Minnesota Department of Commerce
Energy Environmental Review and Analysis

Final Environmental Impact Statement
Line 3 Project

Docket Nos. PPL-15-137/CN-14-916

February 12, 2018

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Line 3 Project Final EIS Cover Sheet

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Abstract

Enbridge Energy, Limited Partnership (Enbridge, or Applicant) has proposed to construct and operate 340 miles of new 36-inch-diameter pipeline in Minnesota with an annual average capacity of 760,000 barrels per day (bpd) and to abandon in place 282 miles of the existing 34-inch-diameter, 390,000-bpd operating capacity, Line 3 pipeline (Line 3 Project, or Project). The existing Line 3 pipeline originates in Canada and crosses the U.S.-Canada border near Neche, North Dakota. It continues through North Dakota and Minnesota and terminates at the Enbridge Superior Station and Terminal Facility (Superior terminal) near Superior, Wisconsin.

As proposed by Enbridge, the new pipeline would generally parallel the existing Line 3 pipeline along the Enbridge Mainline system right-of-way from the North Dakota-Minnesota border in Kittson County to the Clearbrook terminal in Clearwater County. From Clearbrook to the terminal in Superior, Wisconsin, the proposed pipeline would diverge from the existing Line 3 corridor. The proposed Project route and alternatives to the proposed Project route pass through the following counties in Minnesota: Aitkin, Beltrami, Benton, Carlton, Cass, Clearwater, Crow Wing, Hubbard, Itasca, Kanabec, Kittson, Marshall, Mille Lacs, Morrison, Pennington, Pine, Polk, Red Lake, St Louis, Todd, and Wadena.

Enbridge's proposed project requires two separate approvals from the Minnesota Public Utilities Commission (Commission) – a certificate of need (CN) and a route permit. The Commission's docket numbers for these approvals are PL9/CN-14-916 and PL9/PPL-15-137.

Department of Commerce, Energy Environmental Review and Analysis (DOC-EERA) staff is responsible for conducting environmental review for CN and route permit applications submitted to the Commission. This environmental impact statement (EIS) has been prepared to meet the requirements of both review processes.

This **revised** Final EIS addresses the issues identified in DOC-EERA's scoping decision of September 21, 2016. It evaluates the potential impacts of Enbridge's proposed Project and alternatives to the proposed Project, as well as possible mitigation measures for these impacts. It also provides responses to substantive comments on the Draft EIS submitted during the public review period following issuance of the Draft EIS on May 15, 2017.

The revised Final EIS also includes supplemental information requested by the PUC on December 7, 2017. The PUC identified four areas in which additional information was needed. These include the following: indication of how far and where CN Alternative SA-04 would need to be moved to avoid karst topography and what the revised environmental impact analysis of this move would be; clarification that quantitative representations of route and system alternatives do not necessarily reflect the actual qualitative impacts; identification of the extent to which resource impacts of route alternatives are or are not additive; and clarification that the traditional cultural properties survey must be complete prior to the start of construction. To address the PUC comments, the revised Final EIS includes clarification of impacts in Chapters 5 and 6 (revisions are noted in bold red text) and the analysis of revisions to the CN Alternative SA-04 is in Appendix U. It also provides a statement that the traditional cultural properties survey must be completed prior to project construction (see Section 5.4.1.2).

Public Information Meetings and Comment Period

The Draft EIS was issued on May 15, 2017. Comments on the Draft EIS were accepted through July 10, 2017. Public information meetings on the Draft EIS were held at the following locations and times:

Week of June 5th – June 9th	Week of June 12th – June 16th	Week of June 19th – June 23rd
Tuesday, June 6 10:00 AM – 1:00 PM Rice Lake Community Center 13830 Community Loop Bagley, MN 56621	Monday, June 12 10:00 AM – 1:00 PM Grand Casino Hinckley 777 Lady Luck Drive Hinckley, MN 55037	Tuesday, June 20 10:00 AM – 1:00 PM Marshall County Central Schools 310 West Minnesota Avenue Newfolden, MN 56738
Tuesday, June 6 6:00 PM – 9:00 PM IRA Civic Center 1401 NW 3rd Avenue Grand Rapids, MN 55744	Monday, June 12 6:00 PM – 9:00 PM East Lake Community Center 36666 State Hwy 65 McGregor, MN 56718	Tuesday, June 20 6:00 PM – 9:00 PM Hallock City Hall 163 3rd Street SE Hallock, MN 56728
Wednesday, June 7 10:00 AM – 1:00 PM Park Rapids High School Cafetorium 401 Huntsinger Avenue Park Rapids, MN 56470	Tuesday, June 13 10:00 AM – 1:00 PM Fond du Lac Community College 2101 14th Street Cloquet, MN 55720	Wednesday, June 21 10:00 AM – 1:00 PM Ralph Engelstad Arena, Imperial Room 525 Brooks Avenue North Thief River Falls, MN 56701
Wednesday, June 7 6:00 PM – 9:00 PM Palace Casino Hotel 16599 69th Avenue NW Cass Lake, MN 56633	Tuesday, June 13 6:00 PM – 9:00 PM Intercontinental Hotel Saint Paul 11 E. Kellogg Boulevard St. Paul, MN 55101	Wednesday, June 21 6:00 PM – 9:00 PM Plummer Senior Citizen Center 185 Minnesota Street Plummer, MN 56748
Thursday, June 8 10:00 AM – 1:00 PM Downtown Fair Center 107 W. 7th Avenue Floodwood, MN 55736	Wednesday, June 14 11:00 AM – 2:00 PM Staples Community Center 425 6th Street NE Staples, MN 56479	Thursday, June 22 10:00 AM – 1:00 PM Gully Community Center 120 Main Street Gully, MN 56646

Week of June 5th – June 9th	Week of June 12th – June 16th	Week of June 19th – June 23rd
Thursday, June 8 6:00 PM – 9:00 PM Central Lakes College Classroom E54 501 West College Drive Brainerd, MN 56401	Wednesday, June 14 6:00 PM – 9:00 PM Initiative Foundation 405 1st Street SE Little Falls, MN 56345	Thursday, June 22 6:00 PM – 9:00 PM Sanford Center and George W. Nielson Convention Center 1111 Event Center Drive NE Bemidji, MN 56601
Friday, June 9 11:00 AM – 1:00 PM Maslowski Wellness & Research Ctr. 17 5th Street Southwest Wadena, MN 56482	Thursday, June 15 10:00 AM – 1:00 PM Henry's Catering and Banquet Hall 6774 MN-25 Foley, MN 56329	
	Thursday, June 15 6:00 PM – 9:00 PM Phoenix Hotel & Banquet Center 210 MN-23 Milaca, MN 56353	
	Friday, June 16 10:00 AM – 1:00 PM The Grand Event Center 2025 Rowland Road Mora, MN 55051	

Additional Information

Additional information on the Project is available in the Project application listed in the References chapter of this **revised** Final EIS.

Other material related to this docket is available online at: https://mn.gov//commerce/energyfacilities/line3/ or on the eDockets website at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showeDocketsSearch&showEdocket=true&userType=public. To retrieve materials related to this docket via the eDockets website, use the steps below.

Certificate of Need (CN) documents:

- For Docket Number, select "14" from the Year dropdown box and enter "916" in the Docket Lookup box.
- Select "Certificate of Need" from the Docket Type dropdown box.
- Select "Search."

Petroleum Pipeline (PPL) Route Permit documents:

- For Docket Number, select "15" from the Year dropdown box and enter "137" in the Docket Lookup box.
- Select "Petroleum Pipeline" from the Docket Type dropdown box.
- Select "Search."

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APPENDICES

ACRONYMS AND ABBREVIATIONS

Acronym	Definition
°F	Degrees Fahrenheit
µg/m³	micrograms per cubic meter
AADT	annual average daily traffic
ACS	American Community Survey
ADW	Animal Diversity Web
AEO	Annual Energy Outlook
AMA	Aquatic Management Area
AER	Alberta Energy Regulator
AFF	annual failure frequency
ALJ	administrative law judge
AMA	Aquatic Management Area
ANSI	American National Standards Institute
AOI	area of interest
API	American Petroleum Institute
APP	Agricultural Protection Plan
Applicant	Enbridge Energy
AQI	Air Quality Index
ASME	American Society of Mechanical Engineers
ATWS	additional temporary workspace(s)
bbl	barrel(s)
BCC	birds of conservation concern
BGEPA	Bald and Golden Eagles Protection Act
BIA	Bureau of Indian Affairs

Acronym	Definition
BLM	Bureau of Land Management
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BO	Biological Opinion
bpd	barrels per day
BTEX	benzene, toluene, ethylbenzene, and xylenes
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CN	Certificate of Need
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon-dioxide equivalent
Commission	Minnesota Public Utilities Commission
Control Center	Enbridge Control Center
CSW	construction stormwater
CWA	Clean Water Act
dB	decibel(s)
dBA	A-weighted decibel(s)
DDT	Dichlorodiphenyltrichloroethane
dilbit	diluted bitumen
DNR	Department of Natural Resources
DOC-EERA	Department of Commerce, Energy Environmental Review and Analysis
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior

Acronym	Definition
DOS	U.S. Department of State
DPS	distinct population segment
DSDD	Draft Scoping Decision Document
DWSMA	drinking water supply management area
EA	Environmental Assessment
EAW	Environmental Assessment Worksheet
ECD	erosion and sediment control device
ECS	Ecological Classification System
eGRID	Emissions and Generation Resource Integrated Database
EI	Environmental Inspector
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EJ	Environmental justice
Enbridge	Enbridge Energy (the Applicant)
EPA	U.S. Environmental Protection Agency
EQB	Environmental Quality Board
ERAP	Emergency Response Action Plan
ESA	federal Endangered Species Act
ESRI	Environmental Systems Research Institute
Exponent	Exponent, Inc.
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FHWA	Federal Highway Administration

Acronym	Definition
FIRM	Flood Insurance Rate Map
FMA	Fisheries Management Area
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
GAP	Gap Analysis Program
GHG	greenhouse gas
GIS	geographic information system
GLIFWC	Great Lakes Indian Fish and Wildlife Commission
GNTL	Great Northern Transmission Line Project
gpd	gallons per day
gpm	gallons per minute
GSOC	Gopher State One-Call
GWP	Global Warming Potential
H_2S	hydrogen sulfide
HAP	hazardous air pollutant
HARGIS	Historic Architectural/Archaeological Geographic Information System
HCA	high consequence area
HCAADT	heavy commercial vehicle portion of annual average daily traffic
HCVF	high conservation value forest
HDD	horizontal directional drilling
HHFT	high-hazard flammable train
hp	horsepower
HVTL	high-voltage transmission line
I&M	Illinois and Michigan

