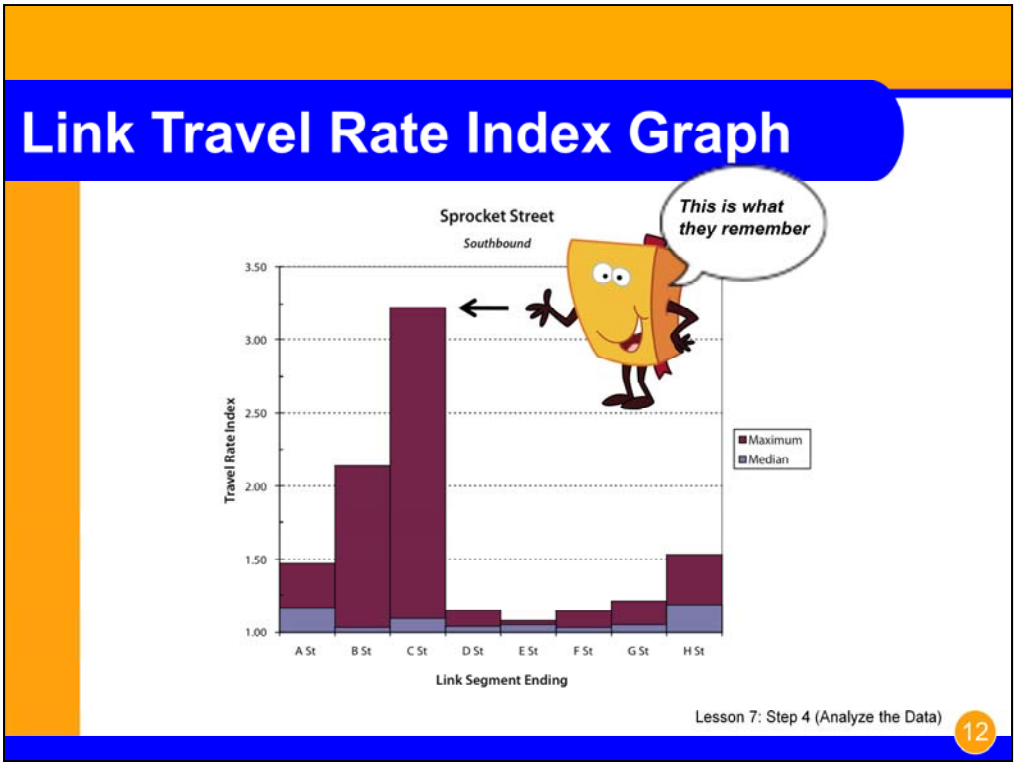
The free-flow condition is calculated by summing the 15th percentile off-peak travel time data for each link in the roadway. Estimating free-flow conditions in this manner eliminates one or two (typically) of the fastest recorded times, thus mitigating the "speed racer" effect of one really fast travel time. This also helps to mitigate the effect of some congested links on the total run's travel time.

In this example, 6 travel time runs are made along a roadway with two links. You can see how much the times between checkpoints differ for the 6 runs. In some cases the times are more than double the previous run.

In the case of the link 1 travel times, you can see that one run was much quicker than the rest (Run 2 – 50 seconds). The remaining runs are about 80 to 100 seconds. Taking the 15th percentile of the times for link 1 results in a time of 73 seconds which is closer to the majority of the travel times, but also takes into account that a vehicle was able to traverse the link in a much shorter time than the majority.

For link 2, you can see that most of the runs took around 40 to 50 seconds, however, two runs took well over 100 seconds. Taking the 15th percentile of the link 2 travel times results in a time of 44 seconds, which puts the travel time much closer to the norm for the list of runs. Because of the two large outliers of 100+ seconds, the average or mean for the set of runs would be 71 seconds which is much longer than the majority of the runs. The median for the group would be 48 seconds which is not too far from the 44 seconds produced by the 15th percentile. This is due to the fact that the 4 travel time runs were so closely spaced between 40 and 50 seconds.

So, the 15th percentile analysis provides a free-flow travel time run for the corridor (link 1 plus link 2) of 117 seconds.



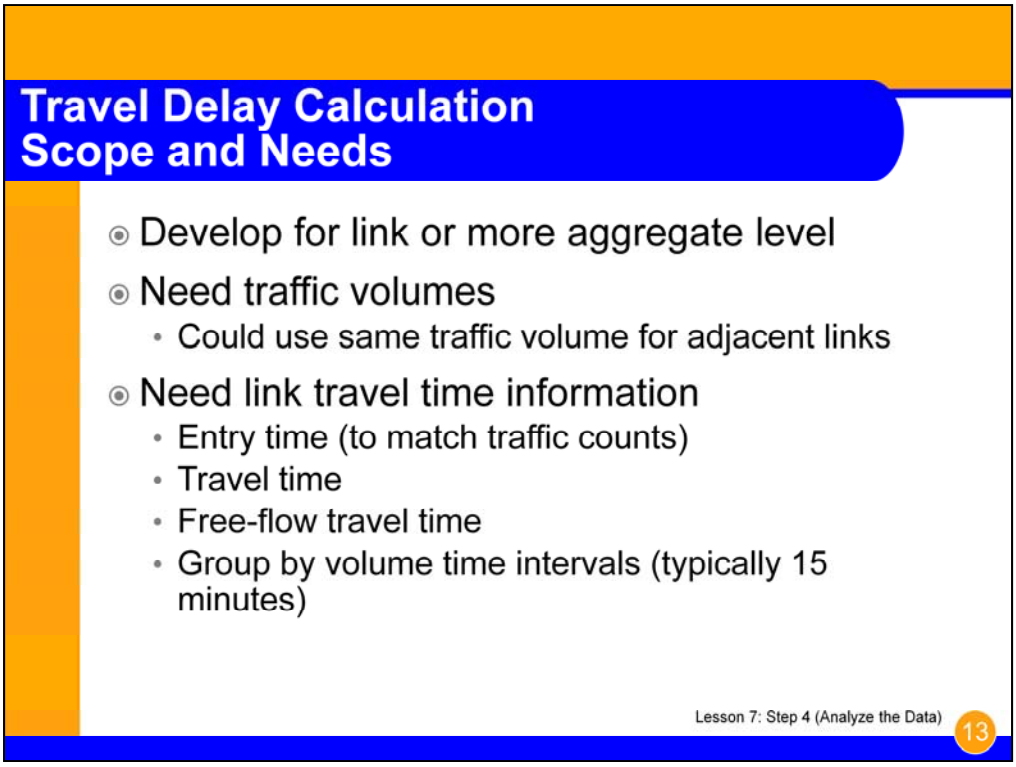
These data are from page 47 of the *Guidebook* and the graphic is on page 49.

This graphic shows the median and maximum travel rate indices along the corridor.

How do you interpret this graph? Where are the problem links or links with more variability in travel?

There appears to be something causing speeds to slow during the peak periods at A, B, C, and H cross streets. These could be busier cross streets that take some of the green time during the peak periods away from Sprocket Street. There were some much longer travel time runs recorded for these links during the peak than off-peak.

The links at D, E, F, and G had very little difference between the peak travel times and off-peak travel times.



Travel delay is a measure that the traveling public understands. They can relate to minutes or hours of their time that are lost due to slower traveling conditions. Delay can be calculated for different transportation system levels (aggregations). Delay can be calculated on a single link of roadway, an entire corridor, an entire functional classification of roadway, or even the entire roadway network.

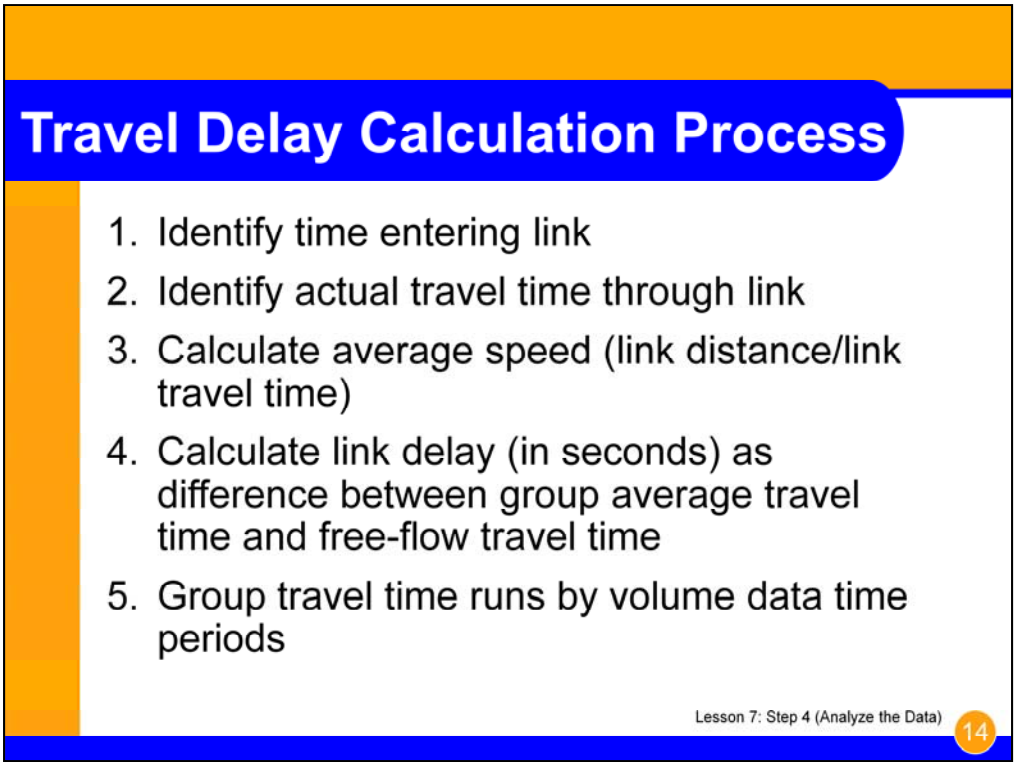
To calculate delay, you need both traffic volumes and travel times. The traffic volumes allow you to turn your estimate of vehicle delay into an estimate of roadway delay.

It may be extremely difficult to obtain traffic volumes for every link of your monitored system. You may be able to collect traffic volumes on one link that can be assumed applicable to several because they have similar cross-sections and total ADT. Traffic counts from one link may not be applicable if the cross-section of roadway changes or the ADT differs by more than 10 percent from the link where the traffic count was obtained.

It is important to assign each travel time run a link entering (start) time. This entering time is the closest minute to the time the travel time run entered the current link. This information will be important as the travel time run is matched to the traffic volumes on each link. So, if a test vehicle run entered the second link along a corridor at 7:12:22, the travel time run would be assigned an entering time for the link of 7:12.

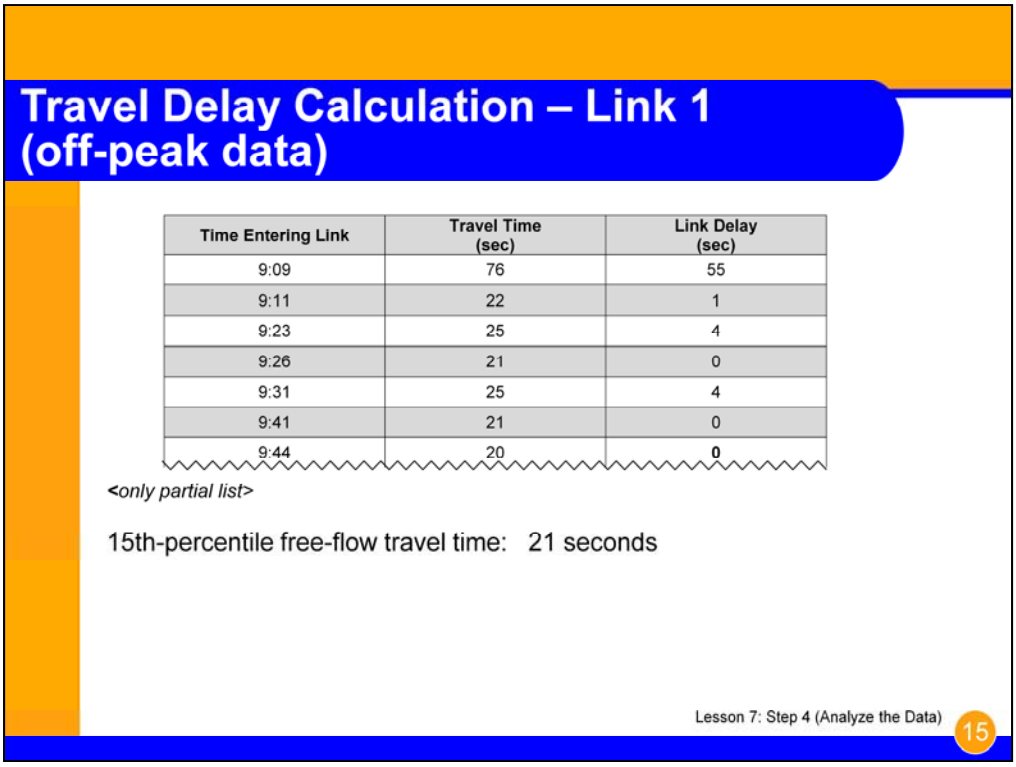
The 15th percentile is taken for the off-peak set of travel time runs to obtain the free-flow travel time for each link. This free-flow travel time for each link is compared against each travel time run made during the peak. If the peak travel time run was longer for the link, the difference is the delay time for that particular peak period run. If the peak travel time is shorter, a value of zero is assigned to the delay time for that particular travel time run.

If the traffic volumes data is collected in 15-minute intervals, the travel time data needs to be visually grouped into these same intervals so that the appropriate traffic volumes can be applied. For each 15-minute grouping of travel time runs, the average link delay will be calculated. This average is then multiplied by the traffic volume moving during that 15-minute period to generate the vehicle delay for the link. The vehicle delay for many links can be added to generate a corridor estimate, corridors can be added to generate a network estimate and so on and so forth.



Instructor describes travel delay calculation with the following steps:

1. Identify the time entering the link rounded to the nearest minute.
2. Identify actual travel time through the link.
3. Calculate the average speed for quick reference and reasonableness check
4. Calculate link delay by subtracting the free-flow travel time from the actual peak period link travel time.
5. Group travel time runs by volume data time periods

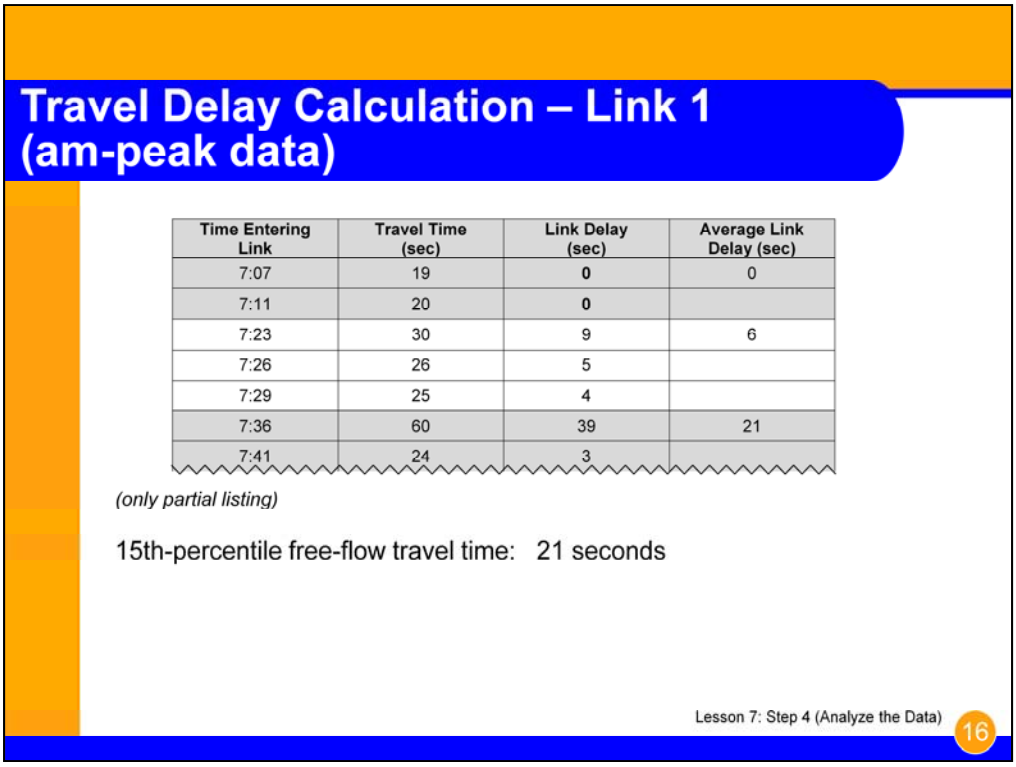


These data are from page 51 of the *Guidebook*.

This slide shows the off-peak travel time runs for a particular roadway link. This data will be used to calculate the off-peak travel time value.

The 15th-percentile is taken from all of the travel times and results in a value of 21 seconds for the link. 21 seconds will be used as the free-flow travel time for this link to calculate travel delay.

Note: The 9:44 run had a travel time of 20 seconds. Since this is faster than the 15th-percentile travel time of 21 seconds, a zero is entered manually for the link delay.



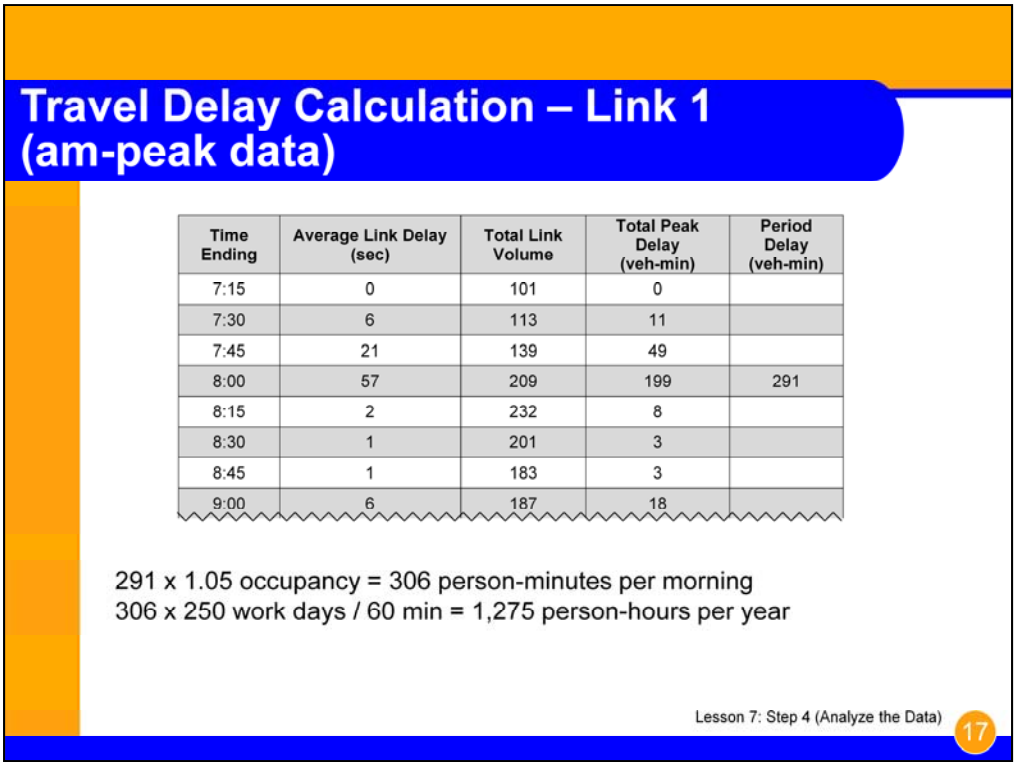
These data are from pages 51 and 52 of the *Guidebook*.

In this slide, the 21 second off-peak travel time for this link is used with some A.M. peak period travel time data to calculate average link delay.

Note in the 7:07 and 7:11 runs that the travel time was faster than the 15th percentile time of 21 seconds so a link delay of 0 was manually entered for these runs.

The travel time runs were grouped into 15-minute periods because traffic volumes were collected for each 15-minute period of the day.

Once the link delays were calculated, an average link delay was calculated for each 15-minute period using the available runs in each 15-minute period.



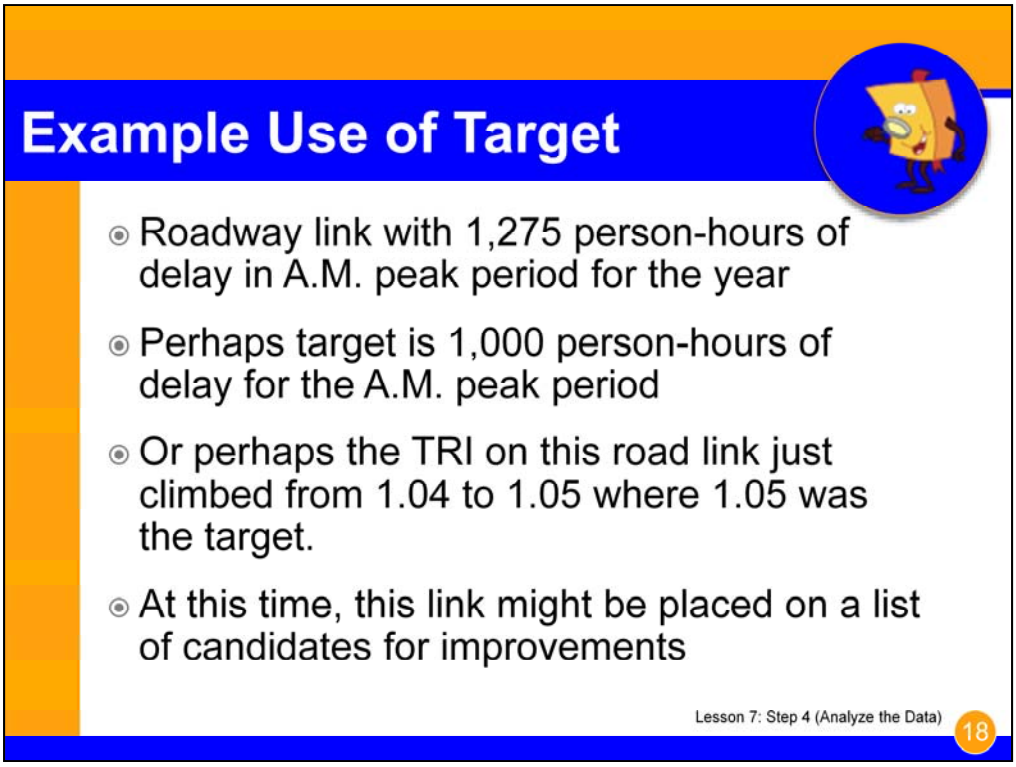
These data are from page 52 of the *Guidebook*.

Applying the average link delays calculated for each 15-minute period will result in a peak period delay for the link.

The average link delay for each period is multiplied by the directional volume for that link during the same 15-minute period. The result is the total link delay in vehicle-seconds or vehicle-minutes. These values can be divided by the appropriate length of time to convert them from vehicle-seconds to vehicle-hours. Once the total link delay by 15-minute period has been calculated, the values are summed to generate the peak period delay estimate.

This peak period delay is still representative of the vehicles on the roadway and not the people in those vehicles. This value of 291 vehicle-minutes can be converted to person-minutes by multiplying the vehicle-minutes by the average occupancy of the vehicles on the link of roadway. In this example the occupancy is shown as 1.05 persons per vehicle. This results in a delay estimate of 306 person-minutes per morning.

Many agencies or decision-makers also want annual delay estimates. The 306 person-minutes is multiplied by 250 (which represents the number of working days per year) and divided by 60 minutes in an hour to convert the final number to person-hours per year. This results in 1,275 person-hours of delay per year on this link of roadway for the A.M. peak period.

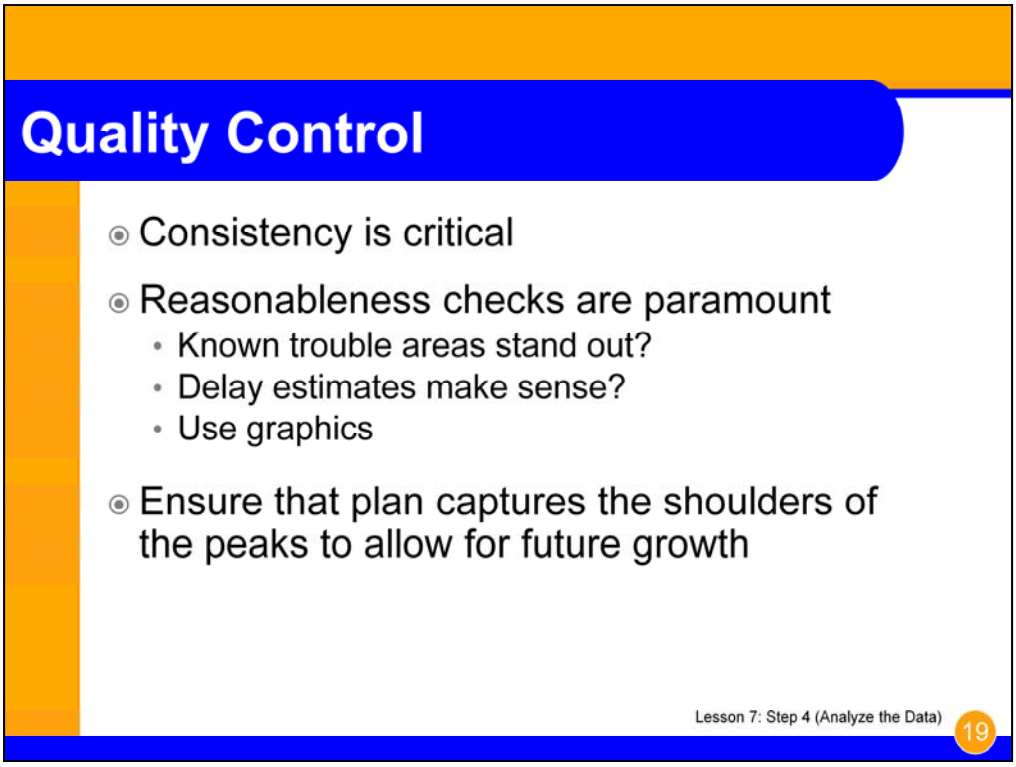


Targets have been discussed in previous lessons. Targets were identified in Step 1.

Following the calculation of performance measures, the results of the travel time data collection can be compared to the targets to determine how each link, or corridor, or entire transportation system is performing relative to those targets.

In this example the roadway link had 1,275 person-hours of delay in the A.M. peak period for the year. Perhaps, the policy for this roadway or for this type of roadway is that the peak period delay should not exceed 1,000 person-hours. Or, perhaps the TRI on this link of roadway just climbed from 1.04 to 1.05 and has equaled the target TRI.

In this case, since the targets established for this link has been reached, this link or entire roadway may be placed on a list as a possible candidate for improvements or for more detailed study.



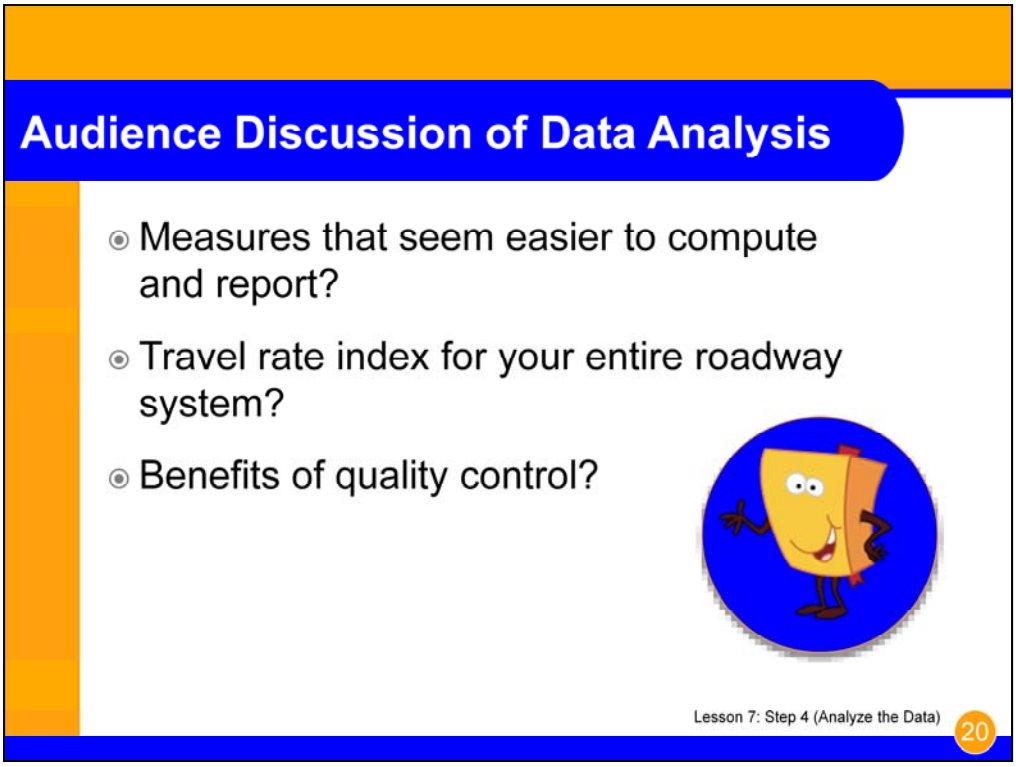
Quality Control is important throughout a monitoring process. Because "monitoring" typically takes place over years, it is important to keep consistency throughout the process. The staff who handle the program may turn over during the monitoring, so it is especially important that everything is documented and that a consistent application of the methods shown in the *Guidebook* are incorporated into the monitoring program.

Reasonableness checks are important. As mentioned on a previous slide, it is not a bad idea to convert the travel times into speeds on the individual links. Because we don't typically think in terms of minutes per mile, it might be easier for you to see some questionable data viewing it in terms of speed.

If you have one roadway corridor that obviously has more traffic congestion than others, did you capture this in your analysis? Do your travel time and delay estimates make sense? If you come up with an estimate of 1 million person-hours of delay on a link of roadway, and your area only has 100,000 persons, does it makes sense that the one roadway link delays everyone in town at least 10 hours per year? Make sure you perform some of these common sense checks before the numbers are rolled out and publicized.

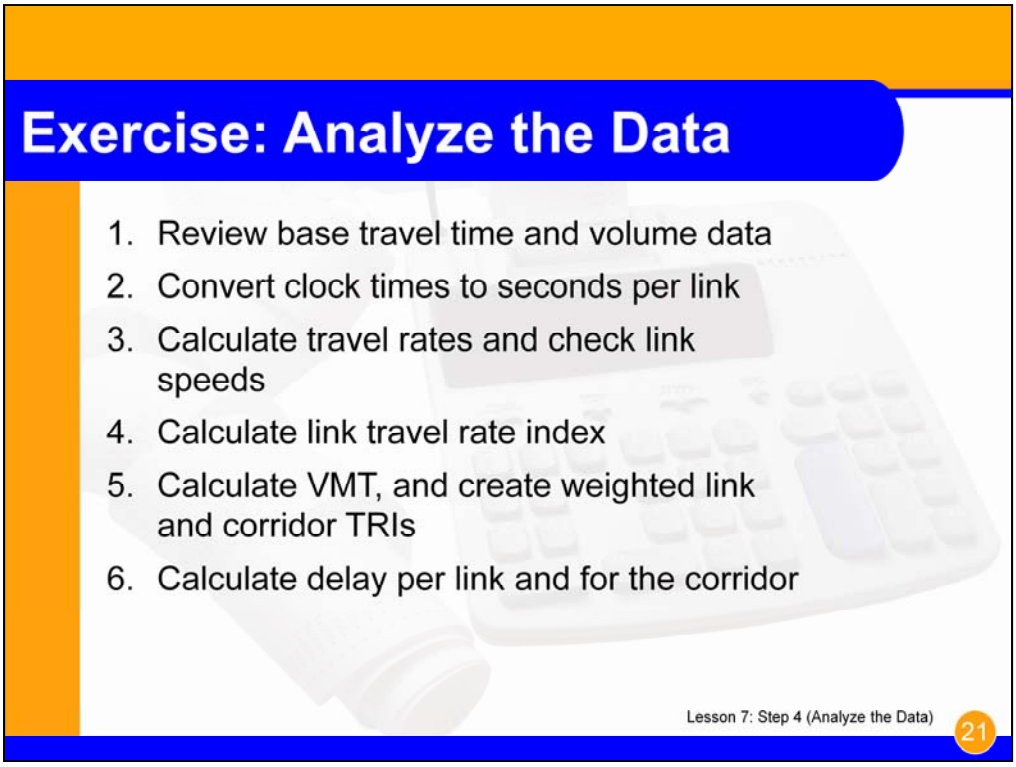
Use graphics to review and report your data. Graphics can help to explain what is going on or really shed light on very congested areas. Sometimes the graphics will help you find questionable data easier than visually reviewing tables of numbers. This will be explained in more detail in the next lesson.

One other important idea in your monitoring is that you ensure that your "peak period" analysis captures some time on each side of the peak that is less or lightly congested. If you just collect data for the peak hour, you may never capture the fact that the peak periods are getting progressively longer. Why? Because the growth is congestion may be happening outside of the peak hour. The "shoulders" of the peak often have some extra roadway capacity available, and this is where a lot of the additional travel may occur. Make sure you set your data collection bands wide enough to capture the peaks and have some "shoulders" of additional time to capture future growth.



Instructor solicits comment and discussion of the topics on this slide by asking the questions:

- Are there any measures that seem easier to compute and report?
- How would you calculate one travel rate index for your entire roadway system?
- Why do we need quality control? What are the benefits?

