6– Chapter 6: Transportation System Condition and Performance

Management of the transportation system requires comprehensive data, appropriate measures, and a consistent method for assessment. The following discussion assesses the safety, condition, and performance of the state's transportation system in achieving the goals of this freight plan:

- Enhance Safety, Security, and Resiliency
- Ensure System Preservation and Enhancement
- Enhance System Operations, Reliability, Efficiency, and Connectivity

A key component of this assessment is the development and application of performance measures. WisDOT has several measures that facilitate this analysis. The state's transportation measures impacting freight are focused, measurable, and drive performance improvement. This chapter inventories the relevant performance measures already used by WisDOT and compares them with the federal requirements. The gaps in the department's existing measures and requirements are considered, and additional measures are proposed. The freight plan then uses existing measures to assess the condition and performance of Wisconsin's multimodal transportation system.

Overview of Chapter 6
Chapter 6 includes the following topics: • **Performance** - This chapter considers significant congestion or delay caused by freight movements • **Safety** - This chapter presents information and analysis of safety and security challenges in moving freight by highway, rail, port, air, and pipeline in Wisconsin • **Condition** - This chapter describes possible improvements to reduce or impede the substantial deterioration of roadways caused by heavy vehicles • **Bottlenecks** - This chapter presents an inventory of freight bottlenecks and a description of strategies to mitigate them on the state-owned and operated transportation system

6.1 About Performance Measures

The department has a long history of using data to monitor and analyze system performance to ensure timely and appropriate investments. Several of WisDOT's existing measures support analysis of freight-specific mobility needs by providing a comprehensive, objective, and consistent set of metrics to assess system condition, identify issues, prioritize investments, and measure the effectiveness of actions.

Recognizing that performance measures are both key to identifying projects and are required by federal legislation, the remainder of this section identifies freight performance measures required by the United States Department of Transportation (U.S. DOT) and describes WisDOT's performance improvement program to set the stage for an in-depth discussion of the performance of Wisconsin's multimodal transportation system.

Federal Performance Measures

The Moving Ahead for Progress in the 21st Century Act (MAP-21) requires states to establish performance measures that assess the condition and performance of the transportation system. MAP-21 requires performance measures focused in the following 12 areas:[1]

- Serious injuries per vehicle miles traveled (VMT)
- Fatalities per VMT
- Number of serious injuries
- Number of fatalities
- Pavement condition on the Interstate System
- Pavement condition on the non-Interstate National Highway System (NHS)
- Bridge condition on the NHS
- Traffic congestion
- On-road mobile source emissions (i.e. pollution caused by vehicles)
- Freight movement on the Interstate System
- Performance of the Interstate System
- Performance of the non-Interstate NHS

Federal Transportation Legislation
MAP-21 • MAP-21 is a funding and authorization bill to govern federal spending on transportation. The bill was signed into law by President Barack Obama on July 6, 2012. The bill provided $105 billion for federal fiscal years 2013 and 2014. **Fixing America's Surface Transportation (FAST) Act** • The FAST Act is a funding and authorization bill to govern federal spending on transportation. The bill was signed by President Barack Obama on December 4, 2015. The bill provided $305 billion for federal fiscal years 2015 to 2020.

Federal Freight Performance Measure
On January 18, 2017, FHWA published the final rule for implementing the national performance management measure regulations to assess Freight Movement on the Interstate Systems that states must address: Percent of the Interstate System Mileage providing for Reliable Truck Travel Time

In accordance with MAP-21, FHWA will determine a state's progress toward meeting the performance targets related to freight movement. If progress is not made, FHWA will provide a written description of the actions the state will take to achieve the targets.

WisDOT's Mobility, Accountability, Preservation, Safety, and Service (MAPSS) performance improvement program includes measures that meet MAP-21 requirements.

[1] 23 USC 150(c)

WisDOT’s Performance Improvement Program

WisDOT’s MAPSS performance improvement program focuses on five core goals: Mobility, Accountability, Preservation, Safety, and Service. The performance measures associated with each core goal guide WisDOT in achieving the department’s mission *to provide leadership in the development and operation of a safe and efficient transportation system*.

The quarterly publication reports on 23 (shown in Table 6-1) separate measures that define and monitor the direction and degree with which WisDOT is meeting the goals. There are fifteen measures that, either in full or in part, reflect factors that affect freight movement (bolded).

Table 6-1: WisDOT MAPSS Performance Improvement Program Measures

Mobility	Accountability	Preservation	Safety	Service
• **Delay** • **Reliability** • Transit availability • Bicycling conditions on rural highways • **Incident response** • **Winter response**	• **TEA Grants** • Timely scheduling of contracts • **On-time performance** • On-budget performance • Surplus property management	• Program effectiveness • **State highway pavement condition (backbone and non-backbone)** • **State bridge condition** • **State-owned rail line condition** • **Airport pavement condition** • **State highway maintenance** • Material recycling	• **Fatalities** • **Injuries** • **Crashes** • **Safety belt use**	• DMV wait times • DMV electronic services • DMV driver license road test scheduling • DMV phone service

Source: Wisconsin Department of Transportation, MAPSS

The remainder of this discussion focuses on these fifteen measures (bolded measures in Table 6-1), which will be used to assess how Wisconsin’s transportation system is current performing relative to freight movement.

For the purposes of the discussion, the following sections group each of the fifteen department MAPSS performance measures into thematic areas that relate to the goals of the plan:

- Freight operations, mobility, and reliability
- Transportation accountability
- Transportation system safety
- Transportation system condition
- Transportation system performance

6.2 Freight Operations, Mobility, and Reliability

State trunk highway reliability – or predictability – is a basic user expectation and necessary for a robust economy. People who travel on Wisconsin's highways expect to reach their destinations within a reasonable and predictable period of time. Shippers and businesses require a reasonable level of system reliability to support their efforts to compete and, where possible, expand.

Highway Operations
Effective, coordinated, and economical operations are part of an efficient transportation system that helps maximize traffic flow. This can reduce travel delays for freight and people and improve safety. The primary goal is to maximize the reliability of the highway system. Highway operations activities focus on traffic flow on the roadway. WisDOT's efforts to improve daily highway operations include implementing and integrating traffic control devices and other applicable technology, as well as facilitating real-time traveler warnings and information.

A wide range of daily events or incidents can disrupt the safe and efficient flow of traffic and affect overall system operation. Vehicle crashes, work zones, natural disasters, special events, and the number and distance of access points such as cross streets or driveways can disrupt system reliability.

WisDOT developed several measures to monitor system operations and assess system operations, mobility and reliability. These include: delay, reliability, incident response, and winter response. Each measure compares recent data to the performance measure target and indicates how the department is doing relative to that goal. As each measure matures, WisDOT assesses opportunities to improve or enhance the quality of the metric and its value in enhancing system performance.

Delay (Hours of Vehicle Delay)

Measuring the amount of delay users experience on the state's highway system provides an indicator of how a highway is impacted by events such as traffic incidents, work zones, and weather. There are three parts to the delay measure:

- Delay
- Hours of vehicle delay
- User delay cost

Travel Time Delay
Highway congestion occurs when traffic demand exceeds the available capacity of the highway system. Congestion can be: • Recurring (regular peak periods) • Non-recurring (incidents and bad weather) Whatever the cause, congestion results in slower speeds, longer trip times, higher levels of harmful emissions, and increased costs for auto, bus, and freight.

Delay is defined as the extra time spent driving in congested road conditions, as compared to free-flowing travel conditions. Hours of delay is calculated by measuring the number of vehicles on a corridor, and then comparing actual travel times to the amount of time it would take to travel the same corridor at the posted speed limit.

Finally, user delay cost is split into two categories: passenger cars and freight vehicles. It is calculated by multiplying user value of time, vehicle delay, and vehicle occupancy rates. Delay is reported on the state's ten Interstate corridors and 28 highway segments.

The department's goal is to reduce vehicle delay and user delay cost. Reducing the annual total hours of vehicle delay and its resulting user delay cost on a corridor provides a positive user traveling experience, and supports regional economic productivity and development.

Vehicle delay is comprised of recurrent and non-recurrent delay. Recurrent delay is caused by normal fluctuations in traffic demand such as morning and evening commuter traffic. Non-recurrent delay differs by seasons and areas of the state. Factors include: traffic surges from weekend holidays and special events, weather-related delays and incidents, and work zone impacts such as road closures, lane restrictions, and traffic detours.

Efforts to improve overall delay have focused on deploying more advanced Intelligent Transportation System technologies, maximizing roadway space to match peak period demands, publicizing travel information through electronic message boards and the 511 Traveler Information System, deploying rapid responses to clear incidents quickly, encouraging drivers to use alternate routes, providing efficient timely winter weather management, and expanding highway capacity through highway improvement projects.

Travel Time Reliability (Planning Time Index)

Travelers expect to arrive at their destination both safely and on-time. Their confidence level and certainty of on-time arrival are intuitive measures of transportation system reliability. The Planning Time Index (PTI) expresses that same value mathematically to help travelers more precisely budget travel time (displayed on variable message signs) and helps transportation planners better measure system performance.

Travel time reliability measures the variability of congestion. A wide variation in the recorded travel time indicates low reliability and a high planning time index. Traffic incidents, weather conditions, special events, holiday travel, sporadic demands, and work zones are all dynamic components of traffic congestion that may adversely affect travel time reliability. Reducing or mitigating the impact of these factors improves travel time reliability.

Travel Time Reliability is reported on the state's ten Interstate corridors and 28 urban freeway and highway segments. The Planning Time Index is calculated from two basic measures: (1) travel time at the posted speed limits, and (2) the 95th percentile travel time, marking the most extreme travel delay in a period (the worst of 20 trips). The ratio of these two measures make up the index. This measure is represented by direction and by weekday, non-holiday peak periods. Travel time information for this measure was acquired from an FHWA-sponsored national data set.

Planning Time Index (PTI) Value

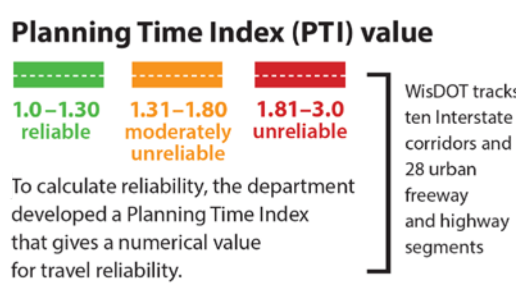
WisDOT wants travelers to arrive at their destinations both safely and on-time. Having a high level of confidence and certainty of on-time arrival are measures of the reliability of the transportation system.

The statewide travel time reliability performance measure tracks the reliability of ten Interstate corridors and 28 urban freeway and highway segments. This provides a precise way to budget travel time and measure system performance.

Sample Travel Scenario:
20 minutes x 1.5 PTI = 30 minutes

A PTI of 1.5 means travel is moderately unreliable. A traveler going for a 20 minute trip during a peak period would be assured of completing the trip in 30 minutes or less 95 percent of the time.

The statewide PTI increased slightly in the spring quarter of 2016 as compared to spring 2015. All corridors saw an increase in PTI. The 70 mph speed limit increase led to slight performance reductions; however, larger changes from the previous quarters are attributed to factors like construction and weather. Work zones that either began or ended during this period influenced the results. Peak hour urban reliability has decreased in new work zones and improved for recently completed improvement projects. Three fewer urban segments were in the reliable category than in the 2015 spring quarter. The number of unreliable segments decreased, while



the number of moderately unreliable segments increased. Drivers in the Milwaukee urban corridor continue to experience the least reliable travel times. [2]

Efforts to improve Travel Time Reliability have included the expanded messaging of 511 Wisconsin through Twitter to include photos, graphics, and videos. Followers are able to receive instant updates on excessive delays, incidents, work zones, and detour information to help alter their routes and avoid congestion. Travel times for alternate routes are displayed during incidents resulting in severe freeway delays. The Madison area work zones also have alternate route travel times displayed to provide drivers opportunities to avoid congestion during peak hours and holiday traffic surges.

Incident Response

Incidents happen on the state's highway system every day. Incidents may range from minor property damage to serious traffic crashes. WisDOT's Incident Response measure focuses on the amount of time it takes to clear intermediate and major traffic incidents on the Interstate and state highways. The department's efforts to monitor incidents on the state trunk highway network are conducted primarily through close coordination of law enforcement, first responders, other agencies, the media, and staff at WisDOT's State Traffic Operations Center (STOC).

Statewide Traffic Operations Center
The WisDOT STOC handles traffic management for Wisconsin. It is staffed 24 hours per day, seven days per week and communicates regularly with sheriffs, fire and police departments, the Wisconsin State Patrol, media outlets, and construction project managers. The actual operations center is located in southeastern Wisconsin in the City of Milwaukee. From the STOC, it is possible to use various traffic management tools such as closed circuit television units, ramp meters, variable message signs, highway advisory radio, roadway sensors, and other tools. It is designed to improve the safety and efficiency of the freeway system by reducing incidents and relieving traffic congestion.

Intermediate traffic incidents typically affect travel lanes and usually require traffic control on the scene to divert roadway users past the blockage. Major traffic incidents usually involve hazardous material (HAZMAT) spills, overturned tractor-trailers, fatalities, multiple vehicles, and/or other natural or man-made disasters. Major incidents can result in closing all or part of a roadway. Regardless of severity, restoring the roadway to full operation as quickly as possible helps reduce secondary incidents, minimize delay for people and freight, and decreases the associated economic impact of traffic delays.

The department's goal is to reduce the length of time traffic flow is disrupted by long-term incidents on the Interstate and state highway system. The goal is to clear 90 percent of all intermediate incidents in less than two hours and to clear 80 percent of all major incidents in less than four hours.[3]

The department's coordination in this area continues to improve both the intermediate and major incident clearance goals. In 2015, the department achieved the lowest incident clearance time in the last five years with an average clearance of 77 minutes. There were eight major incidents on the Interstates that involved either a HAZMAT spill, significant infrastructure damage, multiple tractor-trailer crashes, or fire, each taking over eight hours to clear.[4]

---

[2] Wisconsin Department of Transportation, MAPSS.
[3] Ibid.
[4] Ibid.

The department will continue to conduct after-action reviews on significant incidents across the state in order to help identify strengths, weaknesses, and opportunities for improvement associated with clearance activities. In 2015, 1,300 first responders took Traffic Incident Management (TIM) training on responder safety, safe and quick clearance, and improved communication—all to aid in quick restoration of traffic flow. Through a partnership with the Department of Justice, TIM training became mandatory for all new law enforcement officers in 2016. The department is also working with the state's technical colleges to incorporate formal TIM training into their fire service and tow operator programs. WisDOT will continue to host Traffic Incident Management Enhancement (TIME) meetings and promote TIM trainings across the state for responders from local law enforcement, fire departments, public works and highway departments, towing companies, and other responder disciplines. The meetings are dedicated to improving communication between responder disciplines, identifying and executing best practices at incident scenes, and improving the overall safety of an incident scene for all responders.[5]

Wisconsin TIME Program
Crashes, spilled loads, and stalled vehicles are all examples of traffic incidents. These situations and the traffic congestion caused by them account for approximately one-fourth of all delays on the highway system.[6] Traffic incidents also significantly impact the safety of both motorists and emergency responders. Traffic Incident Management (TIM), a collaborative effort of public safety and transportation agencies, consists of a planned and coordinated multi-disciplinary process to detect, respond to, and clear traffic incidents so that traffic flow may be restored as safely and quickly as possible. Effective TIM reduces the duration and impacts of traffic incidents and improves the safety of motorists, crash victims, and emergency responders. Wisconsin recognizes the importance of TIM in maintaining the operational safety and efficiency of the state's roadways. The Traffic Incident Management Enhancement (TIME) Program is a comprehensive multi-agency, multi-discipline program, led by the Wisconsin Department of Transportation (WisDOT), dedicated to: • Improving responder safety • Enhancing the safe, quick clearance of traffic incidents • Supporting prompt, reliable, interoperable communications The program, initiated in 1995, is a sustained initiative for assessing needs, developing solutions and strategies, and fostering the transportation-public safety partnerships that are essential for effective TIM.[7]

Winter Response

Returning roads to the condition they were in before a winter storm (reaching bare or wet pavement) restores the capacity of the system to move traffic safely. This allows safe travel to work, school, and other destinations. Clear roads also meet the needs for emergency travel and restore travel time reliability, which is important to the movement of freight.[8]

State roads are grouped into two categories: roads maintained 24 hours a day or 18 hours a day. Roads maintained 24 hours a day are to be cleared within four hours, and roads that are maintained 18 hours a day are to be cleared

[5] Wisconsin Department of Transportation, "Programs - Traffic Incident Management Enhancement."
[6] Wisconsin Department of Transportation, Statewide Traffic Operations Center.
[7] Wisconsin Department of Transportation, "Programs - Traffic Incident Management Enhancement."
[8] Wisconsin Department of Transportation, MAPSS.

within six hours of the end of a storm. Eighteen-hour roads have lower traffic counts, are concentrated in peak travel time periods, and are not serviced between 10 p.m. and 4 a.m. The department's goal is to achieve these targets 70 percent of the time.[9]

Each county provides weekly reports covering each storm event. They record the time at two points: (1) when each storm event ends and (2) when roads were restored to bare/wet pavement. For each storm event, the time to bare/wet pavement is calculated as the elapsed time between these two points. The performance measure is the average percent for all storm events that bare/wet pavement conditions are met for 18-hour roads (within six hours) and on 24-hour roads (within four hours). Winter severity is calculated each year based on a set of weather factors including the number of snow and freezing rain events, total duration of all storms, total snow accumulation, and number of incidents (blowing snow, drifting, ice and frost). The index is the gauge by which the department measures the impact of winter on our roads with a typical winter rating of 100.[10]

For the winter of 2015-2016, both the 24-hour and 18-hour roads measures improved over the winter of 2014-2015, with both roads exceeding the 70 percent goal. The winter of 2015-2016 was rated a little below a typical winter, or 90 on the severity scale, compared to the 2014–2015 rating of 100. Milder temperatures enabled salt to be more effective, and spring 2016 was also milder.[11]

Efforts to improve overall winter response are focused on ensuring appropriate materials and resources are available to address conditions during and after each storm event. In addition, the department has begun to implement a route optimization strategy to route trucks based on locations of shops, salt, and fuel supplies to minimize downtime for snowplow operators.[12]

6.3 Transportation Accountability

WisDOT is the steward of the transportation system and manages the state's transportation funding to deliver a safe and efficient transportation system. The continuous effort to use public dollars in the most efficient and cost-effective way requires accountability. Although accountability does not directly support freight movement, it promotes overall efficiency, which positively impacts freight. The two performance measures associated with accountability are:

- Transportation Economic Assistance (TEA) grants
- On-time performance

Transportation Economic Assistance Grants

TEA grants support the creation and retention of jobs through the award of grants for transportation projects that support business development. The TEA program provides state matching grants of up to 50 percent, or $5,000 maximum per job. The grants aid governing bodies supporting local private businesses and consortiums for road, rail, harbor, and airport projects that help attract employers to Wisconsin, or encourage business and industry to remain and expand within Wisconsin. The program strives to increase the number of jobs statewide by responding to the transportation needs of an economic development project contingent on a transportation facility

[9] Wisconsin Department of Transportation, MAPSS.
[10] Ibid.
[11] Ibid.
[12] Ibid.

improvement. The goal is to attract and retain business in Wisconsin, which increases the number of local job opportunities, improves the local tax base, and boosts spending in the local economy.

WisDOT developed a performance measure to monitor the success of the program in awarding grants to businesses in the state. The performance measure target for TEA grants is to achieve $50 of capital investment for every $1 of grant funds awarded. From 2013 to 2015, almost $11 million in grants were awarded. During this same time period, for every $1 of grant funds awarded an average of $53.16 in capital investments were made.[13]

WisDOT conducts extensive outreach at business/industry functions, the Governor's Small Business Summit, and region-sponsored local program symposiums, and it partners with state agencies like the Wisconsin Economic Development Corporation and Department of Administration to promote the TEA Program. WisDOT has streamlined the environmental clearance process and published resources to help guide sponsors and consultants on how to complete the programmatic environmental review. WisDOT is also working to streamline the delivery process to speed-up and ease the burden of moving a project from application to construction.

On-Time Performance

WisDOT's on-time performance measure indicates the department's ability to estimate and manage the amount of time it will take to complete a highway construction project. The better the department is at determining project completion time, the better WisDOT is able to schedule future projects to effectively utilize contractor and department resources. The general public and businesses are affected by construction projects. When the department adheres to a schedule, the better everyone can plan for the impact. The department's goal is to meet the project time frame specified in the construction contract 100 percent of the time.[14]

This measure reports the percent of construction projects that were completed within the original project time frame specified. The numbers are calculated by identifying construction projects that had work completed during the calendar year and then comparing the actual date/days the project took to complete with the date/days that were specified in the contract.

Factors affecting this measure include adverse weather, plan changes during construction, material delays or shortages, utility work delays, and contractor scheduling. The on-time performance is also affected by the quality and completeness of project designs.

The department is focusing on three areas to improve this measure:

- Work with contractors to improve communications and resolve issues that may impact the schedule in a timely manner; the department will also be expanding the deployment of mobile devices to foster timely decision making in the field
- Release larger and more complex construction contracts out for bid in the fall or early winter to ensure that contractors have adequate time to schedule the resources and staffing needed to complete the project on time
- Continue to use historic project data to develop more accurate project schedules

[13] Wisconsin Department of Transportation, MAPSS.
[14] Ibid.

6.4 Transportation System Safety

Transportation system safety is a fundamental mission of WisDOT. The department emphasizes safety in all its efforts, from education and enforcement to engineering and emergency response. WisDOT remains committed to a multidisciplinary philosophy that safety "is everybody's business" and continues to coordinate efforts across the entire department.

As the steward of the state's transportation system, WisDOT is responsible for addressing safety for all transportation modes and systems. The department's ability to influence safety varies depending on who has ownership or jurisdiction over the particular system or mode. For example, WisDOT has direct responsibility for state trunk highways. For the local system, which is owned and operated by local government, WisDOT provides funding, data, and technical assistance. For transport of freight via rail, water, and air, WisDOT supports safety by:

- Coordinating activities with the Office of the Commissioner of Railroads (OCR) regarding rail crossing investments
- Working with railroads when designing and constructing crossing improvements
- Investing in programs that improve railroad tracks and roadbeds; railroad crossings on state-supported rail corridors; tracking the Railroad Crossing Information System (RCIS); working to address safety concerns at crossings; and working with railroads and their police during derailment incidents
- Assisting the Federal Aviation Administration (FAA) and local airport owners with infrastructure improvements and equipment for improved navigation and communications
- Supporting engineering improvements ranging from technical improvements, such as landing and navigational aids, weather monitoring equipment, and rescue and firefighting equipment, to simpler treatments, such as runway lighting, land acquisition for protection zones, and fencing to prevent wildlife incursions onto runways
- The United States Department of Homeland Security's Transportation Safety Agency (TSA) is a major influence guiding the policy of air cargo safety and security. The TSA has a strict policy on how outgoing cargo is stored at its point of origin, requiring that the cargo be sealed before shipped via air. This has led to commercial airports in Wisconsin using an increasing variety of technology to screen outgoing and incoming cargo, while smaller general aviation airports continue a more "cargo in, cargo out" based policy. Many larger commercial airports also have a significant law enforcement presence enforcing this security policy, including local county sheriffs, customs agents, and private security companies.
- Working with the United States Army Corps of Engineers and the United States Coast Guard on port and waterway safety efforts
- For all modes, WisDOT hosts conferences and reviews draft state and federal legislation in order to ensure transportation safety is a focal point

Railroad Police
Railroad police are certified state law enforcement officers that are responsible for the protection of railroad properties, facilities and personnel. Railroad police are employed by the major Class I railroads in the United States and respond to incidents on railroads.

One of WisDOT's goals is to move towards minimizing the number of deaths, injuries, and crashes on the transportation system. The following sections discuss the department's efforts to monitor, measure, and address safety concerns in terms of roadways and railroads.

Roadway Safety

Protecting the safety of motorists and pedestrians is an integral part of the mission of WisDOT, which is reflective in the MAPSS Performance Improvement program. WisDOT's performance metrics measure traffic fatalities, traffic injuries, traffic crashes, and seat belt use on the state highway system.

In 2013, there were over 25,000 total crashes involving light and heavy trucks in Wisconsin. Over 22,000 of which involved light trucks and about 3,200 involved heavy trucks. In addition, 108 crashes involving light trucks were fatal, while 27 crashes involving heavy trucks were fatal. Table 6-2 displays vehicle crashes by truck type and severity in 2013. Some of these crashes can be attributed to unsafe vehicle operating weights, hazardous driving conditions, impaired drivers (including lack of rest), traffic congestion and human error.[15]

WisDOT's Safety Performance Measures
Traffic fatalities: For each calendar year, the department seeks to reduce traffic fatalities by five percent from the prior five-year rolling average. This supports the department's over-arching safety goal of zero deaths on Wisconsin roads (Zero in Wisconsin is the department's safe driving campaign).
Traffic Injuries: The goal of this measure is to reduce the number of personal injuries from traffic crashes by five percent from the prior five-year rolling average.
Traffic crashes: The goal of this measure is to reduce traffic crashes on Wisconsin roads by five percent from the prior five-year rolling average.
Seat belt use: The goal of this measure was to increase safety belt use to 86 percent for all passenger vehicle occupants by 2016. The goal was met, with 88.4 percent usage.

Table 6-2: 2013 Light and Heavy Trucks in Crashes by Plate Type and Severity

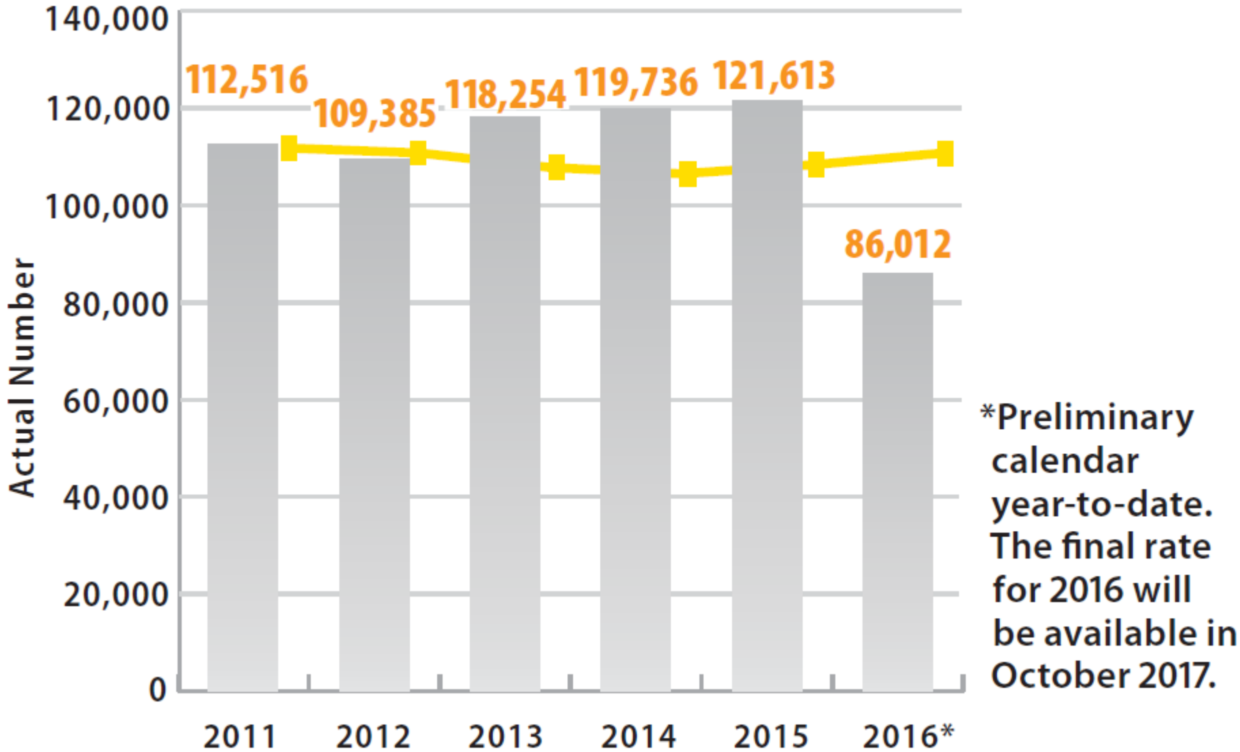
License Plate Type	Crash Severity			Total
	Fatal	Injury	Property Damage	
Light Truck	108	5,476	16,935	**22,519**
Heavy Truck	27	678	2,510	**3,215**
Total	**135**	**6,154**	**19,445**	**25,734**

Source: Wisconsin Department of Transportation, "2013 Wisconsin Traffic Crash Facts"

[15] Wisconsin Department of Transportation, "2013 Wisconsin Traffic Crash Facts."

