Truck Freight Bottleneck Reporting Guidebook

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- Atlanta Regional Council
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- Florida Department of Transportation
- Iowa Department of Transportation
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- Maryland Department of Transportation
- Minnesota Department of Transportation
- Oregon Department of Transportation
- Washington State Department of Transportation
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Acronyms

AADT	annual average daily traffic
AADTT	annual average daily truck traffic
FAST Act	Fixing America's Surface Transportation Act
FHWA	Federal Highway Administration
HPMS	Highway Performance Monitoring System
HERS-ST	Highway Economic Requirements System-State Version
MAP-21	Moving Ahead for Progress in the 21st Century Act
MPO	metropolitan planning organization
NHFN	National Highway Freight Network
NHS	National Highway System
NPMRDS	National Performance Management Research Data Set
PHFS	primary highway freight system
STIP	Statewide Transportation Improvement Program
TIP	Transportation Improvement Program
TPM	transportation performance management
TTTR	truck travel time reliability
USDOT	United States Department of Transportation

Executive Summary

Introduction

Freight traffic is increasing on many highways across the United States, bringing with it challenges for efficient goods movement and wider concerns about safety, infrastructure condition, and reliability of travel. Performance management requirements passed by Congress into law and reflected in Title 23 of United States Code (23 U.S.C. 150) focus attention on these issues by creating national goals and by requiring FHWA to establish performance measures for which States and metropolitan planning organizations (MPOs) must set targets (23 CFR 490.105(a)). Federal performance management regulations (23 CFR part 490) have been adopted by the Federal Highway Administration (FHWA) to meet the performance-related requirements for highways, and are being implemented under the Transportation Performance Management (TPM) program.

Under 23 U.S.C. 150, and specified in 23 CFR 490.107, Congress requires performance reports by States. As part of this reporting, 23 U.S.C. 150(e)(4) requires State DOTs to identify and describe the ways in which they are addressing congestion at freight bottlenecks. The performance management regulations define a *truck freight bottleneck* as "a segment of roadway identified by the State DOT as having constraints that cause a significant impact on freight mobility and reliability" (23 CFR 490.101).

The purpose of this guidebook is to support compliance by States with the truck freight bottleneck reporting required by 23 U.S.C. 150(e)(4). The guidebook reviews the truck freight bottleneck reporting requirements and offers guidance based on best practices from around the country on freight bottleneck analysis as part of broader freight planning efforts.

Although States have flexibility to select the methods to comply with the truck freight bottleneck reporting requirements, the guidebook's framework encourages States and their partners to build a foundation for truck freight bottleneck reporting that combines data analysis, qualitative information, professional expertise and stakeholder engagement. Experience from around the United States suggests that States adopting such approaches can advance their ability to make progress on achieving critical freight transportation operational and infrastructure goals. The framework is designed to integrate with similar bottleneck analysis requirements performed as part of state freight plan preparation under 49 U.S.C. 70202.

Getting Started

☑ What is transportation performance management (TPM)?

The FHWA defines TPM as a strategic approach that uses system information to make investment and policy decisions to achieve national performance goals. TPM requirements are described at 23 U.S.C. 150 and implementing regulations at 23 CFR part 490.

☑ What is a truck freight bottleneck?

Any highway segment identified by a State DOT to have constraints that significantly affect freight mobility and reliability.

Regulatory Citation: *23 CFR 490.101*

☑ What are the requirements and schedule for truck freight bottleneck reporting?

- **Every four years, identify and update a list of truck freight bottlenecks –** State DOTs must document the location of truck freight bottlenecks within the State every four years as part of their baseline performance period report. (First report due in October 2018.)

  Regulatory Citation: *23 CFR 490.107(b)(1)(ii)(E)*

- **Every two years, report on progress –** At two-year intervals within each performance period, States must describe their progress toward relief of identified bottlenecks as part of progress reporting. (First report due in October 2020.)

  Regulatory Citation: *23 CFR 490.107(b)(2)(ii)(D)*, *23 CFR 490.107(b)(3)(ii)(D)*

- **Additional reporting in case of failure to make significant progress on freight reliability** – When a State fails to make significant progress toward its freight reliability target, the following performance report requires detailed inventory information of truck freight bottlenecks.
  Regulatory Citation: *23 CFR 490.109(f)(2)*

☑ What causes truck freight bottlenecks?

- **Congestion –** Slow average truck travel speeds due to congestion, often at daily or seasonal peaks causes recurrent and non-recurrent bottlenecks:
  - Recurrent bottlenecks occur at predictable times and locations when traffic demand at peak periods exceeds a road's capacity.
  - Non-recurrent bottlenecks occur when temporary incidents like crashes, special events, bad weather, or work zones can reduce road capacity, increase travel demand or in extreme cases necessitate re-routing or a complete halt to all travel.
- **Truck restrictions –** Infrastructure restrictions that delay trucks by forcing them to take longer routes, carry smaller loads or move at different travel times.

Truck Freight Bottleneck Identification Framework

☑ **Step 1. Select roadways for bottleneck analysis**

Under 23 CFR 490.603, the performance measures to assess the national freight movement are applicable to the Interstate System. Given, however, that the truck freight bottleneck reporting process should be integrated with the State freight plan bottleneck analysis and must also include bottlenecks identified in the National Strategic Freight Plan (23 CFR 490.107(b)(1)(ii)(E), the freight bottleneck analyses may also include other roadways that the State determines to be vital to the movement of truck freight.

☑ **Step 2. Gather data for bottleneck identification and analysis**

States are strongly encouraged to use data to expedite the truck freight bottleneck identification process. Data analysis allows system elements to be scanned quickly while simultaneously providing an objective rationale for selecting bottlenecks. Key data elements will include travel time information, truck volumes, traffic management center operational data, and truck restriction information from roadway inventories and the State's oversize and overweight truck permitting office.

☑ **Step 3. Screen for truck freight bottlenecks**

A data-driven screening analysis serves as the starting point for more detailed site-specific analysis of selected bottlenecks that will help to fine-tune an eventual list of truck freight bottlenecks.

☑ **Step 4. Validate truck freight bottleneck list**

The data-driven screening process noted in step three is an efficient way to capture most true truck bottlenecks. However, data may suggest false positives—locations flagged by data as a bottleneck that stakeholders or the State DOT disagrees with—and false negatives—locations that are not captured during screening analyses that stakeholders or the State DOT would like to see designated as bottlenecks. Validating results of the screening process by using a combination of approaches, including use of comparable data, expert validation, or additional research, helps to ensure that agencies' final bottleneck lists capture the most significant highway bottlenecks for freight trucks.

☑ **Step 5. Evaluate truck freight bottleneck causes**

Understanding the causes of bottlenecks requires a combination of travel time data analysis, scrutiny of roadway characteristics, field assessment, and discussions with affected road users. This evaluation should be integrated with the State freight transportation planning process.

☑ **Step 6. Prioritize truck freight bottlenecks**

Prioritizing the list of freight truck bottlenecks helps focus freight planning efforts on the highest and best use of limited resources, and it is an important component of performance-based planning and programming. Using a prioritized list of freight bottlenecks will also help in discussing progress toward addressing them in performance reporting.

Stakeholder Engagement

Trusting data exclusively can sometimes generate misleading information that does not fully match on-the-ground conditions or stakeholders' concerns. The process practitioners use to define and identify truck freight bottlenecks should be supported through engagement with internal and external stakeholders who can help verify data analysis assumptions and results.

Completing Baseline and Progress Reports

Documenting freight bottleneck locations – As per 23 CFR 490.107(b)(1)(ii)(E), "The State DOT shall document the location of truck freight bottlenecks within the State, including those identified in the National Freight Strategic Plan." The FHWA encourages inclusion of two truck freight bottleneck documentation elements in States' baseline performance reports:

- **Freight bottleneck maps or lists** – To indicate truck freight bottleneck locations, States should prepare either a map(s) of bottlenecks or a table(s) with sufficient text to accurately identify and locate the bottleneck. If applicable, content from a State freight plan can be used to meet this reporting requirement, as long as the State freight plan was developed within two years of the baseline performance report's submittal.
- **Description of methods for identifying locations** – In addition to the map or list of truck freight bottleneck locations, FHWA encourages States to document the methods by which bottlenecks were identified and any information gathered that could aid in analysis of solutions for resolving them.

Reporting progress toward resolving freight bottlenecks – In their mid- and full-period performance progress reports, States must provide a "discussion on progress of the State DOT's efforts in addressing congestion at truck freight bottlenecks within the State, as described in 23 CFR 490.107(b)(1)(ii)(F), through comprehensive freight improvement efforts of State Freight Plan or MPO freight plans; the Statewide Transportation Improvement Program (STIP) and Transportation Improvement Program (TIP); regional or corridor level efforts; other related planning efforts; and operational and capital activities targeted to improve freight movement on the Interstate System." (23 CFR 490.107(b)(2)(ii)(D), 23 CFR 490.107(b)(3)(ii)(D))

The FHWA encourages States to discuss progress in terms of the range of efforts in a State's planning, environmental review, design, programming and construction activities that relate to any bottlenecks included on the list of bottleneck locations. In addition, the report should address operations-related strategies that support relief of bottlenecks.

Failure to make significant progress – Additional truck freight bottleneck reporting requirements for States failing to make significant progress on the freight performance measure are laid out in 23 CFR 490.109(f)(2). If a failure determination is made, a State should, within six months, amend its most recent biennial report with additional data and discussion to ensure action is being taken to achieve targets, per 23 CFR 490.109(f)(3)).

1. Introduction

Freight volumes are increasing on many segments of the transportation system across the United States. This growth brings with it challenges to goods movement and wider concerns about safety, infrastructure condition, and reliability of travel. Congress focused its attention on these issues by passing performance management requirements codified at 23 U.S.C. 150 that lay out a set of national goals for fixing key challenges common to transportation infrastructure across the United States. These goals include “to improve the national highway freight network, strengthen the ability of rural communities to access national and international trade markets, and support regional economic development.” (23 U.S.C. 150(b)(5))

To support the national transportation goals, the legislation established a set of national performance measures for which States and metropolitan planning organizations (MPOs) must set targets and States must report on regularly. In 23 U.S.C. 150(e), Congress specified that State performance reports must also describe the ways in which they are addressing congestion at freight bottlenecks.

A set of regulations (23 CFR part 490) published by the Federal Highway Administration (FHWA) in 2016 and 2017 implements this legislation. These regulations define a truck freight bottleneck as “a segment of roadway identified by the State DOT as having constraints that cause a significant impact on freight mobility and reliability. Bottlenecks may include highway sections that do not meet thresholds for freight reliability identified in 23 CFR 490.613, or other locations identified by the State DOT.” (23 CFR 490.101) The regulations in 23 CFR 490.107 require that State DOTs (i) document the location of truck freight bottlenecks and (ii) describe efforts to address these bottlenecks. (23 CFR 490.107(b)(1)(ii)(E), 23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D))

Where Can I Find the Requirements?

The requirement for addressing freight bottlenecks are at 23 U.S.C. 150(e)(4). The FHWA promulgated regulations for the Performance Management program at 23 CFR part 490.

23 CFR part 490 has many subparts that cover a variety of topics. The requirements specific to truck freight bottleneck reporting can be found in the following sections:

- Definition – 23 CFR 490.101
- Baseline Performance Period Report– 23 CFR 490.107(b)(1)(ii)(E)
- Mid Performance Period Progress Report – 23 CFR 490.107(b)(2)(ii)(D)
- Full Performance Period Progress Report – 23 CFR 490.107(b)(3)(ii)(D)
- Failure to Make Significant Progress – 23 CFR 490.109(f)(2)

What Is Transportation Performance Management (TPM)?

23 U.S.C. 150(a) establishes a national policy for performance management to transform the Federal-aid highway program and provide a means to the most efficient investment of Federal transportation funds by refocusing on national transportation goals, increasing the accountability and transparency of the Federal-aid highway program, and improving project decision making through performance-based planning and programming.

