

Earthquake Impacts on Pipelines, Utilities, and Hazardous Chemicals

Hundreds of pipelines, utilities, and hazardous chemical facilities blanket the New Madrid Seismic Zone.

In this session, learn where the Missouri facilities are located, how prepared they are to withstand shaking, and plans in place to respond after a big quake.

Missouri Environmental Emergency Response (EER)

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24-Hour Spill Line

573-634-2436

24-Hour EER Spill Line

- An estimated 1,500 reports per year
 - Mostly from firefighters but anyone may call

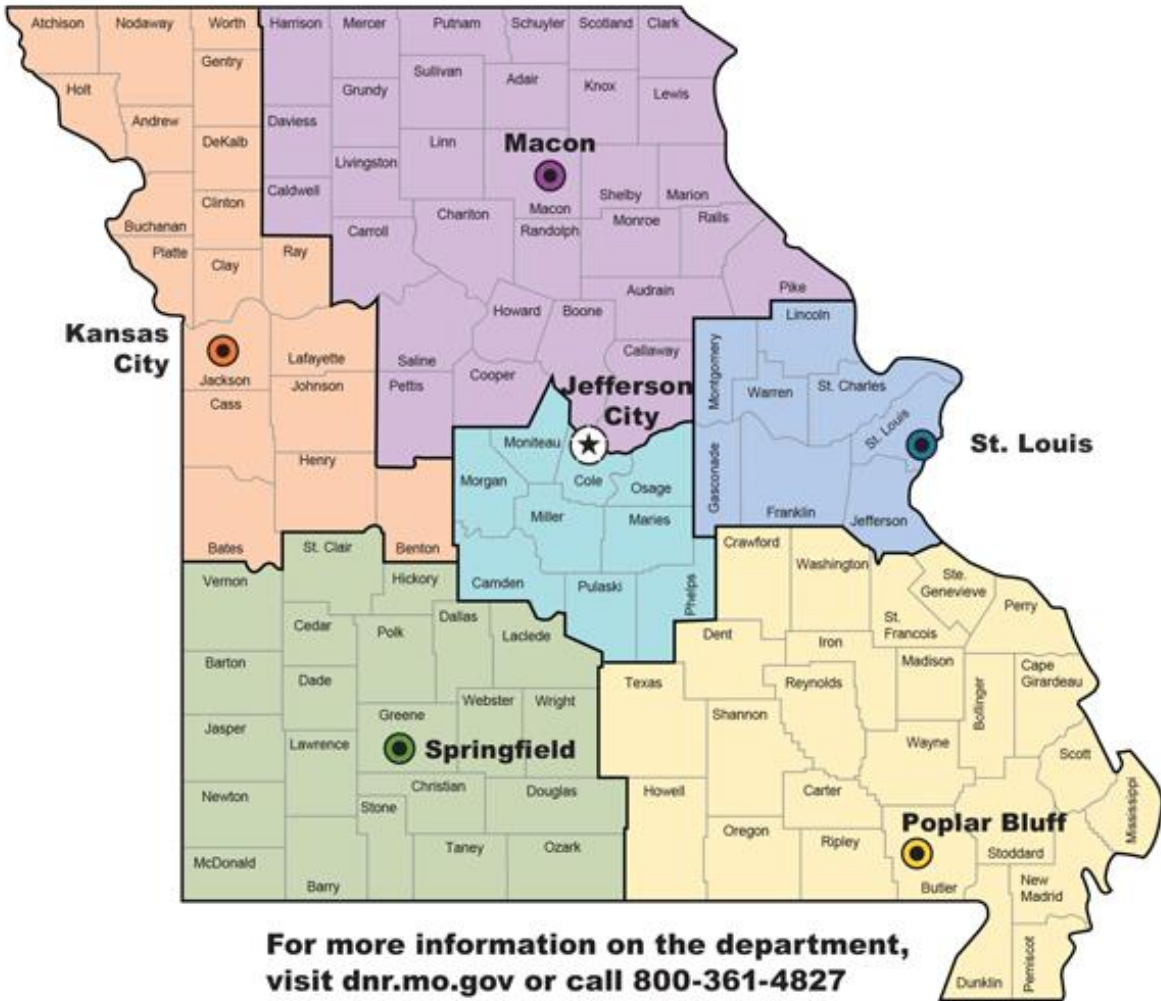
573-634-2436

Duty officers:

- * Give technical help.
- * Contact agencies.
- * Dispatch EER state on-scene coordinators, if necessary.



DNR Regions



For more information on the department, visit dnr.mo.gov or call 800-361-4827



Show Me Pipeline Pipeline Association of Missouri (PAM)

- [Missouri Pipeline Awareness \(showmepipeline.com\)](http://showmepipeline.com)
- Quick Walkthrough, and important points
 - Meeting Schedule
 - Pipeline Operators and locations
 - Nustar- Anhydrous Ammonia [Operations Map - NuStarEnergy](#)
 - Spire- Natural Gas
 - Liberty Utilities – Natural Gas
 - Enterprise Products Operating LLC- Liquefied Petroleum Gas [System Map - Enterprise Products](#)
- Pipeline and Hazardous Materials Safety Administration (PHMSA)
 - Incidents

National Pipeline Mapping System

[Missouri Pipeline Awareness \[National Pipeline Mapping System\]](#)
[\(showmepipeline.com\)](#)

- Find Pipeline Operators
- View pipeline Maps
- [NPMS – Home \(dot.gov\)](#)

U.S. Pipeline Information

- [Pipeline101](#)
- The U.S. has **229,888 miles** of oil, refined products, CO2, and natural gas liquids pipelines.
- Total liquids pipelines have **increased** by **over 6%**, or roughly **15,000 miles**, over the **past five years**.
- 80,000 miles of crude oil pipelines.
- over 70,000 natural gas liquids pipeline miles.
- over 62,000 miles of petroleum products pipeline, and 5,300 miles of CO2 pipeline.

U.S. Pipeline Information

16 MILES OF U.S. PIPELINE BY PRODUCT (2017-2021)					
	2017	2018	2019	2020	2021
Crude Oil	79,211	80,741	84,015	85,307	84,712
Petroleum Products	62,369	62,720	63,117	64,187	64,218
Natural Gas Liquids (NGLs)	69,163	70,269	72,632	74,794	75,603
CO₂/Ethanol	5,252	5,221	5,164	5,167	5,356
Total Miles	215,995	218,951	224,928	229,454	229,888

Source: Pipeline and Hazardous Materials Safety Administration, PHMSA Pipeline Safety, March 2023

