# II. Technological Hazards
# A. Industrial Hazards

The following outline summarizes the significant industrial hazards covered in this section:

1. Fires
    - a. Structural Fires
    - b. Scrap Tire Fires
2. Hazardous Material Incidents
    - a. Hazardous Material Incidents – Fixed Site (including industrial accidents)
    - b. Nuclear Power Plant Emergencies
    - c. Hazardous Material Incidents – Transportation
    - d. Petroleum and Natural Gas Pipeline Accidents
    - e. Oil and Natural Gas Well Accidents

This section covers many related types of events that stem from breakdowns or weaknesses in industry and the built environment. The starting section, structural fires, considers various types of large fires that occur in the midst of important buildings or structures. Since a frequent cause of structural fires involves natural gas explosions, the chapters involving natural gas (pipelines and wells) appear nearby, to make easier a more thorough reading about this shared source of risk. Although small residential fires are common, and can be the cause of larger urban conflagrations, this hazard analysis focuses in particular on those larger-scale fires that have greater potential to affect an entire community—either through a fire's sheer magnitude or through the vital nature of the facilities or resources it affects. For this 2014 edition of the Michigan Hazard Mitigation Plan, new consideration and detail is provided for "urban conflagrations" in which dense urban development may allow fires to spread over many blocks, or even the entire core of the built-up area.

Scrap tire fires are a special case of industrial hazard, for although they do not typically affect a specific structure, these types of fires do involve toxic smoke and chemical residues that have more in common with hazardous material incidents than with ordinary residential and wildfire events. The following chapters, specifically dealing with hazardous material incidents, cover a wide array of extremely hazardous substances across diverse situations that typically involve industrial or warehousing operations. The section on fixed site incidents includes a consideration of fire-related industrial accidents and explosions, even if these did not involve extremely hazardous substances. Again, the emphasis is on events of a relatively large magnitude—those that resulted in community states of emergency, evacuations, impairment or loss of economically significant or critical facilities, or multiple casualties. A separate chapter deals with nuclear power plant emergencies, and then consideration is given to various forms of transportation incidents that may involve hazardous materials, including separate chapters about pipeline infrastructure and wells that have been dug for production purposes.

Overlap Between Industrial Hazards and Other Sections of the Hazard Analysis

Various types of structural, scrap tire, and industrial fires and incidents may stem from deliberate actions, rather than accidental causes. In such cases, the incidents tie in with the terrorism and civil disturbance chapters, in the Human-Related hazards section of the hazard analysis. Large scale disaster events may also cause these types of fires to occur—lightning strikes have actually caused the direct ignition of structural fires, and the destruction caused by tornados can lead to fires as well. Wildfires have a clear potential to ignite structures, and may also come to involve scrap tire storage areas. Although the chances are slim, earthquakes and celestial impact events might also result in the occurrence of structural or industrial fires. There might be certain conditions under which infrastructure failures are connected with fires. An indirect link also exists between extreme temperatures and winter weather, as various means of heating indoor areas have been known to increase fire risks. A major transportation incident has the potential to start a fire, and certain kinds of catastrophic incidents (such as nuclear attack) would certainly create fires.

A structural fire involving one or more critical facilities has the potential to cause infrastructure failures, energy emergencies, flooding, wildfires, dam failures, transportation accidents, and nuclear power plant emergencies. Hazardous materials incidents of any type (including scrap tire fires) may lead to public health emergencies if they are large enough, or if the involved substances are hazardous enough. If a fire or hazardous materials incident stems from some sort of systematic official negligence then there may be a potential for civil disturbance or sabotage/terrorism to take place.

# STRUCTURAL FIRES

*A fire, of any origin, that ignites one or more structures, causing loss of life and/or property.*

***Hazard Description and Analysis***

In terms of average annual loss of life and property, structural fires—often referred to as the "universal hazard" because they occur in virtually every community—are by far the most common hazard facing most communities in Michigan and across the country. Each year in the United States, fires result in approximately 5,000 deaths and 25,000 injuries requiring medical treatment. According to some sources, structural fires cause more property damage and loss of life than all types of natural disasters combined. Direct property losses due to fire exceed $9 billion per year, and much of that figure is the result of structural fires.

In 2008 alone, there were 3,320 civilian deaths and 16,705 civilian injuries as a result of fire in the United States, along with 118 firefighters killed while on duty. There were an estimated 1.5 million fires in 2008, and direct property loss due to fires was estimated at $15.5 billion. This figure includes the 2008 California wildfires, with estimated losses of $1.4 billion. There were 515,000 structure fires in the United States in 2008 that resulted in 2,900 civilian deaths, 14,960 civilian injuries, and $12.4 billion in property damage. Every 22 seconds, a fire department responds to a fire somewhere in the nation. A fire occurs in a structure at the rate of one every 61 seconds, and in particular a residential fire occurs every 78 seconds. Nationwide, there is a civilian fire injury every 31 minutes. In 2008, structure fires represented 34% of the total fires across the United States.

Unfortunately, although the United States has made great strides in lessening deaths and injuries caused by other types of disasters, structural fires are worse problems in this country than in many other industrialized countries (even those with a more densely-developed population pattern). The United States Centers for Disease Control (CDC) figures indicate that fire-associated mortality rates in the United States are approximately 2-3 times greater than those in many other developed countries. According to the Federal Emergency Management Agency's National Fire Data Center, residential fires represent 78% of all structural fires and cause 80% of all fire fatalities. Approximately 83% of those fatalities occur in single-family homes and duplexes. Perhaps the most tragic statistic of all is that over 40% of residential fires and 60% of residential fatalities occur in homes with no smoke alarms. (Studies have repeatedly shown that a working smoke alarm dramatically increases a person's chance of surviving a fire.)

Michigan's fire experience generally mirrors the national fire situation. According to statistics compiled by the Fire Marshal Division of the Michigan Department of Licensing and Regulatory Affairs for 2003, nearly 19,000 structural fires occurred in Michigan, resulting in 161 deaths and 624 injuries. The dollar loss for all fires was estimated at over $230 million. The Fire Marshal Division estimated that a structural fire occurred in Michigan about every 28 minutes in 2003. Michigan's fire death rate of 15.4 persons per million puts it toward the middle of all states in the nation in 2006. As the following table indicates, Michigan is ranked 19th in terms of fire deaths per million population. Michigan's fire death rate is ranked third in the Midwest, behind Missouri and Indiana as of 2007.

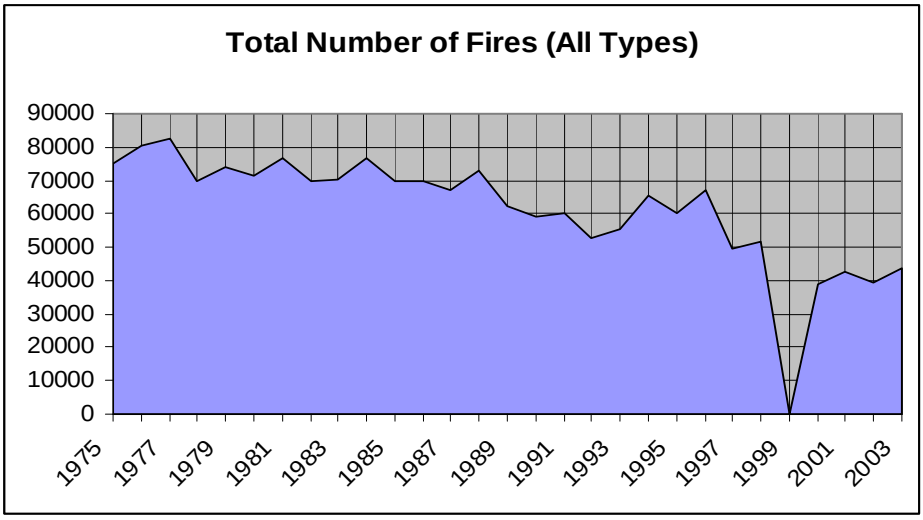
During the period from 1975-2009, the number of reported fires in Michigan (both structural and nonstructural) has trended downwards from a high of just over 80,000 to the current low of around 40,000, with yearly numbers fluctuating within this range. The number of structural fires represents approximately 35-40% of those yearly totals. Although fire risks are clearly a major concern, most of the incidents are of a limited scale and do not threaten or harm an entire community. This analysis will focus on major fires that do cause a severe impact to local communities—as disaster events.

**Fire Death Rate per Million Population: 2007**

| State | Fire Rate | State | Fire Rate | State | Fire Rate |
|---|---|---|---|---|---|
| District/ Columbia | 39.2 | Indiana | 15.6 | Wyoming | 9.6 |
| Mississippi | 28.4 | **Michigan** | **15.4** | Montana | 9.4 |
| Arkansas | 26.0 | Vermont | 14.5 | Connecticut | 9.2 |
| Alaska | 25.1 | Nevada | 14.4 | Washington | 8.8 |
| Oklahoma | 24.9 | Illinois | 14.2 | Iowa | 8.7 |
| West Virginia | 24.8 | Delaware | 13.9 | Idaho | 8.7 |
| Louisiana | 23.8 | Virginia | 13.3 | Minnesota | 8.7 |
| Alabama | 22.6 | Wisconsin | 12.7 | Colorado | 8.3 |
| Tennessee | 22.5 | Ohio | 12.5 | California | 8.2 |
| Missouri | 20.1 | Nebraska | 12.4 | Arizona | 7.9 |
| North Carolina | 19.5 | Utah | 11.6 | New Jersey | 7.5 |
| Pennsylvania | 19.2 | South Dakota | 11.3 | Massachusetts | 6.9 |
| Georgia | 18.8 | Texas | 11.2 | Maine | 6.8 |
| Kentucky | 18.6 | New Mexico | 11.2 | New Hampshire | 6.8 |
| South Carolina | 17.4 | New York | 10.7 | North Dakota | 6.3 |
| Kansas | 17.3 | Florida | 9.8 | Rhode Island | 5.7 |
| Maryland | 16.2 | Oregon | 9.6 | Hawaii | 3.9 |

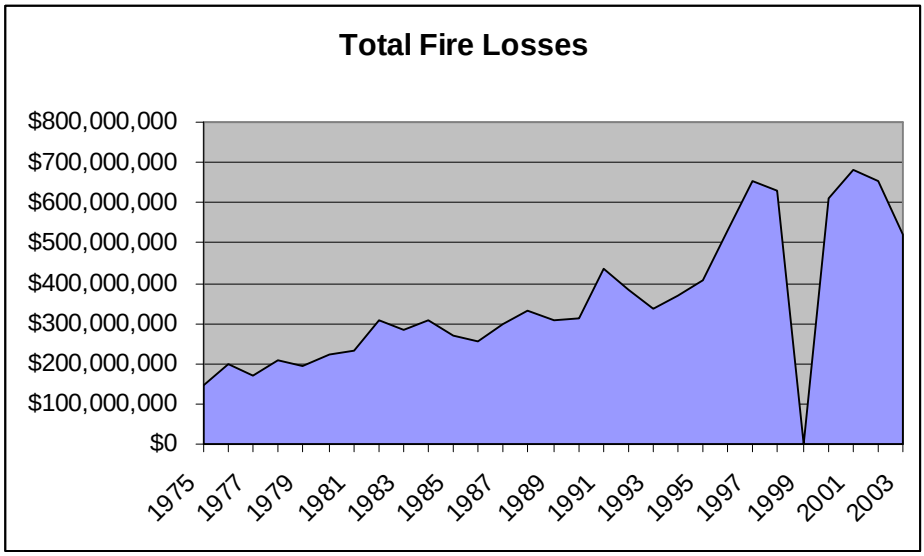
Source: U.S. Fire Administration web page, Federal Emergency Management Agency (National Fire Data Center)

**Total Number of Fires (all types) in Michigan: 1975-2003**




Note: There was no annual report of fires in 1999 due to the transfer to NFIRS
Source: Michigan Department of Licensing and Regulatory Affairs (LARA), Fire Marshal Division / MFIRS
(Note: Approximately 35-40% of the total number of fires are structural fires.)

**Total Fire Losses in Michigan: 1975-2003**




Note: There was no annual report of Fires in 1999 due to the transfer to NFIRS
Source: Michigan Department of Licensing and Regulatory Affairs (LARA), Fire Marshal Division / MFIRS
(Note: Approximately 75% of the total losses are structural fire-related.)

The State Fire Marshal, Department of Licensing and Regulatory Affairs / Bureau of Construction Codes and Fire Safety, and local fire departments are proactive in attempting to reduce the number, scope, magnitude, and impacts of structural fires in Michigan. State and local fire service efforts in the areas of training, public education, incident tracking, construction plan review, site inspection and fire analysis are all oriented toward, and contribute to, structural fire mitigation and prevention. However, like most programs, the amount of work that can be done is directly related to funding and programmatic priorities.

Nature/Composition of Michigan Fire Service

The primary challenge facing the State Fire Marshal, in particular, and the State of Michigan, in general, is the nature and composition of the Michigan fire service. The high proportion of fire fighters that are either volunteer or paid part-time (roughly 3/4 of the fire service) presents significant challenges for sustaining adequate code enforcement and inspection efforts. In addition, the relatively high level of turnover within this group places additional demands on state and local training resources. Also, with the effects of recession, especially in the State of Michigan, many fire fighters have been laid off or had their positions cut due to a lack of funding. For example, in March 2010, the city of Flint laid off 23 firefighters and 46 police officers, and closed two fire stations due to budget deficits.

The lack of full-time professional fire fighters in many areas of the state means that less time is available to conduct fire inspections and take other preventive measures necessary to lessen the structural fire threat. In many small towns and rural communities, local efforts in fire prevention are almost non-existent, due to lack of personnel and time to devote to such activities. Out of necessity, efforts in these communities are directed primarily at fire suppression. Clearly, the lack of full-time paid fire professionals in many areas across the state poses great challenges for maintaining a sustainable fire prevention and inspection program.

Lack of State Fire Safety Code

The other major challenge facing the Michigan fire service is the lack of a state-mandated fire safety code and code enforcement program for all occupancy types. Although the State enforces fire safety codes in schools, dormitories, health care facilities, and correctional facilities, plus some businesses, the remainder of the job is left to local officials. Because there is not a uniform, mandated fire safety code for everyone to adhere to, a plethora

of local ordinances have emerged. In some communities, fire safety codes do not exist at all. This contributes to Michigan's structural fire problem by allowing serious fire safety violations to go unchecked, often for years at a time. This problem manifests itself more seriously in rural areas and small towns, which typically have few, if any, paid full-time fire fighters. In Michigan's larger cities, full-time fire departments with qualified inspectors are the rule rather than the exception. As a result, fire safety inspections are performed on a more regular basis, but not necessarily as often as they should be.

Even if a mandated fire safety code were instituted statewide, it wouldn't totally solve the problem of structural fire prevention because the costs of compliance in existing buildings would often be prohibitive for business owners. Such a measure would, however, help to ensure that new construction doesn't compound the problem.

Impact on the Public

Structural fires can cause displacement and homelessness, in addition to serious injuries, death, and economic losses. Beyond the small-scale structural fires that only affect a single home or two at a time, emergency management authorities are primarily focused on disaster-level events involving multiple or major structures such as hotels, college residence halls, and major employers and community facilities (such as schools and hospitals). The impacts upon local services and economies can be severe in such cases, due to the number of residents served and the diversity of needs being met by these facilities. Structural fires occur more frequently than other Michigan hazards, and also cause more deaths, injuries, and property damage.

Impact on Public Confidence in State Governance

Structural fires may raise questions about code enforcement and other regulations that may be connected with state government. Some fires may originate from utility malfunctions (e.g. natural gas explosions) or wildfire events, and thus call into question the capacity of the state to foresee, regulate, or manage such situations. Emergency management personnel are particularly interested in structural fires that can produce disaster-level events involving major or multiple structures, major employers, or community facilities. Examples include hotels, college residence halls, schools, hospitals, factories, and "main street" commercial areas. If severe economic or service disruptions result from such fires, the viability and reliability of government operations, design standards, and procedures may be called into question. The fact that regulatory controls may be created and implemented at the local level does not necessarily absolve State government from responsibility, since municipalities are legally considered to be "creatures of the state" and could potentially have their safety policies formulated by state legislation, and implemented by state agents.

Impact on Responders

The structural fire hazard, from the perspective of emergency management, does not generally involve common residential fires that primarily affect a single home, but instead deals with large-scale events that involve critical, large, or multiple structures, utilities infrastructure, industrial facilities, nursing homes, dormitories, hospitals, hotels, and other locations that involve greater risk and complexity due to the potential numbers of vulnerable people involved, the vital nature of the site for the community, or the potential for exposure to hazardous materials. Extensive search and rescue operations may be warranted under major structural fire conditions. Special training, staffing, and equipment is often useful or necessary to effectively deal with such events.