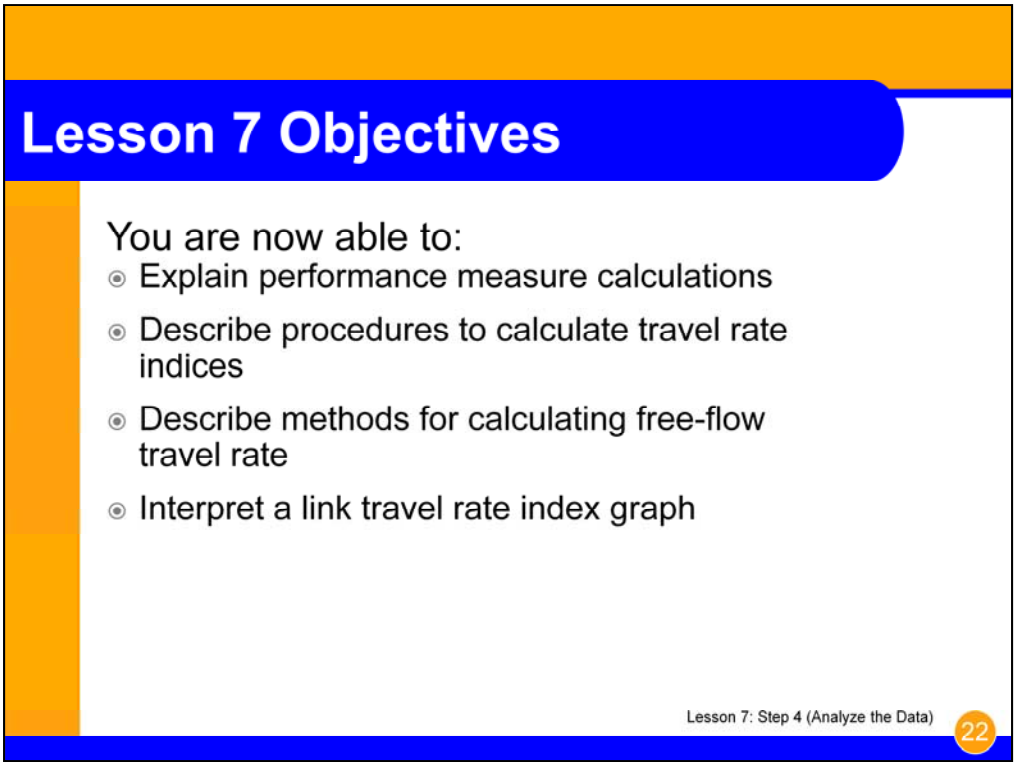


Instructors hand out exercise pages to each participants. Participants are asked to work with their groups again. Calculators are provided for each group of 4-5 individuals.

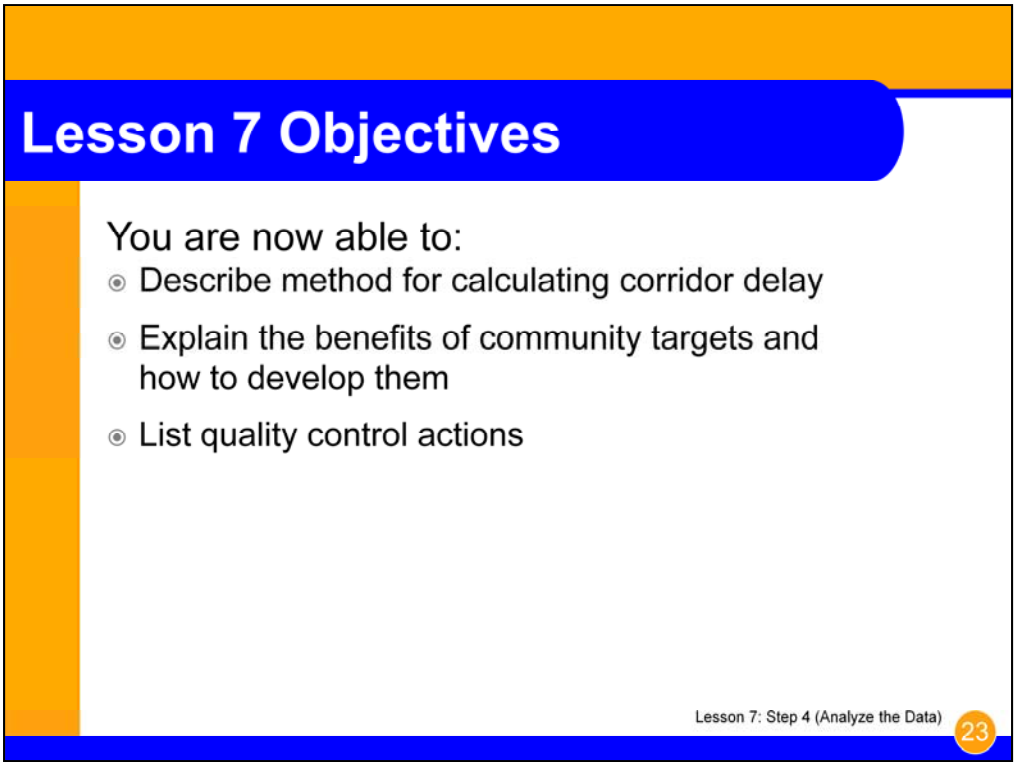
Instructors describe the exercise contents, the blank locations where responses are desired, and the six requirements of the exercise as shown on this slide.

Instructors will take about 5 minutes to set up the exercise and participants will have 15 minutes to perform the calculations, and the instructors will answer questions as needed.

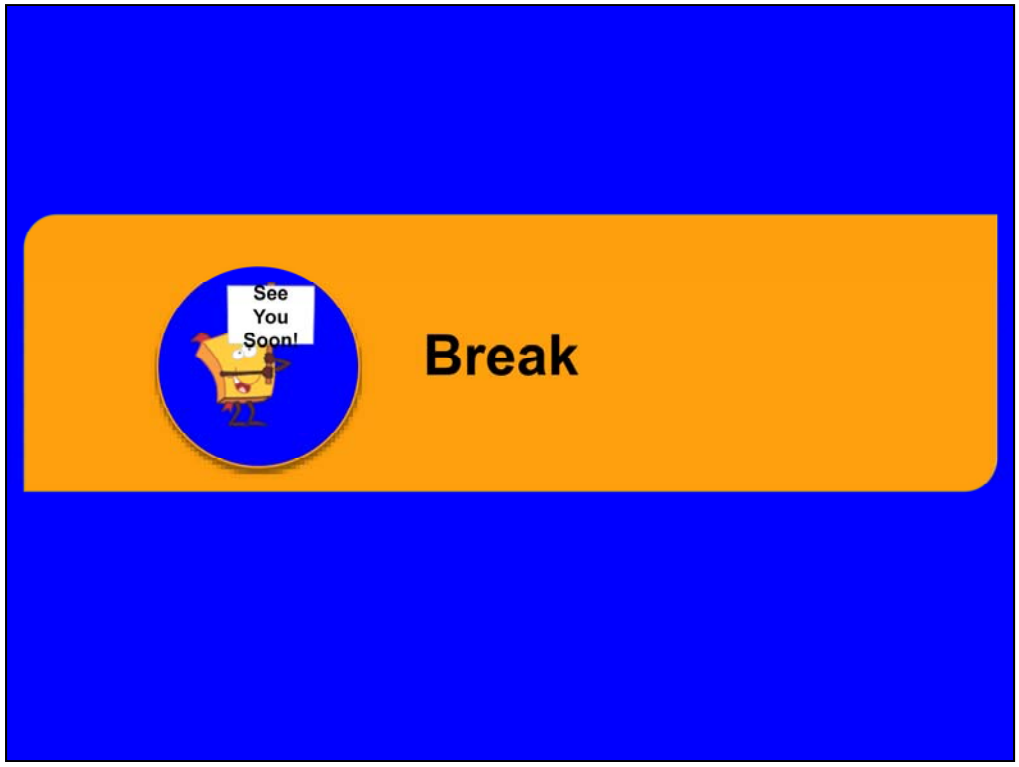
After the exercise, instructors will take 5 minutes to discuss the results and answer any group questions on the exercise calculations.



Restate the Lesson 7 objectives, and ask participants if they have any questions before taking a break.

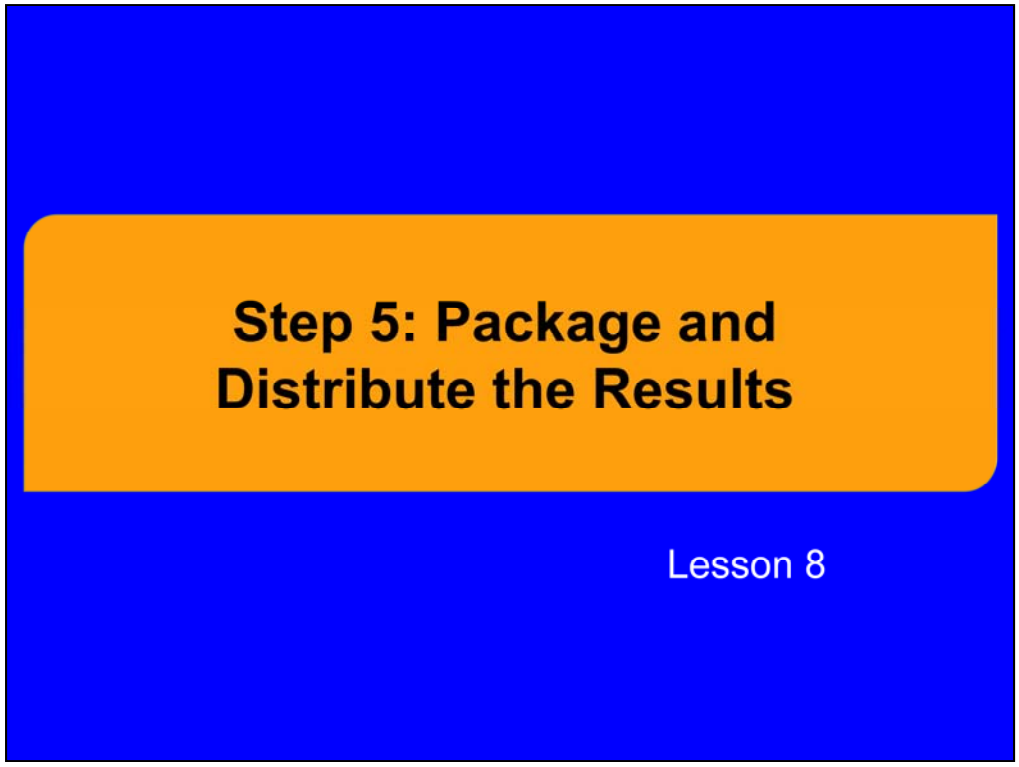


Restate the Lesson 7 objectives, and ask participants if they have any questions before taking a break.



Duration: 15 minutes

Time: 2:40 to 2:55 pm

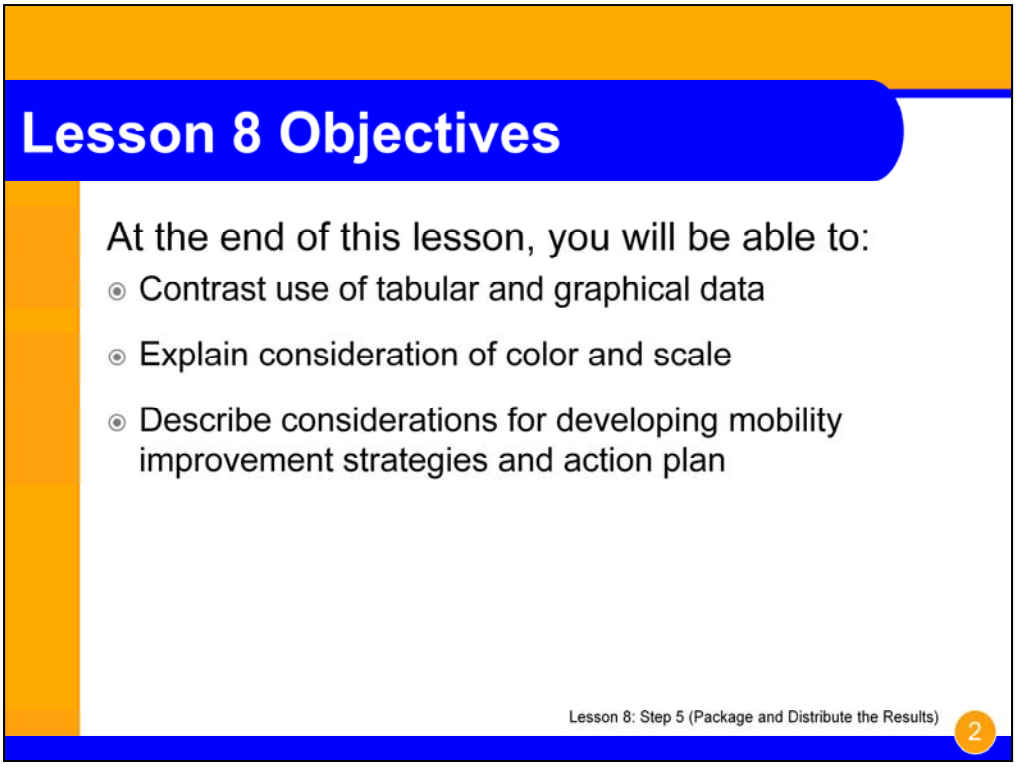


Duration: 35 minutes

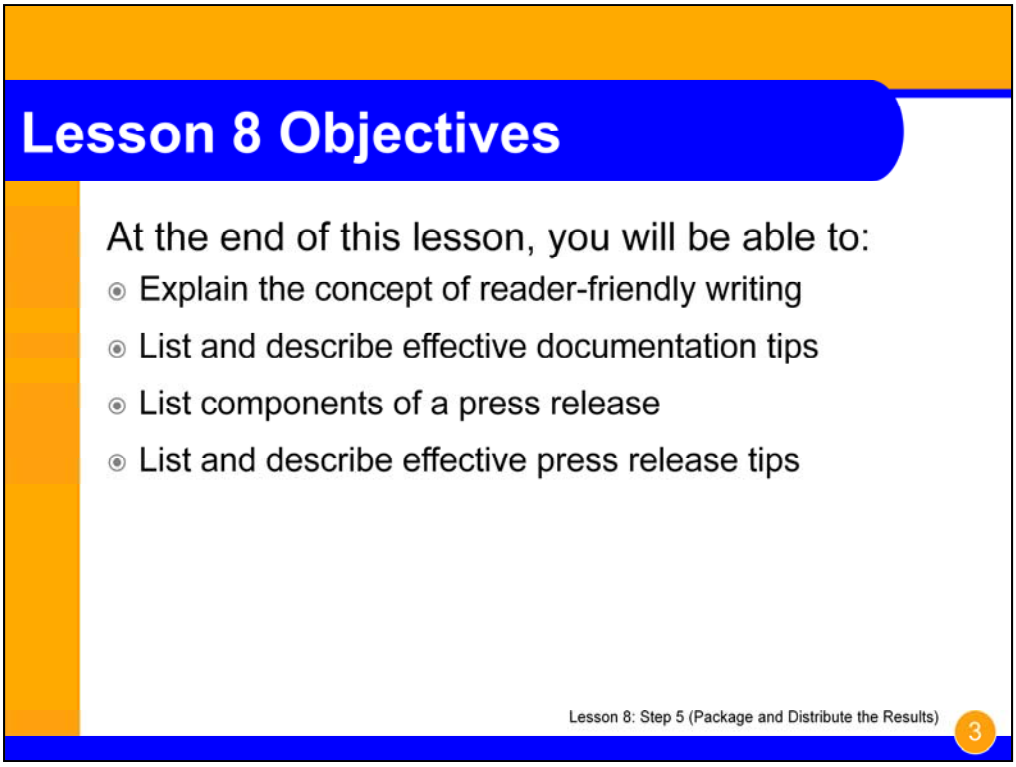
Time: 2:55 to 3:30 pm

Time Allocation:

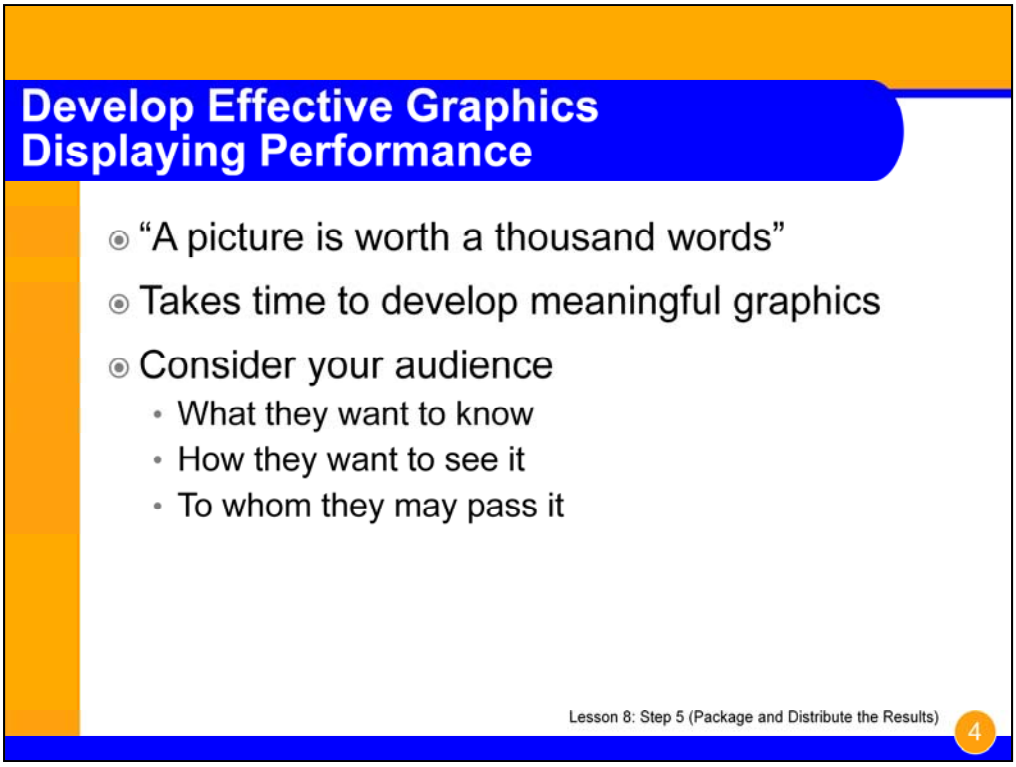
Lecture	25 minutes
Exercise	10 minutes



Verbally state the Lesson 8 objectives for the participants.



Verbally state the Lesson 8 objectives for the participants.

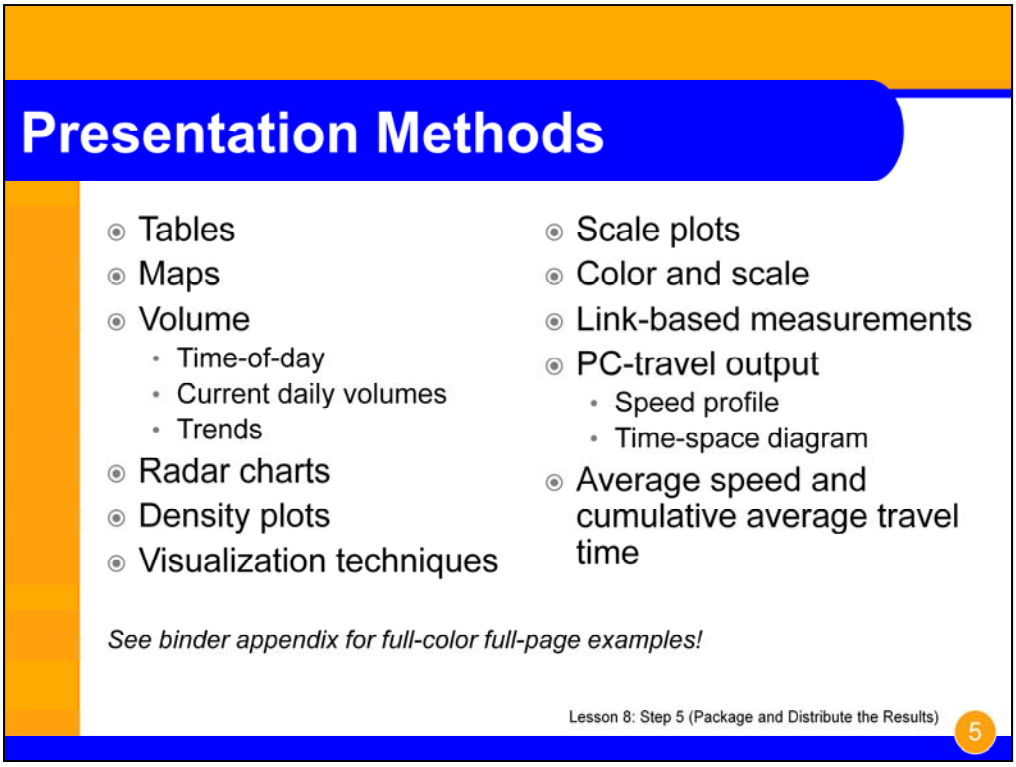


You've heard the saying "A picture is worth a thousand words." Well, the rest of that should include that a picture can tell a better story to relate intensity, distance, and time relationships than an intimidating table full of values.

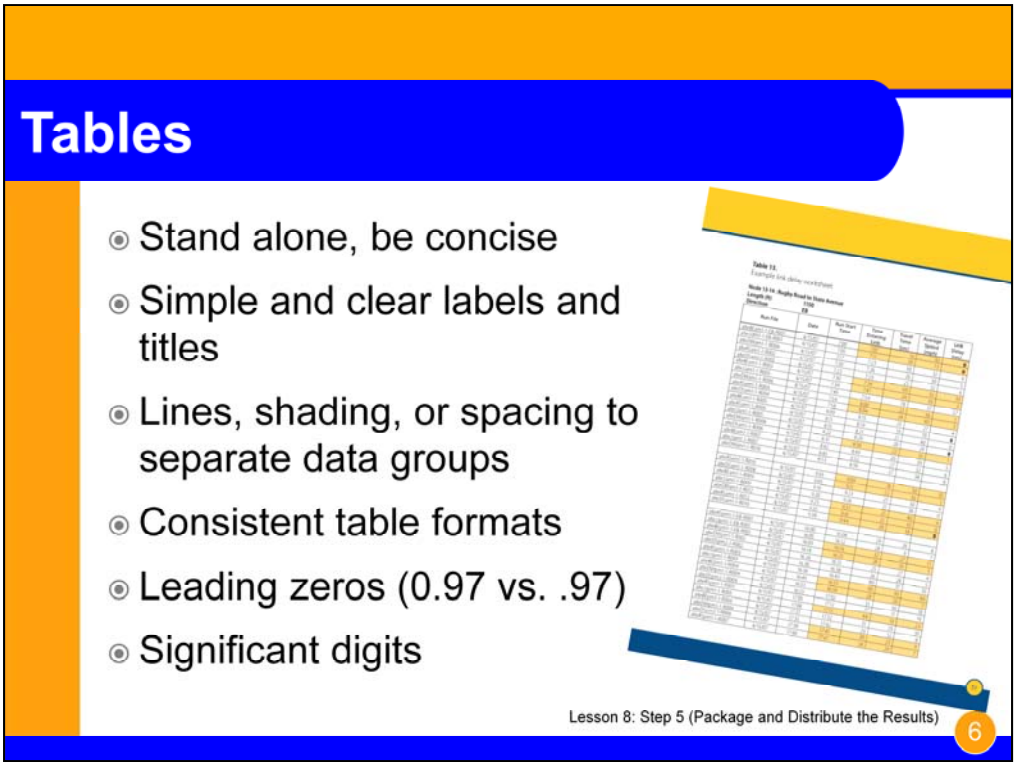
It takes a great deal of time, and trial and error, to develop a meaningful graphic that conveys just the right amount of information in a manner that is easy to understand. As a technical professional, you may not be in tune with the creative half of your brain. So this work can be frustrating and cumbersome. Get help from others in your agency.

With some patience and strength to draw on your creative side, you will be able to develop graphics that convey the power of your data. Several examples of graphics are presented here. These are starting points for you and are not meant to be the one-and-only format for conveying your results to your stakeholders.

Always keep your audience in mind when preparing any supporting graphic. Consider what they want to know, how they want to see it, and to whom they will pass it.



Instructor verbally describes the listed items as possible presentation methods. Examples and highlights of all of these presentation methods are included in this lesson. They are shown in color and as larger graphics in the “appendix” tab.

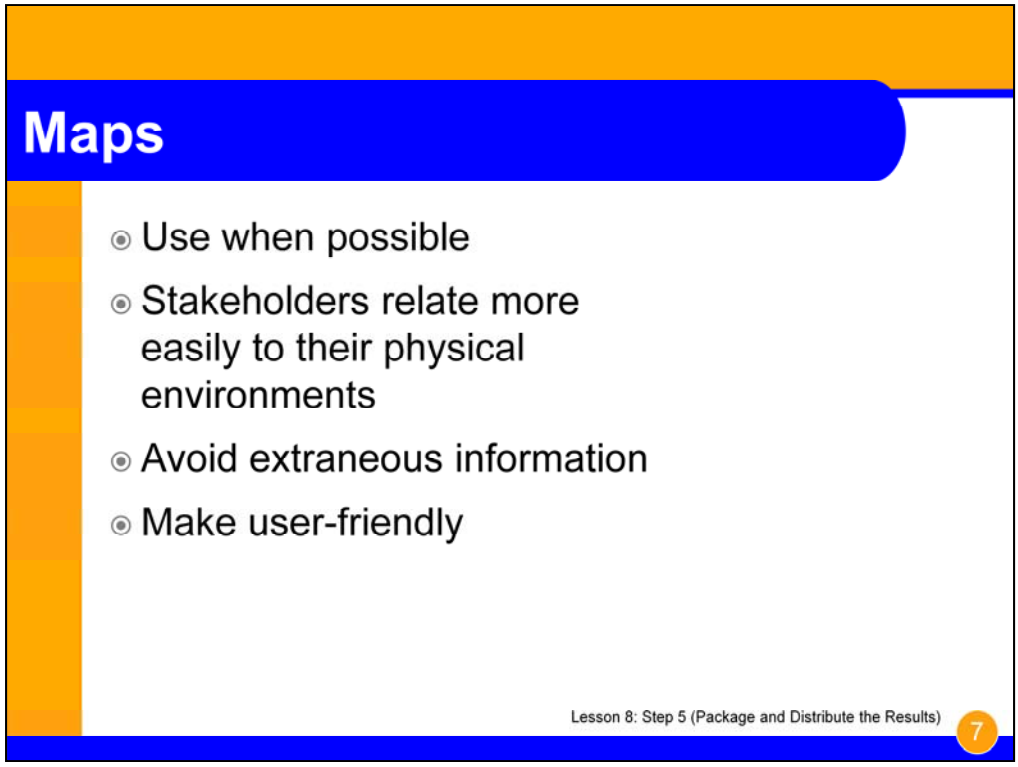


Data tables serve a valuable purpose. Tables should be able to stand alone, be concise, and use simple but clear labels and titles. You should use graphic aids like lines, shading, or spacing to separate data groups. These graphic aids should be used both horizontally and vertically in the table. Separating data groups helps the reader understand where data categories change.

Use consistent table formats in your documents with a font that differs from document text. The best fonts for document text are those that have serifs (the embellishments to the letters that lead the eyes to the next letter or word). Data tables are best displayed in a sans serif font.

Use a leading zero for data between zero and one. Use decimal alignment in columns to clearly convey magnitudes to the reader.

Finally, you should include only the appropriate number of significant digits in the data. Currently available tools are capable of reporting calculated data results out to many decimal places. Your calculated results are only as precise as your least accurate input parameter. Reporting with more significant digits than your least accurate data input is a misstatement of the data.



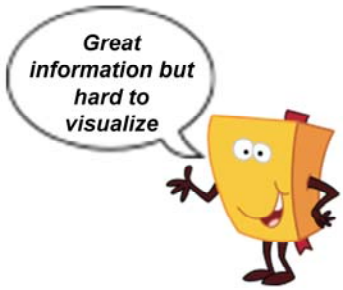
Use map-type graphics when possible. Stakeholders relate easily to their physical environments. Choose an appropriate scale where the area and its context are large enough to orient the reader, while balanced against the need to show enough detail.

Consider the needs of the viewer when preparing your maps. Consider what you want viewers to see and what visual information you need to provide so they can orient themselves. Avoid extraneous information on the map.

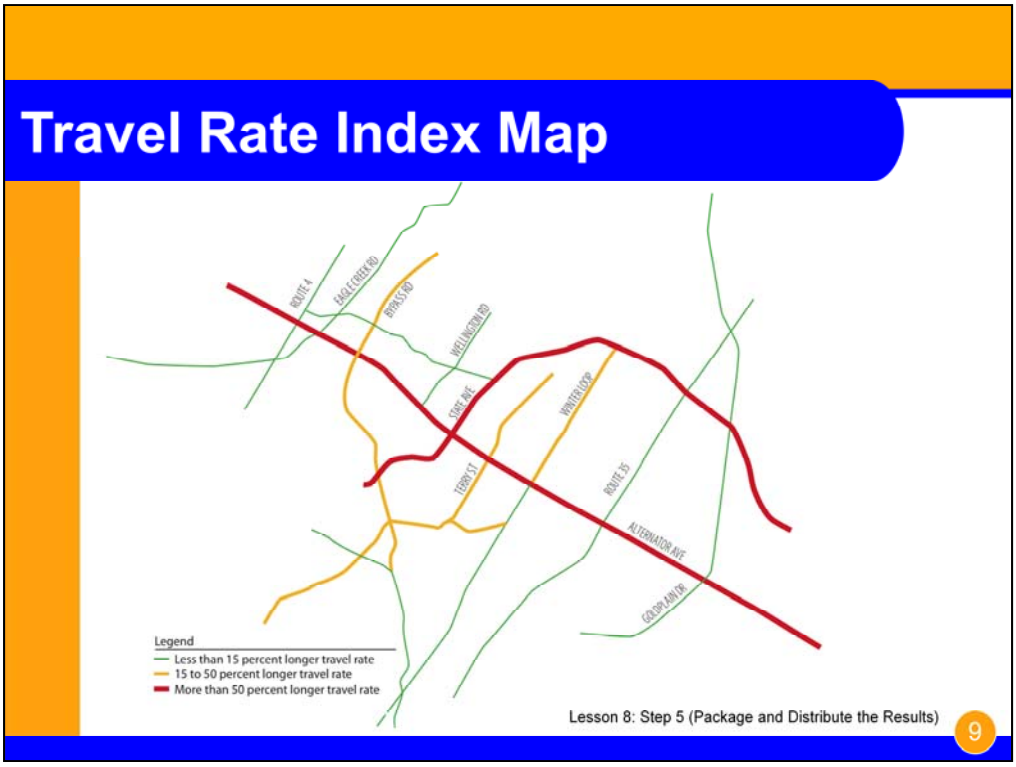
Make maps user-friendly—include only the information that is meaningful to the purpose of the data.

Table of Travel Rate Index Data

	State	Route 4	Route 35	Goldplain	Alternator	Winter Loop	Terry
Link 1	1.65	1.09	1.14	1.08	1.89	1.23	1.40
Link 2	1.80	1.01	1.01	1.12	1.91	1.34	1.35
Link 3	2.23	1.14	1.10	1.09	1.30	1.40	1.29
Link 4	1.30	1.02	1.10	1.14	1.89	1.23	1.30
Link 5	1.54	1.01	1.09	1.15	1.65	1.48	1.43
Link 6	1.90	1.14	1.08	1.13	2.20	1.45	1.49
Corridor=	**1.73**	**1.06**	**1.10**	**1.13**	**1.89**	**1.37**	**1.38**



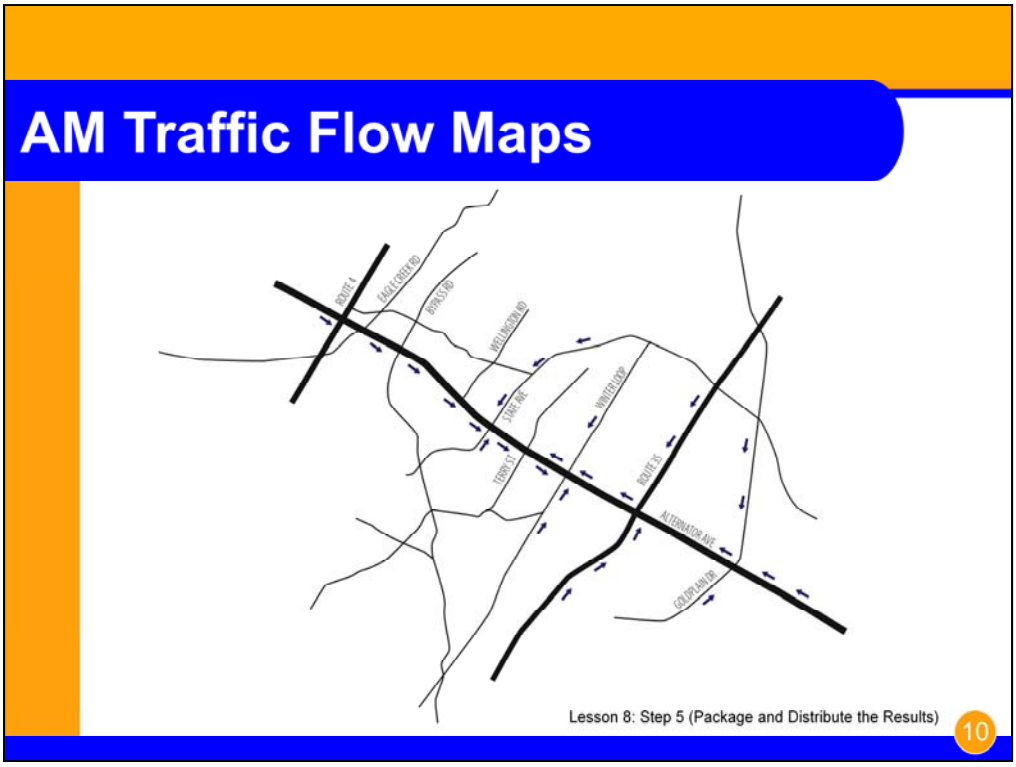
This graphic shows a table of corridor TRI values for several roadways in a community. In this example, all the roadways have five links. While meaningful, the table does not provide a visual context for the data. The analyst is left to visualize the physical context of the values on the roadway network.



Contrast the prior graphic with this graphic. This graphic quickly puts the table information in a meaningful visual context.

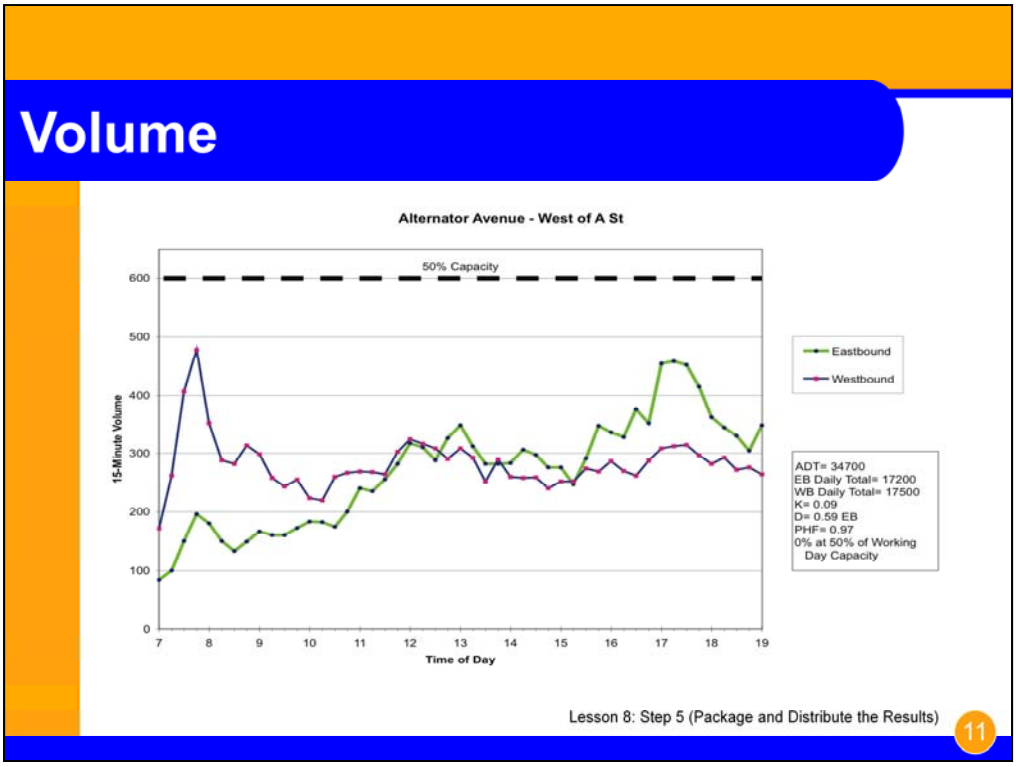
This is Figure 22 on page 60 of the *Guidebook*.