Guidebook Purpose

The purpose of this guidebook is to support compliance by States with the truck freight bottleneck reporting required by Federal law. It reviews the truck freight bottleneck reporting requirements and provides guidance based on noteworthy practices from around the country on freight bottleneck analysis as part of broader freight planning activities. The guidebook relies on a framework that combines data analysis, qualitative information, professional expertise and stakeholder engagement methods to identify truck freight bottlenecks.

Basis for Federal truck freight bottleneck reporting requirements – Truck freight bottleneck reporting requirements are specified above. 23 U.S.C. 150(e)(4) requires States to describe the ways in which the State is addressing congestion at freight bottlenecks as part of its biennial performance reports. Regulatory language for truck freight bottleneck reporting is described in more detail in Chapter 3.

Schedule for truck freight bottleneck reporting – Each State must document its truck freight bottleneck locations as part of a broader baseline performance report submitted to FHWA every four years beginning in October 2018, per 23 CFR 490.107(b)(1)(ii)(E). In addition, at two-year intervals within each performance period, States must describe their progress toward addressing relief of identified truck freight bottlenecks, per 23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D). The reporting schedule is explained in more detail in Chapter 3.

FHWA's principles for truck freight bottleneck reporting – Globalization and economic growth mean many segments of the transportation system in the United States carry growing volumes of freight. A better understanding of where and why truck freight bottlenecks occur and reporting regularly on how they are being addressed will help better accommodate freight transportation needs. The guidance in this document embodies several principles that will help States pursue an efficient, effective, and valuable truck freight bottleneck reporting process that supports wider efforts to use performance-based planning and programming approaches:

- **Truck freight bottleneck reporting should be integrated with broader freight planning activity by States and MPOs –** The truck freight bottleneck reporting requirements should be treated as an integral element within a wider universe of freight planning undertaken by States and their MPO partners. The truck freight bottleneck reporting requirements described in this guidebook draw extensively on the content that State DOTs include in their state freight plan, which is required under the Fixing America's Surface Transportation (FAST) Act (P.L. 114-94, December 4, 2015) for funding of projects under the National Highway Freight Program (23 U.S.C. 167(i)(4)). As such, this guidance may also be helpful for States preparing and updating their state freight plans.

- **Truck freight bottleneck identification is not a one-size-fits-all process –** Neither Federal law nor Federal regulations prescribe a method for identifying truck freight bottlenecks. The state-of-the-practice in truck freight bottleneck identification methods ranges considerably among States and regions, with some adopting highly quantitative and data-driven analytic approaches, some relying on the expert knowledge of professionals on the ground, and others using a combination of both approaches. Agencies should choose bottleneck identification methods that match the traffic characteristics, infrastructure constraints, and impediments to efficient freight movement in their State and that fit with their State freight plan development process.

- **Truck freight bottleneck reporting methods should support broader adoption by States and MPOs of performance-based management practices –** The FHWA believes that bottleneck reporting requirements should be conducted in a manner that drives use of performance data to support decision making and provide accountability for achieving measurable results on freight issues. This practice can help States and MPOs strengthen their capability to support critical freight transportation needs. Truck freight bottleneck reporting also supports the national freight performance goal to improve freight movement and reliability on the Interstate System.

This guidebook on truck freight bottleneck reporting is based on (i) a review of selected States' practices for identifying truck freight bottlenecks and (ii) an assessment of the literature on measurement of freight performance.

Guidebook Audience

This guidebook will be most relevant for freight planners or TPM practitioners at State DOTs who are charged with TPM implementation and particularly preparation of regular baseline and progress reports (discussed in Chapter 3). In addition, the bottleneck identification framework described in Chapter 4 may be valuable for planners preparing or updating their State freight plan, pursuant to 49 U.S.C. 70202(b)(7), which has a similar requirement to inventory facilities with freight mobility issues (such as bottlenecks) and describe the strategies to address the freight mobility issues for those facilities.

The guidebook will also be of interest to practitioners who are responsible for establishing and guiding performance-based processes for developing freight plans, long-range transportation plans, asset management plans, programs of projects, or budget documents. Although the requirements for truck freight bottleneck reporting apply only to States, MPOs will find this guidebook is a helpful resource for MPO transportation plans, regional freight plans, addressing bottlenecks as part of the congestion management process, or working to prioritize freight projects.

Guidebook Organization

Following this **introduction** in Chapter 1, Chapter 2 defines and discusses the causes of the **two major types of truck freight bottlenecks**. Chapter 3 provides direction on fulfilling the **biennial reporting requirements** on truck freight bottlenecks. Chapter 4 outlines the **six-step framework for identifying truck freight bottlenecks** and features practices and processes used by selected State DOTs and MPOs that have identified truck freight bottlenecks as part of recent freight planning efforts. Chapter 5 outlines **how to complete the required baseline and progress reports**, and Chapter 6 examines some **keys to success** for successful implementation of a bottleneck identification process. The references that accompany this guidebook suggest further reading on the topic of effective truck freight bottleneck identification.

2. Definition and Causes of Truck Freight Bottlenecks

A bottleneck for truck freight is "a segment of roadway identified by the State DOT as having constraints that cause a significant impact on freight mobility and reliability." (23 CFR 490.101)

Truck freight bottlenecks occur either when trucks are delayed by slow speeds due to general traffic congestion or where restrictions limit truck travel. Figure 1 shows a taxonomy for truck freight bottlenecks. A State's performance reporting should seek to include both types of bottlenecks to the extent possible.

Bottleneck Classification Example – Washington State DOT's Truck Bottleneck Classifications

Washington State DOT identifies five categories of truck bottlenecks:

Bottleneck Type	Implications for Freight
Slow speed	Travel time increases
Reliability	Travel times are hard to estimate, leading to poor on-time performance
Resiliency	Facility failure causes large statewide economic impacts for shippers, goods receivers and carriers
Restricted access for legal loads	Legal truck loads cannot travel on routes that may be more efficient due to weight restrictions
Clearance restriction for over-height loads	Over-height loads must take detour routes, adding too many additional miles to the trip

Source: Washington State Freight Mobility Plan (http://www.wsdot.wa.gov/NR/rdonlyres/4AB1DCDE-5C29-4F08-B5E7-697F432C34D7/0/2014WashingtonStateFreightMobilityPlan.pdf)

Congestion Bottlenecks

Bottlenecks characterized by significant reductions in average truck speeds can be either recurrent or non-recurrent. Their severity is a function of how many trucks are affected, how significantly truck speeds are reduced, how long the congestion exists, and how often it reoccurs. Advances in data collection have made easy identification of most major congestion bottlenecks within reach of most States or MPOs.

Recurrent congestion bottlenecks – According to FHWA's Localized Bottleneck Reduction Program materials at https://ops.fhwa.dot.gov/bn/lbr.htm, recurrent congestion occurs when traffic over-demand at peak periods routinely exceeds a road's capacity, defined primarily by the number of lanes and the travel speed for which they were designed. The foremost examples are the familiar peak morning and afternoon weekday commute hours, but recurrent congestion may also occur around midday, seasonally or at factory shift-change hours. In addition to lane or speed limitations, recurrent congestion bottlenecks can be caused or exacerbated by other limitations in physical roadway characteristics that particularly affect truck travel speeds, such as:

- Steep grades;
- Tight curves;
- Lane drops;
- Freeway on and off ramps;
- Weaving areas;
- Changes in highway alignment;
- Abrupt changes in lane widths;
- Poor access management;
- Traffic control devices; or
- Border crossings.

States and regions will likely identify a combination of infrastructure improvements and traffic operations strategies to address severe recurrent congestion bottlenecks. Research sponsored by FHWA suggests that recurrent congestion is responsible for approximately 40 percent of bottlenecks.[1] It is anticipated that States will most likely include major recurrent congestion–related truck freight bottlenecks in their reporting as these bottlenecks are easily identifiable using data available to all States.

Non-recurrent congestion bottlenecks – These bottlenecks occur sporadically when out-of-the-ordinary incidents impede road capacity, add travel demand or, in extreme cases, force re-routing or a complete halt to all travel, such as:

- Crashes;
- Special events;
- Work zones; or
- Severe weather.

States and regions will likely rely more on traffic operations strategies than infrastructure improvements to address severe non-recurrent congestion bottlenecks; strategies include work zone management, variable message signs, rapid response patrols, or road-weather management practices. In non-urbanized areas, serious snowstorms, wildfires, or flooding can create issues at forecastable times and locations for which a State DOT can dedicate resources to improve handling of traffic when conditions dictate. Tracking the frequency and severity of different types of non-recurrent congestion bottlenecks can help transportation agencies develop appropriate responses for managing non-recurrent bottlenecks.

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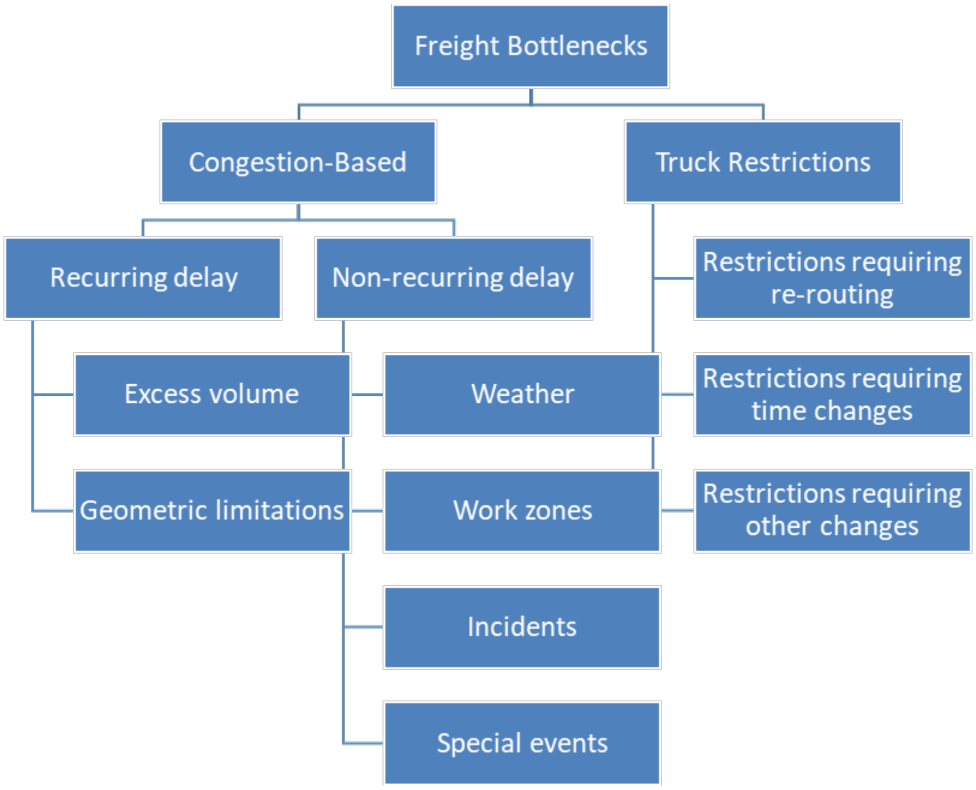
[1] https://www.fhwa.dot.gov/policy/otps/bottlenecks/execsum.cfm

Figure 1 Taxonomy of Truck Freight Bottlenecks by Type



Truck Restriction Bottlenecks

Some truck freight bottlenecks can be attributed to infrastructure restrictions that uniquely impact trucks and may require trucks to take longer routes, carry smaller loads or move at different times of day. Causes of truck restriction bottlenecks include:

- **Roadway geometrics** that slow or restrict trucks, such as tight curves, narrow lanes, or substandard vertical or horizontal bridge clearances;
- Roads or bridges that have additional **truck weight restrictions**, such as weight-posted bridges;
- Tunnels or other sections that have **hazardous materials restrictions**;
- **Steep grades** that are difficult for trucks to climb or descend;
- **Frequent adverse weather**, such as high winds that close highways to high-profile vehicles; or
- **Constraints at facilities**, such as port gates, intermodal rail yards, border crossings, and weight stations.