Acronym	Definition
IAC	Indian Affairs Commission
IAS	Inventory of Archaeological Sites
IBA	Important Bird Area
IBI	Index of Biotic Integrity
ICP	Integrated Contingency Plan
IHPA	Illinois Historic Preservation Agency
ILCS	Illinois Compiled Statutes
Ill. AC	Illinois Administrative Code
IMP	Integrity Management Plan
IMPLAN	Impact Model for Planning
Iowa AC	Iowa Administrative Code
Iowa DNR	Iowa Department of Natural Resources
IPaC	Information for Planning and Conservation
kg/m^3	kilogram per cubic meter
kV	kilovolt
L_{10}	the dBA that may be exceeded 10 percent of the time within 1 hour
L_{50}	the dBA that may be exceeded 50 percent of the time within 1 hour
LBS	Lakes of Biological Significance
LCM	lost circulation material
L_{dn}	day-night sound level
Leq_{24}	24-hour equivalent sound level
LGUs	local units of government
LLBO	Leech Lake Bank of Ojibwe
MAAQS	Minnesota Ambient Air Quality Standards
MBS	Minnesota Biological Survey
MBS Site	Minnesota Biological Survey Site of Biodiversity Significance

Acronym	Definition
MBTA	Migratory Bird Treaty Act
MDH	Minnesota Department of Health
MEPA	Minnesota Environmental Policy Act
MERLA	Minnesota Environmental Response and Liability Act
mg/L	milligrams per liter
mgd	million gallons per day
MGS	Minnesota Geological Survey
MHS	Minnesota Historical Society
MIAC	Minnesota Indian Affairs Council
Minn. R.	Minnesota Administrative Rules
Minnesota BWSR	Minnesota Board of Water and Soil Resources
Minnesota DA	Minnesota Department of Agriculture
Minnesota DNR	Minnesota Department of Natural Resources
Minnesota DPS	Minnesota Department of Public Safety
Minnesota PCA	Minnesota Pollution Control Agency
MLRA	major land resource area
MLV	mainline valve
mm	millimeter
MMcf/d	million cubic feet per day
mm^2/s	square millimeters per second
MNDOT	Minnesota Department of Transportation
MnOPS	Minnesota Office of Pipeline Safety
MP	milepost
MPL	Minnesota Pipe Line Company
MWh	Megawatt hours

Acronym	Definition
NAAQS	National Ambient Air Quality Standards
NACE	National Association of Corrosion Engineers
NATHPO	National Association of Tribal Historic Preservation Officers
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NDAC	North Dakota Administrative Code
NDCC	North Dakota Century Code
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NETL	National Energy Technology Laboratory
NFIP	National Flood Insurance Program
NHIS	Natural Heritage Information System
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NLF	Northern Lakes and Forests
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
North Dakota DH	North Dakota Department of Health
North Dakota PR	North Dakota Parks and Recreation Department
NPC	Native plant community
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRDA	Natural Resource Damage Assessment
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory

Acronym	Definition
NRS	National Response System
NSPS	New Source Performance Standards
NTSB	National Transportation Safety Board
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OAH	Office of Administrative Hearings
OFCVO	Office of Freight and Commercial Vehicle Operations
OPA 90	Oil Pollution Act of 1990
ORV	Outstanding Resource Value
ORVW	Outstanding Resource Value Waters
OSA	Office of the State Archaeologist
OSLTF	Oil Spill Liability Trust Fund
PAD-US	Protected Areas Database of the United States
PAH	polycyclic aromatic hydrocarbons
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIG	pipeline inspection gauge
PM	particulate matter
PM-10	suspended particulate matter less than or equal to 10 microns in diameter
PM-2.5	suspended particulate matter less than or equal to 2.5 microns in diameter
PPE	personal protective equipment
PPV	peak particle velocity
PREP	National Preparedness for Response Exercise Program
PSD	Prevention of Significant Deterioration
psig	pounds per square inch gauge

Acronym	Definition
PW	Public Waters
PWS	Public Water Supply
RA-03AM	Route Alternative RA-03AM
RA-06	Route Alternative RA-06
RA-07	Route Alternative RA-07
RA-08	Route Alternative RA-08
RFAs	reasonably foreseeable actions
ROI	region of interest
RPM	Reasonable and Prudent Measure
RRT	Regional Response Team
RSA	route segment alternative
SA-04	System Alternative SA-04
SCADA	Supervisory Control and Data Acquisition
SCC	social cost of carbon
SDS	State Disposal System
SFHA	special flood hazard area
SGCN	Species of Greatest Conservation Need
SHPO	State Historic Preservation Officer
SHSND	State Historical Society of North Dakota
SMPE	South Mist Pipeline Extension
SMS	Scenic Management System
SNA	Scientific and Natural Area
SO_2	sulfur dioxide
SPCC	Spill Prevention, Containment, and Control
SRHP	State Register of Historic Places
SSURGO	Soil Survey Geographic Database

Acronym	Definition
Superior Terminal	Enbridge Superior Station and Terminal Facility
STB	Surface Transportation Board
SWPPP	Stormwater Pollution Prevention Plan
TASC	Technical Assistance Services for Communities
TCP	Traditional Cultural Property
THPO	Tribal Historic Preservation Officer
TMDL	total maximum daily load
TSP	Total suspended particulates
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VdB	vibration velocity decibels
VOC	volatile organic compound
WAN	Wildlife Action Network
WCA	Wetland Conservation Act
WCSB	Western Canadian Sedimentary Basin
WHAF	Watershed Health Assessment Framework
WHS	Wisconsin Historical Society
WIMN	What's in My Neighborhood
WMA	Wildlife Management Area
WPA	Wellhead Protection Area

Acronym	Definition
WRAPS	Watershed Restoration and Protection Strategy
yard	material/pipe storage yard

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Chapter 10

Accidental Crude Oil Releases

10.1 INTRODUCTION

During the transport of crude oil by pipeline and by the alternative modes of rail and truck transportation, unplanned events may occur that can result in a release of crude oil. Although the probability of a large or major oil release at any specific location is extremely low, the probability of a release of some type along the entire pipeline during its lifetime is not low. In addition, the consequences of a large release can be significant. Therefore, in addition to the analysis of potential Project impacts during construction and normal operations, the potential for unanticipated releases and the potential consequences of such releases must be considered in this Environmental Impact Statement (EIS).

Modeling, statistics, and resource mapping can help predict the probability of an accidental oil release, how crude oil behaves in the environment, and what resources could be at risk should there be an oil spill. However, it is impossible to predict where a spill would happen, the quantity of oil involved, how far the impacts would extend, or exactly what resources would be affected. In part, this is because there are so many incident-specific factors involved. The weather, time of year, water levels, human error, and even what type of wildlife is present at the time a spill occurs all affect its probability and outcome. **Therefore, the analysis in this chapter cannot predict the impact of a spill. Instead, it provides a general assessment of the probability of spill occurring, a general evaluation of the behavior of crude oil in the environment, a general evaluation of how spilled oil affects the environment, and an assessment of the type and quantity of resources that are exposed along each alternative.**

This chapter first describes the relevant federal and state regulations for crude oil transportation by pipeline, rail, and truck and the causes of crude oil releases and then provides a baseline crude oil spill risk analysis (Section 10.1). Section 10.2 describes the behavior of crude oil in the environment, including case studies of prior releases. The crude oil trajectory and fates modeling is discussed in Section 10.3, followed by descriptions of the potential exposure of and impacts on specific resources if a spill were to occur (Section 10.4). Sections 10.5 and 10.6 describe spill prevention and response measures and clean-up and recovery measures, respectively. Lastly, Section 10.7 compares the potential exposure of resources of concern to crude oil releases for the alternatives.

10.1.1 Regulatory Context

Crude oil transport by pipeline, rail, and tanker truck is regulated by a number of state and federal guidelines and standards, which are described below.

10.1.1.1 Pipeline Safety Regulations and Standards

The federal (U.S. Department of Transportation [USDOT]) and state (Minnesota Office of Pipeline Safety [MnOPS]) regulatory requirements for oil pipelines, as well as industry standards for oil pipelines, are discussed below. These regulations and standards apply to each of the pipeline alternatives.

10.1.1.1.1 U.S. Department of Transportation Regulations

USDOT is mandated to regulate pipeline safety under Title 49 U.S. Code Chapter 601. The Pipeline and Hazardous Materials Safety Administration (PHMSA) is the agency within USDOT that has jurisdiction and is responsible for developing and enforcing regulations for the safe, reliable, and environmentally sound operation of interstate pipelines. PHMSA's regulations encompass design, construction, testing, operation, maintenance, and emergency response for hazardous liquid pipelines and related facilities.[1]

49 Code of Federal Regulations (CFR) 195 (Transportation of Hazardous Liquids by Pipeline) include Subparts A through H, establish reporting requirements, design requirements, construction requirements, pressure testing, operation and maintenance, integrity management, required qualifications of pipeline personnel, and corrosion control. For a new hazardous liquid pipeline, high consequence areas (HCAs)[2] must be identified prior to operation, and hazardous liquid pipeline operators are required to develop and submit to PHMSA a written Integrity Management Plan (IMP) within 1 year of the start of operation (49 CFR 195.452).

The Applicant's IMP must include identification of all pipeline segments that could affect HCAs; a baseline assessment plan to ensure integrity of these segments; a process for continual integrity assessment and evaluation; repair criteria to address issues identified by the integrity assessment method; a process to identify, evaluate, and implement preventative and mitigation measures to protect HCAs; and a description of how each element of the IMP would be implemented. Because populations can expand and environmental situations can change, HCA boundaries can change over time; therefore, new HCAs must be incorporated into baseline assessment plans within a year of identification (PHMSA 2016). As a part of IMP implementation, the Applicant would also have to perform periodic integrity assessments on line segments that could affect HCAs at least once every 5 years.

If a pipeline is approved for the Project, it is anticipated that the Applicant's IMP for the new pipeline system would be in large part similar to its existing IMPs for the existing Enbridge pipeline system. The new IMP would include a new baseline assessment plan, identification of HCAs specific to the Project, and other Project-specific information.

10.1.1.1.2 State Pipeline Regulations

Although PHMSA is responsible for regulation, inspection, and enforcement of safety regulatory requirements for interstate pipelines as described above, it also permits individual states to adopt additional or more stringent safety regulations for intrastate pipelines. In states where such an agreement is in place, the state is the delegated inspection authority for compliance with federal rules

[1] Parts 190, 194, 195, 198, and 199 are relevant to hazardous liquid (including crude oil) pipelines. Parts 194 and 195 address issues that are directly related to pipeline system integrity and oil spill risk assessment and environmental consequences. The regulations at 49 CFR 194 (Response Plans for Onshore Oil Pipelines) contain requirements for onshore oil spill response plans that are intended to reduce the environmental impact of oil unintentionally discharged from onshore oil pipelines. Parts 190, 198, and 199 address issues that are tangential to pipeline system integrity, including rulemaking procedures, regulations for grants and state aid for safety programs, and required drug and alcohol testing for operators of pipeline facilities.

[2] HCAs are areas or features where a crude oil pipeline failure, such as a release of crude oil, may have long-term and/or permanent and major impacts on resources. They are defined and discussed in more detail in Section 10.4.1.

while PHMSA retains enforcement authority. MnOPS, a division of the Minnesota Department of Public Safety, inspects pipelines within the state and has such an agreement with PHMSA to inspect pipelines.[3] PHMSA's Office of Pipeline Safety enforces its federal regulations based on the inspections conducted by MnOPS. PHMSA or MnOPS inspections or audits can occur at any time, but typically happen every 2 years. The scope of audits and inspections conducted by these regulators are broad and can include the following (Enbridge 2015c):

- Compliance with aerial patrol requirements;
- Review of integrity dig records to determine both adequacy and accuracy;
- Inspection of cathodic protection systems;
- Review of tank inspection records;
- Review of operation, maintenance, and contingency manuals;
- Review of pipeline integrity methodology;
- Review of leak detection methodology;
- Review of system maximum operating pressures;
- Review of facility integrity manuals;
- Inspections of facilities;
- Review of operation and maintenance procedures and records;
- Review of operator qualification records; and
- Examination of public awareness materials.

