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16. Abstract

Every day almost a million shipments of hazardous materials move safely and securely along our nation's transportation system, via any combination of modes. Only a small fraction of total shipments interrupt their planned journey due to an incident that may severely threaten public and environmental safety. However, this threat of very rare but very severe, sometimes even catastrophic, consequences elevates the concern over transportation of hazardous materials through population centers. Furthermore, concern now exists over possible intentional hazmat releases and their use as a means to invoke human, economic, and environmental damage.

It is vital for the transportation planning community at all levels to fully understand methods to effectively manage the movement of hazardous materials thereby improving incident prevention and mitigation, increasing public safety, and reducing risk, without undue burden to commerce. This report strives to provide an overview of the movement of hazardous materials by the various freight modes, details some of the data related to the movement of hazardous materials in Texas, and examines the issues and opportunities related to relocating hazardous materials outside urban areas.

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UNDERSTANDING AND MANAGING THE MOVEMENTS OF HAZARDOUS MATERIAL SHIPMENTS THROUGH TEXAS POPULATION CENTERS

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DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data, opinions, findings, and conclusions presented herein. The contents do not necessarily reflect the official view or policies of the Texas Department of Transportation (TxDOT), Federal Highway Administration (FHWA), The Texas A&M University System, or the Texas Transportation Institute (TTI). This report does not constitute a standard, specification, or regulation. In addition, the above listed agencies assume no liability for its contents or use thereof.

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TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

CHAPTER 1: INTRODUCTION TO THE MOVEMENT OF HAZARDOUS MATERIALS

BACKGROUND

Vital aspects of everyday life depend heavily on products officially classified as hazardous materials. The term "hazardous materials," or hazmat for short, generally refers to hazardous substances, such as petroleum, natural gas, synthetic gas, acutely toxic chemicals, and other toxic chemicals. Their uses range from everyday household and personal uses to industrial production at various stages, for example from drinking water purification to automotive fuel.

Every day almost a million shipments of hazardous materials move safely and securely along our nation's transportation system, via any combination of modes. Only a small fraction of total shipments interrupt their planned journey due to an incident that may severely threaten public and environmental safety. However, this threat of very rare but very severe, sometimes even catastrophic, consequences elevates the concern over transportation of hazardous materials through population centers. Citizens and officials are increasingly concerned about highway and rail incidents, as well as fixed facility incidents happening in their communities. Recent evidence shows that many people consider hazardous materials incidents to be the most significant threat facing local jurisdictions (*1*). Furthermore, concern now exists over possible intentional hazmat releases and their use as a means to invoke human, economic, and environmental damage.

It is vital for the transportation planning community at all levels to fully understand methods to effectively manage the movement of hazardous materials thereby improving prevention and mitigation operations, increasing safety, and reducing risk, without undue burden to commerce. This research:

- examines the quantities, origins, and destinations of hazardous materials flows in Texas by mode of transportation;
- reviews the respective roles of the several stakeholders;
- investigates the hazmat route relocation potential of multimodal corridors and other rail routes; and
- provides guiding principles on effective state and sub-state level management of hazardous materials movements.

Hazardous Materials Transportation Facts

Shipment facts, according to the Hazardous Materials section of the latest (2002) Commodity Flow Survey (CFS), place Texas at the top of both origin and destination states of hazardous materials shipments, as demonstrated in Table 1 (*2*).

Table 1. 2002 CFS – National and Texas Hazardous Materials Shipments.

Hazardous Materials Shipments	Value (million $)	Tons (thousands)	Ton-miles (millions)	Average miles per shipment
U.S. Total	660,181	2,191,519	326,727	136
Origin: Texas	127,188 (19.3%)	467,196 (21.3%)	72,291 (22.1%)	138
Destination: Texas	120,183 (18.2%)	459,432 (21.0%)	57,616 (17.6%)	151

Modal and hazard class break downs are only available on a nationwide basis, in the national section of the CFS. Highways (trucks) transported roughly 1.2 billion tons (or about 53 percent) of the total 2.2 billion tons of hazardous materials shipped in the U.S in 2002. In terms of ton-miles, trucks accounted for 110 billion ton-miles (34 percent) of the total 327 billion ton-miles of hazardous materials transported in the U.S. in 2002. The numbers show that hazardous materials transportation by rail is a distant second in terms of value and tons. Rail does not fall as far behind truck though in terms of ton-miles, which agrees with the long haul characteristics of general freight rail transportation. Table 2 presents the modal breakdown.

Table 2. 2002 CFS - National Hazardous Materials Shipments by Mode.

Hazardous Materials Shipment Mode	Value (million $)	Tons (thousands)	Ton-miles (millions)	Average miles per shipment
U.S. Total	660,181	2,191,519	326,727	136
Truck	419,630 (63.6%)	1,159,514 (52.9%)	110,163 (33.7%)	86
Rail	31,339 (4.7%)	109,369 (5.0%)	72,087 (22.1%)	695
Water	46,856 (7.1%)	228,197 (10.4%)	70,649 (21.6%)	--
Air (incl. truck & air)	1,643 (0.2%)	64 (~0%)	85 (~0%)	2,080
Pipeline	145,021 (22.0%)	661,390 (30.2%)	--	--

Table 3 shows that of the 2.2 billion tons of hazardous materials transported nationally, the majority represents a small subset of all hazardous materials classes. National hazardous materials shipments place flammable liquids (e.g., crude oil, diesel fuel, gasoline) on top of the hazardous materials list, with over 80 percent of the total tons, over 65 percent of the total ton-miles, and almost 75 percent of the total value. Gases, such as chlorine, generally place at a

distant second, with the remaining hazmat classes totaling less than 10 percent of the tons transported.

Table 3. 2002 CFS - National Hazardous Materials Shipments by Hazard Class.

Hazard Class & Description	Value (million $)	Tons (thousands)	Ton-miles (millions)	Average miles per shipment
U.S. Total	660,181	2,191,519	326,727	136
Class 1. Explosives	7,901 (1.2%)	5,000 (0.2%)	1,568 (0.5%)	651
Class 2. Gases	73,932 (11.2%)	213,358 (9.7%)	37,262 (11.4%)	95
Class 3. Flammable Liquids	490,238 (74.3%)	1,788,986 (81.6%)	218,574 (66.9%)	106
Class 4. Flammable Solids	6,566 (1.0%)	11,300(0.5%)	4,391 (1.3%)	158
Class 5. Oxidizers & Organic Peroxides	5,471 (0.8%)	12,670 (0.6%)	4,221 (1.3%)	407
Class 6. Toxic (Poison)	8,275 (1.3%)	8,459 (0.4%)	4,254 (1.3%)	626
Class 7. Radioactive Materials	5,850 (0.9%)	57 (~0%)	44 (~0%)	--
Class 8. Corrosive Materials	38,324 (5.8%)	90,671 (4.1%)	36,260 (11.1%)	301
Class 9. Miscellaneous	23,625 (3.6%)	61,018 (2.8%)	20,153 (6.2%)	368

Glossaries from the 2008 Emergency Response Guidebook and the U.S. DOT Pipeline and Hazardous Material Safety Administration (PHMSA) are provided in Appendices A and B to help better understand many of the hazardous materials-specific language used in this report. Additionally, for a detailed description of each hazard class, see Appendix C.

Everyday Hazmat

Hazardous materials are not only found in businesses and factories; we all buy and use them every day at home. Many cleaners, fertilizers, pesticides, home maintenance, pool care, fuels, and a host of other products are the same materials, and just as hazardous, as the highly regulated hazardous materials used commercially. Those in our homes are simply not regulated because they do exist in quantities large enough to pose a serious risk to ourselves or to others. Some chemical names and their everyday uses include:

- adiponitrile (insecticide);
- ammonia (fertilizers, pesticides, detergents, plastics, dyes, textiles);
- bisphenol A (used in production of plastics);

- chlorine (disinfectant, bleaching products, water purification, wastewater treatment);
- formaldehyde (preservative, nail polish);
- hydrogen fluoride (production of other chemicals e.g., gasoline, etching glass);
- hydroquinone (photo developer);
- methyl bromide (refrigerant);
- nitric acid (for etching steel);
- paraquat (herbicide);
- phenol (disinfectant);
- sulfuric acid (used in batteries);
- sulfur dioxide (food additive); and
- dry cleaning materials.

ORGANIZATION OF THE REPORT

The goals of the project were to examine the quantities, origins, and destinations of hazardous materials flows in Texas and the roles of stakeholders; provide guiding principles on effective management of hazardous materials movements; and investigate the potential for route-relocations of truck and rail routes. This report addresses these goals in Chapter 1 with a description of what hazardous materials are defined, along with some statistics and information to further the understanding of the transport of hazardous materials. Chapter 2 details the data evaluation undertaken by this project. In Texas hazardous materials are moved by multiple modes of freight transportation throughout the entire state.

Chapter 3 provides information related to the planning for the movement of hazardous materials in Texas. It discusses the stakeholders involved, and most importantly, the strategies available for the management of hazardous material movements. Chapter 4 discusses, in more detail, the challenges and opportunities to relocating hazardous material movements outside urban areas, either on existing infrastructure or new infrastructure. Chapter 5 provides a discussion of the conclusions from this research effort.

Finally, several appendices are included that provide more detailed information discussed in the report or provide reference material to better understand the topic. The appendices include:

- Appendix A: 2008 Emergency Response Guidebook Glossary;

- Appendix B: U.S. DOT Pipeline and Hazardous Material Safety Administration (PHMSA) Glossary;
- Appendix C: Hazard Classification System;
- Appendix D: Hazmat 7-digit STCC Code Description;
- Appendix E: Texas Non-Radioactive Hazardous Materials Routes; and
- Appendix F: Texas Administrative Code – Hazardous Material Routing Designation.

CHAPTER 2: DATA EVALUATION

This chapter details the movement of hazardous materials in Texas by multiple data sources for the different freight modes utilized in Texas. In addition, there is an evaluation of the incidents involving hazardous materials in the U.S. and Texas.

MOVEMENT OF HAZARDOUS MATERIALS BY RAIL

The 2005 Carload Waybill Sample for Texas was obtained for use in this project from the Surface Transportation Board (STB), through the Texas Department of Transportation (TxDOT). The dataset was reduced to those waybills that involved hazardous materials, i.e., commodity code starting with "49." The hazmat waybills were classified into four types of movements defined with respect to the state of Texas for easier understanding of facts and trends: internal, through, originating, and terminating.

Top 10 Hazmat by Rail – State Level

The following table and figures (Table 4 and Figure 1 through Figure 5) show the top 10 hazardous materials in terms of tonnage for each movement separately and for all movements grouped together. The commodity descriptions "Freight forwarder traffic" and "All freight rate shipments" refer to break-bulk hazmat and do not identify an individual commodity simply because the nature of the cargo physically allows for the presence of more than one commodity on the same carload/waybill. Appendix D contains complete descriptions of each commodity in the Waybill hazmat subset by its 7-digit Standard Transportation Commodity Code (STCC7).

In 2005, close to 35 million tons were transported on rail lines in the state of Texas, 43 percent of which was originating tonnage, 25 percent was terminating tonnage, roughly 20 percent was through tonnage, and less than 20 percent was internal tonnage. Since Texas is a primary producer and refiner of petroleum, it is not surprising that petroleum and related products are dominant in internal, originating, or terminating movements. On the contrary, "Freight forwarder traffic" (break-bulk) dominated in through movements. Ethyl alcohol (or ethanol) had the second highest tonnage in through movements and implying that production and consumption of ethanol primarily occurs outside Texas. Chlorine gas tonnage was fourth in terminating movements implying that it is produced outside Texas, but used heavily within the state.

Table 4. Top 10 Hazmat by Rail – Texas 2005.

RANK	INTERNAL			THROUGH			ORIGINATING			TERMINATING			ALL MOVEMENTS		
	STCC7	COMMODITY	TONS	STCC7	COMMODITY	TONS	STCC7	COMMODITY	TONS	STCC7	COMMODITY	TONS	STCC7	COMMODITY	TONS
1	2813966	VINYL CHLORIDE	424,040	4411110	FRT FORWDR TRAF	1,424,624	2911315	PETROLEUM FUEL	915,400	2912190	PETRO GAS LQD	1,005,740	2912190	PETRO GAS LQD	2,082,512
2	2912190	PETRO GAS LQD	320,168	2818446	ETHYL ALCOHOL	954,744	2899991	CHEMICALS, NEC	699,840	1471620	SULPHUR LIQUID	715,039	4411110	FRT FORWDR TRAF	1,899,224
3	2812220	CAUSTIC SODIUM	314,960	4611110	ALL FRT RATE SH	458,160	2813966	VINYL CHLORIDE	649,820	2912128	PROPYLENE	666,880	2813966	VINYL CHLORIDE	1,295,460
4	2911791	PETRO OIL NEC	237,200	2818490	ALCOHOLS,NEC	314,480	2818668	VINYL ACETATE	572,360	2812815	CHLORINE GAS	569,120	2899991	CHEMICALS, NEC	1,233,120
5	2819315	SULPHURIC ACID	185,120	2912190	PETRO GAS LQD	269,620	2911610	ASPH PETRO LIQ	569,424	2819315	SULPHURIC ACID	362,252	1471620	SULPHUR LIQUID	1,193,540
6	2819330	ACID,SULPH SPNT	152,880	2812220	CAUSTIC SODIUM	209,960	2818342	STYRENE, LIQUID	558,600	2911610	ASPH PETRO LIQ	274,196	2812220	CAUSTIC SODIUM	1,047,720
7	2912122	BUTENE/BUTYLENE	149,720	2813966	VINYL CHLORIDE	204,080	2818546	ETHYLENE GLYCOL	541,300	2813320	CARBON DIOXIDE	250,372	2911610	ASPH PETRO LIQ	1,034,196
8	1471620	SULPHUR LIQUID	147,120	2899991	CHEMICALS, NEC	193,280	2912190	PETRO GAS LQD	486,984	2899991	CHEMICALS, NEC	240,640	2818446	ETHYL ALCOHOL	1,030,452
9	2818644	ACETIC ANHYD	146,480	2819815	AMMONIA ANHYDRS	148,232	2812220	CAUSTIC SODIUM	425,280	2911791	PETRO OIL NEC	218,676	2911315	PETROLEUM FUEL	1,006,920
10	2818144	FORMALDEHYDE	146,320	2819450	MURIATIC ACID	145,560	2818692	ACRYLIC ACID	386,640	4411110	FRT FORWDR TRAF	189,200	2812815	CHLORINE GAS	817,280
TOTAL TONS		TOP 10	2,224,008			4,322,740			5,805,648			4,492,115			12,640,424
		ALL	4,706,728			6,353,428			15,005,965			8,544,991			34,611,112
TOP 10 AS % OF ALL TONS BY MVT			47%			68%			39%			53%			37%
ALL BY MVT AS % OF ALL MVTS			14%			18%			43%			25%			100%

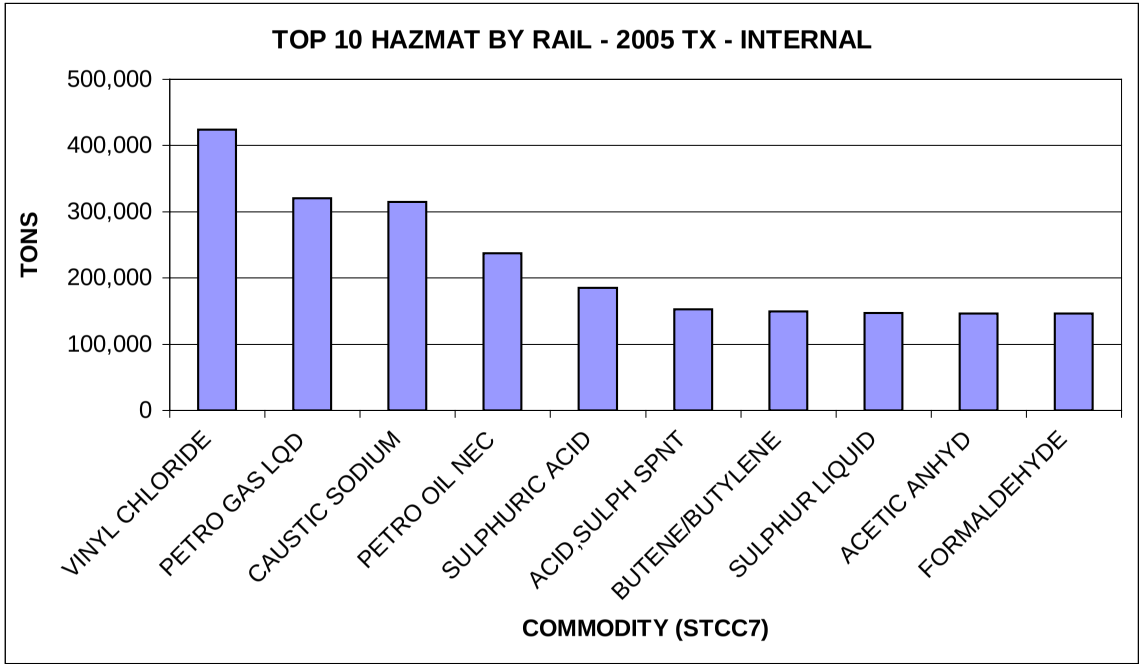

Figure 1. Top 10 Hazmat by Rail – Texas 2005 – Internal.

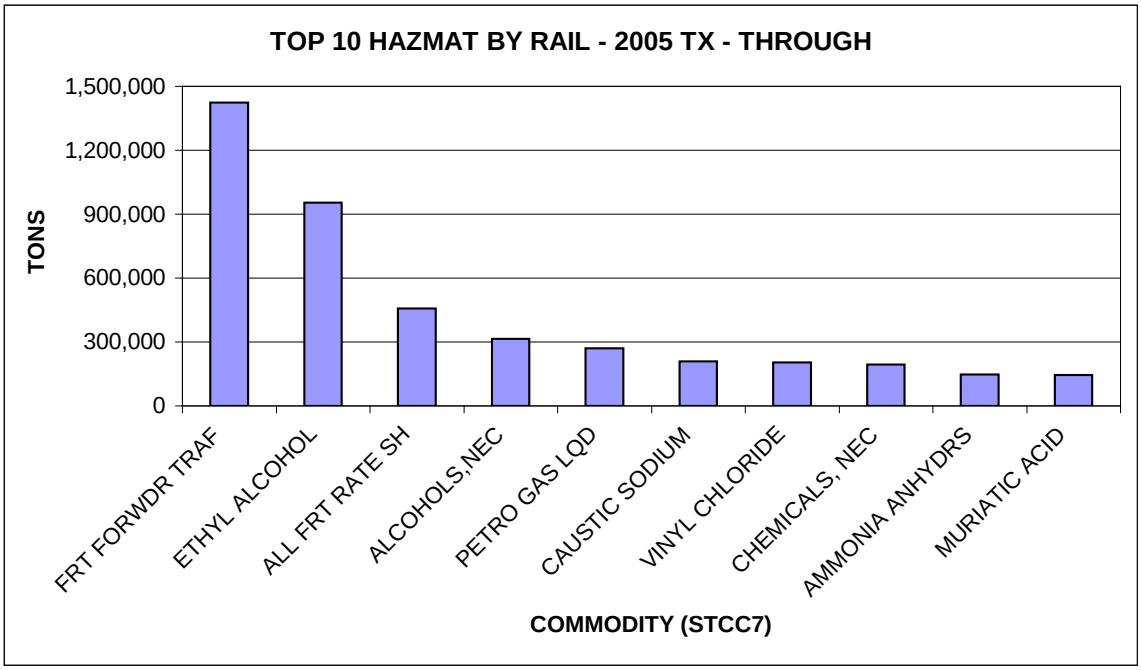

Figure 2. Top 10 Hazmat by Rail – Texas 2005 – Through.

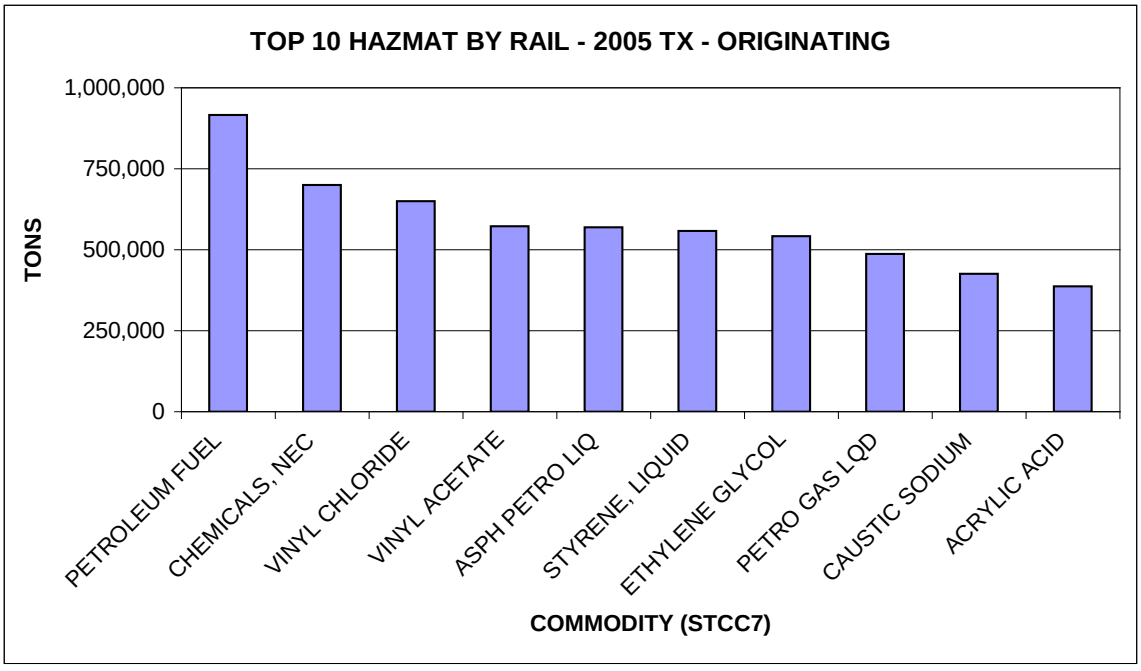

Figure 3. Top 10 Hazmat by Rail – Texas 2005 – Originating.

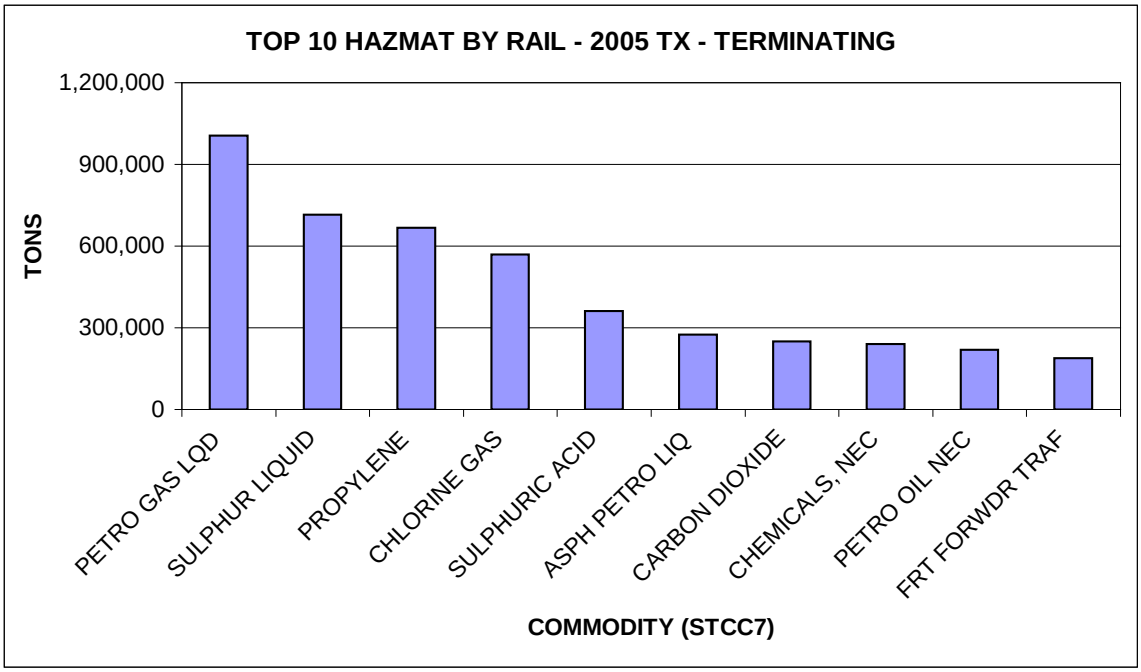

Figure 4. Top 10 Hazmat by Rail – Texas 2005 – Terminating.

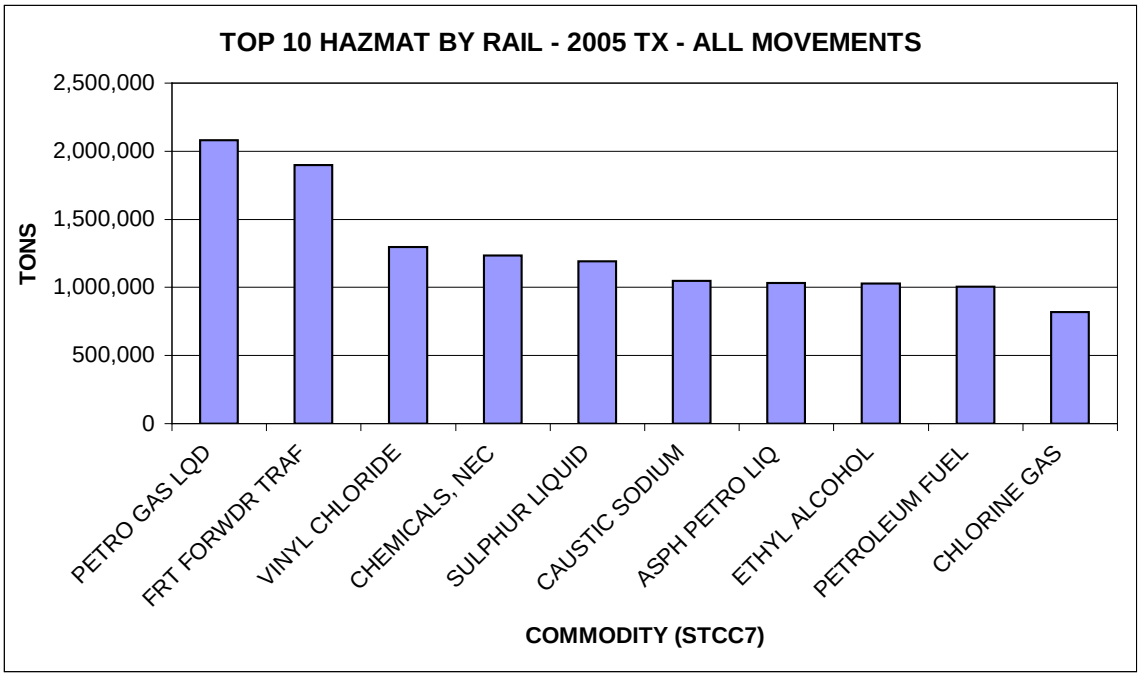

Figure 5. Top 10 Hazmat by Rail – Texas 2005 – All Movements.

Top 5 Origin & Destination Counties with Top 5 Commodities (Tons) by Movement

The 2005 Carload Waybill Sample for Texas was further analyzed and scrutinized to disaggregate and distinguish among all four movements in order to avoid double counting, in contrast to past studies. As mentioned above, the Waybills were grouped into four types of movements with respect to the state of Texas: internal (TX-TX), through (non TX-non TX), originating (TX-non TX), and terminating (non TX-TX). Within each of the four types of movements, the top 5 origin counties as well as the top 5 destination counties in terms of total tonnage were identified. Then the top 5 hazmat commodities in terms of tonnage for each of the top 5 origin or top 5 destination counties were identified. Table 5 through Table 8 tabulates the detailed results in three-dimensional format along with some basic statistics. Following the figures, Figure 6 through Figure 13, show the same data in a two-dimensional format for enhanced clarity, i.e., only the top 5 origin and the top 5 destination counties with their respective rail tonnage, by type of movement.

As expected, the counties in the Houston area shipped and/or received the highest hazmat tonnage by rail in internal, originating, and terminating movements, due to the heavy presence of petrochemical or other industrial facilities. Similarly, top-ranked counties out of state are centroids for shipping/producing and/or receiving/consuming hazmat due to high densities of petrochemical or other industrial facilities, as shown by the originating, terminating, and through movement data.

Table 5. Top 5 Origin & Destination Counties and Top 5 Commodities – Internal.

HAZMAT BY RAIL - TEXAS 2005 - INTERNAL

		CO FIPS	COUNTY	COMMODITY														TOTAL TONS		
				1			2			3			4			5					
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TOP 5	ALL	PERCENT
ORIGINS	1	48201	HARRIS	146,600	2912122	BUTENE/BUTYLENE	134,160	2812220	CAUSTIC SODIUM	110,920	2911982	NAPHTHA,PETROLM	103,120	2912190	PETRO GAS LQD	70,640	2818239	ETHYLENE OXIDE	565,440	1,684,960	34%
	2	48409	SAN PATRICIO	388,520	2813966	VINYL CHLORIDE	49,400	2819450	MURIATIC ACID	3,400	2813990	COMPRESSED GAS	3,200	2813984	FLUORETHANE GAS	--			444,520	444,520	100%
	3	48245	JEFFERSON	150,200	2819315	SULPHURIC ACID	47,080	2819330	ACID,SULPH SPNT	41,640	2818239	ETHYLENE OXIDE	38,440	2818292	METHYLMERCAPTOP	23,840	2818195	ISOPRENE	301,200	407,236	74%
	4	48039	BRAZORIA	104,400	2812220	CAUSTIC SODIUM	69,280	2818265	PROPYLENE OXIDE	42,160	2812815	CHLORINE GAS	25,200	2815124	NONYL PHENOL	24,240	2899850	RUST PREV CPD	265,280	351,240	76%
	5	48183	GREGG	104,560	2911791	PETRO OIL NEC	91,360	2912190	PETRO GAS LQD	43,120	2818427	OCTYL ALCOHOL	15,440	2818299	OCTANAL	14,040	2818103	ACETALDEHYDE	268,520	283,080	95%
	TOTAL TONS		TOP 5																1,844,960	3,171,036	58%
			ALL																1,481,488	4,706,728	31%

		CO FIPS	COUNTY	COMMODITY														TOTAL TONS		
				1			2			3			4			5					
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TOP 5	ALL	PERCENT
DESTINATIONS	1	48201	HARRIS	140,160	2911791	PETRO OIL NEC	112,320	2818644	ACETIC ANHYD	86,680	2912190	PETRO GAS LQD	80,600	2819315	SULPHURIC ACID	71,640	2812220	CAUSTIC SODIUM	491,400	1,521,520	32%
	2	48039	BRAZORIA	416,960	2813966	VINYL CHLORIDE	88,200	2818144	FORMALDEHYDE	69,320	2912190	PETRO GAS LQD	46,200	2912122	BUTENE/BUTYLENE	38,440	2818292	METHYLMERCAPTOP	659,120	814,720	81%
	3	48245	JEFFERSON	139,480	2819330	ACID,SULPH SPNT	35,280	2819315	SULPHURIC ACID	29,840	2912122	BUTENE/BUTYLENE	24,520	2818036	ISOPRENE STL BO	23,840	2818195	ISOPRENE	252,960	406,372	62%
	4	48167	GALVESTON	143,200	1471620	SULPHUR LIQUID	69,120	2911791	PETRO OIL NEC	15,440	2818299	OCTANAL	15,280	2818427	OCTYL ALCOHOL	10,200	2818044	HXAMTYLNDISOCYN	253,240	297,316	85%
	5	48141	EL PASO	74,972	2912190	PETRO GAS LQD	34,160	2818644	ACETIC ANHYD	26,440	2819315	SULPHURIC ACID	19,920	2812220	CAUSTIC SODIUM	17,840	2911610	ASPH PETRO LIQ	173,332	191,092	91%
	TOTAL TONS		TOP 5																1,830,052	3,231,020	57%
			ALL																1,481,488	4,706,728	31%

Table 6. Top 5 Origin & Destination Counties and Top 5 Commodities – Through.