Hazardous Liquid Pipelines

Pipeline data as of 06/14/2022



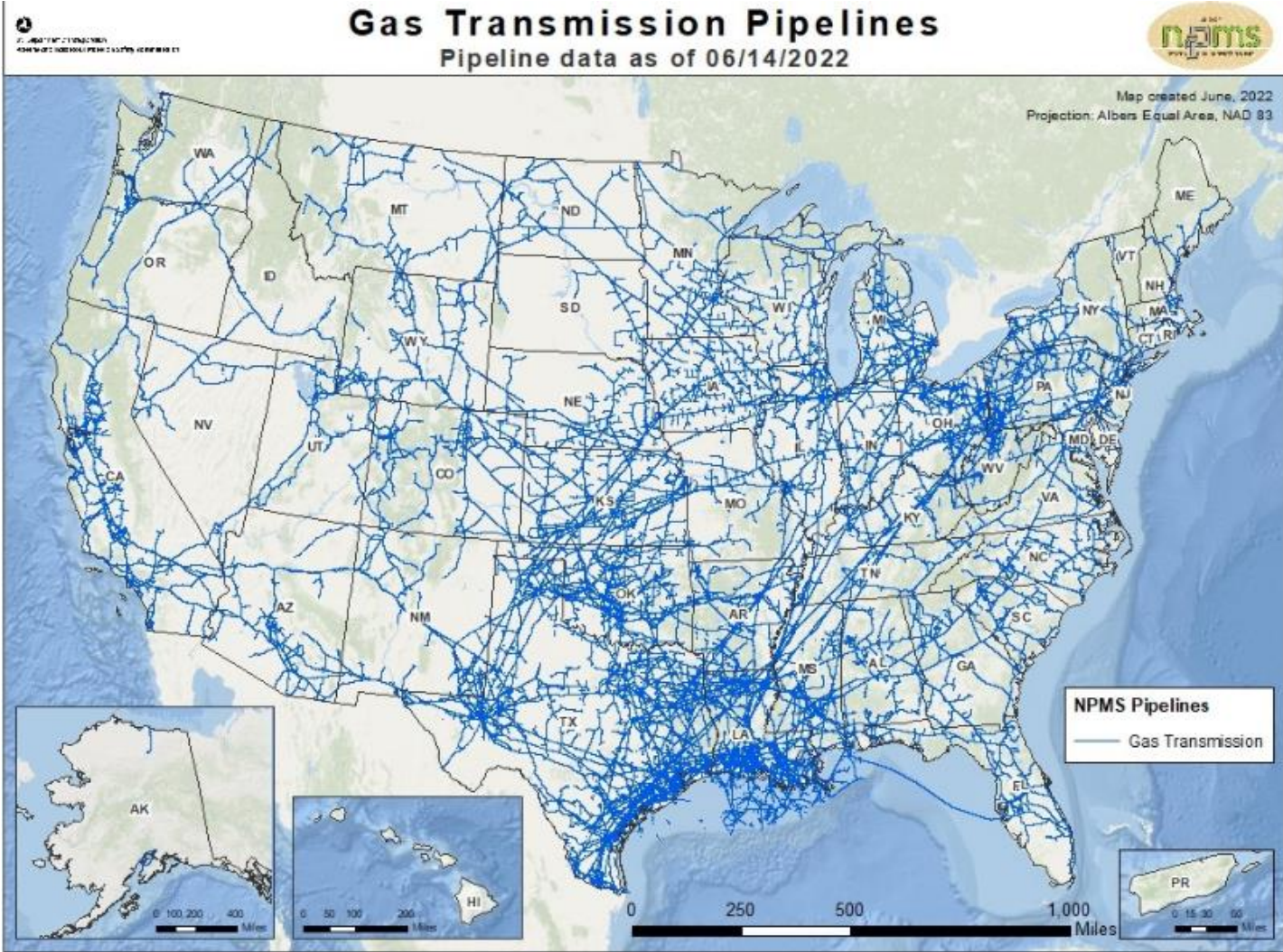
Map created June, 2022
Projection: Albers Equal Area, NAD 83



Gas Transmission Pipelines

- The U.S. has more than **2.6 million miles** of **natural gas pipelines**.
- This includes **2.3 million miles** of natural gas distribution and over 300,000 miles of transmission pipelines.
- Transmission pipelines transport natural gas long distances while distribution lines deliver gas directly to businesses and homes.

Gas
Transmission
Lines





2751 N. High St.
 Jackson, MO 63755
 Phone: 1-855-872-3242
 Website: www.libertyutilities.com

Liberty is a value-driven company. Our brand values shape our corporate culture and unite our national, collective efforts to deliver quality water, gas and electric distribution services to small and mid-sized communities across the United States.

With more than 750,000 customers, Liberty is committed to local decision making that directly meets the needs of its customers. This means providing walk in customer service centers, creating jobs, and providing responsive and reliable service. As a company, Liberty promotes local conservation and energy efficiency initiatives and programs for businesses and residential customers, including the low-income sector. The company measures its performance on customer experience, public and workplace safety, and service reliability. Liberty currently operates in Arizona, Arkansas, California, Georgia, Illinois, Iowa, Kansas, Massachusetts, Missouri, New Hampshire, Oklahoma, and Texas.

COMMITMENT TO SAFETY, HEALTH & ENVIRONMENT

Safety is a main concern of Liberty. We believe that nothing can justify endangering our customers, our communities or our employees. Safety at Liberty is the responsibility of every employee regardless of his or her position. Liberty is committed to:

- Providing a safe, healthy and stable work environment for all employees
- Delivering safe, reliable and efficient service to its customers
- Enhancing general public safety through safe work practices and public education
- Complying with federal, state and local regulations as they pertain to Liberty daily operations

EMERGENCY CONTACT: 1-855-644-8134

PRODUCTS/DOT GUIDEBOOK ID#/GUIDE#:

Natural Gas	1971	115
Water		

MISSOURI COUNTIES OF OPERATION:

Adair	Mississippi
Bates	New Madrid
Butler	Pemiscot
Cape Girardeau	Pike
Cass	Ralls
Clark	Ripley
Dunklin	St. Clair
Henry	Schuyler
Iron	Scotland
Knox	Scott
Lewis	Stoddard
Macon	Wayne
Marion	

Changes may occur. Contact the operator to discuss their pipeline systems and areas of operation.



Emergency Response Guidebook (ERG)

Anhydrous Ammonia

[Emergency Response Guidebook \(ERG\) | PHMSA \(dot.gov\)](https://www.phmsa.dot.gov)

Marked in Green

- Go to table 1
- Go directly to Table 1 (green-bordered pages)
- Look up the ID number and name of the material
- Identify initial isolation and protective action distances –
- Also consult the appropriate Orange Guide

If there is a Fire

- Use the appropriate Orange Guide for EVACUATION distances
- Also protect in downwind direction according to Table 1 for residual material release

INTRODUCTION TO YELLOW PAGES			ID No.	Guide No.	Name of Material	ID No.	Guide No.	Name of Material
<p>For entries highlighted in green follow these steps:</p> <ul style="list-style-type: none"> • IF THERE IS NO FIRE: <ul style="list-style-type: none"> - Go directly to Table 1 (green-bordered pages) - Look up the ID number and name of material - Identify initial isolation and protective action distances - Also consult the appropriate Orange Guide • IF A FIRE IS INVOLVED: <ul style="list-style-type: none"> - Use the appropriate Orange Guide for EVACUATION distances - Also protect in downwind direction according to Table 1 for residual material release <p>Note 1: If the name in Table 1 is shown with (when spilled in water), these materials produce large amounts of Toxic Inhalation Hazard (TIH) (PIH in the US) gases when spilled in water. Some Water Reactive materials are also TIH materials themselves (e.g., UN1746 (Bromine trifluoride), UN1836 (Thionyl chloride)). In these instances, two entries are provided in Table 1 for land-based and water-based spills. If a water-reactive material only has one entry in Table 1 for (when spilled in water) and the product is NOT spilled in water, Table 1 and Table 2 do not apply. You will find safe distances in the appropriate orange-bordered guide.</p> <p>Note 2: Explosives are not individually listed by their ID number because in an emergency situation, the response will be based only on the division of the explosive, not on the individual explosive. For divisions 1.1, 1.2, 1.3 and 1.5, refer to GUIDE 112. For divisions 1.4 and 1.6, refer to GUIDE 114.</p> <p>Note 3: Chemical warfare agents do not have an assigned ID number because they are not commercially transported. In an emergency situation, the assigned orange guide will provide guidance for the initial response. Also consult "Criminal or Terrorist Use of Chemical, Biological and Radiological Agents", pp. 368 to 372.</p>			117	AC		153	L (Lewisite)	
			154	Adamsite		153	Lewisite	
			112	Ammonium nitrate-fuel oil mixtures		152	MD	
			158	Biological agents		153	Mustard	
			112	Blasting agent, n.o.s.		153	Mustard Lewisite	
			153	Buzz		152	PD	
			153	BZ		119	SA	
			159	CA		153	Sarin	
			125	CG		153	Soman	
			125	CK		153	Tabun	
			153	CN		153	Thickened GD	
			153	CS		153	Toxins	
			154	CX		153	VX	
			151	DA		1001 116	Acetylene, dissolved	
			153	DC		1002 122	Air, compressed	
			154	DM		1003 122	Air, refrigerated liquid (cryogenic liquid)	
			125	DP		1005 125	Ammonia, anhydrous	
			151	ED		1005 125	Anhydrous ammonia	
			112	Explosives, division 1.1, 1.2, 1.3 or 1.5		1006 120	Argon	
			114	Explosives, division 1.4 or 1.6		1006 120	Argon, compressed	
			153	GA		1008 125	Boron trifluoride	
			153	GB		1008 125	Boron trifluoride, compressed	
			153	GD		1009 126	Bromotrifluoromethane	
			153	GF		1009 126	Refrigerant gas R-13B1	
			153	H		1010 116P	Butadienes, stabilized	
			153	HD		1010 116P	Butadienes and hydrocarbon mixture, stabilized	
			153	HL		1010 116P	Hydrocarbon and butadienes mixture, stabilized	
			153	HN-1		1011 115	Butane	
153	HN-2		1012 115	Butylene				
153	HN-3							