If MnOPS identifies a violation of Minnesota pipeline laws, it has the authority to issue civil penalties for violations of these laws.

Of the states affected by the pipeline alternatives, only Minnesota has an agreement with PHMSA. The Iowa Utilities Board has primary jurisdiction over the routing and siting of hazardous liquids (including crude oil) pipelines in Iowa but does not have safety jurisdiction over hazardous liquids pipelines—PHMSA retains that authority (Iowa Utilities Board 2017). Similarly, North Dakota, Illinois, and Wisconsin have not entered into agreement with PHMSA to monitor the safety of their pipelines; therefore, PHMSA regulates, inspects, and enforces interstate liquid pipeline safety requirements in those states.

10.1.1.1.3 Pipeline Industry Standards

In addition to adhering to PHMSA regulatory requirements, major oil transport pipelines must also comply with pertinent industry standards. If a pipeline system is selected for approval, the design of the system would be expected to comply with the industry standards and codes listed below. These standards and codes were established to improve pipeline system integrity and safety and to reduce the potential for accidental releases.

- American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) Code B31.4, "Liquid Transportation Systems for Hydrocarbons, Liquid Petroleum Gas, Anhydrous

3 The agreement is codified under Minnesota Statutes, Chapter 299J, Pipeline Safety.

Ammonia, and Alcohols": This standard addresses requirements for materials of construction welds, inspection, and testing for cross-country hazardous liquid pipelines, including crude oil pipelines, to ensure that pipelines are constructed using the appropriate methods and materials to prevent leaks. ASME B31.4 434.15.2 (a) requires mainline block valves on the upstream side of major river crossings and public water supply reservoirs, and either a block valve or a check valve on the downstream side. 49 CFR Part 195, "Transportation of Hazardous Liquids by Pipelines," has incorporated ASME/ANSI B31.4 code by reference.

- American Petroleum Institute (API) 570, "Piping Inspection Code–Inspection, Repair, Alteration, and Re-Rating of In-Service Piping Systems": This code provides guidance on proper inspection and repair of pipelines the petroleum refining and chemical processing industries use, but it may be used for any piping system.
- API RP 1102, "Recommended Practices for Liquid Petroleum Pipelines Crossing Railroads and Highways": This recommended practice is a requirement of ASME/ANSI B31.4. This guide gives primary emphasis to provisions for public safety. It covers the design, installation, inspection, and testing required to ensure safe crossings of steel pipelines under railroads and highways. The provisions apply to the design and construction of welded steel pipelines under railroads and highways.
- API RP 1109, "Recommended Practice for Marking Liquid Petroleum Pipeline Facilities": ASME/ANSI B31.4 advises that this API RP 1109 be used as a guide. The recommended markers are signs that visually alert the public to the presence of a pipeline and the potential hazards associated with excavating near pipelines. Strategic placement of markers and signs also helps the pipeline operator to perform right-of-way surveillance, inspections, and other routine activities.
- NACE [National Association of Corrosion Engineers] RP 0169, "Control of External Corrosion on Underground or Submerged Metallic Piping Systems": ASME/ANSI B31.4 refers to sections of this recommended practice as a guide for an adequate level of cathodic protection. This standard presents acknowledged practices for control of external corrosion on buried or submerged piping systems. It takes into consideration the material of the pipe, the environment around the pipe, and the nature of the contents of the pipe in determining what types of corrosion prevention should be applied to prevent external corrosion from compromising the integrity of the pipe and resulting in a leak.

10.1.1.2 Rail Safety Regulations

Transport of hazardous materials by rail is primarily regulated by PHMSA and the Federal Railroad Administration (FRA). The role of these agencies as well as connected advisory boards and pertinent legislation is discussed below.

10.1.1.2.1 Federal Agency Regulations and Requirements for Rail Transport

The FRA has jurisdiction over railroad safety, including the transport of hazardous materials such as crude oil. Congress passed the Rail Safety Improvement Act of 2008, which directed the FRA to regulate railroad safety so as to reduce the likelihood of train derailments and collisions.

On May 1, 2015, PHMSA and the FRA issued a final rule defining high-hazard flammable trains (i.e., rail cars carrying flammable liquids such as crude oil and ethanol) and addressing safety concerns raised in response to significant rail incidents involving crude oil and other hazardous/flammable materials. High-hazard flammable trains are defined as having a continuous block of 20 or more tank cars loaded with a flammable liquid or 35 or more cars loaded with a flammable liquid dispersed through the train. Components of the requirements include enhanced braking; enhanced standards for new and existing tank cars; reduced operational speeds; implementation of risk assessments for rail routes; and provision of rail routing information to state, local, and tribal officials. The implementation of these preventative actions is meant to reduce the incidence of accidents involving high-hazard flammable trains.

In August 2016, PHMSA issued its final rule to codify tank car safety standards required by the Fixing America's Surface Transportation Act, signed in December 2015. Under these regulations, all DOT-111 tank cars used to transport crude oil, ethanol, and other flammable liquids must be phased out or retrofitted by 2025, and new tank cars must meet enhanced DOT-117 design or performance criteria. These new cars have increased shell thickness, thermal protection, full-height head shields, high-flow pressure-relief valves, protected top fittings, and upgraded bottom outlet valves for increased safety while transporting flammable materials (81 Federal Register 53935).

In addition to the FRA, the Surface Transportation Board (STB) is an independent adjudicatory and economic regulatory agency. The STB established the Rail Energy Transportation Advisory Committee in July 2007 to provide advice and guidance to the STB and to serve as a forum for discussion of emerging issues regarding the transportation of energy resources, including oil, by rail.

10.1.1.2.2 Minnesota Regulations and Requirements for Rail Transport

Minnesota has implemented new rail incident and response efforts. Minnesota Statute 115E.042 requires by June 30, 2015, annual communication to ensure coordination of emergency response activities between the railroad and local responders and the development and annual submittal of spill prevention and response plans. The Minnesota Department of Public Safety has completed its report outlining Minnesota's response capabilities for an oil transportation incident (Minnesota Department of Public Safety 2015). In addition, in April 2016 Governor Dayton appointed a State Rail Director to enhance railway safety, pursue needed infrastructure improvements, continue training and support for first responders, closely monitor rail movements, and work with communities and railroad companies to ensure the safe and efficient operation of rail systems across Minnesota.

10.1.1.3 Tanker Truck Regulations and Requirements

10.1.1.3.1 Federal Agency Regulations and Requirements for Truck Transport

Federal regulations and requirements for truck transport are established in 49 CFR 177, 178, 385, 107, 392, and 397 as described below.

- Federal regulations regarding the transport of hazardous materials, including crude oil, along public highways are provided in 49 CFR 177. Regulations cover vehicular tunnel sizes, driver training, emergency situation protocols, and other topics pertinent to transport of crude oil by tanker truck.
- 49 CFR 178 includes specifications required for the construction of tanker trucks, including USDOT Specification 407 (Cargo Tank Motor Vehicle). These specifications, including those pertaining to materials, structural integrity requirements, and pressure-relief devices, are meant to ensure safe transport of hazardous materials, including crude oil.

- Safety requirements under 49 CFR 385 include the requirement to obtain and maintain a safety permit to transport certain hazardous materials, including crude oil. Federal regulations at 49 CFR 107, Subpart G, require registration with PHMSA for transportation of hazardous materials, including crude oil.
- The Federal Motor Carrier Safety Administration regulations in 49 CFR Parts 392 and 397 set additional requirements for parking, attendance of hazmat vehicles, routing of hazardous materials shipments, and railroad crossings. These safety requirements apply to tanker trucks transporting crude oil.

10.1.1.3.2 Minnesota Regulations and Requirements for Truck Transport

Minnesota has adopted the Federal Motor Carrier Safety Administration regulations governing hazardous materials transportation, including crude oil.[4] The Minnesota Department of Transportation regulates truck transportation of crude oil through its Office of Freight and Commercial Vehicle Operations (OFCVO). OFCVO focuses on at-risk carriers and shippers who pose the greatest threat to highway safety such as those transporting flammable products, including crude oil. OFCVO works closely with the Federal Motor Carrier Safety Administration in administering and enforcing motor carrier laws and regulations that were established to increase the safety of transporting materials such as crude oil and to minimize the potential for accidental release of those materials.

Under the auspices of the Federal Motor Carrier Safety Administration, OFCVO investigators conduct onsite investigations and reviews of interstate carrier and shipper records and determine whether the carrier or shipper has adequate safety controls in place. Safety controls include driver qualifications; weight limitations; vehicle inspection, repair, and maintenance; driver safety; insurance requirements; and placard and labeling requirements. If a carrier or shipper does not meet the safety standards set by OFCVO, the carrier or shipper can be considered unfit, which may lead to severe penalties up to and including a shutdown of its operations.

Minnesota Statute 115E.045 requires the development and maintenance spill prevention and response plans for trucks transporting 10,000 gallons of oil or hazardous substances as bulk cargo or more per month.

10.1.2 Potential Causes of Unanticipated Releases

10.1.2.1 Crude Oil Transport by Pipeline Systems

Modern crude oil pipeline systems are designed, constructed, and operated with technology to minimize the potential for integrity failures and to rapidly detect and manage unanticipated releases. However, releases do still occur, including releases from pipelines, pump stations, mainline valves (MLVs), and storage tanks. According to the ASME (2010), threats of pipeline failure fall within three categories: time-dependent, stable, and time-independent. Time-dependent threats are those that tend to increase over time. Stable threats are those that are always present but only manifest when activated by a change in operations or the surrounding environment. Time-independent threats are those that are not influenced by time (ASME 2010).

Time-dependent threats (e.g., aging infrastructure) include external corrosion, stress corrosion cracking, and internal corrosion. External corrosion occurs when the pipeline walls, seam welds, or joint welds

4 Minnesota Statutes §221.033

weaken from corrosive action from outside the pipe. External corrosion can be caused by the natural conditions of the substrate surrounding the pipeline. Stress corrosion cracking occurs when the combined action of corrosion and applied stress causes cracks. Internal corrosion weakens the pipe through corrosive action on the interior surface of the pipe.

Stable threats include manufacturing, construction, and equipment failure threats. Manufacturing threats are caused by defects in the pipeline system that originated during the manufacturing process, such as pipe seam defects and out-of-roundness. Construction threats result from defects caused during the construction, installation, or fabrication of the pipe and its components. Equipment threats result from a failure of the equipment to perform its intended design or its operational or functional purpose.