HAZMAT BY RAIL - TEXAS 2005 - THROUGH

		CO FIPS	COUNTY, STATE	COMMODITY														TOTAL TONS		
				1			2			3			4			5					
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TOP 5	ALL	PERCENT
ORIGINS	1	17031	COOK, IL	728,480	4411110	FRT FORWDR TRAF	261,800	4611110	ALL FRT RATE SH	33,240	2899991	CHEMICALS, NEC	28,440	2821140	POLYSTYRENE	20,280	3714230	AUTO.CRASH PROT	1,072,240	1,211,240	89%
	2	6037	LOS ANGELES, CA	261,160	4411110	FRT FORWDR TRAF	87,320	4611110	ALL FRT RATE SH	40,568	2912190	PETRO GAS LQD	33,600	2899991	CHEMICALS, NEC	29,760	2899320	FIREWORKS, NEC	452,408	584,088	77%
	3	22019	CALCASIEU, LA	196,960	2813966	VINYL CHLORIDE	60,800	2812220	CAUSTIC SODIUM	22,680	4029170	SLUDGE ACID	15,280	2815166	TOLUENE	11,320	2911791	PETRO OIL NEC	307,040	339,680	90%
	4	22005	ASCENSION, LA	105,760	2819450	MURIATIC ACID	75,680	2815127	METHYLENE DIPHE	19,040	2819454	PHOSPHORIC ACID	15,340	2819815	AMMONIA ANHYDRS	7,560	2815166	TOLUENE	223,380	267,940	83%
	5	17161	ROCK ISLAND, IL	220,320	2818446	ETHYL ALCOHOL	--			--			--			--			220,320	220,320	100%
	TOTAL TONS		TOP 5																2,275,388	2,623,268	87%
			ALL																3,421,628	6,353,428	54%

		CO FIPS	COUNTY, STATE	COMMODITY														TOTAL TONS		
				1			2			3			4			5					
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TOP 5	ALL	PERCENT
DESTINATIONS	1	6037	LOS ANGELES, CA	557,324	2818446	ETHYL ALCOHOL	461,040	4411110	FRT FORWDR TRAF	299,200	2818490	ALCOHOLS,NEC	209,320	4611110	ALL FRT RATE SH	114,920	2899991	CHEMICALS, NEC	1,641,804	2,331,944	70%
	2	4013	MARICOPA, AZ	262,992	2818446	ETHYL ALCOHOL	108,720	4411110	FRT FORWDR TRAF	33,680	4611110	ALL FRT RATE SH	32,012	2911610	ASPH PETRO LIQ	21,120	2912190	PETRO GAS LQD	458,524	549,740	83%
	3	17031	COOK, IL	220,320	4411110	FRT FORWDR TRAF	59,720	4611110	ALL FRT RATE SH	17,920	2911791	PETRO OIL NEC	17,760	2952270	ROOFING TAR	17,720	2899991	CHEMICALS, NEC	333,440	421,712	79%
	4	6013	CONTRA COSTA, CA	119,360	4411110	FRT FORWDR TRAF	71,440	4611110	ALL FRT RATE SH	46,964	2912190	PETRO GAS LQD	12,560	2912122	BUTENE/BUTYLENE	11,840	2912181	PETRO BYPRD,FFP	262,164	312,480	84%
	5	6071	SAN BERNARDINO, CA	160,320	4411110	FRT FORWDR TRAF	26,200	2819522	IRON CHLORIDE	23,600	2819450	MURIATIC ACID	12,016	2912190	PETRO GAS LQD	12,000	4611110	ALL FRT RATE SH	234,136	251,496	93%
	TOTAL TONS		TOP 5																2,930,068	3,867,372	76%
			ALL																3,421,628	6,353,428	54%

Table 7. Top 5 Origin & Destination Counties and Top 5 Commodities – Originating.

HAZMAT BY RAIL - TEXAS 2005 - ORIGINATING

		CO FIPS	COUNTY	COMMODITY															TOTAL TONS		
				1			2			3			4			5			TOP 5	ALL	PERCENT
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION			
ORIGINS	1	48201	HARRIS	882,360	2911315	PETROLEUM FUEL	384,720	2813966	VINYL CHLORIDE	346,240	2899991	CHEMICALS, NEC	344,280	2818112	METHYL MONOMER	341,680	2911982	NAPHTHA,PETROLM	2,299,280	6,923,496	33%
	2	48039	BRAZORIA	203,360	2818342	STYRENE, LIQUID	89,480	2818265	PROPYLENE OXIDE	88,360	2818692	ACRYLIC ACID	83,320	2899991	CHEMICALS, NEC	81,520	2812815	CHLORINE GAS	546,040	991,080	55%
	3	48245	JEFFERSON	264,160	2818546	ETHYLENE GLYCOL	109,000	2818265	PROPYLENE OXIDE	77,680	2818127	DIETHANOLAMINE	70,720	2843128	FATTY ALCOHOLS	63,200	2813950	METHYL MERCAPTA	584,760	940,360	62%
	4	48167	GALVESTON	172,520	2818342	STYRENE, LIQUID	105,760	2818668	VINYL ACETATE	97,372	2911983	ATE, GASOLINE BLEND	72,840	2818610	ACETIC ACID	48,960	2818429	PROPYL ALCOHOL	497,452	758,104	66%
	5	48183	GREGG	119,400	2818427	OCTYL ALCOHOL	97,560	2818416	BUTYL ALCOHOLS	97,120	2818103	ACETALDEHYDE	58,480	2818546	ETHYLENE GLYCOL	56,720	2818118	BUTYRALDEHYDE	429,280	682,680	63%
	TOTAL TONS		TOP 5																4,356,812	10,295,720	42%
			ALL																3,406,844	15,005,965	23%

		CO FIPS	COUNTY, STATE	COMMODITY															TOTAL TONS		
				1			2			3			4			5			TOP 5	ALL	PERCENT
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION			
DESTINATIONS	1	6037	LOS ANGELES, CA	156,560	4411110	FRT FORWDR TRAF	96,560	2899991	CHEMICALS, NEC	46,440	2912190	PETRO GAS LQD	35,520	2911610	ASPH PETRO LIQ	33,200	2812220	CAUSTIC SODIUM	368,280	895,160	41%
	2	17031	COOK, IL	133,000	2818668	VINYL ACETATE	52,640	2899991	CHEMICALS, NEC	41,040	2818547	GLYCOL BOTTOMS	29,120	2912122	BUTENE/BUTYLENE	26,040	2815127	METHYLENE DIPHE	281,840	807,040	35%
	3	--	CANADA	76,040	2818265	PROPYLENE OXIDE	67,600	2813966	VINYL CHLORIDE	50,520	2818132	ADIPONITRILE	48,880	2818668	VINYL ACETATE	44,400	2899991	CHEMICALS, NEC	287,440	669,680	43%
	4	21111	JEFFERSON, KY	227,600	2813966	VINYL CHLORIDE	153,520	2818112	METHYL MONOMER	99,240	2911985	BUTADIENE	72,760	2818115	ACRYLATES	43,280	2819484	HYDFLURIDE AN	596,400	631,200	94%
	5	22071	ORLEANS, LA	123,440	2818546	ETHYLENE GLYCOL	60,760	2818668	VINYL ACETATE	56,480	2819931	HYDROGEN PEROXI	50,520	1471620	SULPHUR LIQUID	44,520	2815127	METHYLENE DIPHE	335,720	528,120	64%
	TOTAL TONS		TOP 5																1,869,680	3,531,200	53%
			ALL																3,406,844	15,005,965	23%

Table 8. Top 5 Origin & Destination Counties and Top 5 Commodities – Terminating.

HAZMAT BY RAIL - TEXAS 2005 - TERMINATING

		CO FIPS	COUNTY, STATE	COMMODITY															TOTAL TONS		
				1			2			3			4			5			TOP 5	ALL	PERCENT
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION			
ORIGINS	1	--	CANADA	399,280	2912128	PROPYLENE	138,440	2911985	BUTADIENE	130,600	4025177	WST CHEM SOFFP	71,200	2911982	NAPHTHA,PETROLM	68,080	2818036	ISOPRENE STLBO	807,600	1,273,400	63%
	2	56013	FREMONT, WY	579,307	1471620	SULPHUR LIQUID	--			--			--			--			579,307	579,307	100%
	3	22019	CALCASIEU, LA	86,280	2812815	CHLORINE GAS	64,960	1471620	SULPHUR LIQUID	55,360	4025177	WST CHEM SOFFP	52,280	2818960	BUTADIENE	39,760	1321110	GASOLINE,NAT	298,640	522,080	57%
	4	22089	ST CHARLES, LA	162,040	2812815	CHLORINE GAS	113,080	2818292	METHYLMERCAPTOP	46,520	2911982	NAPHTHA,PETROLM	19,320	2819491	ACID INORGANIC	18,840	2843128	FATTY ALCOHOLS	359,800	403,000	89%
	5	17031	COOK, IL	88,080	4411110	FRT FORWDR TRAF	52,600	4611110	ALLFRT RATE SH	33,320	2912190	PETRO GAS LQD	24,920	2899991	CHEMICALS, NEC	20,600	2819315	SULPHURIC ACID	219,520	367,436	60%
	TOTAL TONS		TOP 5																2,264,867	3,145,223	72%
			ALL																3,319,031	8,544,991	39%

		CO FIPS	COUNTY	COMMODITY															TOTAL TONS		
				1			2			3			4			5			TOP 5	ALL	PERCENT
				TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION	TONS	STCC7	DESCRIPTION			
DESTINATIONS	1	48201	HARRIS	439,720	2812815	CHLORINE GAS	190,280	2912128	PROPYLENE	162,480	2911982	NAPHTHA,PETROLM	150,800	4025177	WST CHEM SOFFP	147,600	2911985	BUTADIENE	1,090,880	2,706,052	40%
	2	48071	CHAMBERS	710,220	2912190	PETRO GAS LQD	310,640	2912128	PROPYLENE	14,280	2912110	BUTANE GAS LQD	7,800	2912111	PROP GAS LQD	--			1,042,940	1,042,940	100%
	3	48167	GALVESTON	650,079	1471620	SULPHUR LIQUID	28,652	2813320	CARBON DIOXIDE	26,308	2911717	FUEL OIL BNKR C	18,280	2899991	CHEMICALS, NEC	14,200	2814168	TRIPROPYLENE	737,519	805,367	92%
	4	48039	BRAZORIA	113,080	2818292	METHYLMERCAPTOP	49,000	2818239	ETHYLENE OXIDE	42,280	2814168	TRIPROPYLENE	29,360	2818043	PROPYLN TETRAMR	28,800	2899991	CHEMICALS, NEC	262,520	432,728	61%
	5	48245	JEFFERSON	68,080	2818036	ISOPRENE STLBO	64,960	1471620	SULPHUR LIQUID	40,560	2813992	HYDROCARBON GAS	27,040	2912181	PETRO BYPRD,FFP	23,000	2912190	PETRO GAS LQD	223,640	392,344	57%
	TOTAL TONS		TOP 5																3,357,499	5,379,431	62%
			ALL																3,319,031	8,544,991	39%

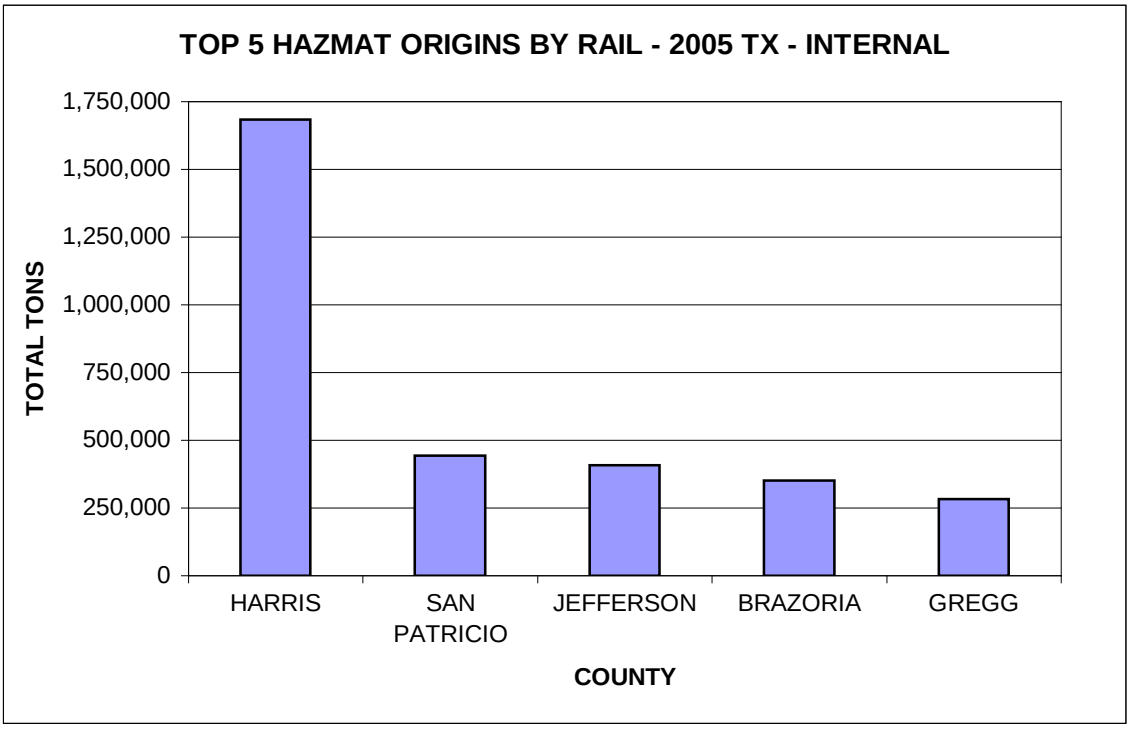

Figure 6. Top 5 Origin Counties – Internal.

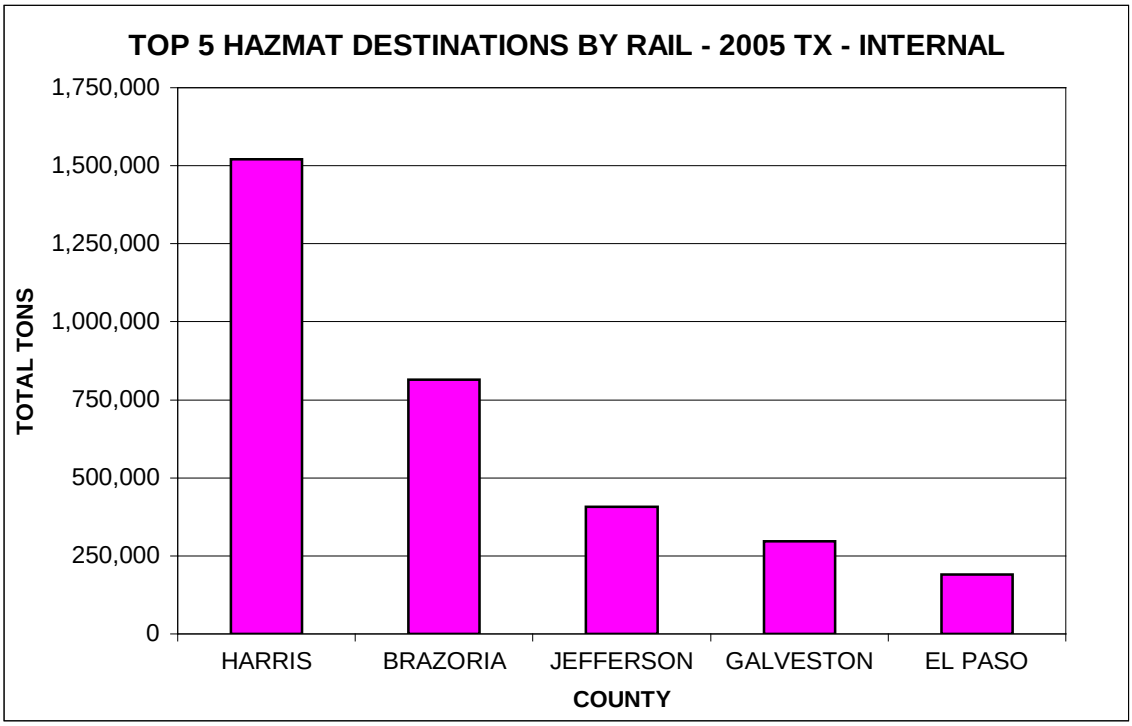

Figure 7. Top 5 Destination Counties – Internal.

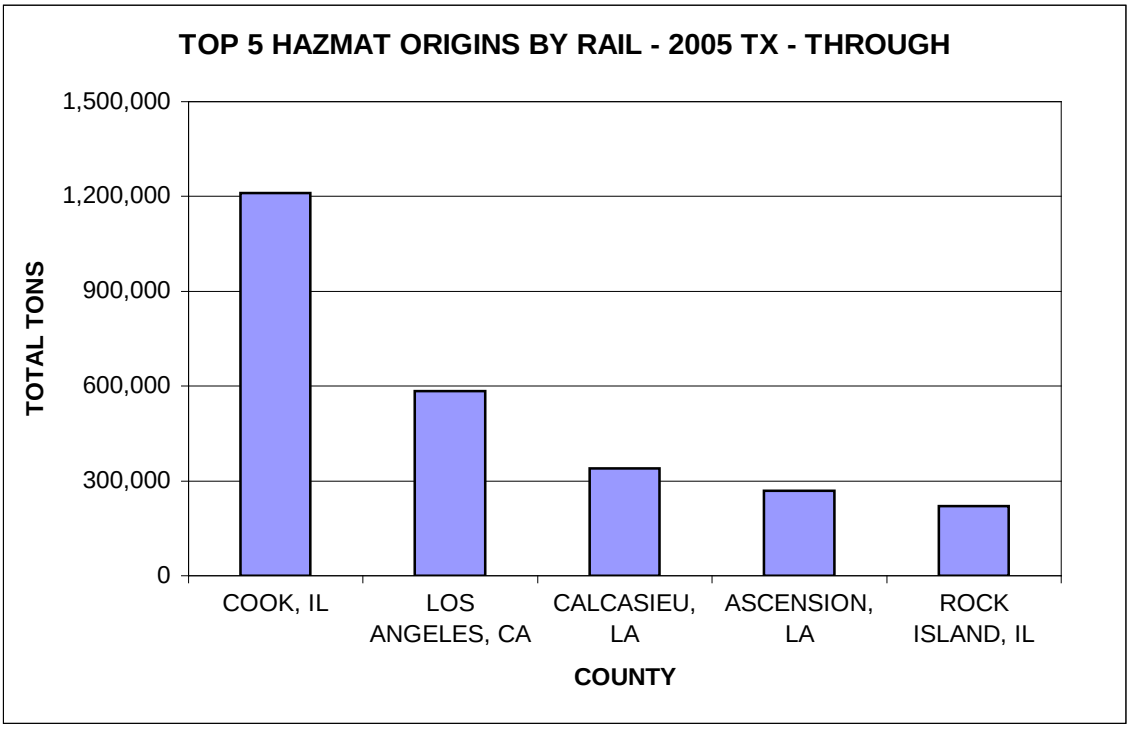

Figure 8. Top 5 Origin Counties – Through.

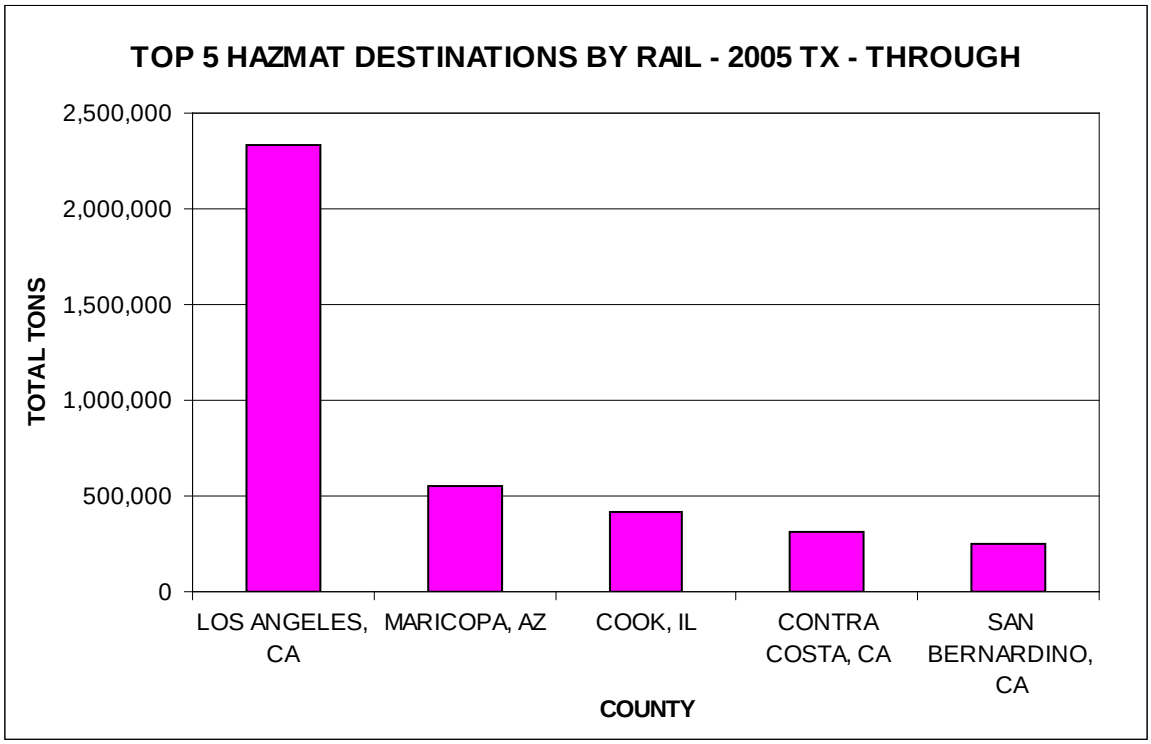

Figure 9. Top 5 Destination Counties – Through.

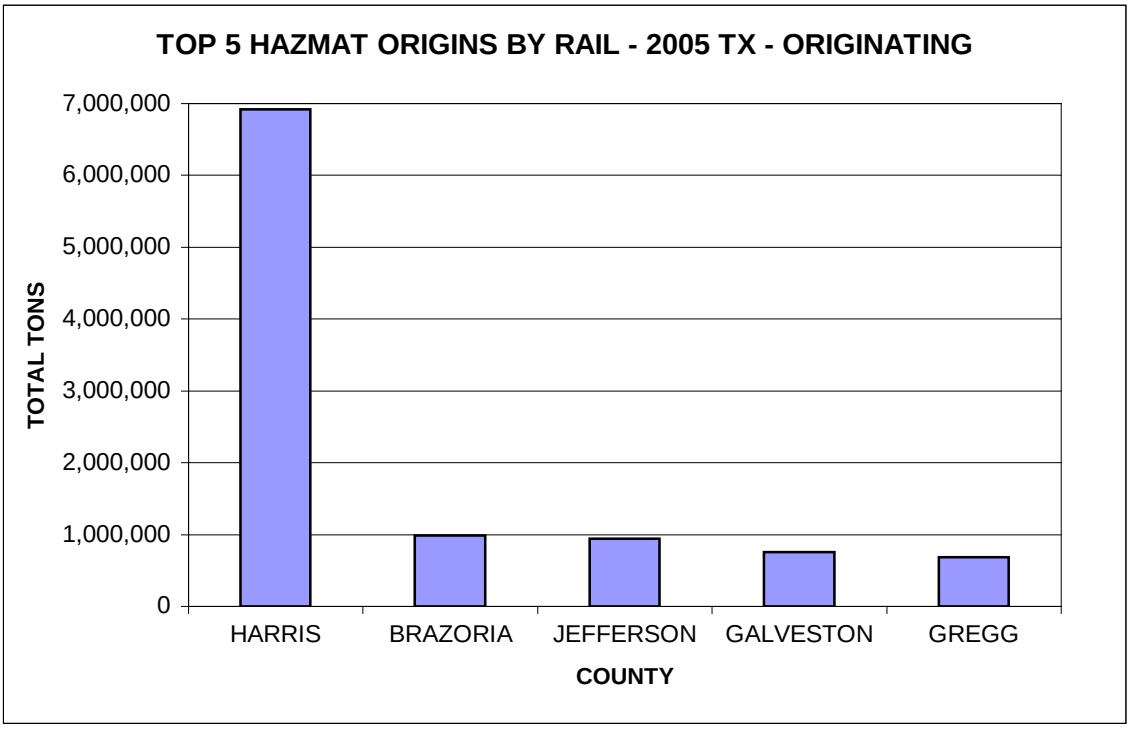

Figure 10. Top 5 Origin Counties – Originating.

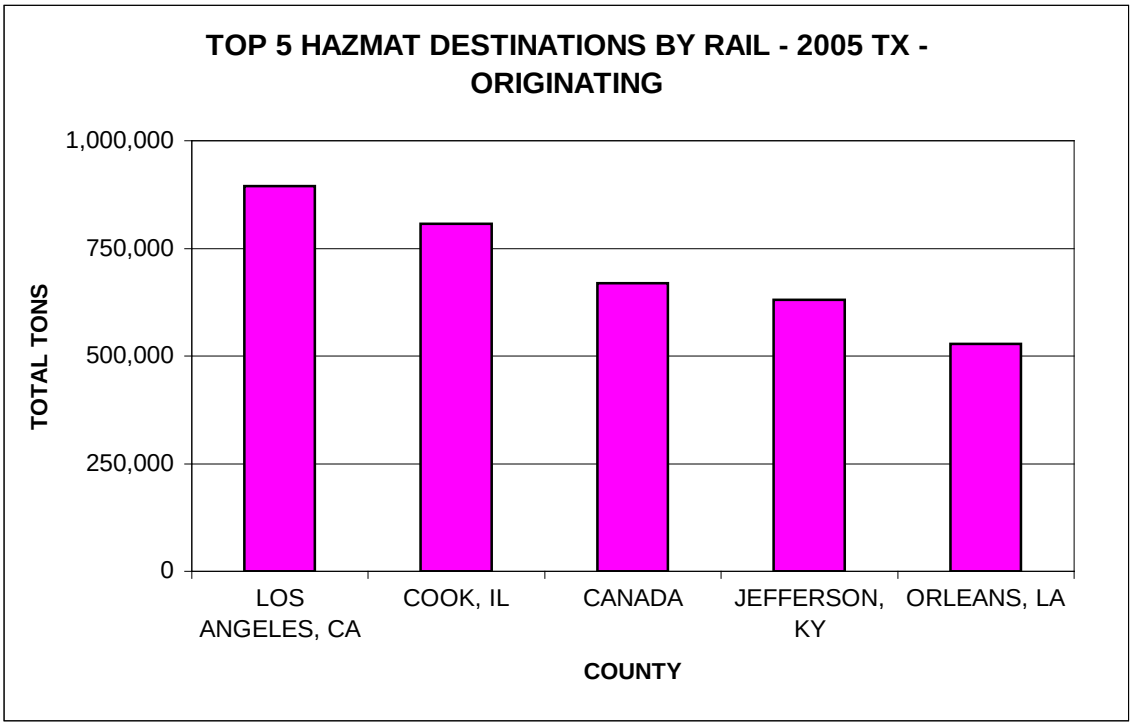

Figure 11. Top 5 Destination Counties – Originating.

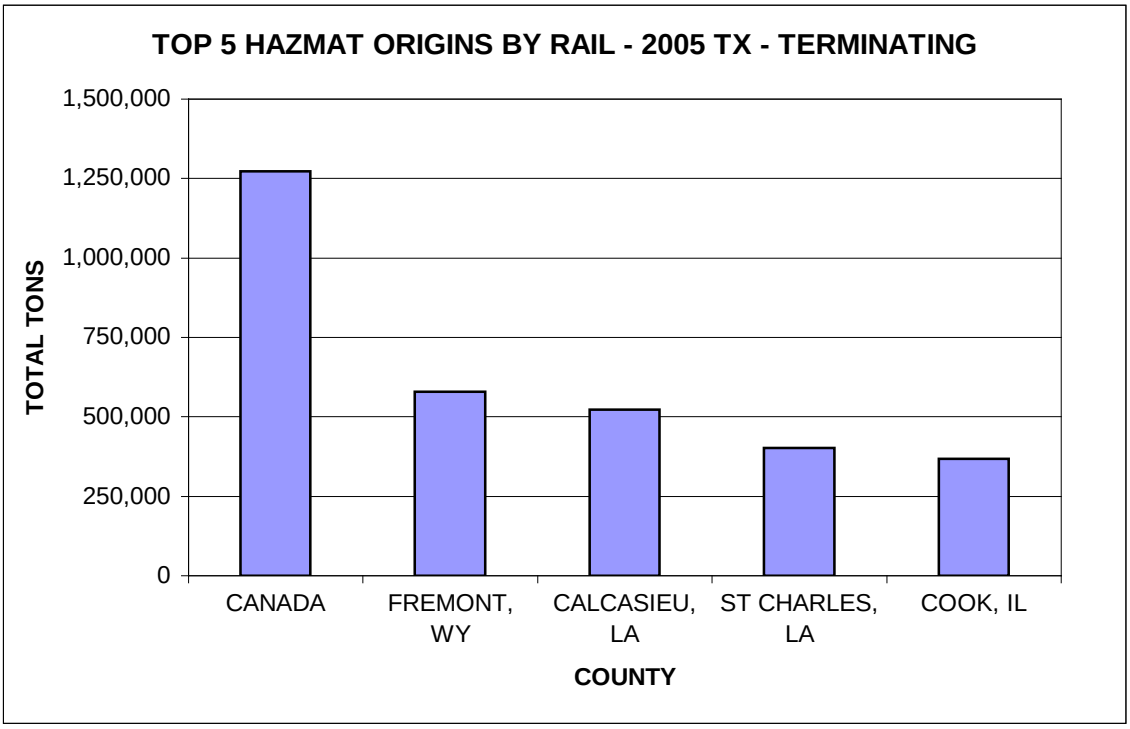

Figure 12. Top 5 Origin Counties – Terminating.