The severity of truck restriction bottlenecks is a function of how many trucks they affect and how greatly they disrupt trip patterns in one or more of the following ways:

- **Trip re-routing to avoid obstacles –** Restrictions such as low bridge height, hazardous materials restrictions, or truck weight limits may require trucks to deviate from an optimal route.
- **Making additional trips –** Restrictions that require trucks to carry less cargo than otherwise would be feasible may lead to additional truck trips. Examples include spring thaw weight restrictions in northern States or truck length limits that necessitate loading cargo into smaller trucks.
- **Trip time-of-day changes –** Some restrictions prohibit trucks from operating at certain times of the day, such as peak-hour urban delivery limits.
- **Constraints at destination facilities –** Inefficient truck operations arise when facilities have inadequate capacity or are managed poorly, causing trucks to wait excessively for access or parking. Facilities with these constraints can include warehouses, port gates, intermodal rail yards, border crossings, and weight stations.

Identification of restriction bottlenecks is within analytic reach for most States and MPOs, but it may be a labor-intensive process that requires scrutiny of disparate data sources and records and conversations with stakeholders.

3. Truck Freight Bottleneck Reporting and Freight Planning Processes

This chapter of the guidebook summarizes (i) key truck freight bottleneck reporting elements that are part of broader federally mandated requirements that affect all States and (ii) other Federal freight planning requirements, particularly those with elements that overlap with truck freight bottleneck reporting requirements. States are strongly encouraged to ensure their freight responsibilities and broader freight planning and TPM activities are coordinated.

Truck Freight Bottleneck Reporting Requirements

The requirement for reporting truck freight bottlenecks involves (i) regular documentation of specific truck freight bottlenecks that affect mobility and reliability, per 23 CFR 490.107(b)(1)(ii)(E), and (ii) subsequent discussion of progress to address them, per 23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D). Truck freight bottleneck reporting activities must be conducted by States as part of a series of State DOT reports that are submitted to FHWA over the course of sequential four-year performance reporting periods. These reports include:

- A baseline performance report;
- Mid and full performance period progress reports; and
- *Failure to make significant progress* amended reporting (only if needed). (23 CFR 490.109(f)(2))

Truck Freight Bottleneck Documentation – Baseline Performance Report

Beginning in October 2018 and every four years thereafter, every State must submit a baseline performance report to FHWA that includes a section identifying (and subsequently updating) truck freight bottleneck locations on any part of the State's Interstate System. (23 CFR 490.107(b)(1)(ii)(E))

In addition to bottleneck information, the baseline performance report must contain documentation of statewide baseline performance levels and targets for various national performance measures. (23 CFR 490.107(b)(1)(ii))

The basic requirement for the report is a list of each truck freight bottleneck location. This requirement includes the following stipulations:

- Highway bottlenecks identified for that State in the National Freight Strategic Plan must be included.
- If the State relies on a bottleneck list from its state freight plan, that plan must have been updated within the previous two years. If the latest state freight plan update is older, the State must update the bottleneck analysis. (23 CFR 490.107(b)(1)(ii)(E))

The regulations do not prescribe a method to be used for bottleneck identification, and they allow each State to base its approach with consideration to the traffic characteristics, infrastructure constraints, and impediments to efficient freight movement that are most relevant. The bottleneck list, however, should be closely aligned with the bottleneck analysis conducted as part of the State freight plan. Details about how to identify truck freight bottlenecks are explained in Chapter 4 of this guidebook.

> ***Baseline Performance Report* – Regulatory Language Extract –** "The State DOT shall document the location of truck freight bottlenecks within the State, including those identified in the National Freight Strategic Plan. If a State has prepared a State Freight Plan under 49 U.S.C. 70202, within the last 2 years, then the State Freight Plan may serve as the basis for identifying truck freight bottlenecks" (23 CFR 490.107(b)(1)(ii)(E)).

Discussion of Progress Toward Addressing Truck Freight Bottlenecks: Mid and Full Performance Period Progress Reports

As part of its submittal of each federally mandated mid performance period progress report and full performance period progress report (due every two years and four years, respectively, from the time of submittal of each performance period's baseline performance period report), a State DOT must include a discussion of progress in addressing the truck freight bottlenecks identified in the baseline performance report, per 23 CFR 490.107(b)(2)(ii)(B) and 23 CFR 490.107(b)(3)(ii)(B). The State DOTs are expected to report actions taken in the previous two years to improve the conditions at identified truck freight bottlenecks, which could range from policy and planning work, to traffic operations initiatives, to advancing an infrastructure improvement project at a specific bottleneck location. The kind of information appropriate for this discussion is discussed in Chapter 5 of this guidebook.

As with the requirements for listing the bottlenecks, States can rely on content from their State freight plan to satisfy the biennial report's discussion of progress. However, if the State freight plan has not been updated since the last biennial report (in the last two years), a new or updated analysis and discussion must be provided.

> ***Mid and Full Period Progress Reports* – Regulatory Language Extract –** "Discussion on progress of the State DOT's efforts in addressing congestion at truck freight bottlenecks within the State, as described in paragraph (b)(1)(ii)(E) of this section, through comprehensive freight improvement efforts of State Freight Plan or MPO freight plans; the Statewide Transportation Improvement Program and Transportation Improvement Program; regional or corridor level efforts; other related planning efforts; and operational and capital activities targeted to improve freight movement on the Interstate System. If the State Freight Plan has not been updated since the previous State Biennial Performance Report, then an updated analysis of congestion at truck freight bottlenecks must be completed" (23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D)).

Failure to Make Significant Progress Amended Reporting (If Needed)

After four years, if FHWA determines a State has failed to make significant progress toward meeting its national freight reliability performance measure target(s), additional reporting for each truck freight bottleneck is required in an amended biennial report that is due within six months of the determination. The requirements in 23 CFR 490.109(f)(2)(iii) for truck freight bottleneck reporting in the next biennial progress report become more prescriptive and include the following:

- The route and milepost location of each bottleneck;
- Applicable roadway section inventory data for bottlenecks, as reported to FHWA in the Highway Performance Monitoring System (HPMS);
- Annual average daily traffic (AADT) and annual average daily truck traffic (AADTT) at each bottleneck;
- Travel time data and a measure of delay, such as travel time reliability or average truck speeds, for the bottleneck;
- A qualitative description of any general capacity constraint or specific truck-related constraint that causes the bottleneck; and
- For all bottlenecks on State-owned or operated facilities, a description of ways in which the State DOT is improving the bottleneck, including improvement efforts planned or programmed through various plans, planning efforts, and operational activities.

In addition to these details on each truck freight bottleneck, a discussion of several general freight- and bottleneck-focused planning efforts must be included in the amended biennial report, per 23 CFR 490.109(f)(2):

- Identification of significant freight system trends, needs, and issues;
- A description of freight policies and strategies that guide the State's truck freight–related transportation investments, and
- A description of ways in which the State is allocating funding to improve truck freight bottlenecks.

> ***Significant Progress* – Regulatory Language Extract –** "If FHWA determines that a State DOT has not made significant progress toward achieving the target established for the Freight Reliability measure in 23 CFR 490.607, then the State DOT shall include as part of the next performance target report under 23 U.S.C. 150(e) [the Biennial Performance Report] the following:
>
> (i) An identification of significant freight system trends, needs, and issues within the State.
>
> (ii) A description of the freight policies and strategies that will guide the freight-related transportation investments of the State.
>
> (iii) An inventory of truck freight bottlenecks within the State and a description of the

ways in which the State DOT is allocating funding under title 23 U.S.C. to improve those bottlenecks:

(A) The inventory of truck freight bottlenecks shall include the route and milepost location for each identified bottleneck, roadway section inventory data reported in HPMS, Annual Average Daily Traffic AADT, AADTT, Travel-time data and measure of delay, such as travel time reliability, or Average Truck Speeds, capacity feature causing the bottleneck or any other constraints applicable to trucks, such as geometric constrains, weight limits or steep grades.

(B) For those facilities that are State owned or operated, the description of the ways in which the State DOT is improving those bottlenecks shall include an identification of methods to address each bottleneck and improvement efforts planned or programed through the State Freight Plan or MPO freight plans; the Statewide Transportation Improvement Program and Transportation Improvement Program; regional or corridor level efforts; other related planning efforts; and operational and capital activities." (23 CFR 490.109(f))

Related Federal Freight Planning Requirements

Over the past two decades, States and MPOs have developed a growing focus on planning specifically for freight. Globalization and economic growth are generating more freight on the Nation's transportation networks, motivating States and regions to recognize freight's specialized needs. Congress has also encouraged advances in freight planning via changes in Federal law. As a result, States and their partners at the regional level now undertake a wide range of data-driven freight analysis and documentation processes. Three freight-related planning requirements stand out as most closely related with the truck freight bottleneck reporting requirements:

- **FAST Act State freight plans –** A planning process and plan document that includes designation of facilities with freight mobility issues, such as bottlenecks (49 U.S.C. 70202);
- **National Highway Freight Network –** A network that consists of the Nation's most critical highways for freight movement and any critical urban freight corridors or rural freight corridors identified by the State and its MPOs (23 U.S.C. 167(c)); and
- **National Freight Performance Measure –** A measure included in FHWA's regulations at 23 CFR part 490) that addresses truck travel time reliability on the Interstate System.

Integration of truck freight reporting requirements with these other freight planning elements will help ensure successful implementation of the truck freight bottleneck reporting requirements. The flexibility of the regulations on truck freight bottleneck reporting is designed so that the States can coordinate their various freight planning processes and products.

State Freight Plans

Under the FAST Act, States must develop a State freight plan to be eligible to obligate Federal funding under the National Highway Freight Program (23 U.S.C. 167(h)(4)). The FAST Act outlines the requirements for state freight plans, which must include the following 10-part set of elements specified in 49 U.S.C. 70202:

1. Identification of significant freight system trends, needs and issues;
2. Policies, strategies and performance measures that will guide the freight-related transportation investment decisions;
3. When applicable, a list of:
   - Multimodal critical rural freight facilities and corridors designated within the State under 49 U.S.C. 70103 and
   - Critical rural and urban freight corridors designated within the State under 23 U.S.C. 167;
4. A description of how the plan will improve the ability of the State to meet National Multimodal Freight Policy goals and National Highway Freight Program goals;
5. A description of how innovative technologies and operational strategies, including freight intelligent transportation systems, that improve the safety and efficiency of the freight movement were considered;
6. In the case of roadways on which travel by heavy vehicles is projected to substantially deteriorate the condition of the roadways, a description of improvements that may be required to reduce or impede the deterioration;
7. An inventory of facilities with freight mobility issues such as ***bottlenecks***, and for those facilities that are State owned or operated, a description of the strategies the State is employing to address those freight mobility issues;
8. Consideration of any significant congestion or delay caused by freight movements and any strategies to mitigate that congestion or delay;
9. A freight investment plan that includes a list of priority projects and describes how funds made available to carry out 23 U.S.C. 167 would be invested and matched and
10. Consultation with the State freight advisory committee, if applicable.

With respect to requirement #7 (inventory of facilities with freight mobility issues), the FAST Act does not provide specific instructions as to what qualifies as a significant mobility impediment or bottleneck. This determination is left to the State, which has flexibility to determine the facilities that are of most concern. A State freight plan may emphasize identification of freight facilities on the National Highway Freight Network (NHFN) (https://ops.fhwa.dot.gov/freight/infrastructure/nfn/index.htm) and the National Multimodal Freight Network, but the US Department of Transportation (USDOT) encourages States also to identify any significant intermodal connector and first- and last-mile or other mobility problems, even if such routes are not on these networks.