Time-independent threats include operational error, damage from weather or natural forces, and third-party damage. Operational errors are caused by human mistakes leading to the incorrect operation of the pipeline system that could ultimately lead to a release. Additionally, weather-related and other natural threats have the potential to damage the pipeline system. Natural forces that could stress or damage pipelines, pump stations, MLVs, and storage tanks include inclement weather (e.g., lightning strikes, flooding) or geological shifts (e.g., earthquakes, landslides, mudslides, ground settlement). Pipeline stress or corrosion can also occur due to the natural conditions of the substrate surrounding the pipeline. For example, many types of peat (which is common in Minnesota) exhibit negative buoyancy and place upward pressure on pipelines, causing stress on the pipe (Ryder et al. 2004). Third-party damage threats consist of potential actions by parties other than the pipeline operator that could compromise the integrity of the pipeline. Unintentional damage by third parties most often occurs when other parties are constructing in the vicinity of an installed pipeline and encounter the pipeline while excavating or conducting other ground-disturbing activities. Third-party damage could also include intentional vandalism or sabotage.

10.1.2.2 Crude Oil Transport by Rail

Crude oil releases associated with rail transport can result in a number of ways. Rail tank car loading or offloading[5] errors, hose failures, or rail tank car valve failures could lead to relatively small releases of crude oil within the loading or offloading facilities.[6] Derailments or other accidents while in transit could lead to larger spills that would generally not be within areas designed to contain releases. Such releases could also enter waterways if the tracks are adjacent to or near a waterbody.

There are relatively few incidents of crude oil rail accidents for analysis. Crude oil has only been transported in larger quantities by rail since about 2005 when the first 20-tank car "key trains" began operating at the rate of one train daily in the US. Between the years 2005 and 2015, there was an 84-fold exponential increase in crude transport by rail (Etkin 2017a). Much of this oil was being transported by "unit trains" with 100 to 120 tank cars. Since 2015, there has been a significant drop in the amount of crude oil transported by rail, though this may change based on economic market factors.

Since no specific analyses were conducted for the spill risk associated with crude-by-rail transport for this EIS for Enbridge Line 3 and to provide a more detailed perspective on recent developments, a review of data from existing modeling and statistical studies was conducted. These analyses were conducted in part for the State of Washington for DEIS and FEIS studies for crude-by-rail facilities in that

5 Loading refers to crude oil being transferred to a rail car or tanker truck from a storage tank; offloading refers to crude oil being transferred from a rail car or tanker truck to a storage tank.

6 Section 10.1.3 defines the size categories of releases.

state, as well as for peer-reviewed technical papers (Etkin et al. 2015b; Etkin 2016a, 2016b, 2017b, 2017). Risk analyses for crude-by-rail spills are challenging in that there are few data that exist on spills and accidents specifically for this mode of crude oil transport as it have been occurring for only limited time period (since about 2011). The studies and data reviewed involved the analyses of freight rail traffic and accidents, in general, with the review of a large number of technical reports and papers in the literature that address specific aspects of freight rail accidents.

Analyses of accidents from all freight rail transport (regardless of cargo) for the years 1975 through 2015 indicate that derailments are the most common type of accident (79 percent of incidents). Collisions between trains, highway-rail crossing accidents (collisions with trucks or automobiles at crossings), and other miscellaneous incidents, including fires in locomotives, are the other types of accidents that occur (Etkin 2016).

Derailments can be caused by collisions with other objects (e.g., vehicular traffic), operational errors (e.g., harsh handling such as hard braking or traveling at high speeds), mechanical failure of the tracks (e.g., broken rails), or mechanical failure of the wheels. According to a recent study, broken rails or broken wheels were the leading cause of derailments at all speeds (Liu et al. 2012). Human factor-related causes such as improper use of switches and violation of switching rules were also prevalent, as were equipment failures (e.g., bearing failure, broken wheel, and axle defects) (Liu et al. 2012). There has been an 80 percent decrease in rail accidents since 1975, with the sharpest drop occurring prior to 1985. Even in the last decade, there has been a 50 percent decrease in accidents (Etkin 2016b; Etkin 2017b). This finding corresponds with a study that indicates a 5.8 percent annual decrease in freight train derailments between 2000 and 2012 (Liu 2015).

The accident rate for freight rail transport averages 1.5 derailment accidents, 0.092 collisions, 0.089 highway-rail crossing accidents, 0.029 fire incidents, and 0.075 miscellaneous accidents per million train miles for loaded trains (Etkin 2017a). However, calculating the likelihood of a crude train spill needs to take into account a number of other factors. Not all train accidents involving loaded tank cars result in the release of cargo. For derailments, 15 percent to 22 percent of accidents with tank cars have resulted in spillage. In addition, there are a number of factors that make crude-by-rail transport different than other types of freight rail transport, which would affect potential accident rates.

In these studies (Etkin et al. 2015; Etkin 2016a, 2016b, 2017a, 2017b) modeling of crude-by-rail accident rates was conducted, taking into account potential increases in the likelihood of accidents (train length) and reduction in accident rates (electronically-controlled pneumatic braking, positive train control, wayside detection systems, track upgrades, and changes in operating procedures), to determine potential accident rates. In addition, the reduced likelihood of a tank car breach that would result in spillage with the use of newer types of tank cars and requirements for lower operating speeds was factored in. The resulting estimate of spill frequency was 0.0062 spills annually per million train-miles, assuming all safety improvements were in place and were effective. Without the benefit of the safety improvements, the spill frequency was 0.15 spills annually per million train-miles. The volume of spillage would be dependent on the number of tank cars involved in each accident, as well as the probability of breach. For a 120-car train, the expected median spill volume was estimated to be 9,280 bbl. For a 100-car train, the median volume was 8,686 bbl. There was a 10 percent chance that a spill would involve 20,000 bbl or more (Etkin 2017a). While it has not yet occurred, rail lines may also become the target of intentional sabotage or terrorism (U.S. Government Accountability Office 2012).

The greatest concern about crude-by-rail train accidents is that they may involve fires and explosions. There have been 20 crude-by-rail accidents with spillage in the US and Canada since 2013.

Table 10.1-1. Notable CBR US and Canadian Accidents with Spillage 2013–2016

CBR Incident	Accident Date	Outcome Synopsis
Paynton, Saskatchewan	1/24/2013	Collision with road grader; 16 cars derailed; 4 cars spilled oil; 667 bbl spilled.
Parkers Prairie, Minnesota	3/27/2013	14 tank cars derailed; 1 car ruptured; 714 bbl spilled; no fire; minimal damage due to frozen ground
Calgary, Alberta	4/3/2013	7 tank cars derailed; 2 tank cars released oil; fire (put out by local firefighters); 640 bbl spilled
White River, Ontario	4/3/2013	22 cars derailed; 1 car spilled oil; 393 bbl spilled
Jansen, Saskatchewan	5/21/2013	Mixed train; 5 cars derailed; 575 bbl spilled.
Lac-Mégantic, Quebec	7/5/2013	63 tank cars derailed; 37,719 bbl spilled; 47 fatalities; 2,000 people evacuated; extensive damage to town
Aliceville, Alabama	11/7/2013	30 tank cars derailed; 12 tank cars burned; 10,846 bbl spilled; No injuries; fire; wetland impact
Casselton, North Dakota	12/30/2013	Collision; 20 crude cars derailed; explosion/fire; > 9,524 bbl spilled; 1,400 residents evacuated; no injuries
Plaster Rock, New Brunswick	2/7/2014	5 tank cars derailed; 5 tank cars burned; 45 homes evacuated; 3,000 bbl spilled; 45 homes evacuated; no injuries; no fire
Vandergrift, Pennsylvania	2/13/2014	19 tank cars derailed; 4 tank cars spilled oil; 108 bbl spilled; no fire; no injuries
Lynchburg, Virginia	4/30/2014	15 tank cars derailed; 3 tank cars burned; 1,190 bbl spilled; immediate area evacuated; some oil in river; no injuries
LaSalle, Colorado	5/9/2014	6 tank cars derailed; 1 tank car spilled oil; 155 bbl spilled; spill contained in ditch; no fire
Mount Carbon, West Virginia	2/16/2015	27 tank cars derailed; 14 tank cars burned; 9,800 bbl spilled; oil entered Kanawha River; drinking water impacts
Gogama, Ontario	2/14/2015	35 tank cars derailed; 7 tank cars caught fire; 4,900 bbl spilled
Galena, Illinois	3/5/2015	6 cars derailed; 2 cars burned; estimated 1,400 bbl spilled.
Gogama, Ontario	3/7/2015	69 tank cars derailed; 7 tank cars caught fire; 4,709 bbl spilled
Heimdal, North Dakota	5/6/2015	6 cars derailed and spilled oil; cars burst into flames; town evacuated; estimated spill 4,000 bbl.
Culbertson, Montana	7/17/2015	22 cars derailed; 4 cars leaked oil; 833 bbl spilled; no injuries, fire, or explosion.
Watertown, Wisconsin	11/8/2015	13 cars derailed; 1 car spilled oil; 12 bbl spilled.
Mosier, Oregon	6/3/2016	11 tank cars derailed; Several cars burned; 1,000 bbl spilled; some oil entered Columbia River

Source: Updated from Etkin et al. 2015.

The largest accident in the US involved 10,846 bbl of spillage and a fire in Aliceville, Alabama, in November 2013. The largest incident occurred in Lac-Mégantic, Quebec, in July 2013, in which nearly 38,000 bbl of Bakken crude oil spilled, and there were 47 fatalities in the resulting fire and explosions. There are a number of reasons that this type of incident would not likely occur in the US, notably that the practice of having a train be under the control of a sole operator, the poor condition of the train, and leaving the train unattended in an abnormal condition, would not be permitted in the US (reviewed in Etkin 2016).

The volatility of Bakken crude during transport has been identified as a major concern; however, there have been rail accidents with fire that have involved the spillage of diluted bitumen as well (e.g., the two incidents in Gogama, Ontario).

10.1.2.3 Crude Oil Transport by Truck

Crude oil releases associated with truck transport are typically related to the failure of equipment during loading or offloading or human error (Heavy Duty Innovations 2014). Loading crude oil to and offloading crude oil from a tanker truck involves transferring the oil through manifolds, hoses, and valves using a pump (typically mounted on the tractor or tank trailer) to move the oil in either direction. If any of the valves on the truck or the transfer pipes of the storage tank are not properly opened when the pump starts, crude oil under high pressure can blow out the hose or the fitting connecting to the truck's tank. These types of releases would be within the containment area of the loading or offloading facility. In addition, trucks traveling along highways and other roads are at risk of collisions and crashes due to the unpredictable nature of other drivers, driver fatigue, poor road conditions, and inclement weather conditions. When a truck crashes, the tank may be punctured or otherwise damaged, allowing the release of crude oil.

10.1.3 Baseline Crude Oil Pipeline Spill Risk Analysis

In order to quantify the incremental risk for the Line 3 Project, the potential spills that might occur need to be compared with the baseline risk of spills from existing, operating crude oil and refined product pipelines in the area. This section provides an overview of pipeline spill rates and trends in the inland[7] U.S. as a whole, as well as an analysis of historical data for existing crude oil pipelines in Minnesota. Additional analysis and supporting data is provided in Appendix S.

10.1.3.1 General Analysis Inland Pipeline Spills in the U.S.

10.1.3.1.1 Pipeline Spill Data

Data analyses on the crude and refined product pipeline spills were based on data available publicly from the PHMSA.[8] A total of 10,810 spill incidents were included. Criteria for inclusion of spill incidents in the database were:

- Spillage of 1 gallon or more;

[7] In this EIS, the term "inland" pipeline specifically excludes any pipelines offshore in marine waters, but does not exclude pipelines that cross inland waterways.