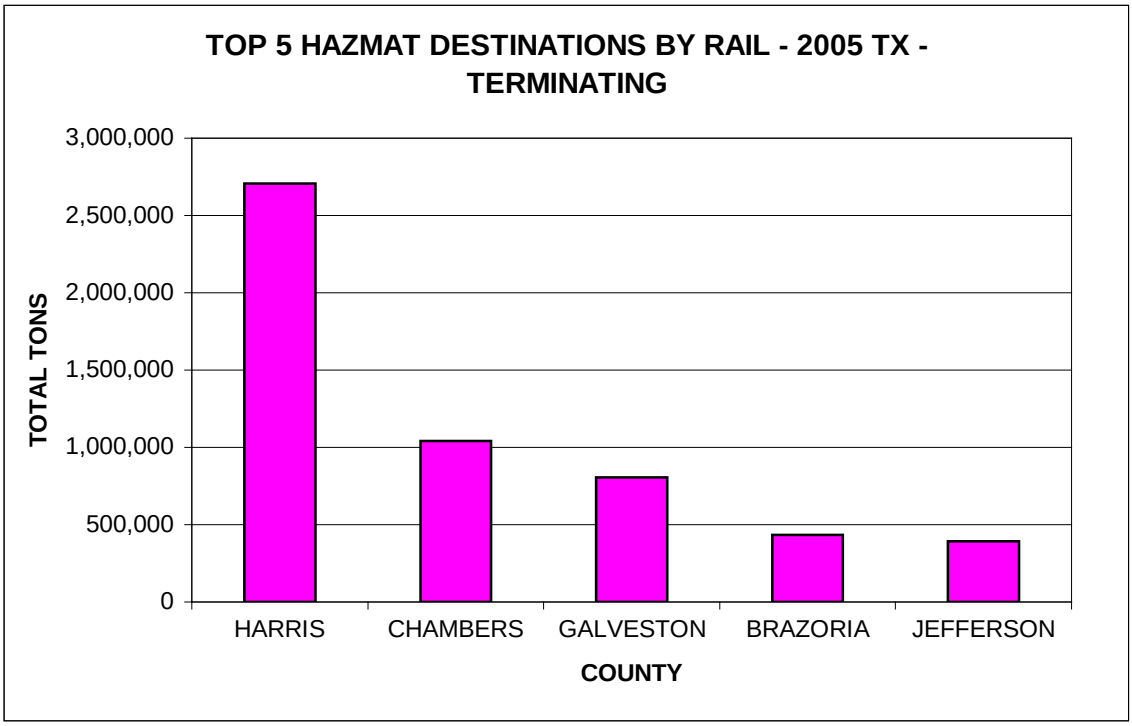

Figure 13. Top 5 Destination Counties – Terminating.

Canada-Texas Hazmat Rail Movements

The dominance of Canada as the top origin in hazmat tonnage terminating in Texas and the third destination in hazmat tonnage originating in Texas gave rise to the need for further disaggregation of the hazmat interchange between Texas and Canada. Those waybills involving hazmat originating in Canada (terminating movements with respect to Texas), terminating in Canada (originating movements with respect to Texas), or passing through Texas from or to Canada (through movements) were further analyzed to identify the top 10 commodities and rank the Canadian provinces in terms of tonnage by type of movement. Table 9, Figure 14, and Figure 15 show the results of this analysis.

In 2005, the total hazmat transportation exchange between Texas and Canada (originating, terminating, and through movements) was more than 2.1 million tons. It is worthwhile to note that almost twice as much tonnage (roughly 1.3 million tons) originated in Canada and terminated in Texas than the reverse (roughly 0.7 million tons). The tonnage passing through Texas from or to Canada was significantly less (around 0.2 million tons). The top 10 commodities represented 85 percent of all tonnage received from Canada and a little less (65 percent) of tonnage shipped to Canada, the latter implying more diversity in hazmat commodities to Canada than from.

Table 9. Top 10 Canada Commodities – To, From, or Through Texas.

RANK	CANADA = ORIGIN			CANADA=DESTINATION		
	STCC7	COMMODITY	TONS	STCC7	COMMODITY	TONS
1	2912128	PROPYLENE	399,280	2818265	PROPYLENE OXIDE	76,040
2	2911985	BUTADIENE	138,440	2813966	VINYL CHLORIDE	67,600
3	4025177	WST CHEM SOFFP	130,600	2818132	ADIPONITRILE	50,520
4	2911982	NAPHTHA,PETROLM	71,200	2818668	VINYL ACETATE	48,880
5	2818036	ISOPRENE STL BO	68,080	2899991	CHEMICALS, NEC	44,400
6	2819924	SODIUM CHLORATE	64,760	2911190	GASOLINE NEC	32,320
7	2912181	PETRO BYPRD,FFP	61,320	2911982	NAPHTHA,PETROLM	31,720
8	2912190	PETRO GAS LQD	53,320	2818662	ADIPIC ACID	31,240
9	2911610	ASPH PETRO LIQ	49,960	1321110	GASOLINE,NAT	29,680
10	2083110	MALT	43,400	2912190	PETRO GAS LQD	22,080
TOTAL		TOP 10	1,080,360			434,480
		ALL	1,273,400			669,680
TOP 10 AS % OF ALL TONS			85%			65%
TONS THROUGH TX			201,632	CANADA GRAND TOTAL		2,144,712

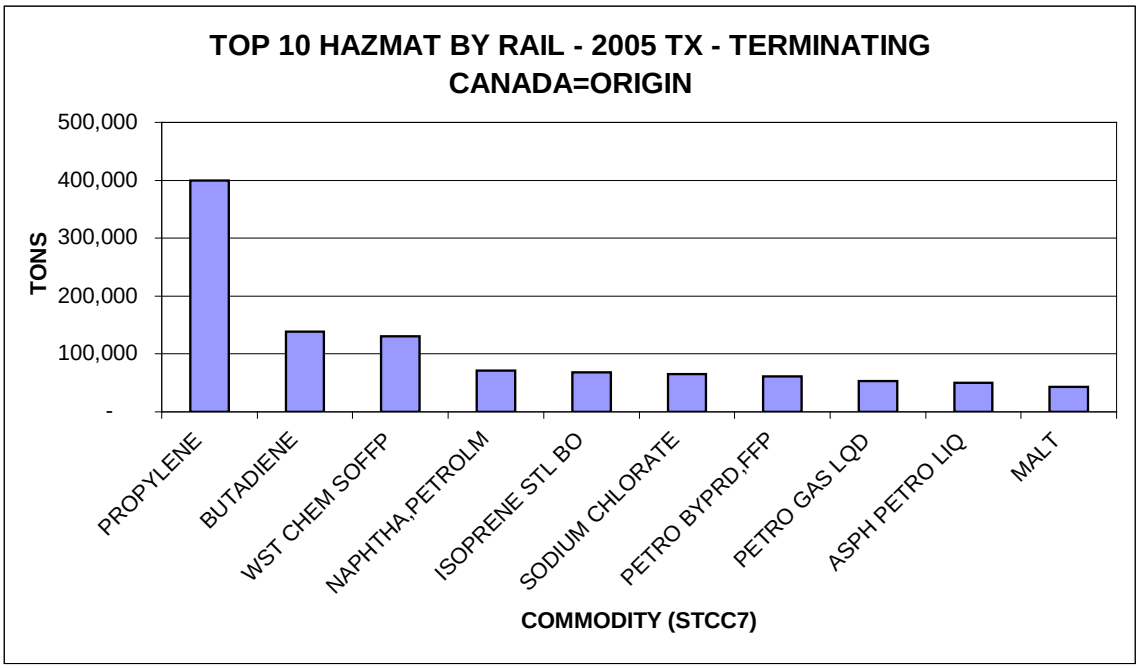

Figure 14. Top 10 Canada Commodities to Texas - Terminating.

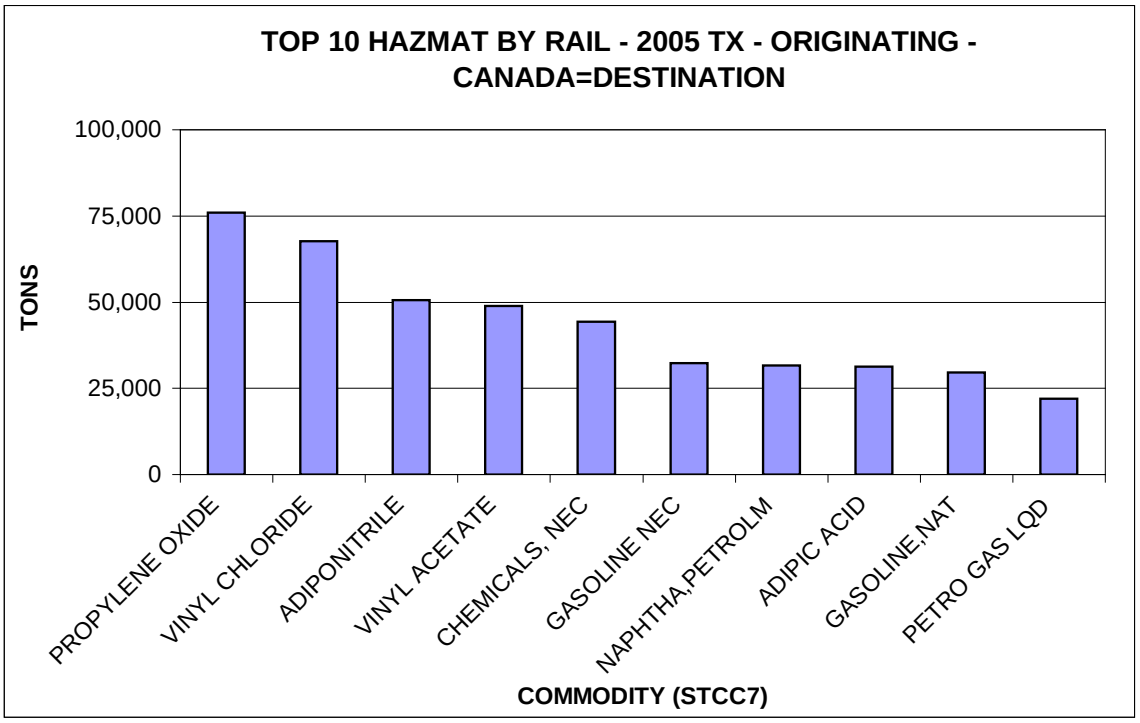

Figure 15. Top 10 Canada Commodities from Texas - Originating.

The origin and destination provinces of hazmat tonnage from and to Canada were then identified and ranked in terms of tonnage by type of movement. Table 10, Figure 16, and Figure 17 show the results of the analysis.

The two basic observations still hold true here obviously, i.e., that in 2005 almost twice as much tonnage (roughly 1.3 million tons) originated in Canada and terminated in Texas than the reverse flow (roughly 0.7 million tons); and that the tonnage passing through Texas from or to Canada was significantly less than either flow (around 0.2 million tons).

An additional observation is that the hazmat tonnage originating in Canada and terminating in Texas originated in seven provinces while the reverse flow terminated in only four provinces, implying less diversity in destination provinces than origin provinces.

Alberta is the top origin with almost 49 percent of total tonnage, while Ontario is the top destination with 84 percent of total tonnage. In addition a vast difference between originating and terminating tonnage exists in the cases of Alberta and Ontario (49 percent versus 9 percent and 12 percent versus 84 percent, respectively). This implies that Alberta is the major Canadian producer/shipper, while Ontario is the major consumer/receiver.

Table 10. Canadian Provinces Ranked by Type of Movement and Tonnage.

RANK	CANADA = ORIGIN			CANADA = DESTINATION		
	PROVINCE	TONS	%	PROVINCE	TONS	%
1	Alberta	622,640	49%	Ontario	564,120	84%
2	New Brunswick	253,440	20%	Alberta	58,640	9%
3	Ontario	155,480	12%	Manitoba	36,120	5%
4	Saskatchewan	93,360	7%	Quebec	10,800	2%
5	Quebec	81,040	6%			
6	Manitoba	34,360	3%			
7	British Columbia	33,080	3%			
TOTAL		1,273,400	100%		669,680	100%
TONS THROUGH TX		201,632				
CANADA GRAND TOTAL		2,144,712				

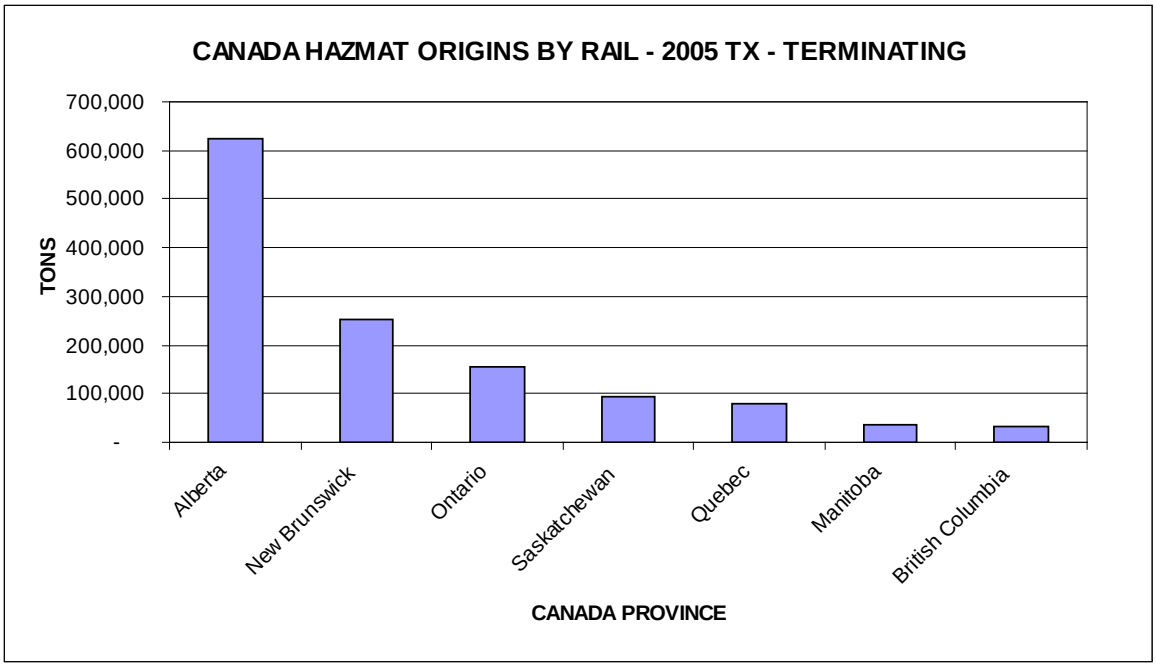

Figure 16. Canadian Province Origins by Tonnage - Terminating.

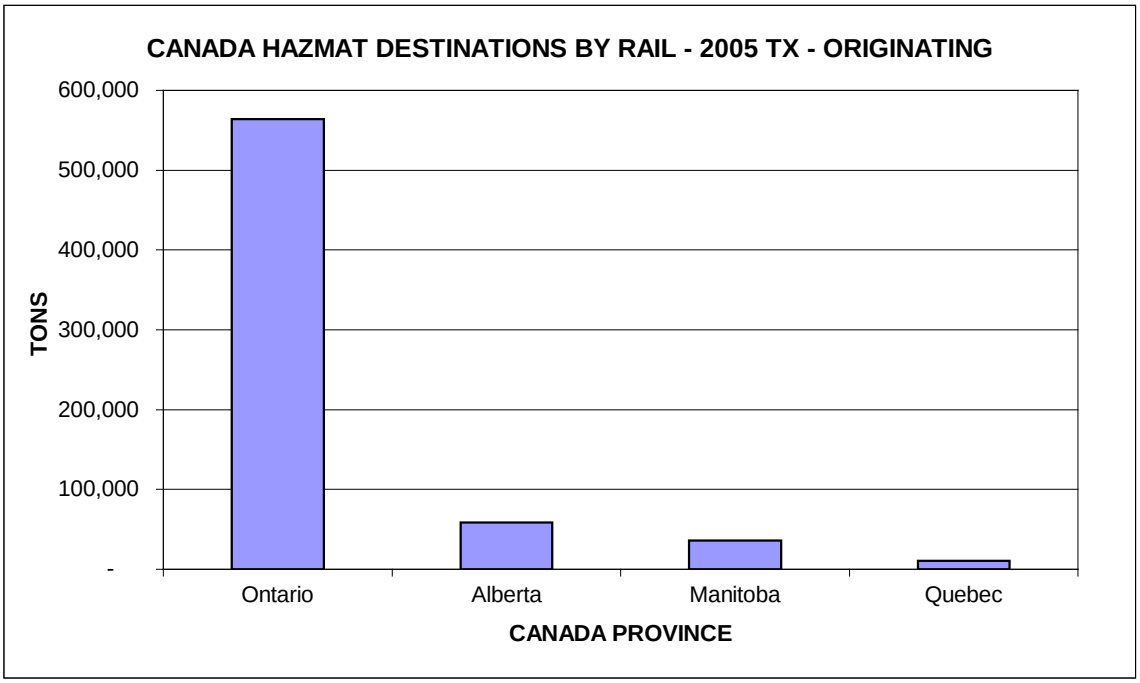

Figure 17. Canadian Province Destinations by Tonnage - Originating.

HAZARDOUS MATERIALS TRANSPORTATION – INLAND WATERWAYS

The latest (2006) waterborne tonnage data were obtained from the U.S. Army Corps of Engineers (USACE) website, more specifically from the annual publication "Waterborne Commerce of the U.S. Waterways and Harbors" (*3*). Domestic internal freight traffic data for the Texas portion of the Gulf Intracoastal Waterway are shown in Figure 18 and Table 11, along with state and national totals. The commodity classification system of the USACE differs from other modes and does not distinguish between hazmat or non hazmat per se. However, it is obvious that the first two categories, *Petroleum & Petroleum Products* and *Chemicals & Related Products* consist primarily of hazardous materials. These two categories account for roughly 65 million short tons (87 percent) of the total 74 million short tons transported over the Texas portion of the GIWW in 2006.

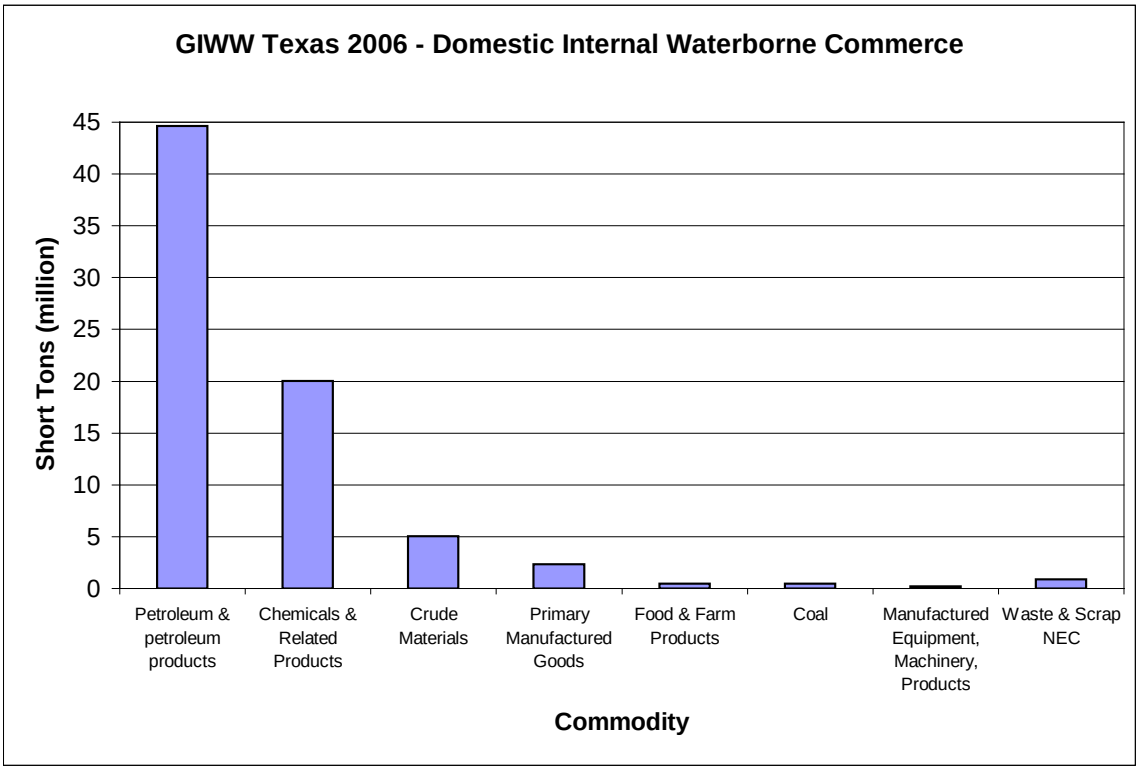

Figure 18. Waterborne Traffic – GIWW Texas 2006.

Table 11. Waterborne Traffic – GIWW Texas 2006.

2006 WATERBORNE COMMERCE OF THE UNITED STATES GULF INTRACOASTAL WATERWAY TEXAS PORTION (SABINE RIVER TO MEXICAN BORDER - 406.2 MILES) DOMESTIC INTERNAL FREIGHT TRAFFIC		
Commodity		**Short Tons (million)**
Petroleum & Petroleum Products		**44.63**
Crude petroleum		5.88
Petroleum Products		38.75
Gasoline		6.20
Kerosene		0.20
Distillate Fuel Oil		11.69
Residual Fuel Oil		7.96
Lube Oil & Greases		2.20
Petroleum Jelly & Waxes		0.05
Naphtha & Solvents		4.91
Asphalt, Tar & Pitch		2.26
Petroleum Coke		0.66
Hydrocarbon & Petrol Gases, liquified & gaseous		0.80
Petroleum Products, NEC		1.82
Chemicals & Related Products		**20.04**
Fertilizers		0.46
Nitrogenous Fertilizers		0.38
Phosphatic Fertilizers		0.02
Potassic Fertilizers		0.02
Fertilizers & Mixes NEC		0.04
Other Chemicals & Related Products		19.57
Acyclic Hydrocarbons		1.59
Benzene & Toluene		4.12
Other Hydrocarbons		5.45
Alcohols		2.42
Carboxylic Acids		0.86
Nitrogen Func. Compound		1.20
Organo-Inorganic Compounds		0.03
Organic Compounds NEC		0.94
Sulphur (liquid)		0.10
Sulphuric Acid		0.88
Ammonia		0.07
Sodium Hydroxide		0.85
Inorganic Elements, Oxides & Halogen Salts		0.25
Metallic Salts		0.28
Inorganic Chem. NEC		0.00
Perfumes & Cleansers		0.01
Plastics		0.07
Chemical Additives		0.36
Wood & Resin Chemicals		0.01
Chemical Products NEC		0.08
Crude Materials, Inedible Except Fuels		5.04
Primary Manufactured Goods		2.33
Food & Farm Products		0.48
Coal		0.46
Manufactured Equipment, Machinery & Products		0.23
Waste & Scrap NEC		0.90
TX Total	**Tons (million)**	**74.1**
	Ton-Miles (million)	**7,231**
TX %	**Tons**	**12%**
	Ton-Miles	**3%**
US Total	**Tons (million)**	**627.6**
	Ton-Miles (million)	**279,778**

FHWA FREIGHT ANALYSIS FRAMEWORK, VERSION 2

The FHWA Freight Analysis Framework, Version 2 (FAF^2) Commodity Origin-Destination database estimates tonnage and value of goods shipped by type of commodity and mode of transportation among and within 114 areas, as well as to and from 7 international trading regions plus 17 additional international gateways (*4*). Based primarily on the Commodity Flow Survey and other components of the Economic Census, the FAF^2 utilizes a 2002 base year and forecasts include from 2010 to 2035 in 5-year increments (*5*). In addition, the FHWA is releasing provisional estimates of goods movement for the most recent calendar year, starting with 2006, which utilize the most current economic indicators and publications. The statistics derived for this report are from the 2007 provisional database. The data, methods, and results developed as part of the FAF^2 are publicly available.

The FAF^2 includes seven modes of transportation and are defined in the *Freight Analysis Framework (FAF) Version 2.2, User Guide* as:

- truck – includes private and for-hire truck;
- rail – any common carrier or private railroad;
- water – includes shallow draft, deep draft, and Great Lakes shipments;
- air (including truck-air) – includes shipments by air or a combination of truck and air;
- truck-rail intermodal – includes shipments by a combination of truck and rail;
- other multiple modes – includes shipments typically weighing less than 100 pounds by Parcel, U.S. Postal Service, or Courier, as well as shipments of all sizes by truck-water, water-rail, and other intermodal combinations; and
- pipeline and unknown – pipeline is included with unknown because region-to-region flows by pipeline are subject to large uncertainty.

The FAF^2 database contains the following data tables, as described in the *Freight Analysis Framework (FAF) Version 2.2, User Guide*:

- Domestic – contains commodity flows between domestic origins and destinations.
  - Fields include zone of origin, zone of destination, commodity, mode, value in millions of dollars, and tons in thousands of short tons.

- Border – contains commodity flows by land from Canada and Mexico via ports of entry on the U.S. border to domestic destinations and from the U.S. via ports of exit on the U.S. border to Canada and Mexico.
    - Fields include zone of origin, zone of destination, port of entry or exit, commodity, mode used on the domestic leg of the movement, value in millions of dollars, and tons in thousands of short tons.
- Sea – contains commodity flows by air and water from overseas origins via ports of entry to domestic destinations and from domestic origins via port of exit to overseas destinations.
    - Fields include zone of origin, zone of destination, port of entry or exit, commodity, mode used on the domestic leg of the movement, value in millions of dollars, and tons in thousands of short tons.
- International Air – contains international air commodity flows from foreign origins via ports of entry to domestic destinations and from domestic origins via port of exit to foreign destinations.
    - Fields include zone of origin, zone of destination, port of entry or exit, commodity, mode used on the domestic leg of the movement (all are "air & truck"), value in millions of dollars, and tons in thousands of short tons.

Freight Analysis Framework Hazardous Materials Commodities

The FAF^2 utilizes commodity codes based on the Standard Classification of Transportation Goods (SCTG). At the 2-digit level there are 43 different commodity code categories, with the final code representing "unknown" commodities. The SCTG classification does not designate hazardous commodities separately from the other commodity classifications. Because of this, the *2002 Commodity Flow Survey* (CFS) was utilized to determine the tons of hazardous materials within the FAF^2. The CFS indicates that only six SCTG codes (codes 17, 18, 19, 20, 22, and 23) contain 99.5 percent of all hazardous materials tonnage (*6*). Table 12 shows the percentage of hazardous materials tonnage for each SCTG code as indicated in the 2002 CFS.

Table 12. 2002 Commodity Flow Survey Hazardous Materials Commodity Designations.
Source: 2002 Commodity Flow Survey (7)

SCTG Code	Commodity Name	Percent Hazmat
17	Gasoline and aviation turbine fuel	100%
18	Fuel oils	100%
19	Coal and petroleum products, n.e.c.	44.6%
20	Basic chemicals	78.5%
22	Fertilizers	10.6%
23	Chemical products and preparations, n.e.c.	32.9%

Note: n.e.c = not elsewhere classified

Freight Analysis Framework 2007 Provisional Estimates – Texas Hazardous Materials

Utilizing the 2007 provisional estimate of goods movements and the hazardous material commodity information provided by the 2002 CFS, the following table (Table 13) shows the estimated 2007 tons by SCTG code. The 657,969,000 tons represent roughly 70 percent of the total tons originating or terminating in Texas within the 2007 provisional database.

Table 13. Texas Hazardous Materials by Commodity – 2007 Provisional Estimates.

SCTG Code	Commodity Name	Tons (1000s)	Percent Hazmat	Hazmat Tons (1000s)
17	Gasoline and aviation turbine fuel	233,333	100%	233,333
18	Fuel oils	119,717	100%	119,717
19	Coal and petroleum products, n.e.c.	400,473	44.6%	178,611
20	Basic chemicals	141,901	78.5%	111,393
22	Fertilizers	11,422	10.6%	1,211
23	Chemical products and preparations, n.e.c.	41,654	32.9%	13,704
Totals		948,500	69.4%	657,969

Figure 19 contains the information from Table 13 in a bar chart in order to view the differences in magnitude of the hazardous material commodity tonnage. Gasoline and aviation turbine fuel (SCTG code 17) is the most shipped commodity by tonnage in Texas.

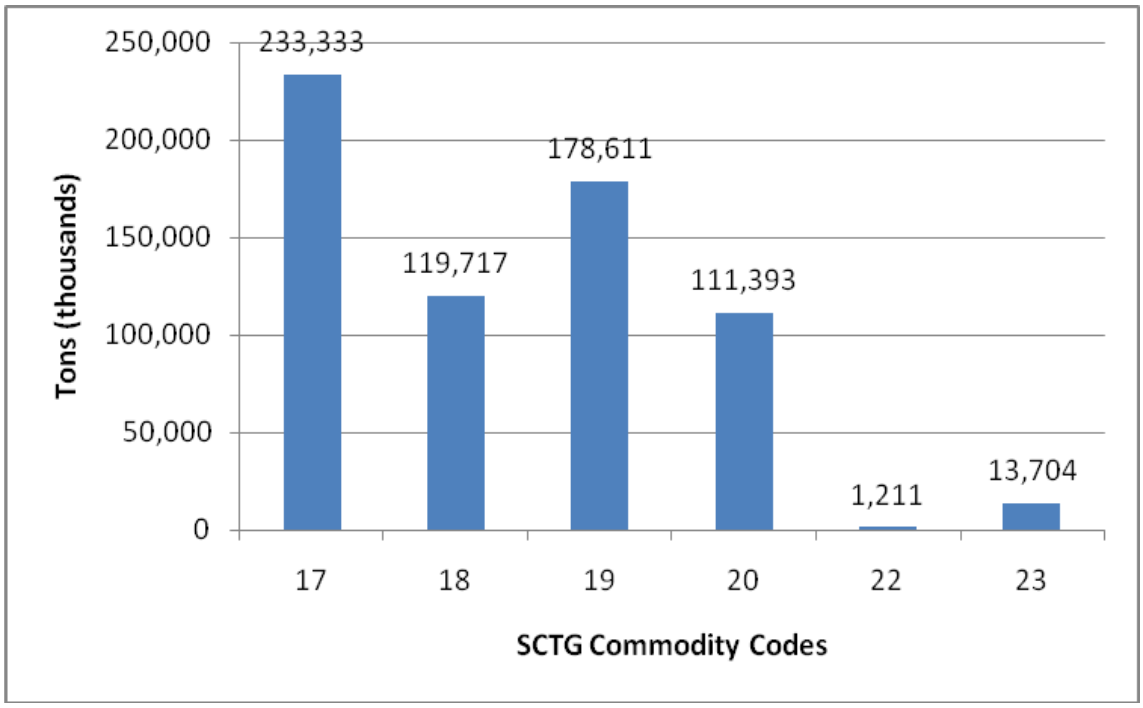

Figure 19. Texas Hazardous Materials by Commodity – 2007 Provisional Estimates.

