

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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SEWRPC Staff Memorandum

OVERVIEW OF CRUDE OIL SHIPMENTS BY RAIL THROUGH SOUTHEASTERN WISCONSIN

February 22, 2019

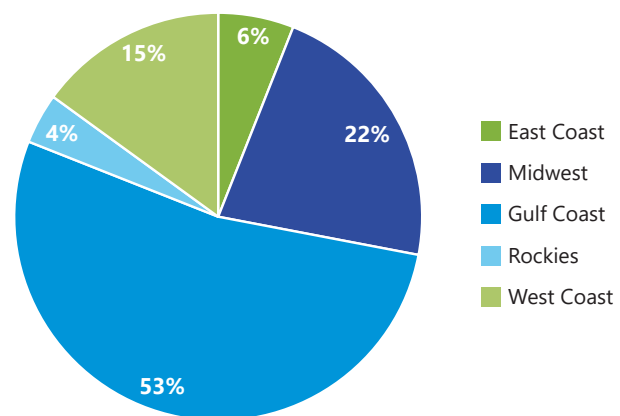
INTRODUCTION

During the past decade, public concern about the safety of shipping crude oil by rail grew as the volume of crude oil transported by rail increased and as the number of derailments of trains transporting crude oil also increased. During this time period, crude oil producers, railroads, and government agencies sought to improve the safety of shipping crude oil by rail. This memorandum summarizes recent changes in the production and transportation of crude oil in the U.S. and Canada, provides an overview of the safety concerns associated with transporting crude oil by rail, and highlights some of the key railroad industry and government actions taken to make shipping crude oil by rail safer.

INCREASING CRUDE OIL PRODUCTION IN THE UNITED STATES AND CANADA

Between 2008 and 2018, total crude oil production in the U.S. and Canada nearly doubled from about 8 million barrels per day to almost 16 million barrels per day. In the U.S., the increase primarily occurred in shale oil production areas including the Permian region in western Texas and southeastern New Mexico, the Eagle Ford region in southern Texas, and the Bakken region in western North Dakota and eastern Montana.¹ In Canada, the increase occurred mainly in the oil sands region in Alberta in western Canada.²

Figure 1
Percent of Total U.S. Refining Capacity by Region



Source: U.S. Energy Information Administration and SEWRPC

CHANGING CRUDE OIL TRANSPORTATION MODES IN THE UNITED STATES

Most crude oil produced in the U.S., as well as imports of crude oil from Canada and other nations, is transported by pipeline, tanker, barge, rail, or truck to one of 135 U.S. refineries. As shown in Figure 1, approximately three-quarters of U.S. refining capacity is located in the Gulf Coast and Midwest regions.³