Impact on the Environment

Air pollution issues are inherent to structural fire events, including vast amounts of carbon released from the flames, various chemicals burning within the building's materials, other forms of air pollution, and ash spread widely around the area. Large, dark, and thick smoke plumes from large burning structures can alter atmospheric conditions and lead to shifting wind patterns that affect other areas. Fires may spread to other structures and to natural vegetation, negatively affecting the environment. The burning of nearby native forests, trees, and grasslands can be some environmental consequences of structural fires. Chemicals from combustion may contaminate nearby water in lakes, reservoirs, rivers, and swamps. Agricultural structural fires can also affect farm animals and ruin agricultural products. The waters used to quell fires can spread the combustion products

(chemicals, soot, ash) into nearby areas, and into municipal sewer systems where they may affect the environment at system outlet locations.

***Significant Structural Fires***

Unfortunately, Michigan has not been immune to large structural fires that resulted in a significant loss of life. Michigan has not had a catastrophic structural fire disaster in recent years that resulted in a significant loss of human life or significant injury. However, in any given year it is not uncommon for several multiple-casualty residential structural fires to occur throughout the state. Despite the best efforts of fire officials in fire safety education and prevention, deadly residential fires continue to occur year after year.

For example, a January 10, 2002 arson fire at an apartment complex in Detroit killed two women and left over 100 people homeless. An August 29, 2002 house fire in Detroit killed three adults and a baby girl and also left one man injured. An October 16, 2002 fire at an unlicensed adult care facility in Flint killed five elderly residents. On January 26, 2003, a kitchen fire in a Detroit home spread through the house, killing five people trapped in by bolted burglar bars around the windows. On July 29, 2003, six persons (mostly children) perished in a house fire in Pontiac. A December 17, 2003 house fire in Grand Rapids killed all seven people inside, ranging in age from two to seventy. On January 25, 2004, burglar bars also trapped one adult and four children during a house fire at a home in Mount Morris Township, Genesee County, killing everyone inside. On July 10, 2007, two persons died in a Livingston County house fire. On Thanksgiving November 22, 2007 two people were killed in an Otsego house fire as a result of non working smoke detectors. On January 20, 2008 a massive structural fire in Grand Rapids resulted in the destruction of over 100 condominium units in two adjacent buildings. Around 200 individuals escaped the building, and although nobody was injured, four persons had to be rescued. On February 12, 2008 a fire raced through a home in rural northern Michigan before dawn, killing a man and his four children and sending the children's mother to the hospital. On September 29, 2008 a house fire in Coopersville resulted in four deaths. On April 25, 2009, a fire at a house in Texas Township, Kalamazoo County killed four young children and one adult. In May 2009 about 777 acres and 33 structures, including houses and outbuildings, burned in Marquette County, southwest of Ishpeming, and caused about 500 persons to be evacuated. On December 31, 2009, two fatalities and several injuries occurred during an apartment complex blaze in Detroit. A townhouse fire in Flint killed four children on February 14, 2010. On March 3, 2010 three children were killed during a Detroit house fire and another four survived by jumping out of a window to be caught by men who were providing assistance. On April 14, 2011 two people died in a house fire in Grand Rapids.

Fires in congregate facilities such as hotels, entertainment venues, schools, and hospitals pose an even greater risk due to the larger number of persons involved. As the following tables indicate, when catastrophic fires occur in congregate facilities, the human toll can be severe.

## Catastrophic Structural Fire Disasters in the United States

### HOTELS:

| Structure | Date | # Fatalities | Structure | Date | # Fatalities |
|---|---|---|---|---|---|
| Newhall House (Milwaukee) | 1883 | 71 | Lane (Anchorage) | 1966 | 14 |
| Hotel Royal (New York City) | 1892 | 28 | Hotel Fire (Seattle) | 1970 | 19 |
| Windsor Hotel East (NewYork) | 1899 | 35+ | Pioneer Intl. (Tucson) | 1970 | 28 |
| **Kerns (Lansing)** | **1934** | **34** | Ponet Sqr. (Los Angeles) | 1970 | 19 |
| Terminal (Atlanta) | 1938 | 35 | Hotel Vendome (Boston) | 1972 | 9 |
| Marlborough (Minneapolis) | 1940 | 19 | Washington House (W .V.) | 1974 | 12 |
| Gulf (Houston) | 1943 | 55 | Pomona (Portland) | 1975 | 12 |
| LaSalle (Chicago) | 1946 | 61 | Path Finder (Nebraska) | 1976 | 20 |
| Canfield (Dubuque) | 1946 | 19 | Coates House (Kansas C.) | 1978 | 16 |
| Baker (Dallas) | 1946 | 10 | MGM Grand (Las Vegas) | 1980 | 87 (700+ inj) |
| Winecoff (Atlanta) | 1946 | 119 | Stouffers Inn (New York) | 1980 | 26 |
| Thomas (San Francisco) | 1961 | 22 | Hilton (Las Vegas) | 1981 | 8 (252 inj) |
| Surfside (Atlantic City) | 1963 | 25 | Royal Beach (Chicago) | 1981 | 19 |
| Roosevelt (Jacksonville) | 1963 | 22 | Alexander Hamilton (N. J.) | 1984 | 15 |

### ENTERTAINMENT VENUES:

| Structure | Date | # Fatalities | Structure | Date | # Fatalities |
|---|---|---|---|---|---|
| Richmond Theatre (Virginia) | 1811 | 160 | Circus (Connecticut) | 1944 | 169(700+inj) |
| Brooklyn Theater (New York) | 1876 | 295 | Restaurant (Ohio) | 1965 | 22 |
| Theater (Chicago) | 1903 | 602 | Lounge (Gary, IN) | 1968 | 13 |
| Rhoads Theater (PA) | 1908 | 170+ | LA Cocktail Lounge (L.A.) | 1973 | 32 |
| Dance Hall (Louisiana) | 1919 | 25 | Social Club (New York) | 1976 | 25 |
| Dance Hall (Mississippi) | 1940 | 207 | Supper Club (Kentucky) | 1977 | 167 |
| Strand Theater (Massachusetts) | 1941 | 13 | Happy Land (New York) | 1980 | 87 |
| Nightclub (Massachusetts) | 1942 | 492 | The Station (Rhode Island) | 2003 | 100 |

### SCHOOLS:

| Structure | Date | # Fatalities | Structure | Date | # Fatalities |
|---|---|---|---|---|---|
| Collinwood (Ohio) | 1908 | 176 | New London (Texas) | 1937 | 295-500? |
| Peabody (Massachusetts) | 1915 | 22 | Cleveland (New York) | 1954 | 15 |
| Cleveland (South Carolina) | 1923 | 77 | Chicago (Illinois) | 1958 | 93 |
| Babbs Switch (Oklahoma) | 1924 | 36 | - | - | - |

### HEALTH CARE:

| Structure | Date | # Fatalities | Structure | Date | # Fatalities |
|---|---|---|---|---|---|
| Hospital (Oklahoma) | 1918 | 38 | Nursing Home (Missouri) | 1957 | 72 |
| Manhattan State (New York) | 1923 | 25 | Hospital (Connecticut) | 1961 | 16 |
| Clinic (Ohio) | 1925 | 125 | Nursing Home (Ohio) | 1963 | 63 |
| Little Sisters of Poor (Pitt., PA) | 1931 | 48 | Nursing Home (Indiana) | 1964 | 20 |
| St. Anthony's Hospital (Illinois) | 1949 | 77 | Nursing Home (Ohio) | 1970 | 31 |
| Mercy Hospital (Iowa) | 1950 | 41 | Nursing Home (P.A.) | 1971 | 15 |
| Nussing Home (Florida) | 1953 | 35 | Mental Hospital (M.S.) | 1978 | 15 |
| Nursing Home (Missouri) | 1956 | 12 | Wayside (Missouri) | 1979 | 25 |

### INDUSTRIAL/ FACTORIES:

| Structure | Date | # Fatalities | Structure | Date | # Fatalities |
|---|---|---|---|---|---|
| New York City (New York) | 1911 | 146 | Texas City (Texas) | 1947 | 561 |
| Pittsburgh (Pennsylvania) | 1927 | 28 | **Livonia (Michigan)** | **1953** | **6** |
| Los Angeles (California) | 1947 | 15 (150+ inj) | Hamlet (North Carolina) | 1991 | 25 |

### PRISONS:

| Structure | Date | # Fatalities | Structure | Date | # Fatalities |
|---|---|---|---|---|---|
| Columbus (Ohio) | 1930 | 329 | Jacksonville (Florida) | 1967 | 37 |

Source: ***The Public Health Consequences of Disasters - 1989,*** U.S. Department of Health and Human Services; Lansing State Journal

December 24, 1913: Not an actual fire, but the threat of a fire caused the suffocation deaths of 73 persons (mostly children) in Calumet's Italian Hall when someone attending a party there yelled "Fire!", sending masses of party goers in a mad rush for the exit. Although there was no fire, 73 persons died while attempting to escape down a stairwell that had doors that opened inward. The perpetrator of the tragic false fire alarm was never identified.

A 1927 fire at the Briggs Manufacturing Plant in Detroit resulted in 21 deaths. A 1934 fire at the Kerns Hotel in downtown Lansing killed 34 and injured 40.

February 8, 1951: Although it did not result in any loss of life, the arson fire at the State Office Building in Lansing was another significant structural fire that had a profound impact on Michigan. That fire, which caused close to $7 million in damage and burned for a week—destroyed thousands of irreplaceable state records and archives, including the Michigan Library. The fire was started by a young employee who thought having a criminal record would prevent him from being drafted into the Korean War.

August 2005: Another example of a catastrophic fire that did not result in any loss of human life is the blaze at a poultry farm in Berlin Township, Ionia County. The fire destroyed an egg-production building at one of the state's largest poultry farms, causing the death of over 250,000 chickens and $5 million in damage. Sixteen fire departments from four counties responded to the fire that destroyed the 150-by 600-foot building, which housed egg-laying hens.

Urban Conflagrations

It seems important to mention some of the major historical fires that have been so destructive to cities in the past, because many historical sections of Michigan's current cities remain at risk, due to their development densities and original designs that would not meet current construction and fire safety requirements. Events such as the Great Chicago 1871 fire, San Francisco's 1906 earthquake-related conflagration, and others should serve as reminders that older sections of cities may be more vulnerable to the spread of structural fires.

The following list refers to significant structural fires in Michigan communities, especially those that affected major facilities or downtown business districts, caused tremendous physical damage, death, loss of tax base due to business closures, and negatively impacted other important aspects of those communities.

**Additional major urban conflagrations or significant structural fire events in Michigan**

6/11/1805 Detroit (Wayne County)

All but one of the town's 300 buildings were destroyed. Territorial governor William Hull then authorized the 1807 plan of Detroit, with a less compact and crowded urban design less amenable to catastrophic fires—a kind of hazard mitigation planning.

5/10/1848 Detroit (Wayne County)

A fire broke out in Detroit that destroyed 107 buildings, including two large warehouses on the river. The burnt district covered over 10 acres of ground. Damage estimates were between $200,000 and $300,000. The number of families deprived of houses was about 200, or nearly 1000 persons.

7/31/1874 Muskegon (Muskegon County)

A fire destroyed a quarter of the business district and about 200 homes.

6/11/1881 Ludington (Mason County)

A fire destroyed almost the entire downtown (67 buildings).

8/5/1881 "Great Thumb Fire"

Nearly all, if not all of the entire buildings were destroyed in towns from the Michigan "thumb" counties of Huron, Tuscola, and Sanilac. Many Lapeer County buildings were also destroyed. 282 people lost their lives and damage was over $2 million. Over one million acres were burned, and this was also the first disaster served by the American Red Cross.

1/18/1884 Lowell (Kent County)

20 downtown buildings were destroyed by a fire.

9/17/1887 Ironwood (Gogebic County)

Over half of the downtown's buildings were destroyed by a fire.

12/22/1888 Hermansville (Menominee County)

A fire destroyed the entire town of more than 400 population, causing over $250,000 in damage.

5/16/1891 Muskegon (Muskegon County)

A fire destroyed about 250 buildings and homes, including the court house.

7/25/1892 Bay City (Bay County)
A fire destroyed nearly 350 homes and businesses in a 40 block area, resulting in around 1,800 people going homeless. Strong gale force winds along with the burning of timber-constructed structures contributed to the great spread.

6/28/1893 Augusta (Kalamazoo County)
Nearly the entire village of Augusta, with a population of at least 600, was destroyed.

11/24/1893 Detroit (Wayne County)
One building was destroyed and several buildings were damaged in a fire that caused 8 fatalities and about $700,000 in damage.

7/5/1897 Lake Ann (Benzie County)
A fire destroyed all but one building in a village of about 1,000 people.

5/10/1900 Fruitport (Ottawa/Muskegon Counties)
A fire wiped out over half of the downtown business district.

5/15/1901 Detroit (Wayne County)
Several buildings were destroyed in a fire, resulting in about $1,000,000 in damages.

7/5/1908 Kalkaska (Kalkaska County)
Nearly the entire town was wiped out by a fire.

12/9/1909 Kalamazoo (Kalamazoo County)
Several buildings were destroyed in a fire, resulting in about $1,000,000 in damages.

4/3/1910 Rose City (Ogemaw County)
A fire destroyed the entire town of more than 30 buildings, except for two concrete structures which were able to endure.

7/11/1911 Oscoda—Au Sable (Iosco County)
A fire destroyed about 600 buildings in the Oscoda and Au Sable area, resulting in five fatalities.

7/6/1913 Perry (Shiawassee County)
A disastrous fire consumed nearly the whole downtown area.

10/21/1930 Dewitt (Clinton County)
A fire destroyed the downtown business district and several historic buildings.

1/24/1938 Marquette (Marquette County)
A fire destroyed downtown buildings during a snow blizzard, resulting in $400,000 in damages.

3/17/1951 Owosso (Shiawassee County)
One large industrial factory was destroyed, resulting in $2,000,000 in damages.

2/20/1954 Hartford (Van Buren County)
One senior citizen home was destroyed, resulting in seven fatalities.

2/11/1955 Owosso (Shiawassee County)
One large industrial factory was destroyed, resulting in $2,500,000 in damages.

1/2/1958 Lowell (Kent County)
Seven businesses were destroyed in a massive fire.

7/23-30/1967 Detroit (Wayne County)
One of the most infamous riots ever in the United States occurred in Detroit from July 23-30, 1967, resulting in over 2,500 buildings damaged. This uprising resulted in the greatest loss of life and the largest destruction of property of any of the national riots of the 1960s. Over 7,000 arrests were made, 43 people were killed, and over 1,000 were injured. Many stores and buildings were set on fire during the riot, as much as six to seven miles out from the initial starting point. Over 150 fires consumed a 15 block area and burned uncontrolled when firefighters were forced to withdraw after being pelted by objects. About 5,000 were left homeless and over 400 structures were burnt or damaged enough to be demolished. Over $50 million in damage had been incurred, due to fires and looting.

10/29-31/1984 Detroit (Wayne County) (Note: the event occurred annually but with varying severity)
The Halloween tradition known as “Devil’s Night” reached its peak destruction level as 810 fires were intentionally set over a three day period in late October, in Detroit. The arson destruction during this time period had roots dating back to the 1930s, and it was very common to have hundreds of fires each year before Halloween. In the late 1990s city of officials created “Angel’s Night” where volunteers and law enforcement officials patrol neighborhoods and monitor abandoned buildings, generally starting the night of October 29.

2/8/1987 St. Johns (Clinton County)
One business was destroyed and resulted in $350,000 in damage.

2/10/1987 Ithaca (Gratiot County)
Four businesses were destroyed and two others were damaged, with total losses estimated at $750,000.

3/6/1987 Ovid (Clinton County)
Three businesses were destroyed, resulting in about $175,000 in damages.

3/13/1987 Detroit (Wayne County)
Two industrial buildings were destroyed, causing three fatalities and six other injuries.

1/26/1988 Alma (Gratiot County)
One business was destroyed, one person died, and total damages were about $150,000.

3/2/1988 Webberville (Ingham County)
One business was destroyed, along with the public library, resulting in about $200,000 in damage.