Emergency Response Guidebook (ERG) Anhydrous Ammonia

Page 298

TABLE 1 - INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES

ID No.	Guide	NAME OF MATERIAL	SMALL SPILLS (From a small package or small leak from a large package)				LARGE SPILLS (From a large package or from many small packages)							
			First ISOLATE in all Directions		Then PROTECT persons Downwind during		First ISOLATE in all Directions		Then PROTECT persons Downwind during					
			Meters	(Feet)	DAY Kilometers (Miles)	NIGHT Kilometers (Miles)	Meters	(Feet)	DAY Kilometers (Miles)	NIGHT Kilometers (Miles)				
—	153	Soman (when used as a weapon)	60 m	(200 ft)	0.4 km	(0.3 mi)	0.7 km	(0.5 mi)	300 m	(1000 ft)	1.8 km	(1.1 mi)	2.7 km	(1.7 mi)
—	153	Tabun (when used as a weapon)	30 m	(100 ft)	0.2 km	(0.1 mi)	0.2 km	(0.1 mi)	100 m	(300 ft)	0.5 km	(0.4 mi)	0.6 km	(0.4 mi)
—	153	Thickened GD (when used as a weapon)	60 m	(200 ft)	0.4 km	(0.3 mi)	0.7 km	(0.5 mi)	300 m	(1000 ft)	1.8 km	(1.1 mi)	2.7 km	(1.7 mi)
—	153	VX (when used as a weapon)	30 m	(100 ft)	0.1 km	(0.1 mi)	0.1 km	(0.1 mi)	60 m	(200 ft)	0.4 km	(0.2 mi)	0.3 km	(0.2 mi)
1005	125	Ammonia, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.1 mi)	Refer to table 3					
1005	125	Anhydrous ammonia												
1008	125	Boron trifluoride	30 m	(100 ft)	0.2 km	(0.1 mi)	0.7 km	(0.5 mi)	400 m	(1250 ft)	2.3 km	(1.4 mi)	5.1 km	(3.2 mi)
1008	125	Boron trifluoride, compressed												
1016	119	Carbon monoxide	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.1 mi)	200 m	(600 ft)	1.2 km	(0.7 mi)	4.3 km	(2.7 mi)
1016	119	Carbon monoxide, compressed												
1017	124	Chlorine	60 m	(200 ft)	0.3 km	(0.2 mi)	1.4 km	(0.9 mi)	Refer to table 3					
1026	119	Cyanogen	30 m	(100 ft)	0.1 km	(0.1 mi)	0.4 km	(0.3 mi)	60 m	(200 ft)	0.3 km	(0.2 mi)	1.1 km	(0.7 mi)
1040	119P	Ethylene oxide	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.2 mi)	Refer to table 3					
1040	119P	Ethylene oxide with Nitrogen												
1045	124	Fluorine	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.1 mi)	100 m	(300 ft)	0.5 km	(0.3 mi)	2.3 km	(1.4 mi)
1045	124	Fluorine, compressed												
1048	125	Hydrogen bromide, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.2 km	(0.2 mi)	150 m	(500 ft)	1.0 km	(0.6 mi)	3.4 km	(2.1 mi)
1050	125	Hydrogen chloride, anhydrous	30 m	(100 ft)	0.1 km	(0.1 mi)	0.3 km	(0.2 mi)	Refer to table 3					

Emergency
Response
Guidebook
(ERG)
Table 3
Anhydrous
Ammonia

TABLE 3 - INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES FOR LARGE SPILLS FOR DIFFERENT QUANTITIES OF SIX COMMON TIH (PIH in the US) GASES

	First ISOLATE in all Directions	Then PROTECT persons Downwind during												
		DAY						NIGHT						
		Low wind (< 6 mph = < 10 km/h)		Moderate wind (6-12 mph = 10 - 20 km/h)		High wind (> 12 mph = > 20 km/h)		Low wind (< 6 mph = < 10 km/h)		Moderate wind (6-12 mph = 10 - 20 km/h)		High wind (> 12 mph = > 20 km/h)		
Meters	(Feet)	km	(Miles)	km	(Miles)	km	(Miles)	km	(Miles)	km	(Miles)	km	(Miles)	
TRANSPORT CONTAINER	UN1005 Ammonia, anhydrous: Large Spills													
Rail tank car	300	(1000)	1.9	(1.2)	1.5	(0.9)	1.1	(0.6)	4.5	(2.8)	2.5	(1.5)	1.4	(0.9)
Highway tank truck or trailer	150	(500)	0.9	(0.6)	0.5	(0.3)	0.4	(0.3)	2.0	(1.3)	0.8	(0.5)	0.6	(0.4)
Agricultural nurse tank	60	(200)	0.5	(0.3)	0.3	(0.2)	0.3	(0.2)	1.4	(0.9)	0.3	(0.2)	0.3	(0.2)
Multiple small cylinders	30	(100)	0.3	(0.2)	0.2	(0.1)	0.1	(0.1)	0.7	(0.5)	0.3	(0.2)	0.2	(0.1)
TRANSPORT CONTAINER	UN1017 Chlorine: Large Spills													
Rail tank car	1000	(3000)	10.1	(6.3)	6.8	(4.2)	5.3	(3.3)	11+	(7+)	9.2	(5.7)	6.9	(4.3)
Highway tank truck or trailer	600	(2000)	5.8	(3.6)	3.4	(2.1)	2.9	(1.8)	6.7	(4.3)	5.0	(3.1)	4.1	(2.5)
Multiple ton cylinders	300	(1000)	2.1	(1.3)	1.3	(0.8)	1.0	(0.6)	4.0	(2.5)	2.4	(1.5)	1.3	(0.8)
Multiple small cylinders or single ton cylinder	150	(500)	1.5	(0.9)	0.8	(0.5)	0.5	(0.3)	2.9	(1.8)	1.3	(0.8)	0.6	(0.4)

TABLE 3

"+" means distance can be larger in certain atmospheric conditions

Emergency Response Guidebook (ERG) Anhydrous Ammonia

Health

- **TOXIC**; may be fatal if inhaled, ingested, or absorbed through the skin.
- Vapors are **extremely irritating and corrosive**.
- Contact with gas or liquefied gas may cause **burns, severe injury, and/or frostbite**.
- **Fire** will produce irritating, corrosive, and/or **toxic gases**.
- **Runoff** from fire control or **dilution water** may cause **environmental contamination**.

GUIDE GASES - TOXIC AND/OR CORROSIVE 125

POTENTIAL HAZARDS

HEALTH

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- Vapors are extremely irritating and corrosive.
- Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
- Fire will produce irritating, corrosive and/or toxic gases.
- Runoff from fire control or dilution water may cause environmental contamination.

FIRE OR EXPLOSION

- Some may burn but none ignite readily.
- Vapors from liquefied gas are initially heavier than air and spread along ground.
- Some of these materials may react violently with water.
- Cylinders exposed to fire may vent and release toxic and/or corrosive gas through pressure relief devices.
- Containers may explode when heated.
- Ruptured cylinders may rocket.
- For UN1005: Anhydrous ammonia, at high concentrations in confined spaces, presents a flammability risk if a source of ignition is introduced.

PUBLIC SAFETY

- **CALL 911**. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- Stay upwind, uphill and/or upstream.
- Many gases are heavier than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).
- Ventilate closed spaces before entering, but only if properly trained and equipped.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Wear chemical protective clothing that is specifically recommended by the manufacturer **when there is NO RISK OF FIRE**.
- Structural firefighters' protective clothing provides thermal protection **but only limited chemical protection**.