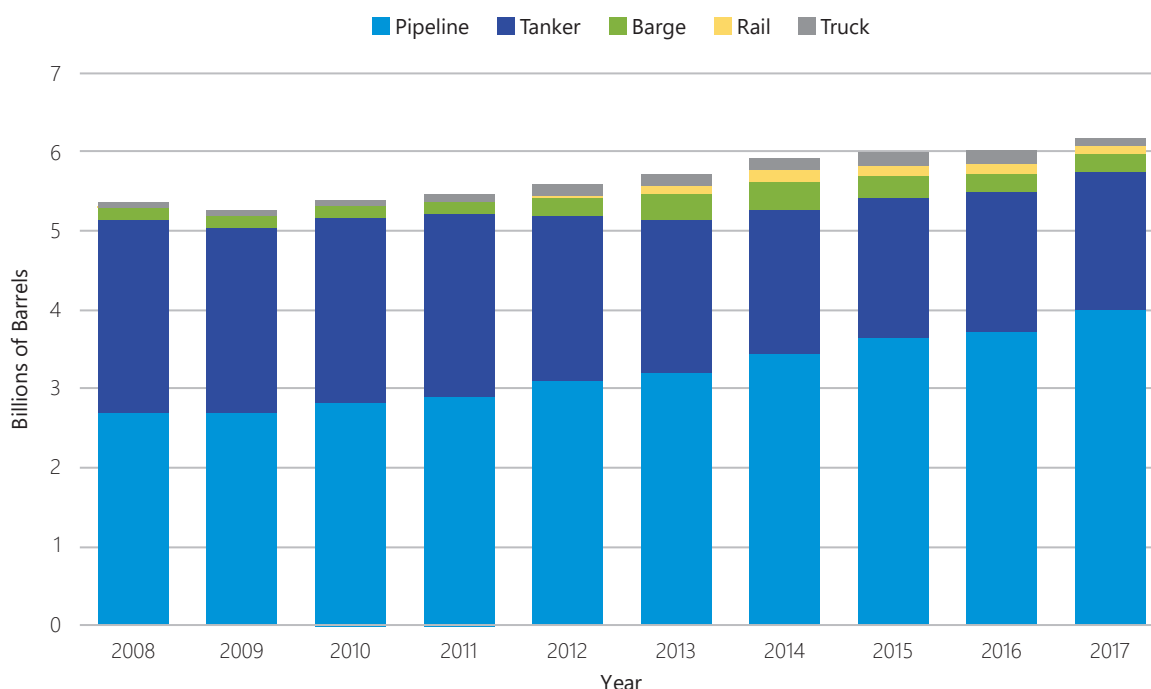
¹ Drilling Productivity Report, U.S. Energy Information Administration, December 2018.

² Estimated Production of Canadian Crude Oil and Equivalent, National Energy Board, accessed February 7, 2019, neb-one.gc.ca/nrg/sttstc/crdlnpdtrlmprdct/stt/stmtdprdctn-eng.html.

³ Refinery Capacity Report, U.S. Energy Information Administration, accessed February 11, 2019, eia.gov/petroleum/refinerycapacity.

In some oil production areas—in particular, the Bakken region and the Canadian oil sands region—increasing crude oil production, insufficient pipeline capacity serving those areas, and other market forces have at times resulted in increased shipments of crude oil by rail. However, most crude oil continues to be shipped by other modes of transportation. As shown in Figure 2, over 90 percent of crude oil shipped to U.S. refineries was transported by pipeline or tanker each year between 2008 and 2017, with the percentage of crude oil shipped by pipeline increasing from 50.1 percent in 2008 to 64.9 percent in 2017. About 0.1 percent of crude oil shipments to U.S. refineries in 2008 was transported by rail. This increased to 2.6 percent in 2014 before declining to 1.6 percent in 2017.⁴ As shown in Figure 3, shipments of crude oil by rail have increased since 2017, in part due to increasing crude oil production in the Canadian oil sands region and insufficient pipeline capacity serving that area. Construction of two pipeline projects that would serve the Canadian oil sands region, TransCanada’s Keystone XL pipeline in the U.S.—which would also serve the Bakken region—and the Trans Mountain pipeline expansion in Canada, have been halted due to environmental and legal concerns.

Figure 2
Annual Shipments of Crude Oil to U.S. Refineries by Transportation Mode: 2008-2017



Notes: Crude oil shipment totals do not include shipments to refineries located in eastern Canada that may travel through the U.S. Some crude oil is trucked short distances between production areas and refineries in Texas due to their proximity.