6/2/1988 Corunna (Shiawassee County)
Four businesses were destroyed and one other was damaged, resulting in total losses of about $2.4 million.
11/8/1990 Ovid (Clinton County)
One business was destroyed and one other was damaged, resulting in total losses of about $100,000.
1/20/1991 Perry (Shiawassee County)
One business was destroyed and three others were damaged, resulting in total losses of about $225,000.
2/28/1993 Ludington (Mason County)
Two apartment complexes were damaged, causing nine fatalities and $50,000 in damage.
6/1/1993 Owosso (Shiawassee County)
One factory was destroyed, totaling about $30,000,000 in damage.
7/18/1993 Grand Ledge (Eaton County)
Three businesses were destroyed and four others were damaged, totaling about $525,000 in losses.
4/25/1995 Flint (Genesee County)
One business was destroyed, causing more than $1,000,000 in damage.
6/26/1999 Suttons Bay (Leelanau County)
One business was destroyed, resulting in damages estimated from $700,000 to $1,000,000.
11/10/1999 Flint (Genesee County)
One convalescent home was destroyed, resulting in five fatalities.
12/1/2000 Detroit (Wayne County)
One apartment complex was damaged, and six fatalities were reported from the fire.
4/2/2001 Detroit (Wayne County)
One 50-unit apartment complex was completely destroyed. Three injuries resulted.
4/30/2001 Wixom (Oakland County)
One apartment complex was destroyed.
5/25/2001 Detroit (Wayne County)
Five buildings were destroyed.
6/1/2001 Highland Park (Wayne County)
Three houses, two buildings, and one apartment were damaged.
7/3/2001 Detroit (Wayne County)
One large downtown building was destroyed by fire, and nearby buildings were threatened.
8/26/2001 Detroit (Wayne County)
One industrial building was destroyed and nine persons were injured.
4/16/2002 Detroit (Wayne County)
One apartment complex was destroyed, resulting in two injuries and more than 100 persons left homeless.
5/20/2002 Detroit (Wayne County)
One apartment complex was destroyed, leaving dozens homeless.
7/5/2003 West Bloomfield (Oakland County)
One building was destroyed, resulting in $2,500,000 in damages.
7/24/2003 Ann Arbor (Washtenaw County)
Four buildings were destroyed.
8/18/2003 Inkster (Wayne County)
An 18-unit apartment complex was destroyed, resulting in one injury.
9/22/2003 Detroit (Wayne County)
A natural gas explosion blew up a vacant home and caused two occupied homes to catch on fire. Up to 30 nearby homes may have been damaged by debris.
12/29/2003 Detroit (Wayne County)
A 34-unit apartment complex was destroyed, resulting in one injury.
1/6/2004 Grosse Pointe (Wayne County)
Three businesses were destroyed, along with six apartment units.
1/20/2004 Springfield Twp. (Oakland County)
One building was destroyed, along with eight salt trucks and seven graders.
3/4/2004 Lake Orion (Oakland County)
Six businesses were destroyed, some of which had dated back to the 19th century.
8/24/2004 Southfield (Oakland County)
One apartment complex was destroyed, but its residents were safely evacuated.
5/13/2005 Highland Park (Wayne County)
A block fire involved several houses being burned. Evidence pointed to its being set by an arsonist.
6/20/2005 Detroit (Wayne County)
A large but vacant industrial plant was destroyed. The incident involved 150 responders and caused three injuries.

7/12/2005 Detroit (Wayne County)
Six units in apartment complex were destroyed and six units were damaged.
8/10/2005 Ionia (Ionia County)
One large and densely populated livestock building was destroyed, causing $3,000,000 in damage, and 250,000 chickens to be killed in the fire.
9/13/2005 Hartford (Van Buren County)
One business was destroyed, and one apartment complex was damaged.
9/23/2005 Utica (Macomb County)
One historic building was destroyed.
10/16/2005 Detroit (Wayne County)
A large but vacant industrial building was destroyed by fire.
3/3/2006 Ann Arbor (Washtenaw County)
An apartment complex was damaged, causing one fatality, two injuries, and more than persons to be evacuated.
5/23/2006 Bay City (Bay County)
One 8-unit apartment building was destroyed, along with several shops.
12/7/2006 Detroit (Wayne County)
One apartment complex was destroyed, causing one fatality and leaving 51 families homeless.
2/8/2007 Ypsilanti (Washtenaw County)
One apartment complex was damaged, destroying six of its units and causing three fatalities.
3/7/2007 Cedar Springs (Kent County)
Fire devastates homes and businesses in the downtown area.
5/7/2007 Millersburg (Presque Isle County)
Five buildings used by a single industry were destroyed in Millersburg.
5/18/2007 Linden (Genesee County)
Three businesses were destroyed.
7/4/2007 Owosso (Shiawassee County)
An apartment complex was destroyed, causing one fatality, and two businesses were damaged.
9/16/2007 Mount Pleasant (Isabella County)
Three businesses were destroyed.
1/20/2008 Grand Rapids (Kent County)
Two buildings were destroyed, involving more than 100 destroyed condominiums and the evacuation of over 200 persons.
1/23/2008 Van Buren Twp. (Wayne County)
One 32-unit apartment building was destroyed.
2/6/2008 Detroit (Wayne County)
One apartment complex was destroyed, leaving more than 100 persons homeless and causing one death and two injuries.
4/3/2008 Bay City (Bay County)
One 18-unit apartment building was destroyed.
6/17/2008 Mount Clemens (Macomb County)
10 apartment units were destroyed in an apartment complex fire.
8/31/2008 Ontonagon (Ontonagon County)
Seven buildings were destroyed resulting in $250,000 in damages.
8/21/2008 Harrison Township (Macomb County)
One 37-unit apartment complex was destroyed.
10/2/2008 Clare (Clare County)
One business was destroyed in a large fire, and the downtown area was evacuated.
12/10/2008 Shepherd (Isabella County)
One business was destroyed in a large fire that also impacted emergency responders.
2/3/2009 Kalamazoo (Kalamazoo County)
One 36-unit apartment complex was destroyed.
2/13/2009 Fenton (Genesee County)
One 18-unit apartment complex was destroyed.
3/7/2009 Cedar Springs (Kent County)
Three businesses and two apartments were destroyed.
5/20/2009 Marquette County (Marquette County)
33 structures were destroyed by wildfire, and more than 500 persons were evacuated.
6/30/2009 Muskegon (Muskegon County)
One 10-unit apartment complex was destroyed, causing five injuries.
7/25/2009 Hancock (Houghton County)
One building was destroyed, and two apartment floors were destroyed by fire, resulting in four fatalities.

8/5/2009 Big Rapids (Mecosta County)
One business was destroyed, resulting in $4,000,000 in damages.
10/25/2009 Ann Arbor (Washtenaw County)
One business was destroyed and four apartments were damaged. More than 600 persons were evacuated during the event.
1/22/2010 Grand Blanc (Genesee County)
One 24-unit apartment complex was destroyed.
1/30/2010 Potterville (Eaton County)
Four businesses were destroyed.
3/19/2010 Wyoming (Kent County)
A fire destroyed a 32 unit apartment complex, displacing all 30 residents.
5/17/2010 Homer (Calhoun County)
An historic 19th-Century community mill was destroyed by fire.
5/19/2010 Gaylord (Otsego County)
One business was destroyed by fire, which also caused three businesses and two apartment complexes to be damaged.
9/7/2010 Detroit (Wayne County)
At least 85 fires destroyed more than 70 homes in Detroit, propelled by strong winds gusting up to 40-50mph, and exacerbated by hot and dry conditions, downed power lines, and a shortage of equipment and manpower. The fires affected multiple neighborhoods throughout the city.
10/14/2010 Alma (Gratiot County)
Two businesses were destroyed, and four other businesses were damaged.
3/26/2011 Jackson (Jackson County)
A large 19th-Century large factory building was destroyed as a result of arson.
5/9/2011 Grand Rapids (Kent County)
One large factory building was destroyed.
6/24/2013 Plainwell (Allegan County)
An industrial building caught fire and required evacuation of persons for ¼ mile around, since the business was a major handler of hazardous materials in the midst of an industrial park. Explosions and thick smoke posed a threat to persons nearby, and more than 30 businesses in the industrial park were closed for at least a day or two, until the situation could be gotten under control.
11/12/2013 Lapeer (Lapeer County)
A fire in the historic downtown area destroyed several businesses and left 15 residents of apartments without their homes. Some limited damage from smoke and water affected a few of the surrounding structures that were otherwise saved by prompt and effective firefighting actions.
1/3/2014 Plainfield Township (Kent County)
A destructive fire broke out in one wing of the main building built into the Minor League baseball stadium for the West Michigan Whitecaps, an affiliate of the Detroit Tigers. A whole section of the building collapsed under the effects of the intense fire, but the stadium intends to rebuild it in time for the 2014 season.

Although structural fires occur every day in both large cities and small towns in Michigan, what was significant about these particular fires was the level of impact they had on the communities. In some cases, the very lifeblood of the community's business and retail districts was destroyed or severely damaged, affecting not only the structures themselves, but also the community's economy as well. Some of the affected businesses never re-opened. (Note: please refer also to the section on Wildfires, for more information about some of these events.)

## College Dormitory Fire Safety

The fire safety of college dormitories across the country was called into question on January 19, 2000 when a predawn fire at a Seton Hall University (New Jersey) dormitory killed 3 students, injured 62, and forced the evacuation of hundreds more students into the freezing cold outside. The Seton Hall tragedy set off a national re-examination of fire safety measures and practices in dormitories and similar congregate housing facilities at colleges and universities. Sensing the need for additional financing of fire safety measures on college campuses, Congress occasionally considers legislation that would authorize appropriations for nationwide competitive grants to help provide fire sprinkler systems in student housing and dormitories.

In Michigan, fires in two college dormitories in March of 2000 provided a reminder that what happened at Seton Hall University in New Jersey could also happen here given the right circumstances. On March 16, an early-morning fire at a Western Michigan University dormitory in Kalamazoo destroyed a first-floor room and forced the evacuation of more than 400 students. No one was injured in that fire. Three days later, on March 19, a fire in a third floor room at a 175-student Ferris State University dormitory hospitalized one person and left two others with minor injuries. The building's second and third floors sustained extensive fire and water damage.

Michigan colleges do have a history of significant fire incidents, such as in 1986 when 34 students were injured in a Michigan State University dorm fire. Also, on March 9th, 1989 a massive fire gutted 50 percent of Sherzer Hall at Eastern Michigan University. It was classified as one of the most devastating events in the University's history.

In 1998/99, state, local and university officials in Michigan had already begun to take a closer look at the fire safety standards and requirements for Michigan's college and university dormitories. That re-examination resulted in the adoption of new fire safety rules that took effect in December 1999. (See the Programs and Initiatives section below for more details.) Below is a chart showing the statistics of U.S. dormitory fires from 1980-2006. It should be noted that dormitories include school, college and university dormitories; nurses' quarters; convent, monastery and other religious dormitories; and bunk houses and worker's barracks.

**U.S. Dormitory Fires: 1980-2006**

| Year | Fires | Civilian Deaths | Civilian Injuries | Property Damage (in millions) |
|---|---|---|---|---|
| 1980 | 3,200 | 13 | 122 | $9.2 |
| 1981 | 2,960 | 4 | 118 | $12.6 |
| 1982 | 2,420 | 0 | 103 | $9.4 |
| 1983 | 2,490 | 9 | 156 | $23.9 |
| 1984 | 2,510 | 5 | 50 | $11.1 |
| 1985 | 2,440 | 0 | 68 | $7.8 |
| 1986 | 2,350 | 5 | 55 | $46.9 |
| 1987 | 2,560 | 0 | 76 | $10.5 |
| 1988 | 2,430 | 3 | 91 | $8.1 |
| 1989 | 2,650 | 0 | 109 | $17.4 |
| 1990 | 2,330 | 2 | 80 | $24.5 |
| 1991 | 2,270 | 8 | 61 | $37.1 |
| 1992 | 2,470 | 2 | 147 | $7.4 |
| 1993 | 2,270 | 0 | 73 | $8.8 |
| 1994 | 2,320 | 0 | 75 | $12.6 |
| 1995 | 2,330 | 0 | 143 | $20.3 |
| 1996 | 2,050 | 0 | 78 | $10.2 |
| 1997 | 2,200 | 9 | 73 | $12.2 |
| 1998 | 1,810 | 5 | 143 | $9.7 |
| 1999 | 1,380 | 0 | 190 | $5.0 |
| 2000 | 1,780 | 7 | 168 | $23.0 |
| 2001 | 2,940 | 6 | 67 | $104.0 |
| 2002 | 3,110 | 1 | 19 | $20.0 |
| 2003 | 3,350 | 1 | 50 | $23.0 |
| 2004 | 3,380 | 3 | 48 | $18.0 |
| 2005 | 3,270 | 1 | 59 | $37.0 |
| 2006 | 4,290 | 2 | 58 | $40.0 |

Source: National Fire Incident Reporting System

State Facility Fire Safety

A February 1999 fire in the G. Mennen Williams Building in Lansing (which houses the Michigan Department of Attorney General) caused $4.2 million in damage and forced the temporary relocation of many employees. The fire is believed to have started in a photocopy machine. Fortunately, the fire occurred over the Presidents Day holiday when the building was mostly vacant, so no injuries occurred. The Williams Building, like many state facilities, was built before sprinkler systems were routinely recommended as a fire safety measure. As a result of this fire, the State Fire Safety Board of the Michigan Department of Licensing and Regulatory Affairs is considering adopting stricter fire safety standards for all state owned and leased facilities—including the installation of fire sprinkler systems in all new facilities and those undergoing major renovation.

A December 22, 2001 fire at the Murray D. Van Wagoner Building in Lansing (which houses the Michigan Department of Transportation) severely damaged the third floor, causing smoke and water damage throughout all of the building's four floors. Fortunately, the building was empty at the time the fire occurred. The fire forced the temporary relocation of several hundred workers until the building could be cleaned up and restored.

**Programs and Initiatives**

Michigan Fire Prevention Act

The Michigan Fire Prevention Act (1941 PA 207), the State's primary fire enabling legislation, provides for the prevention of fires and the protection of persons and property from exposure to the dangers of fire and explosion. The Act gives the State Fire Marshal (Michigan Department of Licensing and Regulatory Affairs) and local fire chiefs broad authority to take actions necessary to prevent fires and stop the spread of fires once they have started. This includes: 1) requiring the razing, repair, alteration or improvement of buildings and premises that constitute a fire hazard; 2) controlling the use and occupancy of such buildings and premises; and 3) engaging in public education activities aimed at preventing or mitigating the effects of fire and explosion.

Michigan Department of Licensing and Regulatory Affairs, Michigan Fire Fighters Training Council

The Michigan Fire Fighters Training Council, housed within the Michigan Department of Licensing and Regulatory Affairs, performs a number of tasks aimed at developing, improving, and enhancing the training of fire fighters in Michigan. This includes, but is not limited to: 1) developing standards for training and fire fighter selection; 2) establishing courses of study and instructor qualifications and certification; 3) evaluating instructors and schools; and 4) assisting fire departments with training. All of these functions contribute to structural fire mitigation by enhancing the skills of fire fighters in preventing and suppressing fires.

The Michigan Department of Licensing and Regulatory Affairs, in conjunction with local fire departments, conducts a number of other important fire-related initiatives, including: 1) statewide public education programs aimed at preventing fires; 2) investigating fires, explosions and hazardous material incidents; and 3) collecting, compiling and analyzing fire-related data (through the National Fire Incident Reporting System) to determine fire frequency, causes, and impacts; 4) membership association and union membership organization for both fire fighters and fire chiefs.

Michigan's Office of Fire Safety

The Michigan Department of Licensing and Regulatory Affairs' Office of Fire Safety is responsible for conducting fire safety and prevention inspections in state-regulated facilities and certain other facilities. Specific services provided include: 1) fire safety inspections of adult foster care, correctional and health care facilities, and hotels/motels; 2) plan review and construction inspections of the regulated facilities in item (1), as well as schools, colleges, universities, and school dormitories; 3) coordination of fire inspector training programs; and 4) coordination of fire alarm and fire suppression system installation in regulated facilities. These activities are important mitigation activities designed to save lives and protect property from structural fire hazards. The State Fire Safety Board, also housed within the Michigan Department of Licensing and Regulatory Affairs, Bureau of Construction Codes and Fire Safety, promulgates rules covering the construction, operation and maintenance of schools, dormitories, health care facilities, and correctional facilities. These rules are designed to protect life and property at these facilities from fire, smoke, hazardous materials and fire-related panic.

National Fire Protection Association

Established in 1896, the National Fire Protection Association (NFPA) conducts research on fires and fire-related issues, develops codes and standards for fire prevention and protection, and disseminates fire safety information to fire departments and the public. The cornerstone of the NFPA's fire prevention activities is its consensus standards development system. The NFPA's consensus process involves over 6,000 volunteers from a wide range of professional backgrounds who serve on more than 200 technical committees, each reflecting a balance of affected interests. This consensus standards development system resulted in the creation and maintenance of the

National Fire Codes, over 300 codes and standards covering all areas of fire safety. Used throughout the world, virtually every building and construction process in place today is affected, in one way or another, by the codes and standards developed through the NFPA system. Even when not written into law, the Association's standards and codes are typically accepted as a professional standard, and are recognized by many courts as such. The NFPA codes and standards help to reduce the structural fire threat in Michigan, and elsewhere.