EVACUATION

Immediate precautionary measure

- Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

Spill

- For **highlighted materials**: see Table 1 - Initial Isolation and Protective Action Distances.
- For non-highlighted materials: increase the immediate precautionary measure distance, in the downwind direction, as necessary.

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.



In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping paper and/or the ERAP Program Section (page 390).

Emergency Response Guidebook (ERG) Anhydrous Ammonia

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GASES - TOXIC AND/OR CORROSIVE		GUIDE 125
EMERGENCY RESPONSE		
FIRE		
Small Fire		
• Dry chemical or CO ₂ .		
Large Fire		
• Water spray, fog or regular foam.		
• If it can be done safely, move undamaged containers away from the area around the fire.		
• Do not get water inside containers.		
• Damaged cylinders should be handled only by specialists.		
Fire Involving Tanks		
• Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles.		
• Cool containers with flooding quantities of water until well after fire is out.		
• Do not direct water at source of leak or safety devices; icing may occur.		
• Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.		
• ALWAYS stay away from tanks engulfed in fire.		
SPILL OR LEAK		
• Do not touch or walk through spilled material.		
• Stop leak if you can do it without risk.		
• If possible, turn leaking containers so that gas escapes rather than liquid.		
• Prevent entry into waterways, sewers, basements or confined areas.		
• Do not direct water at spill or source of leak.		
• Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material.		
• Isolate area until gas has dispersed.		
FIRST AID		
• Call 911 or emergency medical service.		
• Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.		
• Move victim to fresh air if it can be done safely.		
• Give artificial respiration if victim is not breathing.		
• Do not perform mouth-to-mouth resuscitation if victim ingested or inhaled the substance; wash face and mouth before giving artificial respiration. Use a pocket mask equipped with a one-way valve or other proper respiratory medical device.		
• Administer oxygen if breathing is difficult.		
• Remove and isolate contaminated clothing and shoes.		
• In case of contact with liquefied gas, thaw frosted parts with lukewarm water.		
• In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.		
• In case of skin contact with hydrogen fluoride, anhydrous (UN1052), if calcium gluconate gel is available, rinse 5 minutes, then apply gel. Otherwise, continue rinsing until medical treatment is available.		
• Keep victim calm and warm.		
• Keep victim under observation.		
• Effects of contact or inhalation may be delayed.		

Emergency Response Guidebook (ERG)

Anhydrous Ammonia

Public Safety

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- If shipping paper are not available or no answer, refer to the appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- **Stay upwind, uphill, and/or upstream.**
- Many **gases are heavier** than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.)

PROTECTIVE CLOTHING

- Wear positive pressure self-contained **breathing apparatus (SCBA)**.
- **Level A Hazmat suit and hazmat Team.**
- Wear chemical protective clothing that is specifically recommended by the manufacturer when there is **NO RISK OF FIRE**.
- Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

Emergency Response Guidebook (ERG) Natural Gas

PIPELINE TRANSPORTATION

In North America, hazardous materials/dangerous goods are commonly transported through millions of miles of pipelines and related structures. Products transported include **natural gas**, **natural gas** liquids, crude oil, gasoline, diesel fuel, anhydrous ammonia, carbon dioxide, jet fuel, and other commodities. Although most pipelines are buried, often there are aboveground structures and markers indicating the presence of pipelines. First responders should be aware of the pipelines in their jurisdictions, the products they transport, and the operators responsible for those pipelines. Proactive relationships can be beneficial in the safe and effective management of pipeline emergencies.

Types of Pipelines

Natural Gas Pipelines

Natural Gas Transmission Pipelines

Large-diameter, steel pipelines transport flammable **natural gas** (toxic and non-toxic) at very high pressures ranging from 200 to 1,500 psi*. **Natural gas** in transmission pipelines is odorless—generally *not odorized* with mercaptan (the “rotten egg” smell); however, **natural gas** containing hydrogen sulfide (H₂S) will have a distinct “rotten egg” odor.

Natural Gas Distribution Pipelines

Natural gas is delivered directly to customers via distribution pipelines. These pipelines are typically smaller-diameter, lower-pressure pipelines constructed of steel, plastic, or cast iron. **Natural gas** in distribution pipelines *is odorized* with mercaptan (the “rotten egg” smell).

Natural Gas-Gathering and Natural Gas Well Production Pipelines

Natural gas-gathering/well production pipelines collect “raw” **natural gas** from wellheads and transport the product to gas-processing and/or gas-treating plants. These gathering pipelines carry **natural gas** mixed with some quantity of **natural gas** liquids, water, and, in some areas, contaminants such as toxic hydrogen sulfide (H₂S). **Natural gas** in these pipelines is *not odorized* with mercaptan (the “rotten egg” smell); however, **natural gas** that contains hydrogen sulfide (H₂S) will have a distinct “rotten egg” odor.

Hazardous Liquid and Highly Volatile Liquid Pipelines

Hazardous Liquid Pipelines

Crude oil, refined petroleum products (e.g. gasoline, kerosene, jet fuel or diesel) and hazardous liquids (e.g. anhydrous ammonia or ethanol) are often transported by pipelines.

Many liquid petroleum pipelines transport different types of liquid petroleum in the same pipeline. To do so, the pipeline operator sends different products in “batches.” For example, an operator could send gasoline for several hours, and then switch to jet fuels, before switching to diesel fuel.

* Data from <http://naturalgas.org/naturalgas/transport/>

Emergency Response Guidebook (ERG) Natural Gas

- Natural gas can migrate underground from the source of a release to other areas via the path of least resistance (including through sewers, water lines, and geologic formations).
- **Natural Gas distribution pipelines are not marked with above-ground signs.**

Highly Volatile Liquid (HVL) Pipelines

HVL pipelines transport hazardous liquids which will form a vapor cloud when released to the atmosphere and which have a vapor pressure exceeding 276 KPa (40 psia) at 37.8°C (100°F). An example of an HVL is liquid propane.

Pipeline Markers

Since pipelines are usually buried underground, pipeline markers are used to indicate their presence in an area along the pipeline route. Of the three types of pipelines typically buried underground — distribution, gathering, and transmission — only transmission pipelines are marked with the following above-ground markers used to indicate their route.



Markers warn that a transmission pipeline is located in the area, identify the product transported in the line, and provide the name and telephone number of the pipeline operator to call. Markers and warning signs are located at frequent intervals along natural gas and liquid transmission pipeline rights-of-way, and are located at prominent points such as where pipelines intersect streets, highways, railways, or waterways.

Pipeline markers only indicate the presence of a pipeline—they do not indicate the exact location of the pipeline. Pipeline locations within a right-of-way may vary along its length and there may be multiple pipelines located in the same right-of-way.

NOTE:

- Markers for pipelines transporting materials containing dangerous levels of hydrogen sulfide (H₂S) may have markers that say: "Sour" or "Poison."
- **Natural gas** distribution pipelines are not marked with above-ground signs.
- Gathering/production pipelines are often not marked with above-ground signs.

Emergency Response Guidebook (ERG) Natural Gas

Not highlighted in Green.