Source: U.S. Energy Information Administration and SEWRPC

CRUDE OIL TRAIN ROUTES THROUGH WISCONSIN

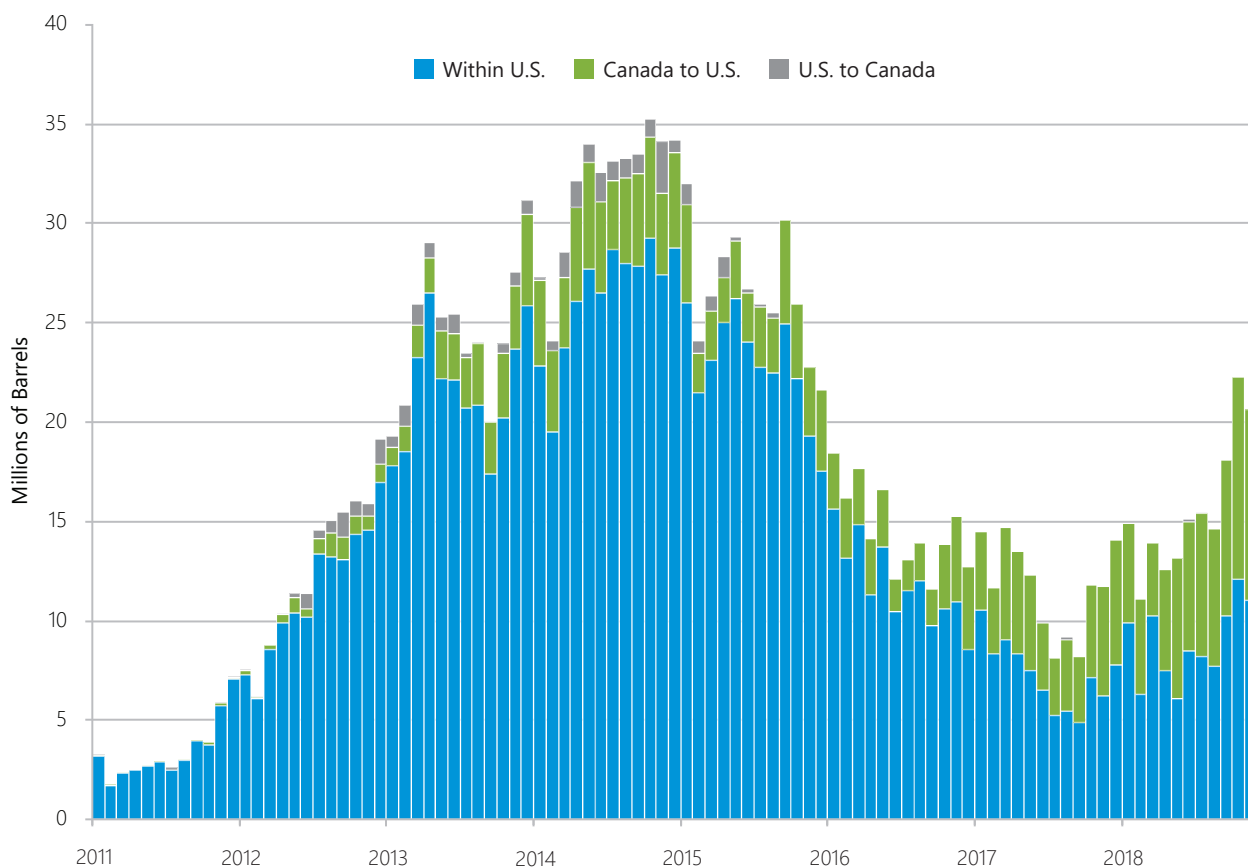
Under Federal law, railroads are “common carriers” and cannot refuse to carry hazardous materials, including crude oil. The two Class I railroads⁵ transporting shipments of crude oil through Southeastern Wisconsin are Canadian National Railroad (CN) and Canadian Pacific Railway (CP). The mainline routes of CN and CP pass through Southeastern Wisconsin, as shown in Map 1. About 21 CP freight trains and 16 CN freight trains per day (not all transporting crude oil) traveled through Southeastern Wisconsin in 2018.⁶

⁴ *Ibid.*

⁵ Class I railroads are the largest railroads operating in the U.S. as measured by operating revenue. The seven Class I railroads currently operating in the U.S. include: Burlington Northern Santa Fe Railway (BNSF), Canadian National Railway Company (CN), Canadian Pacific Railway (CP), CSX, Kansas City Southern (KCS), Norfolk Southern Railway (NS), and Union Pacific Railroad (UP).