In terms of all traffic crashes (passenger vehicles and commercial motor vehicles) in Wisconsin, the state experienced a rise in the number of crashes each year from 2012 (109,385 crashes) to 2015 (121,613 crashes), which is shown in Figure 6-1. Each crash potentially creates a loss of life, debilitating injuries, or lost income and productivity for crash victims. Crashes on the road system also impact traffic flow and the timely movement of goods and people to their destinations. WisDOT's goal is to reduce traffic crashes on Wisconsin roads by five percent from the prior five-year rolling average.

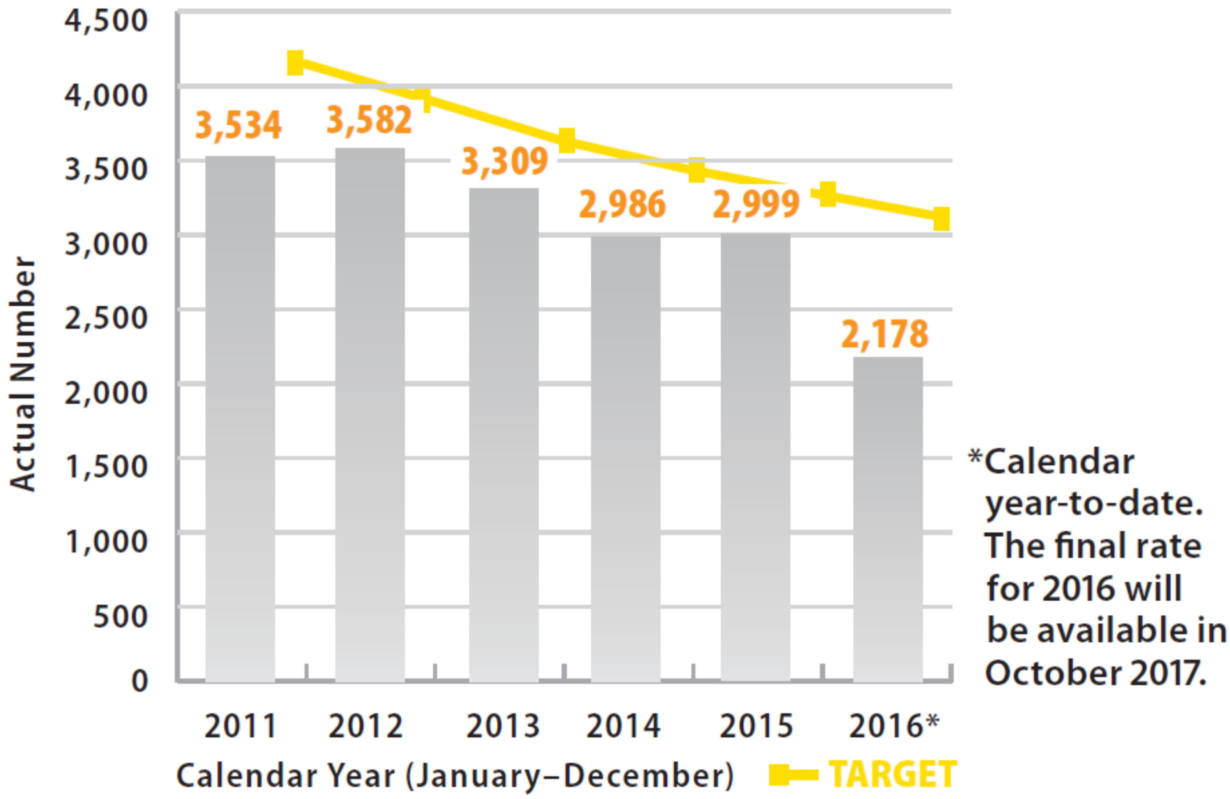
Figure 6-1: 2011-2016 Total Number of Crashes



Source: Wisconsin Department of Transportation, MAPSS

Just like traffic crashes, WisDOT has a goal to reduce the number of personal injuries from traffic crashes by five percent from the prior five-year rolling average. As shown in Figure 6-2, the number of personal injuries from traffic crashes has dropped from 3,582 in 2012 to 2,999 in 2015.

Figure 6-2: 2011-2016 Total Number of Incapacitating Injuries from Traffic Crashes



Source: Wisconsin Department of Transportation, MAPSS

For each calendar year, the department seeks to reduce traffic fatalities by five percent from the prior five-year rolling average. This supports the department's over-arching safety goal of zero deaths on Wisconsin roads (Zero in Wisconsin).[16]

From 2011 to 2015, Wisconsin has averaged 549 traffic fatalities per year. Figure 6-3 shows that the state had 601 fatalities in 2012, but experienced a drop in traffic fatalities in 2013 (527 fatalities) and 2014 (498 fatalities). However, the state has experienced a rise in traffic fatalities in 2015 with 555 fatalities. The state had 99 fatality-free days in 2012, 107 fatality-free days in 2013, 116 fatality-free days in 2014, and 99 fatality-free days in 2015. Even though Wisconsin has had some fatality-free days in recent years, there are still far too many needless and preventable deaths on our roadways. In many instances, drivers and passengers have been ejected from the vehicle because they were not wearing safety belts. The department uses a combined strategy of engineering, education, enforcement, and emergency response to prevent traffic fatalities, including designing safer roads and maintaining the highway infrastructure.[17]

Zero in Wisconsin

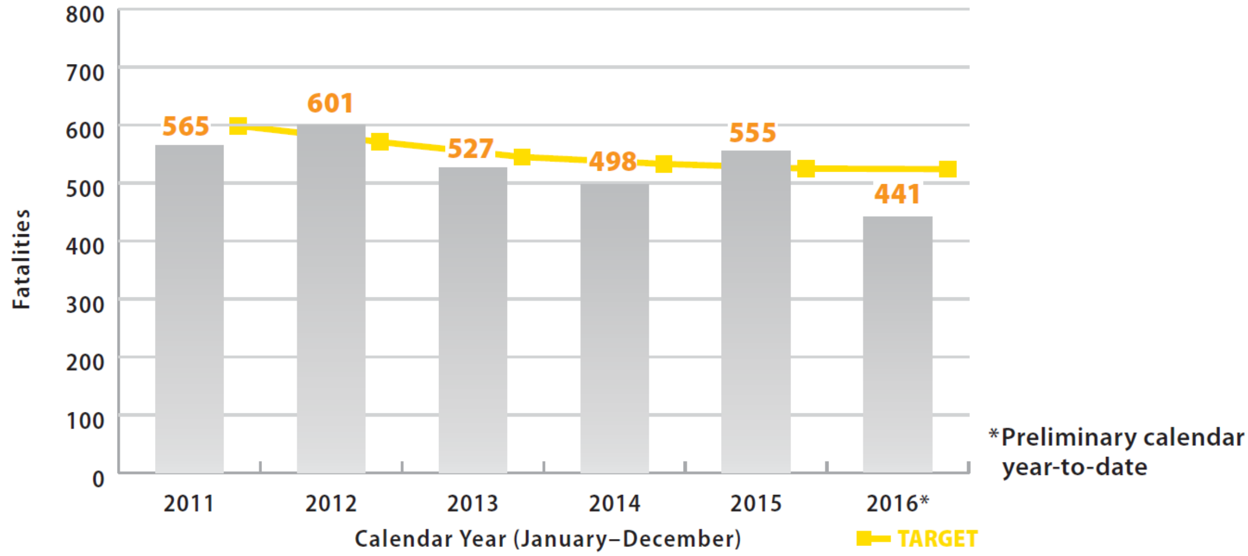
WisDOT, working with its traffic safety partners, launched the Zero In Wisconsin campaign. The campaign demonstrates how simple changes in driving behavior and habits, will prevent motorists from injuring and killing themselves or others.

Simply put, in Wisconsin, the only acceptable number of traffic deaths is ZERO.

ZERO IN WISCONSIN

[16] Wisconsin Department of Transportation, MAPSS.
[17] Ibid.

Figure 6-3: 2011-2016 Number of Traffic Fatalities



Source: Wisconsin Department of Transportation, MAPSS

Highway Safety Improvement Program
The Highway Safety Improvement Program (HSIP) funds highway and local road safety projects at sites that have experienced a high crash history. Emphasis is on low-cost options that can be implemented quickly. Projects typically include intersection safety improvements, improving site distance issues, eliminating roadside obstacles, and installing guardrails and barriers. The overall objective of HSIP is to fund, on a continuing basis, stand-alone safety projects designed to reduce the number and severity of crashes on all streets and highways (state and local).[18] HSIP also includes a high risk rural road subprogram, which focuses on: • Rural minor and major collector corridors • Run-off-the-road crashes • Areas that have experienced fatal and serious injury crashes • Low-complexity, low-costs treatments that can be implemented in under three years FHWA published HSIP and Safety Performance Management Measures rules in April 2016. WisDOT complies with the federal Performance Management Measures rule by submitting annual targets for the five Safety Performance Management Measures to FHWA by the annual deadline.

Enforcement and Emergency Response

WisDOT has expanded the use of multi-jurisdictional High Visibility Enforcement task forces around the state to address impaired driving, speed, pedestrian safety, and safety belt use. Speed and aggressive driving are targeted through increased use of aerial enforcement in partnership with agencies across the state (additional information is provided in the following section).

Using guidelines developed by the National Highway Traffic Safety Administration (NHTSA), the department conducts an annual seat belt use survey in conjunction with the annual Click It or Ticket seat belt enforcement mobilization conducted each spring. The survey data presents a statistically representative sample of the

[18] Wisconsin Department of Transportation, Bureau of State Highway Programs.

percentage of safety belt use in Wisconsin. Safety belt use reached 88.4 percent in 2016, an all-time high for safety belt usage in Wisconsin. That means that approximately one in eight motorists is still not buckling up, putting themselves and others at risk of serious injury or death in the event of a crash. Wisconsin is approaching the 88.5 percent national average for safety belt use but still lags behind the safety belt use of neighboring states like Illinois and Michigan, which estimate safety belt use rates of more than 90 percent.[19]

WisDOT's vision for security is to be able to prevent, prepare for, or coordinate response to any incident, whether caused by natural or human events. By the end of the plan period, WisDOT envisions a state transportation system that will be less vulnerable to incidents, whether caused by natural or human events.

Security considerations have been a part of WisDOT's policies for many years. Hurricanes along the eastern and Gulf Coasts of the United States raised additional concerns about the transportation sector's ability to handle emergencies. More recently, flooding and blizzard events in Wisconsin have affected travelers, businesses, and communities. These experiences have resulted in the public expecting transportation agencies and providers to make the transportation system more resilient. In response, WisDOT has implemented a 511 Traveler Information system, increased the STOC's statewide monitoring and emergency response capabilities, and has developed a fully operational Emergency Transportation Operations (ETO) plan.

WisDOT's role in security and incident management complements the roles of other agencies, from management of disruptive local incidents such as crashes blocking interstate highways, to incidents of regional concern such as HAZMAT spills and fires. In general, incidents are handled by the appropriate agency, depending on the scale and duration of the event. Local law enforcement personnel and emergency crews typically handle incidents of smaller scale and shorter duration; incidents of larger scale and longer duration require broader state and federal oversight.

In addition, within WisDOT's Division of State Patrol's (DSP), the Motor Carrier Enforcement section implemented a Security Contact Review, which thoroughly examines commercial motor carriers' security measures and has a particular focus on vehicles that transport HAZMAT. HAZMAT includes explosives, various types of compressed gases, solids, flammable and combustible liquid, select agents and toxins, and other materials. Because of the risks involved and the potential consequences these risks impose, the handling of HAZMAT is very heavily regulated by all levels of government. WisDOT's DSP enforces Hazardous Materials Regulations (HMR) and regulations for commercial driver license (CDL) operation to ensure safety and security on Wisconsin's roadways.

To enhance safety for all highway users, the Wisconsin State Patrol conducts over 30,000 large-truck inspections and weighs more than 4.5 million trucks in an average year. In addition, State Patrol Inspectors conduct about 13,000 school bus inspections and more than 2,300 inspections of commercial vehicles carrying HAZMAT materials each year. While most operators and trucking firms understand and abide by federal and state regulations, some 7,000 unsafe trucks and 2,300 unsafe drivers are placed out of service in Wisconsin each year.

Education

WisDOT provides ongoing educational outreach to high school students to promote safe driving, use of safety belts, and eliminating driving distractions. The department works to encourage drivers to stay within the speed limit, drive sober, buckle their safety belts, and eliminate driving distractions.

[19] Wisconsin Department of Transportation, MAPSS.

Increased safety belt use is a major component of Wisconsin's Zero in Wisconsin message. WisDOT promotes safety belt use through education and enforcement. The nationwide Click It or Ticket effort, in conjunction with NHTSA, utilizes paid advertising and enforcement to promote public awareness. Much of the educational efforts are targeted at younger drivers whose safety belt use is much lower than other age groups. WisDOT also supports car seat fitting stations to ensure that parents and providers are instructed on how to properly install child car seats and booster seats to keep small children safe in vehicles and training instructors on safety seat installment. By buckling their safety belt every time they get in a vehicle, motorists ensure their own personal safety, as well as the safety of passengers.

WisDOT also participates in a Drive Sober or Get Pulled Over campaign. To save lives and prevent injuries, law enforcement officers from all over Wisconsin and throughout the nation are patrolling in greater numbers and for longer hours to arrest impaired drivers and get them off the road. The goal is not to arrest more impaired drivers. The goal is to deter drunken driving, so that we can reach the ultimate goal of zero preventable traffic deaths.

In 2015, 190 people were killed and nearly 2,900 injured in alcohol-related crashes in Wisconsin. In addition, there were nearly 24,000 convictions for drunken driving in Wisconsin in 2015.[20] Drunken driving is 100 percent preventable, but too many people are still being killed or injured because of the irresponsible decision to drive while impaired.

Engineering

In many ways safer road design can make transportation safer for motorists, bicyclists and pedestrians. Aesthetic, scenic, historic, cultural resources and the physical characteristics of an area are also important factors in designing a road because they help give a community its identity and sense of place, and are a source of local pride.

Highway design standards are continually researched, reviewed and updated to ensure characteristics such as speed, lane width, shoulder width and slope, and stopping-sight distance meet current traffic requirements. Roadway engineering improvements during the past several decades have changed the mix of causal factors and injury outcomes for traffic crashes. Design tools such as guard rails, divided highways, cable barriers, clear zones, and shoulder rumble strips help to minimize the impact of driver error, roadway characteristics, and environmental factors. These tools help keep vehicles on the road, and minimize the consequences of leaving the road – two key department safety goals.

Roadway engineers apply both proactive and reactive tools in their efforts, such as designing facilities, including roundabouts, to modify driver speed behaviors. This requires engineers to anticipate potential problems and determine how drivers could avoid them, while at the same time identifying existing problems and designing facilities to eliminate or reduce their impacts. Examples of specific safety treatments that are considered during road design include:

- Turn lanes
- Flashing yellow arrow left turn signals
- High friction surface treatments
- High tension cable barrier
- Reduced conflict interchange and intersection design
- Pedestrian hybrid beacons

[20] Wisconsin Department of Transportation, Bureau of Transportation Safety.

- Roadway reconfigurations - "road-diet"
- Roundabouts
- Rumble strips
- Safety edge treatment
- Signal head per lane
- Traffic calming road design

Federal and state transportation guidelines stress the importance of good design that is both safe for road users and sensitive to the surrounding environment. For example, the United States DOT adopted guidelines developed by the American Association of State Highway and Transportation Officials (AASHTO) on how to modify roadways to safely accommodate senior drivers and pedestrians as well as other users. Ideas range from larger roadway signs to roadway lighting. WisDOT integrates the AASHTO recommendations on engineering, operations, and maintenance into its activities. WisDOT also continues to increase investments in roadway engineering and operational improvements that reduce the negative influences of roadway design, roadway condition, or environmental factors, and minimize the impact of driver error. The challenge for today's highway designers is to find design solutions, as well as mobility options, that result in a full consideration of these sometimes-conflicting objectives.

In addition to roadway engineering and safety, WisDOT continues to make safety improvements for other modes, such as railroads and aviation. On state-owned rail corridors, WisDOT invests in programs that improve railroad tracks and roadbeds, and railroad crossings (see the Railroad Safety section of this Chapter for more specific details).

On privately-owned corridors, WisDOT works with the OCR and private companies to identify potential needs for improved rail-crossing safety measures such as signals, gates, grade separations, and crossings that should be closed, and it will discourage trespassing by installing fencing.

In terms of aviation, WisDOT supports engineering improvements ranging from technical improvements such as landing and navigational aids, weather monitoring equipment, and rescue and firefighting equipment, to simpler treatments such as runway lighting, land acquisition for protection zones, and fencing to prevent wildlife incursions onto runways.

Air Support for Traffic Enforcement

Speed continues to be a contributing factor in approximately 30 percent of traffic fatalities in Wisconsin. Using a consistent air enforcement presence through the DSP Air Support Unit (ASU), along with dedicated law enforcement vehicles, is an effective method of enforcing speed and aggressive driving. Ensuring ASU is used periodically on traffic corridors helps law enforcement agencies conduct high visibility enforcement efforts and provides a deterrent effect even when air support is not present. Since 2012, the department’s goal has been to conduct 80 ASU traffic enforcement deployments per year. In 2017 WisDOT will evaluate and report on results of research into the impact of aerial speed enforcement on selected corridors.[21]

Depending upon the number of law enforcement cars participating in deployments, DSP considers six to eight traffic stops per hour as optimal performance. Each traffic stop does not necessarily lead to a citation.

There are multiple uses for state planes that impact how often the planes are available for traffic enforcement, including: surveillance for criminal investigations, photo flights to document a scene for evidentiary purposes,

[21] Wisconsin Department of Transportation, MAPSS.

search missions, construction work zone enforcement, and use by other agencies such as the Department of Natural Resources (DNR).

Considering how effective aerial enforcement can be as a law enforcement tool, WisDOT has recommitted to planning and funding additional ASU deployments. DSP has dedicated additional federal funds to deployments in cooperation with local law enforcement agencies on high-volume corridors and is looking for ways to attract trained pilots. Consistent deployment of the ASU, along with a highly visible law enforcement presence on the ground, will encourage drivers to stay within speed limits, curb aggressive driving, provide safer work zones, and prevent crashes.

Local Road Safety

As WisDOT continues its efforts to improve the safety of the state's roadway network, including Wisconsin's local roads and bridges, WisDOT coordinates with local governments to manage available safety funding and to program safety improvements. In addition, WisDOT coordinates with locals on data sharing, providing technical assistance and addressing safety issues.

Local governments may use WisDOT data and technical assistance related to safety issues to prioritize applications for funding through WisDOT local programs. WisDOT local programs primarily rely on local governments and metropolitan planning organizations to prioritize and, in some cases, select projects based on safety and other locally determined criteria within funding limitations set by WisDOT for certain programs, project types, or geographical areas. This process allows local governments to consider safety improvements as part of an eligible project in any WisDOT local program.

Rural Road Minor and Major Collector Definitions
Rural Major Collector: Major collectors provide service to smaller-to-moderate sized places and other intra-area traffic generators, and link those generators to nearby larger population centers (cities, villages, and towns) or higher function routes. These routes generally serve places with populations of 100+. Rural Minor Collector: Minor collectors provide service to all remaining smaller places, link the locally important traffic generators with their rural hinterland, and are spaced consistent with population density in order to collect traffic from local roads and bring all developed areas within a reasonable distance of a collector road. These routes generally serve places with populations of 50+.

WisDOT oversees the HSIP and can use data software that identifies "hot spots" for crashes. A portion of HSIP funds are used for local road safety project needs. Other projects include developing speed management guidelines for roadways, conducting intersection studies for major corridors, and analyzing cross-median crash data. These studies fold into other tools, including the FHWA's urban demand models and the Decision Support System for WisDOT.

Railroad Safety

The safe operation of rail lines is critical to Wisconsin's transportation system. There are many organizations, such as private railroad companies, OCR, WisDOT, and others, that contribute to railroad safety in the state. In addition, there are many safety regulations that these organizations must adhere to. This section further explores some of the roles for some of the organizations involved in rail safety and some of the safety regulations that impact freight movement on the railways.

Railroad Safety Roles

Wisconsin OCR is the state agency with primary jurisdiction for the safety of public roadway-railway crossings, regardless of whether the crossing is at-grade or separated. In carrying out its responsibilities, this office works closely with WisDOT on rail safety issues. The OCR's duties include:

- Authorizing installation, alteration, repair, and consolidation of roadway-railway crossings
- Making determinations on petitions for closures and establishment of new crossings, and on the adequacy of warning devices at railroad crossings
- Making determinations on railroad fencing and railroad track clearance laws

WisDOT is the primary state agency responsible for statewide roadway-railway crossing improvements. WisDOT regularly improves crossings as part of highway projects. These improvements typically address crossing surfaces and active warning devices. Several WisDOT efforts address the security of roads, bridges, buildings, and other transportation assets including rail corridors and stations. Because railroads are typically owned and operated by private interests, WisDOT's enforcement efforts are focused on road traffic at grade crossings. WisDOT also promotes rail safety and security through its website and educational programs such as Operation Lifesaver. At the planning level, WisDOT coordinates with local jurisdictions, metropolitan planning organizations, regional planning commissions, railroads, and rail transit commissions in considering rail safety improvements.

Railroad companies are private entities that typically own the rail lines on which they operate. They are subject to safety and security regulations, primarily at the federal government level. At the state level, they are subject to the regulations of OCR. The responsibilities of railroads, in terms of safety and security, include:

- Maintaining all public roadway-railway crossing surfaces in good repair and in safe condition for public travel (Section 86.12 and Section 86.13, Wis. Stats.)
- Providing advance railroad crossing warning signs for town and county rail crossings (local authority installs the signs)
- Maintaining all installed warning devices, both active and passive, at public at-grade roadway-railway crossings, including interconnecting signals to traffic signals
- Providing safety and security preparedness and emergency response efforts on their rail lines

Amtrak is responsible for ensuring the safety and security of its passenger operations. Examples of the measures it uses include Amtrak police officers and security teams, onboard security checks and canine (K-9) units.

Metra is responsible for ensuring the safety and security of its commuter rail operations. Like Amtrak and private railroad companies, it has its own police department, which provides security for all its lines and stations. Metra also provides training and education on emergency preparedness to its staff and to emergency responders serving communities in which it provides service.

Due to the number of groups having a role in rail safety and security, coordination and communication is very important in ensuring that safety and security issues are addressed quickly and efficiently.

Rail Safety Regulations

Most rail safety rules and regulations fall under the jurisdiction of the Federal Railroad Administration (FRA). The 2008 Rail Safety Improvement Act requires stronger rail safety measures affecting grade crossings, train operations, crews, and hours of service, and calls for the improvement of automatic train stop technologies. Railroads operating in Wisconsin are subject to these federal rules and regulations. As a result of federal preemption, Wisconsin has limited autonomy with regard to rail safety issues. While WisDOT can make the FRA aware of particular issues, the department cannot force a railroad to act.

There are three key safety concerns with rail transportation:

- Crossings
- Quiet zones
- Collisions and derailments

In addition, there are two concerns that impact both safety and security:

- Trespassing
- Shipment of HAZMAT

Rail Crash Data

Rail incidents, such as collisions or derailments, can cause property damage, injuries and fatalities. Crash data is collected from the FRA's Office of Safety Analysis and Wisconsin's OCR. Table 6-3 identifies freight railroad injuries and fatalities in Wisconsin between 2012 and 2015. The number of fatal and injury incidents increased from 2012 to 2014, but has experienced a decline in both categories in 2015. One possible factor in the rise of incidents in Wisconsin is attributed to increased train traffic, which can be attributed to recent booms in sand mining in Wisconsin and crude oil from shale in North Dakota. Fewer shipments of these commodities occurred in 2015 in Wisconsin and thus may have contributed to the decrease in incidents.

In an effort to mitigate passenger vehicle and train incidents, the OCR spends over $4 million a year upgrading rail crossings. Through the Six-year Highway Improvement Program, WisDOT schedules rail crossing projects that occur on state highways (see Chapter 9, *Investment and Implementation*).

Table 6-3: 2012-2015 Railroad Crashes in Wisconsin

Category	CY 2012	CY 2013	CY 2014	CY 2015
TOTAL FREIGHT ACCIDENTS/INCIDENTS	122	156	180	148
--- Total fatalities	4	5	15	7
--- Total nonfatal conditions	68	103	110	90
--- Employee On Duty (EOD) deaths	.	.	.	.
--- Nonfatal Employee On Duty (EOD) injuries	47	67	80	63
--- Nonfatal Employee On Duty (EOD) illnesses	1	2	3	.
--- Total Employee On Duty (EOD) cases	48	69	83	63
--- Cases with days absent from work	28	52	56	48
--- Trespasser deaths, not at Highway-Rail Crossing (HRC)	1	3	4	5
--- Trespasser injuries, not at Highway-Rail Crossing (HRC)	1	3	2	3
FREIGHT TRAIN ACCIDENTS	25	15	34	30
--- Train accident deaths	.	.	.	.
--- Train accident injuries	.	1	3	1
--- Human factor caused	8	5	18	14
--- Track caused	9	6	8	9
--- Motive power/equipment caused	6	2	7	4
--- Signal caused, all track types	.	.	.	1
--- Signal caused, main line track	.	.	.	.
--- Miscellaneous caused	2	2	1	2
--- Collisions	.	.	1	3
-------- Collisions on main line track	.	.	1	1
--- Derailments	18	11	20	20
--- Other types, e.g., obstructions	7	4	13	7
--- Train accidents on main line	8	7	12	10
--- Accidents on yard track	15	4	18	12
--- HAZMAT RELEASES	.	.	1	2
--- Cars carrying HAZMAT	140	87	205	222
--- HAZMAT cars damaged/derailed	3	1	7	32
--- Cars releasing	.	.	1	6
--- Accidents with reportable damage over $100K	2	7	9	11
..... PERCENT of all train accidents	8.0	46.7	26.5	36.7
--- Accidents with reportable damage over $500K	1	2	2	3
..... PERCENT of all train accidents	4.0	13.3	5.9	10.0
--- Accidents with reportable damage over $1M	1	1	1	2
..... PERCENT of all train accidents	4.0	6.7	2.9	6.7
FREIGHT HIGHWAY-RAIL INCIDENTS	42	59	52	34
--- Highway-rail incidents deaths	3	2	10	2
--- Highway-rail incidents injuries	12	22	17	10
--- Incidents at public crossings	35	54	47	33
..... PERCENT of total Highway-rail incidents	83.3	91.5	90.4	97.1
OTHER FREIGHT ACCIDENTS/INCIDENTS	55	82	94	84
--- Other incidents deaths	1	3	5	5
--- Other incidents injuries	56	80	90	79

Source: Federal Railroad Administration, Office of Safety Analysis[22]

[22] Freight operation data reflected are based on the type of equipment reported by railroads to FRA. Casualty data are solely those reported to the FRA that are related to the type of equipment associated with Freight Operations. Total freight Accidents/Incidents are the sum of Train Accidents, Crossing Incidents, and Other Accidents/Incidents. Other Freight Accidents/Incidents are events other than Train Accidents or Crossing Incidents that cause physical harm to persons. The related report numbers are included in the TOTAL FREIGHT ACCIDENTS/INCIDENTS section numbers. Freight Operation data does not support rates based on Freight train miles being calculated when freight or both Region and/or State are selected.