Because a bottleneck inventory is a required element of State freight plans, the required inventory and analyses in biennial performance reports can pull directly from the State's most recent freight plan, as long as the freight plan has been updated within the last two years, per 23 CFR 490.107(b)(1)(ii)(E). If the State freight plan is older, bottleneck or progress analyses must be updated. The USDOT has issued Guidance on State Freight Plans and State Freight Advisory Committees in the *Federal Register* (81 FR 71185, published 10/14/2016).

National Highway Freight Network

The FAST Act Section 1116 amended 23 U.S.C. 167, requiring FHWA to establish an NHFN and to strategically direct Federal resources and policies toward improved performance of the network. The NHFN replaces both the Primary Freight Network and National Freight Network established under MAP-21. The NHFN, as required by 23 U.S.C. 167(c), includes the following subsystems of roadways:

- **Primary highway freight system (PHFS) –** This is a network of highways identified as the most critical highway portions of the United States freight transportation system as determined from measurable and objective national data. The network consists of 41,518 centerline miles, including 37,436 centerline miles of Interstate and 4,082 centerline miles of non-Interstate roads.
- **Other Interstate portions not on the PHFS –** These highways consist of the remaining portion of Interstate roads not included in the PHFS. These routes provide important continuity and access to freight transportation facilities. These portions amount to an estimated 9,511 centerline miles of Interstate, nationwide, and will fluctuate with additions and deletions to the Interstate Highway System.
- **Critical rural freight corridors –** These are public roads identified by the State outside of urbanized areas that provide access and connections between the PHFS, or the Interstate System and important ports, public transportation facilities, or other intermodal freight facilities.
- **Critical urban freight corridors –** These are public roads identified by the State in coordination with MPOs in urbanized areas that provide access and connections between the PHFS, or the Interstate System and important ports, public transportation facilities, or other intermodal transportation facilities.

Performance Measures

One of the performance management measures required under 23 CFR 490.607 assesses the reliability of freight movement on the Interstate System. Specifically, the measure uses a Truck Travel Time Reliability (TTTR) Index, calculated per 23 CFR 490.611 and 490.613 as follows:

- Reporting is divided into five periods: morning (6–10 a.m.), midday (10 a.m.–4 p.m.) and afternoon (4–8 p.m.), Monday through Friday; weekends (6 a.m.–8 p.m.); and overnight for all days (8 p.m.–6 a.m.).
- The TTTR ratio is generated by dividing the 95th percentile time by the normal time (considered to be the 50th percentile) for each roadway segment during each time period.
- The TTTR Index is generated by multiplying each segment's largest ratio by its length, then dividing the sum of all length-weighted segments by the total Interstate length.

For all applicable measures, including the freight measure, State DOTs establish two- and four-year targets as provided in 23 CFR 490.105. States DOTs must report their targets in a State's baseline performance report to FHWA per 23 CFR 490.107(b)(1)(ii)(E). A State has the option to adjust its four-year targets in the mid performance period progress report per 23 CFR 490.105(e)(6). The MPOs are required to establish a four-year target for the freight measure per 23 CFR 490.105(f)(1). To establish their freight target, MPOs must either support their State's target or establish their own targets pursuant to 23 CFR 490.105(f)(3). Regardless of which target establishment option the MPO selects, the target must be established within 180 days of the State's target per 23 CFR 490.105(f)(1).

4. Truck Freight Bottleneck Identification Framework

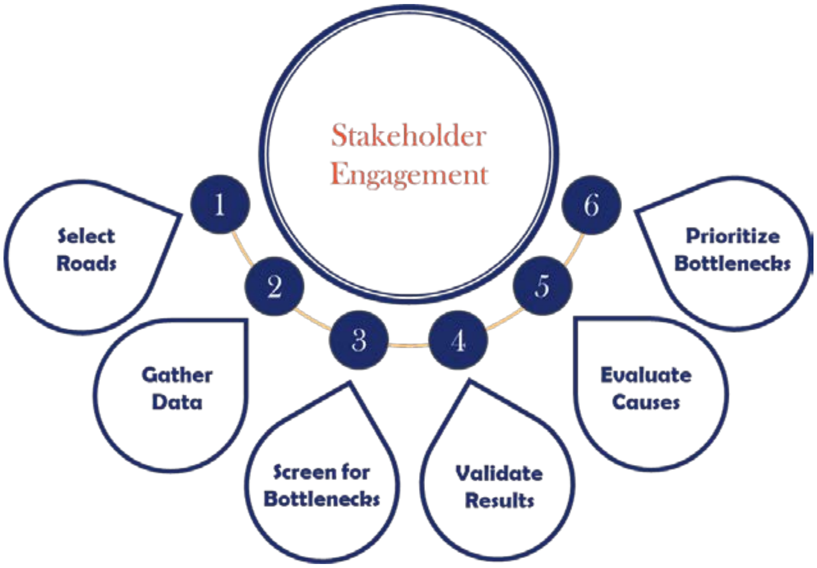
States have flexibility to use methods of their own choice to comply with the truck freight bottleneck reporting requirements. The FHWA encourages States and their partners, however, to use a framework for truck freight bottleneck reporting that features a combination of data analysis, qualitative information, professional expertise, and stakeholder engagement. Evidence from around the United States suggests that States adopting such approaches can improve their ability to make progress on achieving critical freight transportation operational and infrastructure needs.

This chapter offers guidance for States and MPOs that is based on best practices and established methods for the data analysis, qualitative information, professional expertise, and stakeholder engagement elements that comprise a robust approach to truck freight bottleneck identification on a statewide or regional scale. The conceptual framework presented here is organized around six suggested steps that are intended to allow any State or region to adapt its bottleneck analysis activities to the traffic characteristics, infrastructure constraints, and impediments to efficient freight movement that are most significant in its jurisdiction:

- Step one – Selection of roads for analysis
- Step two – Gathering data for analysis
- Step three – Screening for truck freight bottlenecks
- Step four – Validating bottlenecks identified by data
- Step five – Evaluating bottleneck causes
- Step six – Prioritizing bottlenecks

Throughout a State DOT's process for identifying truck freight bottlenecks, regular internal and external stakeholder engagement is vital for ensuring that data-driven bottleneck identification is substantiated by real-world circumstances and reflective of local conditions. A summary of these suggested steps is visualized in Figure 2 below.

Figure 2 Truck Freight Bottleneck Identification Process



Internal and External Stakeholder Engagement

Data analysis serves as a core component of the bottleneck identification framework presented in this guidebook because it offers an efficient, objective, and accurate mechanism for analyzing truck freight bottlenecks. Using data exclusively, however, can sometimes generate misleading information that does not match on-the-ground conditions or stakeholder concerns. The process practitioners use to define and identify truck freight bottlenecks should ideally be supported at each step by engagement with internal and external stakeholders who can confirm assumptions and verify results so that the most accurate list of bottlenecks is generated.

Internal engagement – Although a State DOT's truck freight bottleneck identification process will likely be led by staff located at headquarters, the staff in individual DOT districts around the State should also be engaged as they can play an important supporting role by providing fine-grain local knowledge, as well as connections to important freight stakeholders. Their engagement will likely be a vital complement to the information generated by statewide data analysis, or even the input provided by a statewide freight advisory council. The Minnesota DOT (MnDOT) Freight Office, for example, reaches out to MnDOT district staff already engaged in on-the-ground freight projects and coordinating with local economic development groups. The MnDOT has found this practice has led to a better understanding of the needs and challenges faced by smaller freight users.

After conducting a quantitative statewide analysis, Florida DOT shares the resulting list of bottlenecks with district offices for review and comment. In 2014, Florida DOT established formal district freight coordinators to ensure better integration of local input on freight issues. The district coordinators seek input from a wide spectrum of the industries in their districts in a very decentralized process. The goal is to tap a more diverse set of freight stakeholders in each region than would be reached through central office outreach alone.

External engagement – The knowledge and opinions of external freight stakeholders are also important elements of a robust truck freight bottleneck identification process. By understanding external stakeholders' opinions and learning from their knowledge, a State DOT can fine-tune its analysis approach to reflect local conditions. External stakeholders also serve as an important way to validate data-driven identification of bottlenecks, which usually requires fine-tuning to match with stakeholder perceptions.

Step One – Select Roads for Bottleneck Analysis

The truck freight bottleneck reporting applies, at a minimum, to the Interstate System. Given, however, that the truck freight bottleneck reporting process should be integrated with the State freight plan bottleneck analysis and, per 23 CFR 490.107(b)(1)(ii)(E), must also include any highway bottlenecks identified in the National Strategic Freight Plan, the bottleneck analyses may also include other roadways that the State determines to be most vital to the movement of truck freight. Where a State chooses to look beyond the Interstate for its analysis, FHWA suggests using one or more of three methods to select additional roadways for inclusion in a bottleneck analysis:

- **Route designation –** The simplest approach for including roads in an analysis is to rely on pre-existing freight-related system classifications. The Interstate System is required to be analyzed as part of the truck freight bottleneck reporting. The State may elect to include other roads important to freight. For the bottleneck analysis in the state freight plan, the State will likely consider a wider range of roadways, including a combination of all or some of the following systems:
    - Interstate System
    - National Highway System (NHS)
    - NHS Intermodal Connectors
    - Primary Highway Freight System (PHFS)
    - Critical rural freight corridors
    - Critical urban freight corridors
    - Non-PHFS Interstates
    - National Network
    - A State-defined highway truck freight network

  Note that regardless of designation, bottlenecks identified for a State in the National Freight Strategic Plan must be included in its truck freight bottleneck reporting.

- **Truck volume thresholds –** Some agencies go beyond using designated route networks; instead, they select all roadways for bottleneck analysis that meet or exceed a truck volume threshold of their choosing. Typically, the threshold used is either the total number of trucks or the percentage of truck traffic, or both. Using a total number of trucks threshold will tend to favor high-volume urban locations, and using a percentage of truck traffic threshold will help to identify non-urbanized areas that are disproportionately important to truck freight. If relying on a percentage of trucks threshold, total traffic volumes should also be scrutinized to provide context for a location's overall importance—a facility with no cars and just a few trucks may not warrant inclusion on a final bottleneck list, for example, and travel data for low-volume roads are often unreliable because of low sampling rates.

- **Proximity to important freight facilities –** Some agencies may also select roadways for bottleneck analysis by including roads that connect to important freight origin or destination facilities, as identified by private-sector freight experts and stakeholders. These facilities commonly include:
  - Intermodal facilities
  - Major freight generators
  - Border crossings and ports of entry
  - Energy-sector corridors

  Data on freight facility proximity are not always available or easily integrated with existing data sets. This option should be used by agencies that already have these data established.

Table 1 shows how selected States that were interviewed for this report delineate their road network for freight analysis using these approaches.

Table 1 Roadways Included in Bottleneck Analysis for Selected States and MPOs

State	**Roadways Included in Bottleneck Analysis**
Texas	• Interstates • NHS • Texas Trunk System
Iowa	• Roads with 5,000+ trucks/day, or 30% truck traffic
New York	• Interstates • NHS routes providing a land-based Port of Entry connection with Canada • Any roadway with a continuous segment (>15 miles) of 1,000+ trucks/day • Any roadway segment required to provide connectivity along a corridor • Other roads incorporated based on feedback from NYSDOT regions and MPOs

Interviews of States as part of this report, 2017.

Step Two – Gather Data for Bottleneck Identification and Analysis

The FHWA encourages States to use truck travel time data as a core element for bottleneck identification; a data-driven approach helps expedite bottleneck identification by automating scanning of roadway system segments while also providing an objective basis for selecting bottlenecks. As noted in other sections of this chapter, however, data should always be supplemented by qualitative scrutiny of results and engagement with stakeholders.