⁶ Federal Railroad Administration GIS Web Application, accessed January 16, 2019, fragis.fra.dot.gov/GISFRASafety.

Figure 3
Monthly Shipments of Crude Oil by Rail in the United States: 2011-2018



Source: U.S. Energy Information Administration and SEWRPC

SAFETY OF TRAINS TRANSPORTING CRUDE OIL

Each year railroads safely transport a wide range of non-hazardous and hazardous materials, including crude oil. According to the Association of American Railroads (AAR), less than 1 percent of all train derailments in 2017 involved crude oil tank cars. In addition, the AAR indicates that more than 99.999 percent of all tank cars transporting crude oil arrive safely at their destination.⁷

CONCERNS ABOUT TRAINS TRANSPORTING CRUDE OIL

Even though the risk of an incident involving the derailment of a train transporting crude oil is low, an increase in the number of such derailments between 2008 and 2015—including some derailments that resulted in tank cars exploding or burning and including one derailment in Lac-Mégantic, Ontario, that resulted in 47 fatalities from multiple exploding tank cars—raised concerns, including:

- How trains hauling crude oil are maintained and operated (including train speeds and routes)
- The condition of tracks and bridges used by crude oil trains
- The properties of crude oil produced in the Bakken region
- The strength of crude oil tank cars
- The preparedness of first responders in the event of an accident involving crude oil trains

⁷ Crude Oil by Rail: Helping the U.S. Become Energy Independent, *Association of American Railroads*, accessed January 8, 2019, aar.org/article/crude-oil-by-rail.