The Freight Analysis Framework enhances the understanding of goods movements by identifying the mode of transport. Table 14 presents the tonnage moved by different modes for the six hazardous materials SCTG commodity classes.

Table 14. Texas Modal Hazmat Totals (thousands of tons) – 2007 Provisional Estimates.

SCTG Code	Commodity Name	Pipeline & Unknown	Rail	Truck	Water	Other
17	Gasoline and aviation turbine fuel	124,434	21	93,951	14,825	101
18	Fuel oils	73,229	1,324	27,388	12,908	4,869
19	Coal and petroleum products, n.e.c.	113,356	29,011	25,534	10,093	617
20	Basic chemicals	35,788	24,795	23,791	25,056	1,962
22	Fertilizers	23	252	934	-	1
23	Chemical products and preparations, n.e.c.	138	480	12,651	208	227
Modal Totals		346,969	55,883	184,250	63,090	7,778

Pipeline & Unknown represent over 50 percent of all the hazardous materials moved in Texas, as seen in Figure 20. Trucks move 28 percent, while the remaining modes move under 20 percent of the hazardous material in the state.

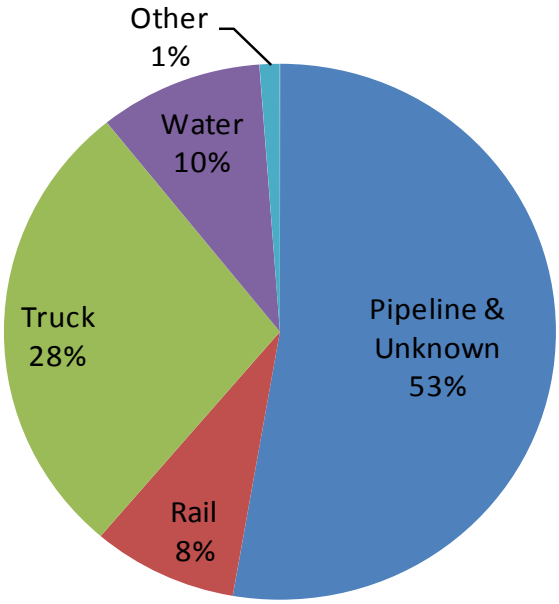

Figure 20. Texas Modal Hazmat Totals – 2007 Provisional Estimates.

In the Freight Analysis Framework, Texas is segmented into the regional areas Austin, Dallas, Houston, and San Antonio, along with a designation of the Remainder of Texas for shipments that originate or terminate outside those regions. Table 15 shows the hazardous materials activity for shipments originating in the designated FAF^2 regions in Texas. The Houston region ships the most hazardous materials by weight, representing almost 52 percent of all the tons shipped. Figure 21 contains the Houston percentage, along with the other region percentages for originating tons.

Table 15. Texas FAF^2 Region Originating Hazmat (thousands of tons) – 2007 Provisional Estimates.

SCTG Code	Commodity Name	Austin	Dallas	Houston	San Antonio	Remainder
17	Gasoline and aviation turbine fuel	1,378	8,285	113,719	5,026	89,253
18	Fuel oils	528	3,028	66,896	1,554	39,981
19	Coal and petroleum products, n.e.c.	3,796	3,100	42,551	2,384	95,451
20	Basic chemicals	148	2,398	74,471	394	21,407
22	Fertilizers	31	146	373	39	266
23	Chemical products and preparations, n.e.c.	77	1,074	5,638	172	2,655
Region Total		5,957	18,033	303,648	9,568	249,011

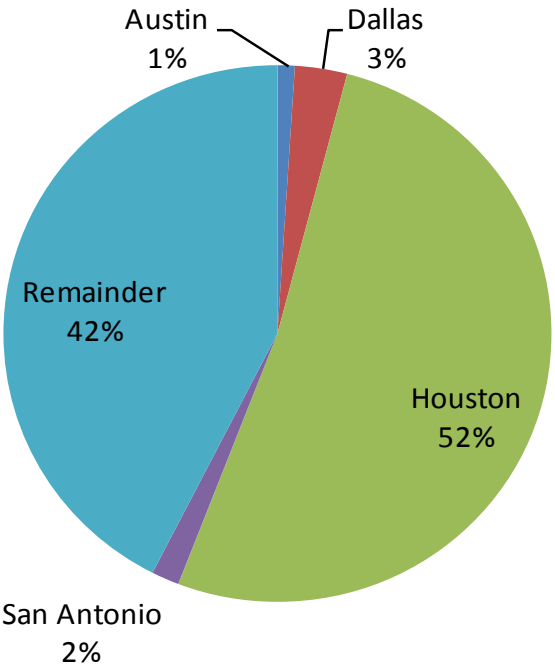

Figure 21. Texas FAF^2 Region Originating Hazmat – 2007 Provisional Estimates.

Table 16 shows the regional totals by commodity for shipments terminating in the Texas regions. Again, the Houston area experiences the most hazardous materials in the state. Figure 22 includes the percentages of terminating hazardous materials tonnages by Texas region.

Table 16. Texas FAF^2 Region Terminating Hazmat (thousands of tons) – 2007 Provisional Estimates.

SCTG Code	Commodity Name	Austin	Dallas	Houston	San Antonio	Remainder
17	Gasoline and aviation turbine fuel	2,056	15,528	110,705	6,995	73,894
18	Fuel oils	776	7,742	64,606	2,267	39,188
19	Coal and petroleum products, n.e.c.	2,120	5,444	49,930	3,904	55,927
20	Basic chemicals	394	4,987	59,426	1,392	22,836
22	Fertilizers	42	254	414	52	362
23	Chemical products and preparations, n.e.c.	150	1,337	2,564	363	1,865
Region Total		5,537	35,292	287,646	14,974	194,071

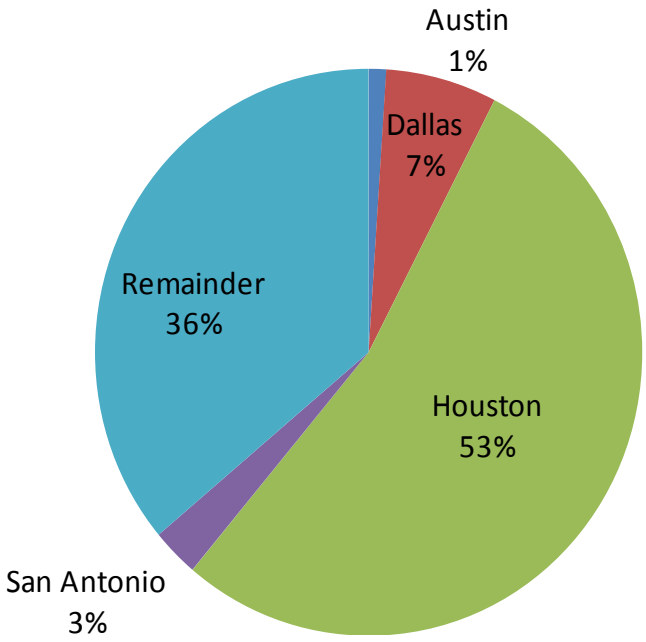

Figure 22. Texas FAF^2 Region Terminating Hazmat – 2007 Provisional Estimates.

A very large portion of the hazardous materials shipments in Texas are internal-internal movements, meaning the shipment both originates and terminates within the state. According to the 2007 provisional estimates, over 465 million tons of hazardous materials moved within Texas. For shipments originating in Texas, the Houston region, Remainder of Texas, and the Dallas region represented the top three destinations. The Remainder of Louisiana, with almost 20.5 million tons and the Detroit, Michigan region, with over 19 million tons rounded out the top five destinations. For shipments terminating in Texas, the top five closely resemble the originating hazardous materials shipments. The Houston region originated 49 percent of all hazardous materials that terminated in Texas, followed by the Remainder of Texas with 32 percent and the Dallas region with less than 3 percent. The other top five origins were the Remainder of Louisiana and New Mexico.

Expected Growth in Hazardous Materials Shipments in Texas

As stated above, the FAF^2 database forecasts freight activity out to 2035. Table 17 provides the base year hazardous materials shipped to or from Texas followed by the 2035 estimates. In general, hazardous materials are expected to grow modestly over the next 30 years with roughly a cumulative growth of 82 percent, or 2.5 percent annually. Making up only a very

small portion of the total hazardous materials tons, the international air movements expect to experience the greatest increase with over 376 percent. Domestic movements are projected to remain dominant in 2035 across all modes.

Table 17. FAF^2 Projected Hazardous Materials.

Data Table	2002	2035	Percent Change	Annual Change
Domestic	566,816	1,029,609	81.6	2.5
Border	6,719	10,957	63.1	1.9
Sea	35,374	67,796	91.7	2.8
International Air	7	35	376.2	11.4
Total	608,916	1,108,396	82.0	2.5

Freight Analysis Framework – Concluding Texas Observations

Utilizing the 2007 provisional estimates and the FAF^2 forecasts, several observations are made regarding hazardous materials movements in Texas:

- 100 percent of gasoline and aviation turbine fuel and fuel oils are hazardous materials.
- 27 percent of the total tons originating or terminating in Texas are hazardous materials.
- All modes move hazardous materials, with pipelines & unknown moving over 50 percent of the volume.
- Water contributes considerably in the movement of hazardous material (more than rail).
- Most of the hazardous materials traveling in Texas have both origins and destination within the state.
- The Houston region originates and terminates the most hazardous material in the state of Texas, with all other non-regional components of the state coming in second.
- Modest growth in hazardous materials is expected between 2002 and 2035.

HAZARDOUS MATERIALS INCIDENTS

The Office of Hazardous Materials Safety of the Pipeline and Hazardous Materials Administration (PHMSA) maintains annual hazardous materials incident databases compiled from incident reports submitted through the Hazardous Materials Information Reporting System

(HMIRS) (*8*). The national 2007 incident database was downloaded from the website and reduced to those incidents that were reported to have occurred in Texas. Further analysis was conducted to yield the most meaningful results that would potentially be most valuable towards effective management of hazmat incidents in Texas.

Table 18 shows a temporal distribution of the total 1,558 hazmat incidents that occurred in Texas in 2007. Figure 23 illustrates the same data, and it can be seen that more incidents were reported during summer months, most probably due to the fact that these are the peak travel months, hence peak fuel demand months and peak frequency of fuel shipments.

Table 18. Hazmat Incidents – Texas 2007 – Monthly Distribution.

HAZMAT INCIDENTS TEXAS 2007		
MONTH	**NO. INCIDENTS**	**%**
JAN	118	8%
FEB	112	7%
MAR	124	8%
APR	127	8%
MAY	154	10%
JUN	159	10%
JUL	149	10%
AUG	186	12%
SEP	138	9%
OCT	124	8%
NOV	99	6%
DEC	68	4%
Total	1,558	100%

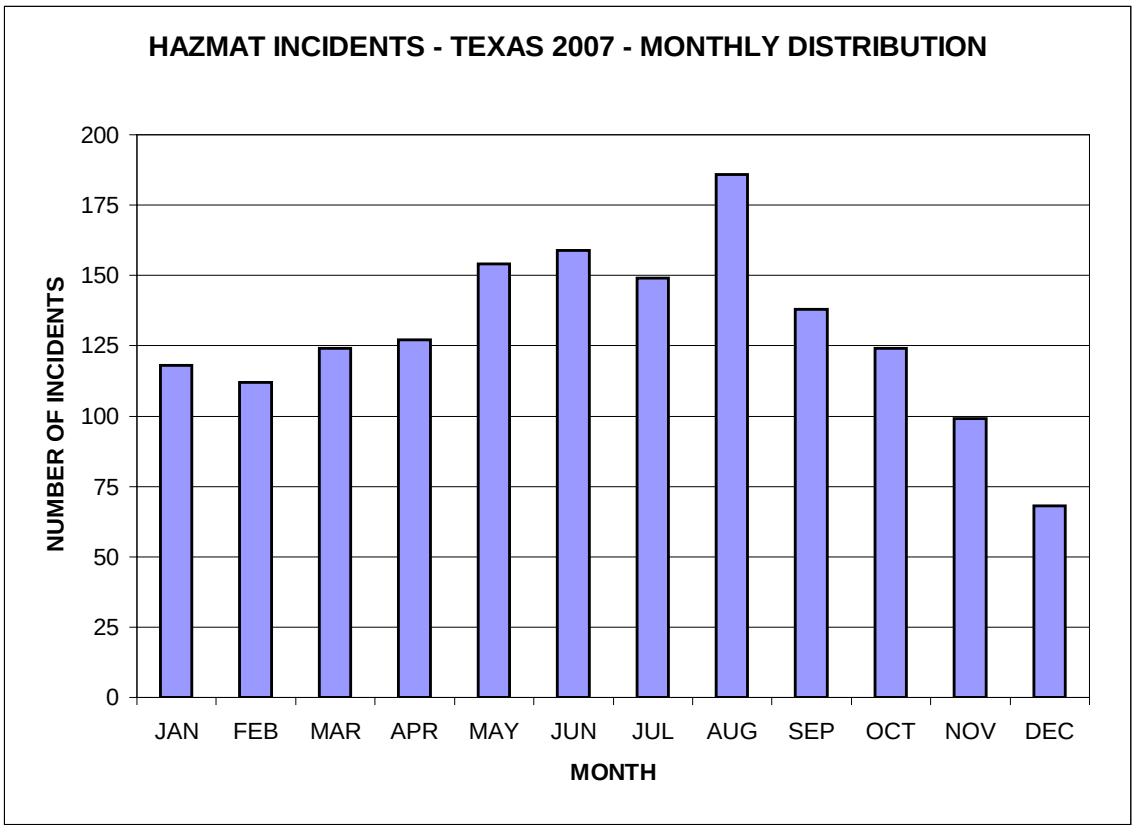

Figure 23. Hazmat Incidents – Texas 2007 – Monthly Distribution.

The incidents were analyzed for spatial distribution, the results of which are shown in Table 19 and Figure 24. A third (33 percent) of the 1,558 Texas incidents occurred in Dallas County and close to a fifth (19 percent) in Harris County. In general, only ten counties accounted for over 80 percent of the incidents reported in 2007 in Texas. When these data are examined in conjunction with transportation volume data, it is intuitive that counties with dense petrochemical or other industrial activity attract or produce more hazmat trip movements, hence the likelihood of an incident increases.

Table 19. Hazmat Incidents – Texas 2007 – Top 10 Counties.

HAZMAT INCIDENTS TEXAS 2007			
	COUNTY	NO. INCIDENTS	%
1	DALLAS	516	33%
2	HARRIS	301	19%
3	TARRANT	118	8%
4	EL PASO	117	8%
5	BEXAR	57	4%
6	LUBBOCK	35	2%
7	WEBB	33	2%
8	JEFFERSON	32	2%
9	GUADALUPE	24	2%
10	TAYLOR	24	2%
	Total	1,257	81%

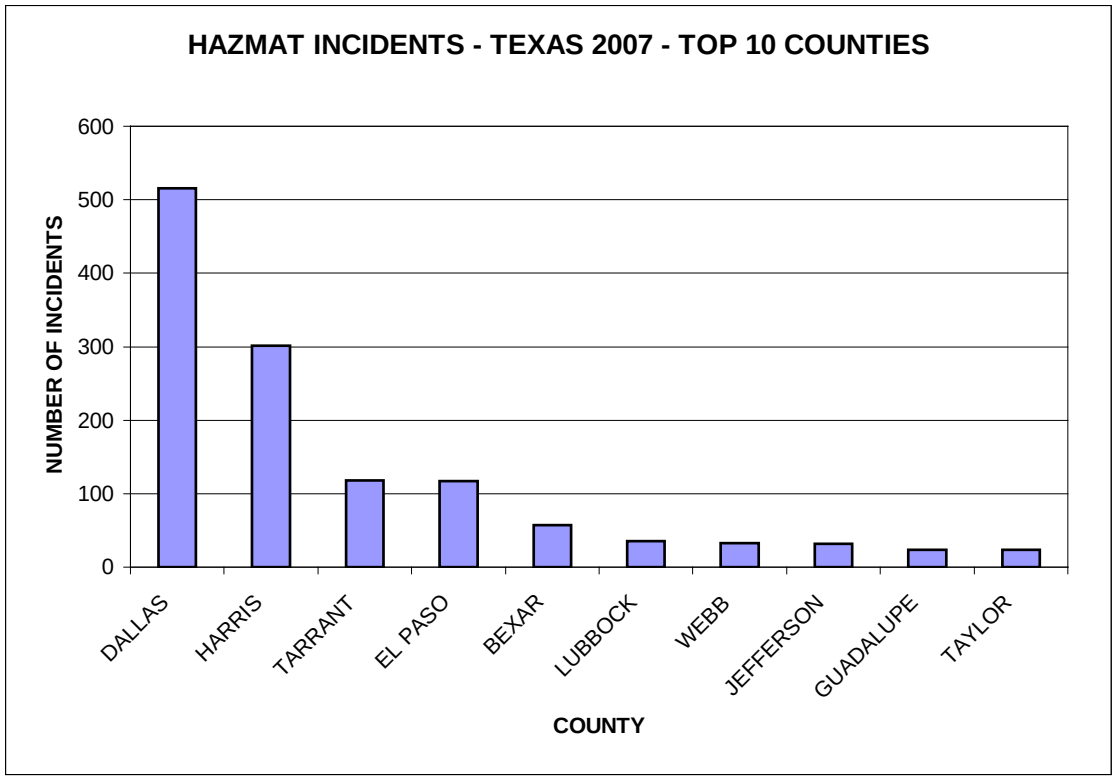

Figure 24. Hazmat Incidents – Texas 2007 – Top 10 Counties.

The HMIRS database contains incidents that occurred on all modes of transportation. Table 20 and Figure 25 show the modal distribution. The vast majority of incidents (90 percent) occurred in the highway mode, i.e., truck shipments while only 6 percent occurred in rail, the

two modes accounting for 96 percent of all incidents. It must be noted here that the PHMSA database only contains deep-water incident data since they are the only ones that are reported to the PHMSA. Detailed analysis of water hazmat incidents (as well as air) though is outside the scope of this research since water and air freight transportation fall only minimally under TxDOT responsibility or control.

Table 20. Hazmat Incidents – Texas 2007 – Modal Distribution.

HAZMAT INCIDENTS TEXAS 2007			
	MODE	NO. INCIDENTS	%
1	HIGHWAY	1,407	90%
2	RAIL	89	6%
3	AIR	58	4%
4	WATER	4	0%
	Total	1,558	100%

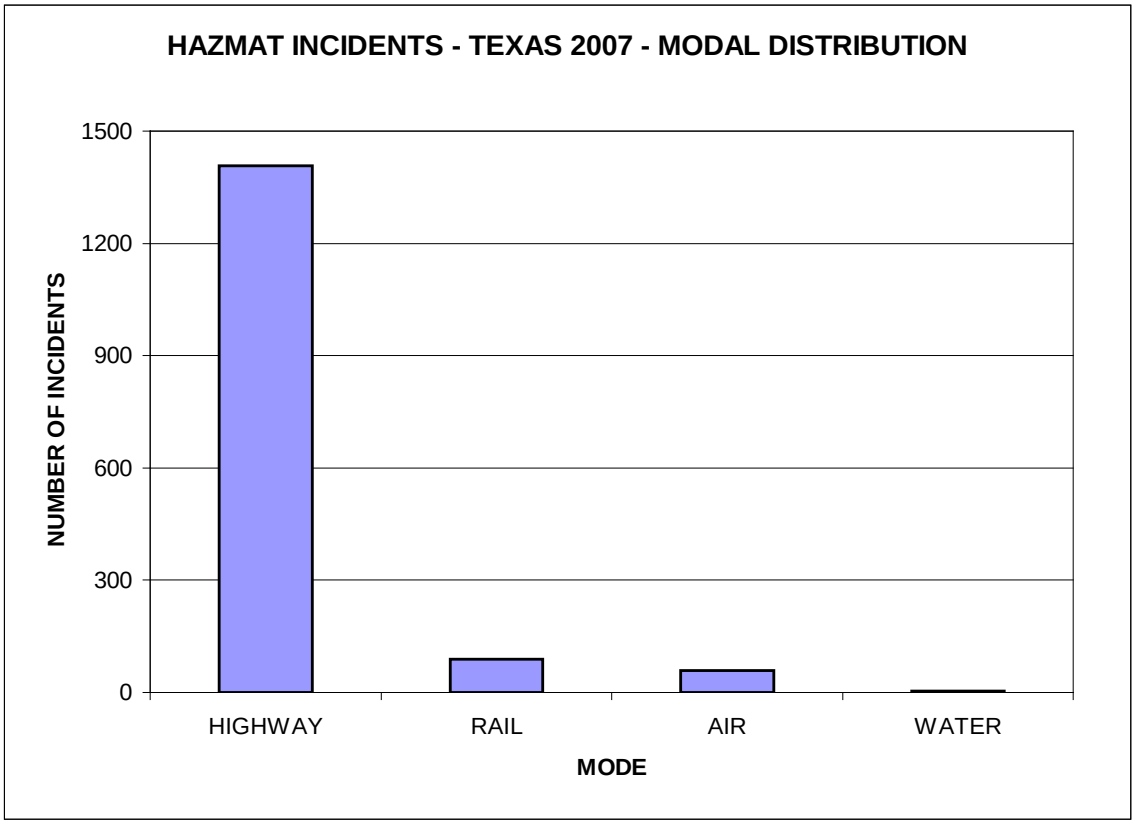

Figure 25. Hazmat Incidents – Texas 2007 – Modal Distribution.

The incident data were further analyzed to yield information on the phase of transportation over which the incident occurred. The results are shown in Table 21 and Figure 26. The majority (60 percent) of incidents occurred in the unloading phase, a fifth (20 percent)

occurred en-route from origin to destination, and less than a fifth (16 percent) occurred in the loading stage.

Table 21. Hazmat Incidents – Texas 2007 – Transportation Phase Distribution.

HAZMAT INCIDENTS TEXAS 2007			
	TRANSPORTATION PHASE	**NO. INCIDENTS**	**%**
1	UNLOADING	931	60%
2	ENROUTE	319	20%
3	LOADING	246	16%
4	TEMP STORAGE/TERMINAL	62	4%
	Total	1,558	100%

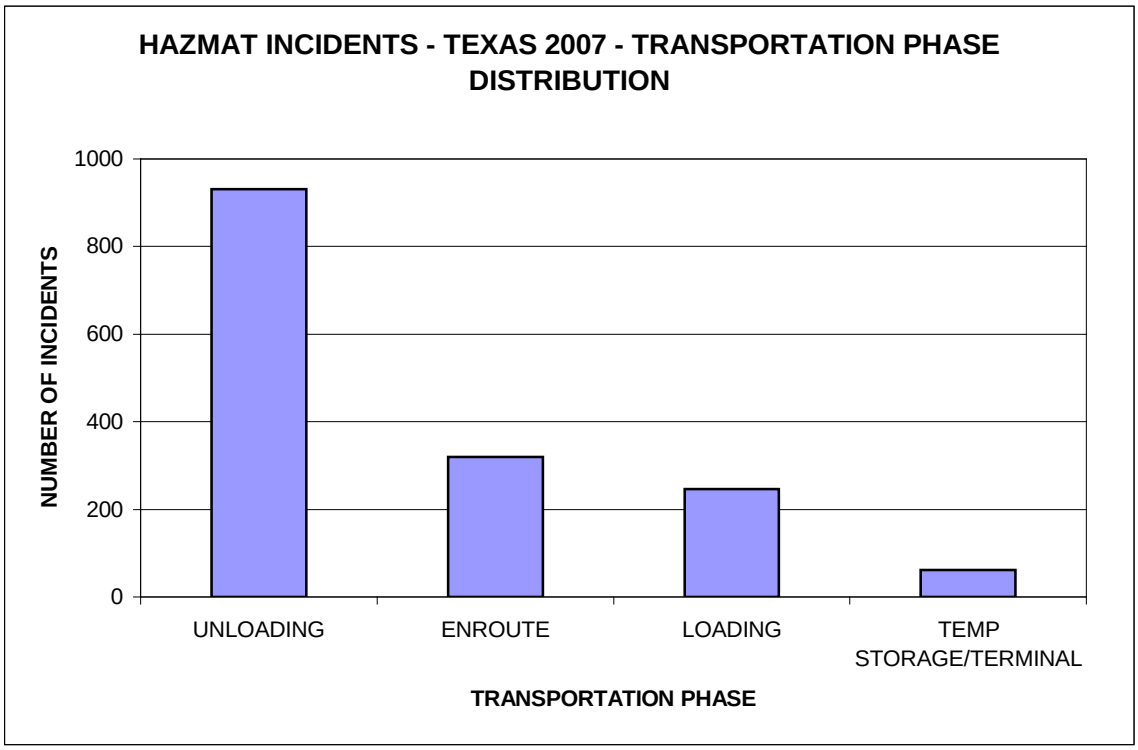

Figure 26. Hazmat Incidents – Texas 2007 – Transportation Phase Distribution.

The incidents were analyzed to yield information on the Hazard Class of the material involved. The results are shown in Table 22 and Figure 27 and are ranked by frequency of occurrence. Over half of the incidents (54 percent) involved Flammable-Combustible Liquids (e.g., petroleum) and a further one-quarter (26 percent) involved corrosive materials, both classes amounting to 80 percent of all incidents.

Table 22. Hazmat Incidents – Texas 2007 – Hazard Class Distribution.

HAZMAT INCIDENTS TEXAS 2007			
HAZARD CLASS	**DESCRIPTION**	**NO. INCIDENTS**	**%**
30	Flammable-Combustible Liquid	839	54%
80	Corrosive Material	400	26%
20	Combustible Liquid	77	5%
22	Nonflammable Compressed Gas	76	5%
90	Miscellaneous HazMat	45	3%
61	Poisonous Materials	39	3%
51	Oxidizer	30	2%
52	Organic Peroxide	17	1%
21	Flammable Compressed Gas	13	1%
41	Flammable Solid	6	0.4%
08	Other Regulated Material, Class D	5	0.3%
23	Poisonous Gas	5	0.3%
42	Spontaneously Combustible	2	0.1%
62	Infectious Substance	2	0.1%
14	Explosive No Blast Hazard	1	0.1%
19	Explosives, Class C	1	0.1%
	Total	1,558	100%

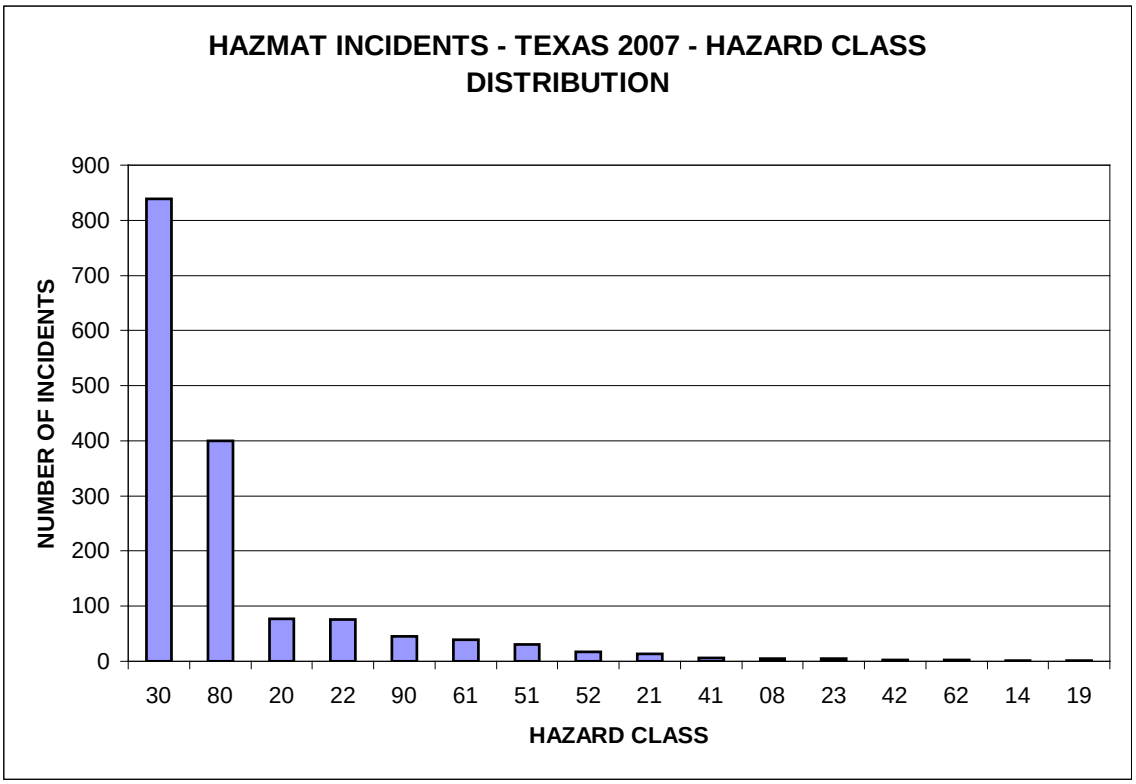

Figure 27. Hazmat Incidents – Texas 2007 – Hazard Class Distribution.

Hazardous Materials Incident Causes

The Office of Hazardous Materials Safety publishes national summaries based on the Hazardous Materials Information Reporting System (HMIRS) databases. The relative rarity of hazardous materials incidents does not lend itself to meaningful state-level summaries or analysis. The vast majority of incidents occur on the highway and rail modes. Table 23 shows the top ten causes for each mode, which account for over 80 percent of incidents as well as the number and percent of incidents by cause for highway and rail. It is obvious that explicit or implicit human error is the most common cause of hazmat incidents in either highway or rail. Causes of incidents nationally can be considered applicable to Texas. This knowledge will help in identifying common causes of incidents and aiding in incident prevention, mitigation, and management.

Table 23. Top 10 U.S. Hazmat Incident Causes – 2007.