Data for Identifying Recurrent Congestion Bottlenecks

Historically, the only data-driven approach for identifying recurrent congestion-related truck freight bottlenecks was to use modeled estimates of daily vehicle and truck traffic that were compared to roadway capacity information. Over the last decade, however, advances in travel-speed data collection technologies that use global positioning systems (GPS), connected vehicles, and mobile devices to anonymously supply location and movement data have made accurate travel speed data for roads available to transportation agencies. Improved data allow for more accurate and thorough analysis techniques. Data needed for such an analysis include:

- **Vehicle travel time data –** The FHWA sponsors production of the National Performance Management Research Data Set (NPMRDS), which contains archived speed and travel time information for all road segments on the NHS, including intermodal connectors, and additional roadways near 26 key border crossings with Canada (20 crossings) and Mexico (6 crossings).[2]

  The NPMRDS provides information about average travel times reported at five-minute increments for roadway segments and includes data broken out by passenger vehicles, freight trucks, and combined traffic. The NPMRDS road segments are based on the Traffic Message Channel (TMC) network, which is the industry standard for depicting road segments in navigation and mapping applications. The FHWA has undertaken initial conflation steps to link the NPMRDS speed data with traffic volume and roadway characteristics data in the Highway Performance Management System (HPMS). As of the publication of this guidebook, only a few of the more than 60 HPMS data items, including total vehicle volume data, have been joined. The FHWA is assessing a process to fully conflate NPMRDS and HPMS data in the future. Comparable commercial data sets also provide travel speed information based on probe data. These other data sets often include roadways beyond the NHS.

[2] More information about NPMRDS and how to access it can be found at https://ops.fhwa.dot.gov/freight/freight_analysis/perform_meas/vpds/npmrdsfaqs.htm

As a complement to NPMRDS and similar data sets, States and regions may also use specialized information sources that use technology like Bluetooth readers or toll-tag readers to obtain travel times between points. Typically, however, these sources are used to gather data on specific roadway facilities and often cannot distinguish between trucks and passenger vehicles. Detectors embedded in roadways can provide location-specific traffic speeds and also distinguish among vehicle types, but because roadway detectors provide speed only at a particular location, additional data processing is needed to estimate travel time along a roadway segment.

For more information about truck travel time data sources, readers can refer to Section 2.1 of FHWA's *Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report*.

- **Truck volume counts –** Volume data are used to determine how many trucks are affected by delay at a given location and for estimating total delay over a corridor or larger area. State DOTs collect traffic volume information by using permanent and temporary roadway detectors, video, and other methods, and traffic volume information is expressed in hourly, daily or annual terms. State traffic monitoring programs typically provide very detailed volume, classification, and weight data. All States submit annual traffic volume information to FHWA as part of the HPMS program. The HPMS contains AADT and AADTT on each NHS roadway segment.

- **Paired travel time and truck volume data –** Because the TMC roadway network segments used to report probe travel time data differ from those for the HPMS traffic volume network, the two data sets need to be joined to perform bottleneck analysis. This procedure requires use of geographic information systems (GIS) tools. NCHRP Report 854, *Guide for Identifying, Classifying, Evaluating, and Mitigating Truck Freight Bottlenecks* (2017) provides a detailed description of how to undertake this procedure. The network used for one data set is selected as the reference, and the network for the other data set is adjusted to fit the reference network. For example, NPMRDS uses the TMC network and contains travel times at five-minute intervals; linking HPMS traffic volume data to NPMRDS requires splitting segment-level HPMS traffic volumes by direction and time of day to match NPMRDS. The new NPMRDS includes AADT and AADTT conflated from HPMS.

  Many transportation agencies also have paired speed-volume observations collected by using roadway detectors at select locations. The benefit of these data is that they include both speed and volume information for the same location, with fine-grain temporal resolution. Once potential bottleneck locations have been identified using more aggregate data sets, State DOTs and MPOs can use paired speed-volume observations from roadway detectors to explore bottleneck characteristics in detail.

- **Congestion management process (CMP) –** The CMP is a systematic and regionally accepted approach for managing congestion that provides up-to-date information on transportation system performance. The CMP uses an objectives-driven, performance-based approach to planning for congestion management. Implementing a CMP involves screening strategies through objective criteria and system performance data, analysis, and evaluation. The data and outcomes of a region's CMP can provide useful inputs to the bottleneck identification process.

Data for Identifying Non-Recurrent Congestion Bottlenecks

Non-recurrent congestion bottlenecks can be identified using the same travel time and truck volume data used for recurrent congestion bottlenecks. Importantly, however, additional analytic screening processes may be needed to prevent these non-recurrent events from getting buried by high-level summaries of the data that favor recurrent events. Particularly, the results of non-recurrent analysis should be combined with data relevant to potential causes of non-recurrent bottlenecks to better understand potential solutions. Data collected by traffic management centers can be used, for example, to provide information about the timing of major vehicle crashes, work zones, special events and weather. Key types of data to review include:

- **Vehicle crashes and other incidents –** Crash location data should be available from a State DOT's safety office.
- **Construction activities –** State DOTs track and announce construction and roadway closures. Illinois DOT, for example, puts out an annual *For the Record* report with all construction activity that occurred in the State for the previous year.
- **Bad weather –** Historical weather data can be ordered from the National Oceanic and Atmospheric Administration. These data should be collected and analyzed for a city or region, as weather patterns can be very different across a State. Traffic management center data can also be used to identify periods of road closure due to weather, including closures to high-profile vehicles due to high winds.
- **Special events –** Finding information on significant special events will be more of an ad hoc process. It may be easiest to look for events in response to observed traffic slowing on particular days in the data.

Data for Identifying Truck Restriction–based Bottlenecks

Unlike congestion bottlenecks, truck restriction bottlenecks may not show up in a data analysis that relies on travel speed and truck volume information, because these bottlenecks usually redistribute some or all truck traffic to other road segments or times. Other data suitable for identifying truck restriction–related bottlenecks may be obtained from a State DOT's roadway inventory database or a truck permitting program. Roadway databases often identify restrictions such as bridges with low clearances or road segments and bridges with weight restrictions. Information may also be obtained on frequent bridge strikes by trucks. Oversize and overweight vehicle permits may have information that describes re-routing plans needed for large trucks to avoid restrictions. Roadway sections with other restrictions, such as tunnels with hazardous material restrictions can also usually be identified via these sources.

Full identification of truck restriction bottlenecks, however, will likely require engagement with stakeholders. Localized truck operating constraints, such as time-of-day restrictions or parking shortages can sometimes be obtained from local governments, but input from truck operators is likely to be the best means for confirming the location and impact of severe truck restriction–based bottlenecks. Freight advisory committees, State trucking associations, port authorities, and other industry representatives can also be good sources of information on truck restriction–based bottlenecks.

Step Three – Screen for Truck Freight Bottlenecks

Truck speed data sets like NPMRDS make data-driven approaches for identifying congestion-related truck bottlenecks an efficient and accurate solution for speedy screening on a statewide scale to identify serious bottlenecks. Screening results can serve as a starting point for both detailed site-specific analysis of selected bottlenecks and engagement with stakeholders that will help to fine-tune an eventual list of bottlenecks. Since analytic capabilities continue to evolve in this area, practitioners are cautioned that initial data-based screening results should always be scrutinized to confirm their validity.

Screening for Truck Freight Congestion Bottlenecks

Choose measures –Travel time and truck volume data can be used with a range of measures, in addition to those that are required under 23 CFR Part 490, to evaluate roadway performance in terms of travel delay or reliability. This enables easy comparison of how individual segments in a roadway network perform over time and allows for selection of a subset of bottleneck locations for further analysis. To ensure all bottlenecks are screened, measures should be calculated for each period of the day, each day of the week and over the course of a year. The NCHRP Report 854, *Guide for Identifying, Classifying, Evaluating, and Mitigating Truck Freight Bottlenecks* provides a list of potential performance measures suitable for screening truck freight bottlenecks (reproduced in Table 2).

Set measure thresholds – Regardless of which additional performance measures are chosen, analysts will need to set thresholds that signal potential bottleneck locations. Thresholds will vary both from State to State and within a State, varying between urban and non-urbanized areas and potentially between cities. If a State uses congestion or reliability performance targets, these may also work as bottleneck thresholds. When applicable, thresholds should be selected in coordination with the appropriate MPO and other stakeholders.

Calculate results – For each of the additional measures shown in Table 2, calculations require comparison of a road segment's actual truck travel time to a reference travel time that is assumed to represent desired or uncongested conditions. Options for selecting a reference travel time include:

- Travel time at free-flow (uncongested) speeds;
- Travel time based on the posted speed; or
- Travel time at a specified speed.

Each method of defining the reference travel time will produce different results. Therefore, agencies should use the same approach over time to allow for comparison from year to year. Once measure results have been calculated for every network segment, the locations with the greatest congestion delay can be identified.

Choose additional measures for screening non-recurrent congestion – Non-recurrent congestion is best identified by measures of reliability. Measures of total delay often exclude causes of non-recurring congestion, such as bad weather, because delays occur less often and the delay through an entire year may be less than most recurring bottlenecks. Using a reliability measure in conjunction with one for overall delay can help to capture severe, non-recurrent congestion points, because reliability calculations rely on the upper extent of delay occurrences.

Because operations improvements and intelligent transportation system tools are key elements of handling non-recurrent bottlenecks, talking with internal operations staff is a helpful step in both identifying locations where the operations staff is already intervening on a regular basis and for developing solutions for the bottleneck. Developing sound solutions requires understanding the causes of delay. This is important for non-recurring congestion given that the causes vary more than for most recurring problems stemming from excessive volume. Performance results can be correlated with data on potential causes of non-recurrent congestion, such as from traffic management center data, to identify whether factors such as crashes, weather or work zones at least partially cause the bottleneck.

Table 2 NCHRP Report 854 Recommended Performance Measures for Screening Bottlenecks

Measure	Description
Total delay per segment	Vehicle-hours per segment
Total delay per mile per segment	Delay per segment, normalized by segment length
Hours of delay per truck	Vehicle-hours of delay normalized by number of trucks
Frequency of congestion per segment	How often time intervals of speed data are congested
Total hours when congestion is present	Sum of time intervals meeting a congestion threshold
Travel Time Index	Ratio of the actual travel time to the uncongested travel time
Planning Time Index	The ratio of the 95th percentile travel time to the 50th percentile travel time (reliability measure) or reference travel time (Similar to the national TTTR measure)
Planning Time Index 80th	The ratio of the 80th percentile travel time to the 50th percentile travel time (reliability measure) or reference travel time
Commuter Stress Index	Same as Travel Time Index except for the peak direction rather than both directions
Value of wasted time and fuel due to congestion for each segment	Calculated as congestion delay multiplied by the value of time or by the value of excess fuel consumption

Source: NCHRP Report 854, Guide for Identifying, Classifying, Evaluating, and Mitigating Truck Freight Bottlenecks, NCHRP (2017)

Screening for Truck Restriction Bottlenecks

Identify potential restrictions – Analysts should first gather and screen data in the State's roadway inventory, information from a State's oversize/overweight permitting office or highway patrol, and any available information from municipalities to identify major potential bottlenecks. Surveys or interviews with freight stakeholders can supplement these data sources. This information will be used to generate a list of potential restriction bottlenecks for screening.

Estimate number of affected truck trips – Once potential bottleneck locations have been identified, agencies should develop an estimate of the daily, weekly, or annual number of truck trips that could be affected by each bottleneck. These could include, for example, trips from a seaport to a warehousing district or movements from an agricultural region to a food-processing center. Although not every truck trip affected by the bottleneck can be estimated, State DOTs and MPOs should be able to identify representative truck movements, focusing on those that are important for the State or regional economy.

Estimate added trip distance and frequency impacts – Various tools can be used to identify alternative route(s) that trucks might follow because of the restriction, including GIS analytical packages, a State DOT's travel demand model, and FHWA's Highway Economic Requirements System–State Version (HERS-ST). By calculating the travel distance and travel time for these routes and comparing them to those of a direct trip without restriction, analysts can estimate the increase in travel time caused by the bottleneck. If the restriction generates more truck trips (due to weight/size restrictions), rather than route diversion, the analyst should consider the payload of smaller trucks versus the assumed payload if there were no bottleneck to estimate how many trucks trips are added due to the bottleneck. Discussions with trucking companies affected by the restriction may help inform understanding of restriction impacts.