ID No.	Guide No.	Name of Material	ID No.	Guide No.	Name of Material
1968	126	Insecticide gas, n.o.s.	1982	126	Refrigerant gas R-14
1969	115	Isobutane	1982	126	Refrigerant gas R-14, compressed
1970	120	Krypton, refrigerated liquid (cryogenic liquid)	1982	126	Tetrafluoromethane
1971	115	Methane	1982	126	Tetrafluoromethane, compressed
1971	115	Methane, compressed	1983	126	1-Chloro-2,2,2-trifluoroethane
1971	115	Natural gas, compressed	1983	126	Refrigerant gas R-133a
1972	115	Liquefied natural gas (cryogenic liquid)	1984	126	Refrigerant gas R-23
1972	115	LNG (cryogenic liquid)	1984	126	Trifluoromethane
1972	115	Methane, refrigerated liquid (cryogenic liquid)	1986	131	Alcohols, flammable, poisonous, n.o.s.
1972	115	Natural gas, refrigerated liquid (cryogenic liquid)	1986	131	Alcohols, flammable, toxic, n.o.s.
1973	126	Chlorodifluoromethane and Chloropentafluoroethane mixture	1987	127	Alcohols, n.o.s.
1973	126	Chloropentafluoroethane and Chlorodifluoromethane mixture	1987	127	Denatured alcohol
1973	126	Refrigerant gas R-502	1988	131P	Aldehydes, flammable, poisonous, n.o.s.
1974	126	Chlorodifluorobromomethane	1988	131P	Aldehydes, flammable, toxic, n.o.s.
1974	126	Refrigerant gas R-12B1	1989	129P	Aldehydes, n.o.s.
1975	124	Dinitrogen tetroxide and Nitric oxide mixture	1990	171	Benzaldehyde
1975	124	Nitric oxide and Dinitrogen tetroxide mixture	1991	131P	Chloroprene, stabilized
1975	124	Nitric oxide and Nitrogen dioxide mixture	1992	131	Flammable liquid, poisonous, n.o.s.
1975	124	Nitrogen dioxide and Nitric oxide mixture	1992	131	Flammable liquid, toxic, n.o.s.
1976	126	Octafluorocyclobutane	1993	128	Combustible liquid, n.o.s.
1976	126	Refrigerant gas RC-318	1993	128	Compounds, cleaning liquid (flammable)
1977	120	Nitrogen, refrigerated liquid (cryogenic liquid)	1993	128	Compounds, tree or weed killing, liquid (flammable)
1978	115	Propane	1993	128	Diesel fuel
			1993	128	Flammable liquid, n.o.s.
			1993	128	Fuel oil
			1994	136	Iron pentacarbonyl

Emergency Response Guidebook (ERG) Natural Gas, Guide 115

• Indications of Pipeline Leaks and Ruptures

- Hissing, roaring, or explosive sound
- **Flames appearing** from the ground or water (perhaps very large flames)
- Vapor cloud/fog/mist
- Dirt/debris/water blowing out of the ground
- Liquids bubbling up from the ground or bubbling in water
- Distinctive, unusually **strong odor** of rotten eggs, **mercaptan** (an odorant in some natural gas pipelines), skunk, or petroleum
- **Discolored/dead** vegetation or discolored snow above a pipeline right-of-way
- Oil slick or sheen on flowing/standing water
- An area of **frozen ground** in the **summer**
- An unusual area of melted snow in the winter

Pipeline Structures (Above Ground)

Natural Gas Transmission Pipelines:	Compressor stations, valves, metering stations.
Natural Gas Distribution Pipelines:	Regulator stations, customer meters and regulators, valve box covers.
Natural Gas Gathering/Well Production Pipelines:	Compressor stations, valves, metering stations, wellheads, piping, manifolds.
Petroleum and Hazardous Liquids Pipelines:	Storage tanks, valves, pump stations, loading racks.

Indications of Pipeline Leaks and Ruptures

Pipeline releases can range from relatively minor leaks to catastrophic ruptures. It is important to remember that gases and liquids behave differently once they are released from a pipeline. Generally, the following could be indications of a pipeline leak or rupture:

- Hissing, roaring, or explosive sound
- Flames appearing from the ground or water (perhaps very large flames)
- Vapor cloud/fog/mist
- Dirt/debris/water blowing out of the ground
- Liquids bubbling up from the ground or bubbling in water
- Distinctive, unusually strong odor of rotten eggs, mercaptan (an odorant in some **natural gas** pipelines), skunk, or petroleum
- Discolored/dead vegetation or discolored snow above a pipeline right-of-way
- Oil slick or sheen on flowing/standing water
- An area of frozen ground in the summer
- An unusual area of melted snow in the winter

Emergency Response Guidebook (ERG) Natural Gas, Guide 115

- **Extremely Flammable** and **easily ignited** by sparks or flames.
- Will form **explosive mixtures** with air.
- Vapors from liquefied gas are initially heavier than air and spread along the ground.
- CAUTION: Hydrogen (UN1049), Deuterium (UN1957), Hydrogen, refrigerated liquid (UN1966), Methane (UN1971) and Hydrogen and Methane mixture, compressed (UN2034) are lighter than air and will rise. Hydrogen and Deuterium fires are difficult to detect since they burn with an **invisible flame**. Use an alternate method of detection (**thermal camera**, broom handle, etc.)

GUIDE 115 GASES - FLAMMABLE (INCLUDING REFRIGERATED LIQUIDS)

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- **EXTREMELY FLAMMABLE.**

- Will be easily ignited by heat, sparks or flames.
- Will form explosive mixtures with air.
- Vapors from liquefied gas are initially heavier than air and spread along ground.

CAUTION: Hydrogen (UN1049), Deuterium (UN1957), Hydrogen, refrigerated liquid (UN1966), Methane (UN1971) and Hydrogen and Methane mixture, compressed (UN2034) are lighter than air and will rise. Hydrogen and Deuterium fires are difficult to detect since they burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.)

- Vapors may travel to source of ignition and flash back.
- Cylinders exposed to fire may vent and release flammable gas through pressure relief devices.
- Containers may explode when heated.
- Ruptured cylinders may rocket.

HEALTH

- Vapors may cause dizziness or asphyxiation without warning.
- Some may be irritating if inhaled at high concentrations.
- Contact with gas or liquefied gas may cause burns, severe injury and/or frostbite.
- Fire may produce irritating and/or toxic gases.

PUBLIC SAFETY

- **CALL 911. Then call emergency response telephone number on shipping paper.** If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- Stay upwind, uphill and/or upstream.
- Many gases are heavier than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing provides thermal protection **but only limited chemical protection.**
- Always wear thermal protective clothing when handling refrigerated/cryogenic liquids.

EVACUATION

Immediate precautionary measure

- Isolate spill or leak area for at least 100 meters (330 feet) in all directions.

Large Spill

- Consider initial downwind evacuation for at least 800 meters (1/2 mile).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.
- In fires involving Liquefied Petroleum Gases (LPG) (UN1075), Butane (UN1011), Butylene (UN1012), Isobutylene (UN1055), Propylene (UN1077), Isobutane (UN1969), and Propane (UN1978), also refer to BLEVE – SAFETY PRECAUTIONS (Page 366).



In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping paper and/or the ERAP Program Section (page 390).

Emergency Response Guidebook (ERG) Natural Gas, Guide 115

Dangers

- Cylinders exposed to fire may vent and release flammable gas through pressure relief devices.
- Containers may explode when heated.
- Ruptured cylinders may rocket.

Health Concerns

- Vapors may cause dizziness or asphyxiation without warning.
- Some may be irritating if inhaled at high concentrations.
- Contact with gas or liquefied gas may cause burns, severe injury, and/or frostbite.
- Fire may produce irritating and/or toxic gases.

Emergency Response Guidebook (ERG) Natural Gas, Guide 115

Public Safety

- **CALL 911**. Then call the emergency response telephone number on shipping paper. If shipping paper are not available or no answer, refer to the appropriate telephone number listed on the inside back cover.
- Keep unauthorized personnel away.
- **Stay upwind, uphill, and/or upstream.**
- Many **gases are heavier** than air and will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.)

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (**SCBA**).
- Structural **firefighters' protective clothing provides thermal protection** but only **limited chemical** protection.
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Emergency Response Guidebook (ERG) Natural Gas, Guide 115

EVACUATION

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Fire

- If tank, rail car or tank truck is involved in a fire, **ISOLATE** for 1600 meters (**1 mile**) in all directions; also, consider **initial** evacuation for **1600 meters** (1 mile) in all directions.

Emergency Response Guidebook (ERG) Natural Gas, Guide 115

FIRE

- DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED. CAUTION: Hydrogen (UN1049), Deuterium (UN1957), Hydrogen, refrigerated liquid (UN1966) and Hydrogen and Methane mixture, compressed (UN2034) will burn with an invisible flame. Use an **alternate method of detection** (thermal camera, broom handle, etc.)

Fire

CAUTION: For LNG - Liquefied natural gas (UN1972) pool fires, DO NOT USE water. Use **dry chemical** or **high-expansion foam**.