TOP 10 U.S. HAZMAT INCIDENT CAUSES						
	HIGHWAY	Number	%	RAIL	Number	%
1	Human Error	2,300	13%	Loose Closure, Component or Device	249	26%
2	Dropped	2,061	12%	Cause Not Reported	136	14%
3	Forklift Accident	1,706	10%	Defective Component or Device	87	9%
4	Loose Closure, Component or Device	1,595	9%	Deterioration or Aging	72	7%
5	Inadequate Blocking and Bracing	1,418	8%	Inadequate Preparation for Transportation	67	7%
6	Defective Component or Device	1,230	7%	Over-pressurized	43	4%
7	Impact with Sharp or Protruding Object (e.g. nail)	1,219	7%	Improper Preparation for Transportation	43	4%
8	Improper Preparation for Transportation	1,217	7%	Missing Component or Device	38	4%
9	Inadequate Preparation for Transportation	959	6%	Human Error	35	4%
10	Cause Not Reported	937	5%	Misaligned Material, Component or Device	33	3%
	Total	14,642	85%	Total	803	82%
	All	17,146	100%	All	975	100%

CHAPTER 3: PLANNING FOR THE TRANSPORTATION OF HAZARDOUS MATERIALS

It is vital for the transportation planning community to fully understand methods to effectively manage the movement of hazardous materials thereby improving operations, increasing safety, and reducing risk, without undue burden to commerce. This chapter describes the stakeholders involved in the movement of hazardous materials and management strategies available to communities and planners.

STAKEHOLDERS

In examining the number of producers, shippers, and carriers of hazardous materials, Transportation Research Board (TRB) Special Report 283 (*9*) utilized multiple data sources to identify over 14,000 establishments involved in the production of hazardous materials nationwide. One estimate of the number of shippers indicates that 45,000 firms regularly ship significant quantities of hazardous materials, while an additional 30,000 firms occasionally ship hazardous materials. These shippers may have multiple business locations, which compounds the number of actual shipping points. These shipments are transported by almost 550,000 carriers, both dedicated and occasional. These carriers utilize about 400,000 dedicated large trucks, 115,000 railroad tank cars, and more than 3,000 tank barges. The population of receivers of hazardous materials varies widely, both in number and type. In addition to the manufacturers, shippers, carriers, and receivers, multiple diverse local, state, and federal agencies are concerned with the safe and secure transport of hazardous materials. Table 24 illustrates the multitude of stakeholders involved with hazardous material transport.

Table 24. Listing of Hazardous Materials Transportation Stakeholders.

Source: TRB Special Report 283(*9*)

I. **Public Sector** - Government entities that are involved in ensuring the safe and secure transportation of hazardous materials

1. Federal level: Primary roles are regulation, enforcement and research.
   - Department of Transportation Research and Special Programs Administration
   - Federal Railroad Administration
   - Federal Motor Carrier Safety Administration
   - Federal Aviation Administration
   - Federal Highway Administration
   - Bureau of Transportation Statistics
   - National Highway Traffic Safety Administration
   - Department of Homeland Security
   - United States Coast Guard
   - Transportation Security Administration
   - Bureau of Customs and Border Protection
   - Federal Emergency Management Agency
   - Department of Energy National laboratories
   - Nuclear Regulatory Commission
   - Department of Defense
   - U.S. Army Corps of Engineers
   - Occupational Safety and Health Administration
   - Environmental Protection Agency
   - National Transportation Safety Board

2. State and Local level: Primary roles include infrastructure management, emergency response, and enforcement
   - State emergency planning management offices
   - Local emergency management offices and committees
   - State and local police
   - Local firefighters
   - State, regional, and local hazardous materials response units
   - State highway, railroad, and transportation agencies
   - State and regional airport and marine port authorities
   - State environmental protection agencies
   - State/county/city MPO government in general
   - Adjacent potentially affected states

II. **Private Sector** - Private companies involved in operations, infrastructure, production, or use of hazmat

- Carriers: associated with any of the modes truck, railroad, pipeline, barge, maritime.
  - They number about 45,000 dedicated carriers and about 500,000 occasional ones.
- Shippers: They number about 45,000 regulars and about 30,000 occasional ones
- Receivers: Located in farms, disposal sites, refineries, factories, retailers, hospitals, swimming pools

III. **Industry Associations** – Responsibility for establishing standards, providing training, and emergency response.

1. Dangerous Goods Advisory Council
2. Commercial Vehicle Safety Alliance
3. Association of American Railroads
   - Bureau of Explosives
   - Tank Car Committee
4. Railway Supply Institute
   - Railway Supply Institute – Association of American Railroads: Tank Car Safety Research and Test Project
5. American Chemistry Council: CHEMTREC, CHEMNET (with shippers)
6. American Trucking Associations
7. National Tank Truck Carriers, Inc.

IV. **General Public** – neighborhood associations, citizen groups, community members.

HAZARDOUS MATERIALS MANAGEMENT STRATEGIES

There may be an array of management strategies, at the planning or operational level, likely to lead to solutions or improvements related to safe transport of hazardous materials, depending on the level of government concerned (local, regional, or statewide). The management strategies generally fall within four categories:

- Route and/or Operational Strategies;
- Planning Strategies;
- Safety Strategies; and
- Infrastructure Strategies.

Route and/or Operational Strategies

Hazardous Materials Route Designation – Route Risk Assessment

The *Highway Routing of Hazardous Materials: Guidelines for Applying Criteria* (*10*) document provides guidance to states, Indian tribes, and local governments on how to apply and implement the federal standards for establishing, maintaining, and enforcing designated Non-Radioactive Hazardous Materials (NRHM) routes. There are two types of designations: designated routes and restricted routes. Designated routes are those highways on which NRHM must be transported, and restricted routes are those highways on which NRHM may not be transported. Restrictions can include tunnels, lanes, time of day, prior notice, escort requirements, etc.

The federal standards provide for enhancement of safety, public participation, consultation with other parties, through highway routing, reasonable routes to facilities such as terminals, timely agreement between jurisdictions, and timely local compliance. In addition, 13 factors are to be considered in the designation process:

- population density;
- highway type;
- NRHM type and quantity;
- emergency response capabilities;
- consultation with others;
- risk exposure of sensitive areas (e.g., homes, hospitals, schools, water sources, natural areas);
- terrain;
- route continuity;
- consideration of alternative routes;
- effects on commerce;
- delays in transportation of NRHM;
- climatic conditions; and
- congestion and accident history.

The methodology reflects approaches for determination of incident probability and consequences in the primary risk calculations. Different methods requiring varying degrees of input data and calculations provide options to agencies. Additional quantitative and qualitative considerations are included as well as a worked example to illustrate the application of preferred methods identified in the main body. In more detail the contents of the *Highway Routing of Hazardous Materials: Guidelines for Applying Criteria* are:

- Section II provides an overview of the process for analyzing hazmat routes and describes routing standards and factors and ways to apply and implement them in the routing process. The concept of risk is defined, and each step in the process is explained.
- Section III discusses the main analytical method for determining risk.
- Section IV presents additional analyses using many of the factors that must be considered when analyzing hazmat routing alternatives.
- Section V presents a worked example as a simple walk-through of the routing analysis process. The example includes population and property risk calculations and uses "preferred" methods where multiple optional methods have been identified in Sections III and IV.
- Appendix A contains background information on managing public involvement, including guidance on how to develop a mailing list and how to conduct public hearings.
- Appendix B contains information on the public information and Federal reporting requirements regarding designated routes.
- Appendix C discusses considerations for assessing risk and other factors associated with routes that include tunnels.
- Appendix D provides background and information on emergency response capabilities.
- Appendix E contains supporting calculations for the example in Section V.
- Appendix F contains blank worksheets and forms for structuring and conducting the route analyses.
- References.

At the beginning of each section a box indicates which of the standards and factors are discussed within that section. This helps the user ensure that all standards and factors are considered as required in the Routing Rule.

Texas Designated Hazardous Materials Routes. At the end of this document, Appendix E identifies the designated hazardous materials routes in Texas, and Appendix F provides the Texas Administration Code that specifies hazardous materials routing designation.

Truck/Highway Operational Management Strategies

There are several reasons to consider truck operational management on highways:

- speed differential;
- grade or curvature issues;
- other difficult operational areas, such as weaving areas and entry/exit ramps or configurations; and
- perceived comfort or safety by traveling public.

The operational management of trucks on highways includes implementing exclusive operating lanes, bypass lanes, dual facilities, or lane restrictions.

Exclusive Lanes. The operational strategy of exclusive lanes provides certain vehicles, usually designated by vehicle type, an exclusive operational lane. The most common types of vehicles designated for this strategy are buses and large trucks. Buses are often given exclusive lanes to provide an incentive for riders by decreasing delay, whereas trucks are separated in an attempt to decrease the effects of trucks on safety and reduce conflicts by the physical separation of truck traffic from passenger car traffic. It should be noted that until recently, very few truly exclusive facilities existed, and many of those facilities actually restricted trucks and/or buses to specified lanes and allowed other vehicles to use any lane (*11*).

The issue of increasing truck traffic is of vital concern to both traffic managers and the general public. Highway traffic operations are the "yardstick" by which the user measures the quality of the facility. The characteristics that matter most to the driver are speed of travel, safety, comfort, and convenience. As a result of increasing demand on highways, many transportation agencies have implemented a variety of strategies or countermeasures for trucks in an attempt to mitigate the effects of increasing truck traffic, including exclusive truck lanes. Feasibility studies regarding restrictions and exclusive lanes found that exclusive barrier-

separated facilities were most plausible for congested highways where three factors exist: truck volumes exceed 30 percent of the vehicle mix, peak-hour volumes exceed 1800 vehicles per lane-hour, and off-peak volumes exceed 1200 vehicles per lane-hour *(12)*.

In 1986, a research study *(13, 14)* by TTI examined the feasibility of an exclusive truck facility for a 75-mile segment of IH-10 between Houston and Beaumont. The options considered in the study included the construction of an exclusive truck facility within the existing IH-10 right-of-way, construction of an exclusive truck facility immediately adjacent to IH-10 outside of the existing right-of-way, or construction of an exclusive facility on, or immediately adjacent to, an existing roadway that parallels IH-10 (US 90). The studies concluded that existing and future trends in traffic volumes did not warrant an exclusive facility along the IH-10 corridor.

Theoretically, truck facilities could have positive impacts on noise and air pollution, fuel consumption, and other environmental issues. Creating and maintaining an uninterrupted flow condition for diesel-powered trucks will result in a reduction of emissions and fuel consumption when compared to congested, stop-and-go conditions. However, the creation of a truck facility may also shift truck traffic from more congested parallel roadways, thereby shifting the environmental impacts. There may also be increases in non-truck traffic on automobile lanes due to latent demand. Feasibility studies for exclusive truck lanes have also been conducted in Virginia, California, the United Kingdom, and the Netherlands. However, to date, none of the proposed exclusive facilities have been implemented *(15)*.

Separation and Bypass Lanes. The separation or bypass lane is a treatment for a specific section or segment of roadway. Several areas have used this management strategy that often addresses a roadway segment that has the following characteristics: weaving area, a significant grade, high percentage of truck traffic, and/or congestion. Weaving areas are segments of freeway formed when a diverge area closely follows a merge area. Operationally, weaving areas are of concern because the "crossing" of vehicles creates turbulence in the traffic streams. Trucks limit the visibility and maneuverability of smaller vehicles attempting to enter and exit the freeway system. An indication of the barrier effect is an over-involvement of trucks in weaving area crashes, rear-end collisions, and side collisions. Some studies have shown that this problem may be magnified when a differential speed limit is present (*16, 17)*.

A truck bypass facility exists on a section of northbound IH-5 near Portland, Oregon, at the Tigard Street interchange; it is similar to some of the California facilities. The bypass lane

requires trucks to stay in the right lane, exit onto a truck roadway, and reenter traffic downstream of the interchange. Passenger cars are also allowed to use the bypass facilities. One reason this facility is needed is a significant grade on the main lanes of IH-5. Without the truck roadway, larger vehicles would be forced to climb a grade and then weave across faster moving traffic that is entering the main lanes from their right. The resulting speed differentials caused by trucks performing these maneuvers created operational as well as safety problems prior to the implementation of the bypass facility. Truck speeds are now typically 50 mph in the merge area; prior to implementation of the bypass lane, truck speeds were 20 to 25 mph. There were no specific cost data available for construction of the bypass lane *(18)*.

Interstate 5 north of Los Angeles is a corridor with a very heavy volume of truck traffic. In the 1970s, Caltrans built truck bypass lanes on IH-5 near three high-volume interchanges. The lanes were built to physically separate trucks from other traffic and to facilitate weaving maneuvers in the interchange proper. The first truck facility encompasses the section of IH-5 that includes the Route 14 and Route 210 interchanges. The other truck facilities are at Route 99 near Grapevine and at the interchange of Route 110 and IH-405. Although these facilities were built for trucks to bypass the interchanges, automobiles and other vehicles also use the lanes to avoid the weaving sections *(18)*.

Dual Facilities. Dual facilities are managed lane strategies that have physically separated inner and outer roadways in each direction. Managed lanes is defined as "a facility that increases freeway efficiency by packaging various operational and design actions. Lane management operations may be adjusted at any time to better match regional goals." The inner roadway is reserved for light vehicles or cars only, while the outer roadway is open to all vehicles. The New Jersey Turnpike has a 35-mile segment that consists of interior (passenger car) lanes and exterior (truck/bus/car) lanes within the same right-of-way. For 23 miles, the interior and exterior roadways have three lanes in each direction. On the 10-mile section that opened in November 1990, the exterior roadway has two lanes, and the interior roadway has three lanes per direction. Each roadway has 12-ft lanes and shoulders, and the inner and outer roadways are barrier separated. The mix of automobile traffic is approximately 60 percent on the inner roadways and 40 percent on the outer roadways *(18)*.

These facilities, referred to as dual-dual segments, were implemented to relieve congestion. Other truck measures that have been implemented on the turnpike are lane

restrictions and ramp shoulder improvements. The restriction implemented in the 1960s does not allow trucks in the left lane of roadways that have three or more lanes by direction. On the dual-dual portion of the turnpike from Interchange 9 to Interchange 14, buses are allowed to use the left lane. The resulting effect is that the left lane becomes a bus lane with the right lane(s) occupied by trucks. The New Jersey Turnpike Authority (NJTA) rates compliance for truck lane restrictions as high *(16)*.

Lane Restrictions. Lane restrictions are a management strategy that limits certain types of vehicles to specified lanes. The most common type of lane restriction addresses truck traffic. A large presence of trucks, both in rural and urban areas, can degrade the speed, comfort, and convenience experienced by passenger car drivers. Some states, to minimize these safety and operational effects, have implemented truck lane restrictions or have designated exclusive truck lane facilities (an example urban highway sign indicating a truck lane restriction is shown in Figure 28).

Figure 28. Truck Lane Restriction Sign on Texas Freeway.

In 1986, the Federal Highway Administration (FHWA) asked its division offices to conduct a survey and report on experiences encountered by states with lane restrictions. This survey indicated a total of 26 states used lane restrictions. The most common reasons for implementing lane restrictions were:

- improve highway operations (14 states),

- reduce accidents (8 states),
- pavement structural considerations (7 states), and
- restrictions in construction zones (7 states).

It should be noted that some states provided more than one reason for the restriction *(19)*.

System Design

Roadway design can play a major role in the safe and efficient movement of hazardous materials through communities, as well as to and from fixed facilities. The movement of hazardous materials does not occur by specialized trucks, when considering operational standards. Thus, the same roadway design considerations that apply to universal truck operations are also valid for hazmat trucks and include:

- turning radii,
- pavement strength,
- interchanges,
- highway entrances/exits,
- merging/weaving locations,
- passing lanes,
- roadway/shoulder widths,
- turn lanes,
- storage space,
- parking facilities,
- signing,
- traffic control, and
- access management.

Planning Strategies

Commodity Flow Survey – Regional Risk Assessment

Federal hazardous materials law established a grants program for states that wish to address transportation-related risks in emergency response planning and provide training funds for emergency responders. Commodity flow surveys are one of the activities eligible for funding under the legislation. The law also authorized states to designate hazardous materials highway routes. Prior to designating routes, planners need to analyze the risks associated with hazardous materials transportation within their jurisdiction. Conducting an analysis of commodity flows is an important step in assessing transportation-related hazardous materials risks. Specific purposes of a commodity flow study include:

- identification of frequently used transportation routes in the area;
- assessment of total truck traffic and its daily and seasonal variations;
- improvement of commercial driver awareness and training;

- assessment and improvement of local emergency response personnel training;
- risk assessment of hazardous materials routes, evaluation of alternative routes, and route designations;
- improvement of highway/infrastructure safety; and
- input to urban planning activities (transportation and facilities).

Commodity flow surveys are resource intensive, in terms of money, labor, and time. Exploration of existing data sources for hazardous materials origins, destinations, and routes in the area is recommended before determining whether expensive field data collection is necessary to fulfill the goals of the study, especially since many hazardous materials movements are restricted to designated routes.

The purpose for the study, the design specifics of the study, and the resources and time available, are interconnected, so multiple revisions and iterations may be necessary at the study design stage. The federal guide, *Guidance for Conducting Hazardous Materials Flow Surveys*:

- provides step-by-step guidance to states, Local Emergency Planning Committees (LEPCs), and other planners on how to conduct a commodity flow study for hazardous materials moving by highway;
- discusses the need and objectives for this type of study and details how to review baseline information and design the study;
- explains the international hazard classification system of the nine classes of hazardous materials;
- includes step-by-step instructions and examples for collecting the data via field studies, analyzing the results, and applying these results back to the purpose of the study;
- describes selected recent state and local hazardous material flow studies;
- illustrates how to conduct and complete a hazmat flow survey from beginning to end through a case study example; and
- describes a model that allocated commodity flows between producers and consumers to further emphasize that models may be useful for predicting national trends, but state and sub-state movements of hazardous chemicals can only be determined more accurately through a commodity flow study (*20*).

Upon completion of a commodity flow study based on this guidance, planners will have a better understanding of hazardous materials transportation patterns and can use these data to conduct planning and estimate risks facing the jurisdiction.

Numerous states and metropolitan areas have successfully conducted hazardous materials commodity flow surveys in the manner recommended by the guide and their case studies are included in the published report.

Comprehensive Hazard Planning

In Texas, the Governor's Division of Emergency Management (GDEM) is "charged with carrying out a comprehensive all-hazard emergency management program for the State and for assisting cities, counties, and state agencies in planning and implementing their emergency management programs (*21*)." The GDEM indicates that a comprehensive emergency management program includes:

- mitigation – pre- and post-disaster mitigation of known hazards to reduce their impact;
- preparedness – preparedness activities, such as emergency planning, training, and exercises;
- response – provisions for effective response to emergency situations; and
- recovery – recovery programs for major disasters.

As indicated in the *Local Emergency Management Planning Guide*, state law directs each political subdivision (county or incorporated city) to maintain an emergency management program or participate in an inter-jurisdictional program. This document provides procedures for submitting these emergency planning documents to the GDEM.

Local Hazardous Materials Planning. According to the GDEM, LEPCs assist local governments in carrying out emergency planning related to hazardous materials. The role of LEPCs is to "form a partnership between local government and industry as a resource for enhancing hazardous materials preparedness," including:

- ensuring the local hazard analysis adequately addresses hazmat incidents;
- incorporating planning for hazmat incidents into the local emergency management plan and annexes;

- assessing capabilities and developing hazmat response capability using local resources, mutual aid and contractors;
- training responders; and
- exercising the plan (*22*).

LEPCs are identified as the link between citizens, industry, and government. With every county having or participating in at least one LEPC, there are 270 LEPCs in Texas.

Planning for Incidents. The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requires LEPCs to develop local plans for emergency response in the event of a release of an extremely hazardous substance. The risk of hazardous materials incidents and the fact that local governments will be completely on their own in the first stages of almost any such incident, necessitate the continuing preparedness capacity by local communities. A specific, tangible result of being prepared is an emergency plan that has recently been tested and revised. Not every community, however, may be ready for or capable of such a complete, comprehensive approach to emergency planning as required by federal law. Likewise, officials of facilities handling chemicals, railroad yards, and shipping and trucking companies need to coordinate their own hazardous materials emergency planning with that of the local community. State officials as the next higher level of government need to be closely coordinated with local plans, assist in their development, revision, and implementation, and complement them through managing the fixed and mobile presence of hazardous materials on a statewide level.

Hazardous materials shipments actually account for only 4 to 8 percent of all freight shipments (*23*). Incidents are therefore relatively rare but can have serious consequences. When comparing the total costs of incidents, non-hazardous materials incident costs are collectively far greater than hazardous materials incidents, but the average cost per hazardous materials incident is higher.

Hazardous materials incidents occur both at fixed facilities (manufacturing, processing, storage, and disposal) and during transportation (highways, waterways, rail, pipelines, and air). Identification of incident risk should indicate the following:

- the types and quantities of hazardous materials located in or transported through a community, region, or state;
- the location of hazardous materials, i.e., facilities and routes. The list is not exhaustive but it typically includes:

    - chemical plants,
    - refineries,
    - industrial facilities,
    - petroleum and LPG tank farms,
    - storage facilities/warehouses,
    - trucking terminals,
    - drinking water plants,
    - wastewater treatment plants,
    - refrigeration plants,
    - railroad yards,
    - vessels in port,
    - select retailers (e.g., agricultural, swimming pool suppliers, home supply stores),
    - hospital, educational, and government facilities,
    - waste disposal and treatment facilities,
    - waterfront facilities, particularly commercial marine terminals,
    - nuclear facilities,
    - airports,
    - major transportation corridors and transfer points; and
- the nature of the hazard (e.g., fire, explosion) most likely to accompany hazardous materials spills or releases.

A vulnerability analysis identifies what in the community or vicinity is susceptible to damage should a hazardous materials release occur and requires information on the following:

- the extent of the vulnerable zone (i.e., the significantly affected area) for a spill or release and the conditions that influence the zone of impact (e.g., size of release, wind direction);
- the sizes and types of populations (e.g., residents, employees, sensitive populations—hospitals, schools, nursing homes, day care centers) that could be within the vulnerable zone;
- the private and public property (e.g., homes, businesses, offices) that may be damaged, including essential services (e.g., water, food, power, medical) and transportation corridors; and
- the environment that may be affected, and the impact on sensitive natural areas and endangered species.

A risk analysis assesses the probability of damage (or injury) that would occur in the community if a hazardous material was released and the extent of damage (or injury) that might result, in light of the vulnerability analysis. Some planners may choose to analyze worst case scenarios. The risk analysis may provide information on:

- the probability that a release will occur and any unusual environmental conditions, such as areas in flood plains, or the possibility of simultaneous emergency incidents (e.g., flooding or fire resulting in release of hazardous materials);
- the type of harm to people (acute, delayed, chronic) and the associated high-risk groups;
- the type of damage to property (temporary, repairable, permanent); and
- the type of damage to the environment (recoverable, permanent).

Land Use Planning/Corridor Management and Preservation

Land Use Planning Considerations. Land use planning can increase safety, provide business development and expansion, and improve transportation efficiency. Some things to consider for public land use planning include:

- zoning for compatible land uses;
- proximity of neighborhoods and population centers compared to Tier II facilities, such as water treatment plants and industrial locations; and
- facilitation of industrial and commercial developments that allows for continued growth and expansion without encroachment of incompatible adjacent land uses.

Corridor Management and Preservation. Corridor management and preservation "generally refer to measures or practices to preserve or protect rights-of-way (ROW) in combination with managing how development occurs along a transportation corridor (*24*)." Corridor management and preservation activities bring together land use and transportation planning decisions. Preserving ROW for future corridor development and managing the development along existing corridors allows for long-term retention of intended function of the corridor. Improper corridor management may reduce operations and safety along a transportation corridor and increase the cost to fix prior planning mistakes.

Corridor management and preservation relates to all transportation corridors, such as highways, rail lines, and waterways. Primarily focusing on management and preservation along highways and rail lines, communities and planners should consider the following aspects:

- Highway Corridor Preservation Considerations (*24*):
    - typical corridor problems – numerous and poorly spaced driveways, closely spaced signals, and lack of interconnectivity between adjacent developments;

- possible long-term consequences – reduced mobility, increased congestion, and reduced safety; decline in property values; and loss or re-alignment of a planned corridor due to development;
- tools and techniques:
  - access management,
  - zoning and development regulations,
  - operational measures and intelligent transportation,
  - miscellaneous techniques, such as impact fees, interim uses, and density transfers, and
  - subdivision regulations;

- Railroad Corridor Preservation Considerations (*25*):
  - primary community concerns – noise, vibrations, air quality, safety, and rail yard activities;
  - private railroad concerns – safety, trespassing, legal considerations, grade crossings, environmental justice, and business development;
  - incompatible land uses for freight rail operations include – residential development, schools, daycare facilities, playgrounds, hospitals, hotels, and high-precision manufacturing operations;
  - effective corridor protection strategies:
    - advance corridor approval and official mapping,
    - protective condemnation,
    - setback standards,
    - development permitting,
    - overlay zoning,
    - joint development and informal negotiations with the private sector,
    - flexible and cluster zoning, and
    - transfer of development rights.

Safety Strategies

Highway-Rail Grade Crossings

Highway-rail grade crossings are an issue for both the rail operator and the roadway users. The Federal Railroad Administration indicates that there are over 14,700 public at-grade crossings in Texas. There were 295 reported highway-rail grade crossing incidents in Texas in 2007. Of these, only two indicated the transport of hazardous materials by the highway user, while 195 indicated the transport of hazardous materials by rail equipment. Railroads transport hazardous materials throughout their system serving producers and customers. Collisions

between trains and vehicles at highway-rail grade crossings represent an increased risk of rail car derailment. Most derailments do not result in rail cars exiting the track, falling over, or receiving structural damage that would result in a hazardous materials release. In addition to the rail car concern, there is also concern at grade crossings with the potential involvement of a roadway vehicle transporting hazardous materials. Several particular truck safety situations at highway-rail grade crossings are discussed below.

Storage Space. Intersections adjacent to a parallel roadway present a scenario where there is limited storage space between the rail track and the intersection. This is indicated with the following signs (see Figure 29). Truck drivers need to be cognitive of the total length of their equipment compared to the available space when approaching intersections with limited storage space, or queuing space. Transportation planners should evaluate these intersections to determine if additional treatments are required to enhance safety, such as altering the stop line position prior to the rail tracks.

Figure 29. Texas 2006 MUTCD Highway-Rail Grade Crossing Signs.

Low-Profile Crossings. Low-profile, or humped crossings result when the approach to the railroad track is steep where a low-profile trailer may get caught on the rail track. The low-profile traffic sign (see Figure 29) indicates crossings evaluated to be a humped crossing. Crossings that present this challenge may require roadway reconfiguration. A full evaluation may also show that with existing adjacent crossings presenting opportunity to close unsafe humped crossings.

Private Crossings. Railroad tracks and right-of-way are private property with access strictly limited to railroad personnel and others granted permission by the railroad. Depending on a crossing need and use, railroad companies issue permits, easements, or leases for

encroachments. Therefore, private crossings, especially those associated with a company or industrial area with frequent hazardous material shipments, may require coordination between public entities, the railroad, and the industries operating over the private crossings.

Commercial Motor Vehicle Inspections

The practice of inspecting commercial motor vehicles means to ensure safe and secure operations of all commercial vehicles, including those transporting hazardous materials. In particular, inspecting commercial vehicles transporting hazardous materials can ensure regulatory compliance and security procedures.

Federal Motor Carrier Safety Administration (FMCSA) Motor Carrier Safety Assistance Program (MCSAP). The MCSAP is a "Federal grant program that provides financial assistance to States to reduce the number and severity of crashes and hazardous materials incidents involving commercial motor vehicles (CMV) (*26*)." The FMCSA describes the North American Standard Driver/Vehicle Inspection Levels in great detail on their website. Below is a brief description of the levels:

- Level I – North American Standard Inspection
  - Includes complete inspection of the driver and vehicle
- Level II – Walk-Around Driver/Vehicle Inspection
  - Includes complete inspection of the driver and vehicle components not requiring inspection under the vehicle
- Level III – Driver-only Inspection
  - Includes complete driver-specific inspection items, such as driver's license, medical certificate, and hours of service
- Level IV – Special Inspections
  - Typically a one-time examination of a particular item
- Level V – Vehicle-only Inspections
  - Includes complete vehicle inspection, without the driver present

The Critical Vehicle Inspection Items include (*27*):

- brake system,
- coupling devices,
- exhaust systems,
- frame,
- fuel system,
- lighting devices,
- safe loading,
- steering mechanism,
- suspension,
- tires,
- van and open-top trailer bodies,
- wheels, rims and hubs,
- windshield wipers, and
- emergency exit for buses.

Education and Outreach

Education and outreach refer to both the commercial vehicle drivers and the traveling public. The Federal Motor Carrier Safety Administration (FMCSA) addresses driver education in several ways. One simple action is to provide drivers with a card that provides basic information related to hazardous materials and also provides a simple check-list for hazardous materials shipments. Figure 30 shows the FMCSA 'Yellow Card.'