[8] https://www.phmsa.dot.gov/pipeline/library/data-stats/raw-data

- Onshore/inland spill location;[9] and
- Incident occurrence during 1968 through 2015.[10]

The spill incidents were individually characterized with respect to:

- Year and data of incident;
- Location (state, county, city, latitude/longitude);
- General oil type (crude or refined);
- Detailed oil type (crude, gasoline, light oil,[11] and heavy oil[12]); and
- Amount of spillage (in barrels).

10.1.3.1.2 Analytical Results and Findings: Annual Spill Numbers and Volumes

Over the 48-year time period, there were a total of 6,433 crude pipeline spills, and 4,377 refined product spills in inland[13] areas of the U.S., involving a total of over 6.7 million bbl of spillage. These figures are for spills of 1 gallon or more.[14]

The data for significant pipeline spills of at least 10,000 gallons (238 bbl) were also analyzed separately.

Five-year averages of spillage for significant spills are shown in Figure 10.1-1. The annual numbers and total volumes are shown in Figures 10.1-2 and 10.1-3.

The average volume of pipeline spills has decreased significantly since the late 1960s, and particularly in the last dozen years. The average spill volume (all oil types) is now less than 50 percent of the average volume 10 years ago, and 12 percent of the volume in the late 1960s.

The vast majority of spillage is attributable to significant spills (238 bbl and larger). Overall, 93 percent of the volume of spillage can be attributed to the 37 percent of incidents that are considered significant by involving 10,000 gallons (238 bbl) or more.

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9 Spills from offshore pipelines were excluded.

10 These were the data that were available at the time of the preparation of this document.

11 Light oil included diesel, jet fuel, kerosene.

12 Heavy oil included heavy fuel oil, transmix.

13 The term "inland" is used to exclude offshore and exclusively marine pipeline spill incidents.

14 Parts of these analyses appeared in Etkin 2014 and Etkin 2017.

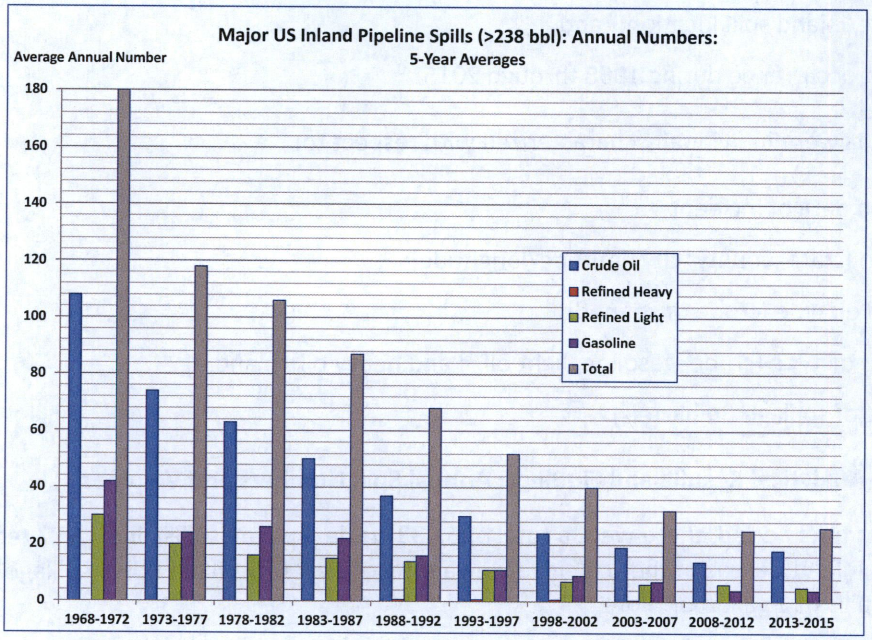

Figure 10.1-1. Significant U.S. Inland Pipeline Spills (>238 bbl): Five-Year Averages of Annual Spill Numbers

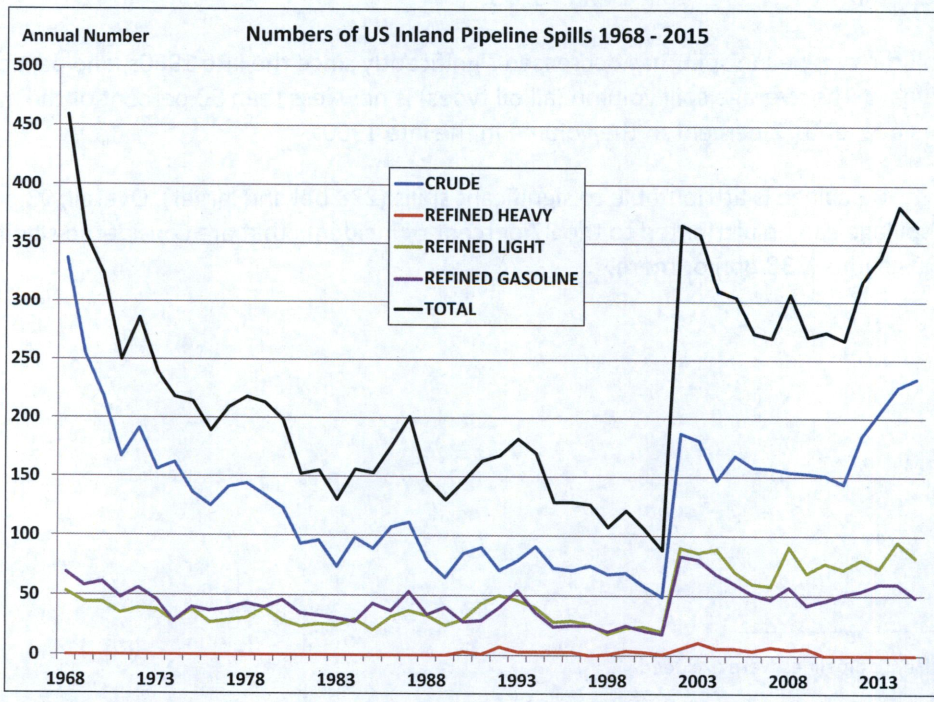

Figure 10.1-2. Annual Numbers of U.S. Inland Pipeline Spills (>1 gallon)

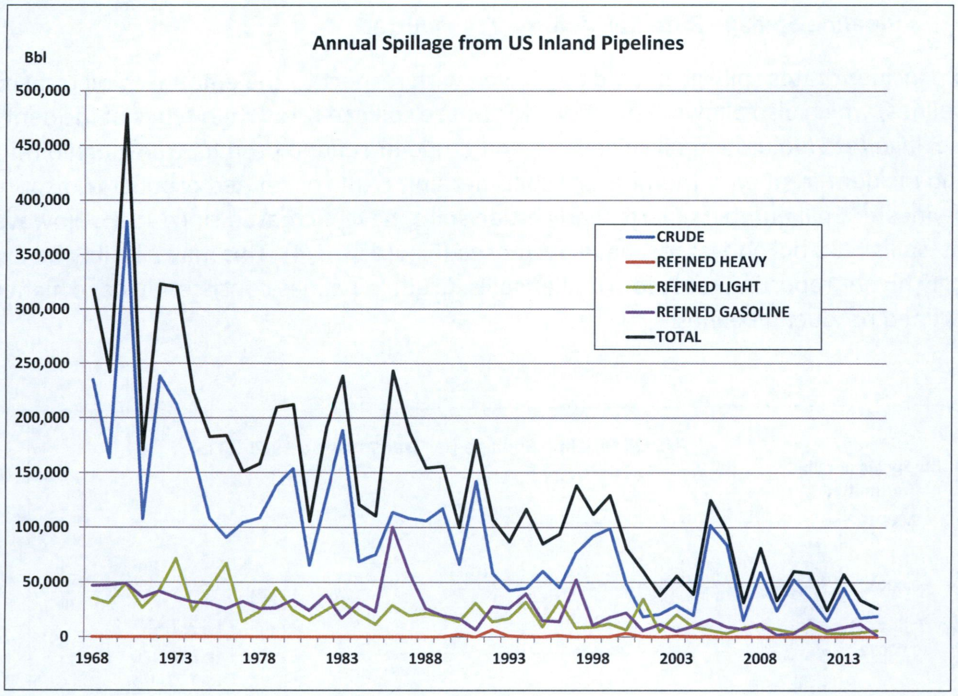

Figure 10.1-3. Annual Volume of Spillage from U.S. Inland Pipelines

10.1.3.1.3 Probability Distribution of Pipeline Spill Volume

The volumes of spills vary from a few drops or a small leak to a very large discharge. The distribution of volumes in the spills from inland oil pipelines over the years 1968 to 2015 indicates the majority of spills released less than 999 bbl, approximately 12 percent of spills ranged between 1,000 and 9,999 bbl releases, and less than 1 percent of spills involved releases of 10,000 bbl or more.

The cumulative probability distribution function of spill volume developed for spills in the last decade only (2006–2015), shown in Table 10.1-2, indicates a shift towards smaller spills in the last decade.

Table 10.1-2. Probability Distribution of Spill Volumes for U.S. Inland Pipelines (2006–2015)

Spill Volume	% Spill Incidents	Number Incidents
<1 bbl	33.51%	1,027
1-9 bbl	34.78%	1,066
10-99 bbl	18.76%	575
100-999 bbl	10.15%	311
1,000-9,999 bbl	2.58%	79
10,000-90,000 bbl	0.23%	7
100,000+ bbl	0.00%	0

10.1.3.1.4 Pipeline Spillage Rate per Volume Transmitted

To determine incident rates spillage should be viewed with respect to the amount of oil transported through pipelines, which also allows projections for future spillage rates. Two types of incident rates analyzed—spillage rate (volume of oil spilled per unit crude or refined product transported through pipelines) and incident frequency (numbers of spills per unit crude or refined product transported through pipelines).[15] Spill numbers, particularly crude spills, have increased since 1985. However, rates of significant spills (238 bbl and larger) have *decreased* (Figure 10.1-4). This may possibly be explained by increasingly higher reporting rates for smaller spills. Crude pipelines consistently have higher spillage rates than refined product pipelines.