Rail-Highway Crossings

Over 7,100 rail-highway crossings are located in Wisconsin. Rail-highway crossings can be either at-grade or grade-separated. At-grade crossings are the most common type of crossing in Wisconsin, accounting for approximately 6,300 open crossings or over 89 percent of all crossings in the state. At-grade crossings occur wherever a railway and highway physically intersect. Grade-separated crossings, approximately 800 in Wisconsin, occur when the railway and roadway are physically separated by an overpass or underpass.[23]

Since 1990, crashes at highway-railway grade crossings have declined by more than 50 percent nationally. Even with this decline, railway-roadway crossing safety remains a concern.[24]

At-grade lights and gates are the most prevalent safety features that warn vehicles and pedestrians crossing Wisconsin railroads. Table 6-4 indicates the prevalence of these features in both publicly and privately-owned railroads.

Table 6-4: At-Grade Warning Devices

Warning Device Type	Public	Private	Pedestrian	Total
Passive	2,136	1,708	68	3,912
Lights (no gates)	924	275	13	1,212
Lights & Gates	941	284	4	1,229
Total	**4,001**	**2,267**	**85**	**6,353**

Source: Railroad Crossing Information System

A passive railroad crossing is a crossing without an active warning device (lights and/or gates), but contains passive warning devices, such as a crossbuck, yield, or stop sign.

[23] Railroad Crossing Information System.

[24] Wisconsin Department of Transportation, "Wisconsin Rail Plan 2030."

At-grade crossings are equipped with warning devices to alert vehicles and pedestrians of the presence of a rail crossing. These warning devices may be either passive or active. Passive devices do not change when a train is approaching. Examples of passive devices include:

- Circular advance warning signs
- Stop signs
- Crossbucks (the familiar X-shaped signs)
- Pavement markings
- Median barriers

In comparison, active devices activate as a train approaches. For example, lights may flash and gates may be lowered. Examples of active devices include:

- Two quad gates
- Four quad (full barrier) gates
- Flashing lights (cantilevered or mast-mounted)
- Bells
- Yield signs
- Highway traffic signals
- Special warning devices such as flagmen

WisDOT and local governments use both active and passive devices.

Crossing safety may also be increased through changes to the roadway or to the area near the crossing. For example, the design of the roadway may be changed to improve sight distances. Likewise, clearing brush or trees can also improve sight distances.

Safe Transportation of Energy Products Grant Award
In 2016, WisDOT was awarded $3 million from the FRA's Safe Transportation of Energy Products (STEP) grant program. The funding supports department and OCR efforts to improve grade crossing safety needs in Western Waukesha County. The project corridor applies to a "sealed corridor concept." The project corridor is a 10-mile stretch going through the communities of Pewaukee, Hartland, and Delafield. On average, every day two Amtrak trains travel the corridor at speeds up to 79 mph, along with 23 daily freight trains traveling up 60 mph - carrying ethanol, Bakken crude oil and other products. The sealed corridor concept will improve safety at 11 consecutive crossings, including a pedestrian crossing, by providing geometric and warning device upgrades and providing the corridor with up-to-date train detection circuitry.

WisDOT's rail crossing data is maintained in the Railroad Crossing Information System. The data is used to analyze the physical characteristics of rail crossings. The department uses this database as a tool to assist decision makers in prioritizing crossing improvements. In terms of improvements, WisDOT and local governments regularly improve roadway-railway crossings as part of roadway projects. Any project that crosses a rail line or ends near a rail line must include a review of whether any crossing improvements are needed. WisDOT and local governments cannot ignore any railway crossing-related improvements when completing a roadway improvement project. In some instances, WisDOT or a local government may improve a roadway-railway crossing even though a project is not planned. In all instances, crossing improvements are coordinated with the railroad company.

With approximately 6,300 at-grade crossings in the state, rail crossing safety remains a challenge and a priority. Actions that can be taken to improve rail crossing safety include minimizing the installation of new crossings of rail lines, increasing education about the dangers of rail crossings, constructing grade-separated crossings, or closing existing crossings.

Educational efforts can increase public awareness of the dangers at roadway-railway crossings and emphasize the need for motorists, pedestrians, and bicyclists to respond properly to crossing warning devices. *Connections 2030* stated that WisDOT will continue to support the Operation Lifesaver program that teaches safe behavior while crossing railroad tracks.

As noted earlier, grade-separated crossings are safer than at-grade crossings because they physically separate vehicles, pedestrians, and bicyclists from trains. Grade-separated crossings also:

- Eliminate the need for signs, barriers, or other safety devices and technologies to warn roadway users of oncoming trains
- Reduce traffic congestion caused by vehicles waiting at a crossing for a train to pass, and as a result may also improve air quality and reduce energy consumption

However, grade-separated crossings are expensive to build and maintain. Typically, these crossings are built in locations with higher volumes of vehicle and train traffic. Construction may be hindered by physical limitations such as existing land uses and topography.

The most effective way to improve crossing safety is to close crossings. While closing a crossing can positively impact crossing safety, it can result in hardships to those directly affected by the crossing. For example, eliminating a crossing may result in greater travel times for drivers, bicyclists, and pedestrians. It can also result in increased emergency response time for emergency vehicles. Closed crossings may also function as barriers, preventing easy or convenient movement within a community and between neighborhoods. As a result, WisDOT and the OCR consider many factors when deciding whether to close a crossing. They include:

- Amount of vehicle and pedestrian traffic
- Response time for emergency vehicles
- Physical conditions and visibility
- Feasibility of rerouting traffic to adjacent crossings
- Crash history and predicted crash frequency rate
- Improvement in livability in the area near the proposed closure

Rail line abandonment can result in the closure of large numbers of crossings. However, rail line abandonments typically occur on low-volume railway corridors. As a result, the derived safety benefit may be minimal. In addition, the bulk of rail line abandonments occurred during the 1980s. While railroads still abandon low-volume corridors, these abandonments occur less often than in the past. Of the 49 crossings closed in the state from 2000 to 2009, none were due to rail line abandonment.

Where possible, WisDOT and OCR target crossing closures in areas with multiple adjacent crossings, concentrating safety improvements at the remaining crossings. By focusing on these areas, many of the negative impacts associated with closures can be minimized.

WisDOT will continue to work with OCR and private railroad companies to identify potential rail crossing safety improvements such as signals, gates, grade separations, or closing crossings. In addition, for rail corridors with intercity passenger rail service, WisDOT will continue to work with OCR to discourage new at-grade crossings of the corridors. WisDOT will work to equip federally-designated high-speed rail corridor crossings with appropriate warning devices.

Collisions and Derailments

While derailments may occur when a train collides with a vehicle, the chances for a derailment increase significantly if a train collides with another train. This section focuses on train-to-train collisions. These collisions may result from natural events, human error, or from a range of other potential causes. Examples of technologies used to minimize or avoid collisions and derailments are depicted in Table 6-5.

Table 6-5: Description of Rail Safety Technology Designed to Reduce Train Collisions and Derailments

Technology	Description
Positive train control	• Enables computers to override human workers in emergency situations • Helps prevent train-to-train collisions, over speed derailments, and casualties or injuries to railway workers • Required for all Class I railroads and Amtrak by the end of 2018 at the earliest
Electronically controlled pneumatic brakes	• Results in shorter stopping distances, fewer derailments and collisions, and reduced severity of collisions that do occur • Allows each car to be braked simultaneously — in comparison to current braking systems which apply power car-to-car from the front of the train to the rear • Allows engineers to "back off" braking efforts to match track grade and curvature without completely releasing the brakes
Distributed power	• Results in improved handling, demonstrated by an average 22 percent reduction in stopping time and a 30 percent reduction in braking distance • Occurs when multiple locomotives, controlled by the lead locomotive, are spaced throughout long trains • Uses radio-signal remote technology to serve as communication link between the locomotives

Source: Wisconsin Department of Transportation, Bureau of Transit, Local Roads, Railroads and Harbors

Trespassing

Trespassing presents both safety and security concerns. Even as roadway-railway crossing-related fatalities have declined, the number of trespassing-related fatalities has risen. Since 1997, trespassing fatalities have become the leading cause of rail-related fatalities in the United States. In Wisconsin, there were sixteen trespassing-related fatalities between 2007 and 2009. Trespassing also presents rail security concerns. Since the events of September 11, 2001, trespassers are now considered a potential security threat.

The public is generally indifferent to trespassing, with some even finding it socially acceptable. Since rail facilities are private property, trespassing is illegal and subject to local and state laws. (Note: There is an exception to the trespassing laws for private crossings, whereby a person who owns the property on each side of a railroad can drive across the railroad on that property.)

Railroads, local jurisdictions, and state and federal agencies rely on a variety of measures to prevent and restrict trespassing. Education is one measure. The FRA sponsors and carries out public education related to the dangers of trespassing on rail facilities. Railroad police departments play a crucial role in monitoring trespassing. These departments work closely with public enforcement agencies. Fencing, lighting, gates and barricades can be installed to discourage trespassing. WisDOT will continue to work with the OCR and private railroad companies to discourage trespassing by installing fencing.

Hazardous Materials Transport

The United States DOT defines HAZMAT as substances or materials capable of posing an unreasonable risk to health, safety, or property when transported in commerce. HAZMAT shipments present a unique safety and security concern. In the absence of a collision, derailment, or security threat, these shipments present little risk. However, if a collision or derailment were to occur, or if a terrorist were to use a HAZMAT shipment as a weapon, the potential consequences would be considerable.

The Office of Wisconsin Emergency Management (WEM) coordinates security concerns in Wisconsin, including coordinating emergency response efforts. WEM contracts with eight regional HAZMAT response teams to provide a high level of response capability to the state's communities. These teams may be activated for an incident involving a HAZMAT spill, leak, explosion, injury, or the potential of immediate threat to life, property, or the environment. County-level response teams respond to lower-level HAZMAT incidents that exceed the capabilities of standard fire departments. In terms of transportation security, WisDOT's role is limited. Currently, WisDOT enhances the security of the transportation system by reducing vulnerability and improving incident response.

WisDOT continues to work with WEM, railroad companies, and other agencies to discuss rail-related security issues. WisDOT also expects rail carriers to comply with regulations related to the transportation of any HAZMAT and work with the appropriate agencies if a spill occurs.

Waterway Safety

As shown in Table 6-6, maritime transportation on inland waterways has the lowest injury and fatality rates compared to highway and rail transportation. Comparing fatality and injury rates between modes shows a ratio of 18.1 fatalities on rail and 132 fatalities on highways per fatality on the inland river system. Similarly, there is one injury on the inland river system for every 95.3 rail and 1,609.6 highway injuries.[25] While these data are not specific to Wisconsin, they do suggest the inland waterway system is substantially safer than highway and rail.

Table 6-6: Fatality and Injury Rate from 2001 – 2009 by Mode

Mode	Fatality Rate (per billion ton-miles)	Injury Rate (per billion ton-miles)
Highway	3.829	87.534
Railroad	0.525	5.183
Inland Towing	0.029	0.054

Source: National Waterways Foundation, "A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2009"

On the Great Lakes, the injury and fatality rate for maritime transportation is the lowest in comparison to rail traffic. From 2002 to 2011, there were 0.15 injuries per 100 billion ton-miles on the waterways compared to 2.59 injuries on Canadian railroads and 10.2 injuries on Class I freight railroads. Additionally, there were zero fatalities due to vessel collisions/strikings or groundings.[26]

6.5 Transportation System Condition

WisDOT uses a comprehensive asset management approach to identify and address the state's transportation system needs. This asset management approach allows WisDOT to analyze transportation system conditions such as pavement, bridge, and rail line condition, and to identify preservation needs using data based on the physical infrastructure, safety, operation, function, and connectivity of the facility. It also allows WisDOT to consider a range of funding and construction alternatives, which results in a systematic and objective approach to cost-effective transportation system preservation. WisDOT uses comprehensive data to monitor the conditions of key infrastructure statewide including highway pavements and bridges. Infrastructure condition is used to identify

[25] National Waterways Foundation, "A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2009."
[26] Great Lakes St. Lawrence Seaway System, "Safety Profile of the Great Lakes-St. Lawrence Seaway System Executive Summary." (March 2014).

system needs and recommend appropriate treatments to achieve or preserve the state's transportation infrastructure. For the state-owned railroad system, WisDOT collects system data to monitor condition and address capital improvement needs with the rail line operator. Use of this data for each mode helps WisDOT to develop cost-effective preservation and maintenance strategies, which, in turn, maximizes prior and current investments.

State Trunk Highway System Pavement and Bridge/Structures Condition

Pavement that is in good condition promotes the safe and efficient movement of people and products throughout Wisconsin. Comprehensive pavement condition data is necessary to determine cost-effective maintenance and improvement strategies that extend the life and serviceability of the state trunk highway system.

Highway maintenance activities focus on the infrastructure along the highway right of way, including, but not limited to, roadway pavement and shoulders, bridges, rest areas, signs, drainage, and pavement markings, which is further discussed in this section. WisDOT maintains nearly 11,800 miles of highway infrastructure, over 5,200 bridges and more than 150,000 acres of roadside adjacent to state trunk highways.[27,28,29] WisDOT prioritizes infrastructure investments based on the state's backbone and non-backbone roadway system. This section provides an overview of the performance of the state's backbone and non-backbone highway system.

Pavement Condition Data
Comprehensive pavement condition data is used to determine cost-effective maintenance and improvement strategies that extend the life of the state highway system. Pavement conditions are impacted by material quality, adequacy of pavement design, traffic loading, improvement and maintenance history, age, and environmental factors such as temperature and moisture. The department considers all of these factors when using asset management tools and strategies to determine investment levels and steward highway improvement funding provided through the state budget.

Highway Pavements

Engineers design roads to accommodate projected vehicle loads; in particular, heavy vehicle axle loads. The life of a pavement is related to the magnitude, number of repetitions and spacing of heavy axle loads. There are instances where heavy vehicles can exceed Wisconsin weight laws. The width of pavement can impact the design of roadways. The average width of paved roadways in Wisconsin ranges from 18 feet to 24 feet from edge of pavement to edge of pavement with most town roads between 20 feet and 22 feet.

Pavement preservation activities usually follow a standard process. Assuming timely preservation improvements, state highways are designed to last 50 to 60 years before they need to be reconstructed. However, several factors influence pavement life, such as the timing and type of maintenance and preservation activities, weather, traffic volumes, vehicle weight, and soil conditions.

To achieve a 50- to 60-year roadway life, resurfacing or reconditioning activities are typically necessary 15 to 25 years after initial construction and several more times before the end of the 50- to 60-year time span. It is at this point that a roadway will likely need complete replacement.

[27] Wisconsin Department of Transportation, Bureau of Planning and Economic Development
[28] Wisconsin Department of Transportation, Bureau of Structures, "Annual Bridge Report." (April 2016).
[29] Wisconsin Department of Transportation, Bureau of Highway Maintenance, "Highway Maintenance Manual." (June 2015).

WisDOT’s Pavement Management System
The development of Wisconsin’s pavement management system began in 1987. Wisconsin has a geographic information system that provides spatial and mapping capabilities. The pavement management system uses pavement inventory data and a decision support system to develop preservation and maintenance programs. The system also provides a database for complex pavement modeling efforts and statewide planning efforts. Pavement sections with identified needs are aggregated into improvement sections (a section whose length is generally more typical of preservation or maintenance projects), with low-, nominal-, and high-level treatment strategies recommended for the entire section. The final treatment selected is based on the relative impacts of five factors: improvement in ride, improvement of distress rating, user inconvenience, initial cost, and life cycle cost. The final product is WisDOT’s Six-Year Highway Improvement Program.

WisDOT uses the Pavement Condition Index (PCI) methodology to rate pavement condition and monitor performance. This methodology relies on visual signs of pavement distress (e.g., cracks, ruts, or potholes) to determine the underlying mechanics impacting the pavement structure and rates it accordingly. PCI is a numerical rating that ranges from 0 to 100, where 100 represents pavement in excellent condition and 55 represents a minimum rating for pavement in fair condition. Specialized pavement data collection vehicles gather data on the state trunk highway system on a two-year statewide collection cycle. Determining when to schedule preservation or maintenance work is a complex task. WisDOT analyzes pavement condition data to determine where and when repairs are needed, and to determine viable alternatives. In addition, the department assesses the metropolitan planning organization recommendations published in each organization’s long-range transportation plan when assessing priority needs.

Pavement Design and Heavy Vehicle Considerations

Pavement designers consider the amount, type and weight of traffic using the road. This data is used to calculate an equivalent single-axle load (ESAL – pronounced “easel”) factor; this factor is a way of measuring the impact that a vehicle will have on a pavement.

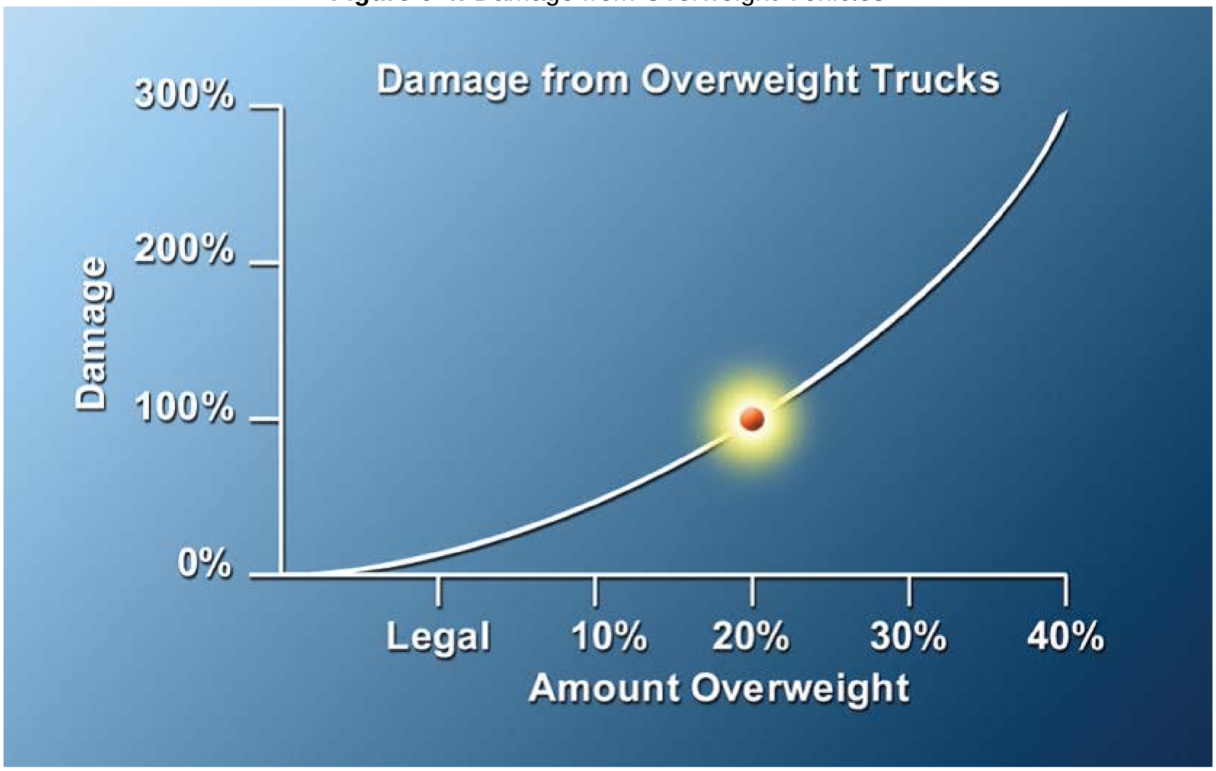
Pavements should be viewed as a “consumable” and are designed to carry an estimated number of ESALs over their design life. As a heavy load passes over a pavement, a portion of its life is consumed. Eventually, a pavement’s life is expended, and it needs to be reconstructed.[30]

Engineers forecast traffic that will travel over a roadway during its design life. This traffic is then used to calculate a design ESAL. If the actual traffic volume and/or vehicle weights exceed forecasts, then the roadway’s “actual” life will be less than its design life. Over the past decades, both traffic volumes and vehicle weights have increased dramatically.

If vehicles are overloaded, the damage to pavement can be severe and exponential. This results in a reduced pavement life. As shown in Figure 6-4, if all vehicles were 20 percent overweight, pavement life is cut in half.

[30] Local Road Research Board, “Roads & Loads: Finding a Balance.”

Figure 6-4: Damage from Overweight Vehicles



Source: Local Road Research Board

"The load equivalency factor increases approximately as a function of the ratio of any given axle load to the standard 18 kip single axle load raised to the fourth power."[31]

The effect of large and heavy equipment on pavements is not constant throughout the year.[32] During the winter, when the ground is frozen, a truck carrying a given load causes less damage to pavements than at other times of the year. During the spring, the inverse is true: pavement structure layers are generally in a saturated, weakened state due to partial thaw conditions and trapped water, causing greater pavement damage by the same truck. During spring thaw, Wisconsin restricts heavy loads greater than 80,000 pounds on roadways.

In Wisconsin, weight limits have been written into state statute (Chapter 348.15) in an effort to protect the significant investment in transportation infrastructure. All roadways are class "A," unless the maintaining authority has posted it as class "B." Class A roadways have a maximum single axle weight allowance of 20,000 pounds when the vehicle has appropriate axle spacing – meaning a distance of 10' between foremost and rearmost axles of a group. Class B roadways allow 60 percent of axle weight allowed on class A roadways. Other weight restrictions might be imposed by local and municipal roadways (348.17 & 349.16).

Backbone Pavement Condition

Good condition pavement promotes the safe and efficient movement of people and products throughout Wisconsin. Comprehensive pavement condition data is necessary to determine cost-effective maintenance and improvement strategies that extend the life and serviceability of the state trunk highway system. The goal is to

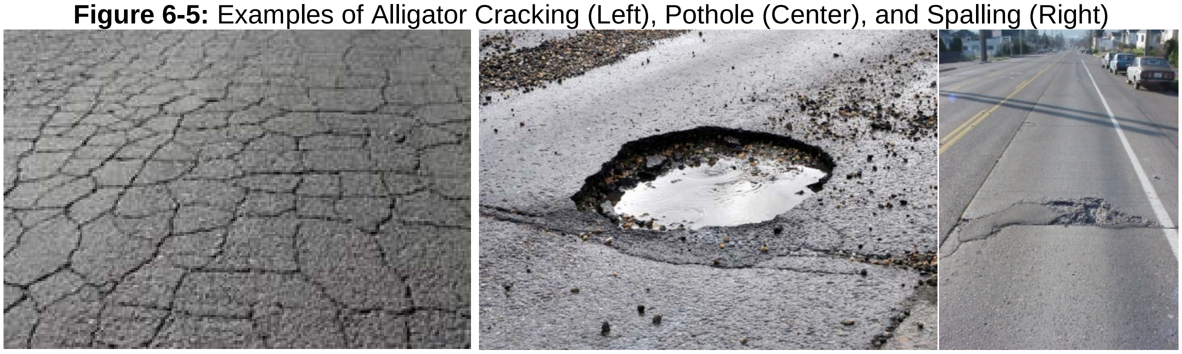
[31] American Association of State Highway and Transportation Officials, "AASHTO Guide for Design of Pavement Structures, 1993."
[32] Local Road Research Board, "Roads & Loads: Finding a Balance."

have 90 percent of backbone highway pavement rated fair or above using the most cost-effective pavement improvement methods available (Figure 6-6).

A pavement is considered in fair or better condition if it has a Pavement Condition Index (PCI) of 55 or more. WisDOT follows PCI, the national standard (ASTM D 6433) for evaluating pavement condition based on visual observation of various distresses, in assessing the state of repair of sections of highways (backbone and non-backbone). Each distress is categorized by type, severity, and quantity. The severity and quantity of each distress type is used to calculate a deduct value to quantify its effect on pavement condition. For the state highway system, distress deducts are combined to generate a numeric rating between 0 and 100, with 100 representing a pavement in perfect condition. The most common classified distresses include the following (Figure 6-5):

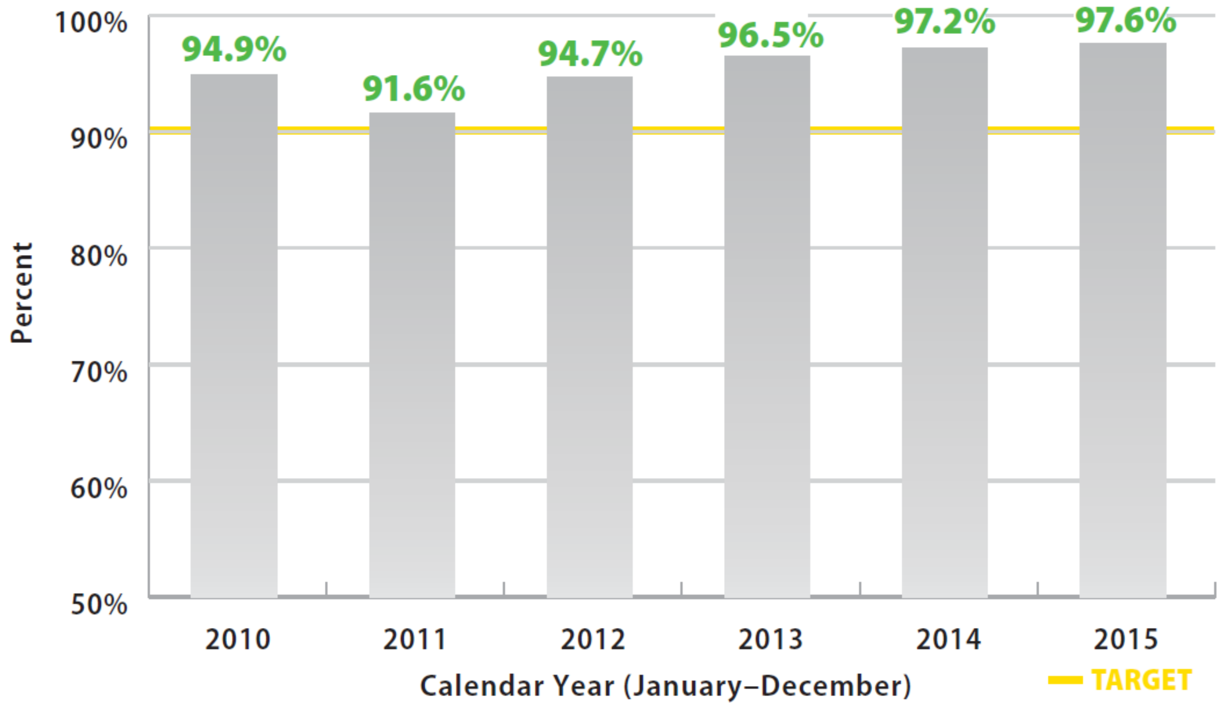
- **Asphalt Pavements –** alligator cracking, block cracking, bleeding, edge cracking, joint reflective cracking, longitudinal and transverse cracking, patching, potholes, rutting, weathering, and raveling.
- **Portland Cement Concrete (PCC) Pavements –** corner breaks, divided slabs, durability cracking, faulting, linear cracking, patching, scaling, joint spalling, and corner spalling.

Figure 6-5: Examples of Alligator Cracking (Left), Pothole (Center), and Spalling (Right)



Source: Wisconsin Department of Transportation, Bureau of State Highway Programs

Figure 6-6: 2010-2015 Percent of State Backbone Highway Pavement Rated Fair or Above



Source: Wisconsin Department of Transportation, MAPSS

The 2015 data shows 97.6 percent of the backbone system is in fair or above condition, a slight improvement over the previous year. Backbone highways typically rate higher than non-backbone highways because backbone pavement needs are prioritized due to their importance to overall system function. While backbone highways represent only 13.5 percent of state trunk highway miles, they carry 49 percent of highway traffic and approximately 85 percent of the freight ton-miles traversing Wisconsin's state trunk highways.