MO Damage Prevention Info, [PHMSA: Stakeholder Communications - State Damage Prevention MO \(dot.gov\)](#)

- Call before you dig- 811
- Incidents in Missouri- Incidents since 2010
 - [Excavation Damage DB \(arcgis.com\)](#)
 - The map depicts the locations of the incidents as well as "heat maps" that show where incidents are concentrated geographically.

Keystone Pipeline Release “Kansas” December 8, 2022

[Site Profile - OPA - TC Energy Mill Creek - UCGRE23702 - EPA OSC Response](#)



Keystone Pipeline Release “Kansas”

- Estimated 588,000 gallons were discharged.
- 3.74 Miles of Mill Creek were impacted by oil contamination.
- Utilized underflow dams, vacuum trucks, and skimmers.
- TC Energy was able to isolate the impacted waterway and created a diversion that pumped surface water downstream of the underflow dams.
- Dewatered 3.5 miles of Mill Creek.
- Diverted water to constructed 5, 5-acre 18.8-million-gallon surface water treatment system.
- **A lot more was done than listed**









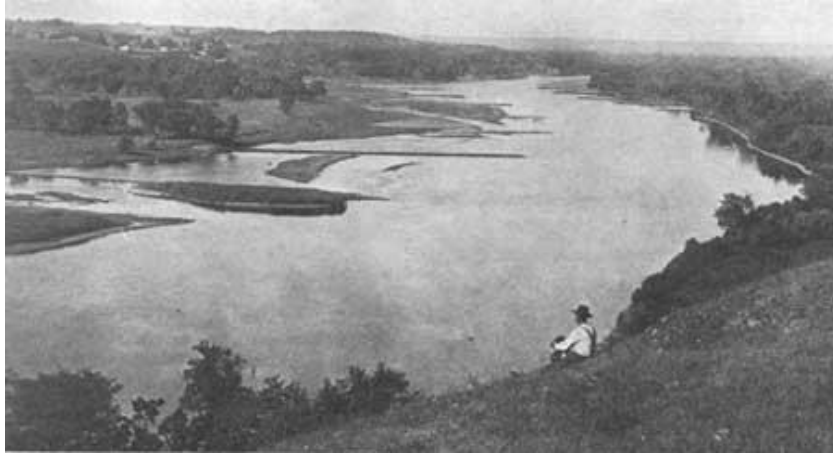
How do we Clean up?

- Oil Absorbent Boom
- **Hydrophobic material**
- Must exchange overtime.
- Does not work with water-soluble products.
- Can also use pads and river boom.





River Systems of 1811 are vastly different from today



H. Bosse, draughtsman with the Corps of Engineers, 1883-1891. (*U. S. Army Corps of Engineers, St. Paul District*)

- Still a major transportation corridor
- Navigational and control systems are now critical elements
- Industrial / commercial / community developments increase associated risk



Friends of the Mississippi River (FMR)

Damage to Ports



USGS/EERI Haiti EQ Damage report



FEMA photo



Rivers are going to be choked with debris



Man made debris - I-35 bridge



Photo credit: Mark Moran Noxen, Pennsylvania



North Shore Emergency Management



Up and Downstream of the Impact zone will become a parking lot

Upstream from Impact Area

Management of river traffic

- Mooring of excess number of vessels unable to go downstream
- Normal operation of vessels operating in area
- Response vessels

River Navigation

- River's infrastructure is deteriorating.
- Backlogged maintenance costs at more than \$1 billion. Should any lock or dam fail long-term, it could create havoc for U.S. commerce.
- In 2013, the American Society of Civil Engineers gave America's inland waterway system a grade of **D minus** for poor conditions and frequent delays.
- The Mississippi and Ohio river systems, two most vulnerable to an earthquake, account for a disproportionate number of delays.

Downstream from Impact Area

Management of river traffic

- Vessels that would have been going up stream
- Vessels operating in area
- Response vessels

Contaminates in the river

- Hazardous materials
- Debris
- Large volumes of soil/silt – i.e. sandbars, islands, landslides,

River channel conditions may be altered

- River channel could shift
- River depth subject to change

Earthquakes and Hazmat

What can we expect?



Secondary Hazards

- Landslides
- Liquefaction
- Disruption of ground water supplies
- Changes to river channels
- Hazardous Materials Release
- Localized flooding
- Fire
- Ground displacement – lateral spreading

Problems on a Good Day – *What if...*



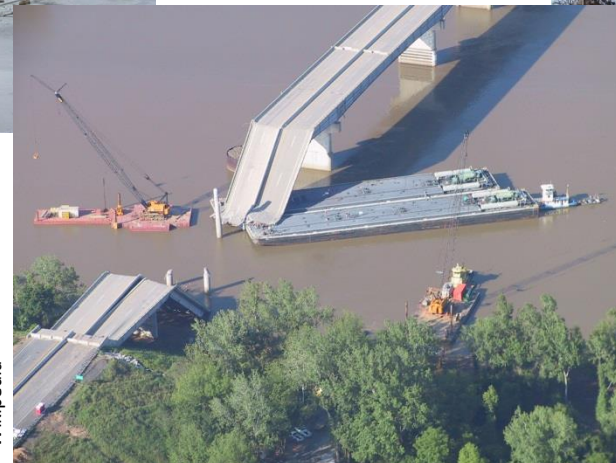
Lance Murphy – Commercial Appeal Photographer



J. Wilkinson CUSEC



J. Wilkinson CUSEC



Wikipedia



(d)



Cubrinovski, Green and others, 2010, Geotechnical Reconnaissance of the 2010 Darfield (Canterbury) Earthquake. Bulletin of the New Zealand Society for Earthquake Engineering, v. 43, no. 4.

Cubrinovski, Misko, "Liquefaction-Induced Damage in The2010-2011 Christchurch (New Zealand) Earthquakes" (2013). International Conference on Case Histories in Geotechnical Engineering. 1.
<https://scholarsmine.mst.edu/icchge/7icchge/session12/1>





Cubrinovski, Green and others, 2010, Geotechnical Reconnaissance of the 2010 Darfield (Canterbury) Earthquake. Bulletin of the New Zealand Society for Earthquake Engineering, v. 43, no. 4.

Cubrinovski, Misko, "Liquefaction-Induced Damage in The 2010-2011 Christchurch (New Zealand) Earthquakes" (2013). International Conference on Case Histories in Geotechnical Engineering. 1. <https://scholarsmine.mst.edu/icchge/7icchge/session12/1>