This map shows travel rate index (TRI) values for a community. Color is used to the congestion range on each roadway. Roadways are clearly marked, and the legend is clear.



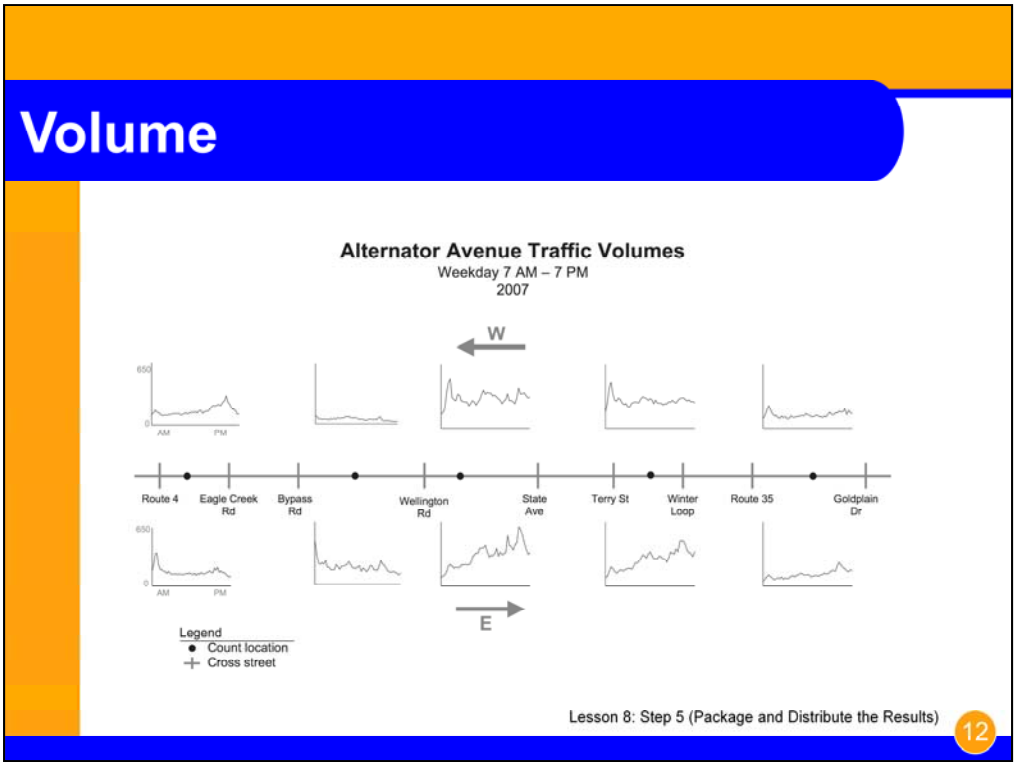
This is Figure 21 on page 59 of the *Guidebook*.

This graphic shows an example of AM traffic flows for a community. Note the generally inbound nature of the flows.



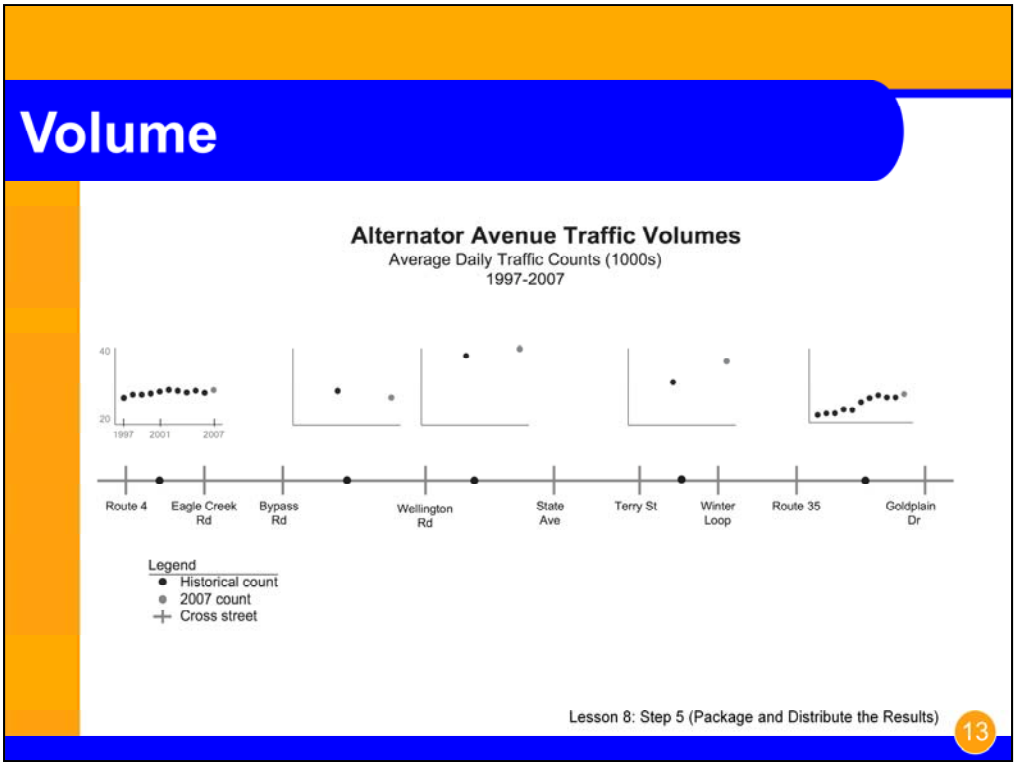
This is Figure 17 on page 57 of the *Guidebook*.

This graphic shows time-of-day directional 15-minute volumes. Note the target of 50% capacity. This was discussed in Lesson 5. Common operational characteristics are summarized to the right of the graphic.



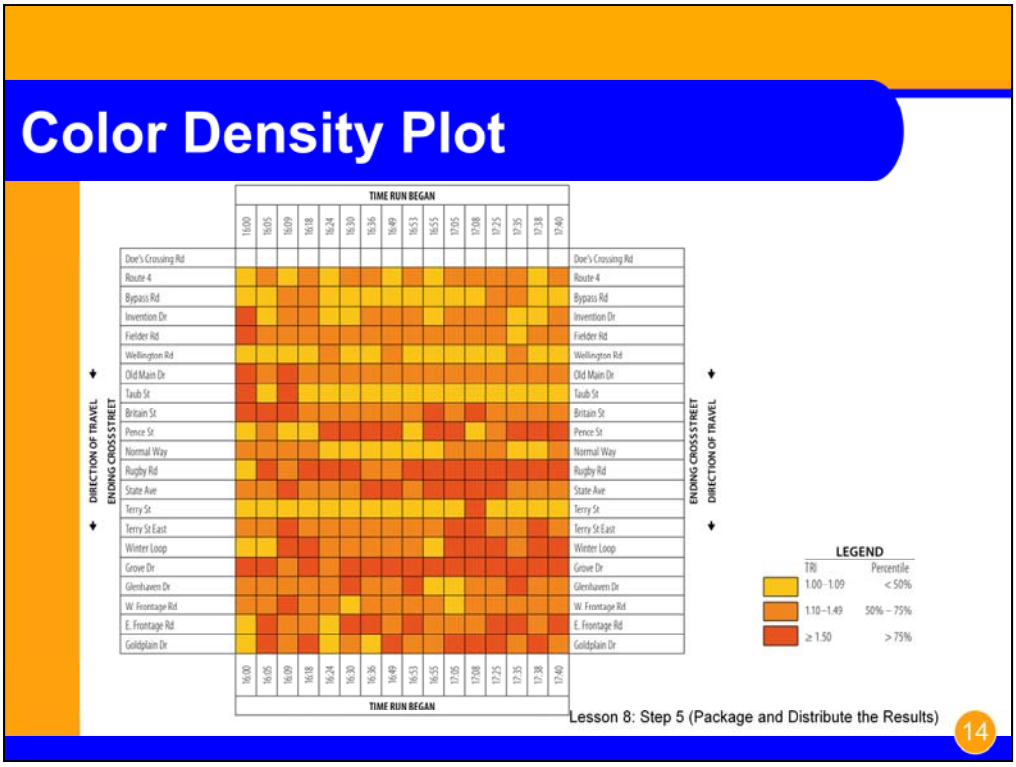
This is Figure 19 on page 58 of the *Guidebook*.

This graphic shows many useful characteristics visually along this corridor. It shows current roadway daily traffic volumes along Alternator Avenue from 7 AM to 7 PM. Traffic count locations are shown in relation to major cross streets on the roadway. The figure also separates out volumes by direction of travel. The graphic is kept relatively simple—no repeating axis values on each graph. Keeping the graphic simple directs the reader's attention to the data and is less distracting.



This is Figure 20 on page 58 of the *Guidebook*.

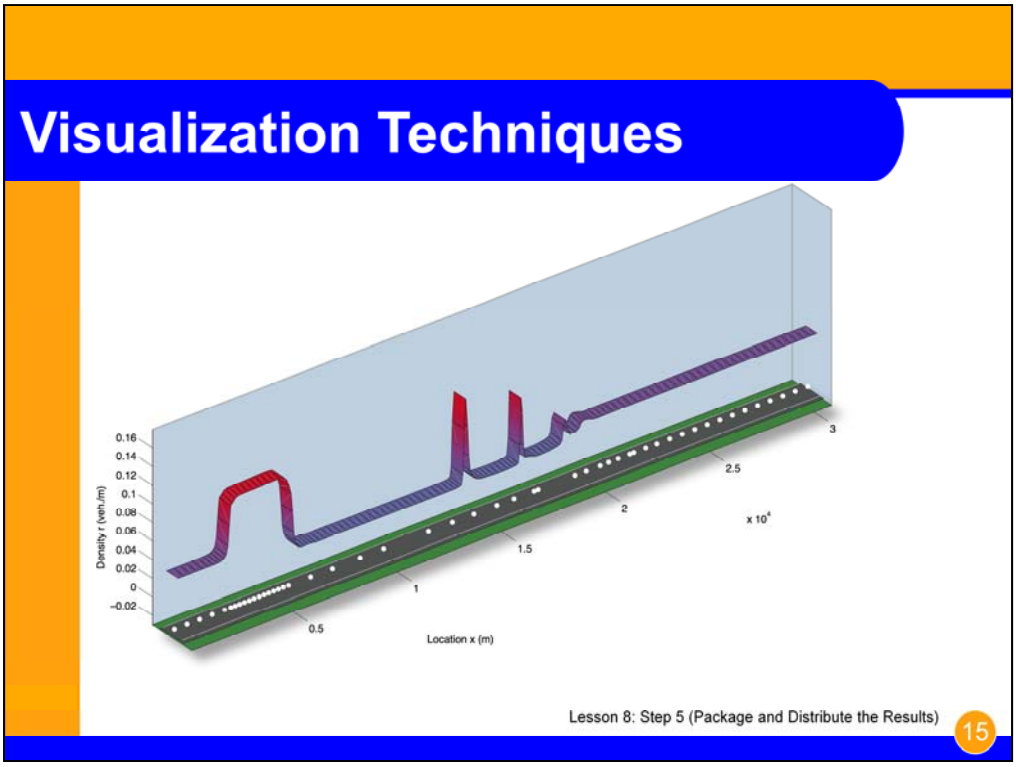
This figure displays historical traffic volumes along Alternator Avenue. Here, we can see data collected in 2001 and 2007 at the three middle traffic count locations, while annual data are available at the ends of the corridor. It is acceptable to show gaps in the data. You can still identify trends with data gaps; however, trends are more evident and stronger conclusions are made when the data gaps are filled.



This is Figure 24 on page 64 of the *Guidebook*.

The density plots on the next three slides provide readers with a sense of congestion intensity along the roadway and through time. This is a basic representation. This density plot compresses all of the data together so that each observation (ending cross-street run time) is weighted equally in terms of plot area. Time is read from left to right in accordance with natural reading tendencies. Likewise, movement along the roadway is conveyed as the reader scans down the graphic. Note that the direction of travel is also indicated to confirm the reader's sense of movement along the roadway.

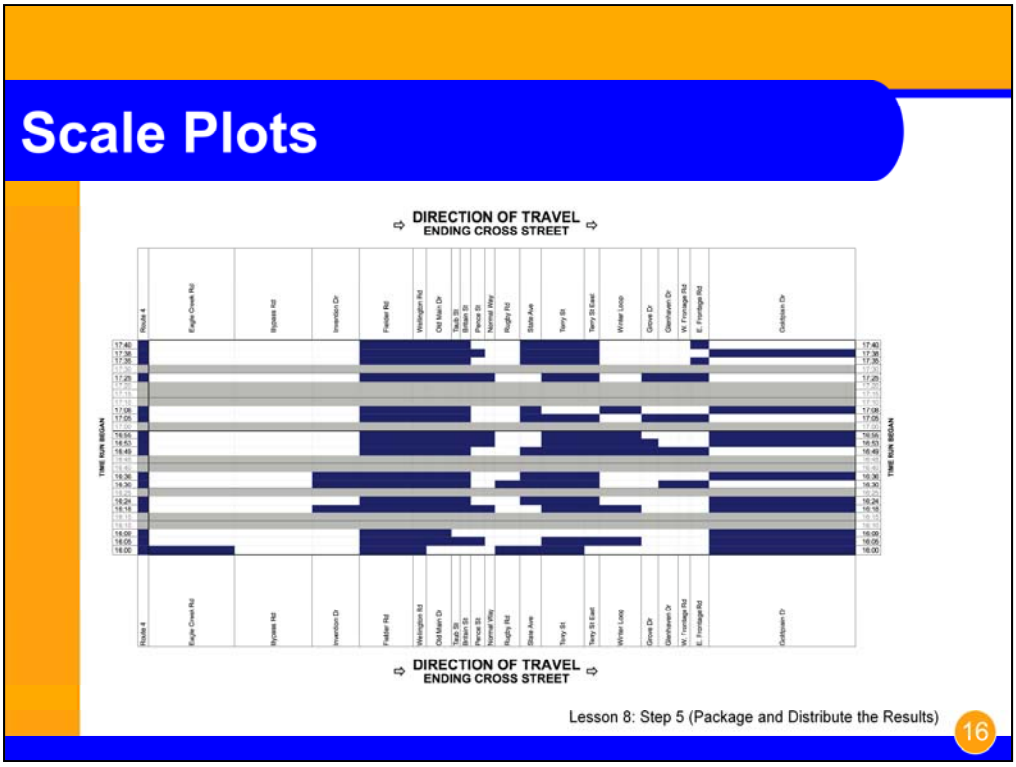
Increasing congestion, or higher travel rate index values, is color-coded through the use of either more intense color saturation or more intense color choices. In this example, decreased mobility can be seen to become more common through time over the afternoon peak period and geographically from midway through to the end of the roadway.



This is Figure 27 on page 67 of the *Guidebook*.

Visualization techniques are an effective means to convey information to the public. This graphic relates vehicle density in a 3-dimensional context (grass, shoulder and pavement, white dots for vehicles, sky) with the density functions hovering above. The technical professional would be able to interpret this standalone density function, but the general public may have a difficult time. The example is able to relate a technical issue in a nontechnical manner. Bringing the physical “sense” of the roadway operation can make an immediate connection with the viewer, allowing them to relate to the information easily.

The interactive CD contains an animated version of this graphic.

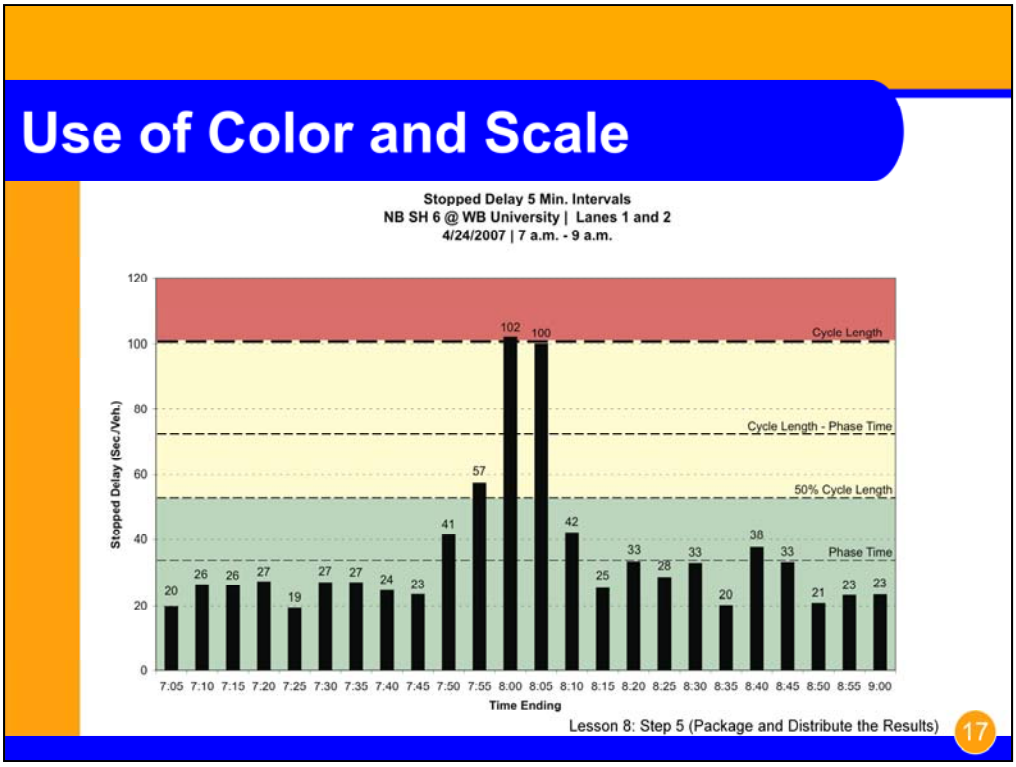


This is Figure 68 on page 28 of the *Guidebook*.

The traveling public easily relates to how long it takes for them to travel between two points. They use these times to base their decisions of when to travel for a reliable arrival time. Where travel times are not reliable, travelers add extra time, or buffer time, to their trips so that they will arrive at their destination on time.

While the last density plot related congestion intensity through color changes, a scale plot of this same route relates to the viewer the actual distance traveled on the route over a fixed increment of time, or time interval. In this graphic, the time interval is two minutes. The alternating color bands (white and blue) for each “Time Run Began” relate where on the route the driver was located in every 2-minute interval.

The figure shows that travelers in the 5 PM rush hour have difficulties progressing through the Terry St East and Winter Loop link taking about 2 minutes to traverse this distance. Outside of the highest peak demand, travelers at Terry St East can typically cover grater distance to reach either W Frontage Road or East Frontage Road in the same 2 minutes.

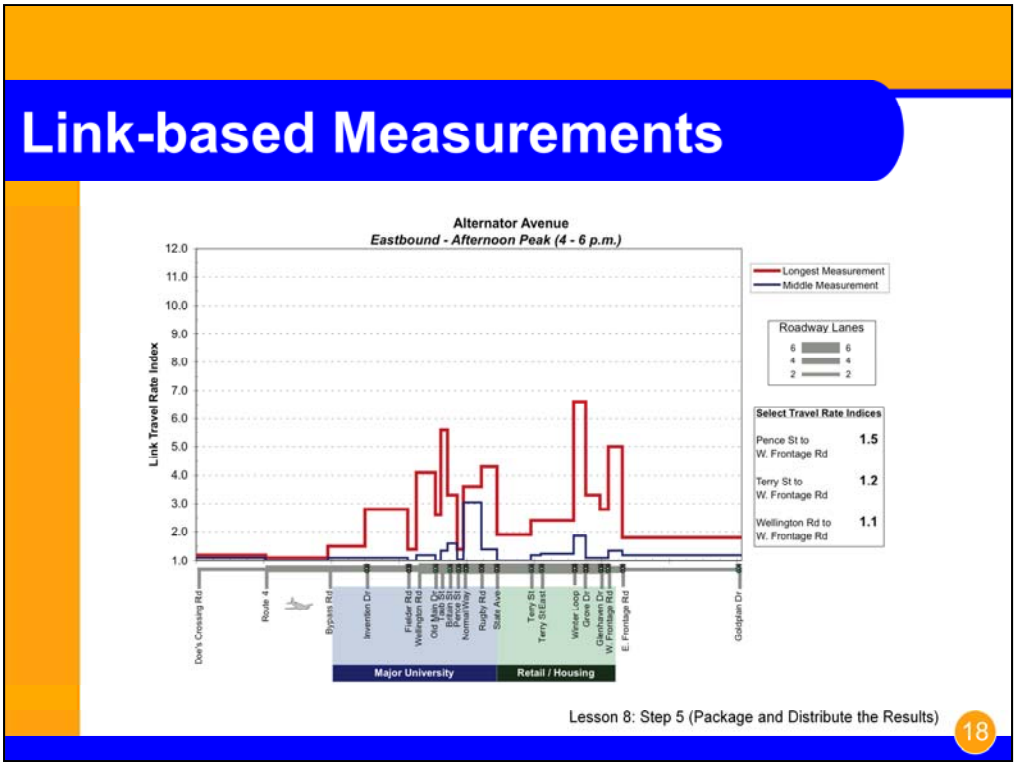


This is Figure 29 on page 69 of the *Guidebook*.

Use of color in your graphics makes them more visually appealing to readers. You likely were trained to develop your graphics for black-and-white reproduction. This is important when you know your results will be shown in a grayscale format. However, many applications you will create these graphics for—workshops, presentations, brochures—are likely to use color.

Carefully select your scale. Time-based scales can either highlight acute, short-duration events or can dampen them so that they appear less severe. Distance-based scales should be used to relate spatial concepts.

This graphic uses color to relate delay intensity and contrast time scales for stopped delay at an intersection. Use of color here relates the measured delay to the signal cycle length, which is a tangible quantity for the reader or driver. The green section of the graph indicates acceptable operation. The yellow area begins at the first target value, defined here as half of the cycle length. Finally, the critical area shown in red indicates when the average stopped delay exceeds the cycle length. This means that a vehicle must wait to be processed through the intersection on the second cycle after its arrival in the queue.



This is Figure 30 on page 71 of the *Guidebook*.

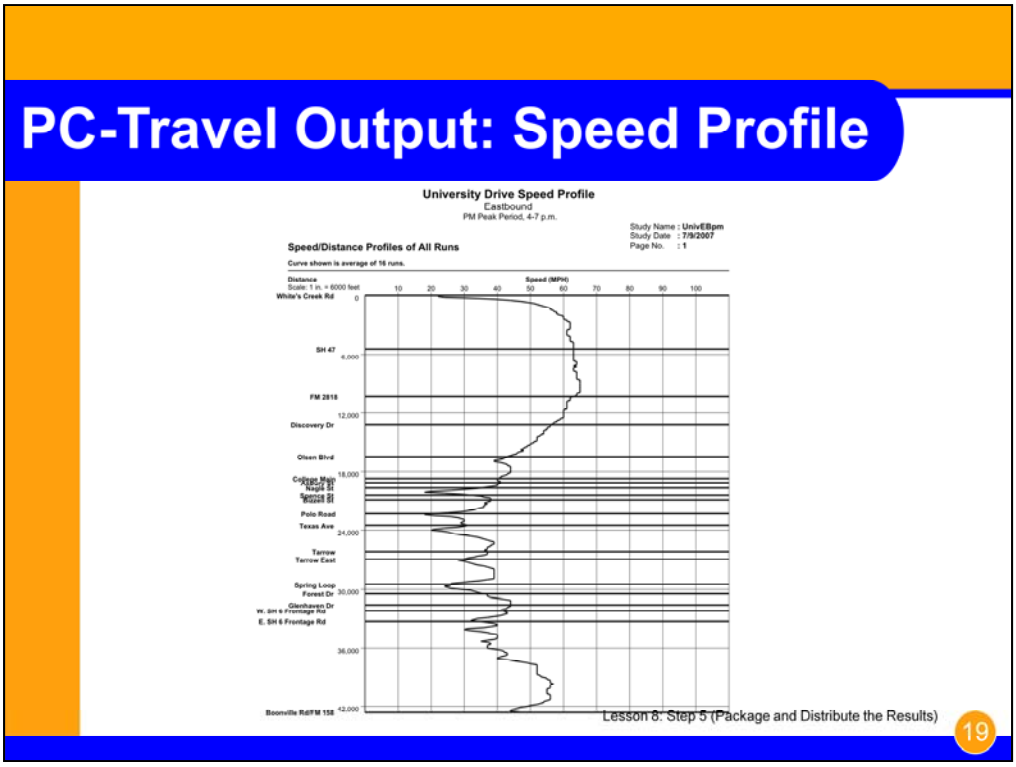
This graphic is an example of a link-based travel rate index for a roadway that provides several packets of information.

First, along the bottom or x-axis, the reader understands the physical aspects for the roadway—its width, distance between cross streets, traffic signal density, and land uses that may impact travel along the roadway.

The blue and red lines relate the travel rates. The thick red line conveys the worst mobility conditions measured. The thinner blue line indicates the median observation, where half of the data experienced higher or lower travel rates.

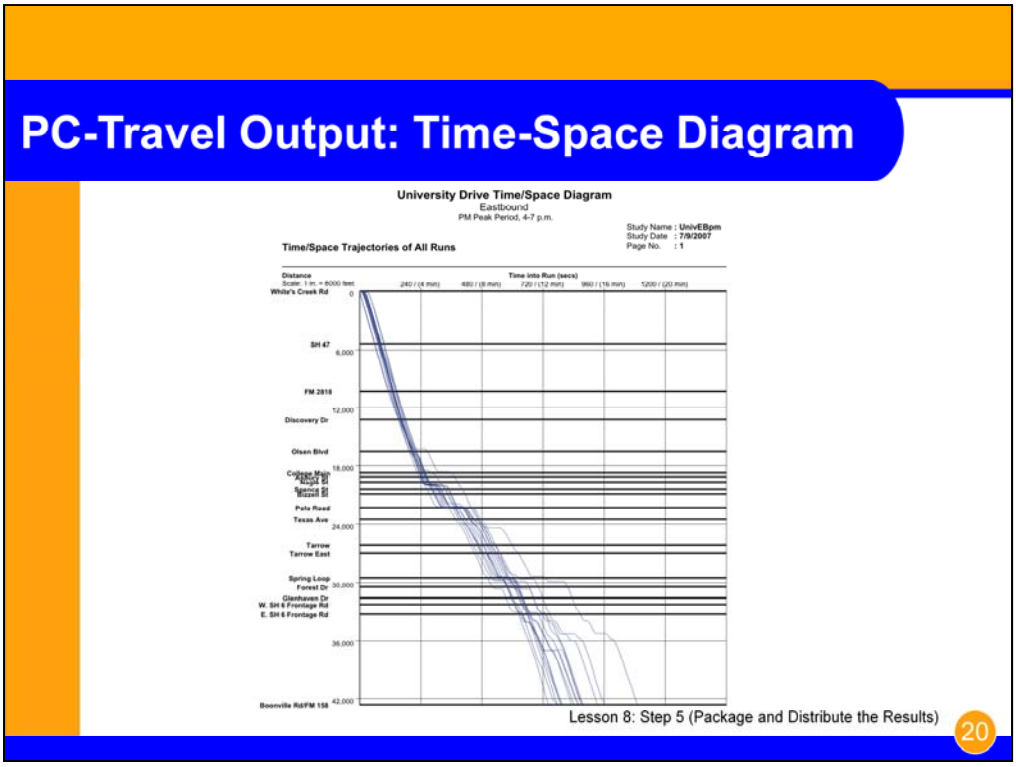
Finally, the summary box on the right side provides the reader with travel rate index values for a few long segments along the roadway.

The y-axis scale is relatively larger than the data within the chart. The scale was lengthened to provide a level comparison for data in other timer periods that approached an index level of 12.0.



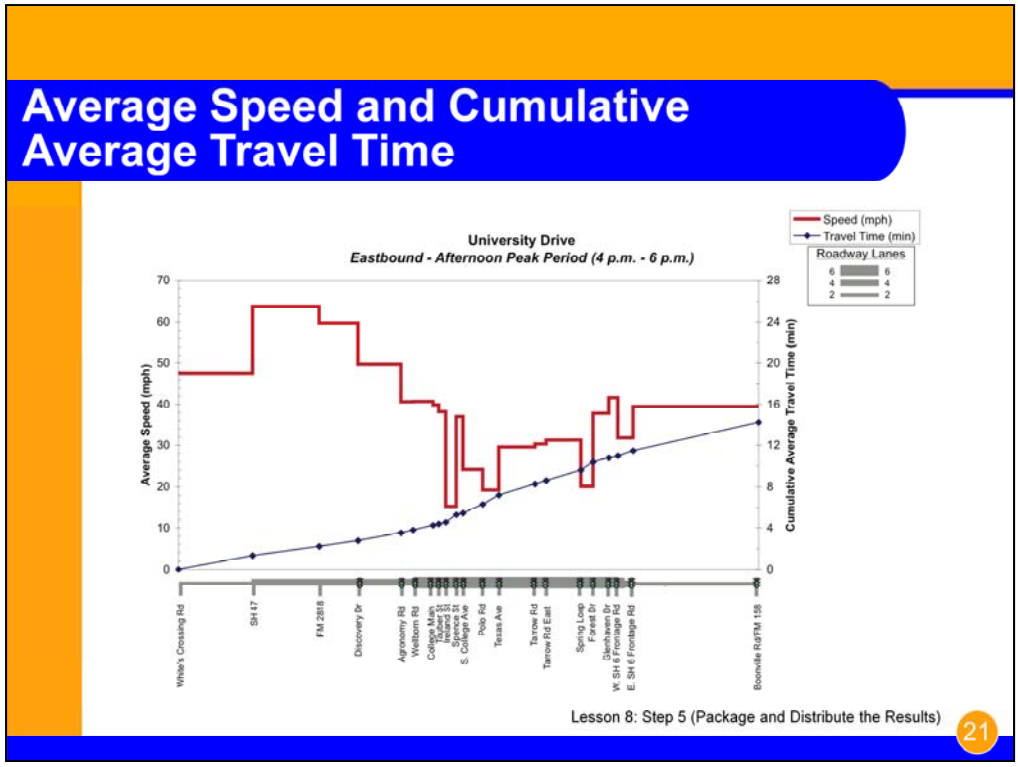
This is Figure 31 on page 72 of the *Guidebook*.

Some specialty, commercially available software is able to translate data, like that collected from travel time runs, into several pre-formatted chart types. The next two slides display chart output generated from PC-Travel. This speed profile is the average speed of several runs during the peak period identified. The chart is able to relate accelerations and decelerations along the roadway.



This is Figure 31 on page 73 of the *Guidebook*.

This time-space diagram also is an example from PC-Travel. The time-space diagram is able to display the trajectory for each individual travel time run. Grouping of trajectories indicates very consistent operations. The reader is able to understand the variability in the data following trajectories down the page to the endpoint of the roadway.

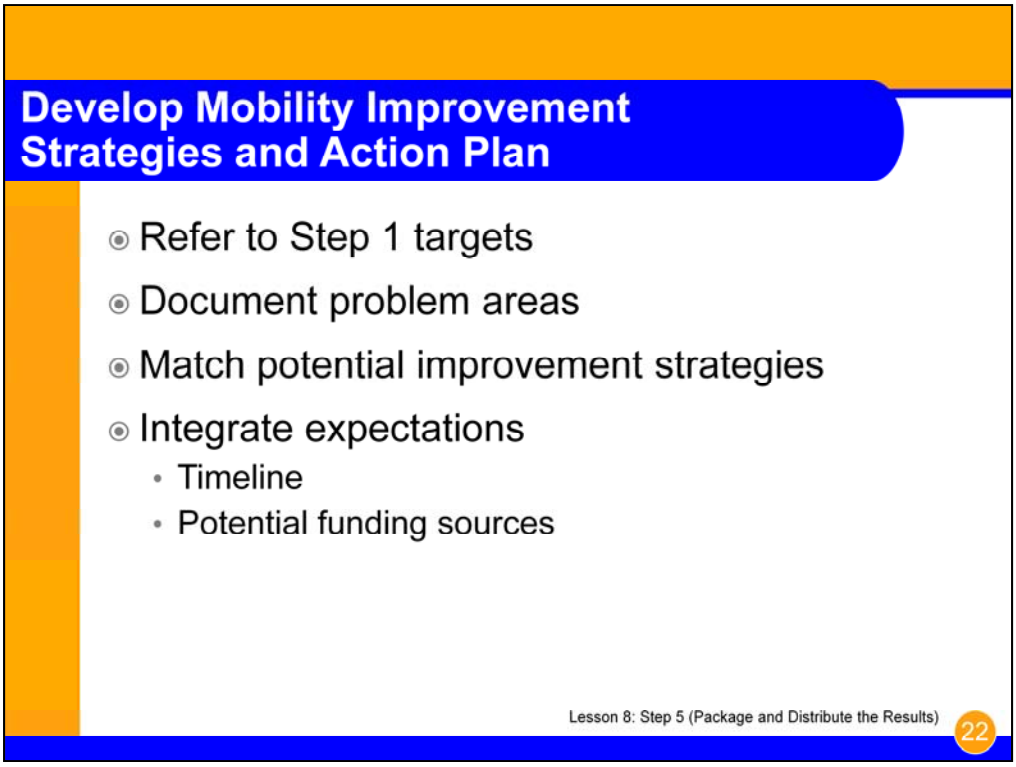


This is Figure 32 on page 74 of the *Guidebook*.

This graphic shows another common method for presenting average link speed and travel time data along the same x-axis for a roadway. The thick red line presents average speed between links. The thin blue line with symbols indicates the average cumulative travel time along the roadway. Similar to link-based measurement graphic, the x-axis presents the number of lanes, cross streets, and signal locations.

This graphic style is presented in the ITE *Manual of Transportation Engineering Studies*.

Source:
“Manual of Transportation Engineering Studies.” Institute of Transportation Engineers, Washington, D.C., 2000. Available: http://ite.gov.