Map 1

Class I Railroads Transporting Crude Oil Through Southeastern Wisconsin: 2019

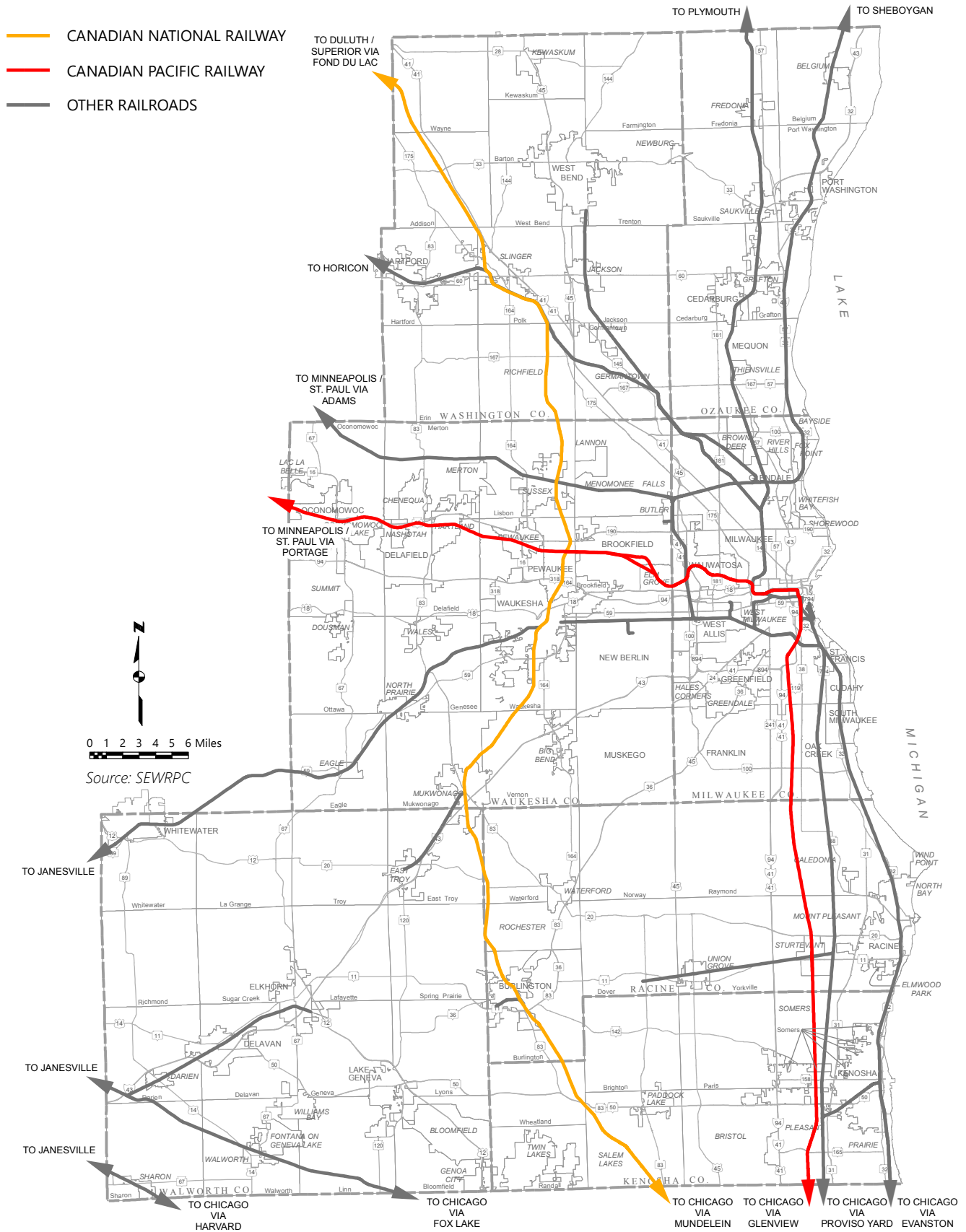


Table 1 summarizes notable derailments of trains transporting crude oil in the U.S. and Canada between 2008 and 2018. Accident investigations conducted by the Federal Railroad Administration (FRA) and National Transportation Safety Board (NTSB) in the U.S. and by the Transportation Safety Board (TSB) in Canada determined that track and train equipment defects were the primary cause of most of these derailments.

Table 1
Summary of Notable Derailments of Trains Transporting Crude Oil in the United States and Canada

Year	Number of Derailments	Fatalities	Derailment Locations
2008	1	0	Oklahoma
2009	0	0	--
2010	0	0	--
2011	0	0	--
2012	0	0	--
2013	7	47 ^a	Alabama, Minnesota, North Dakota, Ontario, Saskatchewan, and Quebec
2014	5	0	Illinois, Pennsylvania, Virginia, and New Brunswick
2015	8	0	Illinois, North Dakota, Montana, Pennsylvania, West Virginia, Wisconsin, and Ontario
2016	1	0	Oregon
2017	2	0	Illinois and Mississippi
2018	1	0	Iowa

Note: Summary may not include minor derailments involving trains transporting crude oil.

^a 47 fatalities attributed to a single derailment in Lac-Mégantic, Ontario.

Source: SEWRPC

RAILROAD INDUSTRY AND GOVERNMENT ACTIONS TO IMPROVE THE SAFETY OF TRAINS TRANSPORTING CRUDE OIL

Oil producers, major freight railroads, and Federal and State governments have enacted a number of changes—enacted voluntarily or as required under new regulations—to how railroads transport crude oil and prepare for potential accidents. These changes include:

- Implementing positive train control (PTC) systems
- Defining high-hazard flammable trains⁸ (HHFTs) and regulating their operation (e.g., maximum allowable speeds, braking systems, and route selection)
- Implementing more robust inspections of tracks and train equipment
- Reducing the volatility of Bakken crude oil
- Requiring use of stronger tank cars
- Requiring assessments of the safety and security risks of existing and potential alternative routes used by HHFTs
- Improving grade crossing safety
- Ensuring first responders are prepared to respond to accidents involving crude oil trains

The following sections describe some of these changes in more detail.

⁸ A high-hazard flammable train (HHFT) is defined as a train comprised of 20 or more loaded tank cars of a Class 3 flammable liquid (e.g., crude oil or ethanol) in a continuous block or 35 or more loaded tank cars of a Class 3 flammable liquid across the entire train.