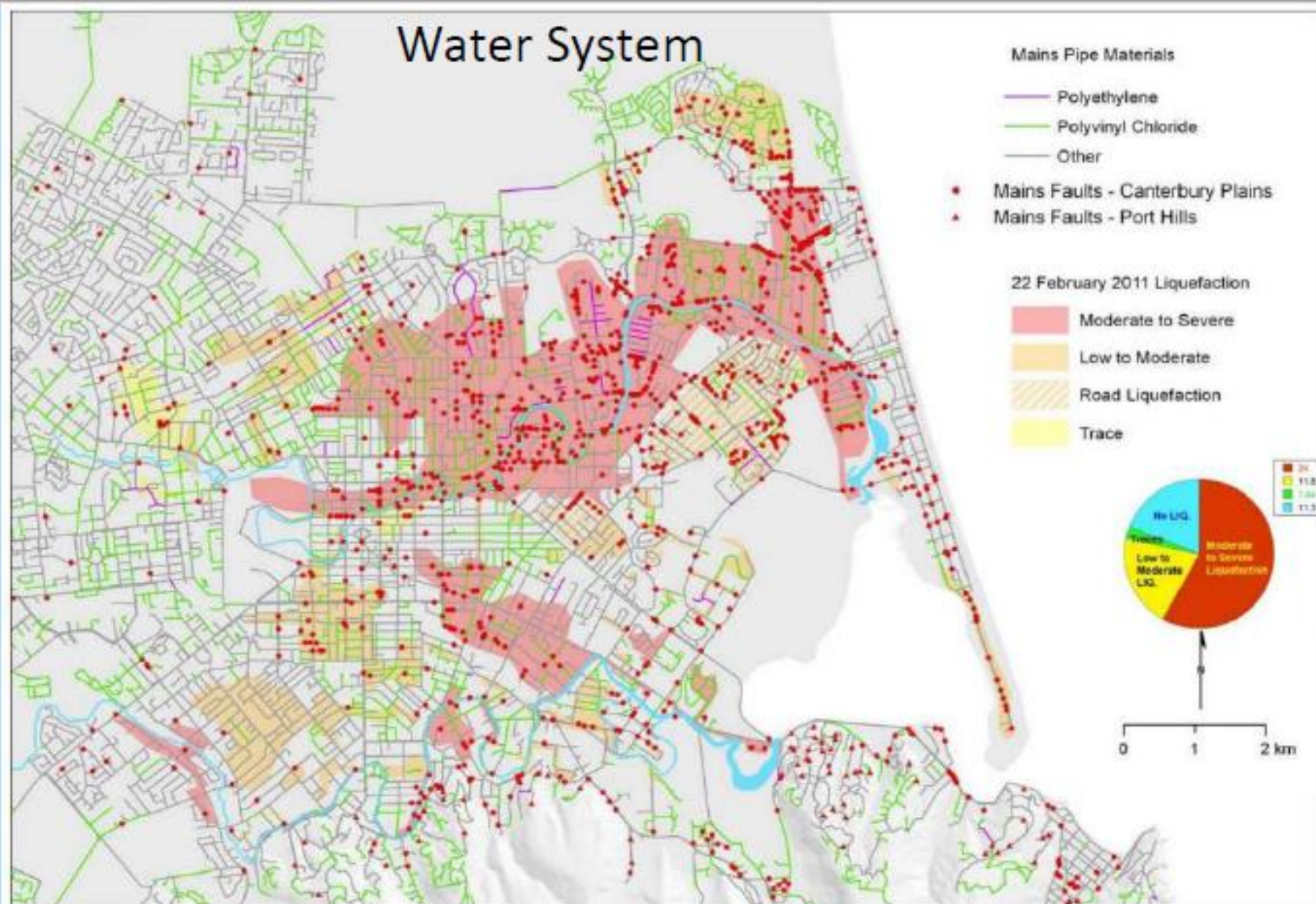


Figure 17. Locations of repairs/faults (red symbols) on the Christchurch watermains network and areas of liquefaction following the 22 February 2011 earthquake

Cubrinovski and others, 2011, Liquefaction Impacts on Pipe Networks, Research Report 2011-04 Civil & Natural Resources Engineering, University of Canterbury, Christchurch, NZ

Response Challenges

- Differing priorities/mandates
- Damage over a **large geographical area**
 - Multiple jurisdictions requesting aid
 - Differing needs/level of response needed
- **Disruption to the infrastructure**
 - **Slows response**
 - **Restricts access**
- Hazardous conditions
- Adjudication of resources -Just not enough to go around
 - Tents
 - Generators
 - Food/Water
 - Repair Specialist



Anchorage Alaska 2018
Magnitude 7.1



Anchorage Alaska 2018
Magnitude 7.1

Anchorage Alaska 2018
Magnitude 7.1



What's Vulnerable?

Anything not built to a current seismic standard!

- Power plants
- **Industrial facilities**
- Levees
- Retention ponds
 - Coal Ash Ponds
- Tank Farms
- **Pipelines**
- Ports
- Cities
- Anything located along or across the river systems
- Navigable waterways now managed by levees, dams, locks



Bootheel
Gymnastics Center



Cargill

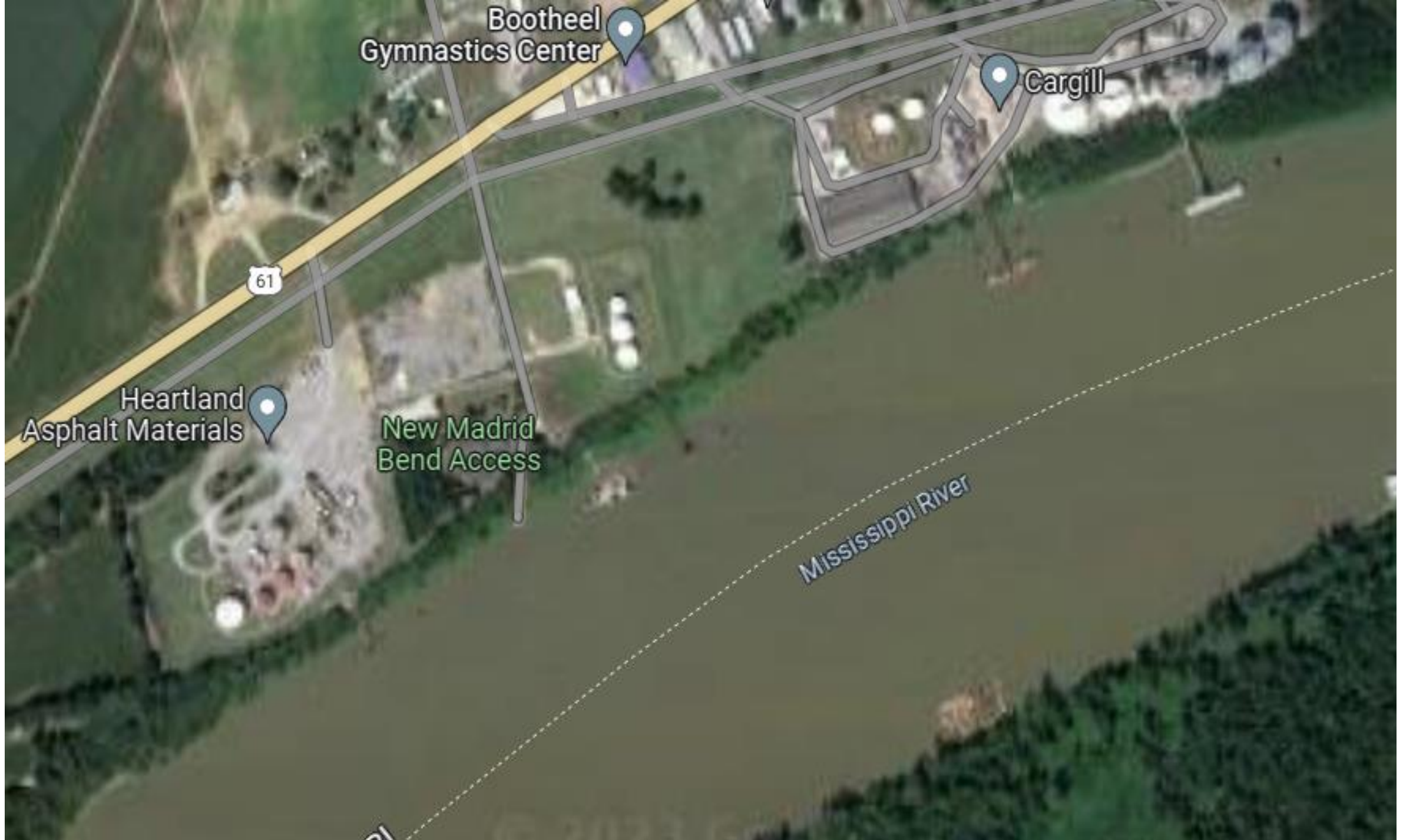
61

Heartland
Asphalt Materials



New Madrid
Bend Access

Mississippi River





SEMO Milling, LLC



Girardeau Stevedores



Consolidated Grain
and Barge Co



Missouri Fibre
Corporation



Cape LaCroix
Creek

River Rd

Harbor Rd

Nash Rd

Bill Bess Dr

Nash Rd

E Rd

Riceland Foods



New Madrid Power Plant



Magnitude 7 Metals



Alubar Metals Missouri



KENTUCKY
MISSOURI

Mississippi River





Cape Girardeau – Trans Montaigne



Cape Girardeau –
Waste Water
Treatment &
Agricultural Facility





Cape
Girardeau-
Petroleum
Storage
Facility



Buzzi Unicem / Lone Star



Risk Factors for Chemical Release

- Location
 - How close to the earthquake
 - High Population Density near Industry
- Structures
 - Inadequate planning / Not seismic resistant
- Preparedness
 - Industry not prepared to respond to earthquake-induced hazards at their facility.