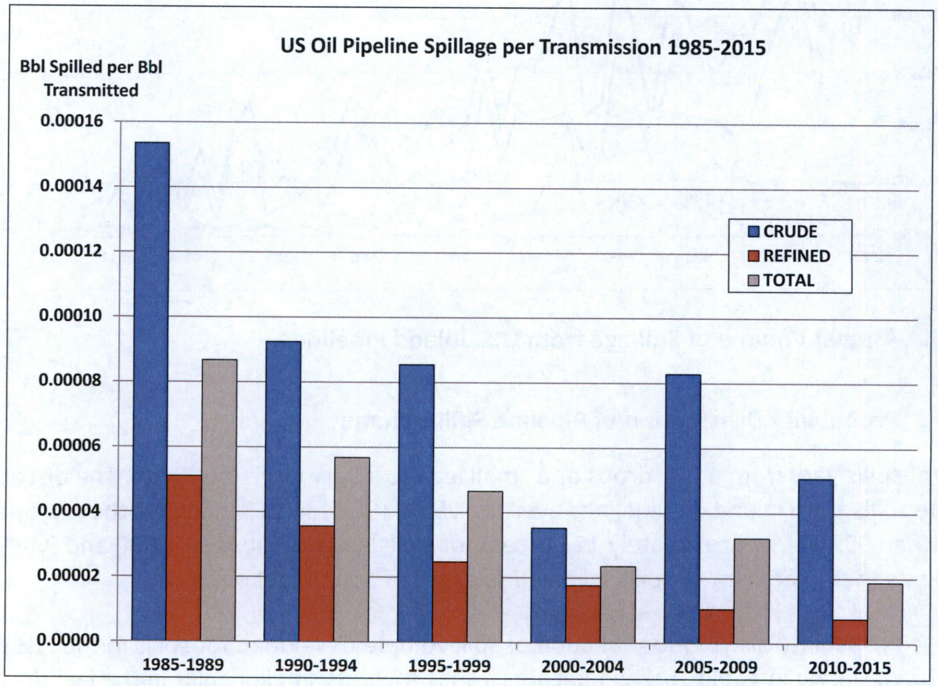

Figure 10.1-4. U.S. Inland Oil Pipeline Spill Number per Volume Transmission (1985–2015)

10.1.3.1.5 U.S. Inland Pipeline Spillage Summary

Based on the analytical results presented above, the following conclusions are reached concerning U.S. inland pipeline spills:[16]

- Each year, it can be expected that about 360 pipeline spills (of any volume) will occur, of which:
  - About 60 percent (216) would be crude spills;

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15 Oil pipeline transmission rates are from U.S. Energy Information Administration. In the U.S. Energy Information Administration data, refined products are combined into one category. Spill incidents from the various refined product categories are combined.

16 Data from analytical results have been rounded to the nearest two significant digits.

  - About 25 percent (90) would be gasoline spills; and
  - About 15 percent (54) would be light refined product spills.
- Heavy refined product pipeline spills are relatively rare.
- Each year, throughout the U.S., it can be expected that there will be about 26 significant pipeline spills of at least 238 bbl (10,000 gallons), of which:
  - About 70 percent (18) would be crude spills;
  - About 15 percent (4) would be gasoline spills; and
  - About 15 percent (4) would be refined light product spills.
- Overall, half of the pipeline spills that do occur would be expected to involve 1 bbl or less. About 90 percent would involve 100 bbl or less. Only 5 percent would be expected to be 400 bbl or more, and only 1 percent would be expected to be 2,500 bbl or more.
- For future projections, assuming that pipeline operations and conditions are constant, any changes in spillage could be estimated from the number of spills per oil transmission and/or volumes of spillage per oil transmission:
  - Inland crude pipeline spills occur at the rate of about one pipeline spill (of any volume) for every 3.3 million bbl transmitted;
  - A significant inland crude pipeline spill of at least 238 bbl (10,000 gallons) might be expected once for every 42 million bbl of crude oil transmitted;
  - Inland refined product pipeline spills occur at the rate of about one spill (of any volume) for every 12.5 million bbl of refined product transmitted;
  - A significant inland refined product pipeline spill of at least 238 bbl (10,000 gallons) might be expected once for every 28 million bbl of refined product transmitted; and
  - About half of the significant refined product pipeline spills might be expected to be gasoline spills and the other half of light refined product spills.

10.1.3.2 Minnesota Pipeline Spill Analysis

The data presented thus far represent pipeline spills of both crude and refined products throughout the U.S. The following analyses specifically focus on crude pipelines that transit within and through Minnesota.

10.1.3.2.1 Minnesota Crude Pipeline Mileage in Comparison with Other States

According to PHMSA, the state of Minnesota currently has 2,416 miles of crude oil pipelines, making it the state with the seventh greatest crude transmission pipeline mileage. Its pipeline mileage is exceeded only by Texas, Oklahoma, California, Wyoming, Louisiana, and Kansas. In terms of "pipeline density," i.e., the mileage of pipelines per square mile, Minnesota ranks eighth, exceeded by Oklahoma, Louisiana, Texas, Illinois, Wyoming, Kansas, and Mississippi. There is one crude pipeline mile for every 35 square miles of land in Minnesota. Oklahoma, Louisiana, and Texas—all oil-producing states—have 2.3, 2.2, and 1.8 times as many pipelines per square mile, respectively, in comparison with Minnesota.

10.1.3.2.2 Minnesota Crude Pipeline Spill History

During the years 1968 through 2016, there were a total of 118 crude pipeline spills (of one bbl or more) reported in Minnesota.[17] A total of 184,239 bbl of crude oil spilled in this time period. Over this whole time period, there has been an average of 2.45 spills per year, though the average annual number has increased in the last 10 to 20 years (3.5 spills per year since 1997, and 2.5 spills per year since 2007 compared to only 1.7 spills per year up to 1997). This may be an artifact of the data in that in the earlier years the reporting of pipeline spills was less rigorous. Smaller spills (of less than a few bbl) were not reported consistently.

The five-year average data are shown in Table 10.1-3. The average annual number of spills has increased; however, the average annual volume and the average volume per spill have both decreased.

The frequency distribution of spill volumes (volume for each individual incident) varies from 0.01 bbl (0.42 gallons or less than 2 quarts) to 40,500 bbl. Just over 69 percent of spill incidents involved less than 100 bbl, about 85 percent less than 1,000 bbl, and nearly 97 percent less than 10,000 bbl.

During the 49-year time frame, there were 32 significant crude pipeline spills (>238 bbl), of which three occurred in the last decade and eight in the last 20 years. These significant spills account for over 98 percent of the total volume of spillage. There have been no pipeline spills in excess of 238 bbl in Minnesota in the last six years. There have been no spills of over 10,000 bbl since 1991.

Table 10.1-3. Five-Year Average Crude Pipeline Spill Data for Minnesota

Years[a]	Annual Number Spills (1 bbl or more)	Annual Volume Spilled (bbl)	Average Volume/Spill (1 bbl or more)
1968–1972	2	3,270	1,318
1973–1977	2	10,565	3,470
1978–1982	1	6,831	4,472
1983–1987	2	1,880	1,120
1988–1992	1	8,214	8,158
1993–1997	2	1,178	455
1998–2002	4	2,551	818
2003–2007	5	976	192
2008–2012	3	1,363	257
2013–2016	2	31	14
Overall Average	**2.4**	**3,760**	**2,068**

a The period 2013-2015 is a four-year average.

17 There were two spills of less than 1 bbl (0.21 bbl and 0.15 bbl) in 2016 and one spill of 0.76 bbl thus far in 2017 that are not included in this analysis.

10.1.3.2.3 Minnesota Significant Crude Pipeline Spills

Data on the 32 significant crude pipeline spills (>238 bbl) in Minnesota are shown in Table 10.1-4 in chronological order.

Table 10.1-4. Significant Crude Pipeline Spills in Minnesota (1968–2016)

Date	Operator[a]	County (City)	Bbl Spilled	Cause
12/8/1968	Enbridge	Red Lake	4,000	Defective weld
7/14/1972	Enbridge	Marshall	8,000	Equipment rupturing line
8/23/1972	Enbridge	Clearwater	3,000	Incorrect operation by carrier
9/9/1972	Enbridge	Carlton	700	Equipment rupturing line
8/13/1973	Enbridge	Marshall	17,000	Incorrect operation by carrier
9/5/1973	Enbridge	Kittson	400	Equipment rupturing line
9/11/1973	Enbridge	Polk	5,000	Incorrect operation by carrier
12/4/1973	Enbridge	Marshall	18,700	Other (no further information available)
7/12/1974	Enbridge	Clearwater	6,900	Defective pipe
4/3/1975	Enbridge	Clearwater	350	Other (no further information available)
11/4/1977	Koch	Todd (Staples)	4,398	Defective pipe
8/20/1979	Enbridge	Beltrami	10,500	Defective pipe
1/11/1980	Koch	Benton	11,847	Defective weld
6/26/1980	Enbridge	Kittson	2,400	Defective pipe
7/21/1982	Enbridge	Clearwater (Clearbrook)	9,200	Other (No further information available)
2/11/1984	Koch	Benton (Foley)	2,196	Defective pipe
11/7/1985	Koch	Anoka (Burns)	5,980	Other (No further information available)
2/10/1986	Koch	Dakota (Inner Grove Hts)	300	Failed weld
9/6/1986	Enbridge	Polk	265	Other (Contractor failed to tighten)
3/6/1987	Enbridge	Clearwater	500	Failed weld
3/26/1989	Enbridge	Pennington (Sanders Twp)	300	Failed weld
3/3/1991	Enbridge	Itasca	40,500	Other (Split in heat affect zone)
8/24/1996	Enbridge	Kittson (Donaldson Station)	5,000	Corrosion
1/3/1997	Marathon	Washington (Cottage Grove)	475	Other (Tank farm pipeline)
9/16/1998	Enbridge	Red Lake (Plummer)	5,700	Excavation damage
2/22/1999	Enbridge	Marshall (Radium)	400	Other (Loose bolts on flange)
7/4/2002	Enbridge	Itasca (Cohasset)	6,000	Material and/or weld failures
2/19/2004	Enbridge	Itasca (Grand Rapids)	1,003	Natural forces (earth movement)
6/27/2006	Koch	Morrison (Little Falls)	3,200	Other outside force damage
11/28/2007	Enbridge	Clearwater (Clearbrook)	325	Incorrect operation by carrier

Table 10.1-4. Significant Crude Pipeline Spills in Minnesota (1968–2016)

Date	Operator[a]	County (City)	Bbl Spilled	Cause
3/23/2008	Koch	Clearwater (Clearbrook)	1,600	Natural forces (earth movement)
12/4/2009	Koch	Todd (Staples)	5,000	Incorrect operation by carrier

a Minnesota Pipeline and Wood River Pipeline are grouped under Koch; Lakehead is grouped under Enbridge.

A summary of Minnesota crude oil pipeline releases of any size per incident type, barrels spilled, and barrel spilled per pipeline mile operated by Enbridge and all Minnesota operators is presented in Table 10.1-5.

Table 10.1-5. Minnesota Crude Oil Unintentional Spill Incidents 2002-2016[a]

Causes of Pipeline Failure	All Minnesota Pipeline Operators: Number of Incidents	All Minnesota Pipeline Operators: Bbl Spilled	All Minnesota Pipeline Operators: Bbl Spilled/ Mile-Year[b]	Enbridge: Number of Incidents	Enbridge: Bbl Spilled	Enbridge: Bbl Spilled/ Mile-Year[b]
Corrosion Failure	3	30	0.001	2	10	0.001
Equipment Failure	32	242	0.006	24	202	0.011
Excavation Damage	1	50	0.001	1	50	0.003
Incorrect Operation	17	5,410	0.136	10	397	0.021
Material Failure of Pipe or Weld	14	6,477	0.163	12	6,294	0.337
Natural Force Damage	14	2,675	0.067	10	1,052	0.056
Other Outside Force Damage	2	3,200	0.080	0	0	0.000
TOTAL	**83**	**18,085**	**0.455**	**59**	**8,005**	**0.429**

a Base on PHMSA incident data and operator reports.

b Barrel spilled per miles of pipeline in operation averaged over the years of the data set.