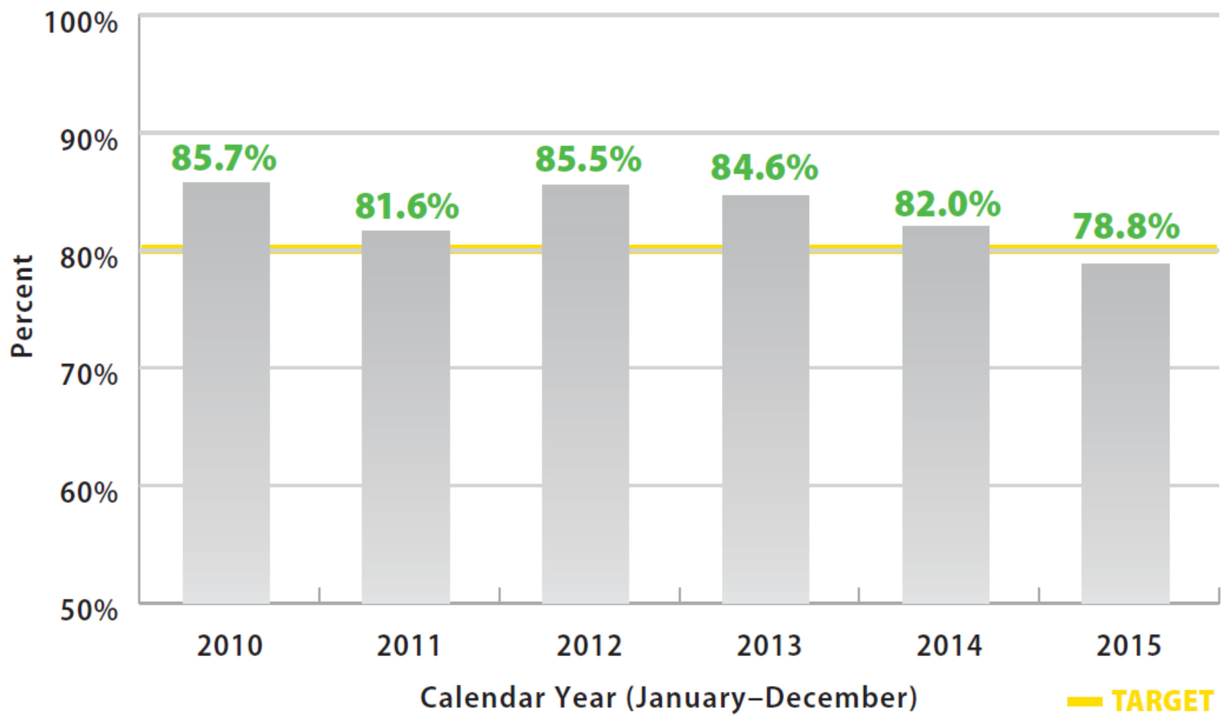
As noted earlier, generally, backbone pavement needs are prioritized above non-backbone pavement needs due to their importance to overall system function. Pavement condition is affected by material quality, adequacy of pavement design, traffic loading, improvement and maintenance history, age, and environmental factors such as temperature and moisture. The department considers all of these factors when using asset management tools and strategies to determine investment levels and steward highway improvement funding provided through the state budget.

The department continues to research, develop, and implement pavement rehabilitation and maintenance processes that maximize the long-term health of the highway system. This includes researching and testing new materials, as well as enhancing asset management strategies with improved data, analysis tools, and prioritization to make sound investment decisions. The improved collection methodology enhances the effectiveness of the Pavement Management Decision Support System (PMDSS). PMDSS uses pavement data to assist engineers, planners, and analysts in determining which segments of roadway to include in the six-year improvement program.

Non-Backbone Pavement Condition

The majority of the 11,800 miles of state trunk highway is on the state's non-backbone highways. Referred to as the 3R (resurfacing, restoration, and rehabilitation) system internally to WisDOT, these highways comprise over 10,000 miles of the entire system, and provide critical system connections to the state's backbone routes. The goal for 3R routes is to have 80 percent of pavements rated fair or above using the most cost-effective pavement improvement methods available (Figure 6-7).

Figure 6-7: 2010-2015 Percent of State 3R/Non-Backbone Highway Pavement Rated Fair or Above



Source: Wisconsin Department of Transportation, MAPSS

The 2015 data shows 78.8 percent of the non-backbone system in fair or above condition, a reduction of about 3.2 percentage points from 2014. Non-backbone highways carry 51 percent of all state trunk highway traffic and approximately 15 percent of the freight ton-miles traversing Wisconsin's state trunk highways.

Similarly to the backbone condition performance measure, the department continues to research, develop, and implement pavement rehabilitation and maintenance processes that maximize the long-term health of the highway system.

Structures and Bridges

The state trunk highway system includes over 5,200 bridges and similar structures, as well as a variety of ancillary structures such as retaining walls, culverts, sign structures, noise barriers, and high-mast light structures.

By FHWA definition, a bridge has a minimum clear span length of 20 feet between the faces of abutments. A culvert can resemble a bridge with similar features and characteristics, but is less than 20 feet long from abutment to abutment. Culverts can also be fixed metal or precast/concrete pipes or chutes. Culverts, unlike bridges, are not inventoried or even inspected in the same manner as state, county, and local bridges.

Most bridges are designed to have a life expectancy of up to 75 years. To achieve this, bridge decks, girders, trusses, and substructures must be regularly maintained. WisDOT performs regular inspections on all bridges, and stores the inspection data in the department's Bridge Management System. Bridge inspections are key to helping the department decide whether future bridge construction or repair is needed.

WisDOT continually monitors and applies emerging technologies to further complement the department's strong asset management philosophy. This enables the department to continually analyze bridge data, monitor bridge conditions, identify potential future problems, and recommend preservation activities. For planning purposes, WisDOT measures bridge performance using two ratings:

- Deck condition – evaluates the riding surface and other deck components on a scale of 0 to 9. A lower score indicates a need for ongoing maintenance and eventual deck replacement.
- Sufficiency rating – rates a bridge's sufficiency (or capability). Factors include the bridge's adequacy, safety, serviceability, and functional obsolescence, as well as how essential the bridge is for public use. Ratings range from 0 to 100. Lower scores indicate a deficiency.

WisDOT developed performance thresholds to rate bridges and structures regarding deck condition, infrastructure quality, and load-carrying capacity. WisDOT uses these performance measures to identify bridges that need preservation or maintenance improvements. The department also uses these performance measures to supplement bridge inspection reports. Both bridge inspections and the performance measures help extend the useful life of the facility and delay structural deterioration that may result in the need for weight limits.

WisDOT has developed a robust asset management program for structures. The program includes defined inspection cycles, replacement, and maintenance strategies.

State-Owned Bridge Condition

Wisconsin's bridges are critical infrastructure assets of the transportation network. Inspecting and evaluating bridges is a key component of meeting the department's transportation safety and efficiency goals. An accurate inventory of the state's bridges allows for planning and prioritizing limited resources to address deterioration concerns and operational needs.

Wisconsin has a known inventory of more than 14,000 bridges that are maintained by the state and local governments. The department performs bi-annual safety inspections and condition assessments of bridges. This is the designated frequency in National Bridge Inspection Standards (NBIS). Through these inspections, condition rating data is collected and reported to WisDOT for the deck, superstructure, and substructure, and an overall rating of good, fair, or poor condition is assigned each calendar year. The final bridge rating is based on the lowest rating a bridge received for any of its components.

Wisconsin Bridges[33]
• 14,116 Bridges (over 20' in length) o 5,259 State owned (37 percent) o 8,857 Locally owned (63 percent)

Bridge Component Definitions
Deck – the portion of a bridge that carries traffic. **Superstructure** –the portion of the bridge that supports the deck and connects one substructure element to another. **Substructure** – the portion of the bridge that supports the superstructure and distributes all bridge loads to below-ground bridge footings.

[33] Wisconsin Department of Transportation, Bureau of Structures, "Annual Bridge Report." (April 2016).

Wisconsin bridges are an important infrastructure asset for the vitality of the highway transportation network. Ensuring safety for the traveling public is a top priority for the department. Inspecting and evaluating bridges is a key component to meeting this objective.

National Bridge Inspection Standards
The NBIS requires inspection of all publicly-owned highway bridges longer than 20 feet. The NBIS establishes minimum qualifications for inspection personnel, identifies which bridges to inspect, and defines the information to be collected and reported as part of the inspection process.

As of 2015, 96.8 percent of Wisconsin's more than 5,200 state-owned or maintained bridges had a good rating or fair rating (Figure 6-8), while 3.2 percent of state bridges had a poor condition rating.[34] Figure 6-8 also shows that Wisconsin has been exceeding the goal of 95 percent in good/fair condition in recent history. When including Wisconsin's 8,857 local bridges, the good/fair bridge condition rating drops to 91.8 percent, which is better than the national average of approximately 89.5 percent.[35]

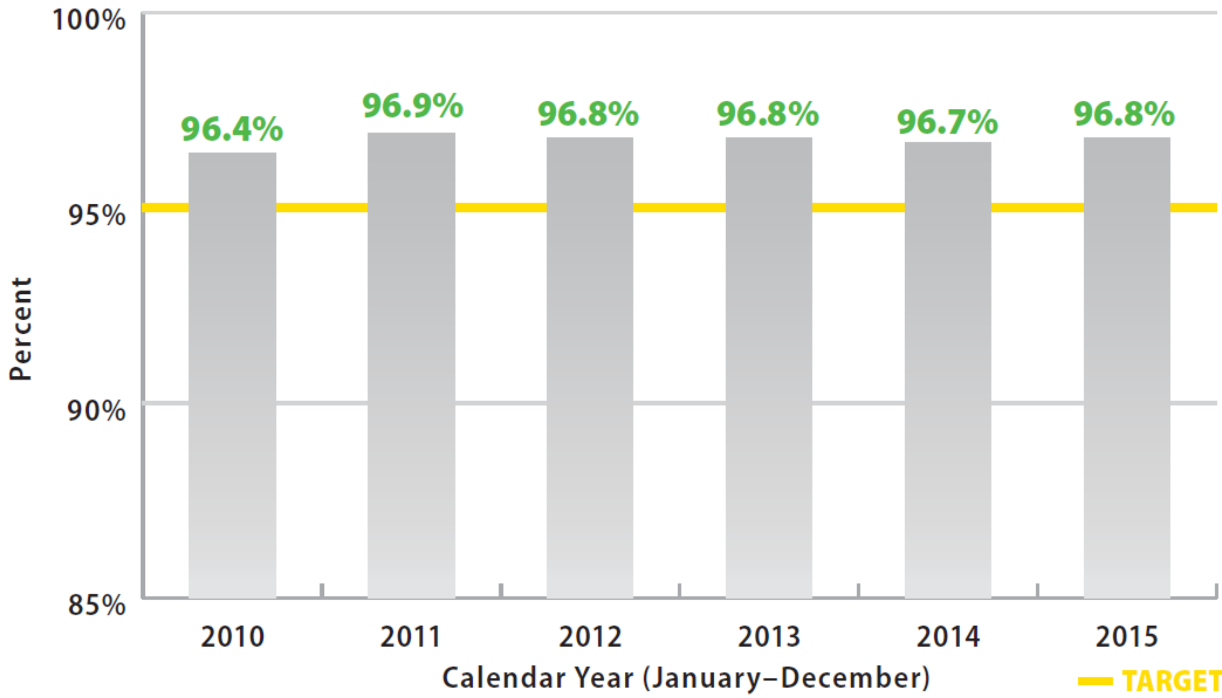
The increasing average age of the state bridge inventory is a significant factor in the overall percentage of bridges rated fair or above. The average age of state system bridges is more than 34 years,[36] and 1,171 state bridges were over 50 years old as of 2015. Wisconsin puts a high emphasis on maintaining and improving its bridges through its rehabilitation and replacement improvement programming. Bridges receive the highest priority in the project selection process. Wisconsin spends additional state money above the federal dollars it receives from the bridge program to maintain its bridges.

Highway Structure Information System
The Highway Structure Information System (HSIS) is a systematic approach to effectively manage state and local structures through a responsive, efficient online system. When state and local program managers are equipped with real-time performance data, they can make better-informed decisions on resource allocation. HSIS also incorporates the concept of structural data life cycle; this allows management of the structure from the planning phase through design, construction, maintenance, and the eventual replacement of the structure.

WisDOT continues to improve bridge inspection and bridge management programs by utilizing new technology and innovative management practices. In 2015, the department deployed mobile device technology for structure inspections and incorporated Highway Structure Information System asset management upgrades to improve the timeliness and accuracy of the state's structural data. Additionally, the department introduced a bridge preservation policy that includes and promotes lower-level treatments and actions to extend the long-term performance of the bridges on state highways.

34 Wisconsin Department of Transportation, MAPSS.
35 Ibid.
36 Ibid.

Figure 6-8: 2010-2015 Percent of Bridges Rated Fair or Above



Source: Wisconsin Department of Transportation, MAPSS

Bridges rated good and fair are safe. Bridges with a poor condition rating and open to traffic are also safe; however, these structures may need corrective action to ensure continued operation. An accurate understanding of the condition of the inventory of bridges allows for planning and prioritization of limited resources to address operational needs.

Good, Fair, Poor Condition Rating
Good – a range from zero problems to some minor deterioration of structural elements. **Fair –** all primary structural elements are sound but may have deficiencies such as minor deterioration, cracking, spalling, or scour. **Poor –** advanced deficiencies such as deterioration, cracking, spalling, scour, or seriously affected primary structural components. Bridges rated in poor condition may be posted with truck weight restrictions.

There were 44 state-owned bridges with weight restrictions in 2015; an improvement from 57 state-owned weight restricted bridges in 2013.[37] There were 305 state-owned bridges that have less than 16 foot vertical clearance in 2015.

[37] Wisconsin Department of Transportation, MAPSS.

Bridge Design and Heavy Vehicle Considerations

The current standard design life of a bridge is 75 years. In order to keep bridges in a good or fair condition, bridges must be designed responsibly in order to maximize the design life of the bridge.

Axle spacing is as important as axle weight in designing bridges. The Federal Bridge Formula was created in an effort to protect roadways and structures, which accounts for axle spacing. The Federal Bridge Formula has two key components:

- The Federal Bridge Formula establishes the maximum weight any set of axles on a motor vehicle may carry on the Interstate highway system.
- It identifies and limits the weight-to-length ratio of a vehicle crossing a bridge. This is accomplished either by spreading weight over additional axles or by increasing the distance between axles.

Maintenance and Preservation of Wisconsin's Transportation System

WisDOT's efforts to protect, maintain, and operate the state's transportation system include using appropriate maintenance and preservation strategies to maximize state investments. Ongoing routine maintenance refers to the daily activities that help maintain and preserve the system so that it provides a satisfactory level of service. While maintenance activities help address immediate system needs, eventually they are insufficient to address underlying infrastructure deterioration. At that point, preservation strategies are used to appreciably extend the infrastructure's useful life.

WisDOT's preservation and maintenance strategies foster:

- Ongoing routine and preventive maintenance
- Long-term preservation
- Continued availability of transportation services statewide

Highway Maintenance Activities

Ongoing routine maintenance refers to the daily activities that help maintain and preserve the system so that it provides a satisfactory level of service. Maintenance activities typically focus on system parts such as roadway shoulders, pavement markings, bridge railings, pavement cracks, and traffic signals. Examples of maintenance activities include:

- Patching potholes on roadways
- Maintaining and repairing publicly-owned rail lines
- Maintaining traffic signals
- Repairing dock walls
- Routinely inspecting bridges
- Repairing damaged bridges

Examples of Highway Maintenance Activities
• Pavement and bridge spot treatments • Shoulder repair • Repair and replacement of signs and pavement markings • Roadside vegetation control • Repair and restoration of state trunk highway facilities and structures after crashes, natural disasters, and vandalism • Maintenance of rest areas, waysides and some park and ride lots

To effectively maintain state trunk highway system infrastructure, WisDOT works to:

- Initiate a formal, ongoing preventive maintenance process
- Promote and implement sound environmental practices for all highway maintenance activities
- Implement proven maintenance management practices

Preventive maintenance is the periodic application of relatively inexpensive roadway treatments (for example, filling the pavement cracks on roadways) that help extend the life of the system by delaying deterioration. Postponing preventive maintenance ultimately results in larger repair projects that take longer to complete and, as a result, can cause such consequences as greater disruption to traffic flow. An effective preventive maintenance process includes:

- Monitoring existing state trunk highway conditions, identifying deficiencies, and setting priorities
- Developing a plan to carry out maintenance activities and address deficiencies

WisDOT addresses the most critical maintenance needs of the state trunk highway system infrastructure, including (not in order of priority):

- Repair needs of bridges and other structures
- Pavement and shoulders
- Pavement cracks
- Signs and markings
- Guardrails and other roadside safety features
- Drainage elements such as culverts, including restoration and replacement
- Traffic signals and other traffic management devices

In addition, WisDOT works to perform numerous other preventive maintenance activities, including:

- Keeping shoulders in good condition and free of debris
- Ensuring visibility at intersections by mowing and using plant growth retardants
- Controlling woody plants within the clear zone using herbicides and mowers
- Keeping rest facilities clean and in good repair
- Providing highway lighting where necessary

To monitor system performance and address deficiencies throughout the year, WisDOT uses a Maintenance and Operations Decision Support System (an extension of the current Maintenance Decision Support System (MDSS) that focuses on winter operations). This decision support system is a computerized information system that supports organizational decision-making activities and is intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions. This system helps highway maintenance staff identify and recommend specific treatments and timing strategies to complete necessary maintenance work. Moreover, WisDOT's regional maintenance field staff monitors county performance, specifically in the areas of establishing work plans, setting priorities and assuring compliance with maintenance standards. In terms of maintenance, WisDOT works to:

- Improve the department's existing maintenance management tools
- Research and evaluate new, cost-effective highway maintenance technologies
- Implement work zone and lane-closure management strategies and tools to maintain safety and minimize impacts on travelers
- Emphasize cost-effective strategies in county maintenance contracts

WisDOT continues to expand and refine its existing management system tools, including the Compass program. Compass is a decision-making tool that helps establish work priorities and allocate resources. A critical input for this program is an annual condition assessment of the state trunk highway system. The assessment provides condition information about shoulders, drainage, roadsides, traffic devices, bridges and winter operations. Over the long term, WisDOT works toward developing and implementing a comprehensive maintenance management system for all highway assets.

In addition to improving existing tools, WisDOT researches and evaluates new, cost-effective highway maintenance technologies and identifies best management practices that leverage existing resources and maximize efficiencies. Emphasis is placed on developing tools that not only pinpoint specific areas that need preventive maintenance, but prioritize the identified needs.

WisDOT emphasizes cost effectiveness in managing contracts with Wisconsin's counties. The department creates and tracks appropriate benchmarks and service delivery outcomes. The department works with counties as they define and provide a comprehensive suite of services.

Also, conducting highway maintenance activities can sometimes disrupt traffic flow. Work zone management strategies help minimize disruption and maintain state trunk highway system reliability. Oftentimes, work zone management requires creativity and flexibility. In response, WisDOT performs more and more of its maintenance work during non-peak traffic hours, including nighttime hours when traffic volumes are typically lower.

Roadside Maintenance Performance

Many factors affect the safety, efficient operation, and longevity of our highway system. Effective and consistent maintenance efforts preserve our investment in the highway system, enhance economic productivity, and minimize the impact to the natural environment.

The department's goal is to maintain a 3.0 out of 4.0 grade point average (GPA) of 28 features evaluated including roadway shoulders, drainage features, roadside elements, and traffic control and safety devices (Figure 6-9).[38]

Condition data is collected each fall as part of a field review process. Rating teams composed of region maintenance coordinators and county patrol superintendents rate a random sample of 1,200 one-tenth mile segments around the state. The condition of elements such as warning signs, markings, shoulder, and roadside litter are assessed and documented. Grading curves are established to help identify areas for improvement, such as reducing gravel shoulder drop-off, removing hazardous debris from shoulders, maintaining visible center line and edge line markings, and providing more visible, longer-lasting traffic signs. The grading curves, developed from maintenance criteria, are used to develop an average GPA.

The criteria for identifying an average GPA comes from five "contribution categories" that have been developed to describe how various roadway elements function with drivers and the overall highway infrastructure.

Critical safety is the first category. Critical safety features are those that require immediate action and remedy a problem situation. Critical safety features include emergency repair of regulatory/warning signs, hazardous debris, drop-off or buildup on paved/unpaved shoulders, centerline markings, protective barriers, and edge line markings.

Safety and mobility features, the second category, are highway attributes and characteristics that protect users against, and provide them with a clear sense of freedom from, danger, injury, or damage. Features include woody vegetation control, mowing for vision, fences, special pavement markings, culverts, storm sewer, cross slope on unpaved shoulders, delineators, and routine placement of regulatory/warning signs.

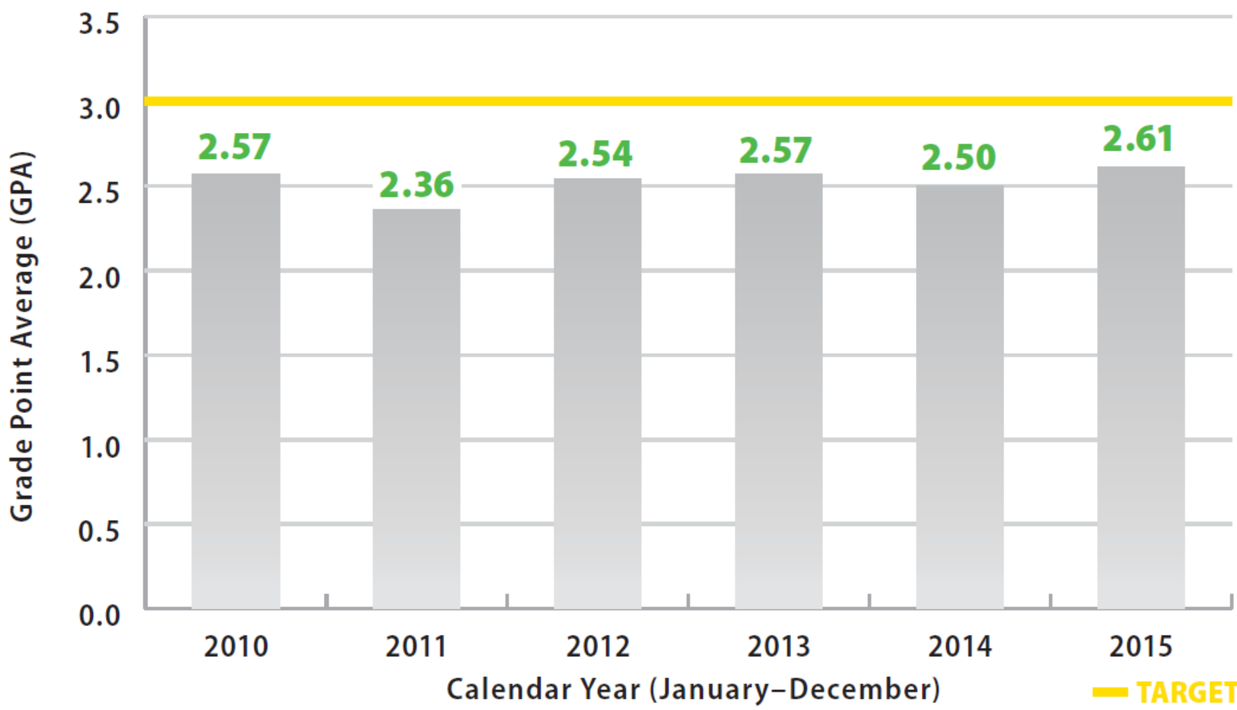
The third category, stewardship, captures performance on routine and preventive maintenance activities that preserve investments and ensure function for their full expected service life or longer. Features include ditches, drains, curb and gutter, flumes, cracking on paved shoulders, and erosion on unpaved shoulders.

Ride quality and comfort features provide a state of ease and quite enjoyment for highway users. Ride/comfort features include potholes/raveling on paved shoulders, emergency repair of "other" signs, and routine replacement of "other" signs.

[38] Wisconsin Department of Transportation, MAPSS.

The last category is aesthetic, which is concerned with the display of natural or fabricated beauty along highway corridors, including landscaping and architectural features, litter, and mowing.

Figure 6-9: Grade Point Average for the Maintenance Condition of State Highway Roadsides



Source: Wisconsin Department of Transportation, MAPSS

Overall conditions improved slightly between 2014 and 2015. The statewide grade point average increased 0.11 in 2015, to its highest level in the last six years. Four features improved their condition one grade level (drop-off/build-up on paved shoulders, delineators, flumes, and potholes/raveling). Three of the four improved grades were the result of minor backlog changes, while one feature (flumes) had a significant improvement. However, one feature (routine replacement of regulatory/warning signs) fell a grade level as a result of a one percentage point change.

The annual GPA is impacted by baseline conditions, maintenance budget levels and policies, winter maintenance costs, and improvement program investments. The highway maintenance condition largely depends on funding from routine maintenance agreements and improvement projects. The department's first priority is snow and ice removal while the balance is spent on non-winter activities. Historically, about three-quarter of maintenance dollars are programmed to winter, pavement and structure maintenance activities, with the balance used on system needs associated with the 29 Compass features. As stated earlier and described in more detail on the following page, Compass is a decision-making tool that helps establish work priorities and allocate resources. A critical input for this program is an annual condition assessment of the STH. The assessment provides condition information about shoulders, drainage, roadsides, traffic devices, bridges, and winter operations.

The department employs innovative strategies to address highway maintenance needs. These approaches include focusing on cost-efficient delivery of winter maintenance services, improved reporting of Compass results to the regions, and linking targets to county routine maintenance agreement activities. A $50 million appropriation increase went into effect in fiscal year 2015 and increased the routine maintenance base program to $170 million annually. At this higher level, the department can effectively respond to annual variability in winter maintenance cost demands while sustaining a viable annual level of financial commitment to non-winter routine maintenance demands. In addition, alternate contracting methods and broader-based delivery options are being piloted to test enhancements to the long standing county-based routine maintenance delivery model. Efficiency gains from these pilot efforts may help to meet the 3.0 target GPA. It is estimated it will take three to five years of investment at current levels to see a sustained impact on the Compass GPA results. The 2015 condition data represents only the second year of increased maintenance funding at the $170 million level.

Compass
Compass is WisDOT's highway operations quality assurance and asset management program. Launched in 2001, it plays a critical role in educating and communicating maintenance needs to WisDOT stakeholders. Compass uses existing WisDOT data and statistical sampling to gather information on existing highway conditions and to explain the relationship between those conditions and the maintenance budget. Annual Compass reports provide information about the conditions of shoulders, drainage, roadsides, selected traffic devices, traveled ways, bridges, and winter maintenance. Compass also works with operations managers to set annual targets for highway operations conditions under current budget levels. Compass will complement the Maintenance and Operations Decision Support System. While the system will help optimize decisions about specific treatment types and the timing for completion of the work, the Compass program will provide information about the extent of work needed and will help WisDOT consider trade-offs among various work priorities.

Preservation Activities

While maintenance activities help address immediate system needs, eventually they are insufficient to address underlying infrastructure deterioration. At that point, preservation strategies are used to appreciably extend the infrastructure's useful life. Preservation requires cost-effective strategies that enhance the long-term performance of the system while improving safety and striving to meet user expectations. These activities may include:

- Rehabilitating bridges and structures
- Resurfacing or reconstructing highways, local roads, and airport runways
- Dredging harbors and shipping channels

State preservation activities, such as retaining current passenger and freight services, also ensure continued availability of critical transportation options. The availability of transportation options to move people and goods enhances Wisconsin's quality of life and economic well-being.