Calculate total bottleneck impact – Multiplying the number of affected truck trips by the added travel time produces an estimate of total vehicle delay associated with each bottleneck. If desired, a State DOT can take steps to quantify the cost impact of the re-routing by using a value for the average cost of trucking per mile or additional inputs from HERS-ST or another economic input-output model.

Screening Results

The list of bottleneck locations resulting from the screening techniques described here should form the basis for a wider discussion about the truck freight bottlenecks of greatest concern. Such a discussion will help agencies fine-tune results to ensure that initial identification of locations matches agency goals, desired definitions of a truck freight bottleneck and stakeholder expectations.

Bottleneck Identification at Iowa DOT

Iowa DOT (IDOT) uses a combination of probe speed data and stakeholder input to pinpoint freight bottleneck locations. Bottleneck conditions are determined by comparing the current reported speed to the reference speed for each segment of road. Reference speed values are provided for each segment and represent the 85th percentile observed speed for all time periods with a maximum value of 65 mph. If the reported speed remains below 60 percent of the reference speed for five consecutive minutes, the road segment is flagged as a bottleneck until the reported speed returns to values greater than 60 percent of its reference value for 10 consecutive minutes. All segments that are flagged at least once in every quarter over a year form the starting point for IDOT's bottleneck list.

Because Iowa's probe data are not truck-specific, staff import the data into GIS and overlay IDOT's own truck traffic data. All segments on the bottleneck list with at least 5,000 total or 30 percent* trucks per day are flagged as truck bottlenecks; these thresholds were chosen based on a literature review.

The resulting list goes out to freight stakeholders for review. Often, stakeholders add more bottleneck locations to the list. IDOT then combines the data analysis and stakeholder additions to finalize the bottleneck location list. The locations are prioritized according to three analyses:

1. **Value –** The agency analyzes each location in the statewide travel demand model, comparing truck travel times on the system with and without each location as a travel option for trucks. The list of bottlenecks is prioritized based on those with the biggest savings in truck travel time.
2. **Condition –** IDOT has developed an in-house analysis tool, called infrastructure condition evaluation, that uses seven criteria to assess condition benefits: Pavement Condition Index, International Roughness Index, structure sufficiency rating, passenger traffic, single-unit truck traffic, combination truck traffic and congestion. The list of bottlenecks is ranked according to the current overall condition of each location.
3. **Performance** – Iowa's speed data provider has an integrated tool to prioritize bottleneck locations based on the number of occurrences in a given time period.

IDOT takes the average of each location's ranking on the three prioritized lists for a final ranking. If there is a tie, the location with the higher truck volume ranks higher. Top-ranked locations become top contenders for inclusion in the freight investment plan and access to National Highway Freight Program funds.

* *Both an absolute number and a percentage are used because the number captures significant truck routes in urban areas, where percentages can be drowned out by the larger number of passenger cars, and the percentage captures high-truck-traffic routes in the non-urbanized parts of the state.*

Step Four – Validate Truck Freight Bottleneck List

The data-driven screening process outlined in step three will help States efficiently identify the majority of true truck bottlenecks. However, data may also identify some false positives—locations flagged by data as a bottleneck that stakeholders or the State DOT disagree with—and some false negatives—locations that are not captured during screening analyses, but that stakeholders or the State DOT consider should be designated as bottlenecks. Validation of screening helps to ensure that agencies' final bottleneck lists accurately reflect a region or State's most significant highway bottlenecks for freight trucks.

Compare with complementary data – States can validate results by performing the same performance metric calculations with a parallel data set comparable to the one used in the initial screening process to see if it identifies the same chokepoints. Three common sources of comparable data include third-party probe data, loop-detector data and information from corridor-specific studies.

- **Probe data –** Some agencies have contracts to access third-party probe data, which are the most comparable source of data to NPMRDS. Some of these sources can differentiate truck traffic from general traffic.
- **Loop-detector data –** Vehicle counts and traffic speed information can be obtained from loop detectors or other ITS devices. From this data, a State DOT can construct a traffic speed scan or cumulative vehicle count curve to visualize the buildup of congestion over the course of a day. Review of data for multiple days can provide a more complete picture of commonly occurring conditions.
- **Corridor studies –** State or MPO corridor studies often contain data, technical analyses, land use information, and forecasted conditions that can be useful for cross referencing screening results.

If discrepancies between results for each data set are observed, additional research may be needed using one of the techniques discussed below.

Seek expert validation of locations – Engagement with freight stakeholders and experts inside the State DOT or MPO should always be used to validate the bottlenecks flagged in a data-screening analysis against on-the-ground experience. This validation will be important for congestion-related bottlenecks and is essential for truck-restriction bottlenecks. State DOTs and MPOs often rely on input from a variety of stakeholders, including State freight advisory committees, State DOT district staff, local governments, freight-dependent companies, State trucking associations, academics, and engineers, to confirm and better understand the causes of identified bottlenecks. For example, States like Florida and Minnesota leverage their district staff to extend the reach of this kind of engagement to tap into the opinions of on-the-ground freight route users.

Stakeholders commonly identify additional locations beyond an initial data screening–based list. When the Iowa DOT, for example, sent its proposed list of 60 bottlenecks to stakeholders, the State received recommendations for 30 additional "write in" locations.

Research unanticipated bottlenecks – Agencies should be prepared to review locations that either unexpectedly appear in screening results or that are conspicuously missing. In addition, agencies should check any additional locations stakeholders have suggested. In these situations, more information should be gathered about on-the-ground truck traffic conditions. A first step could be to check web-based mapping 'street view' applications, roadway imaging video logs, or aerial photography to get a better sense of the location's surroundings; this check can identify situations in which location-referencing information used in the screening was incorrect. Alternatively, State DOT staff can visit the facility or discuss the location with staff familiar with the location.

Data for unanticipated locations should also be examined to identify any temporal or geographic trends and or data quality issues. Scrutiny of daily, weekly, monthly, or seasonal data can reveal trends missed in an annual roll-up of performance, such as seasonal weather issues, non-recurring delays or other special circumstances. Comparing adjacent road segments can help identify data anomalies and better reveal how traffic patterns lead up to bottleneck locations. Finally, analyzing data via histogram plots can help visually identify data quality issues like outliers and understand the nature of variation for a location.

Adjust screening results – Several legitimate reasons may necessitate removing a location identified through data screening or adding a location as a bottleneck despite the absence of data to support its inclusion:

- **Data quality –** Today's speed data sets provide a good general picture of traffic activity and are generally improving, but they still have data quality concerns. For example, on low-volume roads observed speeds may not be available, or a small number of vehicles may dramatically change the recorded speed for certain time periods. Evaluating results based on these anomalies is part of the validation process.
- **Competing goals –** A State DOT may not want to designate a facility as a bottleneck if it conflicts with another agency goal. Washington State, for example, has decided that weight-restricted bridges should not be counted as bottlenecks because WSDOT already has a priority goal to address functionally obsolete bridges. They do not want freight recommendations to conflict with the bridge office's recommendations, and so bridge restriction locations are assessed internally before being added to the bottleneck list.
- **Stakeholder preferences –** Stakeholders may reach a consensus that a certain location or type of slowdown is not significant enough to count as a bottleneck. For example, Oregon freight stakeholders voiced a desire to exclude truck-restricted locations as bottlenecks. In many cases, they argued, truck drivers already have established routes that reflect the current restrictions and they do not feel that the restrictions are a priority given other bottleneck concerns.
- **Lack of solutions –** Some locations may experience truck slowdowns for which there is no reasonable remedy, such as steep mountain passes or locations prone to inclement weather. If a State DOT determines no project or operational improvement

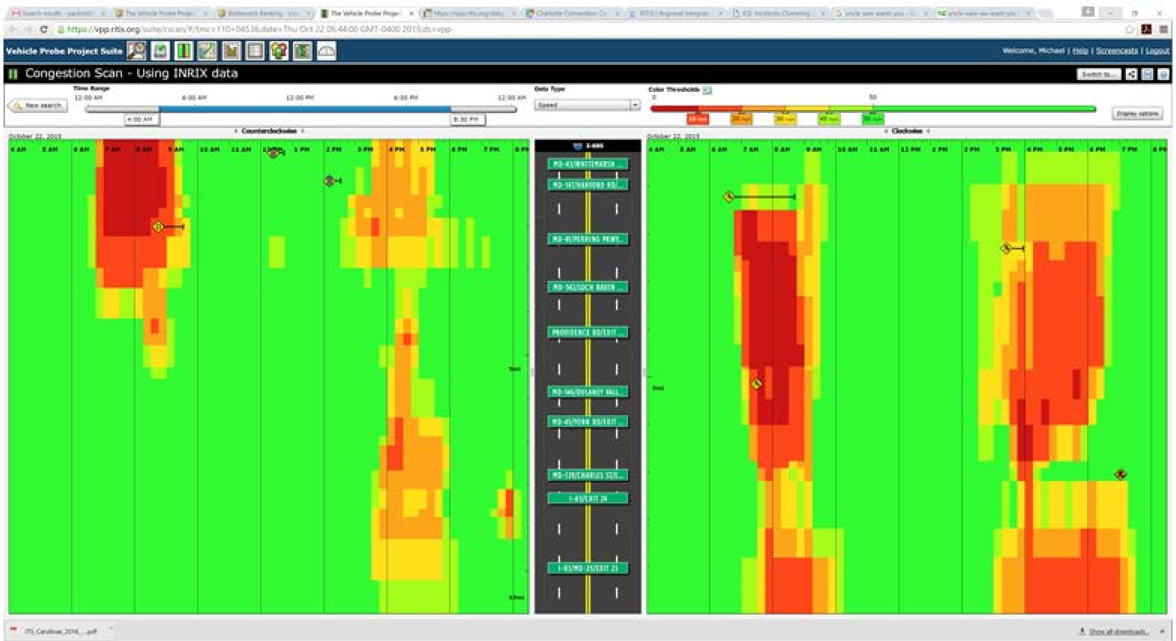
exists for a location, it may prefer not to place it on a bottleneck list, despite what travel time data reveal about performance.

Step Five – Evaluate Truck Freight Bottleneck Causes

Truck freight bottleneck identification is improving as travel time data analysis resources at the disposal of States grow more sophisticated. However, understanding bottleneck causes is still a challenging process that potentially demands a combination of travel time data analysis, scrutiny of roadway characteristics, field assessment, and discussions with affected road users. Reporting requirements call only for documentation of bottleneck locations and a description of progress toward addressing them, unless FHWA makes a finding of failure to make significant progress under 23 CFR 490.109(f)(2). But because knowledge of bottleneck causes is inherently part of the process for development of appropriate solutions, FHWA encourages all agencies to examine the underlying causes of bottlenecks as much as possible as part of their compliance activities. Key techniques for understanding bottleneck causes include data visualizations, indicator analysis and location research.

Data visualizations of bottlenecks – Analytic and visualization tools can help analysts pinpoint bottleneck causes. Visualizations of large data sets, like the example congestion scan shown in Figure 3, help depict congestion patterns along a road segment over time. In these visualizations, the repeating patterns of recurring congestion, which appear across multiple days at roughly the same time, are easily differentiated from non-recurring congestion, which shows as isolated speed reductions. Once the type of congestion is identified, analysts can undertake additional location-specific research to learn what particular roadway geometry or traffic flow elements contribute to recurring delay or what event occurred at an instance of isolated delay.