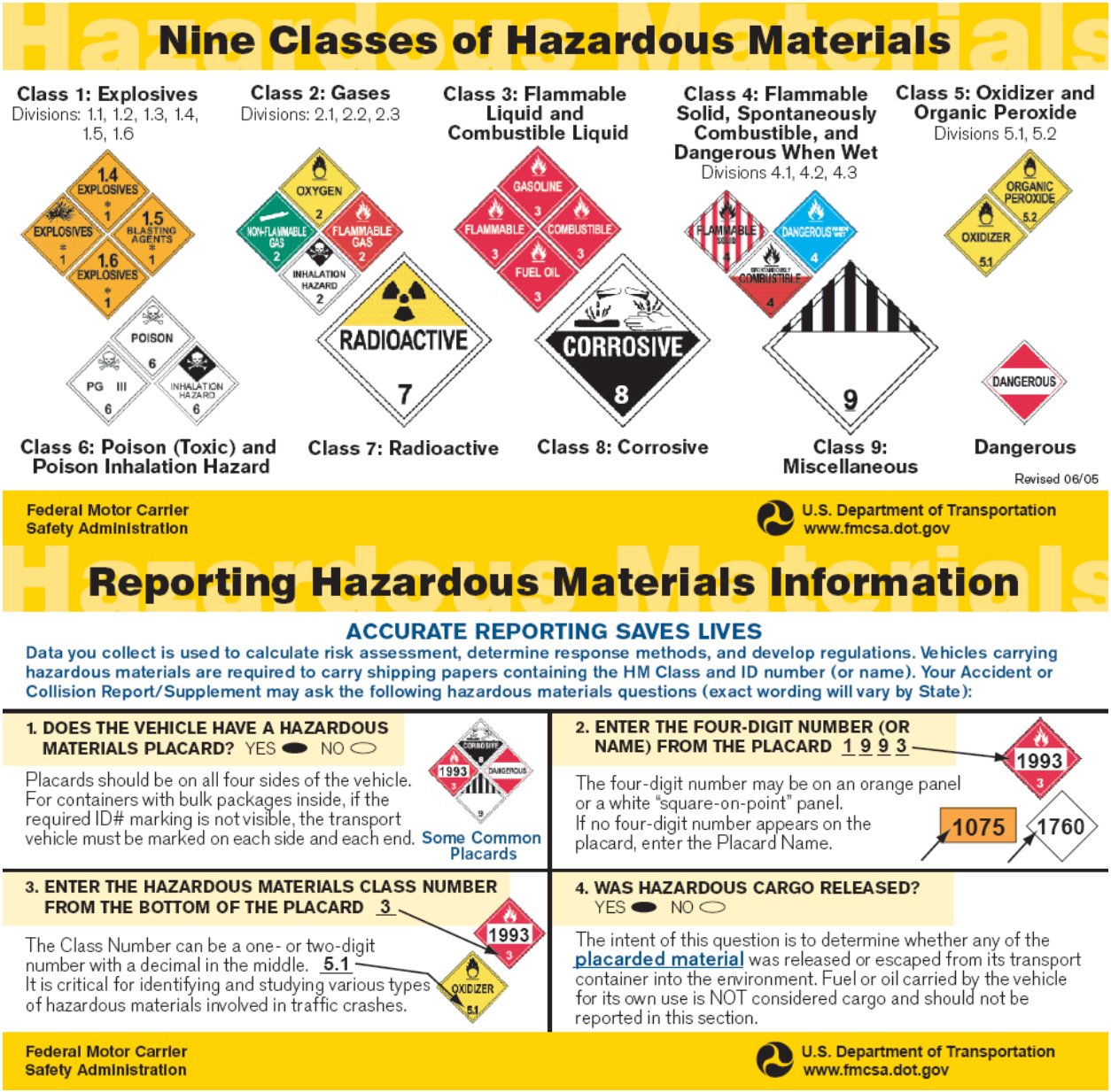

Figure 30. Motor Carrier Safety Administration Yellow Card.
Source: FMCSA (*28*)

The FMCSA indicates that over half of accidents involving commercial motor vehicles have been determined to be due to fault of the passenger vehicle operating around large trucks. The FMCSA has developed an educational initiative called "Share the Road Safely" that identifies safe operations for both commercial vehicle operations and the traveling public as they operate around large trucks and buses.

Of particular concern is the operation of passenger vehicles in commercial vehicle blind spots. These areas are identified as "No-Zones." The FMCSA informs commercial vehicle drivers to be vigilant in recognizing vehicles in the "No-Zones." Also, educational material related to passenger vehicle operations around large trucks has been published and disseminated to the traveling public, as demonstrated in Figure 31.

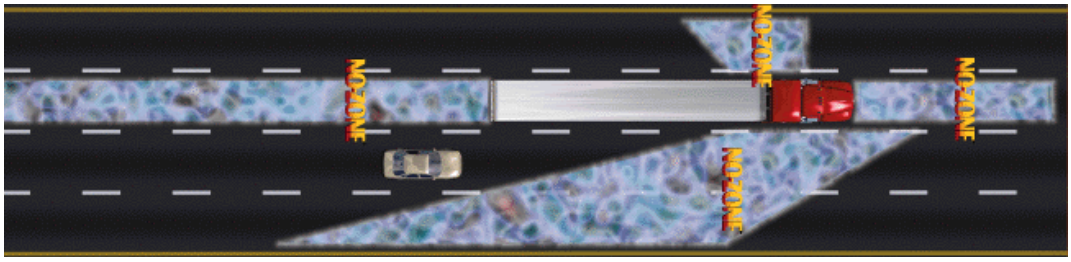

Figure 31. The "No-Zone" Illustration.

The police force in the state can address unsafe vehicle operating practices by monitoring both commercial vehicle and passenger vehicle operations on roadways. Unsafe practices include tailgating, unsafe lane changes, speeding, failing to signal lane changes, and aggressive driving, which is a combination of the previous behaviors. The Austin Police Department is the first municipal department to receive a FMCSA grant for the Ticketing Aggressive Cars and Trucks program. Previously only administered to states, this program strives to reduce fatalities and injuries from unsafe driving behaviors by passenger vehicles and commercial motor vehicles. Educational material encourages the public to "Leave More Space for Trucks," as demonstrated in Figure 32.

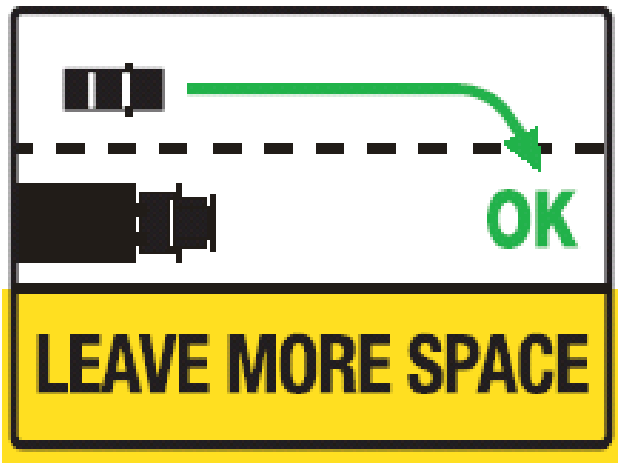

Figure 32. "Leave More Space for Trucks" Illustration.

Alternatives to Hazardous Materials

Hazardous materials are utilized in a wide spectrum of applications, from home cleaning products to catalysts for the production of chemicals. Hazmat is moved because it is needed for a particular use at a particular place. In some instances, hazmat can be substituted with less toxic chemicals or processes. Most of this activity tends to occur within the private industry if driven by market forces. For example, consumers that are concerned about toxic products now have the option of purchasing less toxic and/or "greener" alternatives, which is a growing trend. Some less-toxic processes can also be adopted. For example, the use of ultraviolet rays to kill harmful bacteria at water treatment plants is an option in lieu of using chlorine. However, altering the process or developing a new process that uses less toxic alternatives comes with trade-offs, such as the loss of beneficial residual chlorine in the water system or the cost to reconfigure a water treatment plant for performing an entirely different process.

Security Measures

Until recently the primary concern was the risk of an *accidental* release of hazardous materials that could adversely, and possibly catastrophically, affect public safety and health. Today there is considerable concern for the *intentional* release or use of hazardous materials shipments by terrorists to purposely harm society. Beginning with the 1975 Hazardous Materials Transportation Act, and continuing through its reauthorizing legislation, the Secretary of Transportation's role in hazardous material regulation and enforcement was empowered.

Governmental efforts pushed toward unifying the previously fragmented hazardous materials regulatory and enforcement authorities. Today major legislative and regulatory focus lies on the security of the nation's transportation system, especially freight, and in particular highly dangerous hazardous materials such as the Toxic Inhalation Hazard Materials (TIH).

The industries involved in hazardous materials transport are currently working to improve the security of the shipments. For example, the Association of American Railroads reports that the rail industry created a Railroad Security Task Force in 2001 that developed a "Terrorism Risk Analysis and Security Management Plan (*29*)." The railroads are also working closely with major shippers, the chemical industry, and tank car manufacturers in a partnering effort to increase safety and security of rail shipments. Even more recent proposed and finalized initiatives indicate the types of future actions required to enhance safe and secure transport of hazardous materials. A brief overview of these actions is listed below.

- Tracking of TIH tank car movements in high threat urban areas – The collection and analysis of TIH tank car movements is intended to monitor the standstill time TIH cars remain in one location. Alerts would be issued for excessive dwell times.
- New tank car design – The threat of release would be reduced with increased tank car design requirements, such as wall thickness.
- Requirement of railroads to route hazardous materials based on a range of safety and security factors – Jointly developed between the Department of Homeland Security and the U.S. Department of Transportation, this requires railroads to "perform a safety and security risk analysis to determine the most appropriate route for shipping hazardous materials (*30*)." This item is further discussed in Chapter 4.

Infrastructure Strategies

Infrastructure strategies include the development of new infrastructure to primarily bypass population centers, where existing hazardous materials is routed now. This strategy considers both the relocation of truck and rail shipments. Chapter 4 discusses in more detail the relocation of hazardous materials routes.

CHAPTER 4: RELOCATION OF HAZARDOUS MATERIALS ROUTES - TRUCK AND RAIL

INTRODUCTION

One method of addressing hazardous materials safety in urban areas that has been frequently suggested over the past decade has been the re-routing of non-radioactive hazmat movements to remote locations outside urban areas in order to reduce the risks and potential costs of hazmat incidents and potential releases. Generally, most large urbanized areas have now designated hazmat truck routes along Interstate highway bypass routes that skirt the urban area, with exceptions to traveling these routes provided only for deliveries to and from an origin or destination within the urbanized itself where the hazmat are used or processed further. These truck routes have typically been in place for many years and trucking companies have adjusted their base locations and/or operations to comply with the well-established and well-known routings.

Railroad companies, on the other hand, do not typically have the same latitude in route selection or flexibility in operations to send hazmat tank cars via a more circuitous route in order to avoid urban areas that trucking companies have. Many, if not most, rail routes traverse major urban centers and often pass by or near facilities where high population concentrations exist such as universities, sports venues, or even residential areas. Because railroad companies are limited to the use of their own rail routes—often only one line through and urban area—most railroad hazmat travels along the most direct routing, even if that routing goes through highly-populated areas. Construction of new rail routes outside the urban area is too costly to consider when the likelihood of an incident is so low.

Even those railroad companies that have extensive networks giving them some choice in overall routing of hazmat shipments choose the most effective routing to minimize risk over the entire trip from origin to destination. Although rail transport of hazmat is often contracted over much longer distances than trucks, the ability to avoid individual cities along the route which is determined to have the lowest total risk is not usually an option due to three main factors:

1. lack of available bypass tracks around specific urban areas;
2. additional costs to operate the trains over a longer distance route; and

3. alternative routings with less reliable tracks resulting in more risk of derailment and slower delivery of goods.

As a result, railroad companies have heavily depended on confidentiality of cargoes and speed of movement over their network to maintain security of the movement of hazmat materials.

During the course of this research project in 2008, the federal government issued several notices of proposed rule-making related to the movement of hazmat by rail and to rail tank car security. Joint and overlapping rules were issued by the Federal Railroad Administration (FRA), the Pipeline and Hazardous Materials Safety Administration (PHMSA), and the Transportation Security Administration (TSA) requiring rail companies to justify current rail hazmat routes as the safest or most economically reasonable routes and requiring the replacement of the current tank car fleet by private railcar owners with substantially safer (i.e., less likely to rupture in a derailment or other incident) tank cars over a period of years.

PURPOSE OF HAZMAT RELOCATION EFFORTS

The purpose of truck and rail hazmat relocation efforts is to reduce the risk of highest possible consequences of an incident in which hazmat materials are released. In determining how to selectively route hazmat material movement, planners and public officials must decide if it is safest to re-route from existing corridors to a newly-designated corridor outside a heavily-populated or high consequence corridor or to rationalize several current hazmat routes into a single route (or reduced number of routes) that can be made more secure or less likely to have an incident. In the case of hazmat moving by truck, a separate facility for trucks only or a designated hazmat route along a bypass route may be provided.

For rail, although separate tracks only for hazmat movement have not been implemented and would be too costly to construct, railroad companies that have more than one possible route analyze each route to determine which one has the least risk and least cost to the railroad company. For example, the number of large urban areas through which the shipment must pass, the quality of the tracks along each route, and the number of river crossings where a derailment or an incident might have catastrophic impact are taken into account. A recent federal rulemaking document listed a minimum of 27 factors that railroad companies to consider in identifying hazmat routes to comply with the new proposed rules. Minimum factors to be considered in the performance of this safety and security risk analysis include (*31*):

1. Volume of hazardous material transported;
2. Rail traffic density;
3. Trip length for route;
4. Presence and characteristics of railroad facilities;
5. Track type, class, and maintenance schedule;
6. Track grade and curvature;
7. Presence or absence of signals and train control systems along the route (''dark'' versus signaled territory);
8. Presence or absence of wayside hazard detectors;
9. Number and types of grade crossings;
10. Single versus double track territory;
11. Frequency and location of track turnouts;
12. Proximity to iconic targets;
13. Environmentally sensitive or significant areas;
14. Population density along the route;
15. Venues along the route (stations, events, places of congregation);
16. Emergency response capability along the route;
17. Areas of high consequence along the route, including high consequence targets as defined in § 172.820(c);
18. Presence of passenger traffic along route (shared track);
19. Speed of train operations;
20. Proximity to en-route storage or repair facilities;
21. Known threats, including any nonpublic threat scenarios provided by the Department of Homeland Security or the Department of Transportation for carrier use in the development of the route assessment;
22. Measures in place to address apparent safety and security risks;
23. Availability of practicable alternative routes;
24. Past incidents;
25. Overall times in transit;
26. Training and skill level of crews; and
27. Impact on rail network traffic and congestion.

In addition to infrastructure issues, planners and public officials considering hazmat re-routing must also consider the need for and location of hazmat-dependent businesses within the highly populated areas that are to be bypassed. Water-treatment facilities using tankcars loaded with chlorine or truckloads of jet-fuel being delivered to an airport within or near the urban core are just two examples of how hazmat customers requiring regular deliveries are commonplace. Trucking and railroad companies are compelled by both economic profitability and common carrier obligation must service these customers. In order to minimize costs of such deliveries, customers may also store quantities of hazmat that they deem necessary at local terminals, warehouses, and distribution centers.

RAILROAD RELOCATION OPTIONS

Potential railroad relocations consist of three basic options:

- Undertake improvements along existing urban tracks that would reduce risk – These improvements include upgrading the maintenance of track to a higher track class, improving signals, or adding grade separations to reduce the possibility of rail-vehicle conflicts.
- Reroute to lower traffic-density track outside urban area – Although this option might move the hazmat traffic to a less populated area, there are several drawbacks such as increased cost of movement and potentially slower response time should a derailment or another incident occur.
- Reroute to new infrastructure outside urban area – This option may reduce risk for a period of time although care must be taken to maintain future zoning nearby to new infrastructure to compatible uses.

Moving rail movements outside of a high population area does not always reduce risk. In many cases, the safest, highest quality tracks are located along current routes that pass through urban areas. This has resulted from decades of regular maintenance and investment by railroad companies within a legal environment that, in effect, financially punishes them if a release of toxic hazmat occurs while in transit due to a problem with the track. Railroad companies are required by their common carrier obligation under federal law to publish rates and move the hazmat that is presented to them for movement as long as it is loaded properly and/or enclosed within a functioning tankcar. To prevent a catastrophic escape from occurring following a derailment or other incident, investment and maintenance attention has been focused upon tracks through high-risk, high population areas. Moving these hazmat movements to more rural and, generally, lower track class routes would not necessarily improve the overall safety of each movement and also engender strong responses from citizens located along those routes who would see an increase in risk. Some potential benefits to be derived from urban to rural rail movements are:

- moves hazmat incident risk to less populated areas, thereby reducing potential costs following an incident;
- removes potential for mass casualty security incident from urban areas;

- improves air quality in the urbanized area that may be designated as an air quality non-attainment area;
- frees up additional urban rail capacity for other uses such as transit; and
- reduces possibility of vehicle conflicts and incidents at highway-rail grade crossings by moving to an area of less traffic.

Alternatively, the following could be view as possible adverse effects of moving urban hazmat movements to rural areas:

- exposure threat and potential damage still exists in a larger number of small urban areas;
- longer route may adversely affect timely delivery of goods and drive up costs;
- reduced emergency response capabilities in rural areas compared to well-equipped and trained urban response personnel; and
- quality of tracks along diversion route may not be as high and increase the actual risk of incident occurrence.

Because of this, an analysis of risk versus reward in relocating the hazmat route must be performed by the rail company and/or public sector to determine the wisdom of choosing the new route for hazmat movement versus maintaining the current route.

Issues associated with truck hazmat route relocation were discussed in more detail in the previous chapter. Options include routing hazmat over different but existing bypass routes, to more rural areas over lower graded facilities, and the construction of new, truck-only facilities designed specifically for safety of truck/hazmat movements and increased security.

TEXAS OPPORTUNITIES

Several opportunities exist to address both truck and rail hazmat transport within Texas. Although the "Trans Texas Corridor" concept has been abandoned by TxDOT in early 2009, several strategic corridors continue in development that could potentially re-route long-distance hazmat movements from the most congested urban areas of Texas to new corridors outside existing development. Preserving corridors conducive to hazmat movement and allowing only development that is compatible must be considered if these routes are to be viable alternatives. Inclusion of truck-only facilities in such corridors might further increase the safety of hazmat movement by improving the design features of the roadway and limiting the interaction of trucks

with automobiles. Toll policies on such facilities could also be managed to encourage hazmat trucks to use bypass routes or truck-only lanes that move hazmat trips outside major urban areas. Where an outer loop or bypass route does not exist, limiting the possibility of an hazmat incident by using improved design features is also desirable.

Opportunities to address rail relocation for hazmat movement in Texas are also on the horizon. In 2005, the citizens of Texas passed an amendment to the Texas Constitution that created the Texas Rail Relocation and Improvement fund; however, subsequent legislatures have not yet capitalized the fund. Should sufficient funds become available from this source, several freight rail routes through urban areas could both be rationalized and made more secure or relocated outside the densest urban areas. Many potential projects of this type are identified in the Texas Rail System Plan or in recently completed regional freight studies completed by TxDOT and its rail consultants.

The 2007 Texas Legislature also passed House Bill 160 (HB 160) which required that a study of the economic feasibility of relocating freight rail hazardous materials from Texas' largest urban areas (>1.2 million in population) be completed. Both confidential and public versions of the report were published in March 2008, and the public version is available on TxDOT's website. This report outlines several potential rail relocation routes for each of the urban areas and estimates the costs associated with implementing each based upon the findings of the regional freight studies ongoing at the time of the study.

One final potential opportunity to relocate hazmat within Texas is the use of the Gulf Intracoastal Waterway (GIWW) and other state navigable waterways for movement of hazmat. The GIWW presents an opportunity to move hazmat by a transportation mode with a better safety record than either truck or rail. Diverting coastwise freight movements to waterborne vessels would have the potential of removing hazmat risk from highly populated highway corridors, but also brings the potential of hazmat releases into more fragile water ecosystems.

CHAPTER 5: CONCLUSIONS

At stated previously, this research examined the quantities and origins and destinations of hazardous materials flows in Texas by mode of transportation; reviewed the respective roles of the several stakeholders; provided effective state and sub-state level management opportunities of hazardous materials movements; and investigated the relocation of hazardous materials routes. Based on the findings, this chapter provides several concluding observations established from this research effort.

The public is largely unaware of their coexistence with hazardous materials on a daily basis.

Most urban centers developed around industrial sites, where the jobs were located. That placed many neighborhoods relatively close to these sites. The expansion of urban areas has also placed populations in close proximity to facilities that use or produce hazardous materials.

However, hazardous materials are not only located at industrial sites but also in our homes in small quantities, at the corner fuel center, and at local water treatment facilities, amongst others. The Transportation Research Board reports that there are over 150,000 service stations in the U.S. that receive motor fuel for distribution to the public (*9*). Most of these service stations are located at the entrances of our neighborhoods.

Generally, hazmat will pass—and in most cases must pass—by and through communities to reach the ultimate consumer.

As stated above, neighborhood service stations, urban industrial sites, and public facilities, such as water treatment plants, are often the ultimate consumer of hazardous materials. Additionally, the transportation networks in Texas and the U.S. were designed to serve the urban centers, leaving the major highways and rail lines passing through the urban areas. In most cases, there are few, if any, desirable alternative routes that bypass population centers. As both a major producer and major consumer of hazardous materials, Texas experiences high levels of hazardous materials transport over the entire transportation system.

Many actions to reduce the risk or improve safety exist or are possible in various ways.

This research identified several ways in which community, regional, and statewide planners can address the movements of hazardous materials. Some are directly related to hazardous materials managements, such as designating a hazardous materials route, while others are tools that can be used to address hazardous material shipments in different ways, such as altering the water purification process to utilize less hazardous chemicals. Ultimately, specific community, regional, and statewide concerns will guide the approach or approaches utilized to address hazardous material shipments through communities and urban areas. The guidebook developed as part of this research is designed to present the approaches to address concerns related to the transport of hazardous materials in Texas.

Freight planning initiatives nationally and statewide are enhancing and will continue to enhance safe and efficient movement of hazardous materials.

Increased national and statewide interest in planning for freight within the transportation planning process will promote more efficient and safe movement of freight on our transportation system, thus promoting more efficient and safe movement of hazardous materials. Nationally, recently implemented research programs specifically look at improving freight operations and freight planning; including the Hazardous Materials Cooperative Research Program (HMCRP) that specifically addresses research on hazardous materials topics. Furthermore, in order to better understand the movement of hazardous materials nationally, the 2007 Commodity Flow Survey has expanded its hazardous materials coverage over past surveys.

In Texas, a legislative directive resulted in the examination of relocating shipments of hazardous materials by rail to new infrastructure out of the major urban areas. Additionally, TxDOT has undertaken a comprehensive evaluation of freight rail operations in several urban areas and regions throughout the state. Many more efforts have addressed freight transportation by all the major modes.

National and state hazard management activities provide good framework for agencies to work together to reduce all hazard risks, including hazardous materials.

The development of the Department of Homeland Security, along with statewide directives, have placed an emphasis on multi-level coordination and planning for hazards,

including hazardous materials. These efforts are designed to decrease the likelihood of a hazardous event, along with react effectively once an event has occurred. This framework and continued development of multi-level relationships will only improve the safety of communities.

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APPENDIX A: 2008 EMERGENCY RESPONSE GUIDEBOOK GLOSSARY[1]

Acute Exposure Guideline Levels (AEGLs)	Acute Exposure Guideline Level(s), AEGLs represent threshold exposure limits for the general public and are applicable to emergency exposure periods ranging from 10 minutes to 8 hours. Three levels AEGL-1, AEGL-2 and AEGL-3 are developed for each of five exposure periods (10 and 30 minutes, 1 hour, 4 hours, and 8 hours) and are distinguished by varying degrees of severity of toxic effects; see AEGL-1, AEGL-2 and AEGL-3.
AEGL-1	AEGL-1 is the airborne concentration (expressed as parts per million or milligrams per cubic meter [ppm or mg/m3]) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. However, the effects are not disabling and are transient and reversible upon cessation of exposure.
AEGL-2	AEGL-2 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting adverse health effects or an impaired ability to escape.
AEGL-3	AEGL-3 is the airborne concentration (expressed as ppm or mg/m3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening health effects or death.
Alcohol resistant foam	A foam that is resistant to "polar" chemicals such as ketones and esters which may break down other types of foam.
Biological agents	Living organisms that cause disease, sickness and mortality in humans. Anthrax and Ebola are examples of biological agents.
Blister agents (vesicants)	Substances that cause blistering of the skin. Exposure is through liquid or vapor contact with any exposed tissue (eyes, skin, lungs). Mustard (H), Distilled Mustard (HD), Nitrogen Mustard (HN) and Lewisite (L) are blister agents. **Symptoms:** Red eyes, skin irritation, burning of skin, blisters, upper respiratory damage, cough, hoarseness.

[1] U.S. Department of Transportation, Research and Special Programs Administration (RSPA). *2008 Emergency Response Guidebook*. Washington, D.C. 2008. Online. Available: http://hazmat.dot.gov/pubs/erg/erg2008_eng.pdf

Blood agents Substances that injure a person by interfering with cell respiration (the exchange of oxygen and carbon dioxide between blood and tissues). Hydrogen cyanide (AC) and Cyanogen chloride (CK) are blood agents. **Symptoms:** Respiratory distress, headache, unresponsiveness, seizures, coma.

Burn Refers to either a chemical or thermal burn, the former may be caused by corrosive substances and the latter by liquefied cryogenic gases, hot molten substances, or flames.

CBRN Chemical, biological, radiological or nuclear warfare agent.

Choking agents Substances that cause physical injury to the lungs. Exposure is through inhalation. In extreme cases, membranes swell and lungs become filled with liquid (pulmonary edema). Death results from lack of oxygen; hence, the victim is "choked." Phosgene (CG) is a choking agent. **Symptoms:** Irritation to eyes/nose/throat, respiratory distress, nausea and vomiting, burning of exposed skin.

CO2 Carbon dioxide gas.

Cold zone Area where the command post and support functions that are necessary to control the incident are located. This is also referred to as the clean zone, green zone, or support zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472)

Combustible liquid Liquids which have a flash point greater than 60.5°C (141°F) and below 93°C (200°F). U.S. regulations permit a flammable liquid with a flash point between 38°C (100°F) and 60.5°C (141°F) to be reclassed as a combustible liquid.

Compatibility Group Letters identify explosives that are deemed to be compatible. Class 1 materials are considered to be "compatible" if they can be transported together without significantly increasing either the probability of an incident or, for a given quantity, the magnitude of the effects of such an incident.

- A Substances which are expected to mass detonate very soon after fire reaches them.
- B Articles which are expected to mass detonate very soon after fire reaches them.
- C Substances or articles which may be readily ignited and burn violently without necessarily exploding.
- D Substances or articles which may mass detonate (with blast and/or fragment hazard) when exposed

to fire.

E&F Articles which may mass detonate in a fire.

G Substances and articles which may mass explode and give off smoke or toxic gases.

H Articles which in a fire may eject hazardous projectiles and dense white smoke.

J Articles which may mass explode.

K Articles which in a fire may eject hazardous projectiles and toxic gases.

L Substances and articles which present a special risk and could be activated by exposure to air or water.

N Articles which contain only extremely insensitive detonating substances and demonstrate a negligible probability of accidental ignition or propagation.

S Packaged substances or articles which, if accidentally initiated, produce effects that are usually confined to the immediate vicinity.

Control zones Designated areas at dangerous goods incidents, based on safety and the degree of hazard. Many terms are used to describe control zones; however, in this guidebook, these zones are defined as the hot/exclusion/red/restricted zone, warm/contamination reduction/yellow/limited access zone, and cold/support/green/clean zone. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472)

Cryogenic liquid A refrigerated, liquefied gas that has a boiling point colder than -90°C (-130°F) at atmospheric pressure.

Dangerous Water Reactive Material Produces significant toxic gas when it comes in contact with water.

Decomposition products Products of a chemical or thermal break-down of a substance.

Decontamination The removal of dangerous goods from personnel and equipment to the extent necessary to prevent potential adverse health effects. Always avoid direct or indirect contact with dangerous goods; however, if contact occurs, personnel should be decontaminated as soon as possible. Since the methods used to decontaminate personnel and equipment differ from one chemical to another, contact the chemical manufacturer, through the agencies listed on the inside back cover, to determine the appropriate procedure. Contaminated clothing and equipment should be removed after use and stored in a controlled area (warm/contamination reduction/limited access zone) until

	cleanup procedures can be initiated. In some cases, protective clothing and equipment cannot be decontaminated and must be disposed of in a proper manner.
Dry chemical	A preparation designed for fighting fires involving flammable liquids, pyrophoric substances, and electrical equipment. Common types contain sodium bicarbonate or potassium bicarbonate.
Edema	The accumulation of an excessive amount of watery fluid in cells and tissues. Pulmonary edema is an excessive buildup of water in the lungs, for instance, after inhalation of a gas that is corrosive to lung tissue.
Emergency Response Planning Guidelines (ERPGs)	Emergency Response Planning Guideline(s). Values intended to provide estimates of concentration ranges above which one could reasonably anticipate observing adverse health effects; see ERPG-1, ERPG-2 and ERPG-3.
ERPG-1	The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing more than mild, transient adverse health effects or without perceiving a clearly defined objectionable odor.
ERPG-2	The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair an individual's ability to take protective action.
ERPG-3	The maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to 1 hour without experiencing or developing life-threatening health effects.
Flammable liquid	A liquid that has a flash point of 60.5°C (141°F) or lower.
Flash point	Lowest temperature at which a liquid or solid gives off vapor in such a concentration that, when the vapor combines with air near the surface of the liquid or solid, a flammable mixture is formed. Hence, the lower the flash point, the more flammable the material.
Hazard zones (Inhalation Hazard Zones)	**HAZARD ZONE A:** Gases: LC50 of less than or equal to 200 ppm; Liquids: V equal to or greater than 500 ppm and LC50 less than or equal to 200 ppm, **HAZARD ZONE B:** Gases: LC50 greater than 200 ppm and

	less than or equal to 1000 ppm; Liquids: V equal to or greater than 10 LC50; LC50 less than or equal to 1000 ppm and criteria for Hazard Zone A are not met. **HAZARD ZONE C:** LC50 greater than 1000 ppm and less than or equal to 3000 ppm, **HAZARD ZONE D:** LC50 greater than 3000 ppm and less than or equal to 5000 ppm.
Hot zone	Area immediately surrounding a dangerous goods incident which extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone. This zone is also referred to as exclusion zone, red zone, or restricted zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472)
Immiscible	In this guidebook, means that a material does not mix readily with water.
Improvised Explosive Device (IED)	A bomb that is manufactured from commercial, military, or homemade explosives.
Large spill	A spill that involves quantities that are greater than 200 liters for liquids and greater than 300 kilograms for solids.
Lethal Concentration 50 (LC50)	The concentration of a material administered by inhalation that is expected to cause the death of 50% of an experimental animal population within a specified time. (Concentration is reported in either ppm or mg/m3)
Mass explosion	Explosion which affects almost the entire load virtually instantaneously.
mg/m3	Milligrams of a material per cubic meter of air.
Miscible	In this guidebook, means that a material mixes readily with water.
mL/m3	Milliliters of a material per cubic meter of air. (1 mL/m3 equals 1 ppm)
Nerve agents	Substances that interfere with the central nervous system. Exposure is primarily through contact with the liquid (via skin and eyes) and secondarily through inhalation of the vapor. Tabun (GA), Sarin (GB), Soman (GD) and VX are nerve agents. **Symptoms:** Pinpoint pupils, extreme headache, severe tightness in the chest, dyspnea, runny nose, coughing, salivation,

unresponsiveness, seizures.

n.o.s. These letters refer to "not otherwise specified." The entries which use this description are generic names such as "Corrosive liquid, n.o.s." This means that the actual chemical name for that corrosive liquid is not listed in the regulations; therefore, a generic name must be used to describe it on shipping papers.

Noxious In this guidebook, means that a material may be harmful or injurious to health or physical well-being.

Oxidizer A chemical which supplies its own oxygen and which helps other combustible material burn more readily.