Highway Preservation Activities
• Resurfacing – placing a new surface on existing pavement to provide a better riding surface and to extend or renew pavement life. Generally requires no capacity increase or change in roadway characteristics (such as width, curves or slope). • Replacement – removing all existing pavement layers and replacing with new pavement. Occurs when deterioration is severe. Generally, no capacity or roadway characteristics changes are made. • Reconditioning – work done in addition to resurfacing or replacing pavement. Minor work may include pavement widening and shoulder paving. Major work involves improvement to site-specific roadway characteristic deficiencies, such as isolated grade, curve, or safety issues related to sight distance problems. • Reconstructing – total rebuilding of an existing highway to improve maintainability, road characteristics and traffic safety. Usually completed on existing alignment. Normally requires some right of way acquisition.

WisDOT works to preserve the existing STH infrastructure. To accomplish this, WisDOT uses a performance-based approach to identify state trunk highway system preservation needs, including using a bridge asset management system. In addition, WisDOT continues to refine and expand a state-of-the-art process for prioritizing needs and identifying cost-effective state trunk highway construction alternatives.

Preventive maintenance, resurfacing and reconditioning strategies have extended the useful life of the system. However, infrastructure deterioration – due to increased traffic volumes, freight movements, and typical wear and tear – has resulted in the need for significant improvements, including reconstruction and replacement. Overall, ensuring the continuation of system preservation is critical to maintaining the safety and quality of the state's roadways.

Preventive Maintenance
Preventive maintenance is the periodic application of relatively inexpensive roadway treatments (for example, filling the pavement cracks on roadways) that help extend the life of the system by delaying deterioration. Postponing preventive maintenance ultimately results in larger repair projects that take longer to complete and, as a result, can cause such consequences as greater disruption to traffic flow. An effective preventive maintenance process includes: • Monitoring existing state trunk highway conditions, identifying deficiencies, and setting priorities • Developing a plan to carry out maintenance activities and address deficiencies

Local Roads Pavement and Bridge/Structures Condition

As identified in Chapter 5, *Wisconsin's Transportation System Assets*, Wisconsin's locally-owned and maintained road and bridge system serves as a critical link in the state's total transportation network. With over 100,000 miles of county, town and municipal roads and 8,857 bridges, the local road network accounts for approximately 90 percent of Wisconsin's public road mileage. For freight, local roads are important because they usually carry the "first mile" and "last mile" of a shipment before it reaches its destination.

Centerline Miles
Centerline miles are used to measure the length of roadways. Centerline miles represent the total length of a given road from its starting point to its end point. The number and size of lanes on the road are not considered when calculating its centerline mileage.

As a critical adjunct to the STH, the local road system offers connections not only to local activity centers, but also to state and national facilities of importance such as ports and economic business centers. Local roads connect to the state trunk highway network, airports, rail stations, and bus and ferry terminals. They are the first and usually last link in the state's farm-to-market commerce and offer critical links for area businesses and tourists.

Some of the state's local roads and bridges are not designed to carry heavier loads. Overweight trucks may accelerate deterioration of highways and bridges, and can result in the need for additional infrastructure investment. Allowing oversize and overweight vehicles on Wisconsin's roadways requires a balance between increasing freight movements to meet economic development goals and minimizing impacts to local roads, highways, and bridges.

Local Road Pavement Condition

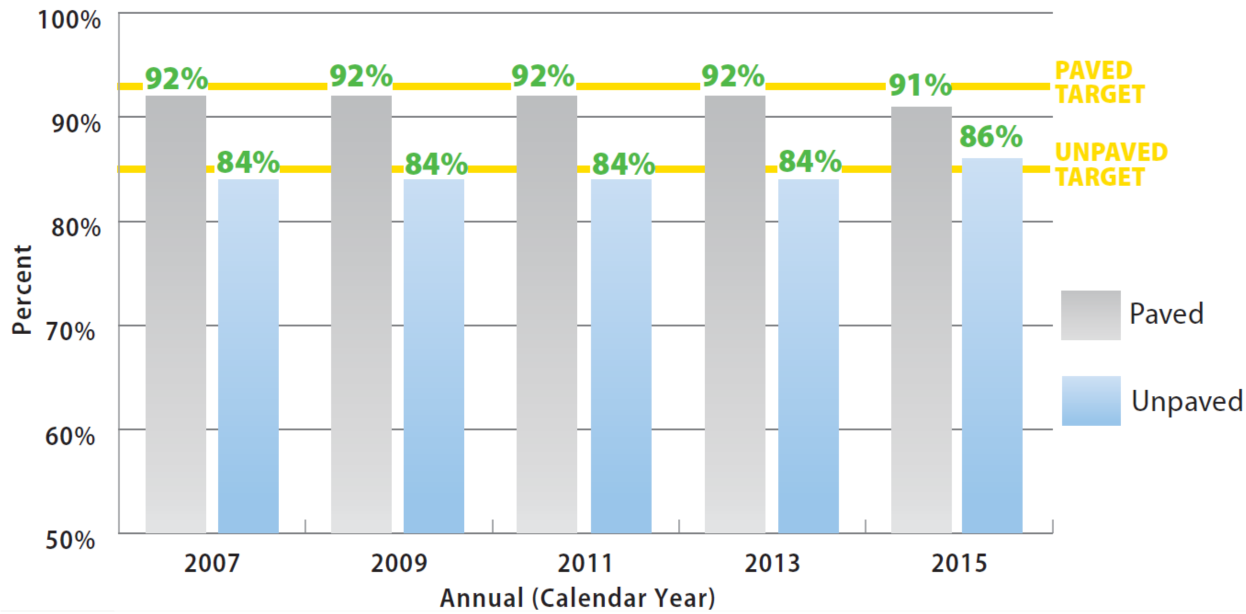
Every two years, municipalities and counties are required, under state statute, to report pavement condition ratings of roads under their jurisdiction to WisDOT. Most local governments collect data for all local roads under their jurisdiction by using the Pavement Surface Evaluation and Rating (PASER) system, a tool designed by UW-Madison's Transportation Information Center to collect pavement data and rate roads. They then may use WisDOT's Wisconsin Information System for Local Roads (WISLR) to manage and analyze the pavement data. WISLR is an Internet-accessible system that helps local governments and the department manage local road data to improve decision-making, and to meet state statute requirements. WISLR is a receptacle for local road information, such as width, surface type, surface year, shoulder, curb, road category, functional classification, and pavement condition ratings. The department's goal is to have 93 percent of all paved, and 85 percent of all unpaved, local pavements in fair or better condition.

The rating scale ranges from 10 (excellent condition) to 1 (failed). In general, most pavements will deteriorate through the phases listed in the rating scale. However, it is common for pavements to skip several levels when major defects appear or when the pavement is repaired. The time it takes to go from an excellent (10) to a very poor condition (1) depends largely on the quality of the original construction and the amount of heavy traffic loading.

As of 2015, 91 percent of Wisconsin's paved local roads are rated fair and above, and 86 percent of the unpaved local roads are rated fair and above (Figure 6-10).[39]

[39] Wisconsin Department of Transportation, MAPSS.

Figure 6-10: 2007-2015 Local Road Pavement Condition – Percent with Rating of Fair or Better



Source: Wisconsin Department of Transportation, MAPSS

Pavement condition is impacted by material quality, adequacy of pavement design, environmental factors such as temperature and moisture, traffic loading, improvement and maintenance history, and pavement age. All of these factors must be considered when determining what rehabilitation strategies will provide cost-effective service life.

Wisconsin makes funding available through a number of programs to help support the transportation infrastructure needs of local governments, including General Transportation Aids (GTA), the Local Roads Improvement Program (LRIP) and the Surface Transportation Program (STP). The department evaluates and compiles condition data to inform state and local decision makers. The department also publishes program guidelines, meets with various partners, and provides training to help local units of government.

WisDOT works with its local partners to define statewide expectations specific to local road network goals and priorities, ensuring development and maintenance of a quality network. WisDOT also develops an appropriate framework within which to promote sound investment decisions at the local level. This is accomplished through the use of available data and asset management tools, such as the pavement analysis tools provided by WISLR. Currently, local road network system performance monitoring is limited to pavement and bridge condition analyses; however, the data and tools offered by WISLR provide a critical starting point for both the state and local governments.

WisDOT continues to analyze local road pavement conditions using WISLR. The department assists local governments by doing system level analysis to identify priority areas and measure progress in addressing local road needs.

Locally-Owned Bridge Condition

Local units of government perform bridge inspections for all local bridges every two years. This is the designated frequency in the NBIS. Through these inspections, condition rating data is collected and reported to WisDOT for the deck, superstructure, and substructure, and an overall rating of good, fair, or poor condition is assigned each calendar year. The final bridge rating is based on the lowest rating a bridge received for any of its components.

Although local bridges are maintained through local decision, there are state programs that provide funding to help offset this expense. Table 6-7 lists the conditions of the locally-owned bridges.

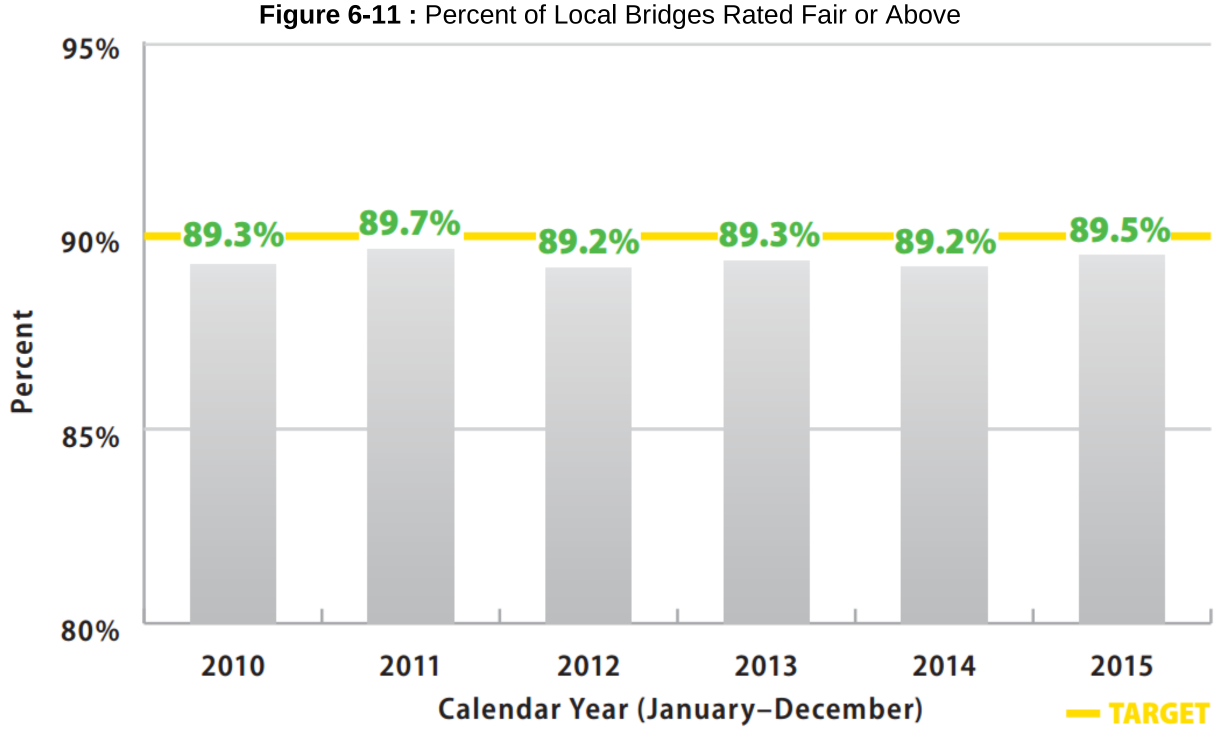
Table 6-7: 2015 Locally Owned Bridge and Deck Conditions

Rating	NBI Condition Rating by # of Bridges	NBI Condition Rating by Deck Area	Deck Condition Rating by # of bridges	Deck Condition Rating by Deck Area
Good	50 %	50 %	61 %	62%
Fair	39 %	41 %	33 %	32%
Poor	11 %	9 %	6 %	6%

Source: Wisconsin Department of Transportation

The department's goal is to have 90 percent of Wisconsin's locally-owned or maintained bridges rated fair or above. As of 2015, 10.5 percent of Wisconsin's locally-owned or maintained bridges have a poor condition rating, leaving 89.5 percent of Wisconsin's 8,857 locally-owned or maintained bridges have a good or fair rating. Local bridge condition saw a 0.3 percent improvement from 2014. Additionally, over the last six years the percentage of good and fair condition bridges has been relatively constant (Figure 6-11).[40]

Figure 6-11 : Percent of Local Bridges Rated Fair or Above



Source: Wisconsin Department of Transportation, MAPSS

Local bridge conditions are affected by the increasing age of bridges; bridge damage caused by corrosion, vehicle collision, and other environmental factors; changing traffic counts; completion of bridge rehabilitation and replacement projects; and funding availability on a state and local level. Decisions on rehabilitating or replacing locally-owned bridges are the sole responsibility of the local units of government.

[40] Wisconsin Department of Transportation, Bureau of Structures, "Annual Bridge Report." (April 2016).

The Local Bridge Improvement Assistance Program, per state statute, was established to rehabilitate or replace, on a cost-shared basis, deficient existing public bridges on Wisconsin's local highway and road systems. WisDOT publishes a list of deficient bridges, and WisDOT regional staff work with counties and local governments by assisting in the application process to identify rehabilitation or replacement bridge projects for funding consideration under the local bridge program. The department also works with partners to implement a change management process to help manage local bridge funding and keep projects on schedule. In addition, the department continues to develop tools to aid local governments in estimating costs and prioritizing eligible projects.

An area of concern related to structures is the number of bridges already posted on secondary roads. These local bridges are load restricted because of condition and obsolescence.

Load Postings in Wisconsin 2015
State – 44 Bridges (0.8 percent) Local – 808 Bridges (9.1 percent)

In many cases, heavy vehicles (mining, agricultural, energy cargo or equipment, and some timber-related vehicles) are not designed to meet the local road and bridge size and weight requirements found in Wisconsin statutes. However, these oversize-overweight (OSOW) vehicles may be eligible for a multi-trip or single-trip permit to traverse state roadways and bridges. Fees collected from these permits do not necessarily generate enough revenue to supplement the damage caused by heavy vehicles. Thus, it is important for the state and local municipalities to have an asset management program to mitigate, reduce, or impede the deterioration of their respective bridges.

Culverts

Over 50,000 culverts are located on the state system, with another 86,000 culverts on the local system. A culvert can resemble a bridge with similar features and characteristics, but is less than 20 feet long from abutment to abutment. Culverts can also be fixed metal or precast/concrete pipes or chutes. Culverts, unlike bridges, are not inventoried or even inspected in the same manner as state, county, and local bridges.

Culverts
Culverts are simply defined as a structure that is less than 20' in length. • State System – Rough estimate would be 50,000+ structures • Local System – Rough estimate would be 86,000+ structures

Rail Line and Bridge Condition

As discussed previously, Wisconsin has more than 3,300 miles of rail corridors in the state, owned by both public and private organizations. In total, approximately 2,600 track miles (over 75% of Wisconsin's track miles) are privately owned, with the remaining being publicly-owned rail lines. WisDOT works in partnership with the railroad operators on the 718 miles of state-assisted lines to review condition, discuss capital improvement needs, and schedule projects.

In 2015, 55 miles were improved to meet FRA Class 2 standards through WisDOT-funded projects and 12.05 miles of rail line deteriorated to below FRA Class 2 standards due to poor tie conditions. A total of 453 of the 700-plus miles of track (63 percent) met the department goal. This is a 43 mile increase from 2014 to 2015 in the number of miles that meet the standard.

Because WisDOT has limited information on the condition of private rail lines, the state's primary focus is on monitoring system performance on state-supported rail lines. WisDOT uses speed and weight data to measure rail line and bridge condition. Therefore, the focus of this section is speed (maximum allowable for a section) and weight (maximum allowable for a section), primarily applied to publicly-owned rail lines.

Rail Line Operating Standards[41]

The FRA sets the operating standards for rail lines. The maximum allowable speed for freight trains by track type is:

- Class 1 - Up to 10 MPH
- Class 2 - Up to 25 MPH
- Class 3 - Up to 40 MPH
- Class 4 - Up to 60 MPH
- Class 5 - Up to 80 MPH

The industry standard for maximum allowable speeds is Class 2. WisDOT uses this information to set goals for operation on the state-support rail lines. Also, achieving Class 2 standards enhances the competitiveness with other rail lines.

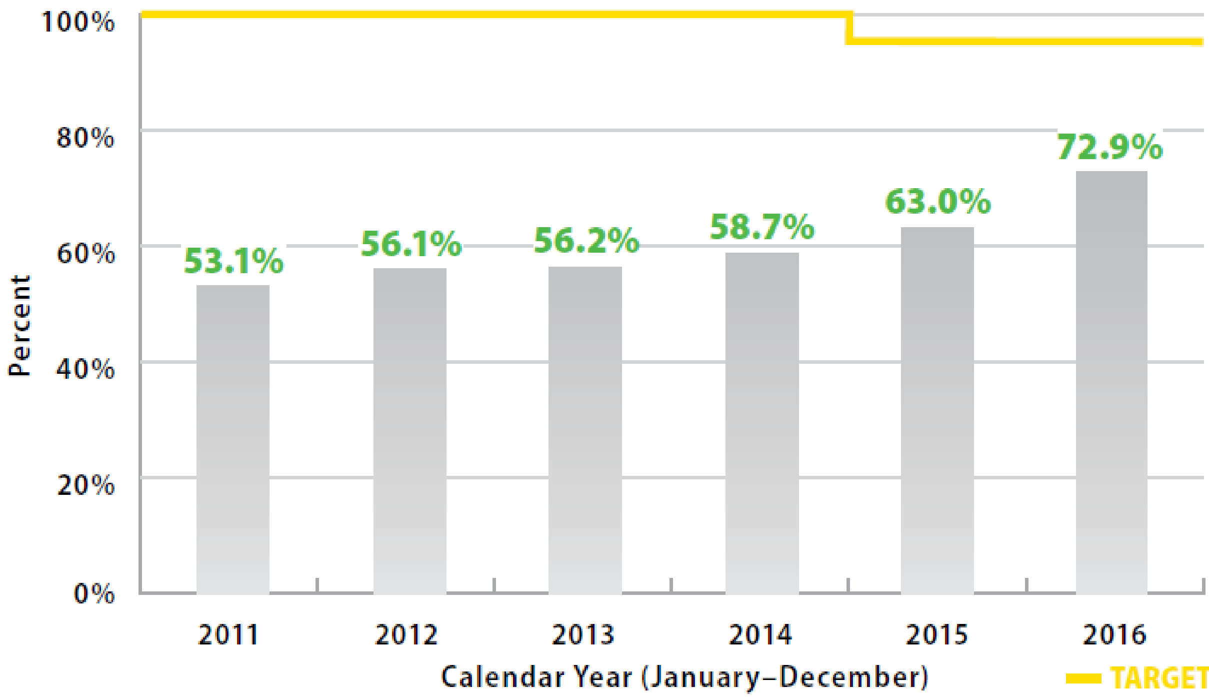
Track Speeds

The department's goal, is to have 95 percent of the system operating at FRA Class 2 operating speed standards. From 2011 through 2014, the department's goal was to have 100 percent of the system operational at Class 2 operating speed standards (Figure 6-12), but was dropped to 95 percent to focus on the state-owned system. The FRA Class 2 standards include tracks capable of operating loaded 286,000 pound rail cars above 10 miles per hour and not exceeding 25 miles per hour (see Figure 6-12).

The track is evaluated based on the percent of track miles operating at speeds allowed by the FRA's Class 2 Track Safety Standards. The percent of miles of rail line meeting the standard is calculated by dividing the amount of track meeting or exceeding FRA Class 2 standards by the total amount of state-owned rail lines. By 2015, 63 percent of the system was operating at Class 2 operating speed standards. The latest quarterly update of this measure reported 73 percent of state-owned rail line miles met or exceeded Class 2 standards in 2016.

[41] Federal Railroad Administration, Office of Railroad Safety, "Track and Rail and Infrastructure Integrity Compliance Manual: Volume II - Chapter 1 - Classes 1 through 5."

Figure 6-12: Percent of Miles of State-Owned Rail Line Meeting FRA Class 2 Standard (10-25 MPH)



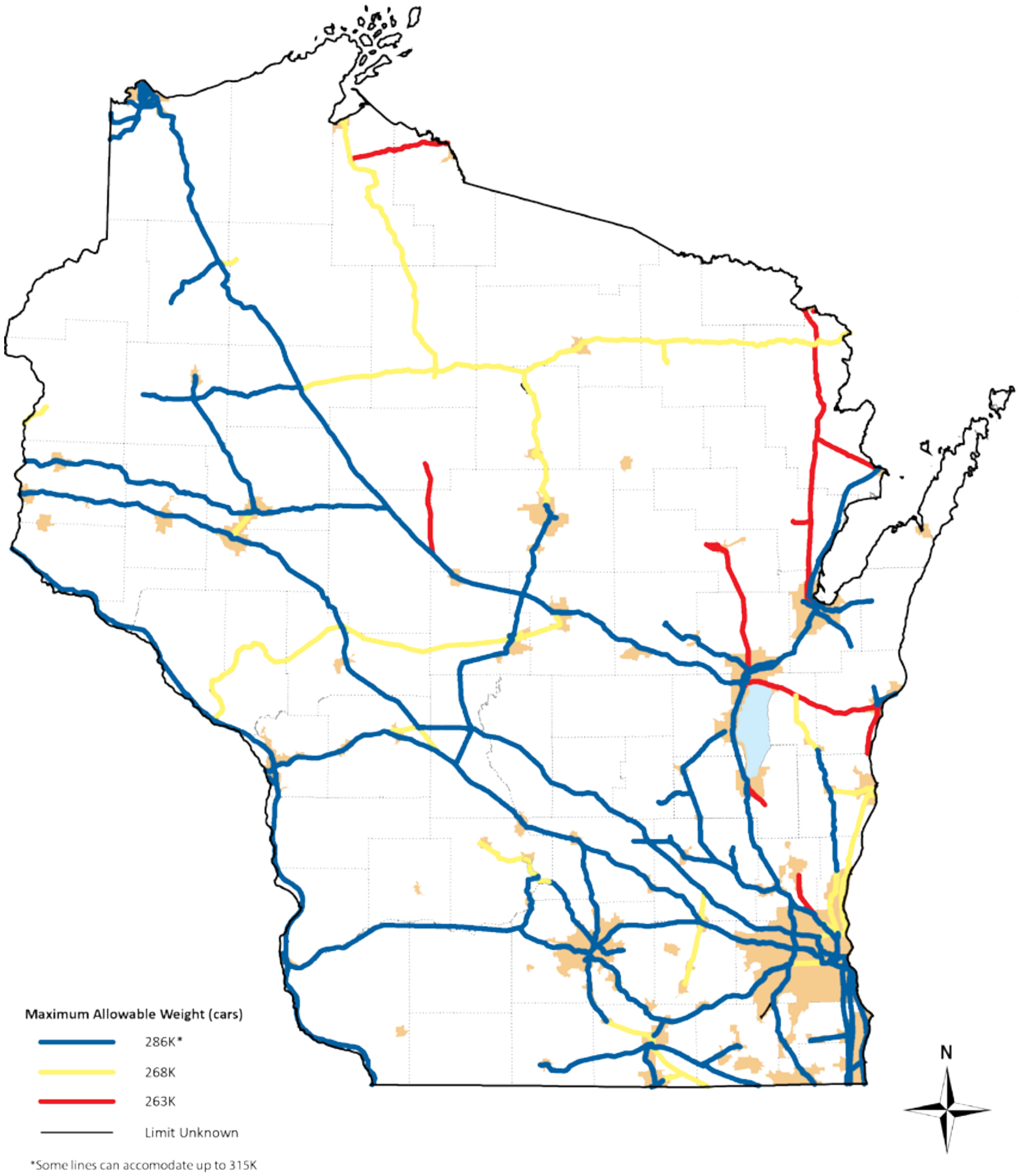
Source: Wisconsin Department of Transportation, MAPSS

The department reviews the annual maintenance plans of companies operating on state-owned railroad track and discusses opportunities to upgrade rail track and structure conditions. The department's rail grant and loan programs help fund railroad infrastructure rehabilitation projects to improve track structure and increase operating speeds each year. Annual compliance inspections are done by WisDOT to ensure that railroads properly maintain state-owned rail lines. Ongoing investment in the state's rail lines and enforcement of maintenance standards have facilitated the upward trend in the percent of miles meeting FRA's Class 2 operating standards (able to handle 286,000 pounds between 10 and 25 MPH) since 2011.

Maximum Allowable Weight

Examining maximum allowable car weights is another way of looking at Wisconsin's rail network capacity, not only in terms of what commodities can be carried, but also the ability of short lines to service local freight that needs a connection to the long-haul (Class I) market. Key condition measures for rail are speed (maximum allowable for a section) and weight (maximum allowable for a section). Figure 6-13 depicts the full system of rail lines and their known maximum allowable weights as of 2016. In Wisconsin, the rail industry will likely maintain the 286,000 pound standard for the near term.

Figure 6-13: 2016 Maximum Allowable Weight per Rail Car



Source: Wisconsin Department of Transportation, Bureau of Transit, Local Roads, Railroads and Harbors

Continuous Welded Rail

Continuous Welded Rail (CWR) refers to the way in which rail is joined to form track. Through CWR, rails are welded together to form one uninterrupted rail that may be several miles long. Although CWR is normally one continuous rail, it may contain joints for one or more reasons (such as insulated joints that electrically separate track segments for signaling purposes).[42]

Regulations governing the installation and maintenance of CWR were first issued in 1971 as part of the Federal Track Safety Standards. Over the subsequent decades driven by legislative mandates together with knowledge

[42] Federal Railroad Administration, Office of Railroad Safety, "Continuous Welded Rail."

gathered from industry, the CWR regulations have expanded. Today railroads are required to adopt and comply with CWR programs that cover procedures for installing, adjusting, inspecting, and maintaining CWR, as well as inspecting joints in CWR track.

Upgrading track on state-owned lines with 115-lb. CWR—replacing legacy rail that is often more than 100 years old—has virtually eliminated rail defects and breakages and reduced the occurrence of derailments wherever CWR has been installed. As a result, new 115-lb. CWR improves transportation efficiency and reliability for Wisconsin shippers.

Rail Bridge Condition

State-owned bridge structures on the rail system are evaluated similar to rail lines. Namely, the weight per rail car at a set speed. The following classifications are used to define the capacity of Wisconsin's state-owned rail bridges:

- 286,000 pounds per car at 25 miles per hour
- 286,000 pounds per car at 10 miles per hour
- Less than 286,000 pounds per car

Many rail bridges in Wisconsin are original and date back to the late 1800s and early 1900s. They were built of varying materials including timber, concrete, and stone. Like other information regarding railroads, condition data on bridges is proprietary.

Bridges can have capacity issues if they cannot support heavier cars or provide enough clearance to accommodate doublestack movements. On the state-owned rail system operated by Wisconsin & Southern Railroad (WSOR), there are 139 timber bridges, 106 steel structures, eighteen concrete bridges, seven stone bridges, and seven highway bridges for a total of 277 bridges. Findings from a recent study concluded that the steel structures could sustain 286,000 pound car traffic. Timber bridges however, if exposed to 286,000 pound traffic, would have at most a life of five years.

WSOR also operates over trackage leased from the Class I railroads, which includes an additional 87 bridges of which the majority are steel structures.

Wisconsin currently has no capacity issues with regard to tunnels or bridges. If, however, UP would run intermodal doublestack containers through Wisconsin there are several bridges on the Milwaukee and Adams subdivisions that would need modifications to support doublestack traffic.

Table 6-8 shows the number of state-supported structures on which Wisconsin and Southern Railroad (WSOR), Escanaba and Lake Superior (E&LS), and Wisconsin Great Northern Railroad (WGNR) operate on.