### U.S. Fire Administration

Established by P.L. 93-498, the Federal Fire Prevention and Control Act of 1974, the U.S. Fire Administration (USFA) provides leadership, coordination and support for the nation's fire prevention and control, fire training and education, and emergency medical services activities. The USFA, a branch of the federal Department of Homeland Security, conducts training for firefighters through the National Fire Academy (NFA), located in Emmitsburg, Maryland. Many Michigan firefighters have attended those training courses. In addition, the USFA administers a number of national fire programs aimed at fire prevention, with a particular emphasis on structural fire prevention. The USFA also supports the National Fire Incident Reporting System (NFIRS), administered and implemented in Michigan by the State Fire Marshal (Department of Licensing and Regulatory Affairs). The NFIRS provides the vehicle for collecting and analyzing information on fire frequency and causes, as well as deaths, injuries and property losses associated with fires. Over 900 local fire departments in Michigan participate in the NFIRS. The NFIRS data is used by the State Fire Marshal and other state and local fire agencies to assess and combat the fire problem in Michigan.

### Local Fire Service

Over 1,000 local fire departments and roughly 30-35,000 fire fighters constitute the bulk of Michigan's fire service forces. By and large, these local forces are either volunteers or paid part-time (approximately 56% paid part-time; 16% volunteer; 28% paid full-time). According to statistics from the State Fire Marshal, local fire departments in Michigan respond to a fire call, on average, every minute and 17 seconds, and to a structural fire call roughly every 28 minutes. In addition to fire suppression, local fire departments in Michigan also conduct vitally important public education, code enforcement and fire investigation activities within their respective communities. Local fire departments are the lifeblood of Michigan's fire prevention and suppression system.

### The Hotel and Motel Fire Safety Act of 1990 (PL101-391)

The Hotel and Motel Fire Safety Act of 1990 was passed into law by Congress to save lives and protect property by promoting fire and life safety in hotels, motels and other places of public accommodation. The law mandates that traveling federal employees must stay in public accommodations that adhere to the life safety requirements in the legislation's guidelines. PL101-391 also states that federally funded meetings and conferences cannot be held in properties that do not comply with the law. The United States Fire Administration (USFA) has been charged with carrying out FEMA's responsibilities with respect to the Hotel and Motel Fire Safety Act of 1990. In addition to compiling, maintaining and publishing the National Master List, the USFA is also responsible for taking steps to encourage states to promote the use of automatic sprinkler systems and automatic smoke detection systems.

### Fire Safety Rules for Michigan Dormitories

Even before the Seton Hall University dormitory fire in January, 2000, the State Fire Safety Board took action to enhance the fire and life safety protection of Michigan's college and university dormitories. On December 21, 1999 two new sets of rules took effect governing the construction, operation, and maintenance of school, college and university instructional facilities and dormitories. These sets of rules were updated to meet the most current nationally recognized standards from the National Fire Protection Association. The new rules adopted the 1997 edition of NFPA 101, Life Safety Code. NFPA standards provide the minimum requirements necessary to establish a reasonable level of fire and life safety and property protection from hazards created by fire and explosion.

The new rules require, among other things, that fire sprinklers be installed in newly constructed dormitories or those undergoing major renovations. However, existing dormitories don't fall under the new rules and therefore do not have to be retrofitted unless they are being renovated.

U.S Fire Corps

In 2002, President George W. Bush announced the creation of the USA Freedom Corps, which is an effort to foster a culture of service, citizenship, and responsibility, building on the generous spirit of the American people. One of the initiatives of USA Freedom Corps is Citizen Corps. Citizen Corps programs share the common goal of helping communities prevent, prepare for, and respond to natural disasters, and other emergencies, at various levels of government. One of the Citizen Corps partner programs is Fire Corps. This program is a partnership between the International Association of Fire Chiefs' Volunteer Combination Officers Section (VCOS), the International Association of Fire Fighters (IAFF), the National Volunteer Fire Council (NVFC), and the White House's USA Freedom Corps Office. The program's ultimate goal is to support and supplement resource-constrained fire departments at all levels, volunteer, combination, and career. This will be accomplished through the use of civilian advocates for non-operational related activities. The program will educate fire departments on how to implement a non-operational citizen advocates program, or improve existing programs. Fire service input to the program is provided through the Fire Corps National Advisory Committee which gives strategic direction and important feedback from the field to Fire Corps.

Michigan Fire Service Coalition

Various websites provide services regarding information, training and news about issues within fire services in Michigan. In October 2005, the Michigan Professional Fire Fighters Union, the Michigan Fire Inspectors Society, the Michigan Fire Service Instructors, the Michigan Association of Fire Chiefs and the Michigan State Firemen's Association united to form the Michigan Fire Service Coalition. Michiganfireservice.com is a site dedicated to the men and women who serve throughout the State as fire fighters, company officers, fire chiefs, fire marshals, training instructors, or permit technicians. The site intends to provide quality information about fire service news, training, and issues that affect Michigan's Fire Service. Michigan Safety News is a similar site for safety professionals across Michigan to discuss contemporary safety issues as a discussion forum to share ideas on success, lend expertise, ask questions, discuss contemporary issues and monitor important news.

Michigan Fire Inspectors Society (www.mfis.org) is a code-related organization in the State of Michigan. With almost 600 members, the organization represents the wide interests of Michigan's Fire Inspectors. Committees include members serving to provide updated rules or to monitor code changes. MFIS works to educate members on current trends and practices at conferences which include the fall educational seminar and winter educational conference. The Michigan Association of Fire Chiefs provides leadership and a voice for the fire service and its providers to government residents, fire service members, and other organizations, to protect and improve the safety of Michigan residents.

***Hazard Mitigation Alternatives for Structural Fires***

- Code existence and enforcement.
- Designs that include the use of firewalls and sprinkler systems (especially in tall buildings, dormitories, attached structures, and special facilities).
- Landlords and families can install and maintain smoke detectors and fire extinguishers. Install a smoke alarm on each level of homes (to be tested monthly, with the batteries changed twice each year). Family members and residents should know how to use a fire extinguisher.
- Proper installation and maintenance of heating systems (especially those requiring regular cleaning, those using hand-loaded fuels such as wood, or using concentrated fuels such as liquid propane).
- Safe use and maintenance/cleaning of fireplaces and chimneys (with the use of spark arresters and proper storage of flammable items). Residents should inspect chimneys at least twice a year and clean them at least once a year.

- Safe installation, maintenance, and use of electrical outlets and wiring.
- Measures to reduce urban blight and associated arson (possibly including Crime Prevention through Environmental Design).
- Defensible space around structures in fire-prone wildland areas.
- Proper maintenance of power lines, and efficient response to fallen power lines.
- Transportation planning that provides roads, overpasses, etc. to maximize access and improve emergency response times to all inhabited or developed areas of a community. (Not just planning for average traffic volumes in the community.)
- Discourage civil disturbances and criminal activities that could lead to arson.
- Enforced fireworks regulations.
- Elimination of clandestine methamphetamine laboratories through law enforcement and public education.
- Condominium-type associations for maintaining safety in attached housing/building units or multi-unit structures.
- Obtaining insurance.

***Tie-in with Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that structural fires were identified as one of the most significant hazards in local hazard mitigation plans for the following counties: Gratiot, Hillsdale, Huron, Jackson, Ontonagon, and Saginaw.

# SCRAP TIRE FIRES

*A large fire that burns scrap tires being stored for recycling or re-use.*

**Hazard Description and Analysis**

With the disposal of an estimated 290 million vehicle tires annually in the United States, management of scrap tires has become a major economic and environmental issue. Michigan generates approximately 10 million scrap tires each year. Although responsible means of storage and disposal have become more common, tire dumps of the last forty years still present environmental and safety hazards. In May 2012, the State of Michigan identified 55 non-compliant scrap tire collection sites containing a total of about 550,000 tire equivalents (unburied ones that pose the greatest fire danger) in outdoor stockpiles scattered around the state. Since the MDEQ Michigan Scrap Tire Program began in 1991, the total amount of Michigan's scrap tire stockpile has gone from 31 million down to about 2.2 million. The department estimates that most of the remaining tires could be disposed of before the end date of the program's funding in December 2015.

**Scrap Tire Disposal Sites in Michigan: November 2009**

| County | Sites | Tires | County | Sites | Tires |
|---|---|---|---|---|---|
| Alpena | 2 | 100,250 | Livingston | 1 | 1,000 |
| Arenac | 1 | 37,341 | Marquette | 1 | 3,000 |
| Bay | 1 | 700 | Mecosta | 1 | 8,000 |
| Benzie | 1 | 10,000 | Menominee | 1 | 2,000 |
| Calhoun | 2 | 5,700 | Midland | 2 | 121,100 |
| Cass | 1 | 37,000 | Monroe | 2 | 7,500 |
| Chippewa | 1 | 500 | Montcalm | 1 | 2,000 |
| Clare | 1 | 700 | Newaygo | 2 | 27,000 |
| Crawford | 1 | 10,000 | Oakland | 2 | 20,633 |
| Dickinson | 1 | 499 | Oceana | 1 | 11,000 |
| Eaton | 1 | 300 | Osceola | 2 | 2,385,000 |
| Genesee | 2 | 152,000 | Ottawa | 1 | 100,000 |
| Grand Traverse | 1 | 1,499 | St. Clair | 3 | 9,400 |
| Gratiot | 1 | 2,500 | St. Joseph | 2 | 48,000 |
| Hillsdale | 1 | 1,300 | Sanilac | 2 | 11,000 |
| Houghton | 2 | 117,500 | Shiawassee | 1 | 1,000 |
| Ingham | 1 | 500 | Tuscola | 2 | 12,700 |
| Iosco | 1 | 4,800 | Wayne | 22 | 168,977 |
| Ionia | 1 | 3,000 | Van Buren | 2 | 3,000 |
| Jackson | 2 | 6,600 | **Total** | 76 | 3,435,499 |

Source: Department of Environmental Quality, Waste and Hazardous Materials Division.

**NOTE:** Inventory totals compiled for tire quantities are approximated and will vary from year to year, as new tires are brought in and others are recycled or otherwise disposed of.

Issues pertaining to the management of scrap tire disposal sites are difficult and diverse. Whole tires are difficult to landfill because they tend to float to the surface. Whole tires are banned from disposal in Michigan landfills due to their associated problems. Scrap tires are breeding grounds for mosquitoes, which can reproduce at thousands of times their natural rate in a scrap tire disposal site, and these mosquitoes can carry and transmit life-threatening diseases. Stockpiles also are home to snakes and small mammals such as rats, opossums, skunks, and raccoons. Stockpiled tires are often soiled with mud, dirt, or other foreign materials that limit potential markets and increase processing costs. From an emergency management perspective, the most serious problem that scrap tire disposal sites pose is that they can be a tremendous fire hazard if not properly designed and managed.

Rather than causing structural damages and loss of life, the majority of the costs of a scrap tire fire are economic and environmental. A scrap tire fire may require the temporary evacuation of some residences and businesses, and the closure of some roadways—all of which have calculable costs. The biggest headache for a community

may be the difficulty in controlling and extinguishing these fires, which can occupy emergency responders for days! For example, a 1997 fire in Osceola County cost about $300,000 to extinguish, and used 478 firefighters from 34 different departments. Such costs can be extremely demanding on rural counties that generally have limited resources. Tire disposal sites can be serious fire hazards due to the sheer number of tires typically present at a site. This large quantity of "fuel," coupled with the fact that the shape of a tire allows air to flow into the interior of a large tire pile, renders standard firefighting practices nearly useless. Flowing burning oil released by the tires spreads the fire to adjacent areas. Some scrap tire fires have burned for months, creating acrid smoke and an oily residue that can leach into the soil, creating long-term environmental problems.

Deep stockpiles of compacted tire shreds can undergo a progressive series of exothermic reactions that increase pile temperatures and generate combustible gases. Surface symptoms of this phenomenon can be subtle, such as a slight sulfur odor, vapor steaming from isolated sections of the pile surface, or a slight oil sheen on adjacent standing water after rainfall. Due to the potential for auto-ignition, surface fires can ignite on a shredded tire stockpile, especially as shreds are removed from the area near the hot zone. Gases and shreds are then exposed to air and may ignite.

Scrap tire fires differ from conventional fires in several respects: 1) even relatively small scrap tire fires can require significant resources to control and extinguish; 2) the costs of fire management are often far beyond that which local government can absorb; 3) the environmental consequences of a major tire fire are significant; and 4) as alluded to earlier, the extreme heat converts a standard passenger vehicle tire into about two gallons of oily residue, which can leach into the soil or drain into streams.

Current technologies are sufficient to address the reuse of newly generated scrap tires, but some waste tires still migrate to the least expensive disposal method, which usually means they end up in a scrap tire disposal site (sometimes illegally). Lightning strikes, equipment overheating or sparks, unattended burning of debris/refuse, and arson are the leading causes of tire fires. Fires are also sometimes started by site operators or local residents in the wake of publicity over clean-up activities. This publicity can include enforcement proceedings or initial abatement activities, suggesting that a landowner may be acting out of frustration or attempting to avoid costs associated with tire abatement.

Much work still needs to be done to mitigate the impacts of scrap tire fires. Incident management planning, recognition of the hazardous material potential of fires at scrap tire sites, and improving and enhancing disposal site selection and design processes are all critical pre-incident preparedness factors that must be addressed by government and the private sector. In light of the potential consequences of scrap tire fires, prevention must become a primary goal in the treatment of scrap tire disposal sites. The Rubber Manufacturers Association has put together a document on the Prevention and Management of Scrap Tire Fires that can be printed and used by local fire officials. This document can be found at: http://www.rma.org/scrap_tires /scrap_tires_ and_the_ environment/fireprevention.cfm.

Impact on the Public

Scrap tire fires often involve extensive smoke and pollution that may prompt evacuations from, and lingering odors in, nearby residences. In addition to the disruption and inconvenience of even a temporary displacement (especially on the elderly, disabled, and very young), negative health effects may result from smoke exposure, and considerable time and expense may be involved in the process of cleaning and deodorizing homes afterward. Nearby local roads, businesses, and facilities may be closed during a fire event. Scrap tire piles also tend to serve as breeding grounds for mosquitoes, which cause additional health and nuisance problems for area residents.

Impact on Public Confidence in State Governance

Some of the public may have an idea that governmental regulations and environmental policy/enforcement should be able to entirely prevent scrap tire piles and fires from presenting a significant hazard. Scrap tire storage/disposal sites, plus any associated fires, can affect an area's property values, reputation, and environment. Local impacts from scrap tire sites should be viewed in terms of the larger-scale, specialized economic functions

being served by these sites and their associated businesses. Abstractions such as economic need/demand are not easy for all residents of an area to immediately understand and accept. The "not in my backyard" (NIMBY) problem is involved in this issue, for although tire disposal must occur (i.e. it is a necessary function) many residents see it as undesirable in their vicinity and would prefer that the service take place at a different location.

Impact on Responders

Scrap tire fires can involve excessive response costs and time/resource commitments that may strain local budgets and staff workloads. Responding personnel are exposed to unusually thick and toxic smoke from these events. Potential problems may also arise involving access to crowded or poorly-organized sites (tire sites with storage arrangements that didn't sufficiently conform to established regulations and restrictions).

Impact on the Environment

Stockpiles of tires may catch fire and the environmental consequences of a major tire fire include air, surface water, soil, groundwater, and residual contamination that have negative impacts on humans, wildlife, and natural vegetation. Scrap tire fires generate dense, black smoke containing partially combusted hydrocarbons. The smoke plume can negatively impact residences and businesses in its path as well as the air quality in a broad area for a significant time period. In addition to smoke, some tire fires produce large quantities of oils that contain hazardous compounds. Under certain conditions, these oils can penetrate porous soils to contaminate groundwater that is a source of the area's drinking water. The oils can also reach surface waters and cause substantial fish kills, due to the oils' depletion of dissolved oxygen levels. Finally, the residuals (ash, wire, and unburned rubber) from a tire fire often require special handling and disposal. Processing equipment can be damaged by handling heavily contaminated or partially burned tires, slowing the abatement process.

**Significant Scrap Tire Fires**

Scrap tire fires have occurred in Michigan in the past. Over the past several years, there has been a decrease in both the frequency and severity of fires at scrap tire disposal sites due to the cleanup of existing stockpiles and an increase in compliance at collection sites. Unfortunately, fire departments are generally ill-equipped and untrained to handle these incidents when they do occur. This is especially true in rural areas where many scrap tire disposal sites are located. Scrap tire fires occur often enough to present a major concern to those communities that have quantities of tires stored at disposal sites within or adjacent to their borders. Given the right set of circumstances, the potential is always there for a major fire that may require evacuation, sheltering, large amounts of fire suppression assistance, and both short and long-term environmental monitoring. Large scrap tire fires can also be very costly for the owner/operator and the affected local jurisdiction(s), as the fires are difficult to extinguish and typically require a large emergency response personnel presence at the fire scene (often for an extended period of time).