Positive Train Control

The Rail Safety Improvement Act of 2008 requires Amtrak and Class I railroads transporting certain hazardous materials or hosting passenger rail service to implement PTC technologies (consisting of on-board and track-side computer and communication systems) to prevent accidents caused by human error, including train-to-train collisions, train derailments caused by excessive speed, unauthorized incursions by trains onto sections of track undergoing maintenance, and the movement of a trains through incorrectly set switches.⁹ By the end of 2018, the Class I railroads were operating PTC systems on 44,700 miles (83 percent) of the 53,700 miles of track required by Federal law, and they anticipate that PTC systems will be fully operational by the end of 2020.¹⁰

Volatility of Bakken Crude Oil

Concerns about the volatility, testing, and classifying of crude oil produced in the Bakken region were raised following the derailment in Lac-Mégantic, Ontario, in 2013. As a result, the U.S. Department of Transportation¹¹ (USDOT) began a program in 2013 to assess the properties, testing, and classifying of Bakken crude oil. In 2014, the USDOT determined that two companies had been improperly classifying Bakken crude oil. In 2015, the State of North Dakota began requiring crude oil producers to reduce the volatility of Bakken crude oil prior to shipping it by rail.¹²

Tank Car Design Standards

The USDOT is responsible for establishing design standards for tank cars that carry crude oil. In 2011, in response to concerns about the ability of older tank cars—constructed to USDOT's DOT-111 standard—to withstand derailments, the railroad industry voluntarily adopted a new, stronger CPC-1232 design standard for new tank cars. In 2015, the USDOT subsequently adopted a new DOT-117 design standard for new and refurbished tank cars that replaced the railroad industry's CPC-1232 standard and required a variety of tank car safety improvements including thicker tank walls, insulation and steel jackets surrounding the tank walls, and full-height shields to protect the ends of tank cars. In 2016, the USDOT adopted a new rule requiring all new and retrofitted tank cars to be equipped with a thermal protection system to help tank cars withstand fires. The new rule also requires a faster phase out of tank cars constructed to older design standards used for transporting crude oil. As of March 1, 2018, DOT-111 tank cars are no longer authorized for transporting crude oil. Beginning on May 1, 2025, CPC-1232 tank cars will no longer be authorized for transporting crude oil.¹³ Following a BNSF train derailment in Iowa in 2018 involving refurbished DOT-117 tank cars that released Canadian crude oil, BNSF subsequently announced that it would require use of new (not refurbished) DOT-117 tank cars under all new shipping contracts.¹⁴

Crude Oil Train Operating Speeds

USDOT rules adopted in 2015 limit the maximum operating speed of HHFTs to 40 mph in High Threat Urban Areas,¹⁵ including the City of Milwaukee and a 10-mile buffer extending from the City's border. The rules limit the maximum operating speed of HHFTs to 50 mph in all other areas.¹⁶

⁹ Positive Train Control, *Federal Railroad Administration*, accessed January 11, 2019, fra.dot.gov/ptc.

¹⁰ Freight Railroads Have Implemented PTC on Over 80 Percent of Required Miles, *Association of American Railroads*, accessed January 25, 2019, aar.org/news/freight-railroads-have-implemented-ptc-on-over-80-percent-of-required-miles.

¹¹ The two USDOT agencies with primary responsibilities with respect to the safety of transporting crude oil by rail are the Pipeline and Hazardous Materials Safety Administration (PHMSA) and the Federal Railroad Administration (FRA).

¹² Amended Oil Conditioning Order No. 29398, *North Dakota Industrial Commission, Department of Mineral Resources*, January 18, 2019.

¹³ 49 CFR Parts 171, 172, 173, et al.

¹⁴ Krishna Kumar, Devika and Renshaw, Jarret, BNSF Adds to Restrictions on Older Oil-Tank Cars Ahead of Phase-Out: Sources, *Reuters*, August 15, 2018.