P The letter "P" following a guide number in the yellow-bordered and blue-bordered pages identifies a material which may polymerize violently under high temperature conditions or contamination with other products. This polymerization will produce heat and high pressure buildup in containers which may explode or rupture. (See polymerization below)

Packing Group The Packing Group (PG) is assigned based on the degree of danger presented by the hazardous material:

PG I : Great danger
PG II : Medium danger
PG III : Minor danger

pH pH is a value that represents the acidity or alkalinity of a water solution. Pure water has a pH of 7. A pH value below 7 indicates an acid solution (a pH of 1 is extremely acidic). A pH above 7 indicates an alkaline solution (a pH of 14 is extremely alkaline). Acids and alkalies (bases) are commonly referred to as corrosive materials.

PIH Poison Inhalation Hazard. Term used to describe gases and volatile liquids that are toxic when inhaled. (Same as TIH)

Polymerization This term describes a chemical reaction which is generally associated with the production of plastic substances. Basically, the individual molecules of the chemical (liquid or gas) react with each other to produce what can be described as a long chain. These chains can be formed in many useful applications. A well known example is the styrofoam (polystyrene) coffee cup which is formed when liquid molecules of styrene react with each other or polymerize forming a solid, therefore changing the name from styrene to polystyrene (poly means many).

ppm — Parts per million. (1 ppm equals 1 mL/m3)

Protective clothing — Includes both respiratory and physical protection. One cannot assign a level of protection to clothing or respiratory devices separately. These levels were accepted and defined by response organizations such as U.S. Coast Guard, NIOSH, and U.S. EPA.

Level A: SCBA plus totally encapsulating chemical resistant clothing (permeation resistant).
Level B: SCBA plus hooded chemical resistant clothing (splash suit).
Level C: Full or half-face respirator plus hooded chemical resistant clothing (splash suit).
Level D: Coverall with no respiratory protection.

Pyrophoric — A material which ignites spontaneously upon exposure to air (or oxygen).

Radiation Authority — As referred to in GUIDES 161 through 166 for radioactive materials, the Radiation Authority is either a Federal, state/provincial agency or state/province designated official. The responsibilities of this authority include evaluating radiological hazard conditions during normal operations and during emergencies. If the identity and telephone number of the authority are not known by emergency responders, or included in the local response plan, the information can be obtained from the agencies listed on the inside back cover. They maintain a periodically updated list of radiation authorities.

Radioactivity — The property of some substances to emit invisible and potentially harmful radiation.

Small spill — A spill that involves quantities that are less than 200 liters for liquids and less than 300 kilograms for solids.

Straight (solid) stream — Method used to apply or distribute water from the end of a hose. The water is delivered under pressure for penetration. In an efficient straight (solid) stream, approximately 90% of the water passes through an imaginary circle 38 cm (15 inches) in diameter at the breaking point. Hose (solid or straight) streams are frequently used to cool tanks and other equipment exposed to flammable liquid fires, or for washing burning spills away from danger points. However, straight streams will cause a spill fire to spread if improperly used or when directed into open containers of flammable and combustible liquids.

TIH	Toxic Inhalation Hazard. Term used to describe gases and volatile liquids that are toxic when inhaled. (Same as PIH)
V	Saturated vapor concentration in air of a material in mL/m3 (volatility) at 20°C and standard atmospheric pressure.
Vapor density	Weight of a volume of pure vapor or gas (with no air present) compared to the weight of an equal volume of dry air at the same temperature and pressure. A vapor density less than 1 (one) indicates that the vapor is lighter than air and will tend to rise. A vapor density greater than 1 (one) indicates that the vapor is heavier than air and may travel along the ground.
Vapor pressure	Pressure at which a liquid and its vapor are in equilibrium at a given temperature. Liquids with high vapor pressures evaporate rapidly.
Viscosity	Measure of a liquid's internal resistance to flow. This property is important because it indicates how fast a material will leak out through holes in containers or tanks.
Warm zone	Area between Hot and Cold zones where personnel and equipment decontamination and hot zone support take place. It includes control points for the access corridor and thus assists in reducing the spread of contamination. Also referred to as the contamination reduction corridor (CRC), contamination reduction zone (CRZ), yellow zone or limited access zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472)
Water-sensitive	Substances which may produce flammable and/or toxic decomposition products upon contact with water.
Water spray (fog)	Method or way to apply or distribute water. The water is finely divided to provide for high heat absorption. Water spray patterns can range from about 10 to 90 degrees. Water spray streams can be used to extinguish or control the burning of a fire or to provide exposure protection for personnel, equipment, buildings, etc. **(This method can be used to absorb vapors, knockdown vapors or disperse vapors. Direct a water spray (fog), rather than a straight (solid) stream, into the vapor cloud to accomplish any of the above).** Water spray is particularly effective on fires of flammable liquids and volatile solids having flash points above 37.8°C (100°F).

Regardless of the above, water spray can be used successfully on flammable liquids with low flash points. The effectiveness depends particularly on the method of application. With proper nozzles, even gasoline spill fires of some types have been extinguished when coordinated hose lines were used to sweep the flames off the surface of the liquid. Furthermore, water spray carefully applied has frequently been used with success in extinguishing fires involving flammable liquids with high flash points (or any viscous liquids) by causing frothing to occur only on the surface, and this foaming action blankets and extinguishes the fire.

APPENDIX B: U.S. DOT PIPELINE AND HAZARDOUS MATERIAL SAFETY ADMINISTRATION (PHMSA) GLOSSARY[2]

AAR
Association of American Railroads

Actuator
A device designed to shut off gas flow upon flame failure, pilot outage, control impulse, overpressure, or underpressure without a person being physically at the location. Valve actuators on mainline transmission systems are primarily operated by pushing a button at a control station.

Anodeless riser
A steel casing with a plastic pipe inside. The plastic pipe inside the steel casing is the service line carrying gas to the customer meter.

ASNDT
American Society for Non-destructive Testing

BTS
Bureau of Transportation Statistics

Bulk Packaging
A packaging (transport vehicle or freight container) in which hazardous materials are loaded with no intermediate form of containment, when the internal volume is greater than:

(1) 450 liters (119 gallons) for a liquid;
(2) 400 kilograms (882 pounds) net mass for a solid; or
(3) 454 kilograms (1,000 pounds) water capacity for a gas.

Note: A bulk packaging is **not** a vessel or barge.

Capital Improvement
An expenditure for a physical improvement to an existing capital asset such as additions and major alterations that are intended to improve performance or increase useful life.

Cargo
Product, including its packaging.

[2] http://phmsa.dot.gov/hazmat/glossary

Cargo Tank
A bulk packaging that is loaded or unloaded without being removed from the motor vehicle. (The tank may or may not be permanently attached to the motor vehicle).

CFR
Code of Federal Regulations

Chart 11
DOT's Hazardous Materials Marking, Labeling and Placarding Guide.

Compatibility
Relates to possible interactions between a material and (1) its container, or (2) other products that may be loaded or transported together.

Compound
Two or more ingredients that are chemically united.

Compressed Gas
Material or mixture meeting criteria in § 173.115(b), (absolute pressure of 280 kPa [41 psia]) at 20°C [68° F] or greater).

Consist
Sequentially lists the location of each rail car in a train. May serve as the shipping paper if the consist has all the information required by the USDOT.

CSA
Canadian Standards Association

Dangerous Goods
International term for hazardous materials.

DMS
Docket Management System (historical system used by DOT prior to the Federal Docket Management System (FDMS)).

Documentation
Completed forms required to accompany hazardous materials. For example, shipping papers, certificates, emergency response information, or manifests.

DOT
U.S. Department of Transportation

Emergency Response Information
Information that can be used in the mitigation of an incident involving hazardous materials.

Etiologic Agent
See Infectious Substance.

ETN
Midwest Energy Association (MEA)/Energy Training Network (ETN)

Exceptions
Relief from certain HM regulations; applies to everyone.

Exemptions
Specific USDOT-written relief from certain HM Regulations, for shippers, carriers, or manufacturers; 2 year limit but may be renewed. (Part 107, Subpart B of 49 CFR)

FDMS
Federal Docket Management System. This system houses current dockets.

FERC
Federal Energy Regulatory Commission

Flash Point
The minimum temperature at which a substance gives off flammable vapor(s). Substance will ignite when coming in contact with a spark or flame.

FOIA
Freedom of Information Act

Forbidden
A material that is prohibited from being offered or accepted for transportation. This prohibition does not apply if these materials are:

- diluted, stabilized, or incorporated into devices **and**
- classed in accordance with Part 173. (See § 172.101(d)(1)).

FR
Used as both Federal Register and Final Rule

FTE
Full-time Equivalent

GAO
General Accountability Office (formerly General Accounting Office)

Generator
An EPA term used for a hazardous waste producer and/or shipper.

GPO
Government Printing Office

Grants
Planning and training grants to deal with hazardous materials emergencies.

Gross Weight
Total weight of packaging, including its contents.

Hazard Class
A group of hazardous materials that share dangerous characteristics. The USDOT has identified nine hazard classes based on the dangers posed in transportation.

Hazard Division
A means of sub-dividing similar hazardous materials which require different hazard communications.

Hazardous Material
A substance or material capable of posing an unreasonable risk to health, safety, or property when transported in commerce.

Hazardous Substance
A material listed in Appendix A to § 172.101 and the quantity in one package equals or exceeds the reportable quantity (RQ). Material may be in solution or mixture. This definition does not apply to petroleum (lubricants or fuel) products.

Hazardous Waste
Any material that is subject to the Hazardous Waste Manifest requirements of the EPA. Refer to 40 CFR Part 262.

Hazardous Waste Manifest
A specific shipping document required by the USDOT and the EPA for hazardous waste shipments. Also referred to as the Uniform Hazardous Waste Manifest (UHWM). If all USDOT requirements [i.e., the basic description (proper shipping name, hazard class/division, ID No., and packing group) are entered on the UHWM, the manifest may be used as a shipping paper. (49 CFR § 172.205)

Hazmat Employee
A person who is employed by a hazardous materials employer and directly affects hazardous materials (hazmat) transportation safety.

Hazmat Employer
A person who uses one or more of its employees in connection with:

- transporting hazardous materials (hazmat) in commerce;
- causing hazmat to be transported or shipped in commerce;
- representing, marking, certifying, selling, offering, reconditioning; or
- testing, repairing, or modifying packagings as qualified for use in the transportation of hazmat.

The term "hazmat employer" also includes any department, agency, or instrumentality of the United States, a State, a political subdivision of a State, or an Indian tribe engaged in offering or transporting hazmat in commerce.

Identification Number (ID No.)
The UN or NA "four-digit number" assigned to hazardous materials, i.e., UN 1203. ID numbers are listed in Col. 4 of the HMT. Used for identification and emergency response.

IG
Office of the Inspector General (also referred to as "OIG"), commonly the office of any Agency which performs these duties. In most documents presented here, assume the Department of Transportation OIG unless otherwise stated.

In-association-with
Refers to the placement of required additional entries on the shipping paper. Usually placed after the complete description for a hazardous material. May be any format, as long as it is clearly part of the entry.

Incident
Unintentional release of hazardous material(s).

Infectious Substance
Living microorganism or its toxin which may cause severe, disabling or fatal disease. Term synonymous with Etiologic Agent. (49 CFR, § 173.134)

Irritating Material
A liquid or solid substance. Upon contact with fire or air, the material gives off dangerous or intensely irritating fumes.

ISO
International Standards Organization

Labels
Hazard class identifiers required on hazardous materials packaging; 100 mm diamond shaped (square-on-point); identify hazard class by symbol, color and sometimes, by name.

Limited Quantity (Ltd. Qty.)
The amount of material for which there is a specific labeling or packaging exception.

Marine Pollutant
Hazardous material which is:

- listed in **Appendix B** to § 172.101 and,
- when in a solution or mixture of one or more marine pollutants, is packaged in a concentration *(for materials listed in Appendix B)* which equals or exceeds:
  (1) 10% by weight of the solution or mixture, or
  (2) 1% by weight of the solution or mixture f*or materials that are identified as severe marine pollutants.*

Markings
Information required to be placed on the outside of the shipping container; may include one or more of the following:

- proper shipping name;
- identification number;
- UN standard packaging marks; and
- instructions/caution.

MEA
Midwest Energy Association (MEA)/Energy Training Network (ETN)

Mitigate
Measures to prevent or lessen the results of a release of hazardous materials.

Mixture
A material composed of one or more compounds.

NACE
National Association of Corrosion Engineers

NARUC
National Association of Regulatory Utility Commissioners

NCCER
National Center for Construction Education and Research

NFPA
National Fire Protection Association

NIST
National Institute of Standards and Technology

NOI
Notice of Inquiry

NPRM
Notice of Proposed Rule Making

NTSB
National Transportation Safety Board

OFR
Office of the Federal Register

OIG
Office of the Inspector General (also referred to as "IG"), commonly the office of any Agency which performs these duties. In most documents presented here, assume the Department of Transportation OIG unless otherwise stated.

OMB
Office of Management and Budget

OSHA (Act)
Occupational Safety and Health Act

OSHA (Administration)
Occupational Safety and Health Administration

P.L.
Public Law

RITA
Research and Innovative Technology Administration (of the U.S. Department of Transportation)

SNPRM
Supplemental Notice of Proposed Rulemaking

Training (Hazmat)
A systematic program (i.e., consistent approach, testing, and documentation) that ensures that a hazardous materials (hazmat) employee has knowledge of hazardous materials and the Hazardous Materials Regulations (HMR), and can perform assigned hazmat functions properly. Refer to § 172.700(b) through § 172.704 of the regulations.

TSI
Transportation Safety Institute

U.S.C.
United States Code

APPENDIX C: HAZARD CLASSIFICATION SYSTEM

The U.S. Department of Transportation divides regulated hazardous materials into the following nine classes, most of which are further divided into divisions:[3]

Class 1: Explosives

- 1.1 - Explosives with a mass explosion hazard (dynamite, TNT, black powder)
- 1.2 - Explosives with a projection hazard (aerial flares, power device cartridges, detonating cord)
- 1.3 - Explosives with predominantly a fire hazard (propellant explosives, liquid-fueled rocket motors)
- 1.4 - Explosives with no significant blast hazard (signal cartridges, practice ammunition, line-throwing rockets)
- 1.5 - Very insensitive explosives with a mass explosion hazard (blasting agents, pilled ammonium nitrate fertilizer-fuel oil mixtures)
- 1.6 - Extremely insensitive explosives

Class 2: Gases

- 2.1 - Flammable gases (propane, methyl chloride, butadienes)
- 2.2 - Non-flammable, non-toxic gases (compressed nitrogen, cryogenic argon)
- 2.3 - Toxic gases (chlorine, hydrogen fluoride, arsine, methyl bromide)

Class 3: Flammable liquids and Combustible liquids (Gasoline, fuel oil, xylene)

Class 4: Flammable solids, Spontaneously combustible materials, and Water-reactive substances ("Dangerous when wet" materials)

- 4.1 - Flammable solids (magnesium, nitrocellulose)
- 4.2 - Spontaneously combustible materials (charcoal briquettes, phosphorus)
- 4.3 - Water-reactive substances/dangerous when wet materials (calcium carbide, magnesium powder, sodium hydride)

Class 5: Oxidizing substances and Organic peroxides

- 5.1 - Oxidizers (ammonium nitrate, calcium hypochlorite)
- 5.2 - Organic peroxides (methyl ethyl ketone peroxide, benzoyl peroxide)

Class 6: Toxic substances and Infectious substances

- 6.1 - Poisonous liquids or solids (aniline, arsenic compounds, hydrocyanic acid, chemical warfare agents)
- 6.2 - Infectious/biohazardous substances (anthrax, botulism, tetanus)

Class 7: Radioactive materials (uranium hexafluoride, yellowcake)

Class 8: Corrosive substances (nitric acid, sulfuric acid, sodium hydroxide)

Class 9: Miscellaneous hazardous materials

Material which presents a hazard during transportation but does not meet the definition of any other hazard class (PCBs, molten sulfur)

[3] http://chemresponsetool.noaa.gov/placards_field_guide/hazard_classes.htm

APPENDIX D: HAZMAT 7-DIGIT STCC CODE DESCRIPTION

WAYBILL TEXAS 2005 HAZMAT STCC 7-DIGIT	
STCC7	**COMMODITY DESCRIPTION**
1321110	GASOLINE,NATURAL (CASINGHEAD),SUITABLE ONLY FOR BLENDING,MIXING OR REFINING
1471620	SULPHUR,LIQUID OR MOLTEN
2812220	SODIUM (SODA),CAUSTIC(SODIUM HYDROXIDE),LIQUID
2812815	CHLORINE GAS,LIQUEFIED
2813320	CARBON DIOXIDE GAS,LIQUEFIED OR CARBONIC ACID GAS
2813950	METHYL MERCAPTAN GAS
2813966	VINYL CHLORIDE (CHLOROETHENE OR CHLORO-ETHYLENE)
2813984	FLUOROETHANE GASES,FLAMMABLE,VIZ.DI-FLUOROETHANE OR DIFLUOROMONOCHLORO-ETHANE (CHLORODIFLUOROETHANE OR DIFLUOROCHLOROETHANE)
2813990	COMPRESSED GASES,NEC,OTHER THAN POISON
2813992	HYDROCARBON GAS,NEC
2814168	TRIPROPYLENE
2815124	NONYL PHENOL
2815127	METHYLENE DIPHENYL DIISOCYANATE
2815166	TOLUENE DIISOCYANATE
2818036	ISOPRENE STILL BOTTOMS
2818043	PROPYLENE TETRAMER
2818044	HEXAMETHYLENEDIISOCYANATE
2818103	ACETALDEHYDE (ACETIC ALDEHYDE,ALDEHYDE,ETHANAL OR ETHYL ALDEHYDE)
2818112	METHYL METHACRYLATE MONOMER
2818115	ACRYLATES,BUTYL,ETHYLHEXYL,HYDROXYETHYL,HYDROXYPROPYL OR ISOBUTYL
2818118	BUTYRALDEHYDE
2818127	DIETHANOLAMINE,MONOETHANOLAMINE,TRI-ETHANOLAMINE OR ETHANOLAMINE STILL BOTTOM MIXTURES
2818132	ADIPONITRILE
2818144	FORMALDEHYDE,LIQUID
2818195	ISOPRENE
2818239	ETHYLENE OXIDE
2818265	PROPYLENE OXIDE
2818292	METHYLMERCAPTOPROPIONALDEHYDE
2818299	OCTANAL
2818342	STYRENE,LIQUID
2818416	BUTYL ALCOHOLS,VIZ.N-BUTYL ALCOHOL (BUTYRIC ALCOHOL OR 1-BUTANOL),SEC-BUTYL ALCOHOL (METHYLETHYLCARBINOL OR 2-BUTANOL) OR TERT-BUTYL ALCOHOL (TRIMETHYLCARBINOL OR 2-METHYL-2-PROPANOL)
2818427	OCTYL ALCOHOL (2-ETHYLHEXANOL,OR 2-ETHYLHEXYL ALCOHOL),ISOOCTYL ALCOHOL,PRIMARY NORMAL OCTYL ALCOHOL (ALCOHOL C-8,CAPRYL ALCOHOL,CAPRYLIC ALCOHOL, HEPTYL CARBINOL,OCTOIC ALCOHOL,OCTYLIC ALCOHOL OR 1-OCTANOL) OR SEC-NORMAL OCTYL ALCOHOL (INACTIVE SECONDARY CAPRYL ALCOHOL,METHYLHEXYLCARBINOL OR 2-OCTANOL),OTHER THAN PERFUMERY GRADE
2818429	PROPYL ALCOHOL (N-PROPYL ALCOHOL OR 1-PROPANOL) OR ISOPROPYL ALCOHOL (DI-METHYLCARBINOL,IPA,ISOPROPANOL,SEC-PROPYL ALCOHOL OR 2-PROPANOL)
2818446	ETHYL ALCOHOL,ANHYDROUS,DENATURED IN PART WITH PETROLEUM PRODUCTS AND/OR CHEMICALS,PETROLEUM PRODUCTS AND/OR CHEMICALS NOT TO EXCEED FIVE PERCENT
2818490	ALCOHOLS,NEC,OTHER THAN ALCOHOLIC LIQUORS

2818546	ETHYLENE GLYCOL (ETHYLENE ALCOHOL OR GLYCOL)
2818547	GLYCOL BOTTOMS
2818610	ACETIC ACID,GLACIAL OR LIQUID
2818644	ACETIC ANHYDRIDE (ACETIC OR ACETYLOXIDE)
2818668	VINYL ACETATE
2818692	ACRYLIC ACID
2818960	BUTADIENE FROM ALCOHOL
2819315	SULPHURIC ACID OR OIL OF VITRIOL
2819330	ACID,SULPHURIC,SPENT
2819450	MURIATIC (HYDROCHLORIC) ACID
2819454	PHOSPHORIC ACID
2819484	HYDROGEN FLUORIDE ANHYDROUS
2819491	ACIDS,INORGANIC,NEC,LIQUID
2819522	IRON CHLORIDE (IRON MURIATE),OTHER THAN CRUDE,LIQUID
2819815	AMMONIA,ANHYDROUS
2819931	ANTIMONY OXIDE OR ANTIMONY TRIOXIDE
2821140	POLYSTYRENE,OTHER THAN LIQUID
2843128	ALCOHOLS,FATTY OR CYCLIC,ETHOXYLATED
2899320	FIREWORKS OR PYROTECHNICS,NEC
2899850	COMPOUNDS,IRON OR STEEL RUST PREVENTING OR REMOVING,OTHER THAN PETROLEUM,NEC
2899991	CHEMICALS,NEC
2911315	PETROLEUM DISTILLATE FUEL OIL,DIESEL OIL OR GAS OIL,NOT SUITABLE FOR ILLUMINAT-ING PURPOSES
2911610	ASPHALT (ASPHALTUM),BY-PRODUCT OR PETROLEUM,LIQUID,OTHER THAN PAINT,STAIN OR VARNISH
2911717	FUEL OIL,BUNKER "C"
2911791	OIL,PETROLEUM,NEC
2911982	PETROLEUM NAPHTHA,NAPHTHA DISTILLATE OR NAPHTHA SOLVENTS
2911983	ALKYLATE, GASOLINE BLEND STOCK
2911985	BUTADIENE FROM PETROLEUM
2912110	BUTANE GAS,LIQUEFIED
2912111	PROPANE GAS,LIQUEFIED
2912122	BUTENE (BUTYLENE) GAS,LIQUEFIED,OR ISO-BUTENE (ISOBUTYLENE),LIQUEFIED
2912128	PROPYLENE
2912181	PETROLEUM BYPRODUCT, FFP
2912190	LIQUEFIED PETROLEUM GAS,NEC,COMPRESSED
2952270	ROOFING TAR
3714230	SYSTEMS,AUTOMOBILE CRASH PROTECTION,GAS GENERATING TYPE,INFLATABLE RESTRAINTS
4025177	AROMATIC CONCENTRATES,BY-PRODUCT OBTAIN-ED IN PRODUCTION OF ETHYLENE,SUITABLE ONLY FOR FURTHER PROCESSING
4029170	SLUDGE,ACID OR ALKALI,CONTAINING NOT LESS THAN 75 PERCENT WATER (AN UNRE-FINED LIQUID WASTE OBTAINED AS A RESI-DUE OF THE METAL FINISHING INDUSTRY)
4411110	FREIGHT FORWARDER TRAFFIC
4611110	ALL FREIGHT RATE SHIPMENTS,NEC,OR TRAILER-ON-FLAT-CAR SHIPMENTS,COMMER-CIAL (EXCEPT WHERE IDENTIFIED BY COMMODITIES,THEN CODE BY COMMODITY)

APPENDIX E: TEXAS NON-RADIOACTIVE HAZARDOUS MATERIALS ROUTES

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
	Bexar	IH 10 (Bexar County) from East IH 410 to the Guadalupe/Bexar county line	M.O.#108547			X
	Bexar	IH 10 (Bexar County) from North IH 410 to the Kendall/Bexar county line	M.O.#108547			X
	Bexar	IH 10 (Bexar County) from the Fredericksburg/Woodlawn interchange to the IH 10/IH 35 interchange	M.O.#108547		X	
	Bexar	IH 35 (Bexar County) from IH 35/IH 10 interchange to the IH 10/IH 35/US 90 interchange	M.O.#108547		X	
	Bexar	IH 35 (Bexar County) from North IH 410 to the Guadalupe/Bexar county line	M.O.#108547			X
	Bexar	IH 35 (Bexar County) from South IH 410 to the Atascosa/Bexar county line	M.O.#108547			X
	Bexar	IH 35 (Bexar County) from the IH 35/IH 37/US 281 interchange to the IH 10/IH 35 interchange	M.O.#108547		X	
	Bexar	IH 37 (Bexar County) from IH 410 to the Atascosa/Bexar county line	M.O.#108547			X
	Bexar	IH 37 (Bexar County) from the IH 35/IH 37/US 281 interchange to the IH 37/Durango St. interchange	M.O.#108547		X	
	Bexar	IH 410 (Bexar County) entire highway	M.O.#108547			X
	Bexar	SH 16 (Bexar County) from South IH 410 to the Atascosa/Bexar county line	M.O.#108547			X
	Bexar	US 181 (Bexar County) from IH 410 to the Wilson/Bexar county line	M.O.#108547			X
	Bexar	US 281 (Bexar County) from North IH 410 to the Comal/Bexar county line	M.O.#108547			X
	Bexar	US 281 (Bexar County) from South IH 410 to the Atascosa/Bexar county line	M.O.#108547			X
	Bexar	US 87 (Bexar County) from East IH 410 to the Wilson/Bexar County line	M.O.#108547			X
	Bexar	US 90 (Bexar County) from West IH 410 to the Medina/Bexar county line	M.O.#108547			X
	Webb	SH 255 (Camino Columbia Toll Road)(Webb County) from IH 35 to International Bridge III	22 Tex Reg 12316	12/12/97		X
Amarillo	Potter/Randall	BI 40 (Amarillo), from West City Limits to FM 1719	5624	9/9/86		X
Amarillo	Potter/Randall	FM 1719 (Amarillo), from North City Limits to BI 40	5624	9/9/86		X
Amarillo	Potter/Randall	Interstate 27/US 87/US 60 (Amarillo), from South City Limits to IH 40	5624	9/9/86		X
Amarillo	Potter/Randall	Interstate 40 (Amarillo), from East City Limits to West City Limits	5624	9/9/86		X
Amarillo	Potter/Randall	LP 335 (Amarillo), from Dumas Dr. (US 87/US 287) to East City Limits	5624	9/9/86		X
Amarillo	Potter/Randall	LP 335 (Amarillo), from Dumas Dr. (US 87/US 287) to West City Limits	5624	9/9/86		X
Amarillo	Potter/Randall	LP 335 (Amarillo), from NE 24th Ave. to IH 40	5624	9/9/86		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Amarillo	Potter/Randall	LP 335 (Amarillo), from West Amarillo Blvd (BI 40/US 60) to City Limits (7 pm - 7 am)	6194	10/10/95	X	
Amarillo	Potter/Randall	US 60 (Amarillo), from East City Limits to East LP 335	5624	9/9/86		X
Amarillo	Potter/Randall	US 60/87/287 (Taylor and Fillmore St only) (Amarillo), from IH 40 to LP 335	6194	10/10/95	X	
Amarillo	Potter/Randall	US 60/87/287(Buchanan St and Pierce St only) (Amarillo) from LP 335 to IH 40 (7 pm - 7 am)	6194	10/10/95		X
Arlington	Tarrant	Interstate 20 (Arlington), from W City Limits to E City Limits	86-545 & 86-168	9/2/86		X
Balch Springs	Dallas	Interstate 20 (Balch Springs), from E City Limits to S City Limits	742-94	11/14/94		X
Balch Springs	Dallas	Interstate 635 (Balch Springs), from North City Limits to IH 20	742-94	11/14/94		X
Beaumont	Jefferson	Interstate 10 (Beaumont), from East City Limits to West City Limits	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	Irving St. From Washington Blvd. to Madison St.	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	Madison St. from Irving St. to Grove St.	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	SH 105 (Beaumont), from West City Limits to US 69/96/287	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	SP 380 (Railroad Ave.) (Beaumont), from US Hwys.69,287,96 (Cardinal Dr.) to Washington Blvd.	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	US 69/96/287 (Beaumont), from North City Limits to Southeast City Limits	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	US 90 (Beaumont), from Interstate 10 to West City Limits	Sec. 13-19.104	8/91		X
Beaumont	Jefferson	Washington Blvd. From SP 380 to Irving St.	Sec. 13-19.104	8/91		X
Benbrook	Tarrant	FM 2871 (Benbrook), from West City Limit to US 377	684			
Benbrook	Tarrant	Interstate 20 (Benbrook), from East City Limits to West City Limits	Title 10, Sec. 10.16.050	1984		X
Benbrook	Tarrant	US 377 (Benbrook), from North City Limits to the South City Limits	684			
Brenham	Washington	BS 36 (Brenham), from N City Limits to FM 577	no ord.#	7/7/81		X
Brenham	Washington	FM 2935 (Brenham), from N City Limits to FM 577	no ord.#	7/7/81		X
Brenham	Washington	FM 577 (Brenham), from East City Limits to BS 36	no ord.#	7/7/81		X
Brenham	Washington	SH 105 (Brenham), from NE City Limits to FM 577	no ord.#	7/7/81		X
Brenham	Washington	SH 36 (Brenham), from S City Limits to S intersection with US 290	no ord.#	7/7/81		X
Brenham	Washington	US 290 (Brenham), from East City Limits to West City Limits	no ord.#	7/7/81		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Center	Shelby	LP 500 (Center), from South US 96 to East SH 7	88-11	8/22/88		X
Center	Shelby	SH 7 (Center), from W City Limits to US 96	88-11	8/22/88		X
Center	Shelby	SH 87 (Center), from East City Limits to LP 500	88-11	8/22/88		X
Center	Shelby	SH 87 (Center), from W City Limits to US 96	88-11	8/22/88		X
Center	Shelby	US 96 (Center), from North City Limits to the South City Limits	88-11	8/22/88		X
Conroe	Montgomery	Interstate 45 (Conroe), from N City Limits to S City Limits	Code - Art. I, Sec. 7-12	9/23/82		X
Conroe	Montgomery	LP 336 (Conroe), entire highway within City Limits	Code - Art. 1, Sec. 7-12	9/23/82		X
Crockett	Houston	FM 2022 (Crockett), from Northeast City Limits to NE LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	FM 2076 (Crockett), from West City Limits to W LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	FM 2110 (Crockett), from Southwest City Limits to SW LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	FM 229 (Crockett), from Northwest City Limits to NW LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	FM 2712 (Lufkin), from South City Limits to S LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	LP 304 (Crockett), Entire Highway	Ord. # D-1	1/16/78		X
Crockett	Houston	SH 19 (Crockett), from South City Limits to South LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	SH 21 (Crockett), from Northeast City Limits to Northeast LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	SH 7 (Crockett), from East City Limits to East LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	SH 7/21 (Crockett), from West City Limits to West LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	US 287 (Crockett), from Southeast City Limits to E LP 304	Ord. # D-1	1/16/78		X
Crockett	Houston	US 287/SH 19 (Crockett), from North City Limits to North LP 304	Ord. # D-1	1/16/78		X
Dallas	Dallas	Interstate 20 (Dallas), entire length within Dallas City Limits	18147	1/25/84		X
Dallas	Dallas	Interstate 30 (Dallas), from West City Limits to LP 12	18147	1/25/84		X
Dallas	Dallas	Interstate 30 (East RL Thornton Freeway)(Dallas), from Interstate 35 E to Malcolm X. Blvd. Overpass	18147	1/25/84	X	
Dallas	Dallas	Interstate 345 (Central Expressway) (Dallas), from IH 45 (Julius Schepps Freeway) to Bryan Street	18147	1/25/84	X	
Dallas	Dallas	Interstate 35 E (Dallas), from North City Limits to LP 12	18147	1/25/84		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Dallas	Dallas	Interstate 35 E (Dallas), from South City Limits to IH 20	18147	1/25/84		X
Dallas	Dallas	Interstate 45 (Dallas), from IH 20 to SE City Limits	18147	1/25/84		X
Dallas	Dallas	Interstate 45 Elevated (Julius Schepps Freeway) (Dallas), from Lamar Underpass to Bryan St. Underpass	18147	1/25/84	X	
Dallas	Dallas	Interstate 635 (Dallas), entire highway within Dallas City Limits	18147	1/25/84		X
Dallas	Dallas	LP 12 (Dallas), from N City Limits of Irving to IH 35E	18147	1/25/84		X
Dallas	Dallas	LP 12 (Dallas), from SP 408 to South City Limits of Irving	18147	1/25/84		X
Dallas	Dallas	SH 180 (Dallas), from LP 12 to W City Limits	18147	1/25/84		X
Dallas	Dallas	SH 289 (Preston Rd) (Dallas), from IH 635 to North City Limits	18147	1/25/84		X
Dallas	Dallas	SH 342 (Dallas), from IH 20 to S City Limits	18147	1/25/84		X
Dallas	Dallas	SP 303 (Dallas), from SP 408 to W City Limits	18147	1/25/84		X
Dallas	Dallas	SP 348 (Northwest Hwy.) (Dallas), from LP 12 to W City Limits	18147	1/25/84		X
Dallas	Dallas	SP 408 (Dallas), from Interstate 20 to LP 12	18147	1/25/84		X
Dallas	Dallas	Spur 366 (Woodall Rodgers Freeway) (Dallas), from U.S. 75 to IH 35 E	18147	1/25/84	X	
Dallas	Dallas	underground tunnel system (Dallas), entire highway	18147	1/25/84	X	
Dallas	Dallas	US 175 (Dallas), from South City Limits to IH 20	18147	1/25/84		X
Dallas	Dallas	US 67 (Dallas), from IH 20 to S City Limits	18147	1/25/84		X
Dallas	Dallas	US 75 (Dallas), from North City Limits to North IH 635	18147	1/25/84		X
Deer Park	Harris	SH 225 (Deer Park), from E City Limits to W City Limits	Code Sec. 9-78	2/22/72		X
Dickinson	Galveston	FM 1266 (Dickinson), from FM 646 to FM 517	201-93	1/11/94		X
Dickinson	Galveston	FM 517 (Dickinson), from FM 646 to W City Limits	201-93	1/11/94		X
Dickinson	Galveston	FM 646 (Dickinson), Entire highway, within City Limits	201-93	1/11/94		X
Dickinson	Galveston	Interstate 45 (Dickinson), from NW City Limits to SW City Limits	201-93	1/11/94		X
Dickinson/League City/Santa Fe	Galveston	FM 517. Revised: Removed from FM 646 to W. City Limits.	TxDOT			
Dickinson/League City/Santa Fe	Galveston	FM 646. Revised: Removed from I-45 S. to SH 6.	TxDOT			