In recent history, the following incidents stand out as examples of the adverse impacts that can occur when fire breaks out at a scrap tire disposal site.

**Significant Scrap Tire Fires in Michigan**

October 30, 1987 – Kent County

A large fire broke out at a scrap tire disposal site in Kent County containing over one million tires. It was estimated that the blaze was contained to about a fifth of the ten-acre site and a fire break was established with bulldozers. Firefighters ultimately concluded that the best course of action was to allow the contained portion of the fire to burn, and that applying water would add no benefit. Nearby residents were evacuated during the early stages of the fire.

December 29, 1995 to January 20, 1996 – Grand Traverse County

A tire fire burned at a re-treading facility in Grawn near Traverse City. Initial fire response was delayed due to attempts by employees at the recycling center to extinguish the blaze without outside assistance. Over the course of the event, surrounding subdivisions were evacuated. The fire engulfed 100,000 tires spread over a three-acre site. Personnel from numerous area fire departments, as well as the U. S. Environmental Protection Agency (EPA) and U. S. Coast Guard, were involved in the containment and suppression effort. In all, 451 responders from 30 separate agencies assisted with the fire over its 22-day duration. The long duration of this fire was testimony to the difficulty of extinguishing fires of this nature.

July 30, 1996 – Clare County

A fire broke out at a scrap tire storage facility located in Redding Township in Clare County. Over the course of the fire, 14 fire departments responded, along with representatives from the EPA and Michigan Department of Environmental Quality (MDEQ). Fortunately, the fire was contained to 250,000 of the 4.2 million tires on the ten-acre site, and was extinguished the following day, some 32 hours after it began.

## April 16, 1997 – Osceola County

The worst tire fire ever in Michigan occurred in Osceola County. The salvage yard where the blaze started contained over 6 million tires. All of the fire departments in a five county area were contacted. Residents within a three-mile radius were evacuated. The fire was extinguished in about two and one-half days by digging a trench around the perimeter of the fire to prevent its spread, and capping the fire with sand. In all, 478 firefighters from 34 different departments fought the blaze. The final cost of putting the fire out came to approximately $300,000. Over 1.5 million tires, two buildings and some trailers were lost in the fire.

## March 26, 1998 – Monroe County

A grass fire spread to a scrap tire pile in London Township, setting fire to between 3,000 and 5,000 tires. The pile was 50'x 30' and about 6 to 10 feet high. Soil samples were obtained afterward, showing no signs of contamination and no surface or ground water effects. The fire was put out by local fire departments.

## February 24, 2000 – Mecosta County

A fire broke out at a tire recycling plant located in Hinton Township in Mecosta County. The fire had started in a pole barn that contained approximately 50,000 shredded tires. Nearby structures that also contained scrap tires were in danger of catching fire as well. Approximately 150 fire personnel from 13 local fire departments fought the blaze. Eventually, sand was brought in by a local contracting firm to smother the flames. Investigators determined that the apparent cause of the fire was a machine that had caught fire earlier and had not been adequately extinguished. The fire had then spread from the machine to the tires.

## October 31, 2000 – St. Joseph County

In the early morning hours, a fire broke out at a tire recycling plant located in Colon Township in St. Joseph County. The 250-foot diameter fire – apparently set by an arsonist – consumed approximately 10,000 of the 350,000 tires at the site. The tires were piled 20 feet high in some places, hindering fire suppression efforts. A total of 10 fire agencies assisted in containing the blaze. Local residents were advised to either evacuate the immediate area or close their doors and windows and stay indoors to avoid breathing the acrid, black, choking smoke from the fire. Although the site was located only 300 feet from the St. Joseph River, a dirt berm around the tire pile prevented runoff from the fire from contaminating the river. The fire was extinguished 12 hours after it had begun.

## June 13, 2003 – Clare County

A large fire broke out at a scrap tire disposal site in Clare County. It was estimated that 135,000 of the 850,000 tires at the site had caught on fire. The fire response and pollution control efforts would have been much more difficult without the $250,000 in funds awarded to Clare County through the DEQ Scrap Tire Grant Program in 2002. The lanes constructed between the tire piles had bought firefighters enough time to prevent the fire from spreading into the remaining piles. Otherwise, they would have been dealing with a much larger fire. This fire occurred at the same location as the scrap tire fire of 1996, when 250,000 tires were involved.

## August 5, 2004 – Ogemaw County

A fire occurred at an old junkyard where tires were in a pile 100 feet wide and 8 feet tall. The fire involved the tire pile and part of some adjacent woods. The fire was fought using water and foam, and by burying the burning tires with soil. The fire was extinguished after about 3 hours. The owner was issued a ticket for failing to control a fire he was using to burn brush and solid waste that had been intermingled with the tires.

## August 17, 2005 – Wayne County

Three firefighters were injured while battling a tire fire early in the morning of August 17, 2005 in southwest Detroit. After a few hours, the fire was under control, but the tire sales and repair building was destroyed.

## April 21, 2006 – Washtenaw County

A man was burning brush in a barrel at a salvage yard and then left the fire unattended to go eat lunch. While he was gone, a piece of burning wood fell on the ground, igniting a grass fire that spread to the tire pile. There were approximately 1,000-1,500 truck tires on the site—some on the ground and some in a semi-trailer. MDEQ staff suggested that the fire fighters try to limit the runoff from fire suppression activities at the site. The fire was put out with water and foam. The largest tire pile had been aflame, but the burning tires were quickly separated from the pile. Ash from the fire and partially burnt tires remained on the site.

## January 24, 2008 – Saginaw County

A fire consumed an abandoned house and hundreds of scrap tires. 50 to 60 firefighters from the Watertown Township, Mayville, Caro, North Branch, Deerfield Township and Millington-Arbela fire departments worked for more than five hours to extinguish the flames and the smoldering embers, which had erupted just after noon. The fire destroyed the house and an attached garage while the burning tires created a lot of thick smoke. Bitter temperatures also caused the water run-off to freeze quickly, presenting an additional hazard for firefighters.

## July 23, 2008 – Ottawa County

A scrap yard fire, fueled by 1,000 tires, kept fire departments from Spring Lake Township, Coopersville, Fruitport, Ferrysburg, Ottawa County, Marne and Grand Haven Township busy for several hours and sent thick plumes of black smoke over the area. This fire in Nunica was first reported at around 3:45 pm and was caused by sparks from workers who were cutting off an automobile's catalytic converter. The blaze was confined to roughly a 50-by-50-foot area. Because the nearest hydrant was about 2,000 feet away, water had to be trucked in. In all, 70,000 gallons of water were poured onto the fire before it was brought under control after 90 minutes. No structures were damaged by the fire and no injuries occured. Because of possible oil contamination from melting tires, the Department of Environmental Quality was notified.

## September 9, 2009 – Kalkaska County

Hundreds of scrap tires were on fire in a wooded area of Springfield Township of Kalkaska County. Natural causes were considered to be unlikely. Despite the size of the area that was burning, a large crew had the area under control in about an hour. Police say the quick response saved several homes and minimized any health risks from the black smoke being generated.

## June 11-13, 2010 – Ingham County

The Onondaga Township Fire Department responded to a tire fire inside a barn in the 4000 block of Gale Road. There were several hundred tires there, and the fire department had to respond 4 or 5 times as the fire burned for 3 days before finally being excavated and extinguished. Some of the tires were so old that they had wooden rims. The equivalent of 800 tires were found throughout the rest of the property, and the landowner was allowed to apply for a grant to have remaining tires cleaned up on his property for free.

## December 31, 2010 – Muskegon County

An early morning fire destroyed a Twin Lake tire business on December 31, 2010 with damage estimates over $325,000. The fire started on the west end of a100-by-60 foot pole barn construction building. The building had several tires inside it which provided extra fuel for the fire after it started. City water was not available on the scene so responding fire crews set up water reservoirs at three sites and used tanker trucks to shuttle water in from other areas. A tanker task force involving 10 area fire departments was used to battle the blaze. Assisting Dalton Township were fire departments from the townships of Muskegon, Blue Lake, Holton, Fruitport, and Egelston, along with the North Muskegon and Fremont city departments, the White Lake Fire Authority and Montague Fire District.

## Programs and Initiatives

The Scrap Tire Regulatory Program

The Scrap Tire Regulatory Program is implemented by the Waste and Hazardous Materials Division of the Michigan Department of Environmental Quality, under the authority of Part 169 of the Natural Resources and Environmental Protection Act (1994 PA 451), as amended. Policies and regulations established under this law provide the basis for the Department of Environmental Quality to implement and administer an effective scrap tire management program.

Overall, the Program has been very successful. Throughout the state, stockpiles of scrap tires have decreased greatly, compliance rates have increased, and markets for scrap tires have increased. Behind the Program's success to date are: (1) continuing an appropriately funded Scrap Tire Cleanup Grant Program to address abandoned scrap tires and those collected prior to 1991, when a predecessor to Part 169 was enacted, and (2) consistent enforcement of Part 169, which helps to ensure a level playing field for those voluntarily meeting Part 169 requirements. It should be noted that although markets for scrap tire material have continued to increase on their own with minimal governmental subsidies, the ongoing need for state funding for cleanup grants, compliance, and enforcement is clear.

Michigan's policy response to the scrap tire problem in the state is two-pronged: encourage market development and require proper management of scrap tires. The purpose of Part 169 is to help reduce illegal scrap tire accumulations and the public health and environmental concerns associated with these solid waste piles. Under this approach, the MDEQ's goals were to:

- Create regulatory incentives to recycle tires (such as a bonding exemption for sites that are in compliance for one year) and financial disincentives for improperly storing or dumping tires (such as higher bonding requirements and penalties for noncompliance);
- Assist in the development of viable end uses and markets for scrap tires;
- Improve management of scrap tires through registration and manifesting requirements (for transporters) and require proper storage through site registration, pile restrictions, mosquito control, and bonding requirements for storage (based on the number of tires);
- Conduct site, hauler, and retailer inspections to assess their management of scrap tires;
- Conduct appropriate enforcement, with criminal and civil culpability for violations, and prosecution of violations; and
- Allow private enterprise to establish market costs.

Part 169 was substantially amended in July 2002. Amendments were made to the definitions, scrap tire hauler registration exemptions, bonding provisions, manifest requirements, grant provisions, and penalty provisions. The MDEQ did not fully support all of the July 2002 amendments to Part 169 because some were contrary to the goals of the Program and would present great challenges from a regulatory perspective. As a result, Part 169 was again amended, effective December 29, 2006, based on the recommendations of the Scrap Tire Work Group. These amendments were developed in conjunction with, and with the support of the MDEQ. These amendments made substantial improvements to the statute in support of Program goals.

An amendment to reduce regulatory burdens and encourage the productive use of scrap tires by:

- Facilitating the processing of scrap tires into higher-value materials by creating a new category of scrap tires designated as a "commodity." Material that qualifies as a commodity is largely exempted from regulation as a scrap tire.
- Improving the definition of end-user, to clarify who meets the exemption from bonding and storage requirements. Also, clarifying the "scrap tire processor" definition and eliminating the definition of "scrap tire recycler," which has caused confusion for the industry.
- Simplifying the definition of scrap tire hauler, exempting retreaders from hauler registration requirements (as well as persons who haul only recognized commodities).
- Simplifying the manifest requirements by allowing the use of a consolidated load manifest by commercial businesses that service their own truck fleets, and for retail establishments and scrap tire haulers that pick up small numbers of scrap tires from multiple locations in the same load.
- Expanding funding eligibility to allow for research and development, capital expenditures, and other expanded areas under the Scrap Tire Market Development Grant Program.
- Specifying that tires can go to locations that have legally accumulated scrap tires below the regulatory threshold and clarifying whom a person can contract with for the removal of scrap tires.

An amendment to encourage the proper management of scrap tires by:

- Requiring that a collection site be in compliance with storage requirements to qualify for official site registration.
- Improving storage of tires at scrap tire collection sites by specifying that tires may only be stored in areas identified for that purpose on a map provided with the site registration application and approved by the MDEQ.
- Clarifying that shreds cannot be placed between piles. An exception is provided for commodities used to create a storage pad for, or access roads to, other commodities. The use of shredded tires between piles increases the fire danger present at collection sites and makes fighting a fire at a collection site more difficult. The open spaces between the tire piles are there to serve as fire lanes to segregate the tires into piles so that fire would not be as likely to spread between the piles.
- Providing local fire chiefs with the authority to determine whether collection site access roads meet the Part 169 requirement to be accessible at all times to emergency vehicles.
- Limiting the growth of unbonded collection sites. Previously, a scrap tire collection site could grow by 10 percent every year even though it was not bonded, provided that it met certain storage requirements. However, the number of tires should not increase on a properly managed collection site, since scrap tires that are brought in should (after processing, if necessary) leave the site for a market soon thereafter.
- Facilitating the proper use of portable shredding operations to clean up scrap tire piles, by ensuring that there is a tie to a properly registered collection site.

An amendment to support the public interest by:

- Providing the state with limited lien authority when state funds are used to clean up tire piles that were created illegally after the predecessor to Part 169 was enacted in 1991. This prevents the unjust enrichment of property owners from the public funds used to eliminate a problem that the landowner had created and profited from.
- Adding explicit inspection authority that allows the MDEQ to conduct inspections at reasonable times to enforce and administer Part 169.

An amendment to provide for the long-term success of the Program by:

- Extending the sunset on Program funding from 2007 to 2012. The Program is funded through a fee of $1.50 for each motor vehicle title transfer, established in the Motor Vehicle Code, 1949 PA 300, as amended (MVC). Continued Program funding was needed to allow the MDEQ to meet the 2009 statutory deadline for clean-up of pre-1991 scrap tires, and to continue efforts to clean up those post-1991 scrap tires that pose a danger to public health, safety, welfare, or the environment. Continued funding also

supports ongoing grants to develop markets for scrap tires and helps to ensure proper disposal of the 10 million scrap tires generated annually in Michigan.

- Adding a requirement for the MDEQ to report every three years on the effectiveness of Part 169 in encouraging reuse and ensuring safe storage of scrap tires. (To read the full 2009 Report, please go to http://www.michigan.gov/documents/deq/DEQ-WHMD-STPTri_Scrap_Tire_Leg_Rpt_2009_309005_7.pdf .)
- Adding a requirement for the MDEQ Director to appoint the Scrap Tire Advisory Committee to advise the MDEQ on the required report, the relevance of national standards and specifications for commodities, and other issues.

## Scrap Tire Management

To be effective, scrap tire management must be viewed from two perspectives. First, methods for dealing with the millions of scrap tires currently being generated must be devised to stop the problem from growing in scope and magnitude. Recycling and re-use appear to be the best options in that regard. Second, measures must be devised to address the issues pertaining to the millions of scrap tires already present in existing disposal sites.

## Mitigation of Scrap Tire Fires

To combat these problems at current disposal sites, suggestions have been made about establishing a state policy and program for acquiring such sites and suitably disposing of the tires at these locations. Other proposals call for educating local jurisdictions on the hazards associated with scrap tire disposal sites so that enforcement of existing legislation is effective in minimizing future potential scrap tire fires.

The EPA developed the Resource Conservation Challenge (RCC), which is a national effort to find more flexible, yet effective ways to conserve natural resources and energy. In 2004, the RCC developed a program to clean up scrap tire piles in the Great Lakes Region. The project supports prioritization, funding and implementation of clean up efforts. The goal was to clean up 55% of tires in stockpiles (from the "2001 baseline") in the Great Lakes region, by 2008. The mitigation of these sites will provide for land revitalization and elimination of a potential source of benzo[a]pyrene (a PBT) in the Great Lakes, which are priorities of the Brownfields Program and Bi-National Toxics Strategy, respectively. A map showing the locations of regulated outdoor scrap tire piles in Michigan can be seen on the MDEQ web site at
http://www.michigan.gov/documents/deq/deq-whm-stsw-scraptiresites_230376_7.pdf.

The November 2006 RMA Scrap Tire Market Report ranked Michigan as tied with Ohio for being the third most improved state in the number of tires consumed by markets reduction of historical stockpiles, on absolute and per capita bases. According to the May 2009 RMA Scrap Tire Market Report, there were about 128 million scrap tires remaining in stockpiles throughout the United States at the end of 2007. This is a reduction of about 87% percent since 1990, when the number of tires in stockpiles was estimated at 1 billion. The reduction of tires below the 2001 baseline level (of 308.4 million) also marks a 58% reduction in stockpiles and therefore exceeds the EPA stakeholders' 2004 goal (of 55%), an accomplishment of which the industry should be proud.

Much of the reduction in illegal stockpiles in Michigan is due to Scrap Tire Cleanup Grants. Since the Legislature first appropriated funding in 1993, more than $27.2 million in public funds have cleaned up approximately 31.1 million Passenger Tire Equivalents (PTEs), restoring the environmental quality and economic value of more than 1,000 sites across the state. The average cost of removal of tires under the grant program has been 88 cents per PTE. Approximately $2.5 million is allocated for cleanup grants in fiscal year 2010. Based on the eligible applications received to date, it is estimated that at least another 1 million PTEs will be removed during the FY 2010 grant cycle.