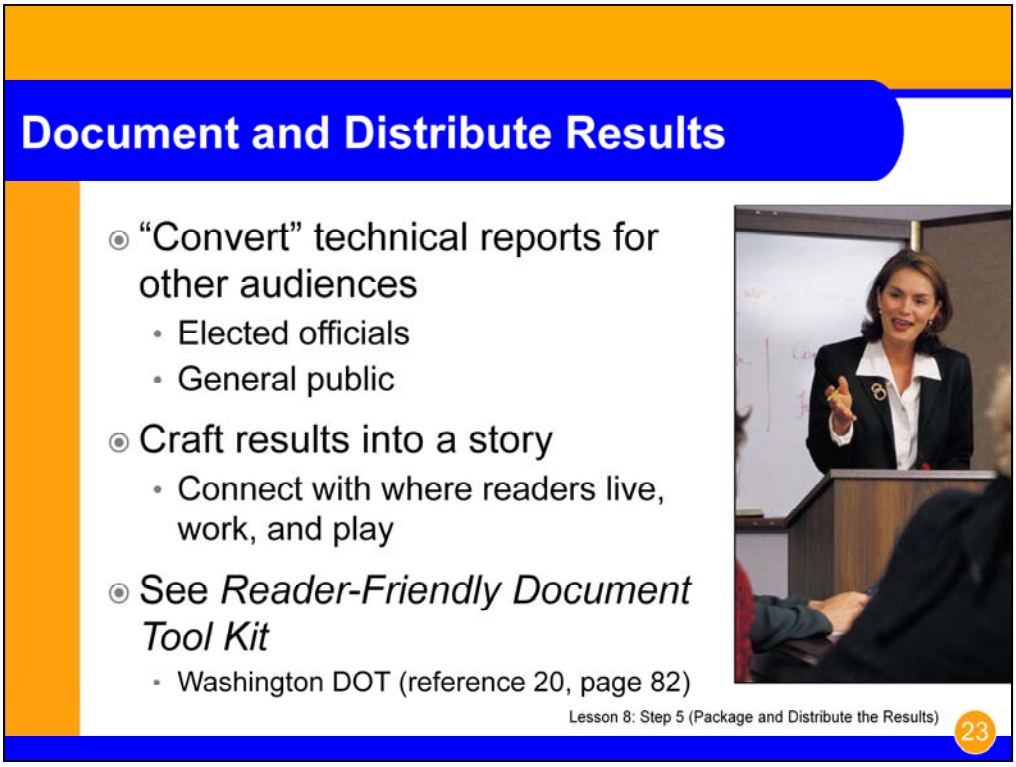


You identified potential improvement strategies in Step 1 (Identify the Needs and Opportunities) that were agreeable to the community. Now that your data are analyzed and you are packaging the results, you will identify problem areas that either do not meet your community's mobility targets or are nearing or crossing some performance targets that may need your attention in the near future.

The public and elected officials will be most interested in mobility solutions after the problems are noted. Match the potential improvement strategies to the locations, problems, and time periods that require mobility solutions.

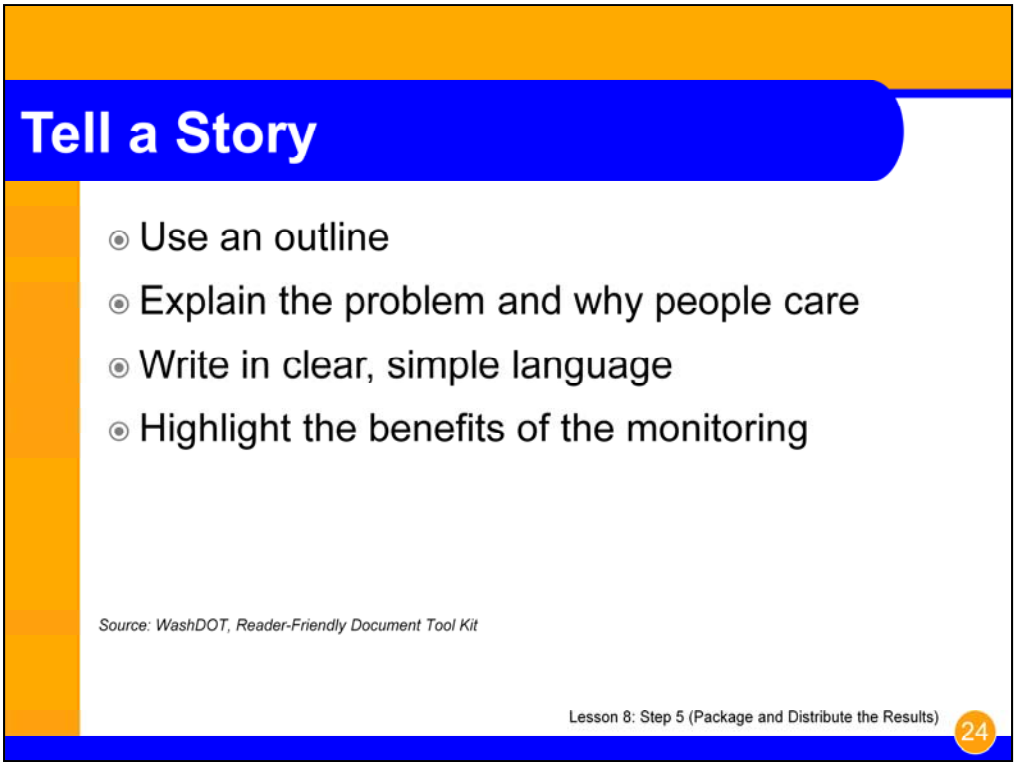
Supplement the solution set with your expectations through an action plan and discussion of potential funding sources. You should address questions like:

- How long will your solution take to implement once funding is secured?
- Does the solution require any construction and design preparation time?
- Does the solution require coordination with other government agencies like the state department of transportation?
- Are state or federal funds available for the project?
- What type of support is needed form your locally elected officials?



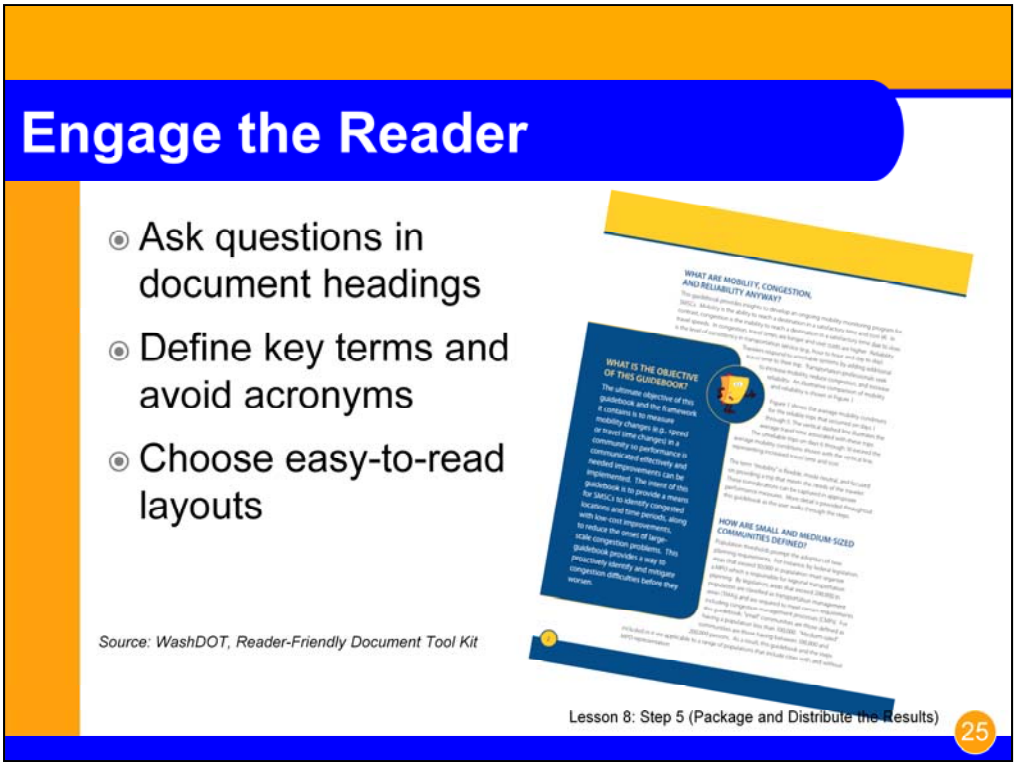
The documents you produce initially to document your findings will likely be written for professional audiences, not for elected officials or the general public. To better connect with elected officials and the general public, craft your results into a story about the community where your readers live, work, and play.

The following are tips from the *Reader-Friendly Document Tool Kit*, published by the Washington Department of Transportation. This is reference 20 in your *Guidebook*, and there is a link for the reference on page 82. The following four slides provide insights from this reference.



The first aspect of the *Reader-Friendly Document Tool Kit* is to tell a story:

- Use an outline for an organized document.
- Explain the problem and why people should care.
- Write in clear, simple language that your neighbor can understand.
- Highlight the benefits of the monitoring process.



The second aspect of the *Reader-Friendly Document Tool Kit* is to engage the reader:

- Ask questions in document headings to better engage your readers.
- Define key terms and avoid use of acronyms; spell out acronyms often to remind the reader what the acronym means.
- Choose easy-to-read layouts that don't overwhelm the audience.

Make it Visual

- Invest time in creating powerful graphics
- Refrain from overusing tables
- Use maps to explain the data

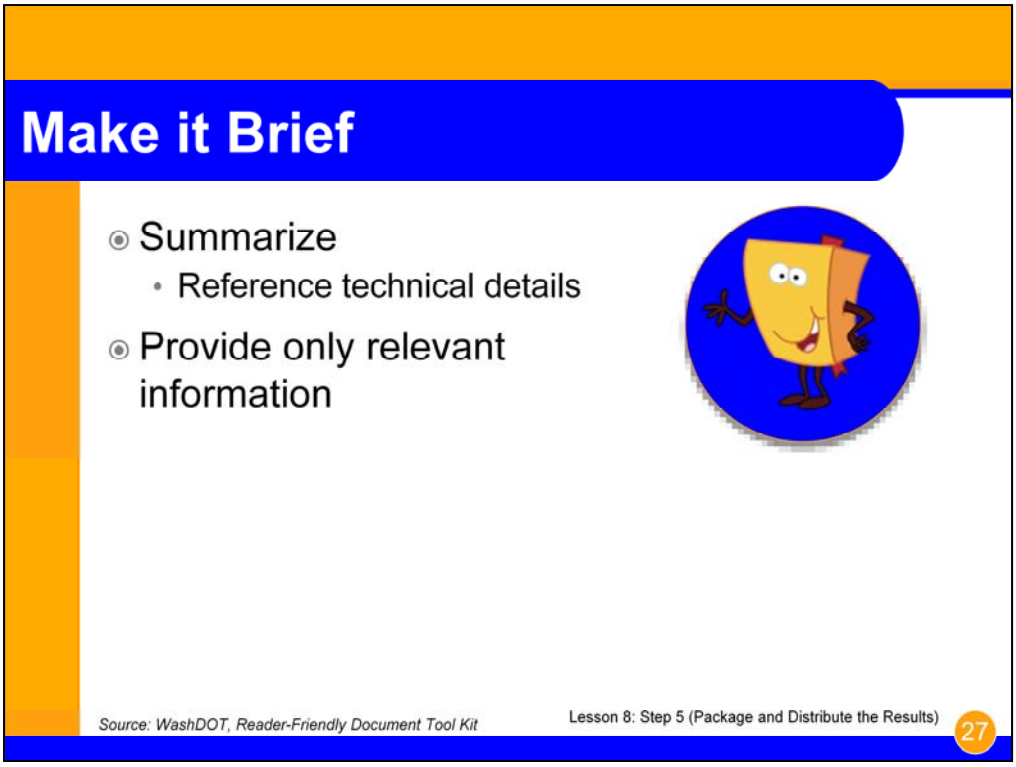
Text Source: WashDOT, Reader-Friendly Document Tool Kit

Lesson 8: Step 5 (Package and Distribute the Results)

26

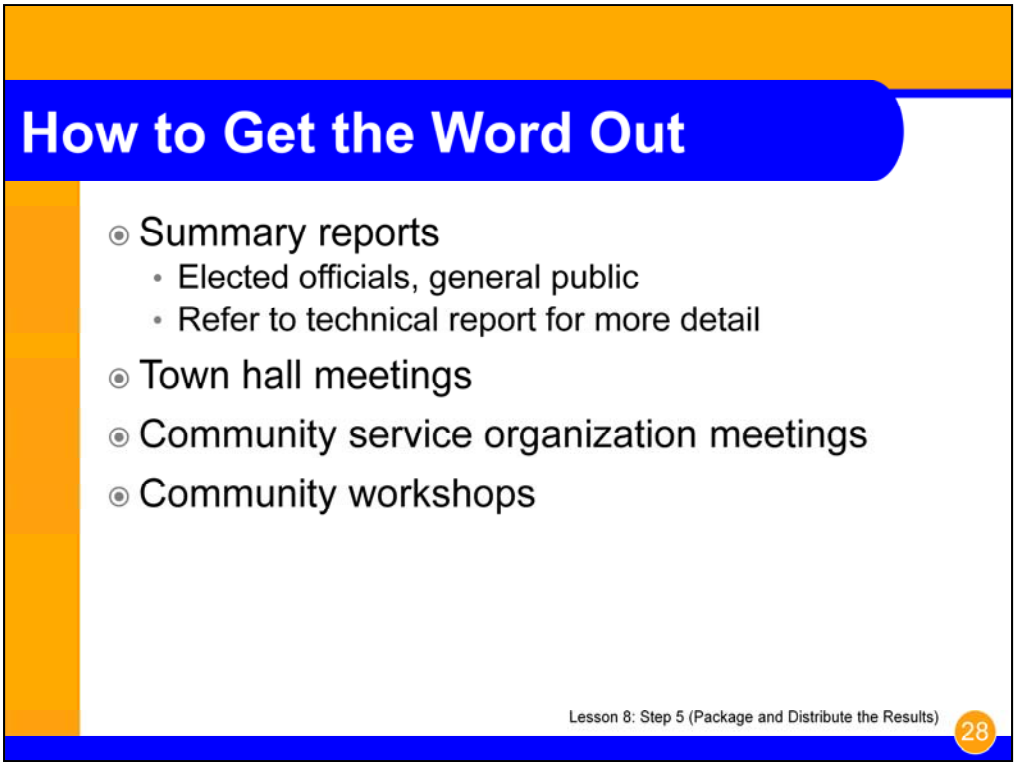
The third aspect of the *Reader-Friendly Document Tool Kit* is to make it visual:

- Invest time early in creating powerful graphic designs of your results.
- Refrain from overusing tables of numbers when visual methods to convey the data would be more effective.
- Use maps to explain the data and show physical relationships.



The forth aspect of the *Reader-Friendly Document Tool Kit* is to make it brief:

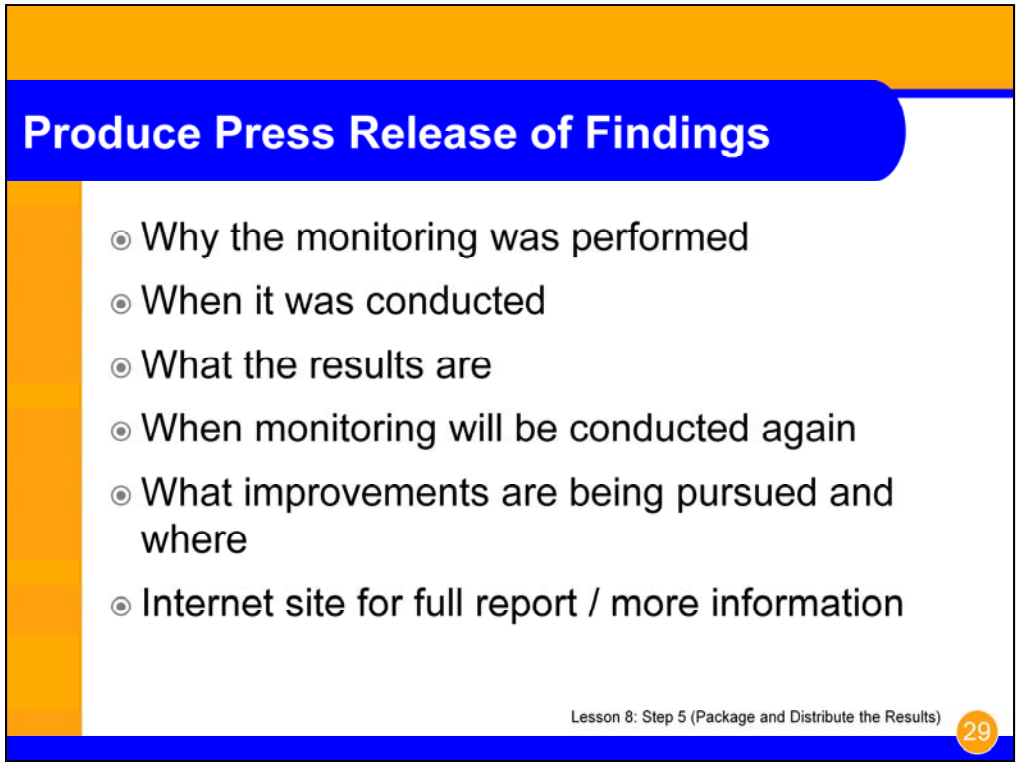
- Keep the document brief by summarizing and referencing technical details.
- Provide only relevant information.



You should use a variety of tools to distribute your results. These tools can include summary reports directed to your elected officials or the general public. Summary reports should be very brief and use powerful graphics that are easy to interpret. In the summary reports, refer to the technical report for additional detail.

Consider making a presentation at a town hall meeting or local community service meeting. It is important that these presentations be developed for a nontechnical audience. Developing your presentation for a wide audience will better engage the listener and allow you to better connect with them so your message is clearly received. Using a lot of technical language can easily shut down the listener's attention. For listeners that approach you after the presentation and seek more information, gauge the conversation for appropriateness of technical language.

Community workshops are another method for distributing your results. They can also be used as a tool to strengthen community support and help you identify potential improvements to your monitoring process. Usually, workshop participants are made up of active and interested community members. These participants are not likely to hold back opinions, so when responding, realize that their suggestions and statements may well lead you to a better process.

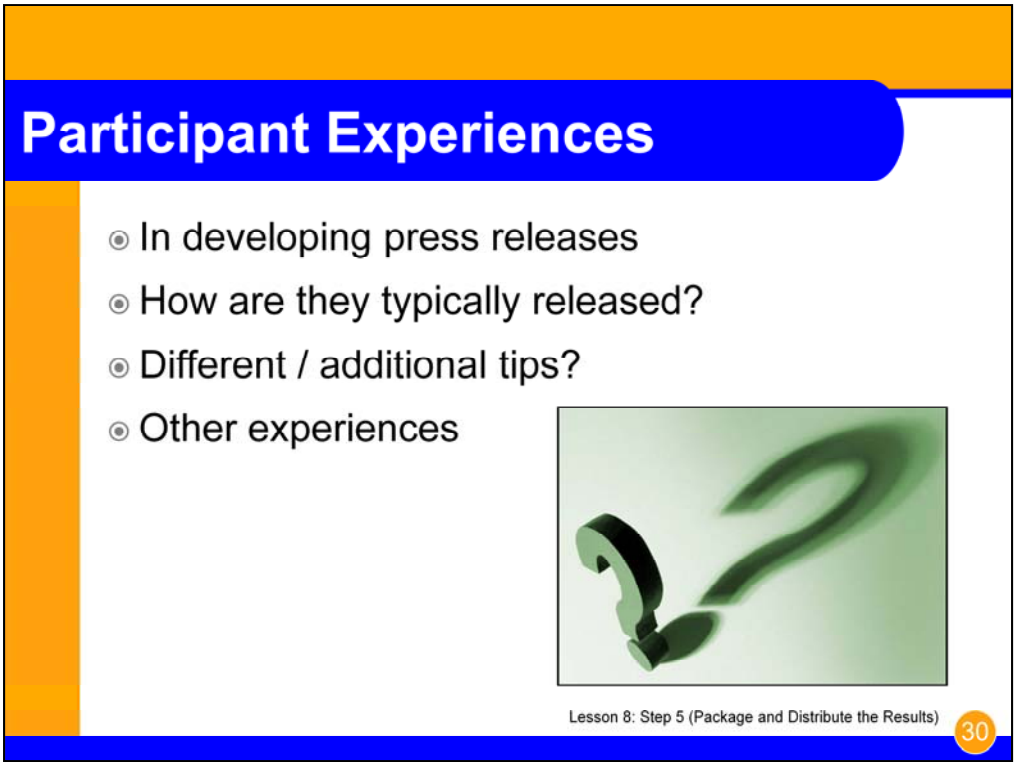


At the beginning of this mobility monitoring process, you defined measurable outcomes or performance measures. Now is the time to push your message out to your community.

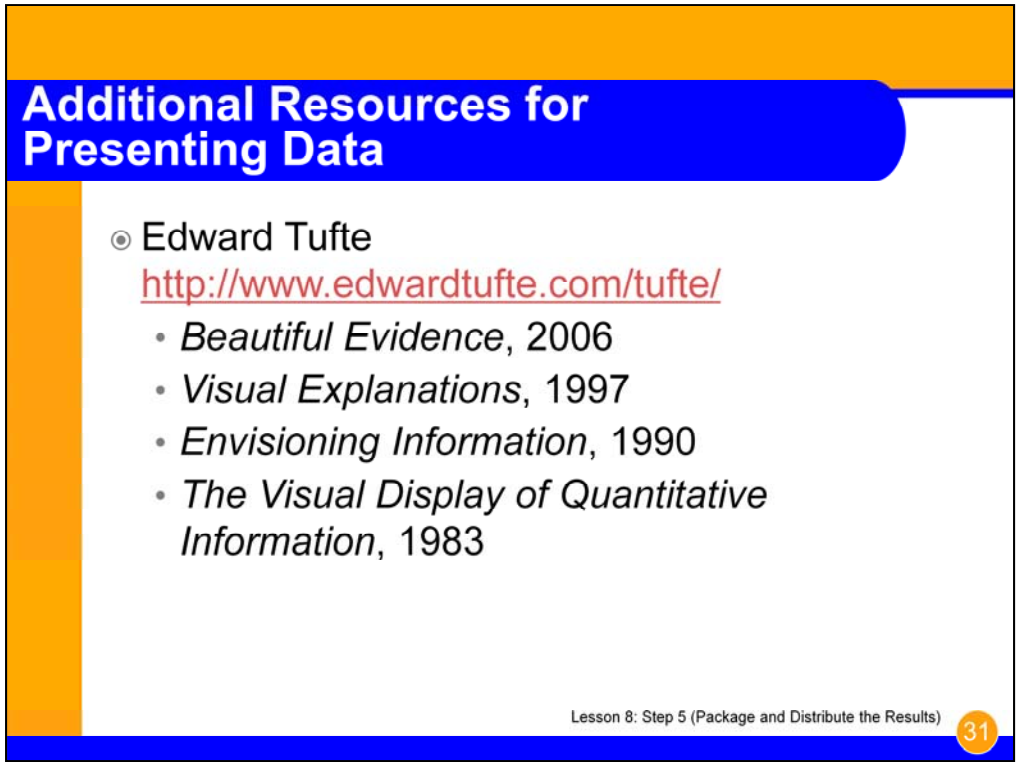
This is where you and your public information officer will work together as a team. You don't have to be the expert on how press releases are formatted or where and how they are sent out. You should be focused on:

- Why the monitoring was performed;
- When it was conducted
- What the results are
- When monitoring will be conducted again
- What improvements are being pursued and where
- Where to go for more information

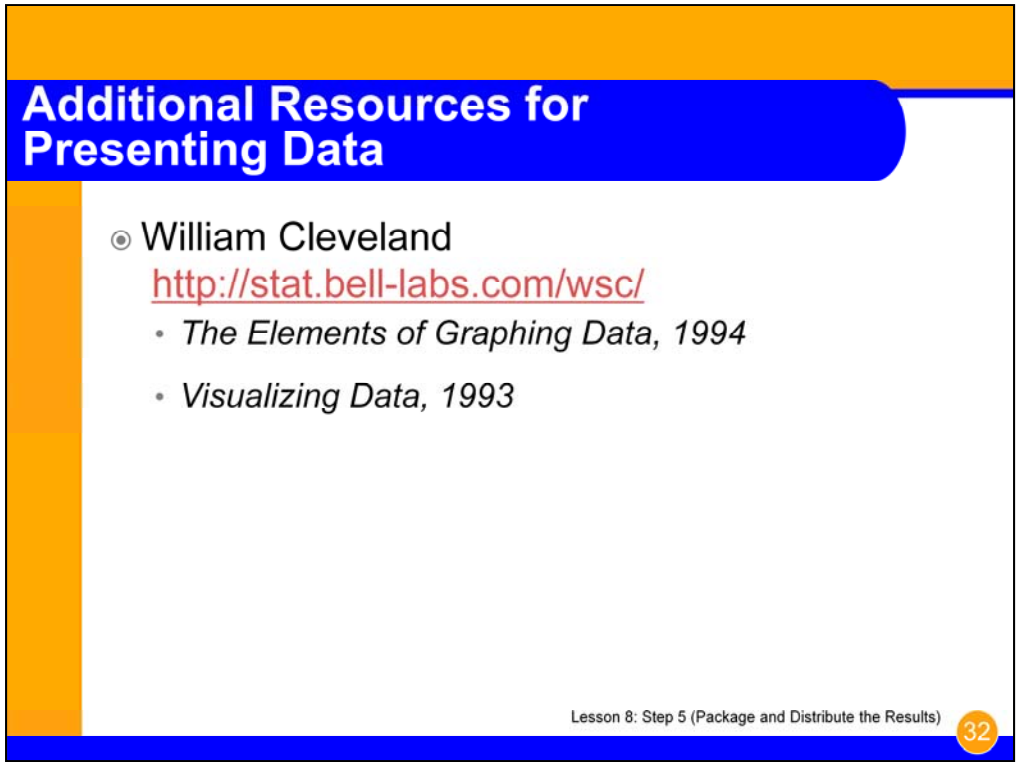
Report to your community how their mobility measures up to their established targets. You can report on how many locations or miles of roadways failed to meet community mobility targets.



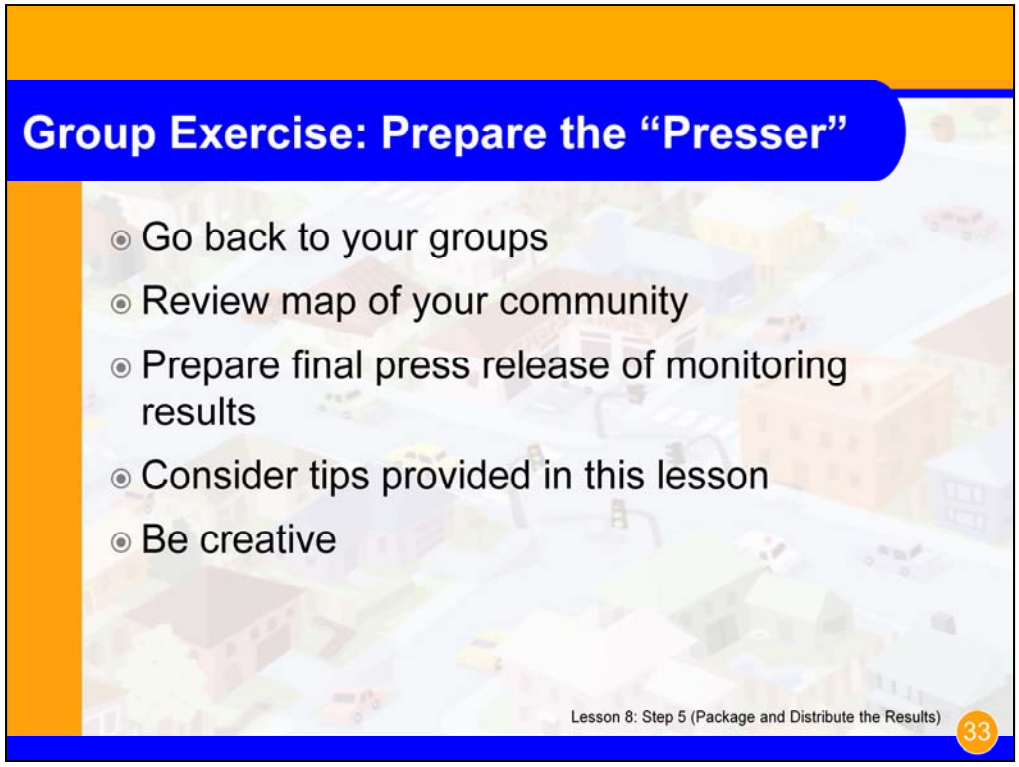
Instructor asks participants for feedback regarding press release experiences of participants.



Edward Tufte has written several books on how to present a lot of data and information in an appealing and understanding way. More information is available on his Internet site.



William Cleveland is another excellent resource for tips on presenting data. More information is available on his Internet site.

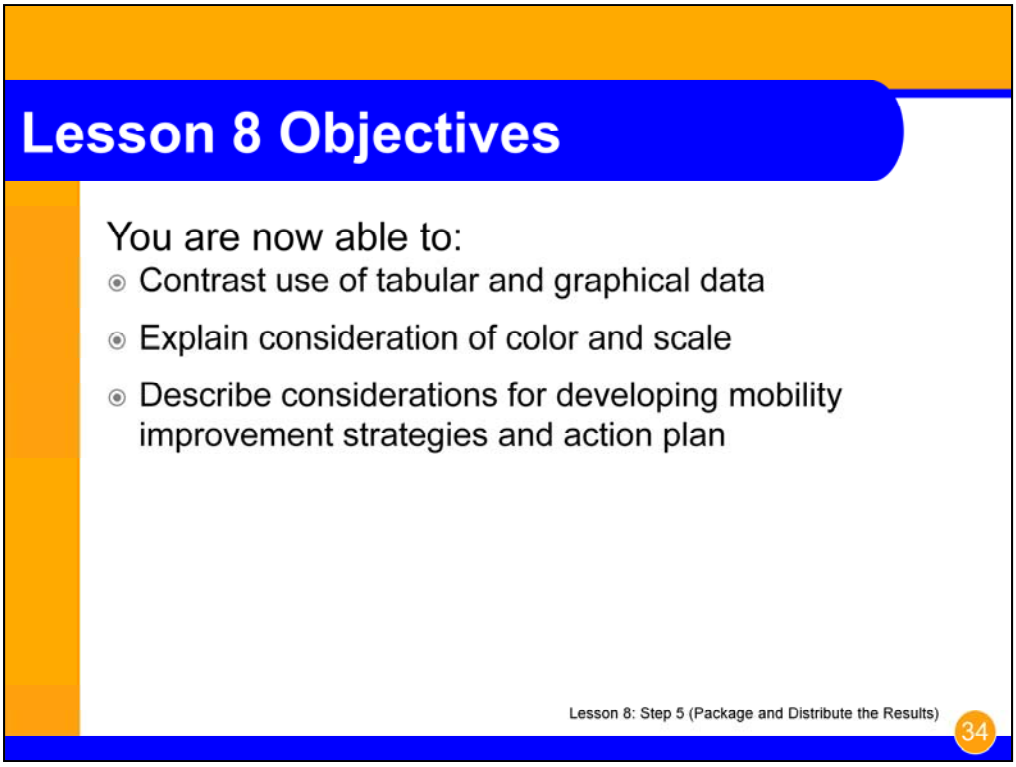


Instructor gives directions identified on the slide for participants to return to their groups to prepare their press release.

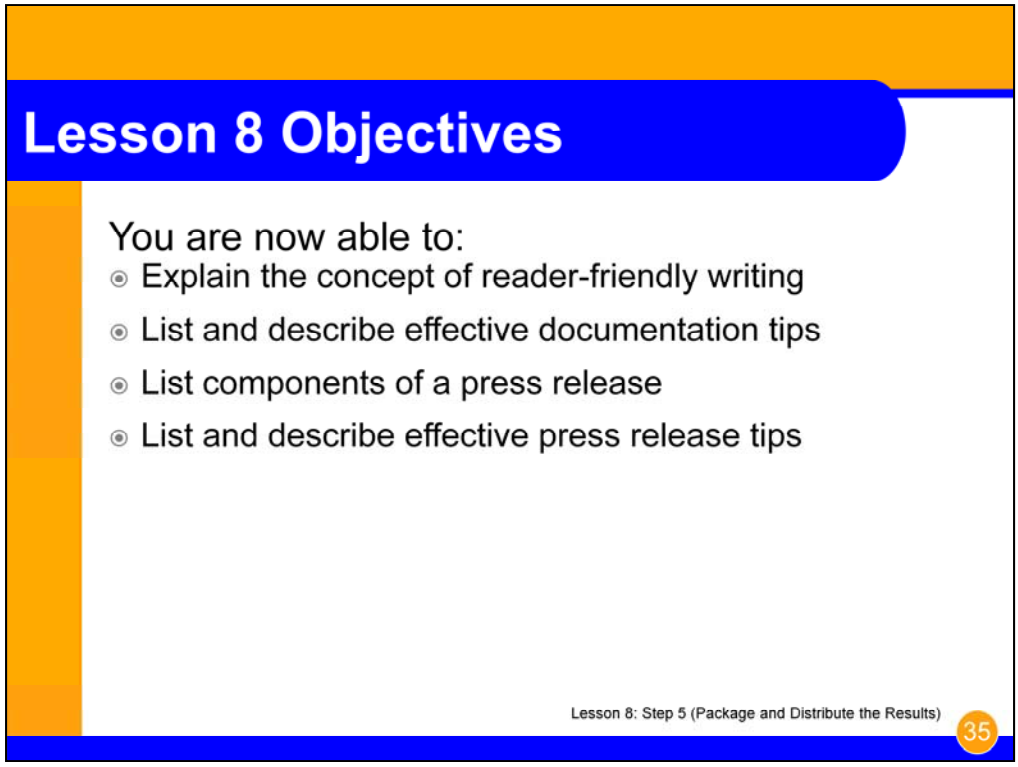
Participants are encouraged to use the tips described in this lesson.

Instructors instruct participants to be creative because the press release will be based on an imaginary monitoring effort. Instructors indicate that there is a press release example in the *Guidebook* on page 77.