10.1.3.2.4 Comparison of Minnesota and U.S. for Significant Crude Pipeline Spills

The rate of significant crude pipeline spills (>238 bbl) in Minnesota was compared with the crude pipeline spillage in the U.S. as a whole for the last 16 years (2001 through 2016), and for the last seven years (2010 through 2016). The latter time period was selected because this was the only time frame for which state-specific pipeline transmission rates were available from PHMSA. Overall, the Minnesota crude pipeline rate was considerably less than that of the nation as a whole, with respect to spillage per pipeline miles and barrels transmitted (Table 10.1-6).

Table 10.1-6. Crude Pipeline Spillage: Minnesota vs. U.S. Nationwide[a]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Significant Spills/Pipeline Mile-Year	0.00023	0.0003	0.767	0	0.00026	0.000
Bbl Spilled/Pipeline Mile-Year	0.43	0.69	0.623	0.015	0.53	0.028
Significant Spills/Million Bbl Transmitted	0.0014	0.025	0.056	0	0.024	0.000
Bbl Spilled/Million Bbl Transmitted	4.3	56	0.077	0.16	51	0.003

[a] U.S. data is for all states inclusive of Minnesota.

[b] Pipeline mile-year is a mile of pipeline in operation for one year. Crude transmission bbl-miles for Koch and Enbridge based on PHMSA data for 2015 and mileage data.

10.1.3.2.5 All Crude Pipeline Spills (2000–2016)

Analysis of the data for crude pipeline spills of *all sizes* that occurred since 2000 indicates there were 91 spill incidents, with one incident occurring in 2017.[18] For the years 2000 through the present (end of June 2017), there were 91 incidents of which nearly 30 percent involved less than one bbl. The average spill volume was 201 bbl. The median (i.e., 50th percentile) was 2.0 bbl. For the years 2010 through the present, there were 37 incidents of which over 81 percent involved less than one bbl. The average spill volume was 7.8 bbl. The median was 0.54 bbl. The spill volumes have been significantly smaller since 2010.

10.1.3.3 Summary of Findings for Minnesota Crude Pipeline Spills

In order to quantify the incremental risk for the Line 3 Project, the potential spills that might occur need to be compared with the baseline of spills occurring from existing pipelines in the area. The analyses of historical data conducted in this chapter provide an overview of pipeline spill rates and trends in the inland U.S. as a whole for existing crude oil pipelines in Minnesota.

10.1.3.3.1 U.S. Crude Pipeline Spills

For crude oil pipeline spillage in the U.S. as a whole, the following conclusions were reached:

- There are about 53,045 miles of crude oil pipeline throughout the U.S.
- The frequency of crude pipeline spills in the U.S. has decreased significantly over the last 48 years.
- Crude pipeline spills have become increasingly lower in volume.
- Projecting into the future, half of the pipeline spills that do occur would be expected to involve 1 bbl or less, and about 90 percent would involve 100 bbl or less. Only 5 percent would be expected to be 400 bbl or more, and only 1 percent would be expected to be 2,500 bbl or more.

[18] There was one crude pipeline spill incident of 0.76 bbl reported for 2017 – on 5 June 2017 in Clearwater.

- Inland crude pipeline spills occur at the rate of about one pipeline spill (of any volume) for every 3.3 million bbl transmitted.
- A significant inland crude pipeline spill of at least 238 bbl (10,000 gallons) might be expected once for every 42 million bbl of crude oil transmitted.

10.1.3.3.2 Minnesota Crude Pipeline Spills

For crude oil pipeline spillage in Minnesota, the following conclusions were reached:

- Minnesota currently has about 2,416 miles of crude oil pipelines.
- Since 1968, there were a total of 118 crude oil pipeline spills of one bbl or more with a total of 184,332 bbl spilled.
- The annual number of reported pipelines has increased; however, this can be attributed to the increase in reporting of smaller spills that previously had not been reported.
- During 1968 through 2016, there were 32 significant pipeline spills (>238 bbl or 10,000 gallons).
- There have been no significant crude pipeline spills in Minnesota in the last six years, and no spills over 10,000 bbl since 1991.
- The rate of spillage in Minnesota has been lower than that in the U.S. as a whole, accounting for pipeline mileage and amount transmitted.
- The rate of significant spills per pipeline mile-year in Minnesota was 77 percent that of the U.S. as a whole during 2001 through 2016. There were no significant spills in 2010 through the present.
- The volume spilled per pipeline mile-year in Minnesota as 62 percent that of the U.S. as a whole during 2001 through 2016, and 3 percent that of the U.S. during 2010 through 2016.
- The number of significant spills per volume transmitted in Minnesota was 6 percent that of the U.S. as a whole during 2001 through 2016. There were no significant pipeline spills in Minnesota since 2010.
- The volume of spillage per amount transmitted in Minnesota was 8 percent that of the U.S. as a whole in 2001 through 2016, and 0.3 percent that of the U.S. as a whole since 2010.
- Since 2010, 62 percent of crude pipeline spills have involved less than 0.1 bbl (4.2 gallons); 81 percent have involved less than 1 bbl.
- A spill of less than 0.1 bbl might be expected once every four months; a spill of less than 10 bbl, once every 16 months; and a spill of less than 100 bbl once every 7.5 years.

Using a conservative (cautionary over-estimating) approach, it was estimated that the volumes of spillage in the seven hypothetical Line 3 spill scenarios—ranging from 8,625 bbl to 16,239 bbl—might be expected once in 26 to 99 years somewhere in the state of Minnesota. *This does not indicate that the incidents would occur at the specific sites selected for modeling.*

10.1.4 Release/Spill Volume Categories

For pipelines, the total volume of a release is influenced by several factors, including size of the breach, pipeline pressure, fluid properties (e.g., temperature and viscosity), time required to detect a release, time to isolate a leak and shut down the pipeline, distance between isolation valves, and effectiveness of the isolation (Stantec and Barr Engineering 2017). For rail, the total volume of the spill depends on the number of rail tank cars affected and the severity of the incident. A spill could be limited to the partial contents of a single tank car or the complete contents of many tank cars. Each tank car has a capacity of up to 800 barrels (bbl; 33,600 gallons) of oil. Therefore, a full unit train of 110 tank cars could transport 88,000 bbl (3.7 million gallons) of oil. For tanker trucks, most spills would be limited to the contents of a single tank. Tanker trucks can carry approximately 190 bbl of oil (7,980 gallons).

The five categories of spill sizes established for the assessment of crude oil releases in the EIS for the Line 67 Expansion Project (U.S. Department of State [DOS] 2017) were determined to be useful in the assessment of potential spills in this EIS as well. Categories for this EIS consist of the following:

- Incidental spills: less than 0.1 bbl (5 gallons);
- Small spills: equal to or greater than 0.1 bbl (5 gallons) and less than or equal to 50 bbl (2,100 gallons);
- Medium spills: greater than 50 bbl (2,100 gallons) and less than or equal to 1,000 bbl (42,000 gallons);
- Large spills: greater than 1,000 bbl (42,000 gallons) and less than or equal to 10,000 bbl (420,000 gallons); and
- Major spills: greater than 10,000 bbl (420,000 gallons).

Incidental spills (less than 0.1 bbl [5 gallons]) are considered minor by PHMSA and reporting is not required at that threshold (the minimum-volume reporting requirement that has been in effect since 2002); therefore, no historical data exist for incidental spills for use in the analysis described below. The behavior of small, medium, large, and major spills in the environment is discussed in Section 10.2.1.3.

10.2 BEHAVIOR OF CRUDE OIL RELEASES

When released into the environment, each type of crude oil exhibits unique behavior that depends on many factors. The primary factors that determine the fate of crude oil released into the environment (regardless of the transport mechanism from which it is released) include the chemical and physical differences between light and heavy crude oils, weathering of the oil over time, the type of environment into which oil is released (e.g., water versus soil), and the size of the spill. These factors are addressed in Sections 10.2.1 and 10.2.2. Section 10.3. presents a summary of the findings of Stantec et al.'s spill trajectory and fate modeling of large-volume crude oil releases (Stantec et al. 2017), including context for the analysis of potential exposures presented in Section 10.4.

10.2.1 Factors Affecting the Behavior of Crude Oil Releases

The physical and chemical properties of the crude oil are the primary influences in determining how a spill spreads and how long it lasts in the environment. These properties are addressed in Section 10.2.1.1. When crude oil is released into the environment, it is physically and chemically altered over time through various processes collectively called "weathering." These processes and their effects on crude oil in the environment are discussed in Section 10.2.1.2. The influence of spill size on crude oil behavior in the environment is addressed in Section 10.2.1.3.

10.2.1.1 *Physicochemical Characteristics of Crude Oil*

Crude oil is a complex mixture of thousands of compounds. An "average" crude oil contains approximately 84 percent carbon, 14 percent hydrogen, 1 to 3 percent sulfur, 1 percent nitrogen, 1 percent oxygen, and 0.1 percent minerals and salts (API 2011). Carbon and hydrogen are present in oil as a large group of compounds called hydrocarbons, which include alkanes (also called *paraffins*); cycloalkanes (also called *naphthenes*); aromatics, including benzene, toluene, ethylbenzene, and xylenes (BTEX); polycyclic aromatic hydrocarbons (PAHs); and polar compounds, including resins and *asphaltenes* (API 1999). The proportions of these compounds in a particular type of crude oil determine its propensity to evaporate or persist in the environment. The greater the percentage of the lighter compounds aromatics and alkanes, the more evaporates in the hours and days after spilling. These components also tend to be the more toxic parts of the oil. The heavier components, such as the PAHs and polar compounds are more persistent in the environment. The heavier components are also those that adhere to substrates and create the greatest difficulties for cleanup.

The following properties of crude oil differ based on the proportions of the above compounds present and affect its behavior in the environment.

- API gravity,[19] a measure of how dense an oil is compared to water (the lower the API, the denser the oil);
- Viscosity, a measure of how readily a crude oil will flow when released;
- Flash point, the lowest temperature at which a crude oil will vaporize and ignite in air;
- Vapor pressure, a measure of how quickly a crude oil will evaporate; and
- Solubility, a measure of the propensity of a crude oil to dissolve in water.

The proposed Project would transport crude oil ranging from light to heavy crude oil, with an assumed annual proportion of 65 percent heavy crude oil, including diluted bitumen (dilbit; see Section 10.2.1.1.2), and 35 percent light crude oil (Enbridge 2016a). The physicochemical properties of light and heavy crude oils differ, and these properties influence the fate, transport, and potential impacts of crude oil in the environment and toxicity to humans and other biological receptors as described below. Crude oils are further differentiated based on their sulfur content. Crude oils that contain less than 1 percent by weight total sulfur are referred to as "sweet," and those that contain more than 1 percent by weight total sulfur are "sour" (API 2011). Both light and heavy crude oils can be sour or sweet.

10.2.1.1.1 Light Crude Oil

Light crude oils are less dense than medium and heavy crude oils due to having a higher percentage of low-molecular-weight or "light" hydrocarbon fractions (i.e., alkanes, cycloalkanes, and BTEX). They are liquids at room temperature and tend to have a lower viscosity, higher API gravity, higher vapor pressure, higher water solubility, and higher flammability than heavier oils. This means a light crude oil released into the environment would likely float on water surfaces (high API gravity), evaporate more

19 If a crude oil has an API gravity greater than 10, the oil is lighter than water and will float; conversely, a crude oil with an API gravity less than 10 will sink in water.