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Duncanville	Dallas	Interstate 20 (Duncanville), from E City Limits to W City Limits	1077	8/18/86		X
Duncanville	Dallas	US 67 (Duncanville), from E City Limits to S City Limits	1077	8/18/86		X
Edinburg	Hidalgo	10th Ave. (Edinburg), from McIntyre St to Cano St (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	12th Ave. (Edinburg), from Cano St to McIntyre St (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	BU 281 (Edinburg), from North N intersection with US 281 to FM 1925 (Thru only)	1408	10/16/90		X
Edinburg	Hidalgo	Bus. US 281 (Edinburg), from FM 1925 to S US 281 (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	Cano St (Edinburg), from 10th Ave. to 12th Ave. (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	Chapin St (Edinburg), from Bus. US 281 to US 281 (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	FM 1925 (Edinburg), from Bus US 281 to FM 2061 (Thru only)	1408	10/16/90		X
Edinburg	Hidalgo	FM 2061 (Edinburg), from Owassa Rd. to FM 1925 (Thru only)	1408	10/16/90		X
Edinburg	Hidalgo	FM 2128 (Edinburg), from Bus. US 281 to US 281 (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	FM 2128 (Edinburg), from Tower Rd. to US 281 (Thru only)	1408	10/16/90		X
Edinburg	Hidalgo	McIntyre St (Edinburg), from 12th Ave. to 10th Ave (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	SH 107 (Edinburg), from 12th Ave. to US 281 (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	SH 107 (Edinburg), from FM 2061 to 10th Ave. (Local dest. Only)	1408	10/16/90		X
Edinburg	Hidalgo	SH 107 (Edinburg), from SH 336 to FM 2061 (Thru only)	1408	10/16/90		X
Edinburg	Hidalgo	SH 107 (Edinburg), from Tower Rd to US 281 (Thru only)	1408	10/16/90		X
Edinburg	Hidalgo	US 281 (Edinburg), from N Bus. US 281 to Owassa Rd (Thru only)	1408	10/16/90		X
El Paso	El Paso	Airway Blvd. (El Paso), from IH 10 to US 62/180	11701	12/28/93		X
El Paso	El Paso	Delta Dr. (El Paso), from Trowbridge Dr. to Fonseca Dr.	11701	12/28/93		X
El Paso	El Paso	Dyer Rd. (SP 478) (El Paso), from Railroad Dr. to N US 54	11701	12/28/93		X
El Paso	El Paso	FM 659 (El Paso) from Border Highway (LP 375) to S. City Limits (Int'l Boundary at Ysleta Port of Entry: Zaragosa Bridge)	11701	12/28/93		X
El Paso	El Paso	FM 659 (El Paso), from East City Limits to its N. intersection with Americas Ave. (LP 375)	11701	12/28/93		X
El Paso	El Paso	Fonseca Dr. (El Paso), from Delta Dr. to LP 375	11701	12/28/93		X
El Paso	El Paso	Fred Wilson Rd. (El Paso), from Airport Rd. to US 54	11701	12/28/93		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
El Paso	El Paso	Interstate 10 (El Paso), from East City Limits to North City Limits	11701	12/28/93		X
El Paso	El Paso	Interstate 110 (El Paso), from Cordova Port-of-Entry to IH 10	11701	12/28/93		X
El Paso	El Paso	LP 375 (Americas Ave.)(El Paso) from Border Highway (LP 375) to IH 10	11701	12/28/93		X
El Paso	El Paso	LP 375 (Border Highway)(El Paso), from US 54 (Patriot Freeway) to LP 375 (Americas Ave.)	11701	12/28/93		X
El Paso	El Paso	LP 375 (Joe Battle Blvd.) (El Paso) from IH 10 to US 62/180	11701	12/28/93		X
El Paso	El Paso	Marshall Rd. (El Paso), from Fred Wilson Rd. to Railroad Dr.	11701	12/28/93		X
El Paso	El Paso	Railroad Dr. (El Paso), from Dyer St. (SP 478) to Fred Wilson Rd.	11701	12/28/93		X
El Paso	El Paso	Trowbridge Dr. (El Paso), from Interstate 10 to Delta Dr.	11701	12/28/93		X
El Paso	El Paso	US 54 (El Paso), from New Mexico to South LP 375	11701	12/28/93		X
El Paso	El Paso	US 62/180 (Montana Ave) (El Paso), from Airway Blvd. to East City Limits	11701	12/28/93		X
Forest Hill	Tarrant	Interstate 20 (Forest Hill), from W City Limits to East City Limits	351	9/2/86		X
Fort Worth	Tarrant	Interstate 20 (Fort Worth), entire highway within City Limits	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	Interstate 30 (Fort Worth), from East City Limits to E. IH 820	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	Interstate 30 (Fort Worth), from West City Limits to W. IH 820	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	Interstate 35W (Fort Worth), from north City Limits to IH 820 N	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	Interstate 35W (Fort Worth), from south City Limits to IH 20	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	Interstate 820 (Fort Worth), entire highway within Fort Worth City Limits	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	SH 180 (Fort Worth), from IH 820 to E City Limits	Code Sec. 22-116	3/6/79		X
Fort Worth	Tarrant	US 377 (Fort Worth), from Southwest City Limits to IH 20	Code Sec. 22-116	3/6/79		X
Fort Worth/Lake Worth	Tarrant	SH 199 (Fort Worth/Lake Worth), from northwest City Limits to northwest IH 820	Code Sec. 22-116	3/6/79		X
Galveston	Galveston	51st St./Seawolf Pkwy. (Galveston), from SH 275 (Harborside Ave.) to 1/4 mile S of Seawolf Park (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83		X
Galveston	Galveston	Broadway Ave. (Galveston), entire length (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83		X
Galveston	Galveston	Interstate 45 (Galveston), from SH 342 to W City Limits (during 30-hour hurricane warning only) (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83	X	

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Galveston	Galveston	Interstate 45 (Galveston), from West City Limits to FM 188/Teichman Rd. (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83		X
Galveston	Galveston	North of Church St. (Galveston), from 14th St. to 2nd St. (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83	X	
Galveston	Galveston	SH 275/Port Industrial Blvd. (Galveston), from Interstate 45 to 9th St. (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83		X
Galveston	Galveston	SH 342 (Galveston), from Broadway Ave. to Seawall Blvd. (during 30-hour hurricane warning only) (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83	X	
Galveston	Galveston	SH 342 (Galveston), from Broadway Ave. to Seawall Blvd. (SEE CITY OF GALVESTON CODE FOR SPECIAL RESTRICTIONS / MORE INFORMATION)	Code Sec. 34-75	10/13/83		X
Garland	Dallas	Interstate 635 (Garland), from SW City Limits to S City Limits	5927	?		X
Haltom City	Tarrant	Interstate 820 (Haltom City), from W City Limits to E City Limits	1307	7/1/86		X
Harlingen	Cameron	25th St. (Harlingen), from Rio Hondo Rd. to North City Limits	81-28	4/15/81		X
Harlingen	Cameron	BU 77 (Harlingen), from North City Limits to South City Limits	81-28	4/15/81		X
Harlingen	Cameron	Commerce St. (Harlingen), from N intersection with BU 77 to South intersection with BU 77	81-28	4/15/81		X
Harlingen	Cameron	FM 106/Harrison St. (Harlingen), from East City Limits to BU 77	81-28	4/15/81		X
Harlingen	Cameron	FM 106/Harrison St. (Harlingen), from US 77 to West City Limits	81-28	4/15/81		X
Harlingen	Cameron	FM 1479/Rangerville Rd. (Harlingen), from Southwest City Limits to US 77/83	81-28	4/15/81		X
Harlingen	Cameron	FM 507/Morgan Blvd. (Harlingen), from Rio Hondo Rd. to BU 77	81-28	4/15/81		X
Harlingen	Cameron	LP 206/Tyler St. (Harlingen), from US 77/83 to W City Limits	81-28	4/15/81		X
Harlingen	Cameron	LP 499/Ed Carey Dr. (Harlingen), from North BU 77 to US77/83	81-28	4/15/81		X
Harlingen	Cameron	Rio Hondo Rd. (Harlingen), from 25th Street to East City Limits	81-28	4/15/81		X
Harlingen	Cameron	SP 54 (Harlingen), from US 77 to US 83	81-28	4/15/81		X
Harlingen	Cameron	US 77 (Harlingen), from Northwest City Limits to Southeast City Limits	81-28	4/15/81		X
Harlingen	Cameron	US 83 (Harlingen), from Southeast City Limits to West City Limits	81-28	4/15/81		X
Hempstead	Waller	Blasengane Rd. (Hempstead), from St. Mary's St. to US 290	no ord.#	12/17/84		X
Hempstead	Waller	FM 1488 (Hempstead), from US 290/SH 6 to E City Limits	no ord.#	12/17/84		X
Hempstead	Waller	FM 1887 (Hempstead), from SH 159 to S City Limits	no ord.#	12/17/84		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Hempstead	Waller	SH 159 (Hempstead), from BU 290/SH6 to SW City Limits	no ord.#	12/17/84		X
Hempstead	Waller	SH 6/BU 290 (Hempstead), from N City Limits to E City Limits	no ord.#	12/17/84		X
Hempstead	Waller	St. Mary's St. (Hempstead), from US 290/SH 6 to Blasengane Rd.	no ord.#	12/17/84		X
Hempstead	Waller	US 290 (Hempstead), from N City Limits to E City Limits	no ord.#	12/17/84		X
Houston	Harris	Holcombe Boulevard (Houston) from Main St. to South Braeswood Boulevard	70-280	3/4/70	X	
Houston	Harris	Interstate 45 (Houston), from Franklin St. to US 59	70-280	3/4/70	X	
Houston	Harris	Interstate 610 (Houston), Entire Highway	70-280	3/4/70		X
Houston	Harris	Main St. (Houston) from N. MacGregor Way to Holcombe Boulevard	70-280	3/4/70	X	
Houston	Harris	N. MacGregor Way (Houston) from South Braeswood Boulevard to Main St.	70-280	3/4/70	X	
Houston	Harris	South Braeswood Boulevard (Houston) from Holcombe to N. MacGregor Way	70-280	3/4/70	X	
Houston	Harris	US 59 (Houston) from IH 45 to Buffalo Bayou	70-280	3/4/70	X	
Hurst	Tarrant	Interstate 820 (Hurst), from W City Limits to SW City Limits	1140	9/9/86		X
Hutchins	Dallas	Interstate 20 (Hutchins), from W City Limits to E City Limits	493	2/9/87		X
Hutchins	Dallas	Interstate 45 (Hutchins), from N City Limits to S City Limits	493	2/9/87		X
Irving	Dallas	LP 12 (Irving), from N City Limits to S City Limits	5981	6/20/91		X
La Grange	Fayette	BS 71 (La Grange), from West City Limits to FM 609	557	6/28/93		X
La Grange	Fayette	FM 609 (La Grange), from West City Limits to BS 71	557	6/28/93		X
La Grange	Fayette	SH 71 (La Grange), from East City Limits to West City Limits	557	6/28/93		X
La Grange	Fayette	US 77 (La Grange), from North City Limits to SH 71	557	6/28/93		X
Lake Worth	Tarrant	Interstate 820 (Lake Worth), from S City Limits to E City Limits	350	10/14/86		X
Lancaster	Dallas	Interstate 20 (Lancaster), from W City Limits to E City Limits	Ord. Art. 10.2200, Sec. 10.2202	1976		X
Lancaster	Dallas	Interstate 35 E (Lancaster), from N City Limits to S City Limits	Ord. Art. 10.2200, Sec. 10.2202	1976		X
Laredo	Webb	International Bridge I (Laredo)	22 Tex Reg 12316	12/12/97	X	
Laredo	Webb	International Bridge II (Laredo)	22 Tex Reg 12316	12/12/97	X	

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
League City	Galveston	FM 517 (League City), Entire Highway	90-82	1/10/91		X
League City	Galveston	FM 646 (League City), Entire highway	90-82	1/10/91		X
League City	Galveston	FM 646. Revised: Removed from I-45 S. to FM 517.	TxDOT			
League City	Galveston	Interstate 45 (League City), Entire highway	90-82	1/10/91		X
Lubbock	Lubbock	Interstate 27 (Lubbock), from North City Limits to South City Limits	9889	3/28/96		X
Lubbock	Lubbock	LP 289 (Lubbock), from W. US 62/82, North, East, South, & West to South IH 27/US 87	9889	3/28/96		X
Lubbock	Lubbock	SH 114 (Lubbock), from West City Limits to West LP 289	9889	3/28/96		X
Lubbock	Lubbock	US 62/82 (Lubbock), from Southwest City Limits to Southwest LP 289	9889	3/28/96		X
Lubbock	Lubbock	US 62/US 82/SH 114 (Lubbock), from Northeast City Limits to Northeast LP 289	9889	3/28/96		X
Lubbock	Lubbock	US 84 (Lubbock), from Northwest City Limits to North LP 289	9889	3/28/96		X
Lubbock	Lubbock	US 84 (Lubbock), from Southeast City Limits to South LP 289	9889	3/28/96		X
Lufkin	Angelina	LP 287 (Lufkin), Entire Highway	Ord. # 364	9/23/88		X
Lufkin	Angelina	SH 103 (Lufkin), from East City Limits to E LP 287/ US 59/69	Ord. # 364	9/23/88		X
Lufkin	Angelina	SH 103 (Lufkin), from West City Limits to West LP 287	Ord. # 364	8/16/88		X
Lufkin	Angelina	SH 94 (Lufkin), from West City Limits to West LP 287	Ord. # 364	8/16/88		X
Lufkin	Angelina	US 59 (Lufkin), from N LP 287 to North City Limits	Ord. # 364	8/16/88		X
Lufkin	Angelina	US 59 (Lufkin), from S LP 287 to South City Limits	Ord. # 364	9/23/88		X
Lufkin	Angelina	US 69 (Lufkin), from E LP 287 to Southeast City Limits	Ord. # 364	9/23/88		X
Lufkin	Angelina	US 69 (Lufkin), from NW LP 287 to Northwest City Limits	Ord. # 364	8/16/88		X
Mansfield	Tarrant/Johnson	US 287 (Mansfield), entire highway	896	4/22/91		X
Mesquite	Dallas	Interstate 635 (Mesquite), from North City Limits to South City Limits	2689	8/6/90		X
Midland	Midland	Cotton Flat Rd. (Midland), from IH 20 to US 80/Bus. IH 20	6226	6/14/83		X
Midland	Midland	Fairgrounds Rd. (Midland), from South City Limits to LP 250	6226	6/14/83		X
Midland	Midland	Garfield St. (Midland), from Bus. SH 158 to Florida Ave.	6226	6/14/83		X
Midland	Midland	Golf Course Rd. (Midland), from Scharbauer Dr. to SH 158	6226	6/14/83		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Midland	Midland	Interstate 20 (Midland), from East City Limits to West City Limits	6226	6/14/83		X
Midland	Midland	LP 250 (Midland), from Interstate 20 to Fairgrounds Rd.	6226	6/14/83		X
Midland	Midland	Midkiff Rd. (Midland), from IH 20 to LP 250	6226	6/14/83		X
Midland	Midland	Midland Dr./FM 868 (Midland), from Bus. SH 158 to LP 250	6226	6/14/83		X
Midland	Midland	Scharbauer Dr. (Midland), from SH 349 to Golf Course Rd.	6226	6/14/83		X
Midland	Midland	SH 349 (Midland), from Interstate 20 to South City Limits	6226	6/14/83		X
Midland	Midland/Martin	SH 349 (Midland) from IH 20 to LP 250	6226	6/14/83		X
Mont Belvieu	Chambers	FM 565 (Mont Belvieu), from LP 207 to East City Limits	87-153	9/28/87		X
Mont Belvieu	Chambers	LP 207 (Mont Belvieu), from North SH 146 to South SH 146	87-153	9/28/87		X
Mont Belvieu	Chambers	SH 146 (Mont Belvieu), from North City Limits to South City Limits	87-153	9/28/87		X
Nacogdoches	Nacogdoches	LP 224 (Nacogdoches), Entire Highway	no ord. #	9/20/77		X
Nacogdoches	Nacogdoches	SH 21 (Nacogdoches), from East City Limits to East LP 224	no ord. #	9/20/77		X
Nacogdoches	Nacogdoches	SH 21 (Nacogdoches), from West City Limits to West LP 224	no ord. #	9/20/77		X
Nacogdoches	Nacogdoches	SH 7 (Nacogdoches), from East City Limits to East LP 224	no ord. #	9/20/77		X
Nacogdoches	Nacogdoches	SH 7 (Nacogdoches), from West City Limits to LP 224	no ord. #	9/20/77		X
Nacogdoches	Nacogdoches	US 59 (Nacogdoches), from North City Limits to N LP 224	no ord. #	9/20/77		X
Nacogdoches	Nacogdoches	US 59 (Nacogdoches), from S City Limits to S LP 224	no ord. #	9/20/77		
New Braunfels	Comal	Interstate 35 (New Braunfels), from North City Limits to South City Limits	93-7	1/8/93		X
New Braunfels	Comal	LP 337 (New Braunfels), from North Interstate 35 to South IH 35	93-7	1/8/93		X
North Richland Hills	Tarrant	Interstate 820 (North Richland Hills), from W City Limits to E City Limits	Resolution # 86-32	8/25/86		X
North Richland Hills	Tarrant	SH 26 (North Richland Hills), entire highway within city limits	Resolution # 86-32	8/25/86		X
Odessa	Ector	Interstate 20 (Odessa), from SW City Limits to SE City Limits	95-58	10/24/95		X
Odessa	Ector	LP 338 (Odessa), from S City Limits to N City Limits	95-58	10/24/95		X
Pearland	Brazoria	FM 518 (Pearland), from W City Limits to E City Limits	Code - Art. 5, Sec. 10-102	3/25/91		X
Pearland	Brazoria	SH 35 (Pearland), from N City Limits to S City Limits	Code - Art. 5, Sec.	3/25/91		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
			10-102			
Rosenberg	Fort Bend	SH 36 (Rosenberg) South from the 3400 block to the 4300 block	90-40	8/6/90		X
Rosenberg	Fort Bend	SH 36 (Rosenberg) West from the 500 block to US 90, 900 block only, to FM 529	90-40	8/6/90		X
Rosenberg	Fort Bend	US 59 (Rosenberg) from the South City Llimits to the North City Limits	90-40	8/6/90		X
Saginaw	Tarrant	Interstate 820 (Saginaw), from W City Limits to E City Limits	Resolution # 86-19	11/18/86		X
San Angelo	Tom Green	LP 306 (San Angelo), from North US 67 to US 87/US 277	10-21-1	10/1/91		X
San Angelo	Tom Green	US 67 (San Angelo), from Southwest City Limits to West LP 306	10-21-1	10/1/91		X
San Angelo	Tom Green	US 87 (San Angelo), from LP 306 to S City Limits	10-21-1	10/1/91		X
Santa Fe	Galveston	FM 1764 (Santa Fe), entire highway within city limits	10-82	5/25/82		X
Santa Fe	Galveston	FM 646 (Santa Fe) Revised: Removed from N. City Limits to SH 6.	TxDOT			
Santa Fe	Galveston	FM 646 (Santa Fe), entire highway within city limits	10-82	5/25/82		X
Santa Fe	Galveston	SH 6 (Santa Fe), entire highway within city limits	10-82	5/25/82		X
Stafford	Fort Bend	US 90 A (Stafford) from West City Limits to East City Limits	397	1/21/87		X
Stafford	Fort Bend/Harris	US 59 (Stafford) from West City Limits to North City Limits	397	1/21/87		X
Temple	Bell	Interstate 35 (Temple), from North City Limits to Southwest City Limits	92-2145	5/21/92		X
Temple	Bell	LP 363 (Temple), entire highway	92-2145	5/21/92		X
Texas City	Galveston	10th St. (Texas City), from 4th Ave. S to 6th Ave. S	72-6	3/1/72		X
Texas City	Galveston	14th St. (Texas City), from LP 197 to 5th Ave. S	72-6	3/1/72		X
Texas City	Galveston	2nd Ave. S (Texas City), from LP 197 to Bay St.	72-6	3/1/72		X
Texas City	Galveston	4th Ave. S (Texas City), from LP 197 to 10th St.	72-6	3/1/72		X
Texas City	Galveston	5th Ave. S (Texas City), from SH 146 to 14th St.	72-6	3/1/72		X
Texas City	Galveston	FM 1764 (Texas City), from IH 45 to SH 146	72-6	3/1/72		X
Texas City	Galveston	FM 519 (Texas City), from SH 146 to LP 197	72-6	3/1/72		X
Texas City	Galveston	Grant Ave. (Texas City), from 5th Ave. S to FM 519/SH 341	72-6	3/1/72		X
Texas City	Galveston	LP 197 (Texas City), from South City Limits to 2nd Ave. S	72-6	3/1/72		X

City	County	Route Description	# of ord or code	Date of ord or code	Prohibited	Through Routing
Texas City	Galveston	SH 146 (Texas City), from North City Limits to South City Limits	72-6	3/1/72		X
Victoria	Victoria	BU 59 (Victoria), from US 77 (downtown) to John Stockbauer Rd.	82-15	10/7/82		X
Victoria	Victoria	John Stockbauer Rd. (Victoria), from US 59 to BU 59	82-15	10/7/82		X
Victoria	Victoria	LP 463 (Victoria), from US 87 to US 77	82-15	10/7/82		X
Victoria	Victoria	SH 185 (Victoria), from BU 59 to S City Limits	82-15	10/7/82		X
Victoria	Victoria	US 59 (Victoria), from US 87 to East City Limits	82-15	10/7/82		X
Victoria	Victoria	US 77 (Victoria), from W City Limits to N City Limits	82-15	10/7/82		X
Victoria	Victoria	US 87 (Victoria), from S City Limits to NW City Limits	82-15	10/7/82		X

APPENDIX F: TEXAS ADMINISTRATIVE CODE – HAZARDOUS MATERIAL ROUTING DESIGNATION

Texas Administrative Code

TITLE 43	TRANSPORTATION
PART 1	TEXAS DEPARTMENT OF TRANSPORTATION
CHAPTER 25	TRAFFIC OPERATIONS
SUBCHAPTER F	HAZARDOUS MATERIAL ROUTING DESIGNATIONS
RULE §25.103	**Routing Designations by Political Subdivisions**

(a) Purpose. Title 49, Code of Federal Regulations, Part 397, Subpart C, authorizes a political subdivision of a state to establish NRHM route designations on roads and highways open to the public under the jurisdiction of the political subdivision. Texas Civil Statutes, Article 6675d, §7(f) requires a municipality with a population of more than 750,000 to develop a route for commercial motor vehicles carrying NRHM on a road or highway in the municipality and to submit the proposed route to the department for approval. This section prescribes the responsibilities of political subdivisions in establishing NRHM route designations and requires a political subdivision proposing the establishment of a new or revised NRHM routing designation to comply with this section in order to ensure that all route designations are properly established.

(b) Costs. The political subdivision is responsible for all costs of NRHM route development, including proposal preparation, public hearings, signs, sign supports, sign installation, and sign maintenance.

(c) Initial contact. A political subdivision considering the establishment of a NRHM route shall contact the local district office of the department and any other political subdivisions within a 25 mile radius of any point along the proposed NRHM route, and shall consult with those entities during the process for determining the best NRHM route. Coordination with the Texas Department of Public Safety and the local emergency planning council or committee is encouraged.

(d) Route analysis and proposal. A political subdivision intending to establish a NRHM routing designation shall fully consider and address in writing all of the federal standards and factors listed in 49 CFR §397.71(b) in the route determination process. When analyzing these standards and factors, the political subdivision shall use the most current version of the United States Department of Transportation publication entitled "Guidelines for Applying Criteria to Designate Routes for Transporting Hazardous Materials" or an equivalent routing analysis tool to develop a route proposal. If an equivalent routing analysis tool is used, the political subdivision shall include in its route proposal a written explanation of how the tool is equivalent to the United States Department of Transportation standards.

(e) Local public hearing. A political subdivision shall hold at least one public hearing on any proposed NRHM routing designation. Public hearings may take the form of a city council or commissioners court meeting and shall conform with all applicable state laws governing public meetings, including the Texas Open Meetings Act, Government Code, Chapter 551. Public notification of the hearing shall comply with the following criteria.

(1) The public shall be given 30 days prior notice of the hearing through publication in at

least two newspapers of general circulation in the affected area, one of which is a newspaper with statewide circulation.

(2) The notice shall contain a complete description of the proposed route, including the location, route name, highway number if the route is on the state highway system, and beginning and ending points of the route, together with the date, time, and location of the public hearing.

(3) The notice shall initiate a 30-day public comment period and shall inform the public where to send any written comments.

(f) Proposal submission. A political subdivision that has conducted a local public hearing in compliance with subsection (e) of this section shall submit eight copies of the NRHM route designation proposal and one original color map of the proposed NRHM route to the department for approval. The proposal and map shall be submitted to the Texas Department of Transportation, Traffic Operations Division, 125 East 11th Street, Austin, Texas 78701-2483. The proposal shall include:

(1) documentation demonstrating compliance with Title 49, Code of Federal Regulations, Part 397, Subpart C, and this section;

(2) a complete description of the proposed route; and

(3) a signature of approval by an authorized official of the political subdivision such as the mayor, city manager, county judge or an equivalent level of authority.

(g) Proposal review. The department will provide the public with notice through publication in the Texas Register, a 30-day period in which to comment, and will conduct a public hearing to receive additional comments on the proposed NRHM routing designation. The public hearing will be conducted before the executive director or the designee of the executive director. The department will publish a notice satisfying the criteria identified in subsection (e) of this section in two newspapers of general circulation in the affected area. Public hearings under this subsection will be held in Austin, Texas.

(h) Consultation with other states or Indian tribes. At least 60 days prior to establishing the NRHM routing designation, the department will provide written notice to the officials responsible for NRHM highway routing in all other affected states or Indian tribes. If no response is received within 60 days from the date of receipt of the notification of the proposed routing designation, the routing designation will be considered approved by the affected states or Indian tribes. The department will attempt to resolve any concerns or disagreement expressed by any consulted states or Indian tribes related to the proposed routing designation. If these concerns or disagreements are not resolved, the department will petition the Federal Highway Administration for resolution of the dispute in accordance with 49 CFR §397.75.

(i) Authorization and approval. If the department determines that a route has met all of the criteria for approval, the executive director will approve the NRHM routing designation, notify the political subdivision in writing that the proposed routing designation is authorized, and issue appropriate notice to the Federal Highway Administration and the Texas Department of Public Safety. A political subdivision that is issued a letter of approval shall designate the NRHM route by ordinance, resolution, rule, regulation, or other official order, and shall forward a copy of the order to the department within 30 days of receipt of the letter of approval.

(j) Route signing. After receipt of department approval and passage of the order, the political subdivision shall submit the proposed sign and installation locations of the NRHM route