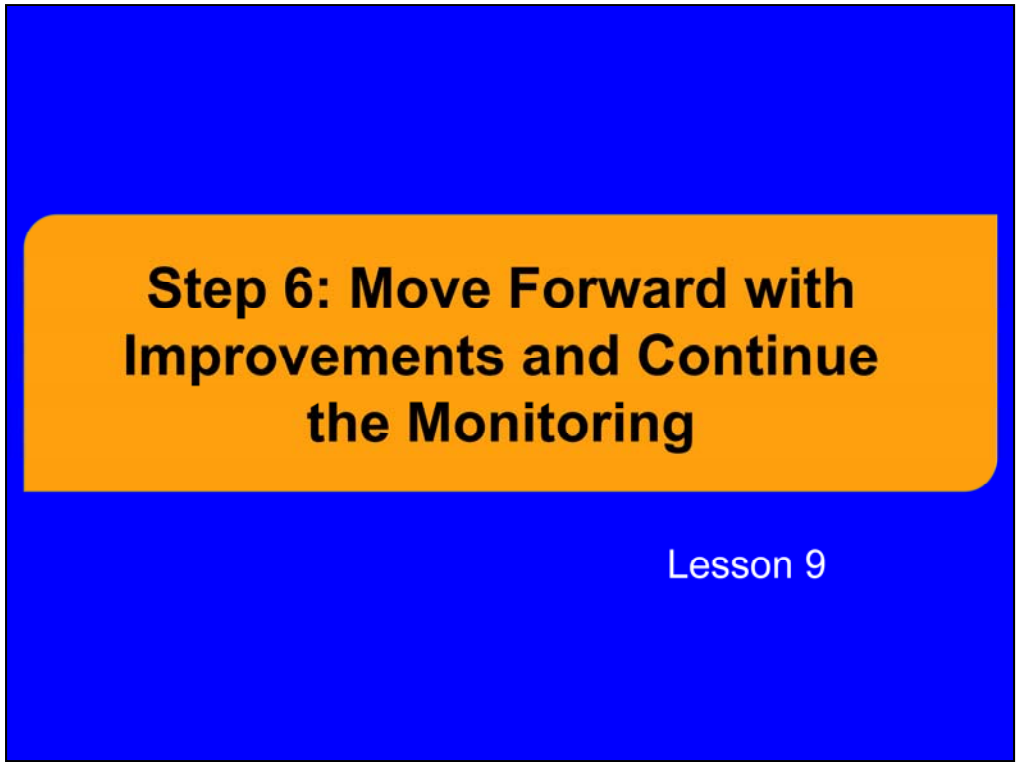
After 5 minutes working, participants are encouraged to share and discuss their press release contents for 5 minutes.



Restate the Lesson 8 objectives, and ask the participants if they have any questions before going to Lesson 9.



Restate the Lesson 8 objectives, and ask the participants if they have any questions before going to Lesson 9.

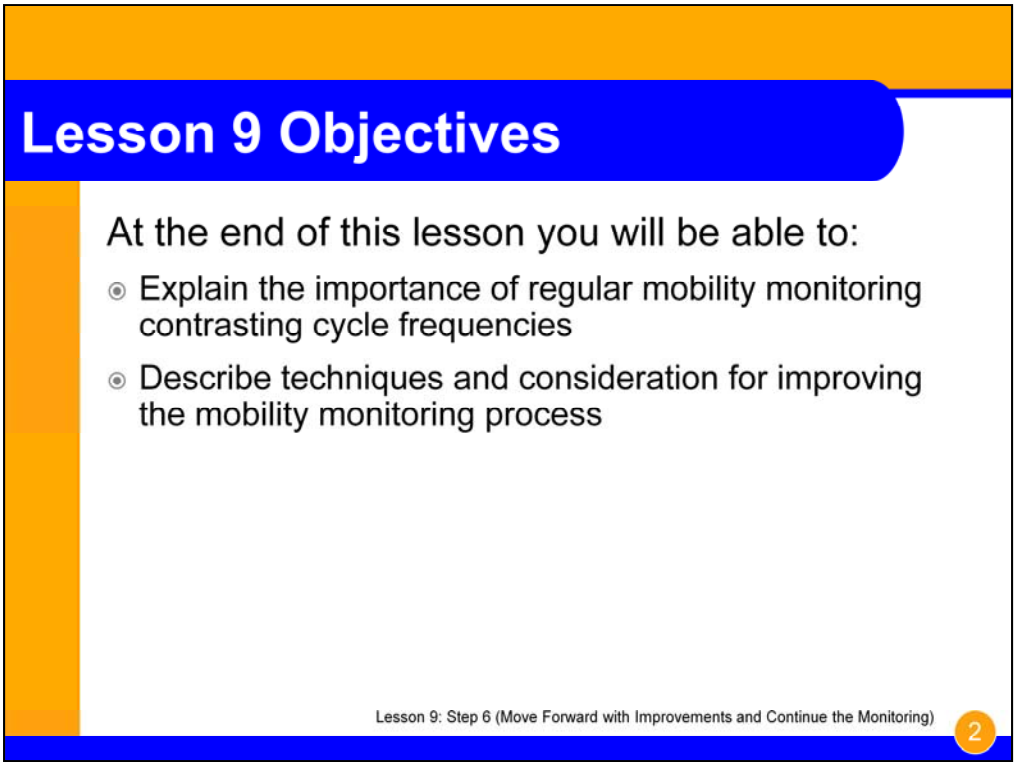


Duration: 10 minutes

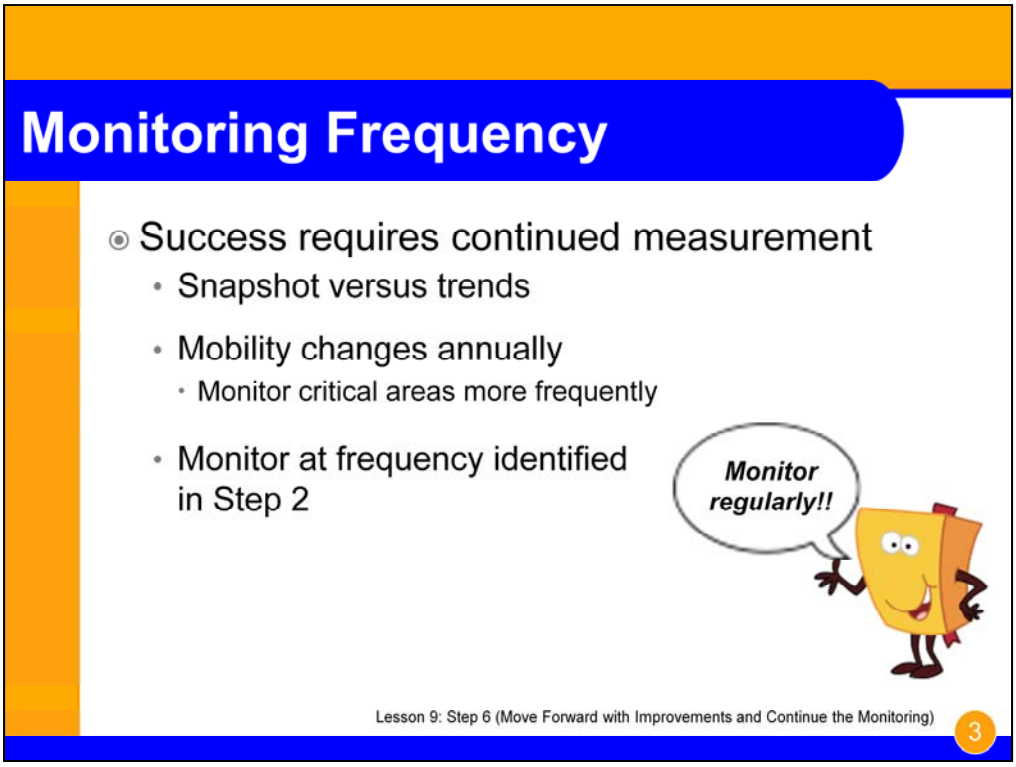
Time: 3:30 to 3:40 pm

Time Allocation:

Lecture	6 minutes
Discussion	4 minutes



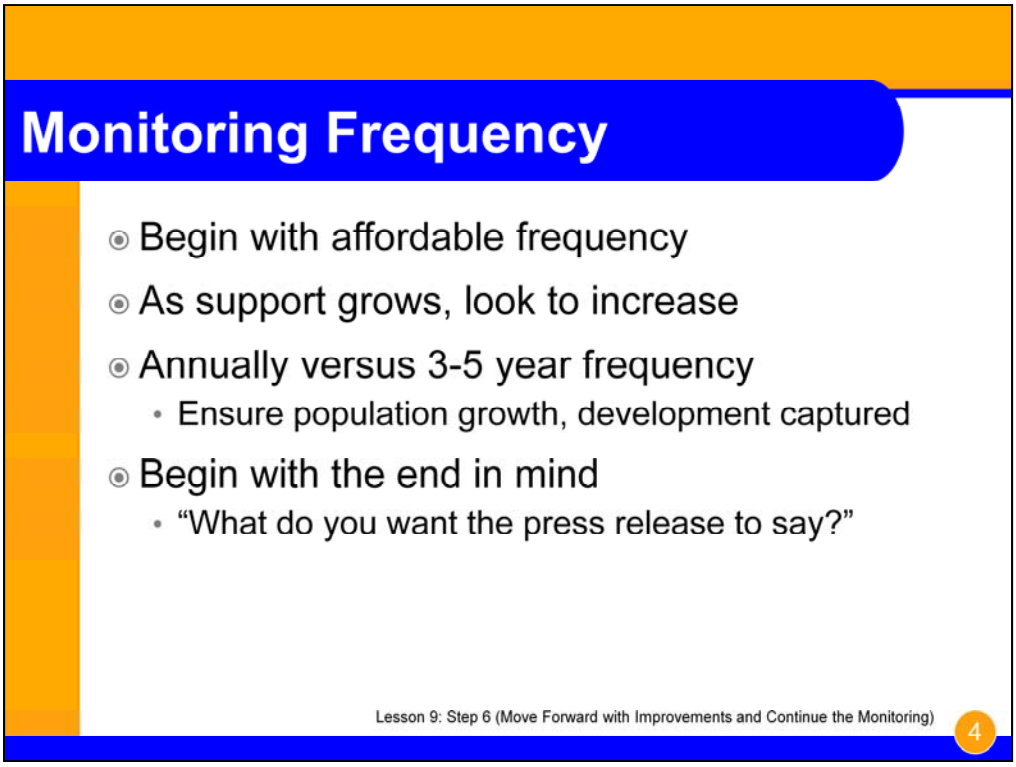
Verbally state the Lesson 9 objectives.



Why is regular monitoring important?

A successful mobility monitoring program requires continued measurement. One-time measurements will provide only a snapshot in time of the mobility conditions in your community. Mobility changes annually, with day of week and season of year. Depending on your community's needs, you may plan to monitor regionally each year, but conduct more frequent monitoring on your one or two most critical roadways.

The motivation for continued monitoring should be recorded in the monitoring plans outcomes/desire/objectives. Monitor your community's mobility at the frequency you identified in Step 2.



How often should I monitor?

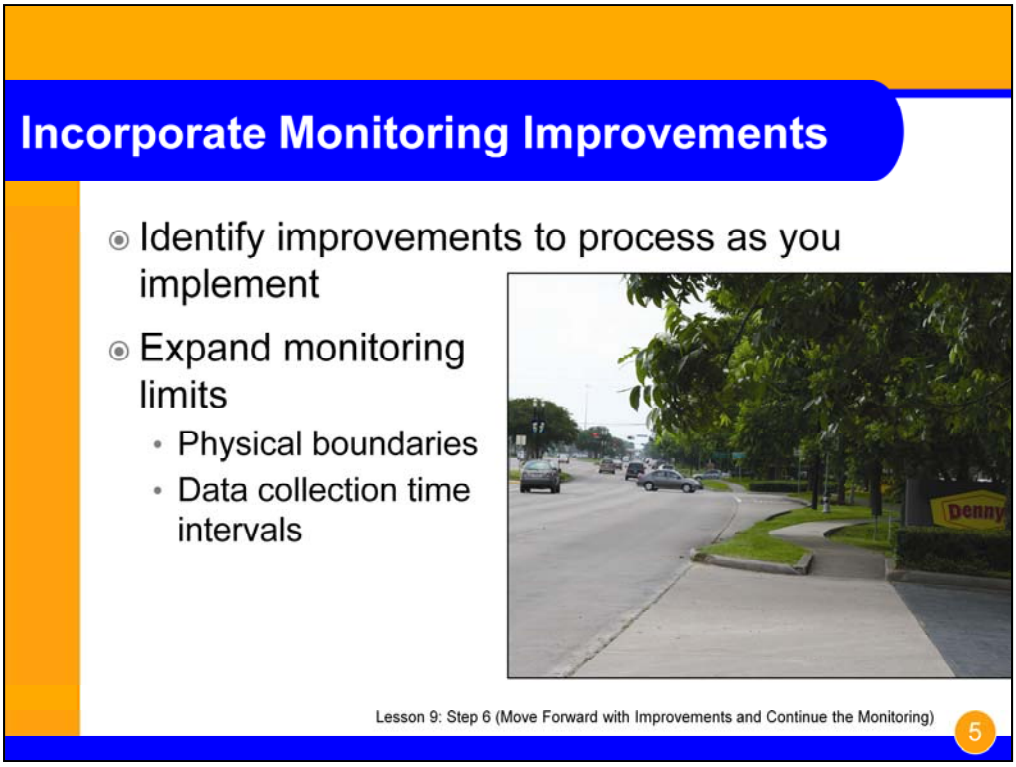
For programs beginning a mobility monitoring process, an annual or bi-annual cycle with some limited, more frequent monitoring, like traffic volumes, may be an adequate starting point. The key is to get started at an affordable frequency.

As support for your mobility monitoring program grows from municipal or county leaders and the general community, you may seek to increase the monitoring frequency for greater feedback to these stakeholders.

Monitoring frequencies greater than 3-5 years may not provide your community enough clarity regarding mobility changes. Lengthy frequencies may not assist you in detecting smaller changes in mobility resulting from population growth and economic development activities within your community. Such long gaps in monitoring may also reduce your ability to detect early warnings of decreasing mobility and, therefore, implement corrective actions.

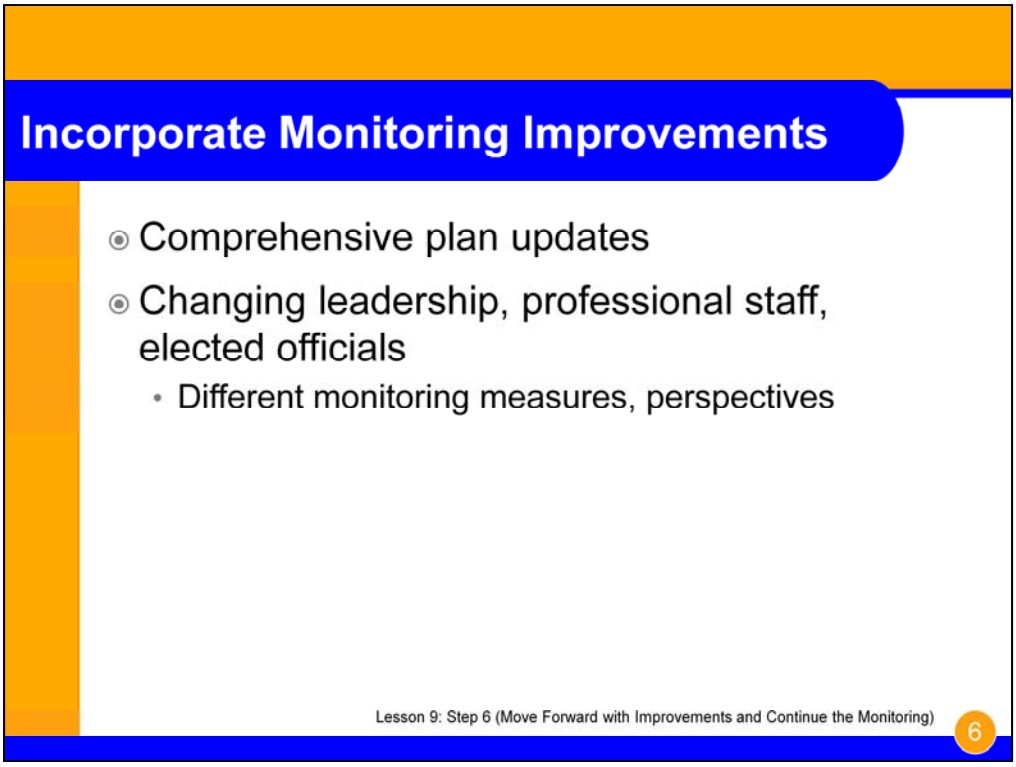
Keep the question "What do we want the press release to say this year, next year, etc.?" in mind. If you desire to report your progress in improving mobility or to strengthen your case for needed resources to halt or turn back worsening mobility, continued monitoring is needed.

Instructors will engage participants in open discussion on additional potential impacts of infrequent monitoring. Instructors will probe participants for what cycle frequency they would consider reasonable and the basis for its reasonableness.



As you complete a monitoring cycle, reflect on the process to identify where improvements can be made. Identifying improvements as you work through the monitoring process may be more helpful so that time will not fade your thoughts. Seeking improvement is a method to provide feedback into the monitoring process.

The planning steps you took at the beginning of your monitoring process enabled you to establish a monitoring process flexible enough to include new locations, roadways, or time periods as they become important to your community. For example, you may need to periodically extend the monitoring length on a roadway as new development begins to push toward your existing limits.

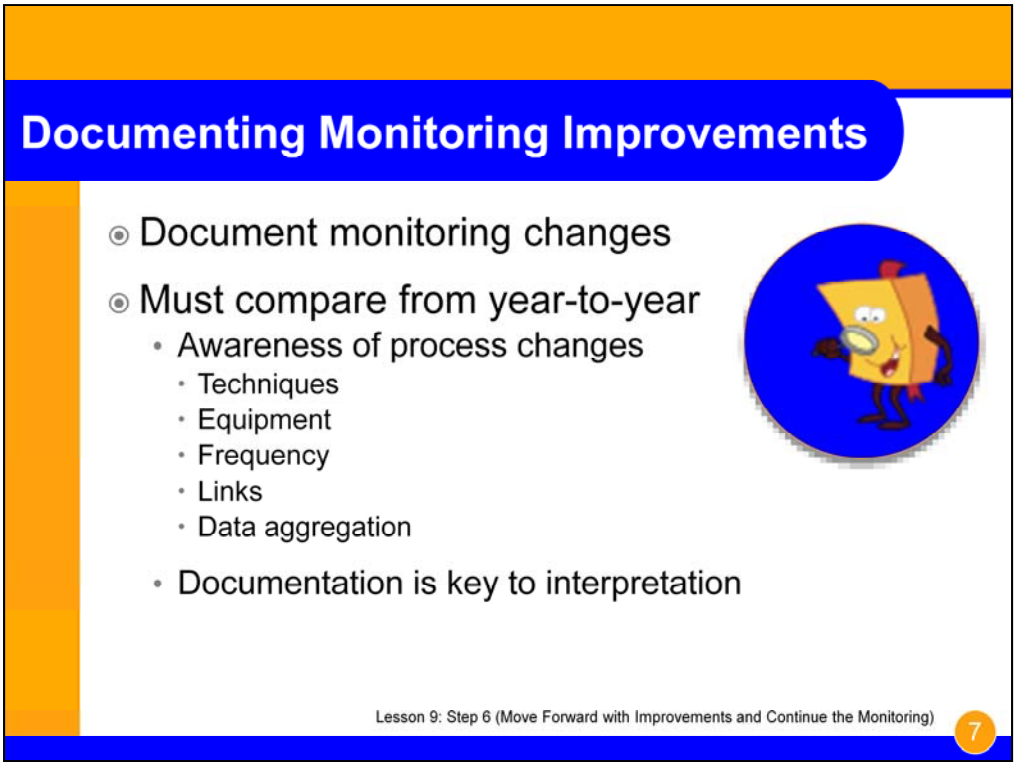


The monitoring process should support and interact with other planning and engineering efforts in your community. Adapt the monitoring process as your community's vision and goals change. When you make updates to your comprehensive plan, adapt your monitoring process to support measurement.

Changing leadership, professional staff, or elected officials are also reasons the monitoring process may change. New leadership may project performance measures in new or different perspectives.

Query participants for methods they use on their job to improve their own processes. Ask how they can modify or implement those techniques to a mobility monitoring process.

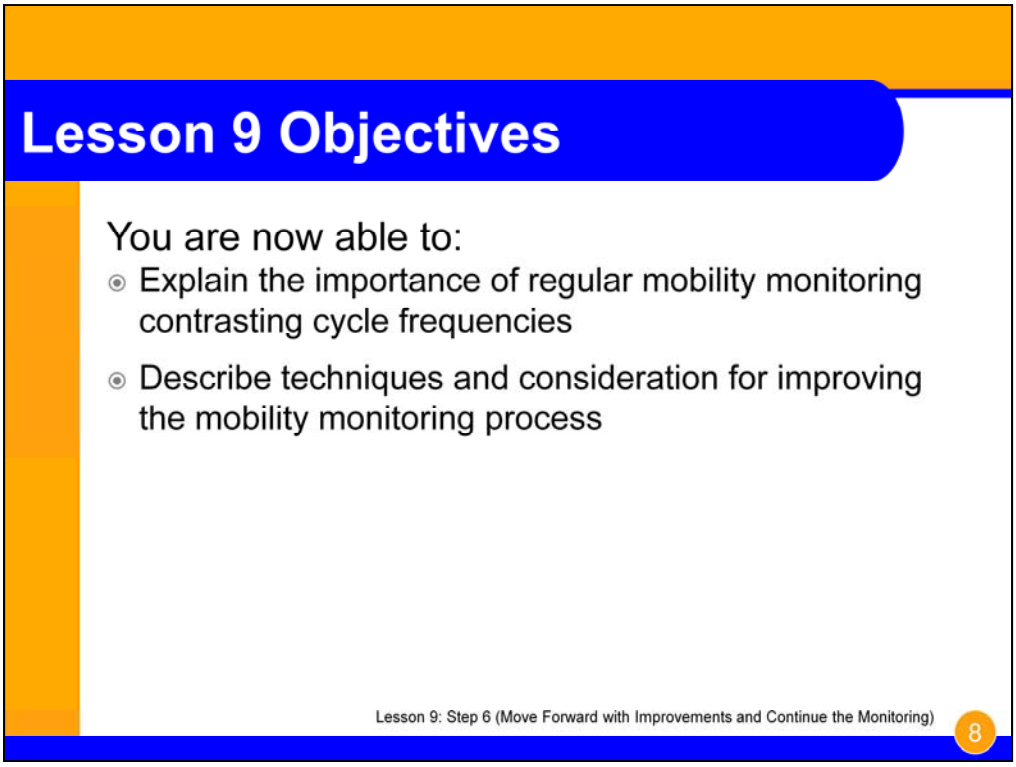
Instructors query participants for examples of how their monitoring plan might be improved in the case study they did in groups.



In all cases, you should document changes and improvements to your monitoring process. As you make comparisons to previous monitoring efforts, you will have to interpret the results – the processes may not be an exact “apples to apples” comparison. Process documentation is your key aid for interpreting your results.

- Was a change in monitoring methods a contributing factor to change?
- Did you add new locations or roadways to your monitoring network?
- Did you change the resolution (in terms of time increments) of your data collection? For example, from 24 to 48 hours of traffic volumes.
- Did you select a new method for estimating your free-flow speeds?

Answers to questions like these will certainly help you better understand your results.



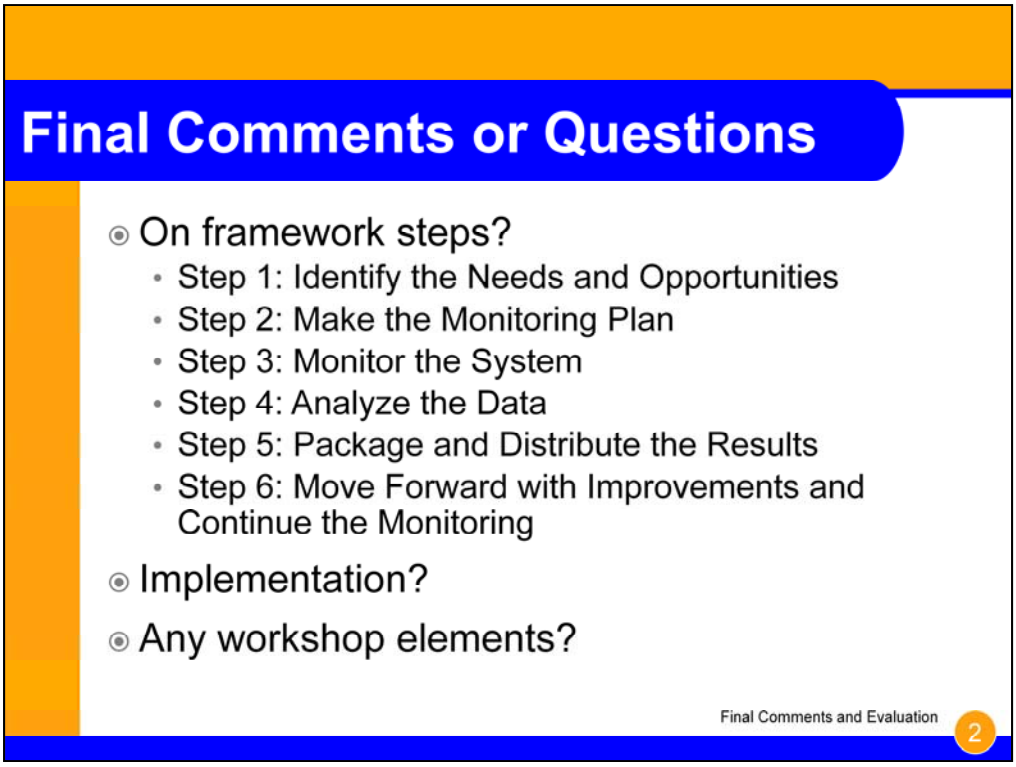
Restate the Lesson 9 objectives, and ask the participants if they have any questions before going to the final session of the workshop.

Duration: 10 minutes

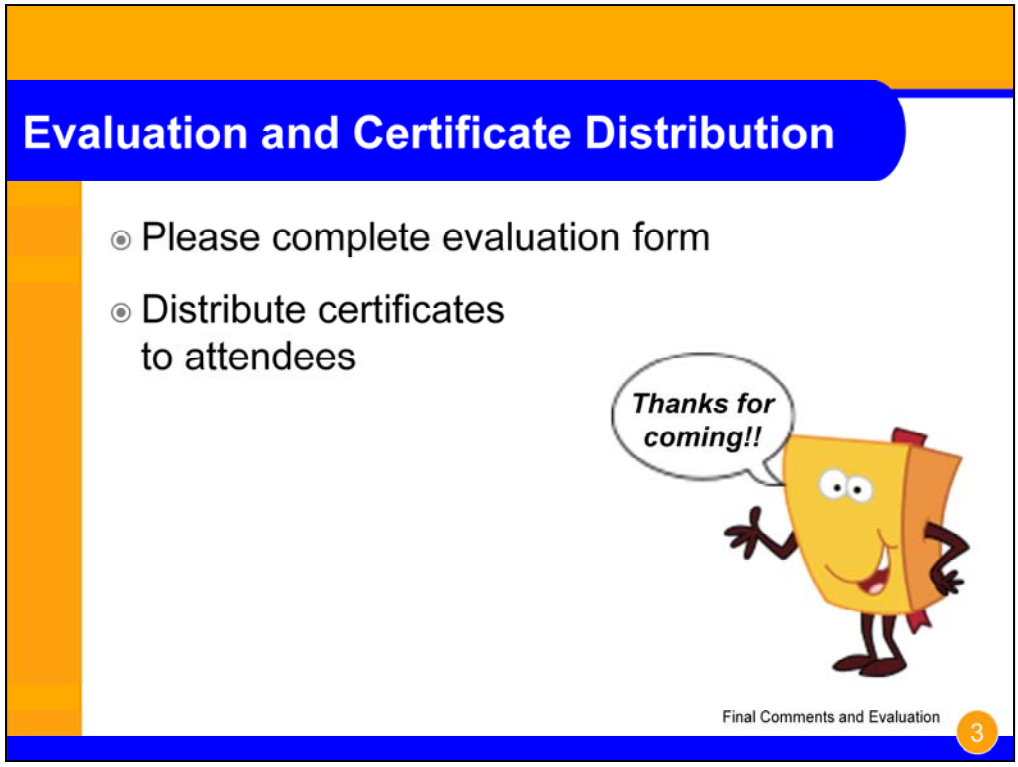
Time: 3:40 to 3:50 pm

Time Allocation:

Discussion and completing evaluations	10 minutes



The instructor asks if there are any final comments or questions related to anything in the workshop. Instructor can read the slide suggestions for points of clarification or discussion.



Instructors circulate an evaluation form for the workshop. Instructors distribute individual certificates of workshop completion to the participants.

Mobility Monitoring in Your Community: Interactive Workshop

Workshop Introduction

Target Audience

- Transportation professionals in growing communities of 5,000 to 200,000 population who are responsible for transportation system monitoring and improvements.

Workshop Objectives

- Describe causes of congestion in SMSCs
- List and describe six steps of the mobility monitoring framework
- Identify a range of mobility performance measures and their application
- Describe the development and application of performance targets
- Develop a mobility monitoring plan

Workshop Objectives

- Calculate basic mobility performance measures
- Describe reader-friendly communication techniques
- Describe benefits of improving monitoring process
- Describe contents and application of the *Guidebook*

Tools You Can Use!

- Something for everyone and every budget
- Low-cost data collection techniques/tips
- Resources for further technical assistance in all areas

Introductions

Course Outline – Morning

- Workshop Introduction
- Congestion Trends
- Introduction to Performance Measures
- Importance of Monitoring
- Step 1: Identify the Needs and Opportunities

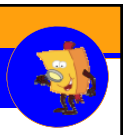
Course Outline – Afternoon

- Step 2: Make the Monitoring Plan
- Step 3: Monitor the System
- Step 4: Analyze the Data
- Step 5: Package and Distribute the Results
- Step 6: Move Forward with Improvements and Continue the Monitoring
- Final Comments and Evaluation

Course Materials

- Participant's notebook
  - Slides
- *Guidebook for Mobility Monitoring in Small to Medium-Sized Communities: A How-To Guide*
  - 12-page non-technical guide
  - Citizen's tri-fold
  - 1-page framework
  - Interactive CD
- Course exercises

Additional Resources



- Research report:
  - *Measures, Methods, and Application of a Mobility Monitoring Process for Small to Medium-Sized Communities*
    - Technical Report 0-5571-1
    - CD of data, travel time data collection cost calculator
- Project Summary Report:
  - *Congestion Monitoring Measures and Procedures for Small to Medium-Sized Communities*
    - Summary Report 5571-S
- All Available: http://mobility.tamu.edu/resources
  - Scroll down to "Mobility Monitoring in Small to Medium-Sized Communities"

Course Guidance

- Start and end times
- Scheduled breaks and lunch
- Cell phones to vibrate
- Share experiences

Congestion Trends

Lesson 1

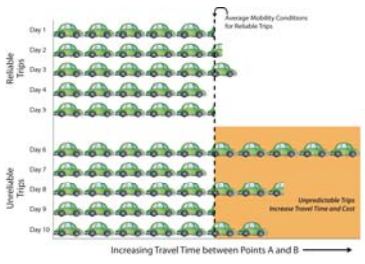
Lesson 1 Objectives

At the end of this lesson, you will be able to:

- Define the terms mobility, congestion, and reliability
- Discuss recent small- and medium-sized community congestion trends
- Explain common causes of congestion

Understanding Key Terms

- Mobility
- Congestion
- Reliability



Causes of Congestion

- What is your experience?
- How does your community define congestion?
- Is your definition different from like-sized communities?
- What causes your congestion?
- What is the recent trend for your community?
- What are your community's expectations?

Typical Causes of Congestion

- Physical Bottlenecks
- Traffic Incidents
- Work Zones
- Weather
- Traffic Control Devices
- Special Events
- Fluctuations in Normal Traffic

Source: FHWA

"In the Field" Definitions

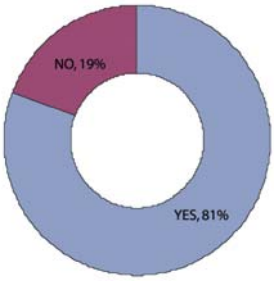
Drivers

- Signal delay of 1-2 cycle lengths
- Queues >5 vehicles at stop-controlled intersections
- Problems making right or left turns

Technical Professionals

- Waiting through 2+ signal cycles
- Travel speed 25% below posted speed limit
- Peak travel time 40% longer than off-peak travel time

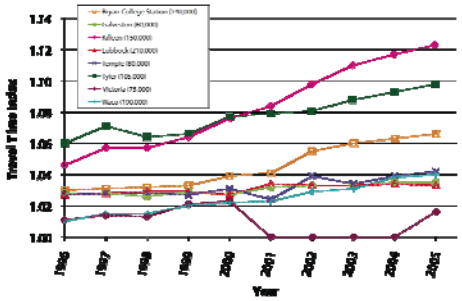
A Wide Issue?



Where is Congestion?

1. State routes
2. Near schools/colleges
3. City streets
4. Interchanges
5. Downtown
6. Near shopping centers
7. Around special events

Recent Congestion Trends



Lesson 1 Objectives

You are now able to:

- Define the terms mobility, congestion, and reliability
- Discuss recent small- and medium-sized community congestion trends
- List and explain common causes of congestion

Introduction to Performance Measures

Lesson 2

Lesson 2 Objectives

At the end of this lesson, you will be able to:

- Identify and describe mobility performance measures and contrast applications at varying analysis levels
- Describe attributes of good performance measures

What Should be Considered in Mobility Performance Measurement?

- Congestion is RELATIVE
- TIME is key input variable
  - Direct measurement
  - Indirect measurement / modeling
- Need multiple measures

Attributes of Good Performance Measures

- Discriminate
- Integrate
- Acceptable
- Accurate
- Affordable
- Appropriate detail
- Target
- Measurable
- Multidimensional
- Not influenced
- Relevant
- Sensitive
- Trends
- Timely
- Understandable

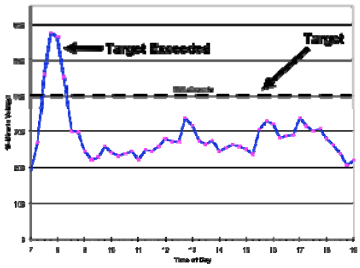
Source: SWUTC

Principles of Roadway Mobility Monitoring

1. Based on time
2. Multiple measures
3. Traditional measures
4. Moving vehicles and people
5. Mobility and efficiency measures
6. Satisfaction measures
7. Three dimensions of congestion
8. Reliability
9. Graphics

Source: NCHRP

"Target" Defined



Target: acceptable level of congestion as determined by the community

Determine a Target Congestion Level for the Community or Areas

- Why is setting a target important?
  - Determines if monitoring results warrant concern/improvements
  - Demonstrate to the community that goals are being recognized
  - Developed with stakeholder input
  - Reasonable and realistic

Typical Mobility Performance Measures and Data Elements

- Average travel time
- Average travel rate
- Average speed
- Travel time or travel rate index
- Total Delay
- Delay per traveler
- Buffer index
- Planning time index
- Person volume
- Traffic volume
- Vehicle-miles of travel
- Person-miles of travel
- Congested travel
- Percent of congested travel
- Percent of congested roadway
- Volume-to-capacity ratio (v/c)
- Accessibility

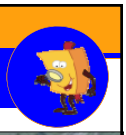
"Individual" Measures

- Delay per Traveler (annual hours or daily minutes)
- Travel Time (person-minutes)
- Travel Time Index (dimensionless)
- Travel Rate Index (dimensionless)
- Buffer Index – extra "buffer" time
- Planning Time Index – total travel time

"Area" Measures

- Total Delay (vehicle-hrs or person-hrs)
- Congested Travel – captures extent
- Percent of Congested Travel – ratio of congested travel to total travel
- Congested Roadway – miles of road with congestion
- Accessibility – extent to which different opportunities can be reached

Analysis Levels



Some measures work better in certain situations

- Travel time
  - Short segment of roadway (great)
  - Regional networks (not as good)
- Travel rate index
  - Short segment of roadway (great)
  - Regional networks (great)
- Congested travel
  - Short segment of roadway (not as good)
  - Regional networks (great)

Analysis Types

- Land development impact
  - Travel time, travel rate, delay per traveler, travel time index, buffer index, total delay
- Prioritization of improvements
  - Delay per traveler, travel time index, buffer index, total delay

How Many Measures Are Needed?