Figure 3 Traffic Scan Visualization of Bottlenecks



Source: National Performance Management Research Data Set (NPMRDS)

Indicator analysis – One of the primary methods for understanding bottleneck causes is to search for the presence of potential contributing factors in the area around a bottleneck location. This search is conducted by compiling a variety of indicators on characteristics tied to potential bottleneck causes for each facility on the final bottleneck list. Analysts can then look for which indicators seem to play a notable role at each location. Indicators of possible causes include:

- Safety – crash and incident data
- Weather – road closures, reduced capacity
- Construction – time of closures, lane restrictions
- Special events – large gatherings, scheduled road closures
- Truck restrictions – time of day, hazmat
- Infrastructure restrictions – height clearance, steep grades, horizontal curves, bridge weight limit
- Road geometry – lane drops, grades, tight curves
- Processing site locations – border crossings, port gates, enforcement sites, intermodal facilities, weigh stations, toll plazas
- Freight generator and other key facility locations – truck terminals, warehouses, manufacturing facilities
- Land use – Areas zoned for high concentration of freight activity
- Location-specific surveillance and counts – anything of note from staff observation

Oregon DOT: Data for Understanding Bottleneck Causes

After screening for freight bottlenecks based on delay and reliability measures, Oregon DOT (ODOT) uses additional information to identify causal factors. Data on the following variables are used to identify geometric and volume- and incident-related bottlenecks.

- **Geometric Bottlenecks**
    - Grade – Proportion of miles greater than 2.5% grade
    - Curvature – Proportion of miles with curvature higher than 3.5 degrees
    - Narrow Shoulders – Average width of shoulder
- **Volume Bottlenecks**
    - Grade – Proportion of miles greater than 2.5% grade
    - Narrow Shoulders – Average width of shoulder
- **Incident Bottlenecks**
    - Volume/ Capacity (VC) Ratio – Modeled V/C ratio using HERS-ST and HPMS
    - Peak congested travel – Proportion of segments with speeds lower than 10 mph (from NPMRDS)
    - Frequency of collision types – Frequency of collision by type, from ODOT incident log
    - Frequency of weather influences on crashes – Frequency of collisions influenced by weather, from ODOT incident log

Source: Oregon DOT

Location research – Additional research into a facility relies on some of the same inputs used for bottleneck validation, and the two processes can be conducted simultaneously. Aerial imagery and street view applications or roadway imaging video logs can give analysts a quick visual image of on-the-ground conditions near the facility in question (see Figure 4). For example, imagery can show commercial or industrial land use in the area, presence of trucks parked or stopped nearby, or the existence of any other facility or infrastructure of note. Staff can also visit the location to survey the surroundings, or they can reach out to groups or individuals with intimate knowledge of the facility and normal activity surrounding it.

Figure 4 Sample Aerial Photograph and Google Streetview Image Used by the Chicago Metropolitan Agency for Planning to Investigate Bottleneck Location

Source: Chicago Metropolitan Agency for Planning GIS

Chicago MPO: In-Depth Bottleneck Analysis

Chicago Metropolitan Agency for Planning (CMAP) started its bottleneck identification process by using traffic scans created from freeway loop detectors located throughout the Chicago area. The agency initially created its own scans, which it used to monitor backups throughout a given day. Now scans are available through the Center for Advanced Transportation Laboratory (CATT Lab) at the University of Maryland, and the agency has integrated NPMRDS data to its process. These new data sources allow both for a broader geography of analysis and for distinction between truck traffic and general traffic, something that was not available with loop data.

When the top 50 bottleneck locations are identified based on the performance measures for delay and reliability, CMAP staff bring in a variety of data to cross reference against to correlate the bottlenecks' likely causes. The data include:

- **Aerial photography and Streetview –** The agency has several years of aerial photography for the city, which allows analysts to zoom in on each location to see what the location looks like on a given day, whether there is a backup, the kinds of vehicles using the facility and whether there is a stoplight at or near the location. Because each photo is a single point in time during which standard backups or activity might not be happening, having multiple years helps to get an accurate picture of regular activity. Streetview provides one more data point to this visual documentation.
- **Location of intermodal facilities and key freight generators** – CMAP maintains its own GIS file of these facilities.
- **Construction zones –** The Illinois DOT's annual *For the Record* report details construction activity throughout the state.
- **Roadway characteristics –** Information such as AADT and AADTT and locations of railroad crossings and stoplights are maintained in databases or GIS files. Identification of roadway geometry that can affect speeds—such as lane drops and interchanges that cause weaving patterns— relies on agency staff's knowledge of the roadway network.
- **Safety statistics –** The Illinois DOT provides crash data.

Conflating all these data sources builds a narrative for what is occurring at the most significant bottlenecks. Each element adds more detail to the agency's understanding of the bottlenecks' underlying causes and can eventually lead to identifying effective solutions.

Step Six – Prioritize Truck Freight Bottlenecks

Not every transportation agency prioritizes its list of freight truck bottlenecks, nor is this step required explicitly by truck freight bottleneck reporting requirements. However, this step can help focus freight planning efforts on the highest and best use of limited resources and is a component of performance-based planning and programming practices that seek to prioritize funding needs across multiple competing objectives. Developing a prioritized list of freight bottlenecks can also help in measuring progress toward addressing bottlenecks in performance reporting.

Most commonly, States base their bottleneck rankings on estimates of total delay, from most to least delay. Generally, States rate bottlenecks as “high,” “medium” or “low” using this approach, which reflects the fact that these calculations are subject to a degree of imprecision, depending on accuracy of information about delays, truck volumes, and so forth.

One advanced variation on a delay-ranking approach bases rankings on the outcomes of interventions that result in delay reductions; such approaches require use of a statewide travel demand model to run “before” and “after” comparisons with and without an improvement. For example, the Iowa DOT runs its statewide model for every identified bottleneck to estimate the impact of addressing each location on freight flows.

The Highway Economic Requirements System State Version (HERS-ST) is a modeling tool supported by FHWA that may be used by States to estimate the economic impact of proposed bottleneck improvements and rank them according to anticipated economic benefits. HERS-ST is designed to evaluate the implications of alternative programs, policies, or projects on the conditions, performance, and user cost levels associated with highway systems. Since the development and release of HERS-ST, Oregon DOT has used the tool to assess the long-range system performance and benefit-cost implications of different transportation improvement options at the corridor and project levels. For example, ODOT used HERS-ST to evaluate options, including “no-build” and a bypass of US 97, to address traffic growth and congestion in the City of Bend, Oregon. The analysis forecasted anticipated performance for metrics such as average peak speed, peak delay and volume/capacity and to quantify the associated benefit of building the bypass. ODOT has used HERS-ST to conduct similar performance and benefit-cost evaluations for other projects such as bypasses and road widening. In addition, ODOT used HERS-ST to quantify the performance and impacts of 12 freight bottlenecks across the State.

5. Completing Baseline and Progress Reports

The performance management regulations administered by FHWA require States to report periodically on (i) the locations of bottlenecks that affect freight trucks and (ii) efforts to address those bottlenecks. (23 CFR 490.107(b)(1)(ii)(E), 23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D))

Over the course of each four-year performance reporting period, States must, per 23 CFR 490.107(b), include the following truck freight bottleneck reports as part of their regular performance reports to FHWA:

- Identification of bottlenecks as part of a baseline performance period report, (23 CFR 490.107(b)(1)(ii)(E))
- Mid and full performance period progress reports that discuss progress on addressing bottlenecks and (23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D))
- Supplemental reports that may be required if a State is determined to have failed to have made significant progress toward its freight performance measure target. (23 CFR 490.109(f)(2))

This chapter of the guidebook provides detailed direction on how States should prepare their various reports.

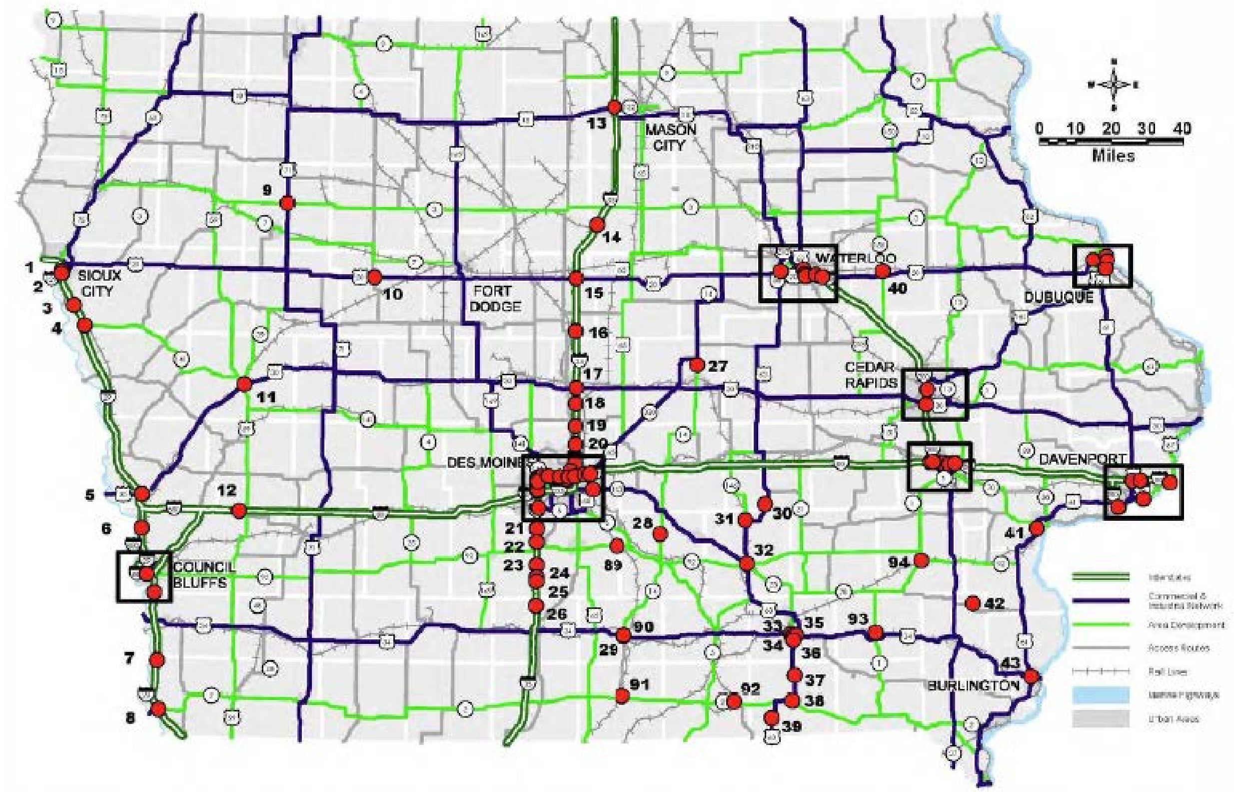
Baseline Report: Documenting Truck Freight Bottleneck Locations

Per 23 CFR 490.107(b)(1)(ii)(E), "The State DOT shall document the location of truck freight bottlenecks within the State, including those identified in the National Freight Strategic Plan." This identification should be coordinated with the bottleneck analysis required as part of the State freight plan and should be based on a process similar to that outlined in this guidebook. The FHWA encourages two documentation elements to be included in States' reports: an account of the identified truck freight bottlenecks, which is explicitly required; and an overview of the method the State used to identify truck freight bottleneck locations, which is encouraged for a fuller understanding of the State's freight context. This information will serve as the foundation for subsequent discussion of progress on addressing freight bottlenecks:

- **Bottleneck maps or lists –** To indicate truck freight bottleneck locations, States should prepare either a map(s) of bottlenecks or a table(s) with sufficient text to accurately identify and locate the bottlenecks. As examples, Iowa DOT's map of bottlenecks is presented in Figure 5, and a table from Virginia's Multimodal Freight Plan, with descriptions of bottleneck locations, is shown in Figure 6. Content from a State freight plan can be used to meet this reporting requirement as long as the State freight plan was developed within the past two years. If the State freight plan is more than two years old, the bottleneck analysis must be updated.