## Scrap Tire Fire Statewide Response Plan

To comply with the 2002 amendments to Section 169 of the Natural Resources and Environmental Protection Act, the State of Michigan has developed a statewide response plan for large scrap tire fires. This plan, which was written by the Michigan Department of Environmental Quality with input from the Michigan State Police and the

Michigan Association of Fire Chiefs, establishes a framework for planning, preparedness and response measures for large scrap tire fires. While this plan will not entirely stop scrap tire fires from occurring, it is hoped that the plan will at least keep the problem in check until more permanent hazard mitigation measures can be instituted to reduce the threat of tire fires across Michigan.

### Scrap Tire News

Scrap Tire News is a publication devoted to providing news and information about tire and rubber recycling. In addition to in-depth tire recycling company profiles that explore operational and market issues facing the industry, Scrap Tire News also provides a way to stay current with changes in the industry through regular reports on technology/design developments and breakthroughs; timely legislative and regulatory information; market trends; product briefs; product advances; global viewpoints; internet guides; and updates on equipment innovations and applications occurring throughout the industry.

The Recycling Research Institute, Suffield, CT (RRI) develops and disseminates information concerning the recovery, reuse, recycling and proper disposal of scrap tires and scrap rubber. In addition to publishing Scrap Tire News, the company produces and publishes the Scrap Tire & Rubber Users Directory—a nationally acclaimed business reference book for the scrap tire and rubber recycling industry. Another RRI publication, State Scrap Tire Management Programs, covers comprehensive profiles of state scrap tire legislation, regulation, and market development initiatives in all 50 states.

### Scrap Tire Cleanup Guidebook

The Scrap Tire Cleanup Guidebook was created to help state and local and local governments reduce the economic burdens and environmental risks associated with scrap tire piles on their lands. The U.S. EPA Region 5 and Illinois EPA, along with the Michigan Department of Environmental Quality, have collaborated to create the Scrap Tire Cleanup Guidebook. The guidebook brings together the experience of dozens of professionals into one resource designed to provide state and local officials with the information needed to effectively clean up scrap tire piles. The guidebook discusses starting a cleanup program, working with contractors to clean up sites, and implementing prevention programs that will reduce scrap tire dumping.

The scrap tire clean up guidebook has a section on fire planning and prevention for site stabilization. Removal of trees, brush, and grass around stockpiles is an effective mitigation measure to avoid fire transmission to and from surrounding areas, especially if the site is inactive. Identification of available fire control resources, installation of supplemental fire control tools, the provision of at least two connected access points for emergency vehicles, and fire lanes (at least 50 feet wide) to divide a large stockpile into isolated segments, can all help to mitigate scrap tire fires. The pile sides should also be tapered to avoid collapse during fire turbulence. Piles generally should be removed early in the abatement process to prevent tire ignition by thrown objects as well as to show abatement progress.

### Scrap Tire Advisory Committee (STAC)

The STAC was originally created by the Waste and Hazardous Materials Division in September 2005 to foster continued interaction between the MDEQ and other stakeholders. The STAC grew out of the Scrap Tire Work Group which was formed in April 2005 to assist the MDEQ with developing recommendations for statutory amendments and other regulatory and policy changes to improve the Scrap Tire Program administered under Part 169 of the Natural Resources and Environmental Protection Act. The Scrap Tire Work Group process highlighted the benefits of having a forum for the MDEQ and stakeholders to exchange information. The STAC will be available to advise the MDEQ on the implementation of Part 169 and to allow both the MDEQ and other stakeholders to identify and address challenges and opportunities in the Scrap Tire Program as they arise. In addition to any other issues the MDEQ wants the STAC to consider, the STAC shall advise the MDEQ on the report required every three years concerning the effectiveness of Part 169 and the relevance of national standards and specifications for commodity determinations.

Michigan Manufacturers' Guide to Environmental, Health, and Safety Regulations

The 2008 "Michigan Manufacturers' Guide to Environmental, Health, and Safety Regulations" is a joint publication of Michigan's Department of Natural Resources, the Department of Environmental Quality and the Department of Licensing and Regulatory Affairs. Manufacturers, suppliers, consultants, and regulators can all benefit from this guide, which steers the reader through the maze of state and federal environmental, health, and safety regulatory programs. Section 2.2.2 (2-7) of the environmental regulations is a section that deals specifically with scrap tires and includes basic requirements for scrap tire generators.

Michigan Department of Environmental Quality, Common Scrap Tire Violations Index

The Michigan Department of Environmental Quality website has an index that is organized into categories of registration application deficiencies and violations common to scrap tire collection sites and scrap tire haulers (http://www.michigan.gov/deq/0,1607,7-135-3312_4122-60866--,00.html). The violations or deficiencies have been identified either during scrap tire collection site or scrap tire hauler inspections, or upon review of registration applications, by MDEQ Waste and Hazardous Materials Division (WHMD) staff. It is not a comprehensive list of all requirements that staff look for while doing inspections or reviews, but should be helpful for those involved with tire storage/disposal sites.

***Hazard Mitigation Alternatives for Scrap Tire Fires***

- Policies for regulated disposal and management of scrap tires, and enforcement of regulations related to them (separation of stored scrap tires from other materials; limits on the size of each pile; minimum distances between piles and property lines; covering, chemically treating, or shredding tires to limit mosquito breeding; providing for fire vehicle access to scrap tire piles; training employees in emergency response operations; installation of earthen berms around storage areas; prevention of pools of standing water in the area; control of nearby vegetation; an emergency plan posted on the property; storing only the permitted volume of tires authorized for that site).
- Proper siting of tire storage and processing facilities (land use planning that recognizes scrap tire sites as a real hazard and environmental threat).
- Pest-control measures for mosquitoes and other nuisances around scrap tire yards.

***Tie-in with Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that the scrap tire fire hazard is not currently identified as one of the most significant hazards in any of Michigan's county hazard mitigation plans. It had previously been identified within the hazard analysis for Osceola County, but since then the number of scrap tires has been shrinking, and the hazard is likely considered to be less significant now.

# HAZARDOUS MATERIAL INCIDENTS

A hazardous material is any solid, liquid, or gas that can cause harm to humans and other living organisms due to its being radioactive, flammable, explosive, toxic, corrosive, a biohazard, an oxidizer, an asphyxiant, or capable of causing severe allergic reactions. Mitigating the risks associated with hazardous materials often requires extensive safety precautions during their transport, use, disposal and storage. Hazardous materials are transported by highway, rail, pipeline, air, and water.

Impact on the Public

Both fixed site and transport-related hazardous material incidents involve the potential for evacuation (or sheltering in place), with significant problems possible for special populations in hospitals, schools, nursing homes, and other critical facilities. Certain types of extremely hazardous substances may result in a public health emergency, and a resulting need for triage, mass treatment, and congregate care. In addition to the direct impacts of the hazardous material event itself, transportation incidents may directly affect the transportation infrastructure in the area and cause extensive delays in travel and the conduct of business. This hazard is ranked as the second most frequent in occurrence (behind structural fires).

Impact on Public Confidence in State Governance

Discontent may arise from the NIMBY problem (as referred to in the Scrap Tire Fires section) or from difficulties in planning to avoid conflicting land uses. Mixed attitudes toward useful and needed employers/businesses may be fairly common, recognizing the economic benefits of companies that use hazardous materials, but unsettled by the perceived risks in the location of some of them (or their number, since there were 2,991 SARA Title III sites in Michigan in late 2009). Such perceptions of risk may be over-generalized toward other, undeserving businesses (e.g. those that pose minimal risks). Part of the public may not understand the balance between regulation and business needs concerning the use and handling of hazardous materials. Transportation delays due to transportation-related incidents may cause dissatisfaction with roadway provision, capacity, and maintenance.

Impact on Responders

Special procedures and additional information tend to be needed for incidents involving hazardous materials. Additional risks to responders may be present from exposure to extremely hazardous substances at or near these incident locations. Exposure can involve direct contact, the presence of toxic fumes, or the risk of fires and explosions from chemical reactions. Additional complexity therefore tends to be present in any response involving hazardous materials. A schedule of exercise activities needs to be maintained for staff preparedness, and larger budgets are needed to accommodate the staffing, training, exercising, and equipment needed. In addition to preparing for and handling this type of response, the creation, support, and participation in a Local Emergency Planning Committee is needed, along with work related to Section 302 site planning and mutual aid arrangements with nearby communities and relevant agencies. Extra work is also involved in creating and maintaining special contact lists for railroads, the MDEQ, drain and road commissions, airports, health departments, and private companies who may also be involved in incident response, as well as the State Emergency Operations Center (SEOC) and its notification/coordination procedures and protocols. Special expertise in substance types and risks, as well as software for plume modeling may also be needed for effective response, and such expertise has an expense associated with its development and maintenance.

Impact on the Environment

An incident involving hazardous material, whether at a fixed site or during transportation, may cause harm to the environment, as various types and quantities of chemicals are released. A hazardous spill involving an industrial or chemical plant can affect air quality, soil surrounding the area of the release, and an area's drinking water. A hazardous spill caused by a transportation accident can similarly impact the air, soil, and nearby lakes and rivers. A toxic release can also destroy the wildlife habitat in or around the areas where the release occurs.

# HAZARDOUS MATERIAL INCIDENTS: FIXED SITE
(INCLUDING INDUSTRIAL ACCIDENTS)

*Hazardous Material Incident – Fixed Site: An uncontrolled release of hazardous materials from a fixed site capable of posing a risk to life, health, safety, property or the environment.*

*Industrial Accident: A fire, explosion, or other severe accident (especially if it involves hazardous materials) at an industrial facility that results in serious property damage, injury, or loss of life.*

***Hazard Description***

Hazardous Material Incidents

Over the past few decades, new technologies have developed at a stunning pace. As a result, hazardous materials are present in quantities of concern in business and industry, agriculture, universities, hospitals, utilities, and other facilities in our communities. Hazardous materials are materials or substances which, because of their chemical, physical, or biological nature, pose a potential risk to life, health, property, or the environment if they are released. Examples of hazardous materials include corrosives, explosives, flammable materials, radioactive materials, poisons, oxidizers, and dangerous gases.

Hazardous materials are highly regulated by federal and state agencies to reduce risk to the general public and the environment. Despite precautions taken to ensure careful handling during the manufacture, transport, storage, use, and disposal of these materials, accidental releases do occur. These releases can cause severe harm to people or the environment, and response actions often need to be immediately performed. Most releases are the result of human error. Occasionally, releases can be attributed to natural causes, such as a flood that washes away barrels of chemicals stored at a site. However, those situations are the exception rather than the rule.

Industrial Accidents

Industrial accidents differ from hazardous material incidents in the scope and magnitude of offsite impacts. Whereas hazardous material incidents typically involve an uncontrolled release of material into the surrounding community and environment that may require evacuations or in-place sheltering of the affected population, the impacts from industrial accidents are often confined to the site or facility itself, with minimal physical outside impacts. Nonetheless, industrial accidents, such as fires, explosions, and excessive exposure to hazardous materials, may cause injury or loss of life to workers at the facility, and significant property damage. In addition, industrial accidents can cause severe economic disruption to the facility and surrounding community, as well as significant long-term impacts on the families of the workers injured or killed.

***Hazard Analysis***

Hazardous Material Incidents

The map at the end of this section illustrates where the identified SARA Title III facilities are located in Michigan. An examination of the map indicates that the greatest concentration of facilities is located in southeastern Michigan and other urbanized areas. Fortunately, these are generally the areas with more resources to prepare for and respond to a hazardous material incident. However, the greater population concentrations also make these areas more vulnerable to a serious hazardous material incident.

Like all heavily industrialized states, Michigan will always be concerned with the risk of accidental hazardous material releases. However, the threat of accidental hazardous material releases that can affect life, health, property or the environment can be greatly reduced by: 1) developing and maintaining adequate community hazardous material response plans and procedures; 2) adequately training hazardous material workers and off-site emergency responders; 3) educating the public about hazardous materials safety; 4) enforcing basic hazardous material safety regulations; and 5) mitigating, wherever possible, the threat of accidental hazardous material releases. Fortunately, many Michigan communities are making great strides in these important areas.

NOTE: Nuclear research facilities can produce / use radioactive materials, as well as other hazardous substances, and therefore need to be dealt with by specially trained personnel. Caution should be exercised at these facilities, and proper radiological survey equipment should be used during a response.

## Industrial Accidents

As a major manufacturing and industrial center, Michigan has had its share of industrial explosions and/or fires that resulted in deaths or injuries. Fortunately, industrial and fire safety regulations enacted over the years have kept these types of accidents to a minimum. Although industrial accidents occur with regularity in Michigan, major incidents with mass casualties, such as the four deadly explosions that occurred in 1998 and 1999, are relatively rare.

### *Significant Fixed-Site Hazardous Material Incidents and Industrial Accidents*

#### December 3, 1984 – Bhopal, India

The world's worst hazardous material incident occurred on December 3, 1984 in Bhopal, India when a cloud of methyl isocyanate gas (an extremely irritating chemical that can cause severe acute respiratory problems) escaped from a Union Carbide chemical plant, killing about 2,500 persons and injuring tens of thousands more. Many of the injured later suffered permanent disabilities. Over 30 tons of the chemical was released. The exact cause of the release was not firmly established, but several safety systems designed to prevent a major release were either inoperative, under maintenance, or not activated by workers. Atmospheric conditions at the time of the release kept the toxic cloud close to the ground as it slowly drifted over the city, increasing the number of persons exposed. Unfortunately, warning systems for the community were not activated in a timely manner and many individuals died in their sleep.

The Bhopal incident helped to illustrate many important points about accidents that involve a release of hazardous materials. First, it was not caused by a single factor; rather, a number of contributing events had to occur for the methyl isocyanate to be released and have such a deadly public health impact. Second, human error and lack of adherence to safety rules and procedures played a substantial role in the incident. Third, the impact would not have been nearly so great had the population around the plant not been so large and densely housed, and had there been better preparation about how to respond to a hazardous materials release. Finally, the deadly release proved that worst-case scenarios do occur, and that emergency planning, training, and education must be geared toward that worst-case incident.

As tragic as the Bhopal incident was for India, it did have a positive side in that it triggered historic federal legislation intended to prevent such disasters from occurring in the United States. Shortly after the Bhopal incident, Congress enacted legislation (the Superfund Amendments and Reauthorization Act, signed into law October 17, 1986) that established new requirements for federal, state and local government, and private industry, for reporting on and planning for hazardous material incidents. (See the Programs and Initiatives section for more information on this law.)

NOTE: A reportable hazardous material incident is one in which all three of the following conditions apply: (1) a material is present that is suspected to be other than ordinary, combustible by-product material; (2) the material is in such a state, quantity or circumstance that, if left unattended, it is presumed to pose a threat to life, health, property or the environment; and (3) special hazardous material resources were dispatched or used, or should have been dispatched or used, for assessing, mitigating or managing the situation.

#### May 25, 1865 – Mobile, Alabama

On May 25, 1865, in Mobile, Alabama, an ordnance depot exploded, resulting in about 300 fatalities. This event occurred just after the end of the American Civil War. The depot was a warehouse where troops had stacked about 200 tons of shells and powder. The shells caught fire and exploded, with flames shooting up into the sky and bursting shells heard throughout the city. After the explosion, there were fires that burned until the entire northern part of Mobile was destroyed. The exact cause of the explosion was never determined.

#### December 6, 1917 – Halifax, Nova Scotia, Canada

One of the biggest and most deadly explosions occurred on December 6, 1917 in Halifax, Nova Scotia, Canada. It is known as the Halifax Explosion. The incident occurred when a French freighter carrying ammunition and wartime explosives collided with a Norwegian ship in Halifax Harbor. About 2,000 people were killed by debris, fires, or collapsed buildings, and it is estimated that over 9,000 people were injured. The French ship had caught on fire 10 minutes after the collision and exploded about 25 minutes later. The explosion was equivalent to about three kilotons of TNT and a fireball rose over a mile in the air to form a giant mushroom cloud. All of the buildings and structures covering nearly 2 square kilometers along the adjacent shore were destroyed, including those in the neighboring communities of Richmond and Dartmouth. The explosion also caused a tsunami in the harbor, with waves as high as 60 feet and a pressure wave of air that snapped trees, bent iron rails, demolished buildings, grounded vessels, and carried fragments of the ship for miles.

#### March 18, 1937 – New London, Texas

On March 18, 1937 the deadliest school disaster in United States history occurred in New London, Texas. An explosion was caused by a natural gas leak and resulted in the death of at least 295 students and teachers. Approximately 600 students and 40 teachers were in the building at the time, and only about 130 escaped without serious injury.