Reduced Response Capacity

- Increased Risk for Hazmat Release
- Damage to on-site Safety & Emergency Equipment
- Emergency response personnel and other resources may not be available

Most Vulnerable Areas

- Sites where chemicals are produced and stored
- **Chemical Storage Tanks**
- Piping
- Oil and Gas Pipelines
- Containment Failure



Industrial Sites

- Multiple Simultaneous releases at single sites and throughout industrial areas.
- Ruptures in Pipelines / Connections
- Buckling / Rupture of storage vessels
- Liquid Sloshing – Tank Damage and Failure
- Damage to the power supply
 - Process upsets and safety equipment failure



Warehouses and Storage

- Drums / Barrels / Sacks
 - Tipping and Falling over
 - Building Collapse / Falling Debris
 - Toxic Reaction Products
 - Fire / Explosions



Damage to Industrial Sites Along Major Rivers Will Result in Secondary Hazards



A number of factories were severely damaged in Sendai, northern Japan *Image: AP*



EPA Office of Water (4608T) | EPA 810-B-18-001 March 2018

Photo - Rick Loomis/ Los Angeles Times



Figure 9. Spilled oil inundated a refinery area in Sendai at the 1978 Miyagi Earthquake (Courtesy of Kahoku Simpo Publishing Co.)

Fires / Dust / Toxic Fumes

- Ignition of Fuel Storage Tanks
- Gas main ruptures
- Building fires
 - Can release Dust, Asbestos, and Fiberglass into the air.
- Tank farm fires
 - Can burn for days causing toxic air





Clean-up Operations

- Asbestos Cement
 - Sawing, Breaking, and Moving can release fibers into the air
- People and workers are susceptible to exposure while cleaning up the mess.

Health Hazards

- Burns – Fire and Chemical
- Respiratory Tract Injuries
- CO Poisoning – heating and cooking unsafely
- Chemical Poisoning
- Worker Injury **Poisoning**
 - Loma Prieda Earthquake - 1989
 - 20% of work-related injuries were caused by exposure to hazardous materials.



Transportation

- Roadways
 - Tipping and Collisions of Chemical Tank Trucks – Rupture and Releases
- Railways
 - Damaged tracks
 - Derailments involving hazardous materials
- Barges
- Direct/Indirect Loss of life
 - Delays in response

Alaska Earthquake 1964





Barge Railroad Collison in Galland Iowa.

[Mississippi River Barge and Train Collide \(ntsb.gov\)](https://www.nts.gov/press-releases/mississippi-river-barge-and-train-collide)



1993 West
Quincy,
Missouri levee
failure

[Causing a
Catastrophe -
Stories by
weather.com |
The Weather
Channel](#)

1993 West Quincy, Missouri levee failure

- Barge crashed into a gas station
- 14,000 Acres of farmland ,and local business were flooded.
- Town was flooded with several feet of flood water.
- Killed 30 people, 100,000 homes destroyed, and approximately 15 million acres of farmland was flooded.





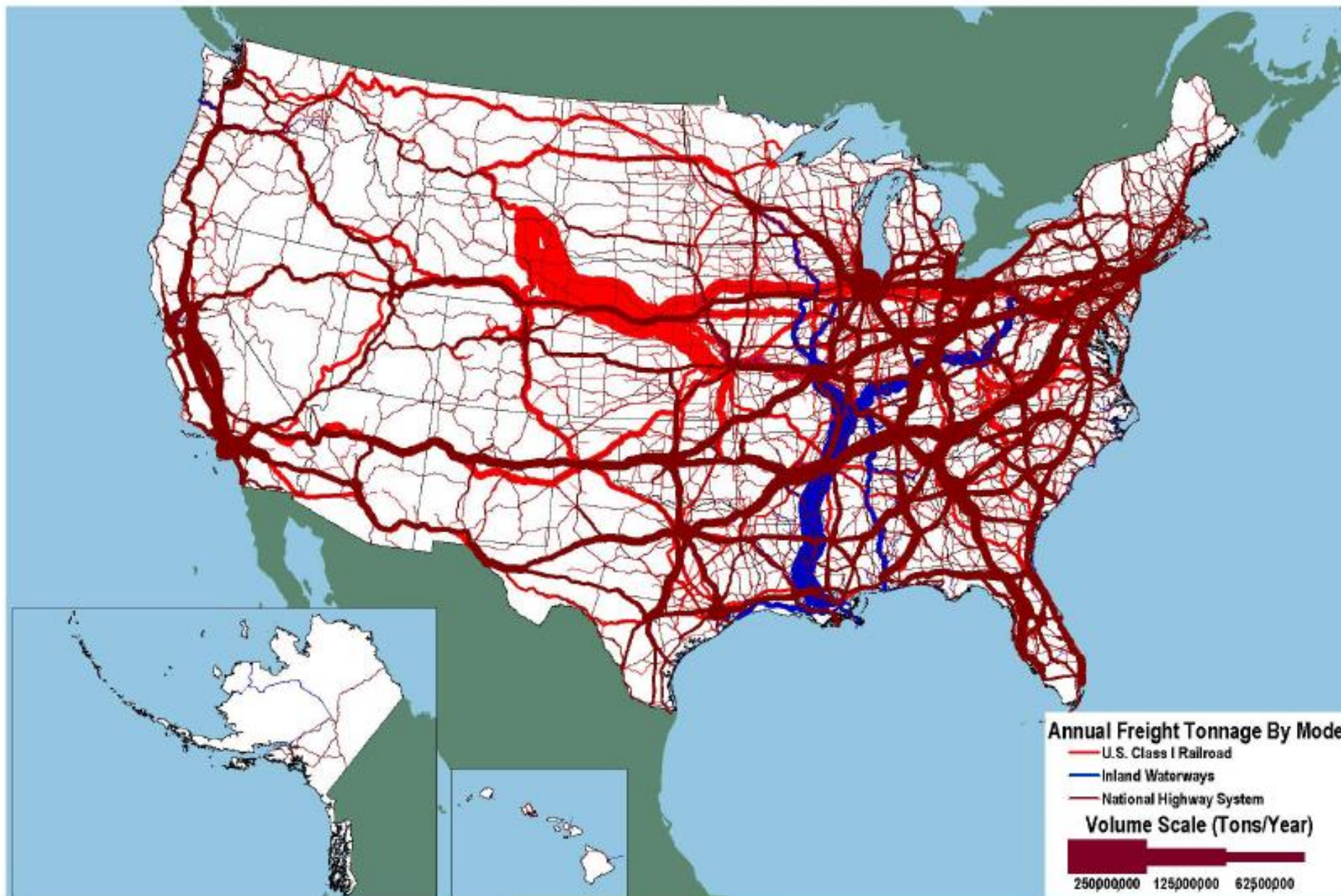
Crude oil barges hit Mississippi River bridge and caught fire.
[Crude oil barges hit Mississippi River bridge and catch fire \(actionnews5.com\)](http://actionnews5.com)



Crude oil barges hit Mississippi River bridge and caught fire



Tonnage on Highways, Railroads and Inland Waterways: 2002



Sources: Highways: U.S. Department of Transportation, Federal Highway Administration, Freight Analysis Framework, Version 2.2, 2007. Rail: Based on Surface Transportation Board, Annual Carload Waybill Sample and rail freight flow assignments done by Oak Ridge National Laboratory. Inland Waterways: U.S. Army Corps of Engineers (USACE), Annual Vessel Operating Activity and Lock Performance Monitoring System data, as processed for USACE by the Tennessee Valley Authority; and USACE, Institute for Water Resources, Waterborne Foreign Trade Data, Water flow assignments done by Oak Ridge National Laboratory.

Pipelines

- Older pipelines susceptible
- The NMSZ contains many large liquid and gas transmission lines.
- We would expect multiple line breaks and problems across the region after a major earthquake.



Questions?