Table 6-8: 2015 Wisconsin Railroad Bridge Capacity

	Total System Structures	Total System Structures in Lineal Feet	Structures 286,000 lbs. Capable at 25 mph	Structures 286,000 lbs. Capable at 10 mph	Structures Not 286,000 lbs. Capable
WSOR	361	31,004	254 (70%)	99 (27%)	3 (1%)
E&LS	40	N/A	29 (73%)	11 (28%)	0 (0%)
WGNR	1	N/A	0 (0%)	1 (100%)	0 (0%)

Source: Wisconsin Department of Transportation, MAPSS

Waterway Condition

Wisconsin is bordered by, and has access to, more than 200 miles of Mississippi River shoreline and more than 800 miles of Great Lakes coastline. The commercial ports of Wisconsin generate more than $1.6 billion in economic activity and support almost 10,000 jobs. These benefits are derived from a range of activities including the movement of freight and project cargo—most often higher weight, lower-value products such as coal, aggregates, and grains. Cement, energy, and petroleum products are also shipped on Wisconsin waterways.

The waterways that surround Wisconsin, the Mississippi River and the Great Lakes, are underutilized as a means to move freight. Recent estimates indicate that the Great Lakes System is operating at about half its potential capacity. Reasons for this underutilization relate to the type of commodities traditionally transported by water and the lack of intermodal connections. Additional information available in Chapter 7, *Freight Transportation Trends, Issues, and Forecasts.*

Bulk commodities (grain, fertilizer, iron ore) have different service requirements than goods shipped by trucks or air, which typically need to be shipped faster. While Wisconsin's waterways are connected to an extensive waterway network, that network is not necessarily well integrated into the road and rail systems.

Wisconsin Commercial Ports Development Initiative

The Wisconsin Commercial Ports Development Initiative is an overarching vision and multifaceted strategic plan for the development of Wisconsin's commercial ports and Inland River system to more fully utilize and develop Wisconsin's port facilities.

The development effort will support sustainable market attraction and growth at ports as well as economic and community development that contributes to the overall well-being and quality of life in the State of Wisconsin. Phase 1 completed in December 2014 included an asset inventory and assessment of priorities. Phase 2 was completed October 2016 and includes identification of goods that could be more efficiently moved by water instead of other modes.

Roadway Connections to Wisconsin's Ports

The road network that connects to the state's ports is a critical, but sometimes-overlooked, part of Wisconsin's transportation system. Typically, these are locally-owned and operated roads. Even though they are local roads, many are part of the NHS because they provide access to intermodal facilities. In some instances, maintenance needs are deferred because they typically do not serve high volumes of passenger traffic.

In addition, the road network can have difficulty serving oversize or overweight trucks traveling to and from the ports. This can result in trucks traveling farther distances to avoid bridges with weight limits, areas with reduced clearances, or roadways with insufficient turning radii.

Since many of these local roads are part of the NHS, the state and local governments typically share responsibility for maintaining them. As part of WisDOT's freight planning and local roads coordination efforts, the department will work with local governments and Wisconsin's ports to identify solutions that address roadway issues for port areas.

Condition of the Great Lakes Navigation System in Wisconsin

Each year, more than 300 million tons of freight moves through Great Lakes ports. Wisconsin has captured less than 10 percent of that volume. Averaging tonnage data between 2006 and 2012 for the ports of Superior, Marinette, Green Bay, Manitowoc, and Milwaukee shows that 96 percent of the cumulative freight tonnage is represented by only six commodities: coal, iron ore, limestone, non-metallic minerals, cement and concrete, and wheat. Overall, roughly 80 percent of the tonnage moved is out-bound from Wisconsin ports.[43]

Federal funding to support waterways has typically been limited, with the majority coming from the United States Army Corps of Engineers (USACE). Historically, a small portion of USACE annual estimated required funds for harbor maintenance are appropriated. In many cases, the needs assessed by USACE exceed available funding. For example, for federal fiscal year 2015, USACE estimated the total project need for eight of Wisconsin's commercial harbors on the Great Lakes Navigation System (GLNS) at $33 million; however, the total amount allocated for the region was $11.4 million, approximately 35 percent of the amount USACE had estimated.[44,45]

USACE uses a structural index for condition classification for coastal structures, which grades structures on an A through F scale (no E), where A is adequate and F is failed. The USACE assesses the condition of the GLNS, and in 2013 reported that 33 percent of Wisconsin's ports conditions reported and over 40 percent of coastal structures reported were rated C or worse. By USACE's internal measures, an A grade indicates unlikely failures, B carries a low risk of failure, C is medium risk of failure, D is high risk of failure, and F is a failed structure.

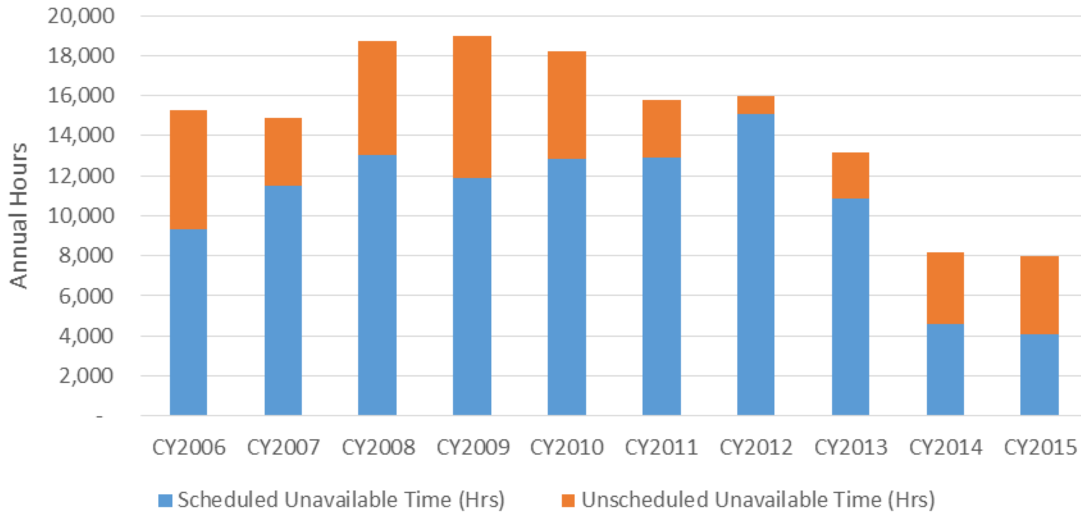
USACE also measures the annual hours of scheduled and unscheduled closures of locks on the Great Lakes. Unreliability could result in lower utilization of waterways or necessitate greater inventory, resulting in increased costs. Figure 6-14 displays both scheduled and unscheduled unavailability. Scheduled unavailability is attributable to seasonal as well as mechanical issues. USACE defines delay as any waiting greater than zero.

While the total annual hours of delay impacts the ability of shippers and carriers to use waterways to move freight, unscheduled closures are especially detrimental as they decrease the reliability of the waterway. A 2015 United States Department of Homeland Security study found that an unexpected six-month closure of the Poe Lock at Sault Ste. Marie could have a $1.1 trillion negative affect on GDP and could result in 10.9 million jobs being lost.[46]

---

[43] National Center for Freight & Infrastructure Research & Education, "Wisconsin Commercial Ports Development Initiative." (December 2014).
[44] Includes Ashland Harbor, Green Bay Harbor, Manitowoc Harbor, Milwaukee Harbor, Port Washington, Sturgeon Bay Harbor and Lake Michigan Ship Canal, Duluth-Superior Harbor, and Menominee Harbor.
[45] U.S. Army Corps of Engineers, "Summary of Appropriations - FY2015."
[46] U.S. Department of Homeland Security, "The Perils of Efficiency: An Analysis of an Unexpected Closure of the Poe Lock and Its Impact." (October 2015).

Figure 6-14: Soo Lock Unavailability



Source: CPCS analysis of U.S. Army Corps of Engineers Lock Usage Report

Condition of Upper Mississippi Lock and Dams

Wisconsin has two commercial ports located on the Mississippi River: La Crosse and Prairie du Chien. The primary commodities for the Mississippi River ports are more highly concentrated than the Great Lakes ports with the top four commodities representing 95 percent of the cumulative freight tonnage moved: grains (69 percent), cement (82 percent), salt (89 percent), and pig iron (95 percent). Overall, there is a 70/30 outbound-to-inbound split with grains accounting for the majority of outbound tonnage.

The system of locks and dams on the Mississippi and Illinois Rivers allow barge transportation along Wisconsin's western boundary, as well as from Milwaukee to the Gulf of Mexico. The majority of commodities transported out of Wisconsin ports via river barges are agricultural-related items.

In 2014, between 12 percent and 35 percent of vessels traveling through the Wisconsin portion of the Upper Mississippi River locks and dams experienced delays. The Upper Mississippi River system has a disproportionate share of delays compared to other rivers in the Mississippi River System. In 2010, the Upper Mississippi River experienced half of the 36 most delayed locks in the United States. Many of the inland waterway locks, including locks numbered 1 to 25 in the upper Mississippi River (see Chapter 5, *Wisconsin's Transportation System Assets*) are too small for modern barge tows, increasing delays and operating costs. Table 6-9 depicts the locks and dams on the Upper Mississippi connected to Wisconsin and the delays experienced.

Table 6-9: Wisconsin Locks and Dams in Upper Mississippi River

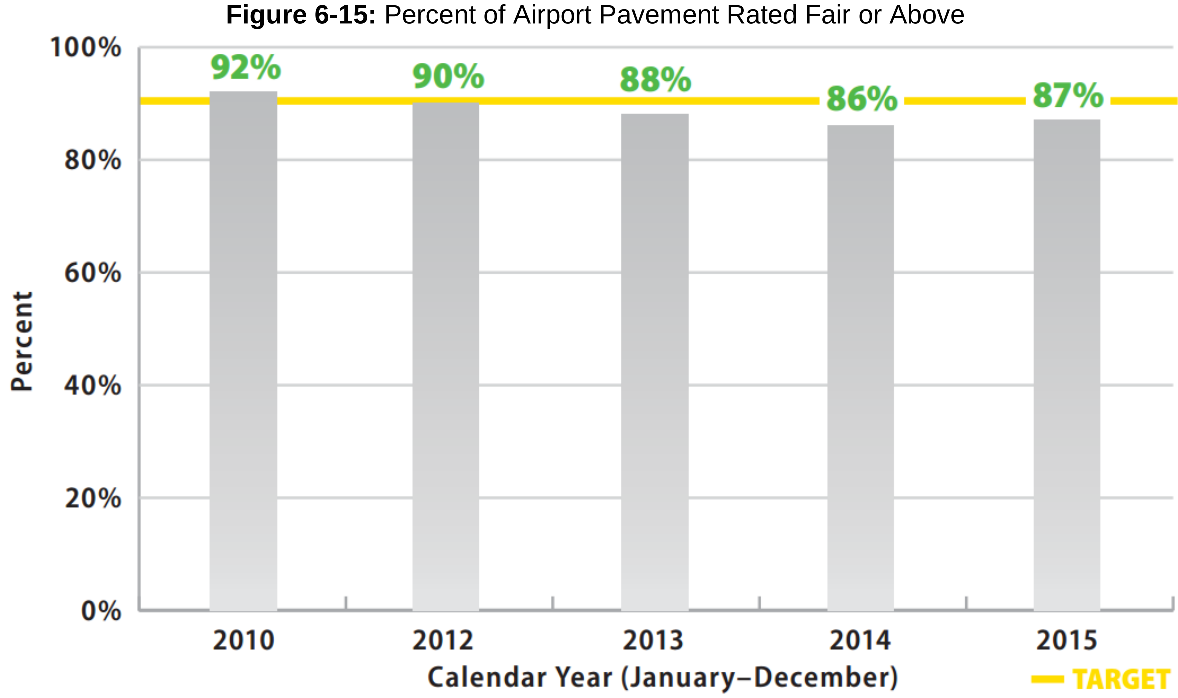
Lock and Dam Number	Wisconsin or Neighboring State City	Year of Construction	Year of last Major Rehabilitation	2014 % of Vessels Delayed
3	Red Wing, MN	1938	1991	24%
4	Alma, WI	1935	1994	12%
5	Winona County, MN	1935	1998	26%
5A	Fountain City, WI	1936	2000	30%
6	Trempealeau, WI	1938	1999	22%
7	La Crescent, MN	1937	2002	23%
8	Genoa, WI	1937	2003	33%
9	Lynxville, WI	1937	2006	35%
10	Guttenberg, IA	1937	2006	27%
11	Dubuque, IA	1937	2012	43%

Source: U.S. Army Corps of Engineers, Rock Island District

Airport Pavement Condition

Airport pavement condition ratings are a primary indicator of the long-term structural health of the state's airport system. Like the condition measures for highways, airport pavement is rated using PCI. The department evaluates pavement conditions at 98 publicly-owned airports in the State's Airport System Plan (SASP), of which 83 are airports listed in the National Plan of Integrated Airport Systems that qualify for federal funds. This encompasses airports of all sizes including the state's largest, General Mitchell International Airport. Eight airports are classified as "Air Carrier/Air Cargo." The department's goal is to have 90 percent of airport pavement with a rating of fair or above as determined by airport classification and pavement function (Figure 6-15).

Figure 6-15: Percent of Airport Pavement Rated Fair or Above



Source: Wisconsin Department of Transportation, MAPSS

Approximately one-third of the 98 SASP airports are inspected each year. The average is calculated and compiled for each calendar year and includes an assessment of all runways, taxiways, and aprons at the 98 SASP airports. The measure includes an analysis of both runway and taxiway pavements, as well as aircraft parking aprons.

Airports are locally-owned and decisions regarding improvements are handled at the local level. Investment decisions can be challenging when a pavement needs rehabilitation but other projects (typically safety-focused) must be addressed first. As high priority safety projects are completed, airports are again shifting their focus to pavement rehabilitation needs. In addition, as runway pavement needs are met, WisDOT anticipates that taxiway and apron pavement rehabilitation will become a higher priority that will result in a rebound in the overall rating at or near the target level in the coming years.

The department established minimum PCI levels that provide a threshold value for pavements according to use and airport classification. These thresholds provide the department and local authorities with the ability to prioritize projects and the capability to budget and program future pavement rehabilitation projects. The goal is to keep these pavements at or slightly above their minimum values when construction work occurs.

In order to encourage the local authorities to preserve proper pavement conditions, the airport must have pavements above the minimum PCI value before airports can receive federal or state aid for any other airport improvement project.

6.6 Transportation System Performance

A comprehensive, objective, and consistent set of freight-related performance measures for Wisconsin's transportation system is important for assessing the condition of that system, identifying its problems, prioritizing actions to resolve those problems, and measuring the effectiveness of the remedial actions. Performance measures are an important tool because they help ensure resources are used in the most strategic, effective, and efficient way possible.

Transportation system performance affects economic productivity in several ways. For example, traffic bottlenecks can increase the cost and time associated with the movement of freight traffic, which can affect economic growth. Measuring and targeting bottlenecks is key to ensuring freight moves efficiently in the state.

The performance of transportation affects economic productivity and freight movement in several ways. American businesses require more operators and equipment to deliver goods when shipping takes longer, more inventory when deliveries are unreliable, and more distribution centers to reach markets quickly when traffic is slow.[47] Likewise, both businesses and households are affected by sluggish traffic on the ground and in the air. The growth in freight is a major contributor to congestion in urban areas and on intercity routes, and congestion affects the timeliness and reliability of freight transportation.[48] A significant contributor to local congestion is long-distance freight movements. Local congestion can impede freight, which could reduce local and distant economic activity.

Growing freight demand increases recurring congestion at freight bottlenecks, places where freight and passenger service conflict with one another, and where there is not enough room for local pickup and delivery.[49] Congested freight hubs include international gateways such as ports, airports, and border crossings, and major domestic

[47] Federal Highway Administration, "Freight and Congestion."
[48] Ibid.
[49] Ibid.

terminals. Bottlenecks between freight hubs are caused by converging traffic at highway intersections and railroad junctions, steep grades on highways and rail lines, lane reductions on highways and single-track portions of railroads, and locks and constrained channels on waterways.[50]

Railroad bottlenecks can occur when passenger trains (such as Amtrak) and freight trains compete for space on the railroad network.

Bottlenecks can cause recurring, predictable congestion in selected locations, whereas the temporary loss of capacity, or nonrecurring congestion, is widespread and less predictable. Sources of nonrecurring delay on roadways include incidents, weather, work zones, and other disruptions. Weather, maintenance activities, and incidents have similar effects on aviation, railroads, pipelines, and waterways. Aviation is regularly disrupted by local weather delays, and inland waterways are closed by regional flooding and droughts.[51]

Additionally, freight congestion is caused by other factors that are considered either recurring if they are systemic problems or non-recurring if they represent an isolated event. Recurring and non-recurring sources of freight congestion include equipment shortages, short-term labor disruptions, and long-term shortages in key occupations such as truck drivers, inefficient operating practices at terminals and border crossings, and traffic backups at toll booths.

The next sections will assess the performance, which includes a bottleneck assessment, of Wisconsin's multimodal transportation system by mode.

Air Performance

As identified in Chapter 5, *Wisconsin's Transportation System Assets*, Wisconsin businesses use air freight to ensure the availability and freshness of products with short shelf lives, aid in just-in-time manufacturing and expand market reach. In 2013, almost 105,000 tons of air freight cargo was shipped by planes, with a total value exceeding $10 billion.[52]

Air Bottlenecks

Air freight coming into and out of Wisconsin is not limited by the capacity of any of the state's airports. Even with higher amounts of air freight being shipped within the past decade, there are no capacity issues. Wisconsin's airports have the capacity to accommodate growth in air freight. No specific bottlenecks were identified for air freight in Wisconsin.

[50] Federal Highway Administration, "Freight and Congestion."
[51] Ibid.
[52] 2013 IHS Transearch Database.

Roadway Performance

As of 2015, the state's highways were the most common transportation method of all freight within and through Wisconsin. One of the primary and common operational constraints affecting highway freight distribution is congestion, which can create bottlenecks (locations where truck traffic experiences recurring slow speeds due to an operational or network deficiency) on the system and results in reduced predictability for system users. As identified in Chapter 7, *Freight Transportation Trends, Issues, and Forecasts*, traffic volume on Wisconsin's highways is projected to increase during the next 30 years, including on several key freight corridors in Wisconsin. Increased traffic presents a significant operational challenge for highway freight vehicles and the distribution of commodities. Therefore, the primary performance measure applied to roadways is the identification of bottlenecks. The remainder of this section will assess the performance of Wisconsin's roadways.

Traffic Movement and Congestion

As stated earlier, safety and traffic movement performance thresholds determine whether infrastructure improvements are needed. WisDOT measures traffic movement or congestion levels using a level of service (LOS) performance threshold. LOS compares the amount of traffic on a road to its capacity. It takes into consideration traffic conditions (number of vehicles, vehicle types, and directional distribution) as well as roadway conditions (lane width, shoulder width, passing opportunities, and design speed). LOS is measured on a scale of A to F and ranges from "no congestion" to "extreme congestion." WisDOT developed traffic movement performance thresholds for the state trunk highway system using the level of service categories (Table 6-10). The thresholds differ according to road classification and function.

Roadway Capacity
Roadway capacity is defined as the number of vehicles a roadway can carry. Capacity is determined by several factors, including the number of lanes; width of lanes and shoulders; traffic signal timing; intersection controls; number and type of access points such as interchanges, driveways and intersections; and speed and alignment points such as grades and curves. Enhanced roadway capacity should improve mobility, traffic flow, and safety.

The thresholds also vary for highways in urbanized and non-urbanized areas. A need is not triggered on a Corridors 2030 Backbone road located in a non-urbanized area until Level D is reached. For Corridors 2030 routes located in urbanized areas, the level of service trigger varies depending on whether or not the route is a Backbone road. Backbone routes have a lower level of service threshold because they function as higher-level roadways carrying traffic at higher speeds between communities.

Table 6-10: Level of Service Performance Thresholds

Level of Service	Description	Characteristics
A	No congestion; traffic flows smoothly	On both two-lane and four-lane highways • Free-flow operating speeds can be maintained • Vehicles can maneuver freely within traffic • Vehicles can enter the highway with little problem
B	No congestion; traffic flows smoothly	On both two-lane and four-lane highways • Speeds generally can be maintained • Vehicles can maneuver within traffic with only slight restrictions
C	Minimal congestion; traffic flow and speeds are slightly restricted	• Drivers must be more vigilant changing lanes on a four-lane highway • Minor incidents along the roadway can be absorbed, but tie-ups may form behind any significant blockage
D	Moderate congestion; speeds and distance between vehicles are reduced, constricting traffic flow	• Freedom of drivers to maneuver within the traffic stream or entering the highway is more noticeably limited • Minor incidents can result in traffic jams because the traffic stream has little space to absorb disruptions • Passing slow-moving vehicles on two-lane highway becomes very difficult because gaps in traffic occur less frequently • Turning vehicles and roadside distractions cause major shock waves in the traffic system
E	Severe congestion; vehicle speeds and spacing severely restricted	• The roadway is reaching capacity • Vehicles are closely spaced leaving little room to safely accommodate vehicles changing lanes or entering the roadway • Even minor incidents can impact traffic flow, resulting in extensive traffic back-ups • Passing vehicles on two-lane highway is virtually impossible, as slower vehicles or other interruptions are encountered
F	Extreme congestion; stop-and-go, bumper-to-bumper traffic	• Traffic demands exceeds the carrying capacity of the roadways • Serious delays in travel occur when congestion reaches this level

Source: Wisconsin Department of Transportation, Bureau of State Highway Programs

Highway Congestion

WisDOT’s vision for optimizing traffic movement on the state trunk highway system is to improve the system to reduce congestion, improve safety, and support economic growth in Wisconsin. To achieve this vision, WisDOT uses tools and strategies to improve capacity on existing facilities and construct new facilities to increase capacity, where appropriate and warranted.

The efficiency and reliability of Wisconsin’s STH is impacted by several factors such as traffic volume, roadway design, bad weather, and incidents such as crashes, stalled vehicles, and construction. These factors can result in increased congestion. A safe, efficient, and reliable highway system requires routine monitoring, maintenance, and preservation to meet established performance thresholds and reduce highway bottlenecks. As identified earlier, WisDOT’s delay and travel reliability performance measures help to enhance mobility and reliability on the state’s highway system. The next section addresses highway bottlenecks, which can cause congestion. Identifying and reducing bottlenecks can reduce highway congestion.

Highway Bottlenecks

Bottlenecks typically result from roadway design limitations. This may happen when there is a reduction in the number of lanes, or at interchanges or intersection locations. Traffic bottlenecks can quantifiably increase the cost and time associated with the movement of freight traffic, which in turn can affect economic growth.

Bottlenecks tend to be found on highways that serve high volumes of trucks, specifically in areas considered to be domestic freight hubs, or urban areas where national freight lanes intersect urban freight routes. Trucks do not necessarily cause bottlenecks, rather bottlenecks may be caused by a roadway that isn't properly designed to handle the demand of freight trucks. In this instance, a bottleneck is defined as a localized section of highway that experiences reduced speeds and delays due to a recurring operational influence or a nonrecurring event, such as an incident or bad weather. A bottleneck is on a shorter portion of the facility and not along an entire corridor. Highway-specific bottlenecks can be further broken down into recurring and nonrecurring:

- **Recurring Bottlenecks –** Can be caused by fixed facility constraints such as interchanges, sharp hills or curves, narrow lanes, lack of shoulders, signalized intersections, or lane drops.
- **Nonrecurring Bottlenecks –** Can be caused by a temporary loss in capacity, such as a lane closure from an incident or bad weather, or a temporary increase in demand such as a special event

Bottlenecks on highways that serve high volumes of trucks are freight bottlenecks. A truck bottleneck is defined by a combination of three features: the type of constraint, the type of roadway, and the type of freight route. A truck bottleneck may be caused by congestion at an interchange on a freeway serving as an intercity truck corridor, or a truck bottleneck may be caused by poorly timed traffic signals at intersections on an arterial road that serves as an urban truck corridor.

As a part of the Freight Performance Measures initiative (FPM), the FHWA Office of Freight Management and Operations collaborated with the American Transportation Research Institute (ATRI) to identify and quantify the impact of bottlenecks on truck-based freight at 250 specific locations nationwide using 2014 data.[53] This data of truck congestion is collected via truck based GPS data points utilizing customized software tools, developed specifically for the FPM program. The 250 specific locations were identified based on surveys of public and private stakeholders, as well as past analysis of freight flow congestion. A "total congestion value" at each specific site is derived by measuring several factors including:

- **Free-Flow Speed –** the speed at which congestion has no constraint on mobility, and is assumed to be greater than 50 mph on the Interstate System
- **Average Truck Speed –** collected via FPM program and subtracted from free-flow speed to determine the total mph below free flow
- **Hourly Freight Congestion Value –** a multiplication of the total mph below free-flow speed (on an hour by hour basis) by the total number of commercial trucks in each hour block

Table 6-11 identifies bottleneck type and potential performance measures to alleviate bottleneck congestion in the state.

[53] American Transportation Research Institute, "Congestion Impact Analysis of Freight-Significant Highway Locations - 2015."

Table 6-11: Bottleneck Type and Potential Performance Measures

Bottleneck Type	Potential Performance Measures
Slow Speed	• Number of hours spent in interstate traffic below the posted speed • Percent of time that travel speeds are less than 75% of the free-flow speed • More than 50% of sampled trucks traveling below 60 percent of the posted speed
Reliability	• Travel time index: average peak period travel time/non-peak hour travel time • Planning Time Index: 95th percentile travel time/non-peak hour travel time
Resiliency	• Disruptions caused by severe weather that have had at least one full closure lasting longer than 24 hours over the last 20 years
Restricted Access for Legal Loads	• Highway facility has a posted weight limit below the current legal limit, or it does not allow overweight loads
Clearance Restrictions for OSOW Loads	• Highway facility has a height clearance of less than 17 feet

The FAST Act mandates that "an inventory of facilities with freight mobility issues, such as bottlenecks…" are included in state freight plans, additionally requiring "a description of the strategies the State is employing to address the freight mobility issues" on all facilities that are state owned. Table 6-11 gives an inventory of the specific types of bottlenecks seen on major highways in Wisconsin.

WisDOT, through its programming of projects (see Chapter 9, *Investment and Implementation*), seeks to address identified highway bottlenecks in Table 6-14 to facilitate the safe and efficient movement of freight statewide. WisDOT's data, relative to system performance and condition, as well as feedback from stakeholders and system users, serve as indicators of the progress made on highway freight bottlenecks.

Table 6-14 includes a list of identified Interstate System and non-Interstate NHS bottlenecks in Wisconsin, in accordance with MAP-21 and the FAST Act, based on travel time reliability, average speed, bottleneck duration, and bottleneck frequency. The bottlenecks are ranked using a normalized mathematical calculation called a "z-score," which is based on travel time reliability, average speed, bottleneck duration, and bottleneck frequency.

Figure 6-23 includes analysis on truck travel time reliability. Truck travel time reliability is calculated per the MAP-21 System Performance rule. This applies only to interstates and is the ratio of the 95th percentile over the 50th percentile (median) travel time over the entire year. The minimum value is 1. If no value is provided it was not calculated for that segment.

Figure 6-24 evaluates average truck travel speed. Average truck speed is calculated per the MAP-21 and FAST Act System performance proposed rule. The final rule removed average truck speed as a required performance measure, but the measure was included in the SFP to further show the performance of roadways. The proposed rule used 50 mph as the threshold for reporting mileage as congested or not.

The bottleneck duration, as established in Figure 6-25, is the total of all hours over the year where the truck speed is below 50 mph. A bottleneck is deemed to occur when speeds drop below a threshold for a given duration. The threshold used for this analysis was 60% of the free flow speed; calculated as the greater of 70 MPH or the 85th percentile speed over the year. An event was flagged as a bottleneck if the speed was below that threshold for 15 minutes or longer and ended by an uninterrupted period of 15 minutes above the threshold speed (Figure 6-26).