- **Description of methods for identifying locations –** While the State freight planning process will document much of the information on truck freight bottleneck locations, FHWA encourages States to include the method by which truck freight bottlenecks were identified and any information gathered that could aid in analysis of a solution as part of the performance reporting.

Figure 5 Map of Iowa DOT's Highway Freight Bottlenecks



Source: Iowa In Motion – State Freight Plan, 2017

Figure 6 Locations of Iowa's Truck Bottlenecks

ID	Location	Identified	Occurred
1	I-29 N/S @ I-129/U.S. 20/U.S. 75/exit 144	D	756
2	I-29 N/S @ Old Iowa 75/Industrial Rd/exit 143	D	815
3	I-29 N/S @ exit 134	S	35
4	I-29 N/S @ Iowa 141/exit 127	S	10
5	U.S. 30 E/W through Missouri Valley	S	1563
6	I-29/680 N/S @ Rosewood Rd	DS	49
7	I-29 N @ County Road L-31/exit 24	DS	14
8	Iowa 2 W @ County Road L-31/195th Ave and I-29 N/S @ Iowa 2/exit 10	D	1256
9	Iowa 3 W @ U.S. 71/130th St	DS	0
10	Iowa-4 S @ U.S. 20/270th St	DS	169
11	U.S. 30 E/W @ U.S. 59/Iowa 141	S	387
12	I-80 W @ 385th St	DS	14
13	I-35 N @ U.S. 18/exit 194	D	89
14	I-35 N @ County Road C-47/exit 159	DS	31
15	I-35 N/S @ U.S. 20/exit 142 and U.S. 20 E/W @ I-35/exit 153	D	420
16	I-35 S @ County Road D-65/exit 128	DS	17
17	I-35 N/S @ U.S. 30/exit 111 and U.S. 30 E/W @ I-35/exit 151	D	336
18	I-35 N/S from Iowa 210 to U.S. 30	S	0
19	I-35 N/S from Northeast 126th Ave to Iowa 210	S	0
20	I-35 N/S from 36th St to Northeast 126th Ave	S	0
21	I-35 N/S @ Fillmore St (MP 61.5)	S	0
22	I-35 N/S @ Hoover St (MP 58.5)	S	0
23	I-35 N/S @ G-50/exit 52	S	68
24	I-35 N @ Quaker St (MP 49.1)	S	0
25	I-35 N/S @ G-64/exit 47	S	90
26	I-35 N/S @ Robin St (MP 40.8)	S	0
27	Iowa 4 N/S from Marshalltown north city limits to Iowa 330	S	576
28	Iowa 14 N/S @ Des Moines River	S	88
29	U.S. 34 E/W @ Iowa 14	S	167
30	U.S. 63 N/S from Iowa 146 to Iowa 85	S	0
31	U.S. 63 N/S @ Iowa 146	S	0
32	U.S. 63 N/S through Oskaloosa	S	143
33	U.S. 34 E/W from Quincy Ave to roundabout	S	14
34	U.S. 34 E/W @ U.S. 63 (roundabout)	S	580
35	U.S. 34 E/W from roundabout to U.S. 34/U.S. 63	S	580
36	U.S. 63 N/S @ 0.9 miles south of U.S. 34	S	0
37	U.S. 63 N/S from Ottumwa south city limits to Iowa 2	S	103
38	U.S. 63 N/S @ Iowa 2	S	548
39	Us 63 N/S from Iowa 2 to Missouri state line	S	331
40	Iowa 150 N/S through Independence	S	0
41	U.S. 61 S @ Iowa 92/Grandview Ave	D	114

Source: Iowa In Motion – State Freight Plan, 2017

Mid and Full Period Reports: Addressing Truck Freight Bottlenecks

As per 23 CFR 490.107(b)(2)(ii)(D) and 23 CFR 490.107(b)(3)(ii)(D), States must provide in their mid and full performance period progress reports, a "discussion on progress of the State DOT's efforts in addressing congestion at truck freight bottlenecks within the State, through comprehensive freight improvement efforts of State Freight Plan or MPO freight plans; the Statewide Transportation Improvement Program and Transportation Improvement Program; regional or corridor level efforts; other related planning efforts; and operational and capital activities targeted to improve freight movement on the Interstate System."

The discussion on progress is intended to capture any action that a State or region has taken to advance a solution to a bottleneck. The spirit of the requirement is to make clear that agencies are considering truck freight bottlenecks and potential solutions within their planning, programming, and operations processes. Unless a State fails to make significant progress on its freight reliability performance measure, which triggers additional reporting requirements as outlined below, this discussion of actions is sufficient to meet reporting requirements.

Elements of the progress discussion can focus on the entire range of efforts in a State's planning, environmental review, design, programming, and construction activities in the project delivery process. In addition, the report can incorporate operations-related strategies that support relief of bottlenecks. Particular questions a State DOT can answer to develop a full discussion in the progress report include:

- Have identified bottlenecks included in the baseline performance report received any kind of prioritization?
- Have appropriate projects or interventions been identified to address any bottlenecks included in the baseline performance report, particularly the highest priority bottlenecks?
- What planning or National Environmental Policy Act–related activities are underway or completed that will address bottlenecks included in the baseline performance report?
- What design activities are underway or completed that will address bottlenecks included in the baseline performance report?
- Have any projects that will address bottlenecks included in the baseline performance report been programmed in the statewide transportation improvement program (STIP) or MPO transportation improvement program (TIP)?
- Has the State initiated construction on projects that will address any bottlenecks included in the baseline performance report?
- Has the State undertaken any transportation system management and operations initiatives that will help improve reliability or reduce delays at bottlenecks included in the baseline performance report? If so, what have been their impacts in terms of performance metrics?

- Have any corridor management plans been developed or implemented?
- Has the State undertaken any initiatives to enhance mode shift through improvements to intermodal connections to rail, water or air?
- Is the State exploring the use of emerging technologies to improve the efficiency of freight movement?
- Has the State observed any improvement in bottleneck conditions?

Failure to Make Significant Progress

Additional truck freight bottleneck reporting requirements for States failing to make significant progress on the freight performance measure are outlined in 23 CFR 490.109. If a failure determination is made, pursuant to 23 CFR 490.109(f)(3), a State should, within six months of the determination, amend its most recent biennial report with additional data and discussion. An example of such discussion is shown in Table 3.

Table 3 Reporting Requirements for Failure to Make Significant Progress (23 CFR 490.109(f)(2))

Reporting requirement	**Possible sources for additional content**
Identification of significant freight system trends, needs and issues within the State	State's most recent freight plan
Description of freight policies and strategies that will guide the freight-related transportation investments in the State	State's most recent freight plan Biennial reporting investment strategy discussion Statewide long-range transportation plan Statewide transportation improvement program (STIP)
Freight-related bottleneck inventory A description of how the State DOT is allocating funding under title 23, U.S.C. to improve bottlenecks, including an identification of methods to address each bottleneck on State-owned facilities and improvement efforts planned or programmed. Additional information shall include • Route and milepost • HPMS roadway section inventory data • AADT • AADTT • Travel time data and measure of delay • Capacity feature causing the bottleneck • Geometric, weight, grade or other constraints affecting trucks	State's most recent freight plan (updated if plan is older than two years), transportation improvement program, corridor studies and plans, other planning efforts, operational and capital activities Biennial reporting investment strategy discussion Statewide long-range transportation plan Statewide transportation improvement program State DOT–owned management systems State DOT internal bottleneck inventory HPMS Other logs or databases
A description of the actions the State DOT will undertake to achieve the target established for the Freight Reliability measure in 23 CFR 490.607	Statewide long-range transportation plan STIP

6. Keys to Success

The truck freight bottleneck reporting process discussed in this guidebook is part of the overall freight planning and analysis process. Over the last two decades, many States have directed an increased focus toward planning for freight as globalization and economic growth have generated more freight on the Nation's transportation networks, motivating States and regions to recognize freight's specialized needs. Additionally, Congress is advancing freight planning via changes in Federal law, including 23 U.S.C. 150, 23 U.S.C. 167, and 49 U.S.C. 70202. The freight bottleneck reporting requirements discussed in this guidebook will help support States' and regions' wider efforts to address the Nation's freight transportation infrastructure needs. Keys to successful implementation include:

- **Rely on both quantitative and qualitative information –** The FHWA encourages bottleneck identification practices that draw on a combination of data analytics and qualitative information sources. Data analytics can expedite bottleneck identification by scanning system elements quickly while providing an objective rationale for selecting bottlenecks. Agencies are cautioned, however, that a "data only" approach risks missing certain types of bottlenecks because useful "on-the-ground" information can be obscured in the data. Consequently, consideration of qualitative information and validation with stakeholders are critical steps in bottleneck identification.

- **Integrate bottleneck lists with broader freight planning activity by States and MPOs –** The bottleneck reporting requirement should be treated as an integral part of overall freight planning and analysis activities undertaken by States and their MPO partners. As such, the truck freight bottleneck reporting requirements described in this guidebook draw extensively on the content that State DOTs include in their state freight plans under 49 U.S.C. 70202, which are required under the FAST Act for States' projects to be eligible for funding under the National Freight Performance Program by 23 U.S.C. 167.

- **Recognize that bottleneck identification is not a one-size-fits-all process –** The Federal regulations do not prescribe a particular method for identifying truck freight bottlenecks, which freight planners interviewed during preparation of this guidance often characterize as an emerging field. Agencies should choose bottleneck identification methods for reporting that match the traffic characteristics, infrastructure constraints, and impediments to efficient freight movement in their State.

- **Engage district staff –** Although a State DOT's truck freight bottleneck identification process will likely be led by staff located at headquarters, DOT districts around the State can play an important supporting role. Staff in individual DOT districts provide fine-grain local knowledge and connections to important freight stakeholders that are a vital complement to the information generated by statewide data analysis.

- Keep external freight stakeholders involved in the analysis process – Data analysis is a core component of the bottleneck identification framework presented in this guidebook because it offers an efficient, objective, and accurate mechanism for analyzing truck freight bottlenecks. Relying on data exclusively, however, can sometimes generate misleading information that does not match on-the-ground conditions or stakeholder concerns. The process practitioners use to define and identify truck freight bottlenecks must be supported at each step by engagement with external stakeholders who can confirm assumptions and verify results so that the most accurate list of bottlenecks is generated.

- **Bottleneck reporting methods should support broader adoption by States and MPOs of performance-based management practices –**States' compliance with Federal bottleneck reporting requirements should include the use of performance data to support decision making and provide accountability for achieving measurable results on freight issues. These methods can help States and regions strengthen their capability to support critical freight transportation needs.

Additional Resources

An Initial Assessment of Freight Bottlenecks on Highways, FHWA (2005)

Assessment of Multimodal Freight Bottlenecks and Alleviation Strategies for the Upper Midwest Region, Mississippi Valley Freight Coalition, National Center for Freight and Infrastructure Research and Education (CFIRE) (2010)

Recurring Traffic Bottlenecks: A Primer Focus on Low-Cost Operational Improvement, FHWA (2012)

Freight Performance Measure Approaches for Bottlenecks, Arterials, and Linking Volumes to Congestion Report, FHWA (2015)

R*eview and Analysis of State Freight Plans: National Freight Strategic Plan Elements and Freight Goals*, FHWA (2015)

National Highway Freight Program (NHFP), FAST Act Section 1116 Implementation Guidance, FHWA (2016)

Guidance on State Freight Plans and State Freight Advisory Committees, Federal Register, October 14, 2016

Hershkowitz, Paul, "Navigating Freight Data in the FAST ACT Era," AMPO Conference, October 26, 2016, Fort Worth, TX

Oregon Freight Highway Bottleneck Project Final Report, Prepared for Oregon Department of Transportation, WSP Parsons Brinckerhoff (2017)

NCHRP Report 854, *Guide for Identifying, Classifying, Evaluating, and Mitigating Truck Freight Bottlenecks*, NCHRP (2017)