#### July 17, 1944 – Port Chicago, California

A major munitions explosion occurred at a naval base in Port Chicago, CA on July 17, 1944. The incident occurred during World War II, when munitions detonated while being loaded onto a cargo vessel, killing 320 sailors and civilians and injuring 390 others. The explosion resulted in an enormous fireball.

#### October 20, 1944 – Cleveland, Ohio

A significant gas explosion occurred on October 20, 1944 in Cleveland, Ohio. It resulted in 130 fatalities and destroyed one square mile around Cleveland's east side. The event occurred when an above-ground storage tank, holding liquefied natural gas in the East Ohio Gas Company's tank farm, began to emit vapors. As the gas flowed and mixed with air and sewer gas, the mixture ignited. In the ensuing explosion, manhole covers launched skyward and massive

fires erupted from the depths of the sewer lines. Then a second above-ground tank exploded, leveling the tank farm. The explosions and fires continued to occur, trapping many who had returned to what they thought was the safety of their own homes. Over 600 people were left homeless, and 70 homes, two factories, many cars and miles of underground infrastructure were destroyed. The explosion also had a long-range impact on the natural gas industry. Until the disaster, above-ground storage of natural gas, used as fuel for homes, office buildings and factories, was a common sight in cities across America. Following the disaster, utility companies and communities began to rethink their natural gas storage systems, and below-ground storage of natural gas grew in popularity.

April 16, 1947 – Texas City, Texas

One of the worst industrial accidents in United States history occurred on April 16, 1947 in Texas City, Texas. Approximately 2,300 tons of ammonium nitrate detonated and resulted in a chain reaction of fires and explosions. The incident started with a mid-morning fire on board the French-registered vessel SS Grandcamp in the port of Texas City. The fire led to a massive explosion that sent a 15 foot wave across the water—a wave that was detectable along about 100 miles of the Texas shoreline. The incident resulted in at least 581 fatalities, over 5,000 injuries, and the destruction of nearly 1,000 buildings, including a Monsanto Chemical Company plant. The Grandcamp explosion also caused the ignition of refineries and chemical tanks on the waterfront. Windows were shattered 40 miles away in Houston, and people reported feeling the shock about 250 miles away.

The Texas City disaster triggered the first ever class action lawsuit against the United States government, under the then-recently enacted Federal Tort Claims Act (FTCA), on behalf of 8,485 victims. The Texas City disaster led to widespread disaster response planning to help organize local and regional responses to emergencies. Offers of assistance came in from all over the country and several funds were established to handle donations, mainly the Texas City Relief Fund.

## Hazardous Material Incidents

Michigan has not experienced such a large-scale hazardous material release involving mass casualties as that which occurred in Bhopal, India. This can be attributed, in large part, to the steps taken by government and private industry to carefully regulate those processes and practices that could cause an accidental hazardous material release. Michigan's population density is also lower, and its zoning and planning personnel tend to separate conflicting land uses from each other. Bhopal's 2001 population density was 12,655 persons per square mile, whereas Michigan's highest population density (according to the 2010 census) is the city of Hamtramck, at 10,751 persons per square mile. (Hamtramck, coincidentally, had a hazardous materials event of its own in 1984, as described later in this section.) Bhopal's population was reported as totaling 1.5 million in 2001—Michigan's smaller and more widely spaced urban developments tend to make it less vulnerable to the most severe types of impacts, as do the regulations it currently has in place to oversee the handling of extremely hazardous substances.

However, as the list on the following pages illustrates, Michigan has had numerous fixed-site hazardous material incidents in recent years that required a response by local fire departments and hazardous material response teams, and implementation of evacuation, in-place sheltering, and other protective actions. From 1994 through 1998, local fire chiefs in Michigan reported 730 hazardous material incidents on the Michigan Fire Incident Reporting System (MFIRS). Of those 730 reported incidents, approximately 15-20% (about 120 incidents) occurred at an industrial or service business site. That figure represents an average of one reportable fixed-site hazardous material incident statewide approximately every 15.2 days. (Note: 1998 is the last year for which statewide hazardous material incident response statistics were available.)

## Industrial Accidents

Michigan has seen its share of tragic industrial accidents over the past few years, resulting in numerous deaths and injuries, serious property damage, and economic disruption to facilities and their surrounding communities. Following are brief synopses of the more significant accidents and their impacts:

### *Some Significant Industrial Accidents in Michigan*

March 21, 1892 – East Jordan (Charlevoix Co.) – Explosion at Lumber Mill

On March 21, 1892 a boiler explosion occurred at a lumber mill in East Jordan. The accident resulted in six fatalities and three others left critically injured. The noise from the explosion could be heard from 14 miles away.

November 6, 1895 – Detroit (Wayne County) – Boiler Explosion at a Building

Another major fatal accident occurred on November 6, 1895 when a boiler explosion occurred in Detroit. The boiler exploded in the basement of the building occupied by the Detroit Journal and destroyed the building as well as another adjacent building. The incident resulted in at least 40 fatalities, and 20 more injuries. Several buildings on nearby blocks were shaken by the force of the explosion.

April 23, 1927 – Detroit (Wayne County) – Explosion/Fire at Automobile Plant

One of Michigan's worst industrial accidents occurred in Detroit on April 23, 1927 at the Briggs Manufacturing Plant (which built and painted auto bodies and parts for several automobile companies). In that accident, 21 workers died when sparks from machinery or mercury-vapor lamps in the paint booths ignited paint fumes, causing an explosion and tremendous fire that killed the workers and severely damaged the plant. Arson investigators later determined the explosion and fire to be accidental.

### October 2, 1961– Detroit (Wayne County) – Explosion at Plastics Plant

On October 2, 1961 four people were killed and two others injured in an explosion in Detroit. The incident occurred at a plastics plant and the explosion occurred in a large gas-operated steam heating boiler.

### December 11, 1971 – Port Huron (St. Clair County) – Explosion at Water Treatment Plant

A significant construction operation accident occurred on December 11, 1971 in Port Huron when 22 workers perished in a water project tunneling incident. The explosion occurred within a six-mile, 16-foot diameter tunnel that was being constructed 230 feet below the lake bed to draw up to 1.2 billion gallons of water per day when complete. Tragically, methane gas accumulated in an unventilated portion of the tunnel and was later inadvertently sparked, leading to the devastating underground explosion. Forty-three men were in the tunnel when it exploded. Twenty-one men were killed that day and another man got out of the tunnel but died 10 months later. The explosion ranks as one of the state's most deadly construction industrial accidents.

### January 23, 1976 – Zilwaukee (Saginaw County) – Explosion at Grain Elevator

On January 23, 1976 five workers were killed and 12 others were injured in a grain elevator explosion in Zilwaukee, MI. The explosion occurred in a tower seven stories tall that housed grain hoists and other equipment. Eighteen men were working in the area at the time. The explosion was so powerful that it showered chunks of concrete over an acre of ground.

### December 11, 1998 – Osseo (Hillsdale County) – Fireworks Plant Explosion

On December 11, 1998 an explosion at the Independence Professional Fireworks Company manufacturing plant near Osseo, in Hillsdale County, killed seven employees and leveled one building at the site. The blast, which occurred in a fireworks shell assembly room, sent debris flying in all directions for about 300 yards and could be heard for at least 20 miles. Fifteen other workers escaped serious injury in the explosion. Subsequent investigations by the Federal Bureau of Alcohol, Tobacco and Firearms, the Michigan State Police Fire Marshal Division, and the Michigan Occupational Safety and Health Administration (MIOSHA) were unable to determine a definitive cause of the explosion. This explosion was the worst industrial accident in Michigan in 20 years.

### February 1, 1999 – Dearborn (Wayne County) – Automobile Plant Boiler Explosion

On February 1, 1999 an explosion in one of several large boilers at the Ford Motor Company Rouge Power Plant killed six workers, critically injured another 14, and caused extensive structural damage. State officials who investigated the accident concluded that human error played a major part in the explosion, when a work crew failed to shut off one of two gas mains leading to the boiler's furnace. That error caused a buildup of natural gas in the boiler that was somehow ignited and caused the explosion. The force of the explosion split open the 60-foot high furnace, blew off the roof of the power plant, ignited fires on five floors, and sprayed surrounding workers with super-heated water that caused severe burns. The blast, which forced the shutdown of the Rouge Complex and other Ford plants for several days, was the second worst industrial accident in Michigan in 20 years and the deadliest at an automobile plant in over 50 years. It also turned out to be the most expensive workplace disaster in U.S. history, with final costs of at least $1 billion. The seven-month probe by state officials was the largest and most complex in the history of state workplace safety investigations.

### March 29, 1999 – Osseo (Hillsdale County) – Fireworks Plant Explosion

Another devastating explosion occurred at the same plant that had suffered a disastrous explosion the previous year, killing five more employees and destroying another building at the site. This second explosion, which included among its victims the company co-owner, was later determined by investigators to be accidental. The devastation brought by the two explosions, which resulted in a total of 12 deaths, forced the company to permanently shut down the business. Federal and state regulators have since issued numerous citations to the company for safety violations at the plant, with fines totaling several hundred thousand dollars.

### November 10, 1999 – Flint (Genesee County) – Nursing Home Explosion

On November 10, 1999 an explosion at the Clara Barton Terrace Convalescent Home in Flint killed five persons, injured 32 others, and caused extensive to the basement and other parts of the facility. Although several theories surfaced as to the cause of the blast, subsequent investigations by the National Transportation Safety Board (NTSB) and the Michigan Department of Consumer and Industry Services (as it was then called) had stalled. The NTSB withdrew from the investigation in January 2000 after its investigators could find no pre-existing conditions linking the blast to natural gas lines leading to the nursing home. The Michigan Department of Consumer and Industry Services also pulled out of the investigation after determining that three boilers in the facility's basement were intact and not likely to be the cause of the blast. Officials had indicated that determining the cause of the explosion may be difficult unless new information comes to light.

### April 12, 2000 – Muskegon (Muskegon County) – Chemical Plant Explosion

On April 12, 2000 two explosions occurred in rapid succession at a chemical plant in Muskegon, resulting in 10 workers sustained injuries. The contract workers were installing two tanks and upgrading the waste treatment system at the site of the explosions. The first, smaller blast occurred in a two-inch stainless steel pipe leading from a building to the wet well. The second, larger blast occurred below grade in the southwest quadrant of the wet well. The facilities sustained substantial damage from the second blast and the estimated magnitude of the second blast was equivalent to 250 pounds of TNT.

### March 18, 2001 – Warren (Macomb County) – Plant Explosion

A plastics coating plant building was completely destroyed by a natural gas explosion around 8:20 am on a Sunday morning. Fortunately, no one was at the plant to be injured or killed by the explosion, but the 75 workers employed by the plant no longer had a place to come to work at, on Monday morning.

### May 25, 2001 – Bagley Twp. (Otsego County) – Particle Board Plant Explosion

Two separate explosions on May 25 and 26, 2001, at a mill near Gaylord that produces particle board, injured a total of seven firefighters and nine plant workers (five critically), and caused extensive structural damage to the building. The first explosion occurred on May 25 in an area where glue is mixed with wood chips. The second explosion occurred on May 26 when the initial fire spread to an adjacent silo containing wood chips. As firefighters opened the silo to spray water on the flames, the sudden infusion of oxygen caused the blast.

### July 21, 2002 – Battle Creek (Calhoun County) – Auto Supplier Factory Explosion

An explosion and a fire at a Johnson Controls Inc. plant sent seven employees and three firefighters to the hospital. The victims were not badly hurt and were quickly treated and released. They all suffered headaches and eye and skin irritation caused by the burning of an unknown toxic substance. The fire was extinguished in about 25 minutes and the plant suffered minor damages. Fire crews remained on the scene to clean up the hazardous materials.

### September 17, 2003 – Dearborn (Wayne County) – Explosion at Industrial Plant

A leaking oxygen line exploded outside the Rouge Steel plant in Dearborn and destroyed 20 employee cars in the area. Five hundred employees were evacuated from the plant. The fire department later ordered a second round of evacuations, as a precautionary measure. No injuries were reported in the incident.

### March 21, 2005 – Dearborn (Wayne County) – Explosion / Fire at Industrial Plant

Spilled molten steel caused a fire and two explosions on March 21, 2005 at a Dearborn steel plant, injuring 10 people. A vehicle carrying molten steel was backing into a building at the sprawling River Rouge industrial complex when some of its high-temperature cargo sloshed out, causing the fire and explosion.

### August 9, 2005 – Romulus (Wayne County) – Chemical Plant Explosion

A series of explosions and fires occurred at a chemical plant in Romulus on August 9, 2005. Potentially toxic soot was strewn across neighborhoods surrounding the plant, and dangerous chemicals stewed in the hot rubble left by the explosions. The event caused evacuations within the cities of Romulus and Wayne and caused an environmental health scare. It was later determined that the debris strewn from the plant was not toxic, and the fire was put out after two days of burning.

### February 20, 2006 – Hamtramck (Wayne County) – Explosion / Fire at Industrial Plant

Three people were injured after an explosion at an industrial plant in Hamtramck. The explosion occurred at a hydraulic pump station. The Hamtramck Fire Department and Detroit Fire Department responded to the explosion and were able to control the flames.

### August 28, 2006 – Detroit (Wayne County) – Explosion / Fire at Chemical Plant

Several explosions and a fire spread through a chemical facility on Detroit's east side. The fire started in an aerosol decommissioning area. Three employees suffered injuries, and residents within a half-mile of the plant had to be evacuated for several hours.

### April 4, 2007 – Chesterfield (Macomb Co) – Explosion / Fire at Plastics Plant

A fire at a plastics plant resulted in an explosion involving at least 30 propane tanks. The explosion knocked down phone lines, disabling the Chesterfield Township 9-1-1 system. Police shut down 21 Mile Road near Interstate 94, as firefighters struggled with high winds, terrain obstacles, and nearby power lines. There were no injuries.

### August 4, 2009 – Clio (Genesee County) – Explosion / Fire at Chemical Plant

Explosions and a fire occurred at a chemical plant in Genesee County, resulting in more than 100 firefighters battling the blaze at the facility. An evacuation was ordered for a 2-mile wide radius around the fire, displacing roughly 1,000 residents. The Environmental Protection Agency advised those in the area to keep their windows closed.

### August 27, 2009 – Hamtramck (Wayne County) – Explosion / Fire at Chemical Plant

A fire and an explosion at a chemical plant forced the temporary evacuation of hundreds of people and sent huge plumes of black smoke billowing into the sky above Detroit. The fire began when a rail tanker car ignited while being refueled. Drivers were told to evacuate the service drive in that area in both directions. About 300 homes in the Hamtramck Colonel housing development adjacent to the plant were also evacuated. Amtrak passenger rail service was suspended between Pontiac and Detroit. Amtrak passengers were shuttled about 20 miles between the cities by charter bus. There were no reports of injuries.

### October 20, 2009 – River Rouge (Wayne County) – Explosion / Fire at Industrial Plant

Billows of thick, black smoke could be seen for miles on October 20, 2009 after a fire engulfed an asphalt spill nearly the size of a football field in an industrial area southwest of Detroit. The blaze at the plant was largely contained to its outdoor storage yard. A roughly 100-gallon oil tank also exploded during the fire. Hazardous materials crews, environmental cleanup workers, and other emergency personnel responded to the scene.

### August 24, 2009 – Detroit (Wayne County) – Explosion / Fire at Industrial Plant

A fire at a Detroit chemical company was caused by chemicals inside a heating oven that caused several explosions and the factory to be evacuated. The fire created thick black smoke and could be seen in the air for miles. One firefighter was taken to a hospital with minor injuries.

### November 2, 2009 – Marysville (St. Clair County) – Explosion / Fire at Chemical Plant

Fire crews extinguished a blaze with thick plumes of black smoke at a welding supply company in Marysville after a series of explosions rattled the nearby neighborhood, injured a worker, and sent pieces of metal flying through the air. About 15 to 20 nearby residents, Cleveland Elementary School and the Grant Education Center, along with some nearby businesses, were ordered to evacuate the area. Authorities told others to stay inside and close the windows because of the potential for airborne chemicals. Hazmat teams surveyed the area for several hours after the blast and determined that the air quality around the fire did not endanger the residents. Everyone was allowed to return to their homes.

## *Selected Fixed-Site Hazardous Material Incidents in Michigan Since 1976*

### January 22, 1976 – Saginaw (Saginaw County)

An explosion and fire at a farm supply shipping plant and grain tower killed five persons and injured 12 others. Grain storage areas often contain air that becomes loaded with flammable dust and has a high risk of an explosion being triggered from a spark or flame.

### October 7, 1977 – Midland (Midland County)

A chlorine gas leak valve burst on a tank at chemical plant, producing a vapor cloud that incapacitated several schools. A total of 1,500 students and another 5,000 residents were evacuated.