As identified earlier in this chapter, the performance measures in this chapter will be adapted and used to establish baselines for the MAP-21 and FAST Act performance measure for "Freight movement on the Interstate System:"

- Truck Travel Time Reliability Index on the Interstate System

FHWA requires states to monitor and report on the performance metrics for freight movement, along with other performance measures identified under the other generalized or non-freight specific areas. The first four-year performance reporting period for the freight-related measure begins January 1, 2018 and extends through December 31, 2021. In 2020, WisDOT may adjust targets and will report on progress to FHWA as required by MAP-21 and the FAST Act. WisDOT will provide FHWA a full reporting period report in 2022.

In accordance with MAP-21 and the FAST Act, FHWA will determine a state's progress toward meeting the performance targets related to freight movement. If progress is not made, WisDOT will provide a written description of the actions the state will take to achieve the targets.

Local Road Bottlenecks

Many of the state's bottlenecks occur on state highways. However, bottlenecks do occur on local roads. As identified previously, WisDOT's assesses local road pavement and bridge condition. Assessing local road pavement and bridge condition can help to reduce bottlenecks on local roads.

A strong local road network can provide sufficient property access and reduce the number of access points to the STH. When developed, these networks encourage drivers to use local roads for short local trips instead of state trunk highway system.

Wisconsin administers funding for several programs to help support the transportation infrastructure needs of local governments, including General Transportation Aids, the Local Roads Improvement Program, and the Surface Transportation Program. The funding could be used to reduce bottlenecks on the local system.

WisDOT's regional staff works with counties and local governments to identify and prioritize rehabilitation projects for consideration of funding under the Local Bridge Program. The department has also worked with various state and local partners to implement a process to help keep bridge projects on schedule, which can help reduce bottlenecks.

Railroad Performance

As identified in Chapter 5, *Wisconsin's Transportation System Assets*, Wisconsin's approximate 3,300 miles of railroad system makes up about 2 percent of the nation's rail network. As a subset of the 3,300 miles of railroad, Wisconsin has 718 miles of state-assisted rail corridors, of which approximately 624 miles are publicly-owned and operated primarily by Wisconsin and Southern Railroad Co. (WSOR).

The state's rail system is owned and operated by ten active, privately-owned freight railroads and the State of Wisconsin. The private railroads each hold Surface Transportation Board (STB) freight carrier certificates and operate over a network of mainlines, branches, industrial leads, spurs, rail yards, and terminals.

Railroad Bottlenecks

Railroads carry the second highest amount of freight tonnage in Wisconsin, which makes identifying locations with freight mobility issues on rail lines extremely important. The importance is intensified by the fact that the efficient movement of products on railroads provides many economic benefits to the state. Wisconsin's railroad freight bottlenecks are identified in Table 6-12.

Table 6-12: Railroad Freight Bottlenecks on Wisconsin's Publicly-Supported System

Railroad Freight Bottlenecks on Wisconsin's Publicly-Supported System
Limited rail access and no intermodal container service at Port of Milwaukee: • Wisconsin & Southern Railroad (WSOR) not able to access Port without trackage rights over Canadian Pacific • UP does not have sufficient clearance under eleven bridges through South Milwaukee to access port with double-stack container cars
Madison–Prairie du Chien (Prairie Subdivision) train speeds limited to 10 mph due to: • Class 1 track on most of subdivision • Several bridges restricted to 10 mph for 286,000-pound carloads
WSOR must use UP-owned track segment (and await UP dispatching) in Janesville to move between the Waukesha or Madison subdivisions and the Monroe Subdivision, Fox Lake Subdivision, and Chicago.
Merrimac Bridge (Reedsburg Subdivision) limited to 263,000-pound carloads at 10 mph. Shippers in Baraboo and Reedsburg are thus limited to 263,000-pound carloads.
WSOR limited to one train per day (each way) over Metra track to interchange with other railroads at Belt Railway yard at Clearing, IL (Chicago).

Table 6-12 includes bottlenecks identified on Wisconsin's publicly-supported system and does not contain any bottlenecks that might be associated with Class I railroads. Class I railroads are private companies and these companies invest in their own rail lines. However, Wisconsin's Freight Rail Infrastructure Improvement Program (FRIIP) and Freight Railroad Preservation Program (FRPP) are resources that can be used to enhance freight mobility on rail lines (see Chapter 9, *Investment and Implementation*).

Waterway Performance

Wisconsin's ports and waterways are an important component of Wisconsin's freight infrastructure. The remainder of this section outlines the performance measures used to assess the Upper Mississippi River and Wisconsin's ports. The Inland waterway system has a number of sources of delay, including lock operations, aging infrastructure, number of vessels, tonnage, average daily delay time, and lock closures. USACE data on the proportion of vessels delayed and average delay on the Upper Mississippi River Locks will be used to define performance.

As shown in Table 6-13, between 12 percent and 35 percent of vessels traveling through the Wisconsin portion of the Upper Mississippi River locks and dams experienced delays in 2014.

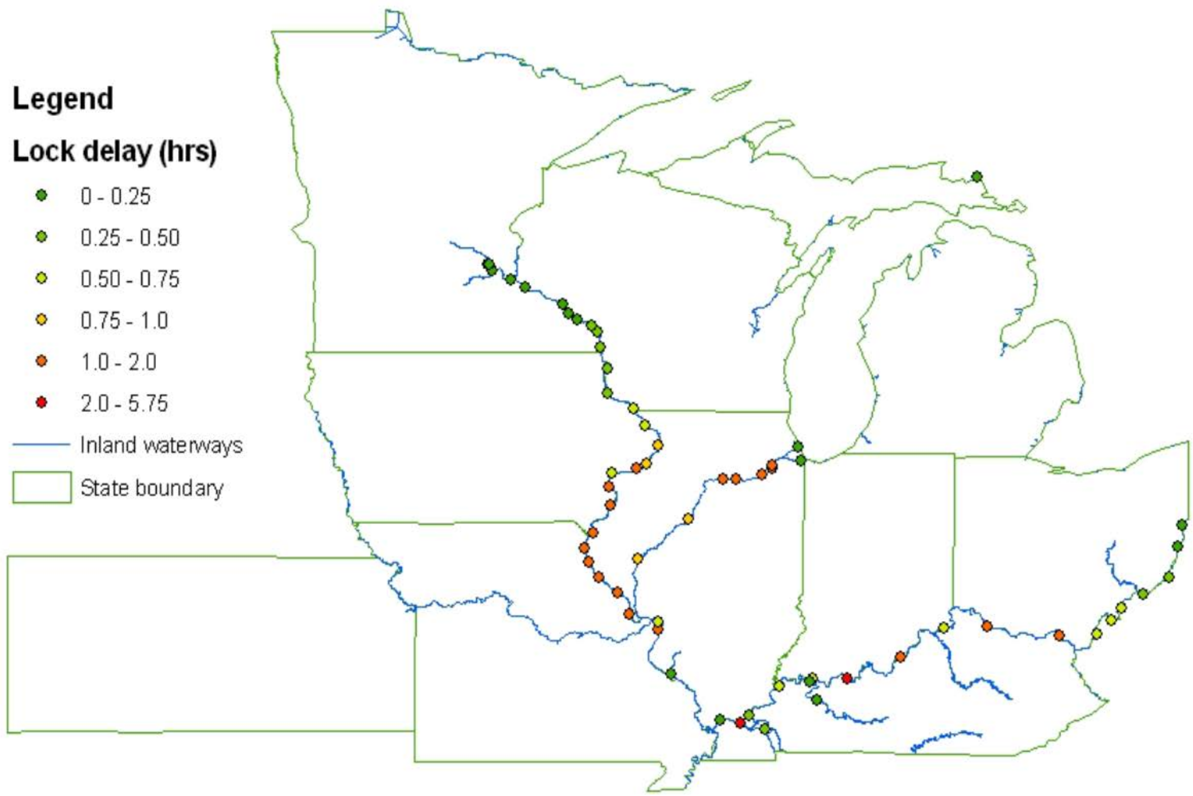
Table 6-13: 2014 Upper Mississippi River Locks and Dams Average Delays

Lock and Dam Number	Lock Location	Average Delay (Hours)	% Vessels Delayed
3	Red Wing, MN	1.35	24%
4	Alma, WI	1.60	12%
5	Winona County, MN	1.13	26%
5A	Fountain City, WI	1.12	30%
6	Trempealeau, WI	1.01	22%
7	La Crescent, MN	0.64	23%
8	Genoa, WI	1.28	33%
9	Lynxville, WI	1.10	35%
10	Guttenberg, IA	1.02	27%
11	Dubuque, IA	1.04	43%

Source: U.S. Army Corps of Engineers, Rock Island District

Figure 6-16 puts the Upper Mississippi River system within the context of the larger Inland waterway system. Overall, the Upper Mississippi River system has a disproportionate share of delays compared to other inland waterways. In 2010, the Upper Mississippi River experienced half of the 36 most-delayed locks in the U.S.

Figure 6-16: Midwestern Lock Delays



Source: U.S. Army Corps of Engineers

Waterway Bottlenecks

Given the condition, size, and average delay of the locks bordering Wisconsin, all are considered freight bottlenecks. It is clear that a lack of repairs, maintenance, and modernization will continue to have a negative impact and the deterioration of the infrastructure will go on. Failure or closure of a lock could be catastrophic for the region. Commodities would still need to be transported, inadvertently leading to the long-term transport of goods shifting to highways and railroads. Deterioration of road and rail infrastructure would occur at an increased rate. Additionally, it would cause increased costs to shippers, resulting in decreased cost advantages to Midwestern producers and missed economic opportunities available through the expansion of the Panama Canal.

In 2014, the United States DOT's Maritime Administration approved designation of the Upper Mississippi River from St. Louis, MO to St. Paul, MN as the M-35 Marine Highway Corridor. This designation, cosponsored by WisDOT, is a necessary step toward planning for an integrated, multimodal regional transportation system. WisDOT is working with the Upper Mississippi River Basin Association, a group formed by the Governors of the five states along the Upper Mississippi – Iowa, Illinois, Minnesota, Missouri, and Wisconsin – to assess the current state of river navigation and evaluate ways to increase the efficiency and reliability of the lock and dam system, and identify opportunities to increase utilization of the Upper Mississippi River.

In terms of bottlenecks at Wisconsin's commercial ports along the Great Lakes, many of the ports are operated by either private entities or municipalities. Like railroads, the ports operated by private entities and municipalities are responsible for responding to bottlenecks. However, many organizations such as the USACE, United States Coast Guard, municipalities, private and public entities, and WisDOT have been working cooperatively to address issues at the commercial ports in Wisconsin.

In addition, member of the Conference of Great Lakes and St. Lawrence Governors and Premiers Regional Maritime Task Force has developed a strategic plan to improve the efficiency and competitiveness of the Great Lakes maritime transportation system. Action items have been developed to increase maritime transportation efficiency and reduce costs, build new markets, increase economic activity, and plan for the future.

Created in 1979, the Harbor Assistance Program (HAP) assists port communities along the Great Lakes and Mississippi River in maintaining and improving waterborne commerce (see Chapter 9, *Investment and Implementation*). Port projects typically include dock reconstruction, mooring structure replacement, dredging, and the construction of facilities to hold dredged material. HAP program funds may also be used to reduce bottlenecks at Wisconsin's ports.

In order to further enhance freight mobility, in 2014, the Maritime Administration granted the five Upper Mississippi River States' request to designate the Upper Mississippi River as the M-35 Marine Highway Corridor. Since this designation, the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin continue to work with industry and other stakeholders to enhance freight mobility by integrating strategic approaches, and promoting the inland waterways as a means to relive landside transportation congestion. Although no funding is associated with the M-35 Marine Highway Corridor, the designation underscores the importance of freight mobility on the Upper Mississippi River.

Pipeline Performance

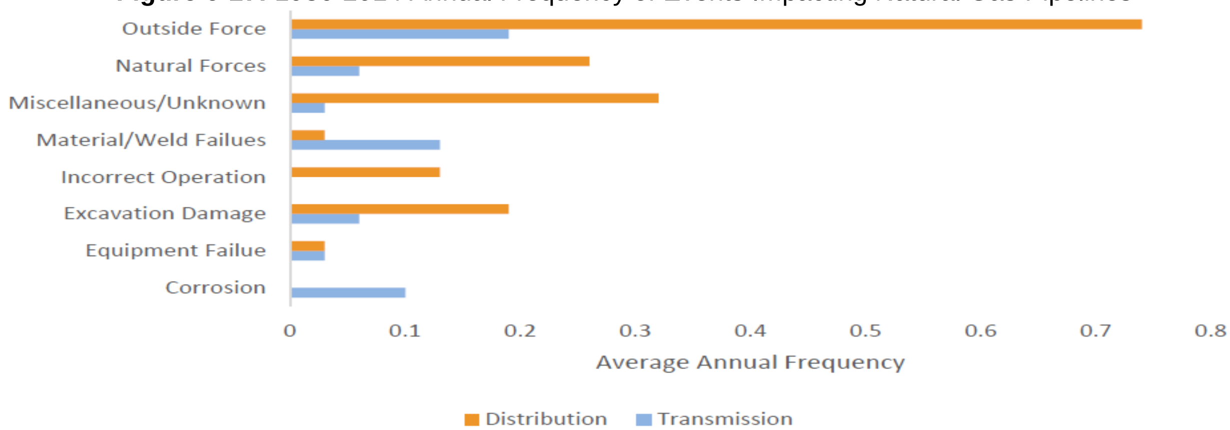
Data on condition and performance of pipelines is difficult to get at a segment level. Additionally, WisDOT does not have a role in the inspection or repair of pipelines. Therefore, the focus of the condition and performance of the pipeline system is on the frequency of incidents on the system in Wisconsin. The following section presents the condition and performance of Wisconsin's pipeline assets.

Natural Gas Pipeline Performance

According to the United States Department of Energy's energy sector risk profile, the most frequent type of event impacting both natural gas transmission and distribution pipelines in Wisconsin is outside force, which is an event due to a car accident, sabotage, or vandalism (Figure 6-17). Outside forces, along with natural force and excavation damage are not due to the condition of the pipelines, whereas material/weld failures, incorrect operation, equipment failure, and corrosion could be related to the condition and/or performance of the pipeline system. Of the events that a pipeline company has control over, corrosion and material/weld failure are significant issues for transmission lines, whereas incorrect operation is the largest issue for distribution lines.

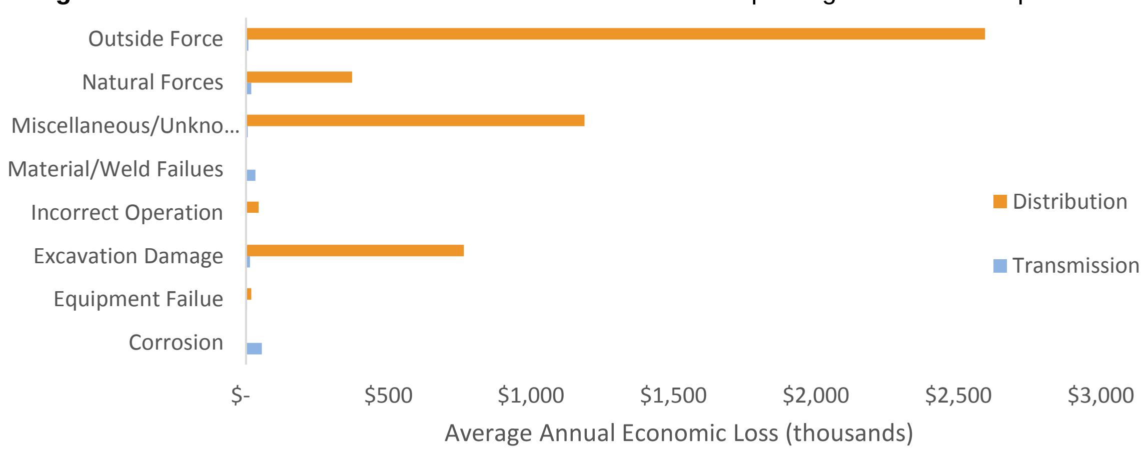
The Wisconsin Public Service Commission noted that Wisconsin's natural gas pipeline system functions well and has fewer leaks compared to other states. The condition of Wisconsin's pipelines is partially due to Wisconsin's cold climate forcing leaked natural gas into basements where it is detected by home owners.[54] Home owners will then contact their gas provider and the leak will be fixed. This contrasts with warmer climates where unfrozen ground allows the natural gas to escape from pipelines, sometimes occurring without those in close proximity noticing. Figure 6-17 and Figure 6-18 display the frequency and cost of natural gas pipeline events from 1986-2014.

Figure 6-17: 1986-2014 Annual Frequency of Events Impacting Natural Gas Pipelines



Source: U.S. Department of Energy, "State of Wisconsin Energy Sector Risk Profile"

Figure 6-18: 1986-2014 Annual Economic Cost of Events Impacting Natural Gas Pipelines



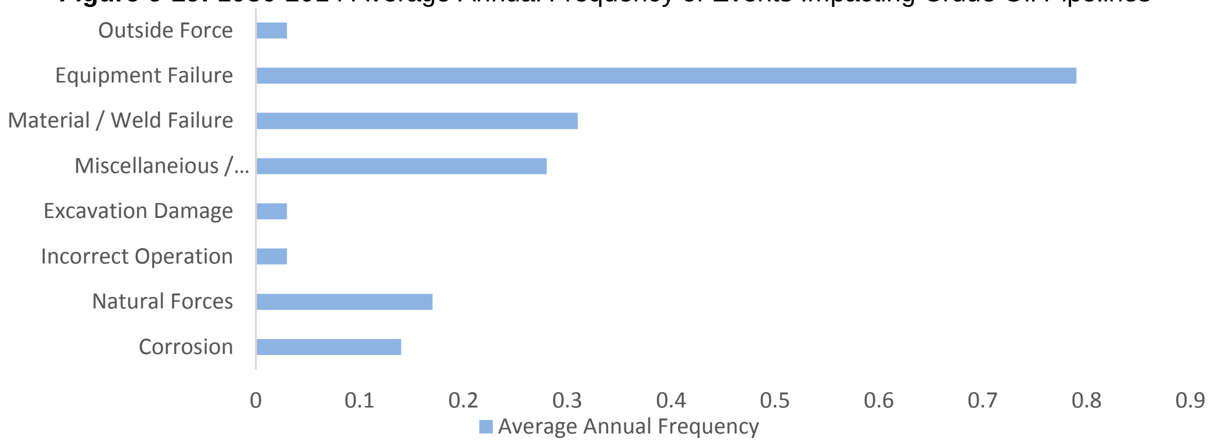
Source: U.S. Department of Energy, "State of Wisconsin Energy Sector Risk Profile"

[54] Mercaptan is added to natural gas producing a distinct rotten egg odor to make it detectable by smell.

Crude Oil Pipeline Performance

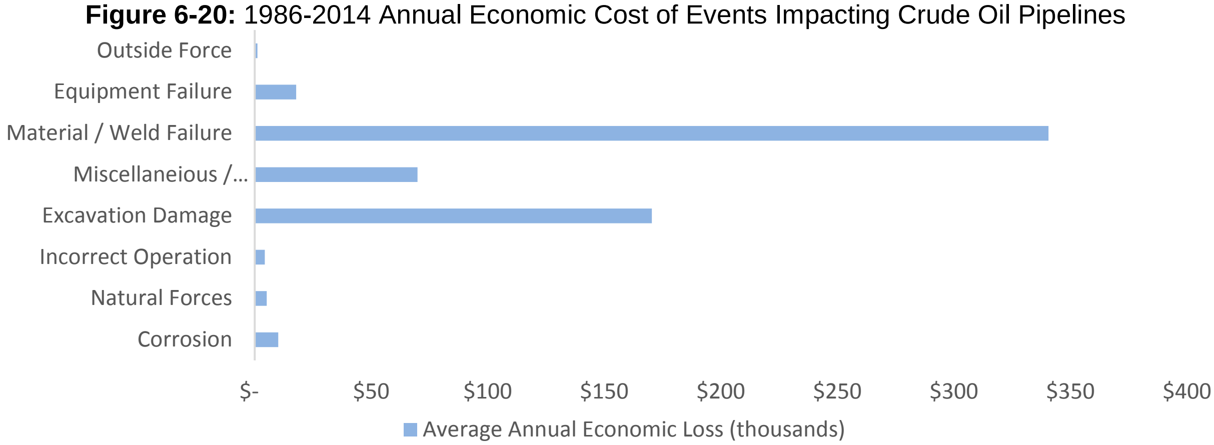
Unlike natural gas pipelines in Wisconsin, the mostly frequent event affecting crude oil pipelines from 1986-2014 was equipment failure, but the most costly were material/weld failures, with much of the cost related to the clean-up following a rupture (See Figure 6-19 and Figure 6-20).

Figure 6-19: 1986-2014 Average Annual Frequency of Events Impacting Crude Oil Pipelines



Source: U.S. Department of Energy, "State of Wisconsin Energy Sector Risk Profile"

Figure 6-20: 1986-2014 Annual Economic Cost of Events Impacting Crude Oil Pipelines

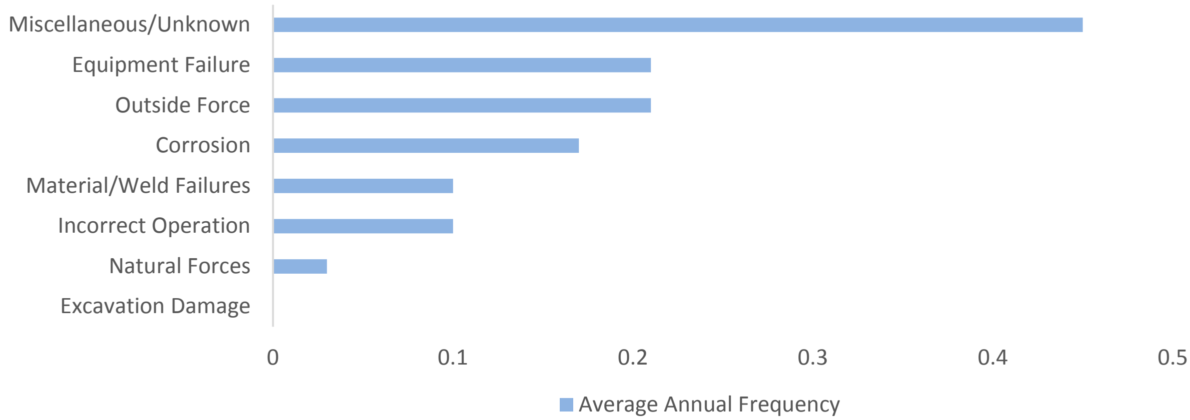


Source: U.S. Department of Energy, "State of Wisconsin Energy Sector Risk Profile"

Petroleum Product Pipeline Performance

Figure 6-21 and Figure 6-22 display the annual frequency and annual average cost per event (rupture, damage, or some other incident), on a petroleum product pipeline. Events are most frequently classified as "miscellaneous or unknown," with equipment failure and outside force comprising the next two most frequent events. Consultations with industry suggest that the frequency of shutdowns on some of the state's petroleum product pipelines are increasing. The West Shore Pipeline was specifically mentioned as experiencing recurring issues. Over time these issues have affected not only the Green Bay area, but also Northeast Wisconsin and Michigan's Upper Peninsula, which are served by the Green Bay Terminal. This is due to the fact that the Green Bay Terminal was exclusively served by the West Shore Pipeline while other parts of Wisconsin are served by multiple pipelines. The most recent incident affecting the West Shore Pipeline occurred in March 2016, which removed the pipeline from service north of Milwaukee. In April 2017 the owners decided to permanently close the pipeline.[55] The closure has resulted in both truck and waterway transportation of petroleum products to Green Bay.

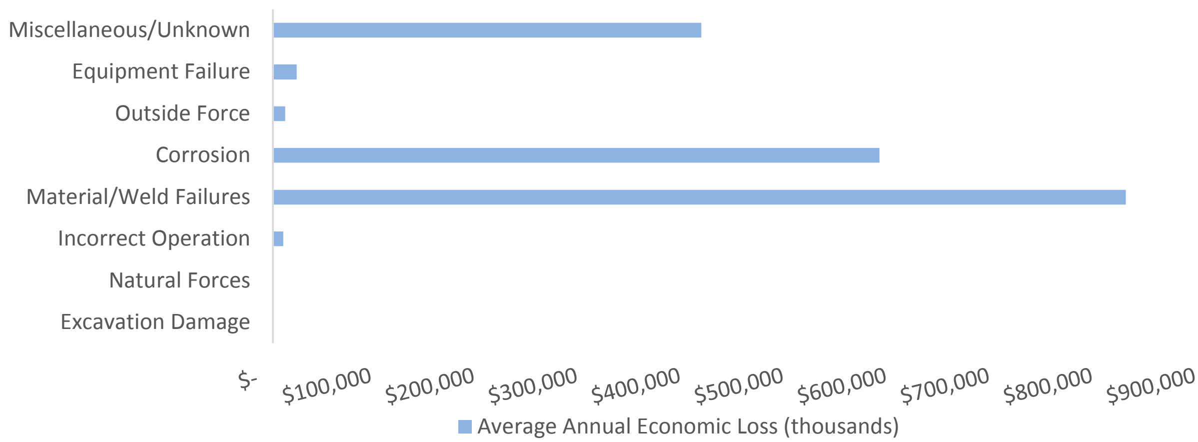
Figure 6-21: 1986-2014 Average Annual Frequency of Events Impacting Petroleum Product Pipelines



Source: U.S. Department of Energy, "State of Wisconsin Energy Sector Risk Profile"

The economic loss attributable to petroleum product events is more than twice as costly for most events, compared to the losses resulting from a crude oil rupture. Overall, the economic losses for petroleum products are significantly higher than those for natural gas and crude oil.

Figure 6-22: 1986-2014 Annual Economic Cost of Events Impacting Petroleum Product Pipelines



Source: U.S. Department of Energy, "State of Wisconsin Energy Sector Risk Profile"

6.7 Performance Using Federally Available Data Sets

As noted in this chapter, a critical component of the freight plan is the identification of roadway segments with poor performance relative to reliability, speed and bottlenecks. Figures 6-23 through 6-27 display roadway segment performance, measured by reliability, average speed, bottleneck duration, bottleneck frequency, and aggregate Z score. The bottlenecks in the table below are ranked using a normalized mathematical calculation called a "Z score," which is based on a combination of travel time reliability, average speed, bottleneck duration, and bottleneck frequency.

[55] Milwaukee Journal Sentinel, "Company won't replace only fuel pipeline to Green Bay." (April 21, 2017).