Table 10.6-2. Potentially Applicable Federal and State Laws and Regulations That Establish Liability for Crude Oil Spills

Statute/Regulation	Description
Oil Pollution Act of 1990 (OPA 90), 33 U.S. Code 2701 et seq.	OPA 90 established a program of prevention, response, liability, and compensation to address vessel and facility-caused oil pollution to navigable waters of the United States. Section 1002(a) provides that the Responsible Party for a pipeline from which oil is discharged, or which poses a substantial threat of a discharge, is liable for (1) certain specified damages resulting from the discharged oil; and (2) removal costs incurred in a manner consistent with the National Contingency Plan. Per Section 1018(a), OPA 90, does not preempt state law. States may impose additional liability (including unlimited liability), funding mechanisms, requirements for removal actions, and fines and penalties for Responsible Parties.
Resource Conservation and Recovery Act (RCRA), 42 U.S. Code 6973	The U.S. Environmental Agency (EPA) may issue an order or bring a suit in district court against any person who has contributed or who is contributing to the handling, treatment, storage, transportation, or disposal of solid or hazardous waste that may present an imminent and substantial endangerment to health or the environment. Persons who violate an order are subject to civil penalties of up to $7,500 per day. RCRA Section 7003(a), 42 U.S. Code 6973(a), authorizes the EPA "upon receipt of evidence that the past or present handling, storage, treatment, transportation or disposal of any solid waste or hazardous waste may present an imminent and substantial endangerment to health or the environment" to "bring suit in district court or to issue an administrative order to any person who contributed or is contributing to that handling, storage, treatment, transportation," to restrain or take any other action in response. Oil released from a pipeline would constitute solid or hazardous waste, and the authority allows the EPA to require action if the spill "may present an imminent and substantial endangerment."
Safe Drinking Water Act (SDWA), 42 U.S. Code 300f et seq.	The EPA may issue orders to any person in circumstances where a "contaminant" is present in or is likely to enter a public water system or an underground source of drinking water (defined broadly to include almost all groundwater), which may present an imminent and substantial endangerment to the health of persons and states (to whom primary responsibility is granted under the SDWA) that are not acting. The orders may require that person to take such actions as the EPA deems necessary to protect health (42 U.S. Code 300i [a]). Civil penalties are available for failure to comply with such an order. SDWA Section 1431(a), 42 U.S. Code 300i(a), authorizes the EPA "upon receipt of information that a contaminant which is present in or is likely to enter a public water system or an underground source of drinking water, which may present an imminent and substantial endangerment to the health of persons," to take "such actions as [it] deems necessary," including issuance of orders and civil judicial actions. This authority is quite broad. An underground source of drinking water is virtually any underground water that has the potential to be used for drinking water, and a "contaminant" is any biological, chemical, or physical substance in water.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S. Code 9601 et. seq.	This act is similar to OPA 90 but addresses releases of hazardous substances and specifically *excludes* oil and petroleum. CERCLA created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. It provides for liability for response costs and natural resource damages against owners or operators of a pipeline who arranged for disposal of hazardous substances. The act contains similar defenses as OPA 90, as well as contribution rights. It also provides the EPA authority to issue administrative orders requiring response actions. Local CERCLA access provides funds (limited to $25,000) in the form of reimbursements for expenses, to local, county, and tribal governments that respond to a hazardous substance release in their jurisdiction (Region 5 RRT 2017).

Table 10.6-2. Potentially Applicable Federal and State Laws and Regulations That Establish Liability for Crude Oil Spills

Statute/Regulation	Description
Environmental Response and Liability Act (MERLA) Minnesota Statutes § 115B	MERLA is the Minnesota State Superfund law. Among other things, it allows the Minnesota Pollution Control Agency and the Minnesota Department of Agriculture to clean up contaminated sites and seek recovery of their expenses from those persons who are responsible for the contamination. The law creates a Superfund account to provide funding for the cleanup and provides that any money recovered shall be deposited in the account. The law provides a statute of limitations for the state to bring a cost recovery lawsuit.
Oil and Hazardous Substance Discharge Preparedness Minnesota Statutes § 115E	Statute 115E requires persons handling oil and hazardous substances to prevent discharges that endanger the environment or public health. It also requires certain kinds of facilities to prepare spill response plans.

10.7 COMPARISONS OF ALTERNATIVES BASED ON FAILURE PROBABILITY AND POTENTIAL EXPOSURES OF RESOURCES

The following sections summarize and compare the key results of the failure probability analysis among the transport mode alternatives and an evaluation of resources of concern that could be exposed following a crude oil release:

- Comparison of Failure Probability Estimates for the Applicant's Preferred Route and Certificate of Need Alternatives (Section 10.7.1),
- Comparisons of Potential Exposure Assessment Results for the Applicant's Preferred Route and Certificate of Need Alternatives (Section 10.7.3), and
- Comparisons of Potential Exposure Assessment Results for the Applicant's Preferred Route and Route Alternatives (Section 10.7.4).

10.7.1 Comparison of Failure Probability Estimates for the Applicant's Preferred Route and Certificate of Need Alternatives

The potential causes for spills for truck, rail, and pipeline are presented in section 10.1.2 and the baseline crude oil pipeline spill risk analysis is presented in section 10.1.3.

Compared to pipelines, both truck and rail transportation alternatives have a higher likelihood of accidents and spills due to the number of transits required to transport the crude oil and the associated increase in risk due to human error. Tanker trucks use major roadways and present a greater risk of injury and fatalities to personnel and the public; this transport mode has a substantially greater annual probability of a spill incident and an estimated recurrence interval of 1.46 days (0.004 years multiplied by 365 days per year). Even though the risk of an event occurring is higher for trains and trucks, the size of the release, if an incident occurs, is typically much smaller because the volume of a tanker truck or train car is smaller. The average size of crude oil from a truck incident is 16 barrels (687 gallons); from a train incident, 40 barrels (1,688 gallons); and from a pipeline incident, 462 barrels (19,412) gallons

The very large number of trucks required for this alternative would greatly increase the risk of releases and impacts on other roadway users along the major routes between loading and offloading facilities. Similarly, the large number of unit trains required to transport 760,000 bpd of crude oil results in a relatively high estimated annual probability of a spill incident, with such an incident estimated to occur approximately once per year. When total volume of releases is compared to the volume of crude oil transported, rail and truck transport release a significantly higher percentage of the volume transported, 0.309 percent and 0.154 percent respectively. Comparatively, pipeline transport releases an average of 0.006 percent of the volume of crude oil transported.

Table 10.7-1 provides additional context in the form of historical incident data for truck and rail transport of hazardous materials, a category that includes crude oil, normalized to reportable incidents per year. Figure 10.7-1 shows the average annual volume of crude oil transported and percent of transported crude oil spilled for different transportation modes.[56]

Table 10.7-1. Annual Number of Incidents for Rail and Truck Transportation of Hazardous Materials

Mode	Number of Incidents per Year[a]
Rail (2007–2017)	623
Truck (2007–2017)	1,199
Pipeline (2010–2017)	391

Sources: PHMSA 2017a, 2017b.

[a] Hazardous material transport includes the transport of crude oil; hazardous materials transportation incidents required to be reported are defined in 49 CFR 171.15, 171.16 (Form F 5800.1).

56 Average number of crude oil (49 CFR 171.15, 171.16 [Form F 5800.1]) transport incidents based on Pipeline and Hazardous Materials Safety Administration data. Average number of rail incidents per year based on data spanning the period 2007–2017. Average number of truck incidents per year based on data spanning the period 2007–2017. Average number of pipeline incidents per year based on data spanning the period 2010–2017. Average volume of yearly transport based on Energy Information Administration U.S. Refinery Receipts of Crude Oil by Method of Transportation data spanning the period 2010–2016.

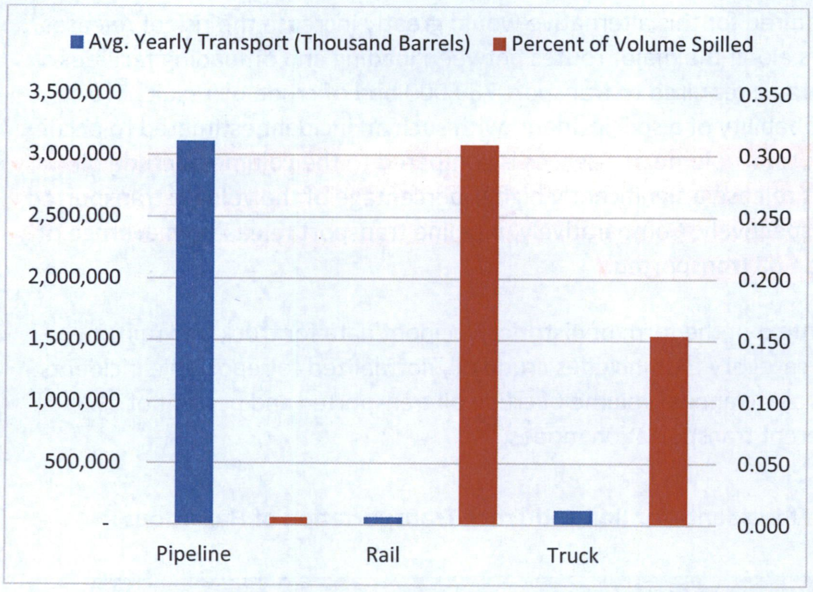

Figure 10.7-1. Annual Average Volume of Oil Transported and Percent Spilled

10.7.2 Comparisons of Potential Exposure Assessment Results for the Applicant's Preferred Route and Certificate of Need Alternatives

The presence of HCAs and AOIs within the ROIs, as described in Section 10.4.1, was compared among the Applicant's preferred route and the CN Alternatives. These are considered the resources of concern. The two ROIs consist of a 5,000-foot-wide (2,500 feet on each side of the centerline of the pipeline or train or truck route) ROI corridor for releases on land and a 10-mile-long, 1,000-foot-wide (500 feet on each side of the centerline of the waterbody crossed) downstream ROI corridor for releases to water; these were established as areas within which oil could be present after a release. Table 10.7-2 summarizes the exposure of resources of concern in the ROIs and is presented along a color gradient (green to red). CN Alternatives are coded in a gradient from green to red based on the extent of the potential exposure of resources in their ROIs in comparison to the other alternatives.

A more detailed listing of each HCA and AOI category is provided in Table 10.7-3, and this table also codes CN Alternatives using the same gradient from red to green. The same approach to comparing the Applicant's preferred route and route alternatives is provided associated with resources of concern and HCA and AOI categories in Tables 10.7-4- and 10.7-5-.

As shown in Tables 10.7-2 and 10.7-3 for the Applicant's preferred route compared to the CN Alternatives, system alternative SA-04 has the lowest total acreage of AOIs, followed by the Applicant's preferred route, existing use of Line 3, transportation by rail, and transportation by truck. Existing Line 3 supplemented by truck and existing line 3 supplemented by rail have the greatest total AOI acreages, being over three times greater than that of the Applicant's preferred route and system alternative SA-04.