- As many as it takes!
  - To monitor your community
  - To meet stakeholder needs
- Ultimately depends on what you are communicating and to whom

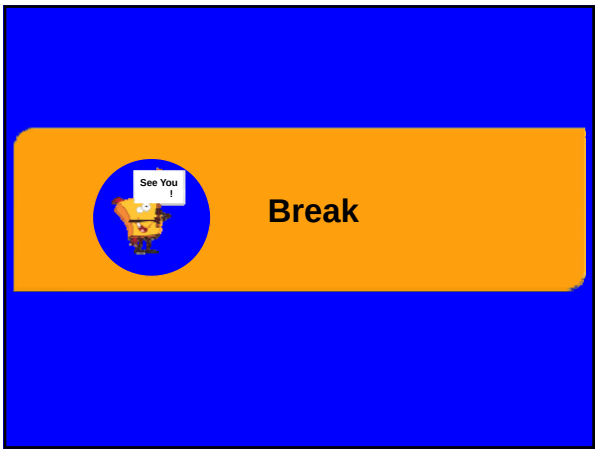
Discussion of Performance Measures

- Other mobility measures?
- Which measures most relevant?
- How do different measures work with different audiences?

Lesson 2 Objectives

You are now able to:

- Identify and describe mobility performance measures and contrast applications at varying analysis levels
- Describe attributes of good performance measures


See You !
Break

Importance of Monitoring

Lesson 3

Lesson 3 Objectives

At the end of this lesson, you will be able to:

- Describe the benefits of mobility monitoring
- Discuss the benefits of repeated monitoring

Background to Monitoring Need

- Growth equates to additional congestion issues
- Congestion is typically highest along state or U.S. highways
- Solutions and performance-measure targets differ from large cities

Why Monitor?

- Understand and alleviate congestion better
- Establish baseline conditions
- Proactively address potential congestion problems
- Obtain objective mobility information
  - Efficiently prioritize improvements

Why Monitor?

- Objective monitoring data
  - Assists decision-making of elected officials
- Justify to elected officials and motoring public
  - Good stewards of limited resources

Why Monitor — Repeatedly?

- Identify where congestion is growing
  - Duration, extent, intensity
- Develop graphics showing trends
  - Communicates results
  - Technical and non-technical audiences

Monitoring Experiences

- Other reasons for monitoring?
- Current monitoring activities?
  - Performance measures
  - Targets
- Types of monitoring data currently collected?

Lesson 3 Objectives

You are now able to:

- Describe the benefits of mobility monitoring
- Discuss the benefits of repeated monitoring

Step 1: Identify the Needs and Opportunities

Lesson 4

Lesson 4 Objectives

At the end of this lesson, you will be able to:

- Discuss the importance of identifying public cares and concerns
- Identify the primary users of mobility monitoring
- Describe key early considerations for developing a monitoring plan
- Describe the considerations for the mobility monitoring outcomes

Identify Public Cares and Concerns

- Community values and important concerns
- Vision and goals of the community
- Transportation's rank as a priority
- Identifying transportation needs
  - How and What
- Typical causes of decreased mobility in SMSCs

Understand the Transportation Building Process

- How can typical improvements be made?
- How are transportation projects planned and built?

Ultimate Outcome(s) from Monitoring

- What is the end result of monitoring?
  - Compare to targets
  - Compare trends
  - Project planning
  - Prioritize list of problem locations

Ultimate Outcome(s) from Monitoring

- What should the final press release say?
  - Describe baseline congestion levels
  - Identified congestion time periods
  - Measures used and key statistics
- Provides a clearer vision as you work through the entire framework

Ultimate Outcome(s) from Monitoring

- How will outcomes be tied to local community mobility goals?
  - Visions and goals from community comprehensive plans or agency mission statements
  - Demonstrate how monitoring will assist in reaching goals

How Do We Define Congestion?

- Survey community
- Discussions during plan updates

Identify What Congestion Reduction Strategies are Agreeable to the Community

- What range of improvements are appropriate for smaller areas?
  - Build toolbox of mobility improvements
  - Pursue the improvements in the community
  - Consider what will/won't work in your specific community or area

Determine the Preferred Method of Communication to the Public and Other Users

- Most effective communication methods
  - Tables: monitoring results
  - Maps: congestion severity by location
  - Graphics: trends

Group Exercise: Identify the Needs and Opportunities

- Background to map scenario
- Discussion of local transportation issues
  - Complaints
  - Needs
  - Opportunities

Group Discussions

- Who are primary users of the mobility monitoring information?
- What information should the final press release convey?
- How do you define congestion?
- What measures will you use?
- What is your congestion target?
- What is your toolbox of improvements?
- How might ongoing monitoring be funded?

Lesson 4 Objectives

You are now able to:

- Discuss the importance of identifying public cares and concerns
- Identify the primary users of mobility monitoring
- Describe key early considerations for developing a monitoring plan
- Describe the considerations for the mobility monitoring outcomes

Lunch

Step 2: Make the Monitoring Plan

Lesson 5

Lesson 5 Objectives

- At the end of this lesson, you will be able to:
  - Identify commonly available data sources
  - Describe and contrast data collection methods
  - Describe quality assurance checks
  - Discuss the importance of repeated mobility monitoring
  - Develop a sketch monitoring plan

What Data Are Necessary?

- What do you ultimately want to know or answer?
  - Quantify desired mobility measures
  - Output from Step 1
- Typical data elements
  - Hourly volumes
  - Speed
  - Travel time

What Data Are Available?

- City
- County
- MPO
- State

Other Potential Data Sources

- Signalized Intersections
- Probe Vehicle Data
- Others

What Monitoring Methods Are Best?

- Roadway Studies
  - Travel time runs
  - Videolog
- Point Studies
  - Volume, classification, occupancy counts
  - Speed
- Special Studies
  - Stopped delay study

Travel Time Runs

- Travel Time Runs
  - Defined links of a roadway
  - Different "test vehicle" techniques
    - Manual, DMI, GPS
- FHWA *Travel Time Data Collection Handbook*
- Use existing transportation agency staff

Lesson 5: Step 2 (Make the Monitoring Plan) 7

Comparing Travel Time Test Vehicle Data Collection Methods

Instrumentation Level	Costs			Level of Data Detail
	Capital	Data Collection	Data Reduction	
Manual:				
Pen and Paper	Low	Moderate	High	Low
Tape Recorder	Low	Low	High	Low
DMI	High	Low	Low	High
GPS	High	Low	Low	High

Lesson 5: Step 2 (Make the Monitoring Plan) 8

Videolog

- Identify physical environment
- Narrate the video

Lesson 5: Step 2 (Make the Monitoring Plan) 9

Collecting Your Own Volume Counts

- Traditional
  - At least 48 continuous hours
  - Between major intersections
  - Tuesday through Thursday
  - April and/or October

Collecting Your Own Volume Counts

- Locally typical traffic
  - Saturday retail, weekday lunch
  - AM/PM peaks
  - Special events or other festivals

Classification Counts

- Vehicle mix of traffic along key corridors
  - Passenger cars
  - Buses
  - Single-unit trucks
  - Semi-trailer trucks
- Sources
  - State DOT
  - MPO
  - Manual collection

Occupancy Counts

- Average number of persons per vehicle
- Person movement measures efficiency
- Collected manually in the field

Stopped Delay Study

- Travel time, delay
  - Signalized intersection
  - Unsignalized intersections
- Trend of delay changes over time
- Estimates time stopped at intersection
- Can be “added” to link travel time data

Ensure Key Locations Covered

- Sampling and prioritizing factors
  - *Travel Time Data Collection Handbook*
    - Perceived bottlenecks or congested conditions
    - Percent change in congestion level
    - ADT/lane
    - ADT

Ensure Key Time Frames Covered

- Typical conditions
  - Tuesday through Thursday
  - April and October
- Holidays and special events
- Defined by study objectives and local conditions

Monitoring Frequency

- Budget and equipment resources
- Periodic basis to effectively monitor
  - Identify changes
  - What is working?
  - Where are improvements still needed?
- Annually versus every 3-5 years

Group Exercise: Make the Monitoring Plan

- Data elements needed?
  - Consider measures used
  - Travel time, volume, intersection studies, videologs, other
  - Where?
  - What time periods?
- Prioritize monitoring efforts
- What monitoring frequency?

Lesson 5 Objectives

You are now able to:

- Identify common available data sources
- Describe and contrast data collection methods
- Describe quality assurance checks
- Discuss the importance of repeated mobility monitoring
- Develop a sketch monitoring plan

Step 3: Monitor the System

Lesson 6

Lesson 6 Objective

At the end of this lesson, you will be able to:

- Describe considerations and management contingencies to mitigate data collection problems and negative issues

What Does the Action Plan Include?

- Travel time runs
- Videolog
- Volume counts
- Classification counts
- Occupancy counts
- Stopped delay studies

Expert Tips: Travel Time Data Collection

- Train your drivers
- Drive the roadways with your drivers
- Provide travel time data collection forms
- Have drivers arrive early
- Meet after data collection
- Run vehicles in a continuous circuit
- Use existing staff

Expert Tips: Travel Time Data Collection

Expert Tips: Traffic Counters

- Ensure pneumatic tubes are securely fastened
- Monitor during travel time data collection
- Two persons for safety

Record Supplemental Information

- Incident information
- Weather information
- Road work information

Expert Tips: Videolog

- Narrated video from the front windshield
  - Overpasses, buildings, hills
- Record with two individuals

Videolog Data Collection

Participant Experiences

- Data collection
  - Travel time data
  - Volume
  - Intersection studies
  - Videologs
  - Other?

Lesson 6 Objective

You are now able to:

- Describe considerations and management contingencies to mitigate data collection problems and negative issues

Step 4: Analyze the Data

Lesson 7

Lesson 7 Objectives

At the end of this lesson, you will be able to:

- Explain performance measure calculations
- Describe procedures to calculate travel rate indices
- Describe methods for calculating free-flow travel rate
- Interpret a link travel rate index graph

Lesson 7 Objectives

At the end of this lesson, you will be able to:

- Describe method for calculating corridor delay
- Explain the benefits of community targets and how to develop them
- List quality control actions

Basic Measures - Background

- ADT – Average Daily Traffic
  - Average of the number of 24-hour traffic periods
- Directional Factor
  - Ratio of directional volume
- K-factor
  - Proportion of daily traffic occurring during the peak hour

Basic Measures - Background

- Peak-hour Factor
  - Ratio of the highest hourly volume to the highest 15-minute volume, multiplied by 4
- Target Capacity
  - Represents the maximum volume (hourly or less) on a road before drivers have a perception that congestion exists

Basic Mobility Measure Calculations

- Travel Rate (minutes per mile)
  - Ratio of travel time in minutes to the distance traveled in miles
  - Used to calculate travel rate index (dimensionless)

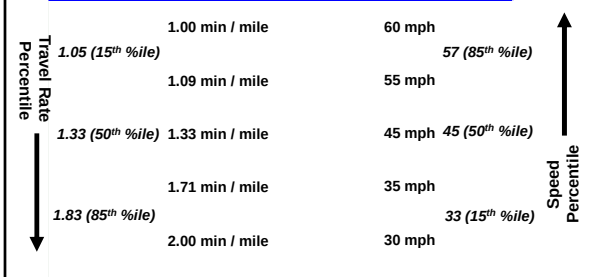
Why Travel Rate?

1.00 min / mile	→	60 mph
1.09 min / mile	→	55 mph
1.33 min / mile	→	45 mph
1.71 min / mile	→	35 mph
2.00 min / mile	→	30 mph

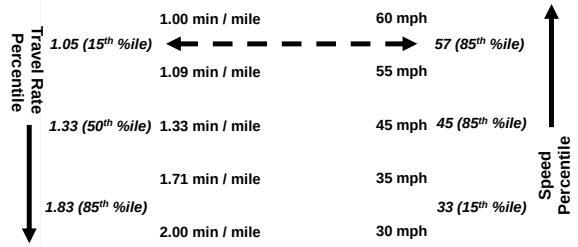
Basic Mobility Measure Calculations

- Travel Rate Index
  - Ratio of measured travel rate to free-flow travel rate
  - Free-flow travel rate can be based on
    - Posted speed limits
    - Travel time measurements – 15th percentile

A Word About Percentile



A Word About Percentile



Lesson 7: Step 4 (Analyze the Data) 10

Free-flow Travel Rates

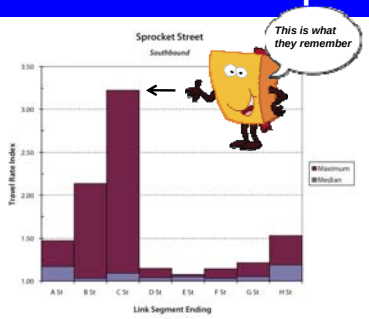
Sum the 15th percentile off-peak (free-flow) travel time data for each roadway link

Run	Link 1	Link 2	Link 2 Statistics
Run 1	82 sec	48 sec	Min = 39 sec
Run 2	50 sec	109 sec	Max = 140 sec
Run 3	81 sec	45 sec	15th = 44 sec
Run 4	100 sec	47 sec	Median = 48 sec
Run 5	89 sec	140 sec	Mean = 71 sec
Run 6	108 sec	39 sec	
15th Percentile:	73 sec	44 sec	

Free-flow travel time for corridor = 73 + 44 = 117 seconds

Lesson 7: Step 4 (Analyze the Data) 11

Link Travel Rate Index Graph



Lesson 7: Step 4 (Analyze the Data) 12

Travel Delay Calculation Scope and Needs

- Develop for link or more aggregate level
- Need traffic volumes
  - Could use same traffic volume for adjacent links
- Need link travel time information
  - Entry time (to match traffic counts)
  - Travel time
  - Free-flow travel time
  - Group by volume time intervals (typically 15 minutes)

Travel Delay Calculation Process

1. Identify time entering link
2. Identify actual travel time through link
3. Calculate average speed (link distance/link travel time)
4. Calculate link delay (in seconds) as difference between group average travel time and free-flow travel time
5. Group travel time runs by volume data time periods

Travel Delay Calculation – Link 1 (off-peak data)

Time Entering Link	Travel Time (sec)	Link Delay (sec)
9:09	76	55
9:11	22	1
9:23	25	4
9:26	21	0
9:31	25	4
9:41	21	0
9:44	20	0

<only partial list>

15th-percentile free-flow travel time: 21 seconds

Travel Delay Calculation – Link 1 (am-peak data)

Time Entering Link	Travel Time (sec)	Link Delay (sec)	Average Link Delay (sec)
7:07	19	**0**	0
7:11	20	**0**	
7:23	30	9	6
7:26	26	5	
7:29	25	4	
7:36	60	39	21
7:41	24	3	

(only partial listing)

15th-percentile free-flow travel time: 21 seconds

Travel Delay Calculation – Link 1 (am-peak data)

Time Ending	Average Link Delay (sec)	Total Link Volume	Total Peak Delay (veh-min)	Period Delay (veh-min)
7:15	0	101	0	
7:30	6	113	11	
7:45	21	139	49	
8:00	57	209	199	291
8:15	2	232	8	
8:30	1	201	3	
8:45	1	183	3	
9:00	6	187	18	

291 x 1.05 occupancy = 306 person-minutes per morning
306 x 250 work days / 60 min = 1,275 person-hours per year

Example Use of Target

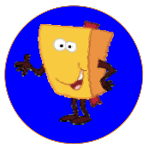
- Roadway link with 1,275 person-hours of delay in A.M. peak period for the year
- Perhaps target is 1,000 person-hours of delay for the A.M. peak period
- Or perhaps the TRI on this road link just climbed from 1.04 to 1.05 where 1.05 was the target.
- At this time, this link might be placed on a list of candidates for improvements

Quality Control

- Consistency is critical
- Reasonableness checks are paramount
  - Known trouble areas stand out?
  - Delay estimates make sense?
  - Use graphics
- Ensure that plan captures the shoulders of the peaks to allow for future growth

Audience Discussion of Data Analysis

- Measures that seem easier to compute and report?
- Travel rate index for your entire roadway system?
- Benefits of quality control?



Exercise: Analyze the Data

1. Review base travel time and volume data
2. Convert clock times to seconds per link
3. Calculate travel rates and check link speeds
4. Calculate link travel rate index
5. Calculate VMT, and create weighted link and corridor TRIs
6. Calculate delay per link and for the corridor

Lesson 7 Objectives

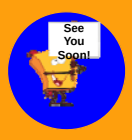
You are now able to:

- Explain performance measure calculations
- Describe procedures to calculate travel rate indices
- Describe methods for calculating free-flow travel rate
- Interpret a link travel rate index graph

Lesson 7 Objectives

You are now able to:

- Describe method for calculating corridor delay
- Explain the benefits of community targets and how to develop them
- List quality control actions



Break

Step 5: Package and Distribute the Results

Lesson 8

Lesson 8 Objectives

At the end of this lesson, you will be able to:

- Contrast use of tabular and graphical data
- Explain consideration of color and scale
- Describe considerations for developing mobility improvement strategies and action plan

Lesson 8 Objectives

At the end of this lesson, you will be able to:

- Explain the concept of reader-friendly writing
- List and describe effective documentation tips
- List components of a press release
- List and describe effective press release tips

Develop Effective Graphics Displaying Performance

- "A picture is worth a thousand words"
- Takes time to develop meaningful graphics
- Consider your audience
  - What they want to know
  - How they want to see it
  - To whom they may pass it

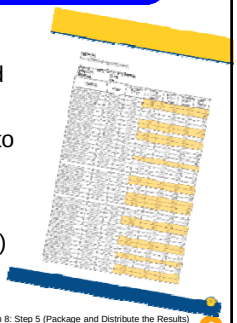
Presentation Methods

- Tables
- Maps
- Volume
  - Time-of-day
  - Current daily volumes
  - Trends
- Radar charts
- Density plots
- Visualization techniques
- Scale plots
- Color and scale
- Link-based measurements
- PC-travel output
  - Speed profile
  - Time-space diagram
- Average speed and cumulative average travel time

See binder appendix for full-color full-page examples!

Tables

- Stand alone, be concise
- Simple and clear labels and titles
- Lines, shading, or spacing to separate data groups
- Consistent table formats
- Leading zeros (0.97 vs. .97)
- Significant digits

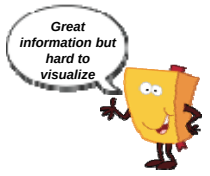


Maps

- Use when possible
- Stakeholders relate more easily to their physical environments
- Avoid extraneous information
- Make user-friendly

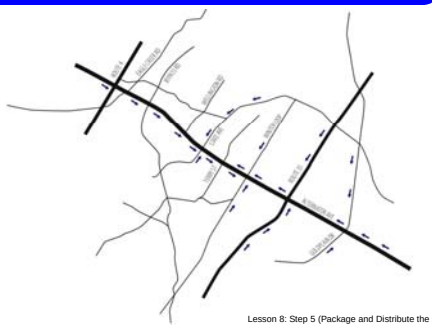
Table of Travel Rate Index Data

	State	Route 4	Route 29	Goldplain	Alternator	Water Loop	Tory
Link 1	1.65	1.09	1.14	1.08	1.68	1.23	1.40
Link 2	1.60	1.01	1.07	1.12	1.97	1.34	1.35
Link 3	2.23	1.14	1.18	1.08	1.30	1.49	1.28
Link 4	1.30	1.02	1.19	1.14	1.89	1.23	1.30
Link 5	1.66	1.01	1.09	1.15	1.60	1.48	1.48
Link 6	1.80	1.14	1.05	1.13	2.20	1.45	1.48
Corridor=	1.73	1.08	1.10	1.10	1.88	1.37	1.38



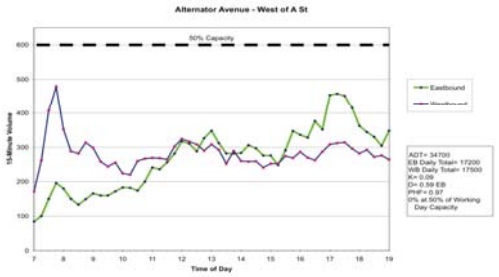
Travel Rate Index Map

AM Traffic Flow Maps



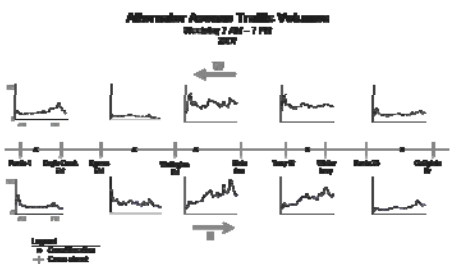
Lesson 8: Step 5 (Package and Distribute the Results) 10

Volume



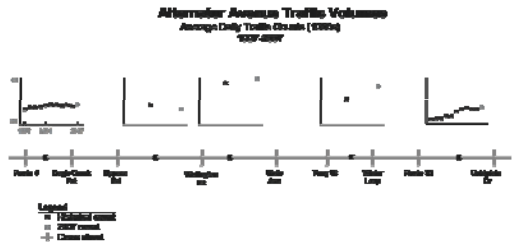
Lesson 8: Step 5 (Package and Distribute the Results) 11

Volume



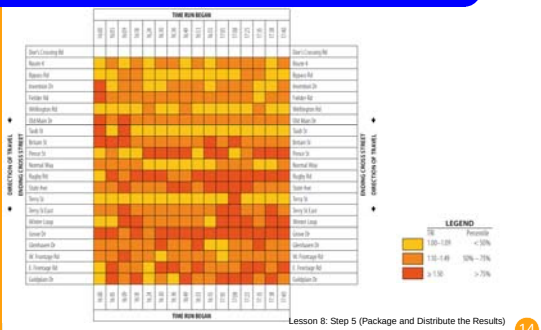
Lesson 8: Step 5 (Package and Distribute the Results) 12

Volume



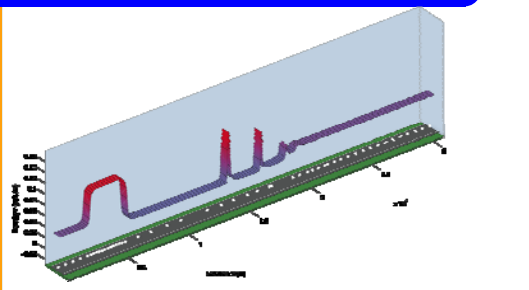
Lesson 8: Step 5 (Package and Distribute the Results) 13

Color Density Plot



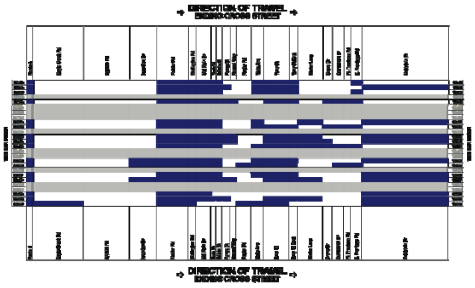
Lesson 8: Step 5 (Package and Distribute the Results) 14

Visualization Techniques

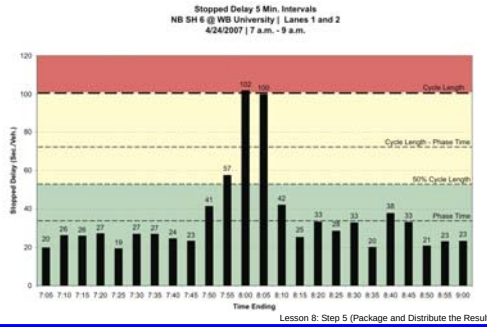


Lesson 8: Step 5 (Package and Distribute the Results) 15

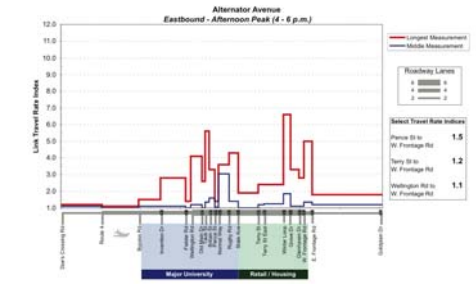
Scale Plots



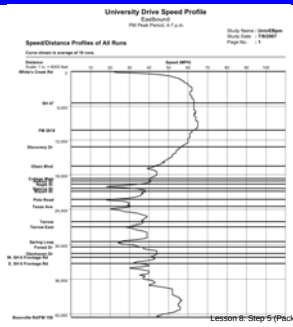
Use of Color and Scale



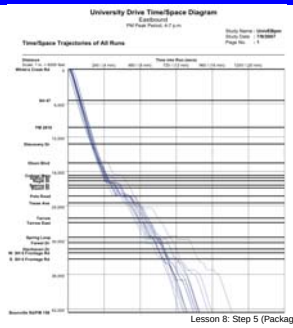
Link-based Measurements



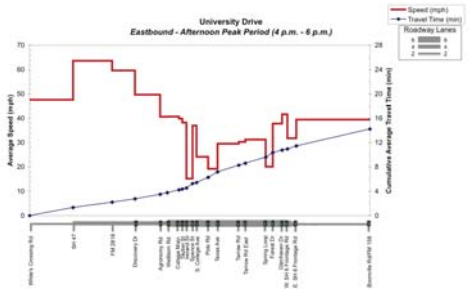
PC-Travel Output: Speed Profile



PC-Travel Output: Time-Space Diagram



Average Speed and Cumulative Average Travel Time



Develop Mobility Improvement Strategies and Action Plan

- Refer to Step 1 targets
- Document problem areas
- Match potential improvement strategies
- Integrate expectations
  - Timeline
  - Potential funding sources

Document and Distribute Results

- "Convert" technical reports for other audiences
  - Elected officials
  - General public
- Craft results into a story
  - Connect with where readers live, work, and play
- See *Reader-Friendly Document Tool Kit*
  - Washington DOT (reference 20, page 82)

Tell a Story

- Use an outline
- Explain the problem and why people care
- Write in clear, simple language
- Highlight the benefits of the monitoring

Source: WashDOT, Reader-Friendly Document Tool Kit

Engage the Reader

- Ask questions in document headings
- Define key terms and avoid acronyms
- Choose easy-to-read layouts

Source: WashDOT, Reader-Friendly Document Tool Kit

Make it Visual

- Invest time in creating powerful graphics
- Refrain from overusing tables
- Use maps to explain the data

Text Source: WashDOT, Reader-Friendly Document Tool Kit

Make it Brief

- Summarize
  - Reference technical details
- Provide only relevant information

Source: WashDOT, Reader-Friendly Document Tool Kit

How to Get the Word Out

- Summary reports
  - Elected officials, general public
  - Refer to technical report for more detail
- Town hall meetings
- Community service organization meetings
- Community workshops

Produce Press Release of Findings

- Why the monitoring was performed
- When it was conducted
- What the results are
- When monitoring will be conducted again
- What improvements are being pursued and where
- Internet site for full report / more information

Participant Experiences

- In developing press releases
- How are they typically released?
- Different / additional tips?
- Other experiences

Additional Resources for Presenting Data

- Edward Tufte
  http://www.edwardtufte.com/tufte/
  - *Beautiful Evidence*, 2006
  - *Visual Explanations*, 1997
  - *Envisioning Information*, 1990
  - *The Visual Display of Quantitative Information*, 1983

Additional Resources for Presenting Data

- William Cleveland
  http://stat.bell-labs.com/wsc/
  - *The Elements of Graphing Data, 1994*
  - *Visualizing Data, 1993*

Group Exercise: Prepare the "Presser"

- Go back to your groups
- Review map of your community
- Prepare final press release of monitoring results
- Consider tips provided in this lesson
- Be creative

Lesson 8 Objectives

You are now able to:

- Contrast use of tabular and graphical data
- Explain consideration of color and scale
- Describe considerations for developing mobility improvement strategies and action plan

Lesson 8 Objectives

You are now able to:

- Explain the concept of reader-friendly writing
- List and describe effective documentation tips
- List components of a press release
- List and describe effective press release tips

Step 6: Move Forward with Improvements and Continue the Monitoring

Lesson 9

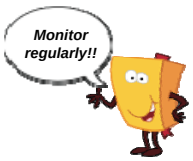
Lesson 9 Objectives

At the end of this lesson you will be able to:

- Explain the importance of regular mobility monitoring contrasting cycle frequencies
- Describe techniques and consideration for improving the mobility monitoring process

Monitoring Frequency

- Success requires continued measurement
  - Snapshot versus trends
  - Mobility changes annually
    - Monitor critical areas more frequently
  - Monitor at frequency identified in Step 2



Monitoring Frequency

- Begin with affordable frequency
- As support grows, look to increase
- Annually versus 3-5 year frequency
  - Ensure population growth, development captured
- Begin with the end in mind
  - "What do you want the press release to say?"

Incorporate Monitoring Improvements

- Identify improvements to process as you implement
- Expand monitoring limits
  - Physical boundaries
  - Data collection time intervals

Incorporate Monitoring Improvements

- Comprehensive plan updates
- Changing leadership, professional staff, elected officials
  - Different monitoring measures, perspectives

Documenting Monitoring Improvements

- Document monitoring changes
- Must compare from year-to-year
  - Awareness of process changes
    - Techniques
    - Equipment
    - Frequency
    - Links
    - Data aggregation
  - Documentation is key to interpretation

Lesson 9 Objectives

You are now able to:

- Explain the importance of regular mobility monitoring contrasting cycle frequencies
- Describe techniques and consideration for improving the mobility monitoring process

Mobility Monitoring in Your Community: Interactive Workshop

Final Comments and Evaluation

Final Comments or Questions

- On framework steps?
  - Step 1: Identify the Needs and Opportunities
  - Step 2: Make the Monitoring Plan
  - Step 3: Monitor the System
  - Step 4: Analyze the Data
  - Step 5: Package and Distribute the Results
  - Step 6: Move Forward with Improvements and Continue the Monitoring
- Implementation?
- Any workshop elements?

Evaluation and Certificate Distribution

- Please complete evaluation form
- Distribute certificates to attendees

WILLIAM WAY
AIRPORT
FRANK ST
JEFFREY AVE
IH 35
AMANDA AVE
SPRINGDALE DR
ST. JOHN'S RD
MIDDLE SCHOOL
CHADWICK ST
BUTLER DR
ELEMENTARY SCHOOL
CORDERO CT
WINDING WAY
DAVID DR
UNIVERSITY
SPECIAL EVENTS CENTER
TRACY BLVD
ADRIAN WEST AVE
ADRIAN EAST AVE
MEANDERING WAY
HIGH SCHOOL
HIGH SCHOOL STADIUM COMPLEX
LOOP 50
NATHAN ST
MICHELLE LN
CHARLES EAST RD
LEONARD RD
CEMETERY
MALL
WALLACE RD
PARK
JASON DR
PARKER ST
CENTRAL ST
CHARLES WEST RD
HELEN ST
HOSPITAL
JOSHUA RD
SUNSET RD
SH 100
TRUCK STOP
SPARTY BLVD
WALLACE RD.
ZACHARY RD
PRESTON PKWY
ARMY AVE
LARGE SCALE DISCOUNT STORE
MILITARY BASE

LEGEND

SCALE: 12 inches = 2 miles

- Freeway
- Major Arterial
- Minor Arterial
- Planned Roadway
- Interchange
- Railroad
- Traffic Signal
- Stop Sign
- Commercial
- Industrial
- Office, High Density
- Office, Low Density
- Park/Open Space
- Public
- Residential, High Density
- Residential, Low Density
- Developing

AIRPORT

SPECIAL EVENTS CENTER

SH 2

HIGH SCHOOL & STADIUM

MICHELLE ST

ELIZABETH AVE

BRIANNA BLVD (BUSINESS SH 2)

BRITTANY BLVD

NICOLE ST

ELEMENTARY SCHOOL

LAUREN LN

ANNE LN

MEGAN WAY

SYDNEY ST

HOSPITAL

DOWNTOWN

MIDDLE SCHOOL

ENTERTAINMENT CENTER

TRUCK STOP

PARK

MARIE ST (US 80)

SHOPPING CENTER

LARGE SCALE DISCOUNT STORE

JUNIOR COLLEGE CAMPUS

BISCUIT BLVD

ELEMENTARY SCHOOL

CATHERINE ST

FACTORY

DISTRIBUTION CENTER

CORINNE CT

N

LEGEND

SCALE: 12 inches = 1 mile

- Freeway
- Arterial
- Collector
- Interchange
- Planned Roadway
- Railroad
- Traffic Signal
- Stop Sign
- Commercial
- Industrial
- Park
- Public
- Residential, High Density
- Residential, Low Density
- Developing

AIRPORT

SPECIAL EVENTS CENTER

HIGH SCHOOL & STADIUM

ELIZABETH AVE

BRIANNA BLVD (SH 2)

BRITTANY BLVD

MICHELLE ST

NICOLE ST

ELEMENTARY SCHOOL

LAUREN LN

MEGAN WAY

SYDNEY ST

HOSPITAL

DOWNTOWN

MIDDLE SCHOOL

SYLVIA ST

ENTERTAINMENT CENTER

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ANNE LN

CATHERINE ST

FACTORY

DISTRIBUTION CENTER

CORINNE CT

N

LEGEND

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- Arterial
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- Railroad
- Traffic Signal
- Stop Sign
- Commercial
- Industrial
- Park
- Public
- Residential, High Density
- Residential, Low Density
- Developing

Mobility Monitoring in Your Community: Interactive Workshop

Feedback to Transportation Professionals from various stakeholders

Medium-sized Community (approximately 75,000 in population)

"Our community is losing its 'small-town' feel with development on all sides of the city. Traffic is increasing significantly along all major roadways. Isn't there anything that can done?"

—Long-time resident

"The east-west railroad tracks south of SH 100 divide our community. I live south of the tracks, and trains frequently interrupt my trips to shopping along SH 100, the high school, and downtown. The trains add at least 10 minutes to these trips."