Table 6-14: 2014-2015 Highway Freight Bottleneck Segments (Ranked by Aggregate Z-Score)

County	Route	Direction	Distance (mi)	Reliability (95th/50th)	Average Speed (mph)	Bottleneck Duration (hours)	Bottleneck Frequency (count)	Composite (Z-Score)
Milwaukee	I-94	WB	0.42	5.47	29.0	4,323	538	15.62
Walworth	US-14	NB	1.73	13.16	44.1	1,568	200	15.22
Milwaukee	I-94	EB	0.61	4.73	29.3	4,274	577	15.14
Milwaukee	I-94	WB	0.43	5.06	29.0	4,183	489	15.00
Dane	US-18	WB	0.57	3.79	29.4	4,839	725	14.95
Dane	US-18	EB	0.96	5.15	39.8	3,516	624	14.66
Milwaukee	I-94	WB	0.38	4.33	29.3	4,170	448	14.06
Milwaukee	I-94	WB	0.65	4.27	36.0	4,243	520	13.80
Milwaukee	US-45	SB	1.11	3.86	38.9	2,316	503	12.59
Milwaukee	US-45	SB	0.43	4.46	40.6	1,802	429	12.49
Wood	US-10	EB	5.86	9.55	48.3	1,027	109	12.26
Dane	US-18	WB	1.25	2.70	33.4	4,881	493	11.99
Milwaukee	I-43	SB	0.32	5.60	41.4	1,107	231	11.75
Crawford	US-18	EB	3.90	4.39	41.6	2,165	290	11.56
Dane	US-18	EB	0.75	2.53	27.6	5,035	367	11.53
Rock	US-14	SB	1.98	3.09	35.2	2,499	329	10.98
Milwaukee	I-43/I-94	SB	0.61	3.67	40.6	2,409	281	10.88
Milwaukee	US-45	SB	0.93	3.33	43.0	1,726	410	10.85
Milwaukee	I-43	SB	0.28	4.61	41.4	1,059	228	10.85
Ashland	US-2	EB	20.92	2.62	44.6	2,466	547	10.66
Dane	US-51	SB	3.38	2.88	42.7	2,710	424	10.64
Milwaukee	I-94	EB	0.51	1.89	41.0	4,004	700	10.62
Milwaukee	I-94	WB	0.33	3.09	41.9	3,273	308	10.42
Milwaukee	US-41	SB	1.48	2.28	25.6	2,998	280	10.33
Dane	US-14	EB	4.59	2.75	44.3	2,569	432	10.30
Rock	US-14	NB	0.67	2.03	22.3	2,941	295	10.21
St Croix	US-63	SB	2.23	1.84	27.6	2,996	435	10.19
Milwaukee	I-43	SB	0.74	3.70	43.1	1,210	268	10.14
St Croix	US-12	WB	1.05	2.85	22.1	1,718	146	10.11
La Crosse	US-14	EB	2.03	2.20	28.5	3,101	301	10.07
Marinette	US-141	SB	8.85	2.86	47.5	2,012	410	9.89
Milwaukee	US-45	SB	1.09	2.77	45.5	1,673	422	9.88
Milwaukee	US-41	NB	1.48	2.28	25.5	2,935	204	9.73
Milwaukee	I-94	WB	0.96	2.00	39.3	4,692	382	9.49
Milwaukee	I-894	NB	0.42	2.81	46.6	1,090	406	9.46
Marinette	US-41	NB	1.63	1.70	25.2	2,883	339	9.46
Waukesha	I-94	EB	0.42	2.00	49.6	2,857	606	9.43
Dane	US-151	NB	0.82	2.45	32.3	2,751	208	9.41
Dane	US-151	NB	1.37	2.33	27.6	2,850	175	9.36
La Crosse	US-14	WB	1.60	2.25	26.3	3,336	150	9.20
Waukesha	US-18	WB	0.85	2.24	33.4	2,997	230	9.17
Waukesha	I-94	EB	2.63	2.17	46.2	1,656	497	9.16
Dane	US-51	NB	1.75	2.29	41.0	3,246	301	9.15
Milwaukee	I-43	SB	0.63	2.44	48.0	1,155	470	9.10
Milwaukee	I-43	NB	0.84	2.30	47.2	1,766	447	9.10
Milwaukee	I-94	EB	0.76	2.11	42.7	4,196	340	9.08
Milwaukee	US-45	NB	1.58	2.17	36.2	3,449	258	9.07
Milwaukee	I-894	NB	0.97	2.16	45.9	2,097	440	9.00
Milwaukee	I-94	EB	1.03	1.81	40.8	5,076	378	8.95
Milwaukee	I-43	SB	0.74	2.36	47.6	1,308	428	8.85
Milwaukee	US-45	SB	1.10	1.73	42.9	4,997	415	8.77

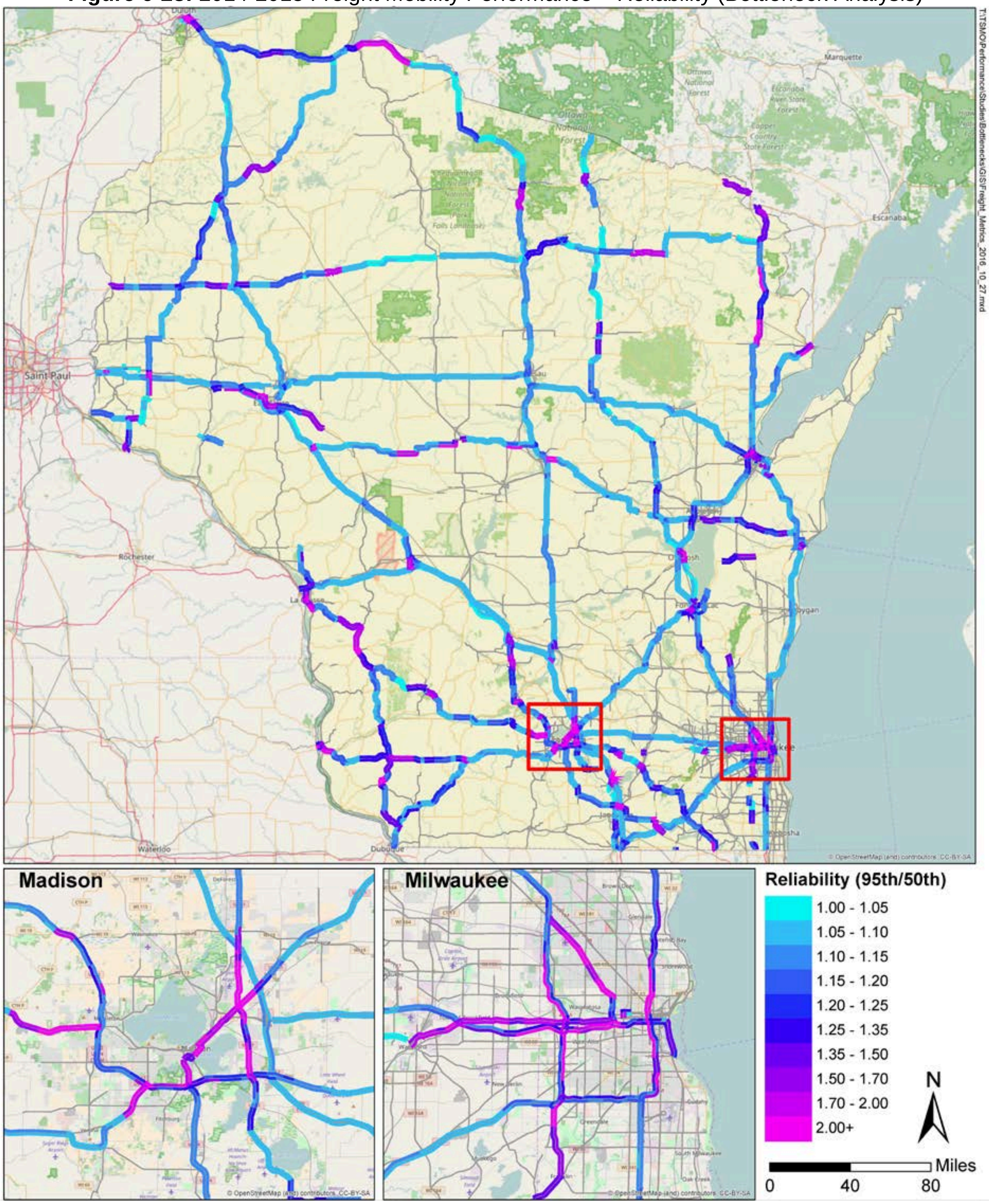
Dane	US-151	SB	0.91	2.11	30.4	3,436	160	8.66
Dane	US-51	NB	0.53	2.67	41.0	2,120	184	8.62
Milwaukee	I-43	NB	0.69	2.36	46.5	1,391	365	8.60
Milwaukee	I-894	NB	0.56	2.49	48.0	1,086	368	8.55
Dane	US-151	SB	0.95	2.24	33.3	2,939	158	8.53
Portage	US-10	WB	3.64	2.26	42.0	3,821	223	8.53
Rock	US-14	SB	0.49	2.71	29.3	2,057	68	8.45
Dane	US-14	WB	4.47	2.42	45.6	2,295	252	8.37
Milwaukee	I-43/I-94	SB	0.60	2.38	46.8	1,410	321	8.36
Dane	US-51	SB	0.42	2.33	31.5	2,477	114	8.31
Marinette	US-41	NB	2.68	2.04	46.2	2,166	358	8.27
Grant	US-18	WB	9.16	1.94	49.3	1,907	458	8.26
Milwaukee	I-43	SB	0.94	2.24	44.1	2,396	254	8.22
Milwaukee	US-41	NB	0.25	2.62	27.8	1,550	66	8.21
Milwaukee	I-894	NB	0.28	2.05	46.4	2,579	326	8.18
Dane	US-18	WB	0.67	2.24	48.9	878	415	8.16
Dane	US-51	SB	1.76	2.18	41.4	3,209	197	8.09
Dane	US-18	WB	0.88	1.95	49.4	1,214	478	8.08
Milwaukee	I-43/I-94	SB	0.43	2.21	47.6	1,469	333	8.07
Milwaukee	US-45	SB	1.21	2.04	32.8	3,263	138	8.06
Grant	US-61	SB	2.40	2.89	35.1	1,482	73	8.04
Douglas	US-53	SB	1.44	2.41	42.3	3,153	151	8.02
Dane	US-151	SB	0.70	2.20	30.7	2,861	97	8.02
Dane	US-151	NB	0.94	2.07	32.2	3,065	127	8.00
Dane	US-151	NB	0.69	2.01	30.7	2,759	130	7.99
Trempealeau	US-10	WB	1.65	2.23	35.2	2,205	140	7.97
Dane	US-151	SB	1.04	1.93	29.4	3,015	129	7.96
Marinette	US-141	SB	8.33	2.51	52.2	1,242	300	7.86
Dane	US-18	EB	1.23	1.93	34.9	5,084	130	7.85
Calumet	US-10	WB	0.29	2.12	26.5	1,691	90	7.80
Milwaukee	I-94	EB	0.54	1.75	43.1	3,745	285	7.77
Crawford	US-18	EB	1.40	3.39	45.0	1,620	56	7.66
Dane	US-151	NB	0.86	1.82	31.7	3,301	131	7.59
Dane	US-51	NB	0.52	2.36	36.9	1,893	105	7.57
Rock	US-14	NB	0.40	2.21	27.3	1,716	63	7.55
Dane	US-51	NB	0.55	1.98	30.2	3,775	77	7.55
Portage	US-10	EB	4.01	2.19	44.1	3,667	151	7.55
Milwaukee	I-43/I-94	SB	0.68	2.14	49.7	1,153	329	7.54
Dane	US-151	SB	0.83	2.01	33.6	2,420	109	7.40
Milwaukee	US-18	EB	2.03	1.92	35.0	2,684	131	7.37
Manitowoc	US-151	SB	0.66	2.06	31.0	1,925	91	7.36
Dane	US-51	NB	3.32	2.29	44.8	2,299	152	7.36
Dane	US-51	SB	0.27	2.95	40.2	1,703	46	7.36
Eau Claire	US-12	WB	2.25	2.23	40.5	3,019	107	7.35
Milwaukee	I-894	NB	0.81	2.02	49.2	901	347	7.28
Brown	US-141	NB	0.91	2.04	31.6	2,220	83	7.27
Dane	US-151	SB	0.47	1.82	27.3	2,508	85	7.26
Rock	US-14	NB	1.97	2.19	38.1	2,140	108	7.26
Milwaukee	I-94	EB	0.72	1.64	44.5	4,056	263	7.26

Source: Wisconsin TOPS Lab (NPMRDS 2015 Data)

Roadway Reliability

Figure 6-23 displays truck travel time reliability, which is similar to the performance measure proposed under MAP-21, but with the addition of non-Interstates. Truck travel time reliability is the ratio of the 95th percentile over the 50th percentile (median) travel time over the entire year.

Figure 6-23: 2014-2015 Freight Mobility Performance – Reliability (Bottleneck Analysis)

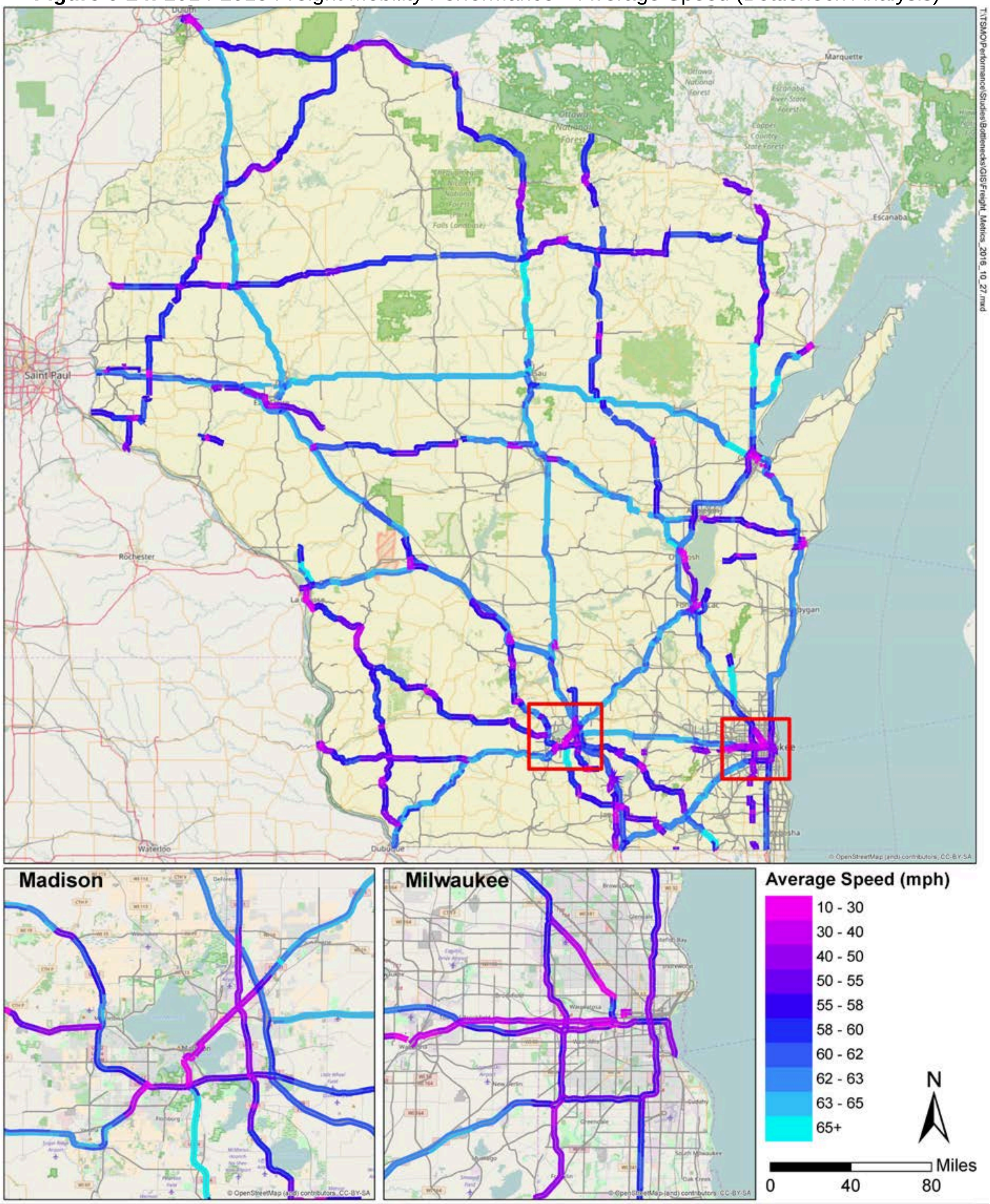


Source: Wisconsin TOPS Lab (NPMRDS 2015 Data)

Average Truck Speed

Figure 6-24 displays the average truck speed, similarly to the MAP-21 System Performance proposed rule, but with the addition of non-Interstates. Figure 6-24 displays the average speed observed over the entire year.

Figure 6-24: 2014-2015 Freight Mobility Performance – Average Speed (Bottleneck Analysis)

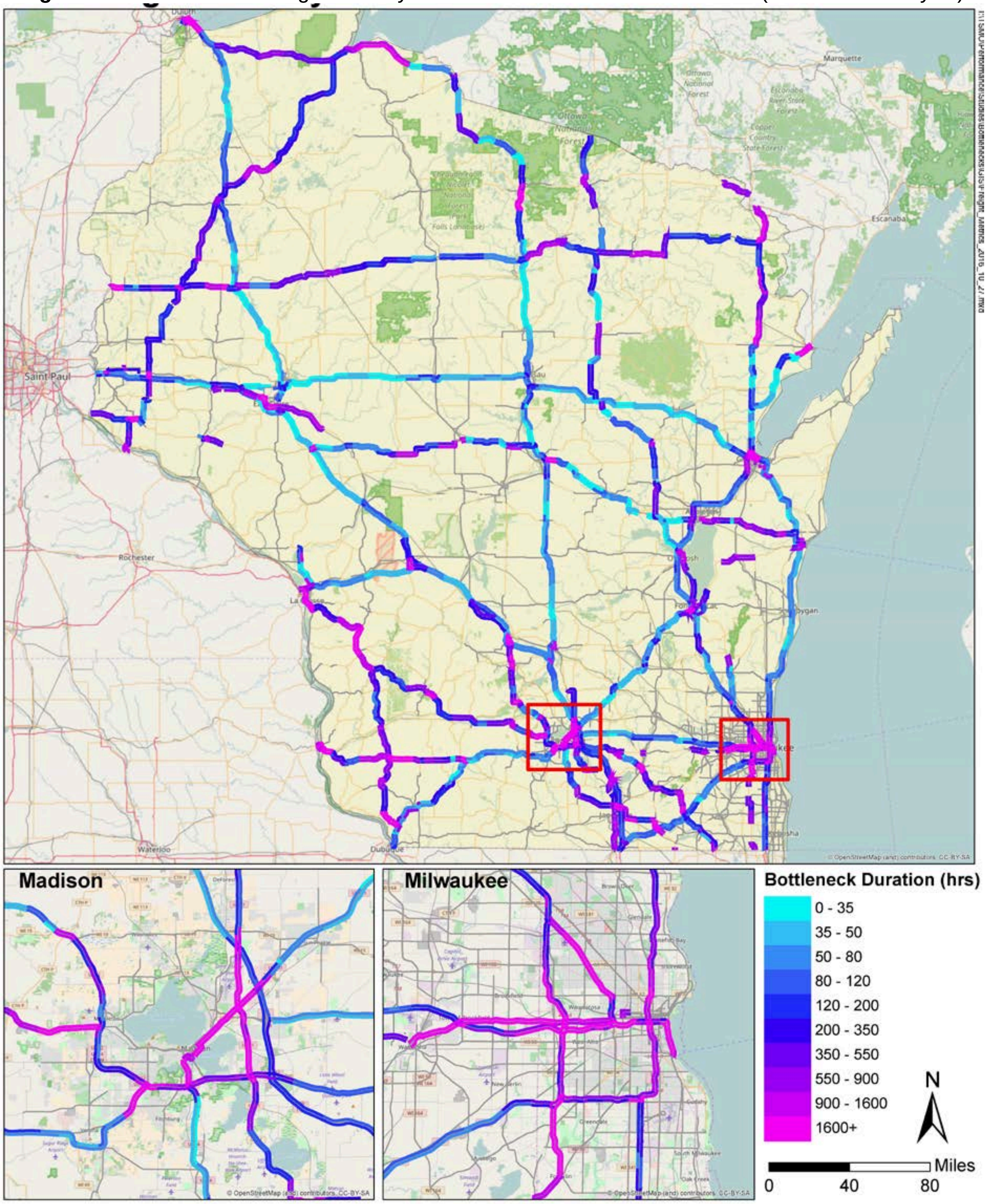


Source: Wisconsin TOPS Lab (NPMRDS 2015 Data)

Bottleneck Duration

Figure 6-25 displays bottleneck duration, the total time throughout the year where truck speed is below 50 mph.

Figure 6-25: 2014-2015 Freight Mobility Performance – Bottleneck Duration (Bottleneck Analysis)

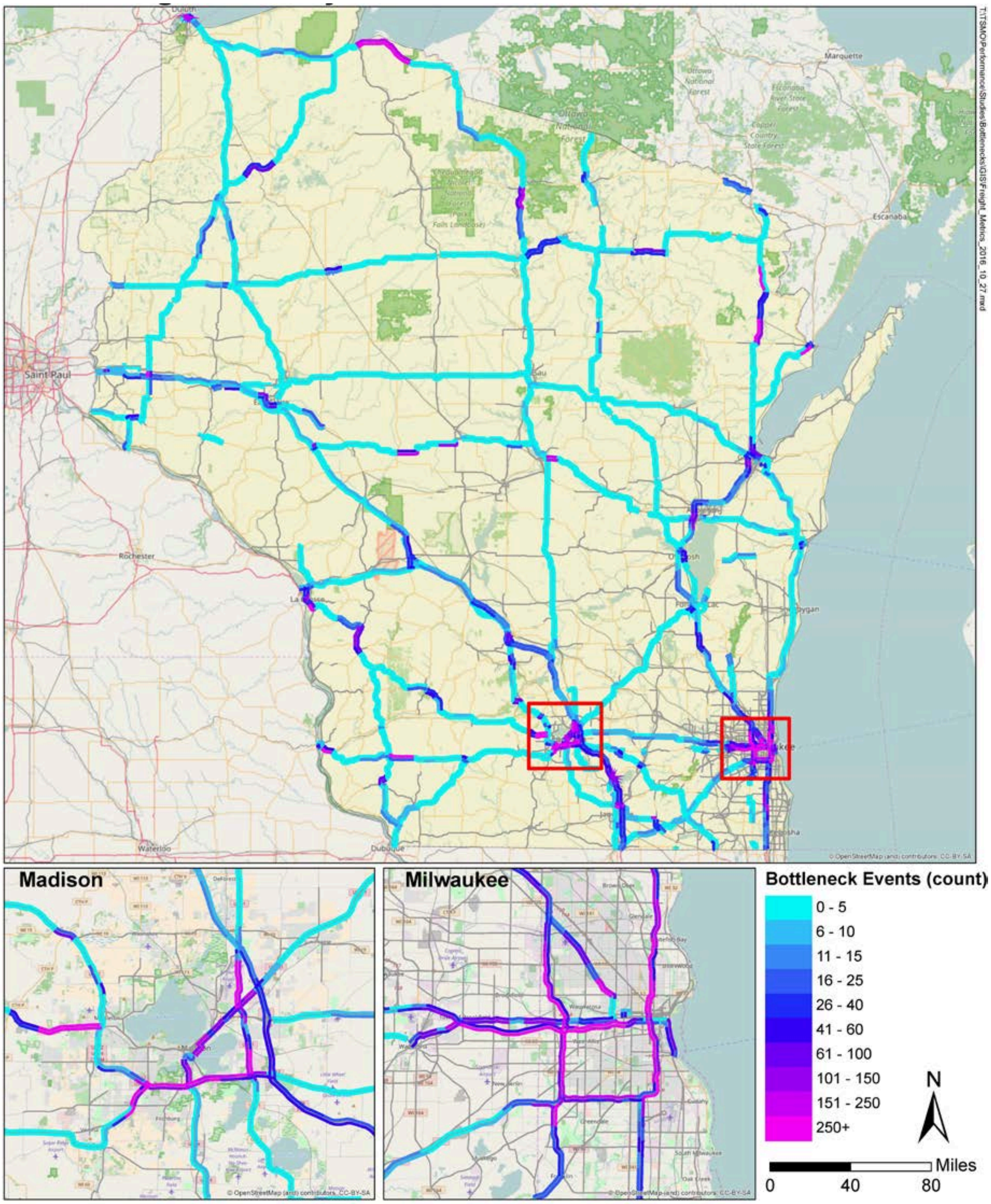


Source: Wisconsin TOPS Lab (NPMRDS 2015 Data)

Recurring Bottlenecks

Figure 6-26 displays recurring bottlenecks throughout Wisconsin. A bottleneck event is defined as a segment's speeds dropping below 60% of the free flow speed, defined as the 85th percentile speed over the year and capped at 70 MPH, for 15 minutes or longer. The bottleneck ends when it encounters a segment with uninterrupted period of 15 minutes above the threshold speed.

Figure 6-26: 2014-2015 Recurring Bottlenecks in Wisconsin (Bottleneck Analysis)

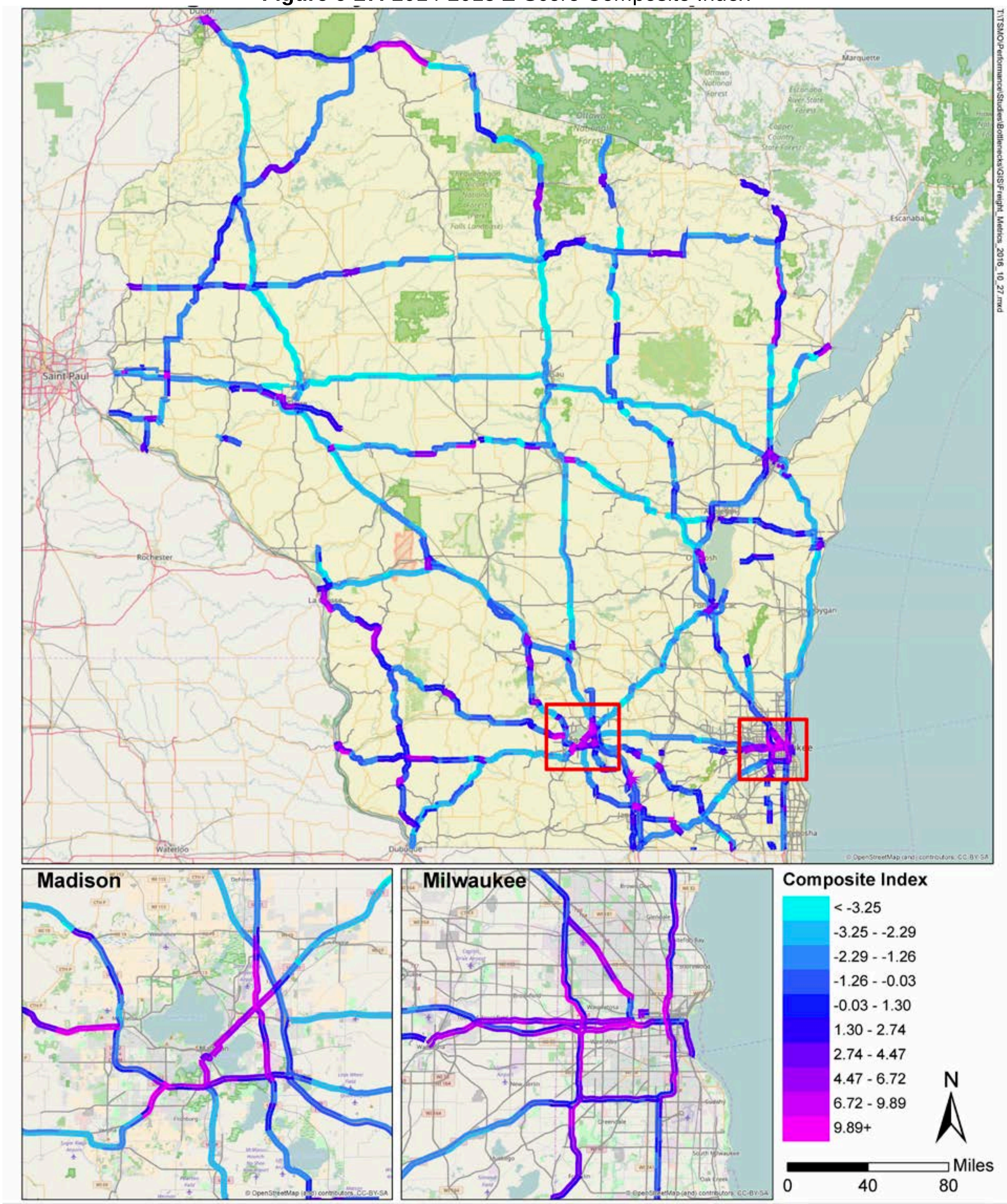


Source: Wisconsin TOPS Lab (NPMRDS 2015 Data)

Z Score

Figure 6-27 displays the Z score for Wisconsin roadways. The Z score is a combination of the four metrics (Reliability, Average Speed, Bottleneck Duration, and Bottleneck Count), where each measure is transformed to a standard normal distribution and segments are compared to the average. The lower the overall score, the better that segment is performing.

Figure 6-27: 2014-2015 Z-Score Composite Index



Source: Wisconsin TOPS Lab (NPMRDS 2015 Data)

THIS PAGE INTENTIONALLY LEFT BLANK