¹⁵ High Threat Urban Areas are defined by 49 CFR 1580.3.

¹⁶ 49 CFR Parts 171, 172, 173, et al.

Crude Oil Train Route Selection

USDOT rules adopted in 2015 require railroads operating HHFTs and railroads transporting certain quantities of explosive, poisonous by inhalation, or radioactive materials to annually assess the safety and security risks of the routes used to transport these hazardous materials, and to annually identify and assess the safety and security risks of practicable alternative routes for transporting these materials. Federal rules recommend railroads seek relevant information from state, local, and tribal officials, as appropriate, when conducting these analyses, and railroads are required to identify a point of contact with respect to routing issues and to provide the contact information to state and/or regional fusion centers¹⁷ and to state, local, and tribal officials in jurisdictions that may be affected by routing decisions and who directly contact the railroad to discuss routing decisions. The USDOT provides oversight of railroad routing decisions.¹⁸

Grade Crossing Safety Improvements

In 2016, the USDOT awarded the Wisconsin Department of Transportation (WisDOT) \$3 million in Federal funding from the Safe Transportation of Energy Products by Rail Program, matched by \$750,000 in State funding, to improve safety along CP's mainline track between Hartland and Pewaukee. Scheduled to be completed in 2020, the project will implement grade crossing safety improvements at the following locations:

- Vettelson Road in the City of Delafield
- Cottonwood Avenue and Maple Avenue in the Village of Hartland
- North Shore Drive (CTH KE) in the Town of Delafield
- Parkside Lane and Duplainville Road in the City of Pewaukee
- Kopmeier Drive, Wisconsin Avenue, Clark Street (new pedestrian crossing), Oakton Avenue, and Forest Grove Drive in the Village of Pewaukee¹⁹

First Responder Training

The USDOT, in partnership with other government agencies and the private sector, has developed Transportation Rail Incident Preparedness and Response (TRIPR) training resources to help first responders prepare for potential accidents involving trains transporting flammable liquids, including crude oil.²⁰

CONCLUSION

Each year railroads safely transport a wide range of non-hazardous and hazardous materials through Southeastern Wisconsin, including crude oil. According to the railroad industry, the risk of an incident involving a crude oil train derailment is quite low. However, during the past decade increasing shipments of crude oil by rail across North America—resulting primarily from increasing U.S. and Canadian crude oil production and constrained pipeline capacity—and a corresponding increase in the number of crude oil train derailments in the U.S. and Canada raised public concerns about the safety of crude oil trains. In response to these concerns, crude oil producers, railroads, and government agencies have taken a number of steps to increase the safety of trains transporting crude oil through the Region, including:

- Implementing PTC along routes used by crude oil trains

¹⁷ Fusion centers are collaborative efforts involving two or more agencies that provide resources, expertise, and information with a goal of detecting, preventing, investigating, and responding to criminal and terrorist activity. The two fusion centers in Wisconsin are the Wisconsin Statewide Intelligence Center (WSIC), which serves the entire State, and the Southeastern Wisconsin Threat Analysis Center (STAC), which serves Jefferson, Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties.

¹⁸ 49 CFR Parts 171, 172, 173, et al.

¹⁹ Ball, Matt, Federal Railroad Administration Awards Wisconsin \$3 Million to Increase Safety along Railroad Crossings, Informed Infrastructure, February 23, 2016, informedinfrastructure.com/20412/federal-railroad-administration-awards-wisconsin-3-million-to-increase-safety-along-railroad-crossings.

²⁰ dothazmat.vividlms.com/tools.asp.

- Reducing the volatility of Bakken crude oil transported by rail
- Strengthening the design standard for tank cars used to transport crude oil by rail
- Reducing crude oil train operating speeds
- Requiring annual assessments of the safety of routes used by crude oil trains
- Improving grade crossing safety along CP's mainline track in Waukesha County