—Common complaint of residents south of the tracks

"I live near the high school stadium complex, and I take Charles East and Charles West to get to the mall. It takes longer to get there than it used to in the past. I've tried to take David Drive to IH 35, but that takes even longer."

—Long-time resident

"I work downtown, and I have to allow more time now than I used to because it takes longer to get to the airport. I've tried taking several different routes, but they all seem to take longer."

—Common complaint of downtown employees, and the Mayor

"I live off of Wallace Road, and do business on Charles West, and I frequently have to wait forever to turn left onto Charles West. I've tried going over to Amanda Avenue, but then I get caught at more signals and that burns more gas. And gas is costly! My customers tell me the same thing."

—Charles West business owner

"I live near Joshua Road and Amanda Avenue, and I work at the truck stop. I have to drive down SH 100 because it is too far to go back around to the freeway. I always have to sit through at least two red lights at Amanda Avenue, and half of the remaining signals are red."

—Resident comment

"There are many trucks making deliveries along SH 100 and downtown. Also, traffic is always backed up because of slow-moving and loud trucks near the SH 100 truck stop."

—Resident comment

"Some of us that live near the high school stadium complex, drop kids off at the elementary school on David Drive before traveling to the University to work. It just seems to take longer to get to University parking at St. John's and David."

—Resident comment

Mobility Monitoring in Your Community: Interactive Workshop

Feedback to Transportation Professionals from various stakeholders

Small Community (approximately 25,000 in population—relief route around the city)

"Our community is losing its 'small-town' feel with new development around the city. Traffic is increasing significantly along all major roadways. Isn't there anything that can done?"
—Long-time resident

"The east-west railroad tracks north of Marie Street divide our community. I live south of the tracks, and trains frequently interrupt my trips to downtown, shopping along Brianna Boulevard, and the special events center. The trains add at least 10 minutes to these trips."
—Common complaint of residents south of the tracks

"I live near Anne Lane and Nicole Street, and I work at the junior college campus. No matter which way I go, it seems I always get caught for the signal downtown or at Marie Street and Brianna Boulevard. My drive takes longer than it used to in the past. I've tried different routes, and don't tell me to take SH 2 around!"
—Long-time resident

"We run delivery trucks from our distribution center on the southwest side of town to the airport. The trips across town are taking longer. My truck drivers say that they are frequently caught at more red lights than in the past."
—Distribution Center Manager

"I live between Elizabeth Avenue and Anne Lane, and I will be the new manager at the large scale discount store. I'm currently employed at the shopping center on Marie Street, and that trip has been taking longer compared to the past. I'm worried about the additional time to get to the discount store, and being closer to all that truck traffic by the truck stop.""
—Resident comment

"We are finally getting some new affordable housing north of SH 2. As the factory and distribution centers increase staff, then traffic is bound to increase along Elizabeth Avenue. There is not a problem now, but I don't want to see one in the future."
—Major

"I live near Brianna Boulevard and Catherine Street, and I have to drop my kids off at the elementary school on Biscuit Boulevard before going to my job at the hospital. Traffic is very busy when dropping off the kids at the school. I've tried every alternate route, and if I'm not waiting for red lights, I'm burning gas going too far out of the way!"
—Resident comment

Mobility Monitoring in Your Community: Interactive Workshop

Feedback to Transportation Professionals from various stakeholders

Small Community (approximately 25,000 in population—no relief route around the city)

"Our community is losing its 'small-town' feel with new development around the city. Traffic is increasing significantly along all major roadways. Isn't there anything that can done?"
—Long-time resident

"The east-west railroad tracks north of Marie Street divide our community. I live south of the tracks, and trains frequently interrupt my trips to downtown, shopping along Brianna Boulevard, and the special events center. The trains add at least 10 minutes to these trips."
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—Resident comment

"There are too many trucks traveling Brianna Boulevard. We need to get the trucks out of downtown!"
—Common resident comment

1. BASE DATA - TRAVEL TIMES AND TRAFFIC VOLUMES

Travel Time Data

Marie Street **Eastbound** **Date: Tuesday Apr 10**

Run Start Time	Link Start Time					Run End Time
Time 1 1.0 mi west of Elizabeth Ave	**Time 2** Elizabeth Ave	**Time 3** Anne Ln	**Time 4** Brianna Blvd	**Time 5** Brittany Blvd	**Time 6** Sylvia St	**Time 7** 1.0 mi east of Sylvia
Link Distance (miles):	1.0	0.5	0.8	0.7	1.2	1.0
Posted Speed Limit :	50	40	40	40	40	50
7:04:00	7:05:08	7:05:59	7:07:09	7:08:22	7:10:08	7:11:19
7:28:00	7:33:15	7:34:10	7:35:23	7:36:34	7:38:22	7:39:36
7:53:00	7:54:16	7:55:15	7:56:32	7:57:51	7:59:49	8:01:09
8:11:00	8:12:15	8:13:17	8:14:33	8:15:54	8:17:47	8:19:05
8:32:00	8:33:13	8:34:13	8:35:28	8:36:47	8:38:38	8:39:55
8:50:00	8:51:10	8:52:05	8:53:18	8:54:31	8:56:20	8:57:35
9:11:00	9:12:09	9:12:57	9:14:08	9:15:14	9:16:57	9:18:07
9:32:00	9:33:07	9:33:54	9:35:06	9:36:15	9:37:59	9:39:13
9:48:00	9:49:10	9:49:56	9:51:09	9:52:14	9:53:56	9:55:04

Travel Time Notes: Encountered stopped train near Elizabeth on 2nd run

off-peak travel times

A stopped train equates to incident delay and must be eliminated for a travel rate index calculation

Traffic Volume Data

Marie Street **Date: Tuesday Apr 10**

Eastbound	Link 1 Elizabeth Ave	Link 2 Anne Ln	Link 3 Brianna Blvd	Link 4 Brittany Blvd	Link 5 Sylvia St	Link 6 1.0 mi east of Sylvia
15-minute period						
7:00-7:15	200	230	250	270	240	180
7:15-7:30	125	240	270	295	250	200
7:30-7:45	250	265	290	315	290	210
7:45-8:00	270	290	320	350	335	225
8:00-8:15	280	295	325	360	330	220
8:15-8:30	285	295	330	370	315	215
8:30-8:45	275	290	315	350	305	210
8:45-9:00	265	285	305	325	300	205
Link Sum =	1,950	2,190	2,405	2,635	2,365	1,665

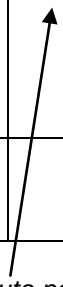
15-minute traffic counts for eastbound Marie St

Note: For each 15-minute period of traffic volumes, a travel time run is needed. When one does not exist for each 15-minute period, interpolation can be used to estimate a travel time run from the runs before and after the missing time period. If travel time runs do not exist, it may be necessary to aggregate some 15-minute periods into 30-minute or 1-hour periods.

2. CONVERT CLOCK TIMES TO SECONDS PER LINK

Travel Time (in seconds)

Run Start Time 1.0 mi west of Elizabeth Ave	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylvia St	**Link 6** 1.0 mi east of Sylvia
7:04:00	68	51	70	73	106	71
7:15:00	71	53	71	72	107	72
7:28:00	74	55	73	71	108	74
7:53:00	76	59.0	77	79	118.0	80
8:00:00	75	60	76	80	115	79
8:11:00	75	62	76	81	113	78
8:32:00	73	60	75	79	111	77
8:50:00	70	55	73	73	109	75
9:11:00	69	48	71	66	103	70
9:32:00	67	47	72	69	104	74
9:48:00	70	46	73	65	102	68
Off-peak Travel Time (median):	69	47	72	66	103	70
Off-peak Travel Time (15th percentile):	68	46	71	65	102	69



Shaded areas were interpolated for 15-minute periods where travel time runs were missing. The 74 in the 7:28 line is interpolated from the 7:15 and 7:53 runs to account for the incident where train was parked on tracks.

3. CALCULATE TRAVEL RATES AND CHECK LINK SPEEDS

Travel Rates (minutes per mile)

Run Start Time 1.0 mi west of Elizabeth	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylva St	**Link 6** 1.0 mi east of Sylva
7:04:00	1.13	1.70	1.46	1.74	1.47	1.18
7:15:00	1.18	1.77	1.48	1.71	1.49	1.20
7:28:00	1.23	1.83	1.52	1.69	1.50	1.23
7:53:00	1.27	1.967	1.60	1.88	1.639	1.33
8:00:00	1.25	2.00	1.58	1.90	1.60	1.32
8:11:00	1.25	2.07	1.58	1.93	1.57	1.30
8:32:00	1.22	2.00	1.56	1.88	1.54	1.28
8:50:00	1.17	1.83	1.52	1.74	1.51	1.25
9:11:00	1.15	1.60	1.48	1.57	1.43	1.17
9:32:00	1.12	1.57	1.50	1.64	1.44	1.23
9:48:00	1.17	1.53	1.52	1.55	1.42	1.13
Off-peak Travel Rate (median):	1.15	1.57	1.50	1.57	1.43	1.17
Off-peak Travel Rate (15th percentile):	1.13	1.54	1.49	1.55	1.42	1.14

Travel Rate = Minutes per Mile

Speed (miles per hour)

Run Start Time 1.0 mi west of Elizabeth Ave	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylvia St	**Link 6** 1.0 mi east of Sylvia
7:04:00	53	35	41	35	41	51
7:15:00	51	34	41	35	40	50
7:28:00	49	33	39	35	40	49
7:53:00	47	30.5	37	32	36.6	45
8:00:00	48	30	38	32	38	46
8:11:00	48	29	38	31	38	46
8:32:00	49	30	38	32	39	47
8:50:00	51	33	39	35	40	48
9:11:00	52	37	41	38	42	51
9:32:00	54	38	40	37	42	49
9:48:00	51	39	39	39	42	53

Can perform "reasonableness check" with these calculated link speeds

4. CALCULATE LINK TRAVEL RATE INDEX

Travel Rate Indices (based on Median)

Run Start Time	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6
1.0 mi west of Elizabeth Ave	Elizabeth Ave	Anne Ln	Brianna Blvd	Brittany Blvd	Sylvia St	1.0 mi east of Sylvia
7:04:00	1.00	1.09	0.97	1.11	1.03	1.01
7:15:00	1.00	1.13	0.99	1.09	1.04	1.03
7:28:00	1.00	1.17	1.01	1.08	1.05	1.06
7:53:00	1.10	1.255	1.07	1.20	1.146	1.14
8:00:00	1.00	1.28	1.06	1.21	1.12	1.13
8:11:00	1.09	1.32	1.06	1.23	1.10	1.11
8:32:00	1.06	1.28	1.04	1.20	1.08	1.10
8:50:00	1.01	1.17	1.01	1.11	1.06	1.07

Travel Rate Index = Peak Travel Rate / Off-peak Travel Rate (median)

Travel Rate Indices (based on 15th Percentile) - used for all subsequent calculations

Run Start Time	Link 1	Link 2	Link 3	Link 4	Link 5	Link 6
1.0 mi west of Elizabeth Ave	Elizabeth Ave	Anne Ln	Brianna Blvd	Brittany Blvd	Sylvia St	1.0 mi east of Sylvia
7:04:00	1.01	1.10	0.98	1.12	1.04	1.03
7:15:00	1.05	1.14	1.00	1.10	1.05	1.05
7:28:00	1.09	1.19	1.02	1.09	1.06	1.08
7:53:00	1.12	1.274	1.08	1.21	1.153	1.17
8:00:00	1.11	1.30	1.07	1.23	1.12	1.15
8:11:00	1.11	1.34	1.07	1.24	1.10	1.14
8:32:00	1.08	1.30	1.05	1.21	1.09	1.12
8:50:00	1.04	1.19	1.02	1.12	1.07	1.09

Travel Rate Index = Peak Travel Rate / Off-peak Travel Rate (15th percentile)

5. CALCULATE VEHICLE-MILES OF TRAVEL AND CREATE WEIGHTED LINK AND CORRIDOR TRAVEL RATE INDICES

Vehicle-miles of Travel

Run Start Time 1.0 mi west of Elizabeth Ave	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylvia St	**Link 6** 1.0 mi east of Sylvia	sum
15-minute period							
7:00-7:15	200	115	200	189	288	180	1172
7:15-7:30	125	120	216	207	300	200	1168
7:30-7:45	250	133	232	221	348	210	1393
7:45-8:00	270	145.0	256	245	402.0	225	1543
8:00-8:15	280	148	260	252	396	220	1556
8:15-8:30	285	148	264	259	378	215	1549
8:30-8:45	275	145	252	245	366	210	1493
8:45-9:00	265	143	244	228	360	205	1444

VMT = Traffic Volume x Length of Link

Weighted TRI Factors

Run Start Time 1.0 mi west of Elizabeth Ave	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylvia St	**Link 6** 1.0 mi east of Sylvia
15-minute period (Use TRI based on 15th percentile)						
7:04:00	201	127	196	211	298	186
7:15:00	131	137	215	228	314	210
7:28:00	274	157	238	240	367	227
7:53:00	304	184.8	276	296	463.7	262
8:00:00	311	191	277	309	445	253
8:11:00	316	198	281	321	418	244
8:32:00	297	188	265	296	397	236
8:50:00	274	169	250	254	384	224

TRI Factor = TRI x VMT

Continued Run Start Time	Run Sum TRI Factors	Run Sum VMT	Weighted TRI
7:04:00	1220	1172	1.04
7:15:00	1235	1168	1.06
7:28:00	1502	1393	1.08
7:53:00	1787.3	1543.0	1.158
8:00:00	1786	1556	1.15
8:11:00	1778	1549	1.15
8:32:00	1679	1493	1.12
8:50:00	1556	1444	1.08
	12544	11317	1.108

Run TRI

Weighted Corridor TRI

6. CALCULATE DELAY PER LINK AND FOR CORRIDOR

Delay per Vehicle per Link (in seconds)

Run Start Time 1.0 mi west of Elizabeth Ave	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylvia St	**Link 6** 1.0 mi east of Sylvia
7:04:00	0.4	4.7	0.0	7.7	3.7	2.4
7:15:00	3.4	6.7	0.0	6.7	4.7	3.4
7:28:00	6.4	8.7	1.7	5.7	5.7	5.4
7:53:00	8.4	12.70	5.7	13.7	15.70	11.4
8:00:00	7.4	13.7	4.7	14.7	12.7	10.4
8:11:00	7.4	15.7	4.7	15.7	10.7	9.4
8:32:00	5.4	13.7	3.7	13.7	8.7	8.4
8:50:00	2.4	8.7	1.7	7.7	6.7	6.4

Delay per Link = Travel Time on Link - Off-peak Travel Time (15th percentile)

Delay per Link (vehicle-seconds) and Corridor Summary

Run Start Time 1.0 mi west of Elizabeth Ave	**Link 1** Elizabeth Ave	**Link 2** Anne Ln	**Link 3** Brianna Blvd	**Link 4** Brittany Blvd	**Link 5** Sylvia St	**Link 6** 1.0 mi east of Sylvia	
15-minute period							
7:04:00	80	1081	0	2079	888	432	
7:15:00	425	1608	0	1977	1175	680	
7:28:00	1600	2306	493	1796	1653	1134	
7:53:00	2268	3683.0	1824	4795	5259.5	2565	
8:00:00	2072	4042	1527	5292	4191	2288	
8:11:00	2109	4631	1551	5809	3371	2021	
8:32:00	1485	3973	1166	4795	2653	1764	
8:50:00	636	2480	518	2502	2010	1312	
Sum Factor	10675	23803	7079	29044	21200	12196	
Sum VMT	1950	1095	1924	1845	2838	1665	sum of
Avg Delay per Link (sec)	5.5	21.7	3.7	15.7	7.5	7.3	all links
Delay (veh-sec)	10675	47606	8849	41492	17667.1	12196	138486
Daily (veh-hours)	3.0	13.2	2.5	11.5	4.9	3.4	38.5
Annual (pers-hours)	778	3471	645	3025	1288.2	889	10098

Notes:
Sum Factor = sum of (Delay per Link x Traffic Volume)
Sum VMT = sum of (VMT per Link)
Average Delay per Vehicle = Sum Factor / Sum VMT
Delay (veh-sec) = Avg Delay per Link x Sum of Traffic Volumes for Link

Average Occupancy = 1.05
Annual Workdays = 250

"Analyze the Data"
Answer Key

2. CONVERT CLOCK TIMES TO SECONDS PER LINK

#1: 7:55:15 – 7:54:16 = 59 seconds
#2: 7:59:49 – 7:57:51 = 118 seconds

3. CALCULATE TRAVEL RATES AND CHECK LINK SPEEDS

#1: (59 seconds / 60 sec/min) / 0.5 mile = 1.967 minutes/mile
#2: (118 seconds / 60 sec/min) / 1.2 miles = 1.639 minutes/mile
#3: (1/1.967min/mile) x 60 min/1 hr = 30.5 mph
#4: (1/1.639min/mile) x 60 min/1 hr = 36.6 mph

4. CALCULATE LINK TRAVEL RATE INDEX

#1: 1.967 / 1.57 = 1.253
#2: 1.639 / 1.43 = 1.146
#3: 1.967 / 1.54 = 1.277
#4: 1.639 / 1.42 = 1.154

5. CALCULATE VEHICLE-MILES OF TRAVEL AND CREATE WEIGHTED LINK AND CORRIDOR TRAVEL RATE INDICES

#1: 290 vehicles x 0.5 mile = 145 VMT
#2: 335 vehicles x 1.2 miles = 402 VMT
#3: 1.277 TRI x 145 VMT = 184.7
#4: 1.154 TRI x 402 VMT = 463.5
#5: 304 + 184.8 + 276 + 296 + 463.7 + 262 = 1,786.5
#6: 270 + 145 + 256 + 245 + 402 +225 = 1,543
#7: 1,787.3 / 1,543 = 1.158
#8: 12,544 / 11,317 = 1.108

6. CALCULATE DELAY PER LINK AND FOR CORRIDOR

#1: 59 seconds – 46 seconds = 13 seconds
#2: 118 seconds – 102 seconds = 16 seconds
#3: 13 seconds x 290 vehicles = 3,770
#4: 16 seconds x 335 vehicles = 5,360
#5: 7.5 seconds x 2,365 vehicles = 17,737.5 veh-sec
#6: 17,737.5 veh-sec / 3600 sec/hr = 4.9 veh-hr
#7: 4.9 veh-hours x 250 days/yr x 1.05 persons/vehicle = 1,293 person-hours

Mobility Monitoring in Your Community: Interactive Workshop

Instructors

	Poor				Excellent
Delivery	☐	☐	☐	☐	☐
Organization	☐	☐	☐	☐	☐
Subject Knowledge	☐	☐	☐	☐	☐

Tell us how well you can perform each of these workshop learning objectives

	Poor				Excellent
Explain common causes of congestion.	☐	☐	☐	☐	☐
Describe attributes of good performance measures.	☐	☐	☐	☐	☐
Discuss benefits of repeated monitoring.	☐	☐	☐	☐	☐
Describe key early considerations for developing a monitoring plan.	☐	☐	☐	☐	☐
Develop a sketch monitoring plan.	☐	☐	☐	☐	☐
Explain performance measure calculations.	☐	☐	☐	☐	☐
Contrast use of tabular and graphical data.	☐	☐	☐	☐	☐

Was the Workshop Useful to you?	☐	☐	☐	☐	☐

Will you do something different because of what you learned today? Yes No

If “yes,” what will do you differently?

Please see reverse side!

Please tell us the most important point(s) made in this presentation?

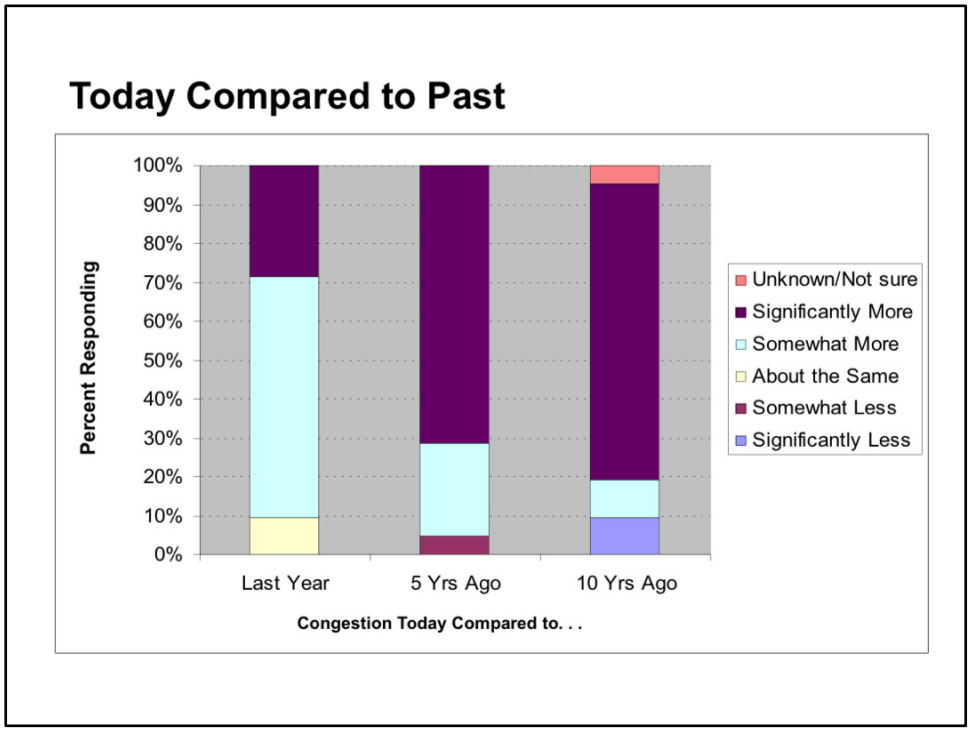
What questions do you still have?

How could this workshop be improved?

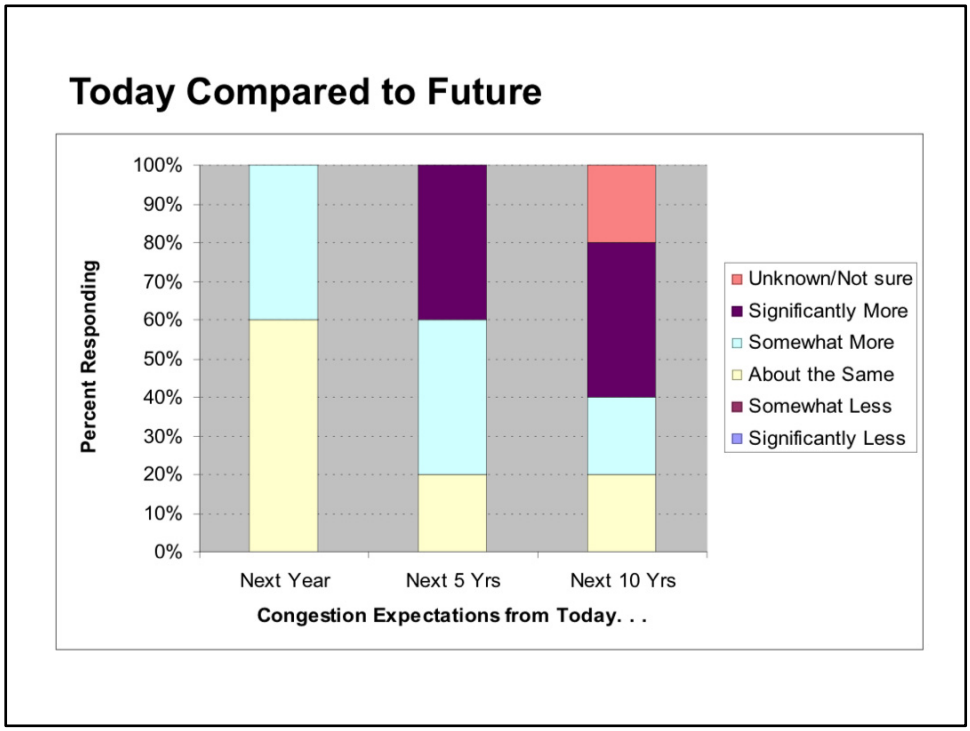
Thanks for your feedback!

Name (optional): _____

Agency (optional): _____

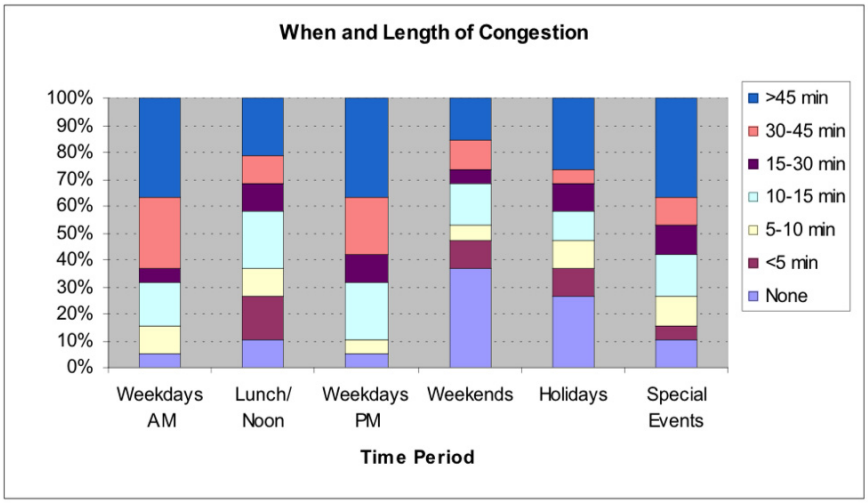


When asked to compare their congestion to past conditions, 90% said congestion was worse than last year and 95% thought congestion was worse than 5 years ago. In fact, 70% of respondents thought congestion was significantly more today than 5 years ago.



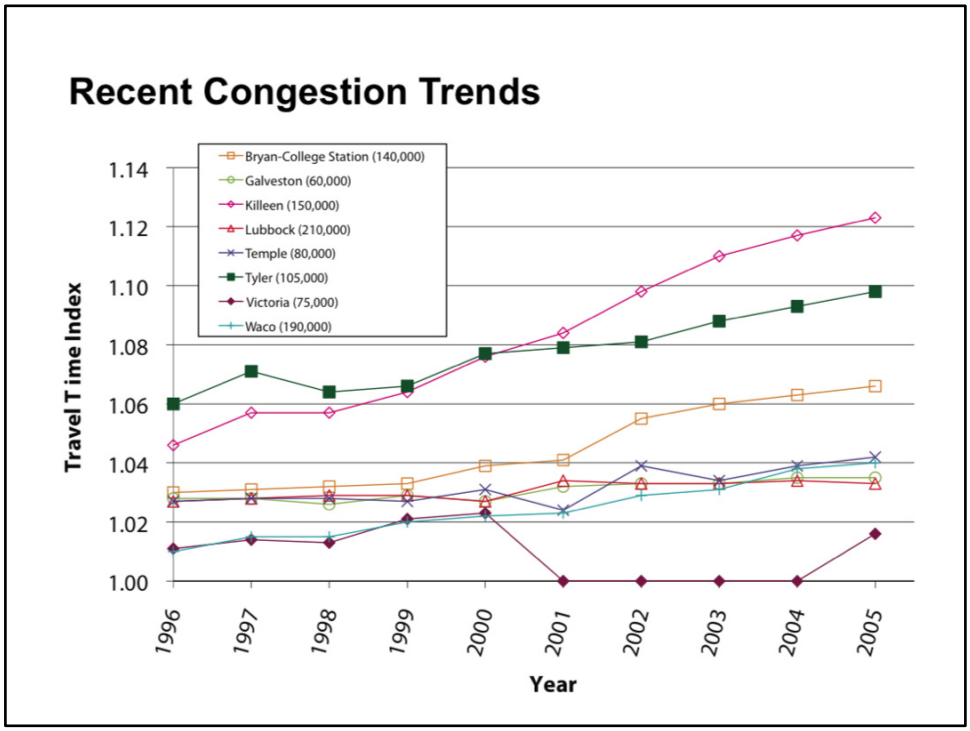
Looking to the future, the respondents were asked to predict congestion compared to today's conditions. 40% indicated congestion would increase next year, 80% predict congestion will be worse in 5 years with half expecting significantly more congestion.

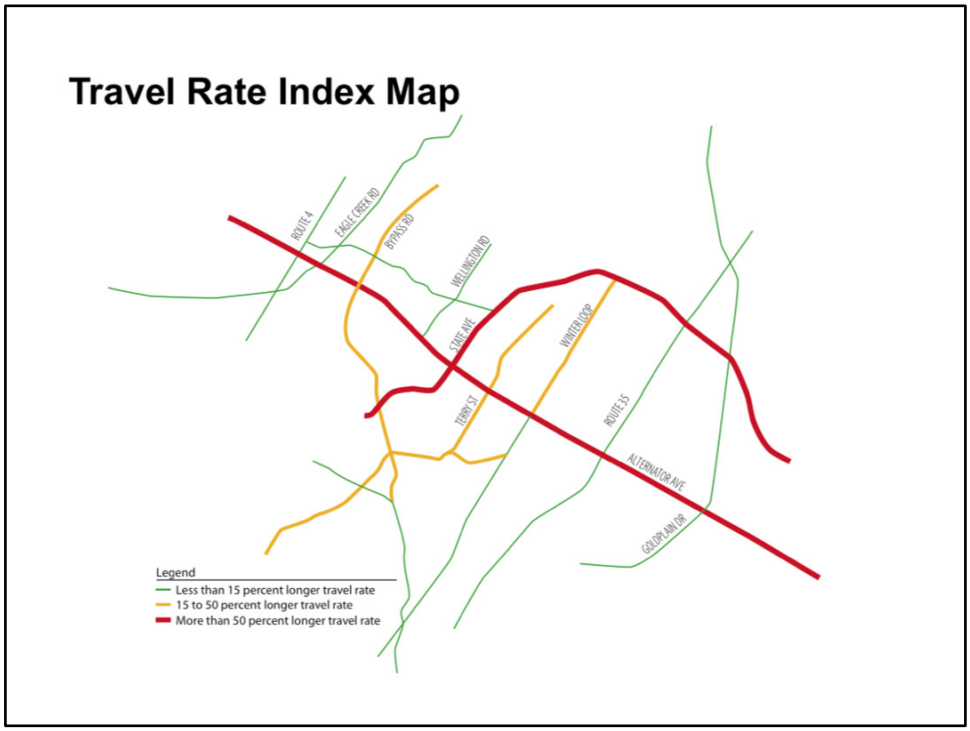
State Routes: Time and Length of Congestion



As might be expected, congestion on state routes is highest on weekday rush hours and associated with special events.

Ask participants if they concur or how they differ and why.

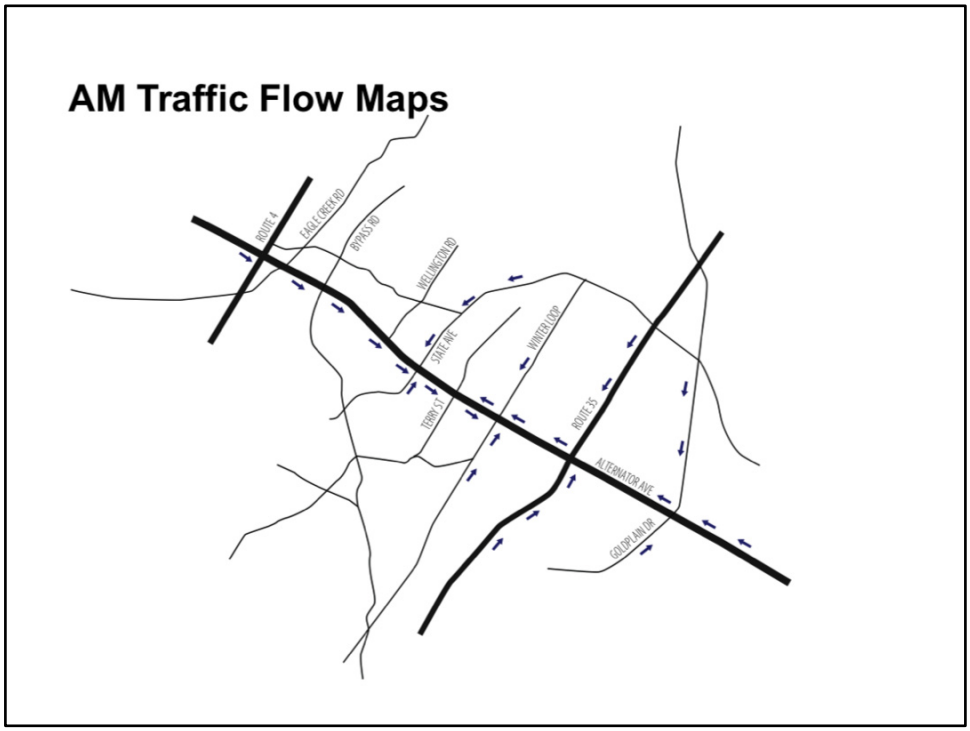

Recent Congestion Trends
Bryan-College Station (140,000)
Galveston (60,000)
Killeen (150,000)
Lubbock (210,000)
Temple (80,000)
Tyler (105,000)
Victoria (75,000)
Waco (190,000)
Travel T ime Index
1.14
1.12
1.10
1.08
1.06
1.04
1.02
1.00
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Year



Contrast the prior graphic with this graphic. This graphic quickly puts the table information in a meaningful visual context.

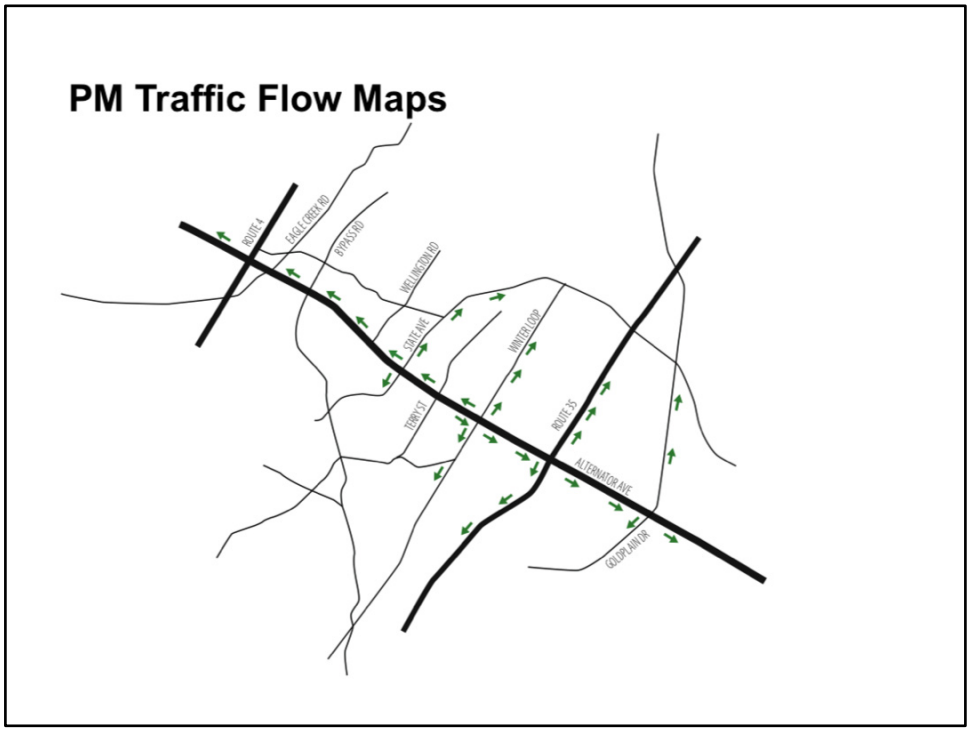
This is Figure 22 on page 60 of the *Guidebook*.

This map shows travel rate index (TRI) values for a community. Color is used to the congestion range on each roadway. Roadways are clearly marked, and the legend is clear.



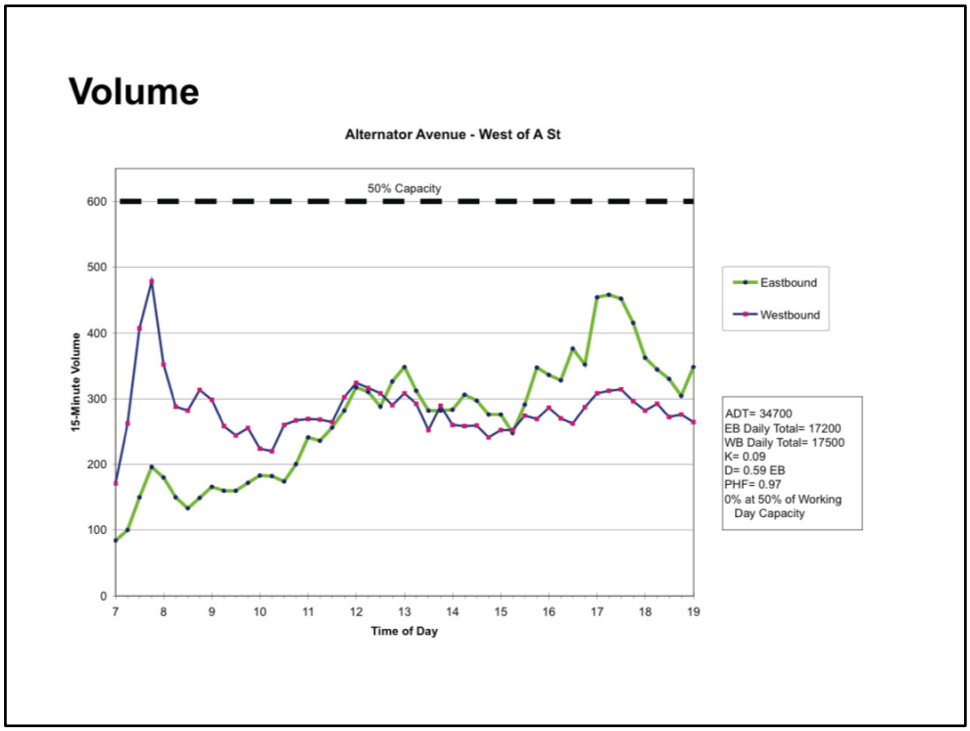
This is Figure 21 on page 59 of the *Guidebook*.

This graphic shows an example of AM traffic flows for a community. Note the generally inbound nature of the flows.



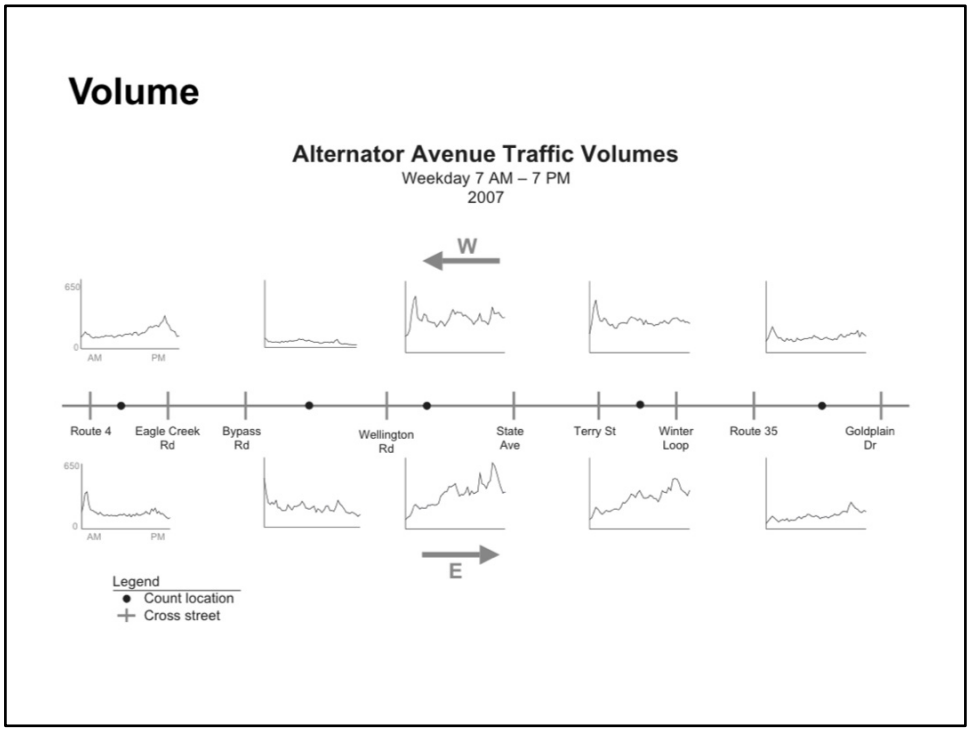
This is Figure 21 on page 59 of the *Guidebook*.

This graphic shows an example of PM traffic flows for a community. Note the generally outbound nature of the flows.



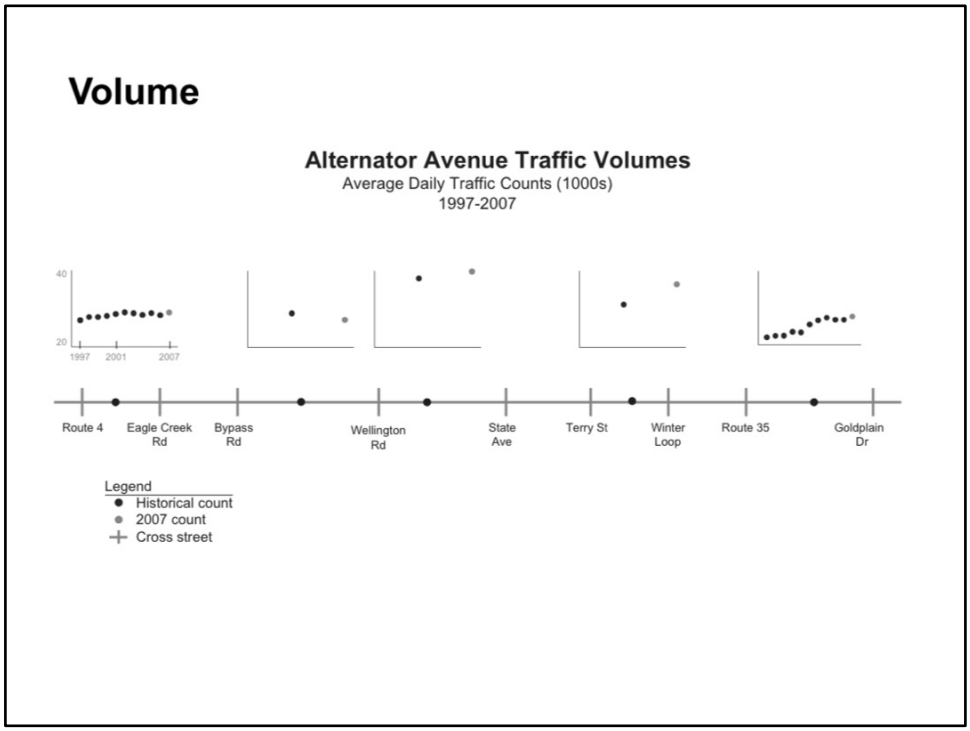
This is Figure 17 on page 57 of the *Guidebook*.

This graphic shows time-of-day directional 15-minute volumes. Note the target of 50% capacity. This was discussed in Lesson 5. Common operational characteristics are summarized to the right of the graphic.



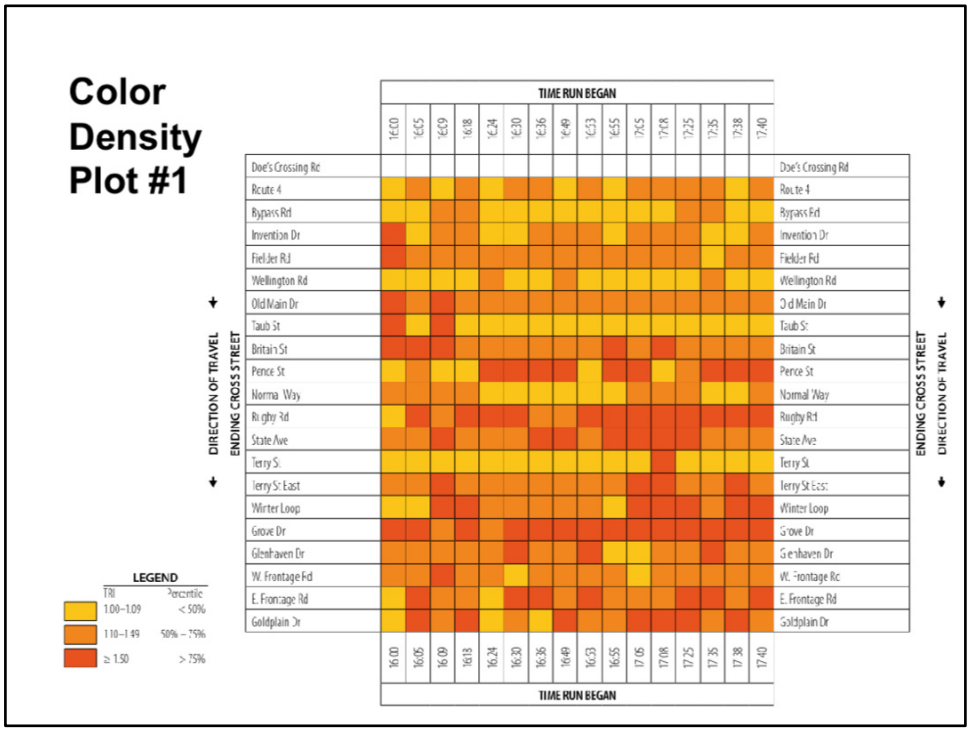
This is Figure 19 on page 58 of the *Guidebook*.

This graphic shows many useful characteristics visually along this corridor. It shows current roadway daily traffic volumes along Alternator Avenue from 7 AM to 7 PM. Traffic count locations are shown in relation to major cross streets on the roadway. The figure also separates out volumes by direction of travel. The graphic is kept relatively simple—no repeating axis values on each graph. Keeping the graphic simple directs the reader's attention to the data and is less distracting.



This is Figure 20 on page 58 of the *Guidebook*.

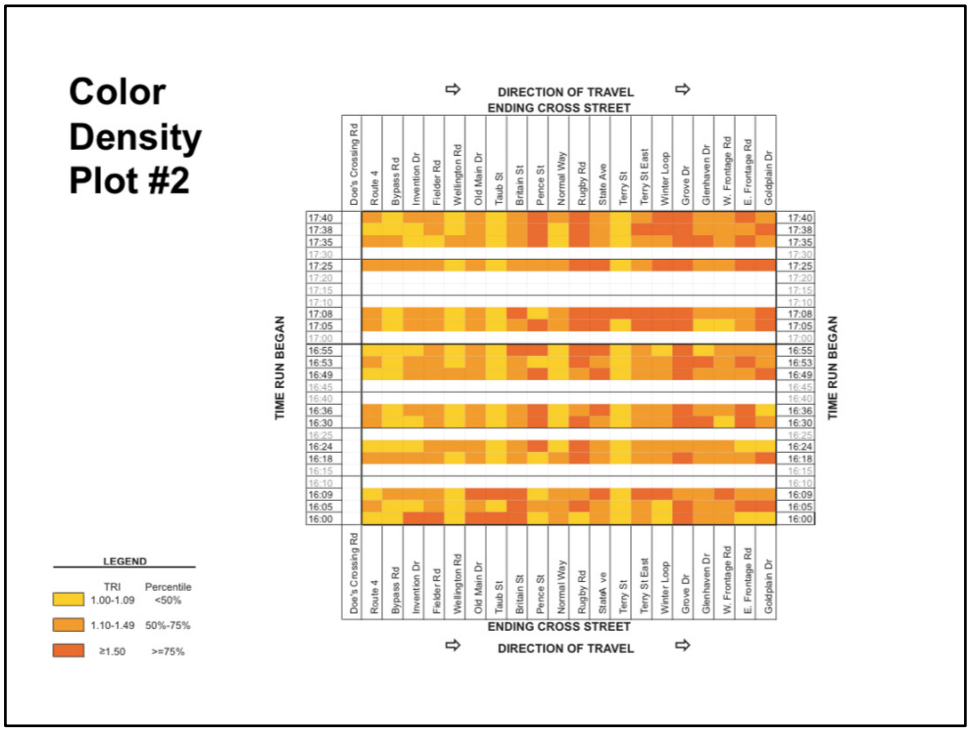
This figure displays historical traffic volumes along Alternator Avenue. Here, we can see data collected in 2001 and 2007 at the three middle traffic count locations, while annual data are available at the ends of the corridor. It is acceptable to show gaps in the data. You can still identify trends with data gaps; however, trends are more evident and stronger conclusions are made when the data gaps are filled.



This is Figure 24 on page 64 of the *Guidebook*.

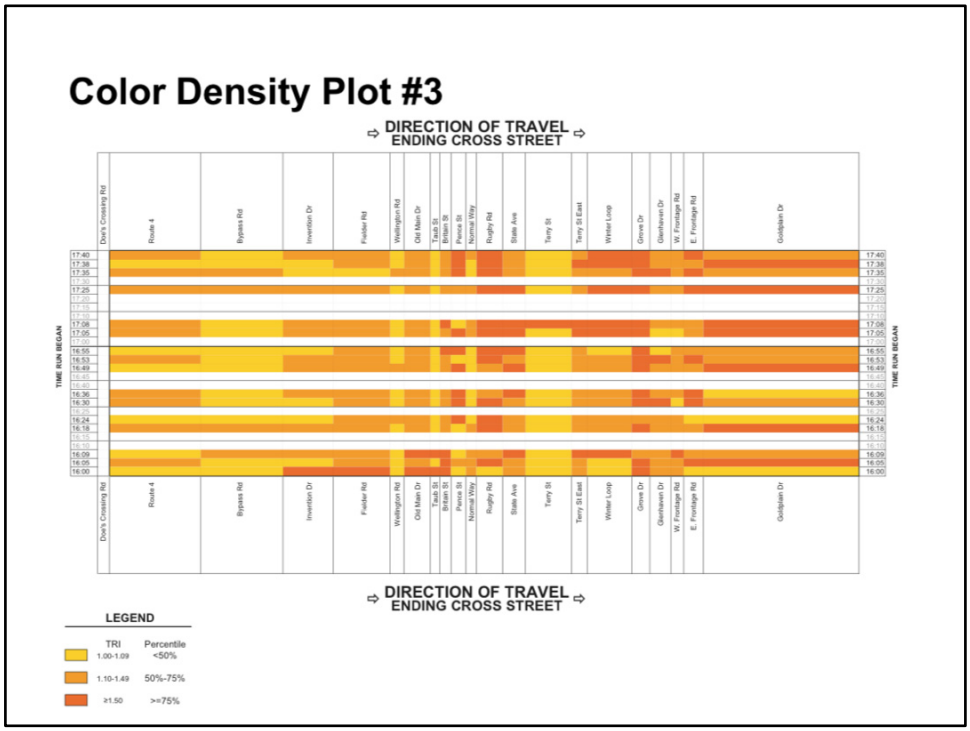
The density plots on the next three slides provide readers with a sense of congestion intensity along the roadway and through time. This is a basic representation. This density plot compresses all of the data together so that each observation (ending cross-street run time) is weighted equally in terms of plot area. Time is read from left to right in accordance with natural reading tendencies. Likewise, movement along the roadway is conveyed as the reader scans down the graphic. Note that the direction of travel is also indicated to confirm the reader's sense of movement along the roadway.

Increasing congestion, or higher travel rate index values, is color-coded through the use of either more intense color saturation or more intense color choices. In this example, decreased mobility can be seen to become more common through time over the afternoon peak period and geographically from midway through to the end of the roadway.



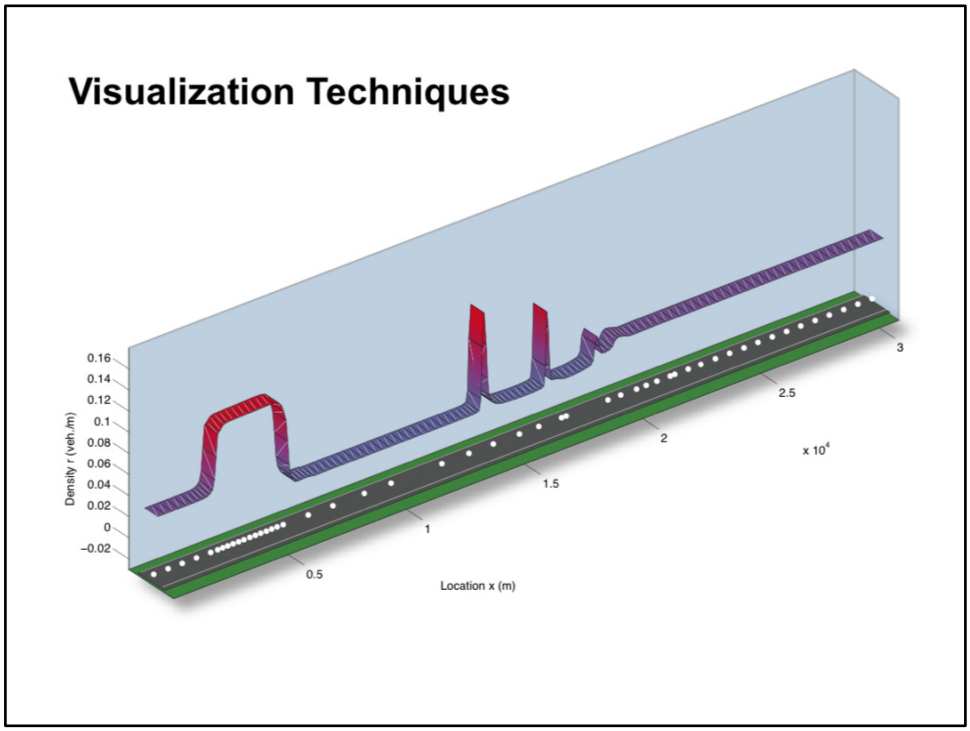
This is Figure 25 on page 65 of the *Guidebook*.

This density plot provides the read more information by adding blank rows for times (in this case at 5-minute intervals) where data were not collected. This graphic switches column and row headers to show movement along the roadway in a left-to-right configuration. This is shown as an upward movement, forcing the reader to begin at the bottom of the graphic and work up through the visual data.



This is Figure 26 on page 66 of the *Guidebook*.

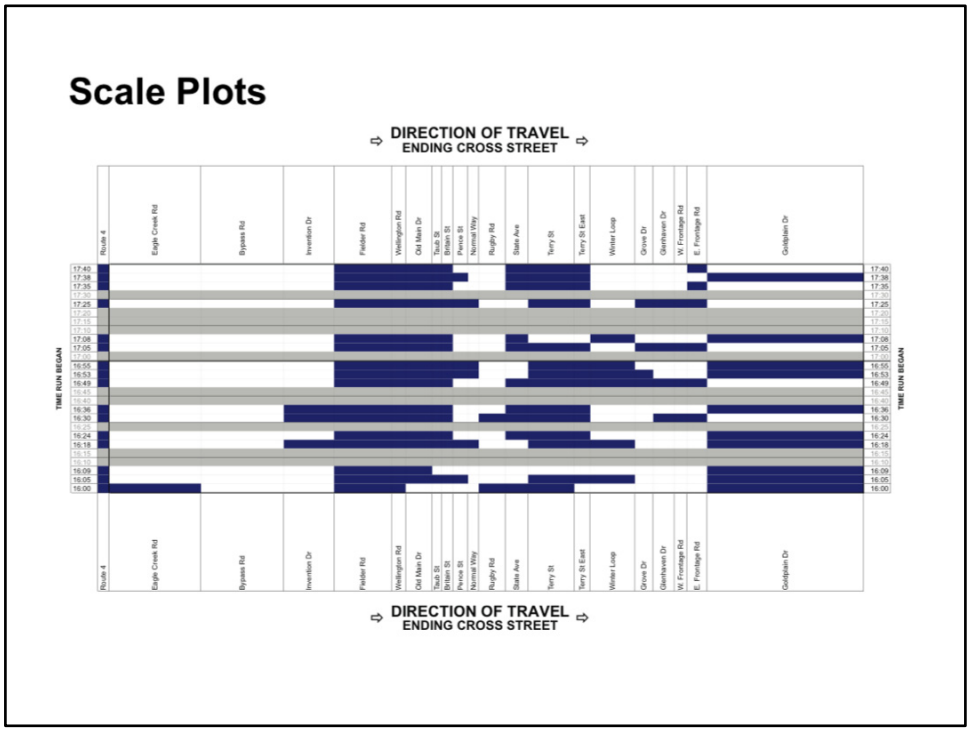
This graphic is the last density plot in this progressive series. This figure builds upon the previous figure by relating the length of the individual roadway segments. This graphic succeeds relating congestion intensity and duration over a spatial representation. For instance, travel rate index values near the center of the roadway are intense over short links.



This is Figure 27 on page 67 of the *Guidebook*.

Visualization techniques are an effective means to convey information to the public. This graphic relates vehicle density in a 3-dimensional context (grass, shoulder and pavement, white dots for vehicles, sky) with the density functions hovering above. The technical professional would be able to interpret this standalone density function, but the general public may have a difficult time. The example is able to relate a technical issue in a nontechnical manner. Bringing the physical “sense” of the roadway operation can make an immediate connection with the viewer, allowing them to relate to the information easily.

The interactive CD contains an animated version of this graphic.

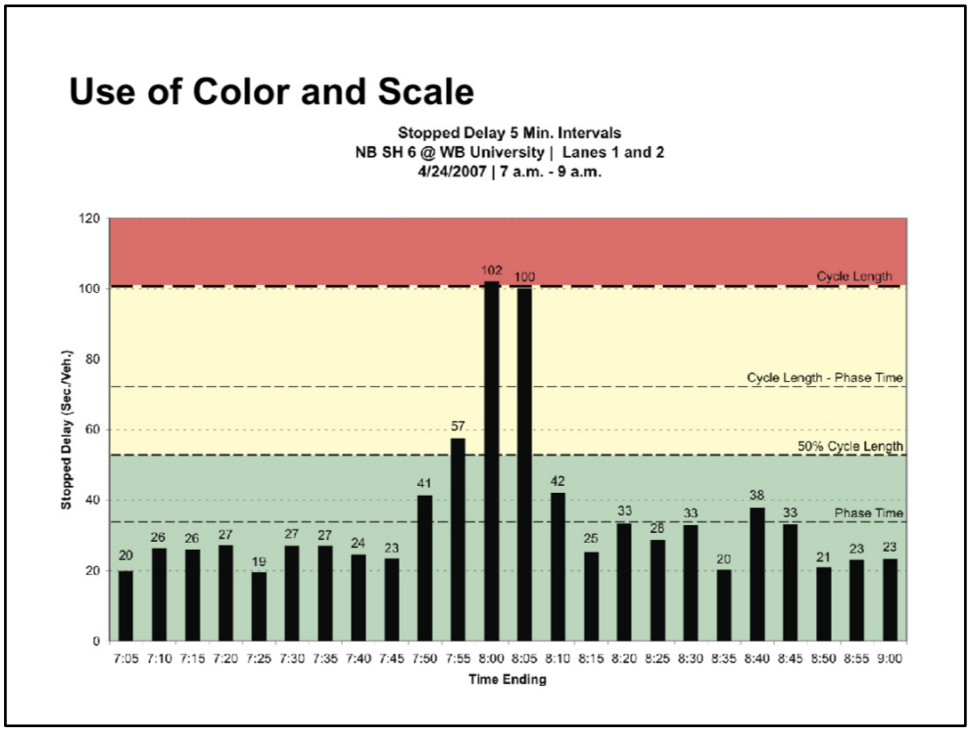


This is Figure 68 on page 28 of the *Guidebook*.

The traveling public easily relates to how long it takes for them to travel between two points. They use these times to base their decisions of when to travel for a reliable arrival time. Where travel times are not reliable, travelers add extra time, or buffer time, to their trips so that they will arrive at their destination on time.

While the last density plot related congestion intensity through color changes, a scale plot of this same route relates to the viewer the actual distance traveled on the route over a fixed increment of time, or time interval. In this graphic, the time interval is two minutes. The alternating color bands (white and blue) for each “Time Run Began” relate where on the route the driver was located in every 2-minute interval.

The figure shows that travelers in the 5 PM rush hour have difficulties progressing through the Terry St East and Winter Loop link taking about 2 minutes to traverse this distance. Outside of the highest peak demand, travelers at Terry St East can typically cover grater distance to reach either W Frontage Road or East Frontage Road in the same 2 minutes.

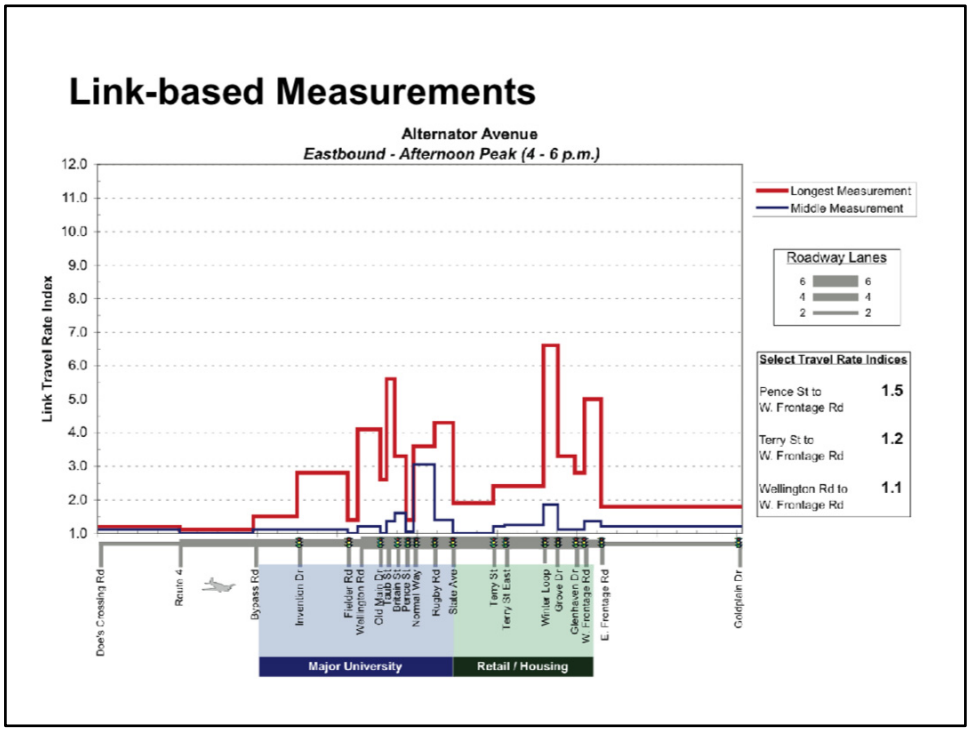


This is Figure 29 on page 69 of the *Guidebook*.

Use of color in your graphics makes them more visually appealing to readers. You likely were trained to develop your graphics for black-and-white reproduction. This is important when you know your results will be shown in a grayscale format. However, many applications you will create these graphics for—workshops, presentations, brochures—are likely to use color.

Carefully select your scale. Time-based scales can either highlight acute, short-duration events or can dampen them so that they appear less severe. Distance-based scales should be used to relate spatial concepts.

This graphic uses color to relate delay intensity and contrast time scales for stopped delay at an intersection. Use of color here relates the measured delay to the signal cycle length, which is a tangible quantity for the reader or driver. The green section of the graph indicates acceptable operation. The yellow area begins at the first target value, defined here as half of the cycle length. Finally, the critical area shown in red indicates when the average stopped delay exceeds the cycle length. This means that a vehicle must wait to be processed through the intersection on the second cycle after its arrival in the queue.



This is Figure 30 on page 71 of the *Guidebook*.

This graphic is an example of a link-based travel rate index for a roadway that provides several packets of information.

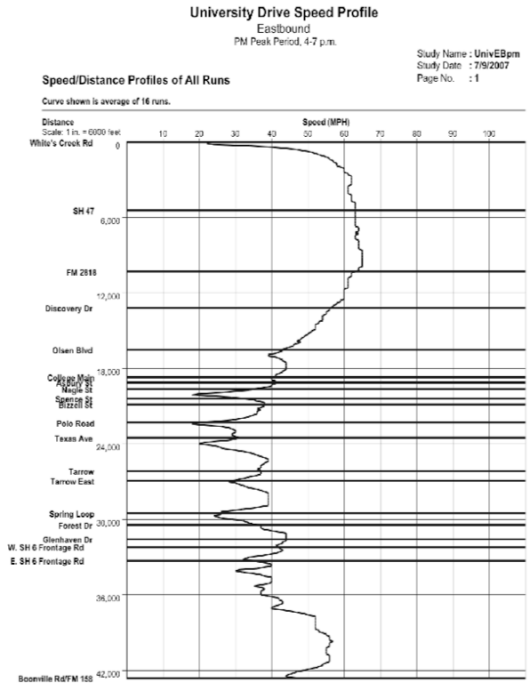
First, along the bottom or x-axis, the reader understands the physical aspects for the roadway—its width, distance between cross streets, traffic signal density, and land uses that may impact travel along the roadway.

The blue and red lines relate the travel rates. The thick red line conveys the worst mobility conditions measured. The thinner blue line indicates the median observation, where half of the data experienced higher or lower travel rates.

Finally, the summary box on the right side provides the reader with travel rate index values for a few long segments along the roadway.

The y-axis scale is relatively larger than the data within the chart. The scale was lengthened to provide a level comparison for data in other timer periods that approached an index level of 12.0.

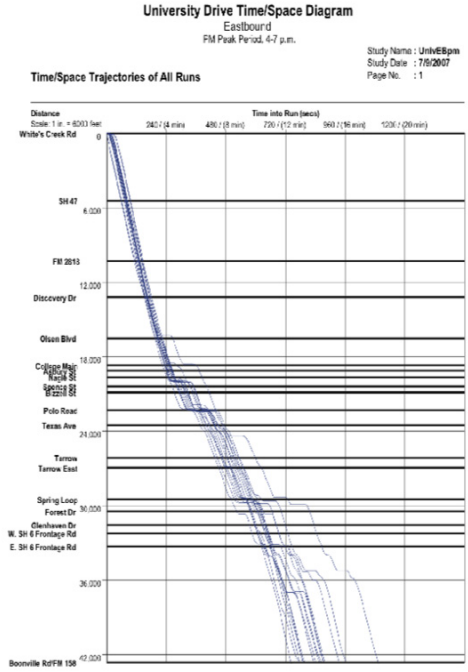
PC-Travel Output: Speed Profile



This is Figure 31 on page 72 of the *Guidebook*.

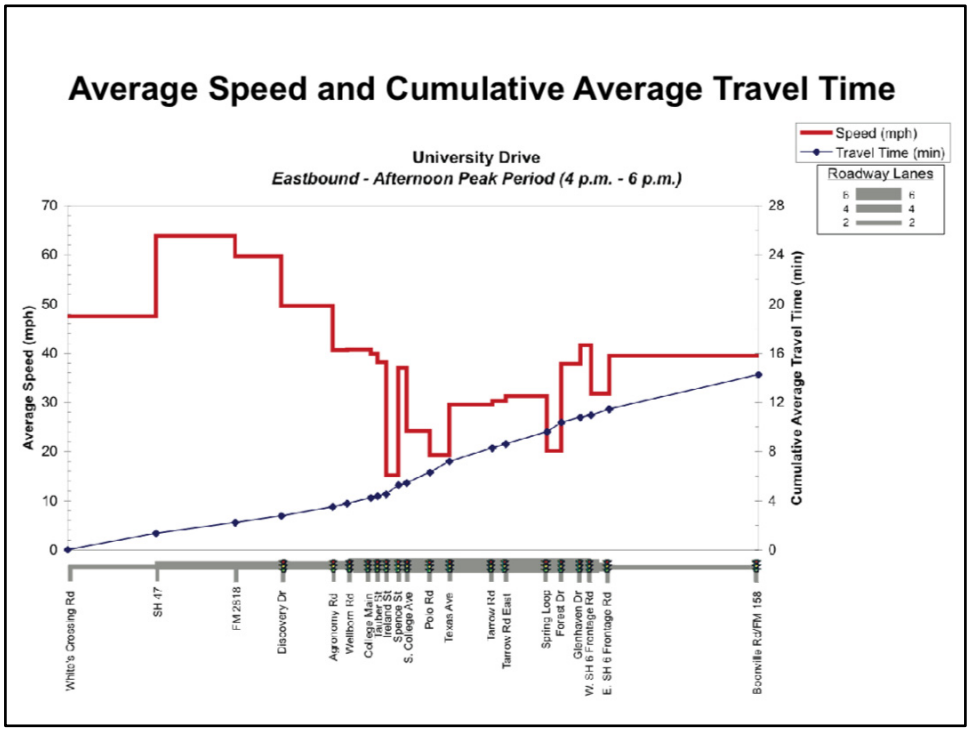
Some specialty, commercially available software is able to translate data, like that collected form travel time runs, into several pre-formatted chart types. The next two slides display chart output generated from PC-Travel. This speed profile is the average speed of several runs during the peak period identified. The chart is able to relate accelerations and decelerations along the roadway.

PC-Travel Output: Time-Space Diagram



This is Figure 31 on page 73 of the *Guidebook*.

This time-space diagram also is an example from PC-Travel. The time-space diagram is able to display the trajectory for each individual travel time run. Grouping of trajectories indicates very consistent operations. The reader is able to understand the variability in the data following trajectories down the page to the endpoint of the roadway.



This is Figure 32 on page 74 of the *Guidebook*.

This graphic shows another common method for presenting average link speed and travel time data along the same x-axis for a roadway. The thick red line presents average speed between links. The thin blue line with symbols indicates the average cumulative travel time along the roadway. Similar to link-based measurement graphic, the x-axis presents the number of lanes, cross streets, and signal locations.