### May 3, 1979 – Adrian (Lenawee County)

Curene 442 (a chlorinated hydrocarbon) leaked from a plant into the nearby sewers in a five block area, affecting the Raisin River.

### April 23, 1981 – Swartz Creek (Genesee County)

A court-ordered hazardous waste site cleanup forced the evacuation of 60 residents for one month. The possibility of cyanide and acid mixing had prompted the evacuation.

### April 28, 1983 – Benton Harbor (Berrien County)

A chemical spill at a manufacturing plant (involving 6,500 gallons of toluene di-isocyanate) forced the closure of M-139.

### June 17, 1983 – Shelby Twp. (Macomb County)

A fire at a hazardous waste site caused six injuries and forced the evacuation of 1,200 people.

### March 5, 1984 – Adrian (Lenawee County)

A fire at a plastics plant (involving polystyrene) forced the evacuation of 1,000 people from nearby mobile home parks and a subdivision.

### August 6, 1984 – Hamtramck (Wayne County)

A fire at a chemical plant involved exploding tanks of anhydrous ammonia, forcing the evacuation of 300 people from the scene. Several firefighters were injured.

### May 12, 1988 – Detroit (Wayne County)
A chemical fire (involving sulfur chloride) at a manufacturing plant forced the evacuation of persons living around the plant.

### October 24, 1988 – St. Clair Shores (Macomb County)
A chemical spill at a plant injured 40 persons and forced an evacuation of the site.

### November 29, 1988 – Flint Twp. (Genesee County)
A fire at a plastics plant created a toxic plume that forced the evacuation of 75 homes. A total of 97 firefighters were injured while fighting the blaze, and 20 required hospitalization.

### April 22, 1990 – Egelston Twp. (Muskegon County)
A release of phosphorus oxychloride from a plant created a toxic plume that covered a two-mile area, forcing the evacuation of 1,000 people from two mobile home parks.

### March 27, 1998 – Brighton (Livingston County)
A fire at a plastics plant burned for 16 hours, injuring two persons, forcing the evacuation of 50 homes, and closing of US-23 for several hours. One-third of the plant was destroyed.

### October 29, 1999 – Livonia (Wayne County)
An explosion and flash fire at a chemical plant released a plume of chromic acid over a nearby residential area and freeway, forcing 40 people to seek medical treatment at nearby hospitals. Persons within a quarter-mile radius of the plant were advised to stay indoors and keep doors and windows closed. A 1.5-mile stretch of Interstate 96 was closed for several hours, to allow for air monitoring and testing.

### January 12, 2000 – Livonia (Wayne County)
An ammonia leak inside a food processing plant caused an explosion and fire that tore out the side of the building, injured three persons, forced the evacuation of 12 employees, and closed nearby roads for approximately 9 hours. The cleanup effort was complicated by the discovery that the leaked ammonia had mixed with water, creating a solution of ammonium hydroxide that can cause severe burns to skin and eyes, and in some cases, death. An environmental firm was brought in to clean up the solution.

### April 12, 2000 – Egelston Twp. (Muskegon County)
An explosion and flash fire at a chemical plant injured 10 persons and flattened part of the plant's production area. The explosion is believed to have been caused by the chemical tetranitromethane, once used to make rocket fuel. Although the plant never produced the chemical, it may have been an unintended by-product of the company's herbicide production. The explosion shook buildings more than a mile from the plant and hurled sections of steel I-beams onto the roof of a nearby factory more than 200 yards away. The cleanup operation forced the evacuation of businesses within a one-half mile safety zone around the plant.

### July 14, 2001 – Riverview (Wayne County)
An explosion at a chemical plant killed three plant workers, injured nine others, and forced the evacuation of 2,000 nearby residents. The explosion was caused when methyl mercaptan – a colorless flammable gas used in the manufacture of additives for chicken feed and pharmaceuticals and as an additive to natural gas – seeped from a 25,000-gallon rail car and exploded at the plant. (Methyl mercaptan is a foul smelling gas that can be toxic to humans if they are exposed to heavy concentrations for up to one hour. Exposure to small amounts of the chemical for several hours can cause headaches and burning sensations in the eyes and throat.) The toxic chemical cloud briefly threatened the city of Amherstburg in Ontario, Canada, but a wind shift reduced the threat and the need to evacuate. Fire officials at the scene indicate the situation could have been much worse had another nearby tanker containing methyl mercaptan, and three others containing chlorine, also ignited. Favorable wind conditions also helped push the fumes away from surrounding communities, reducing the need to evacuate more residents.

### August 27, 2001 – Detroit (Wayne County)
A fire at a metal plating plant injured eight firefighters, forced the evacuation of residents within a five-block radius, and completely destroyed the plant. The fire, which continued to smolder for more than 24 hours, consumed large tanks of cyanide, sulfuric acid, and other chemicals. Toxic fumes from the fire forced a one-week closure of a local elementary school.

### April 9, 2002 – Dearborn (Wayne County)
At least 15,000 gallons of oil was dumped into the Detroit and Rouge rivers, contaminating 27 miles of shoreline. The oil was apparently dumped into a Dearborn storm sewer, but the Environmental Protection Agency was unable to find conclusive evidence to point to one polluter. Federal authorities spent $3.7 million cleaning up the area.

### July 7, 2003 – Linwood (Bay County)
A large industrial fire occurred at the American Recycling Company in Linwood. The fire involved butyl rubber (approximately 1,000 bags of 1,000 lbs. each) and 200 barrels of fuel additives. Residents of a mobile home park were evacuated to a safe location.

### February 1, 2004 – Sarnia, Ontario (St. Clair River)
39,000 gallons of toxic chemicals leaked into the St. Clair River near Sarnia, Ontario. Methyl ethyl ketone and methyl isobutyl ketone, which are low toxicity solvents, leaked into the river from an Imperial Oil plant. Local residents were urged to refrain from using the tap water for cooking, bathing, or drinking, until the water could be tested.

### October 16, 2007 – Melvindale (Wayne County)
Residents and three schools were evacuated after a leak was reported at a Melvindale chemical company, totaling nearly 3,000 evacuated residents. Hydrochloric acid was released into an overflow container, so it was not a direct spill. It was released into a container and was contained by Hazmat teams.

### September 15, 2007 – Lowell (Kent County)
A fire and an explosion destroyed several connected buildings at a Lowell factory. The fire affected a quantity of 10% solution of sulfuric acid that was between 5 and 10 thousand gallons. There was a concern over the effect on groundwater, and on the Lowell municipal water supply. The blaze sent black and gray smoke billowing high into the evening sky, visible at least 10 miles away, and attracted hundreds of onlookers. A half-dozen area fire departments, from as far as East Grand Rapids and Belding, helped Lowell firefighters battle the blaze. There was at least one reported injury.

### December 14, 2007 – Fraser (Macomb County)
A truck spilled 550 gallons of sulfuric and nitric acid in Fraser, closing a boulevard. Local businesses were evacuated and crews conducted a total cleanup of the area. The Clinton Township hazardous materials team arrived on the scene and determined that all of the truck's contents had emptied, some of which had run off the road and into a nearby sewer and drain. No one was injured in the incident.

July 18, 2008 – Grand Blanc (Genesee County)

Residents near a Grand Blanc plant were evacuated when several tanks filled with sulfuric acid caught fire. Police were called to the plant and most of the fires were quickly under control. However, firefighters were concerned about hazardous vapors in the air and began evacuating residences and businesses. One tank continued to burn from the inside, making it difficult for firefighters to put the flames out.

September 25, 2008 – Grand Haven (Ottawa County)

A small leak from a faulty plug in a one-ton sulfur dioxide tank, delivered to the Grand Haven wastewater treatment plant, forced authorities to evacuate about 75 homes for three hours. The plug had a faulty thread, allowing the liquid substance to escape and immediately turn to gas. There were no reported injuries or effects from the gas release.

March 9, 2009 – Detroit (Wayne County)

The Detroit Fire Department handled a chemical spill clean-up after an undetermined amount of sulfur dioxide had leaked from a railroad car in southwest Detroit. The leak happened at a city wastewater treatment plant just west of Zug Island. The car was carrying about 90 tons of sulfur dioxide, but it was unclear how much leaked out. A professional chemical handling company oversaw the transfer of the remaining sulfur dioxide to another railcar.

July 10, 2010 – Monroe County

Southbound I-75 was closed during the early morning hours because of a chemical spill at a Toledo industrial park. Although the spill was outside of the state, there was still an effect upon one of Michigan's major Interstate highways.

February 15, 2012 – Edwardsburg (Cass County)

An old fertilizer and bulk chemical facility burned down in Edwardsburg, with thick clouds of smoke billowing out for about two hours.

March 10, 2012 – Adrian (Lenawee County)

A large fire occurred at a plastics recycling facility, causing a nearby sports game at Siena Heights University to be called off at half-time in order to avoid the risk of having smoke affect the spectators. Nearby residents were asked to shelter indoors, due to the huge amounts of smoke generated from the blazing 8,000 square-foot structure. High winds made firefighting challenging, and during the several hours that it took for more than a dozen area fire departments to contain the blaze, one firefighter received a minor injury and was transported to a hospital for treatment.

June 24-25, 2013 – Plainwell (Allegan County)

On June 24th an operational process within the Drug & Laboratory Disposal, Inc. plant created a chemical reaction that resulted in a fire at the business. Their staff activated their contingency plans and contacted 911, bringing the Plainwell Department of Public Safety to the scene. Several additional fire departments responded to the incident, and the fire was extinguished by late afternoon. During the night hours, however, another chemical reaction caused the fire to rekindle. An evacuation ordered was issued for the nearby residents and businesses. The second fire was extinguished during the early morning hours of June 25th. US Environmental Protection Agency (EPA) and MDEQ staff were included in the response and investigation. The evacuation order was lifted on the afternoon of June 25th.

***Programs and Initiatives***

Note: Many of the programs and initiatives designed to mitigate, prepare for, respond to, and recover from hazardous material transportation incidents have the dual purpose of also protecting against fixed-site hazardous material incidents and some industrial accidents. As a result, there is some overlap in the narrative "Programs and Initiatives" sections for each respective hazard. This redundancy allows each hazard section to stand alone, eliminating the need to refer to other hazard sections for basic information.

Superfund Amendments and Reauthorization Act (SARA), Title III

As explained earlier, the Bhopal, India tragedy initiated a chain of events aimed at enhancing preparedness activities to minimize the potential for a similar event to occur in the United States. On October 17, 1986 the Superfund Amendments and Reauthorization Act (SARA) was signed into law. A major SARA provision is Title III (the Emergency Planning and Community Right-To-Know Act, also known as SARA Title III), which establishes hazardous material emergency planning, reporting, and training requirements for federal, state and local governments, and private industry. In Michigan, the SARA Title III program is jointly administered and implemented by two state departments—the Michigan State Police and the Michigan Department of Environmental Quality.

The emergency planning provisions of SARA Title III require each state to establish a state emergency response commission, emergency planning districts, and a local emergency planning committee for each district. The state commission and local committees are responsible for preparing and implementing emergency plans, as well as receiving and disseminating copies of material safety data sheets, chemical inventories, and other reports and forms necessary for compliance under the Act. The community right-to-know provisions of SARA Title III allow the public to access information on the hazardous materials stored in their community, and the quantities of toxic materials released into the environment.

## State Emergency Response Commission

The Michigan Emergency Planning and Community Right-to-Know Commission (commonly known as the State Emergency Response Commission or SERC) was established in 1987 and then re-organized in 1994 and 1995. It consists of 17 members appointed by the Governor. The membership includes several state agencies, the general public, and a variety of other groups and professional disciplines (including agriculture, industry, labor, education, local government, and environmental protection and stewardship). The SERC is chaired and administered by the Emergency Management and Homeland Security Division, Department of State Police (EMHSD/MSP), in cooperation and conjunction with the Michigan Department of Environmental Quality (MDEQ). The primary purpose of the SERC is to monitor SARA Title III activities in the state and develop policy and overall direction for program administration. The EMHSD/MSP and MDEQ provide professional staff to assist the SERC in carrying out Title III planning, training, exercising and reporting activities.

## Local Emergency Planning Committees

One of the major provisions of SARA Title III is the establishment of Local Emergency Planning Committees (LEPCs) for designated planning districts. The LEPCs are responsible for developing emergency response plans for communities that have facilities in their jurisdiction subject to SARA Title III emergency planning requirements. The LEPC is the primary mechanism through which local SARA Title III planning, training and exercising activities are implemented. Michigan has 88 designated LEPCs – one for each of the 83 counties and 5 in major cities. Nearly 2,800 facilities across the state have been identified as being subject to Title III emergency planning provisions. A facility is subject to SARA Title III provisions if extremely hazardous substances (as determined by the U.S. Environmental Protection Agency) are present at the facility in quantities at or above the minimum threshold quantities established in Section 302 of the Act. The map at the end of this section provides a breakdown of Title III (Section 302) sites by county.

Individual firms doubtlessly vary a great deal in their safety records, just as they vary in the types and quantities of hazardous materials that they handle. Use of GIS can be helpful since Section 302 sites can be located spatially and then ringed with a buffer representing the identified evacuation zone. A vulnerability assessment would primarily be based on the development that exists within that zone—especially if vulnerable populations are located within that area, such as schools, hospitals, other medical facilities such as blood banks or kidney dialysis centers, high-rise senior facilities, and day care centers. The probability of a local incident might be assessed from historical records of industrial accidents or chemical releases. Wide variation in estimates is likely, depending on whether the history of an entire industry or only of a particular site is used. Often, a local site may appear to have an incident-free history, but the risk cannot be assumed to be zero.

## Hazardous Material Response Planning

Each Section 302 site must be covered by a community response plan that addresses the emergency planning requirements found under SARA Title III. Inclusion of Michigan Firefighter Right-to-Know provisions of the Michigan Occupational Health and Safety Act (1986 PA 80) is also encouraged in the planning guidance provided by the Emergency Management and Homeland Security Division, Department of State Police. The EMHSD/MSP provides technical planning assistance to the LEPCs to facilitate the development and maintenance of those required plans. That assistance typically includes provision of written planning guidance, interaction with the planning team, plan reviews, and limited financial assistance (via federal grant funds) to offset the costs of preparing the plans. Each facility plan must address the following critical areas: 1) hazard identification (to include chemical inventories, locations, release detection, and chemical-specific response information); 2) vulnerability map and analysis (to include a vulnerability zone, special populations affected, and other facilities and areas that may contribute to risk); 3) population protective actions (to include warning, access control, evacuation and in-place sheltering); 4) response procedures (to include both on-site and off-site expertise and equipment); and 5) a training and plan exercising program. The plans must be reviewed and commented upon by the Michigan SERC.

The Michigan Department of Environmental Quality and the Michigan Department of Agriculture and Rural Development provide technical information and planning assistance in the areas of community-right-to-know, material safety data sheets, chemical inventories, incident reporting, and (on a limited basis) incident cleanup.

### Hazardous Material Response Training

The Emergency Management and Homeland Security Division, Department of State Police, provides a wide array of hazardous material response training programs through the Michigan Hazardous Material Training Center. The Center provides training courses for individuals and companies responsible for planning, inspection, response, mitigation, and cleanup activities involving hazardous materials. Specific subjects include: 1) computer-aided management; 2) hazardous materials chemistry; 3) hazardous materials emergency response; 4) hazardous waste worker compliance; 5) incident management; 6) hazardous materials monitoring/sampling; and 7) other specialized hazardous materials-related courses such as highway and rail cargo tanker handling, confined space entry, emergency medical services, and technical rescue. Courses are conducted at the Center in Lansing and at various other locations throughout the state.

### Federal/State Hazardous Material Response Resources

Even prior to the Bhopal, India incident in 1984, there were numerous groups at the federal, state, and local levels, and in private industry, trained to deal with hazardous material incidents. Those groups include the National Response Team (NRT), Regional Response Teams (RRTs), and state and local hazardous material response teams. The Chemical Manufacturers Association established the Chemical Transportation Emergency Center (CHEMTREC) to provide 24-hour technical advice to emergency responders. The National Response Center (NRC), which operates much like CHEMTREC, was established to provide technical advice and coordinate federal response to a hazardous material incident.

In Michigan, a 24-hour statewide notification system called the Pollution Emergency Alerting System (PEAS) was established for reporting chemical spills to the Department of Environmental Quality. As a companion to the PEAS, the Michigan Department of Agriculture and Rural Development (MDARD) has established a 24-hour Agriculture Pollution Emergency Hotline for use by agri-chemical users to report fertilizer and pesticide spills. Callers to the MDARD hotline gain immediate access to appropriate technical assistance, regulatory guidance for remediation, and common sense approaches for addressing the problem.

### U.S. EPA Chemical Emergency Preparedness and Prevention Office

The USEPA's Chemical Emergency Preparedness Office (CEPPO) provides leadership, advocacy and assistance to states, local governments, and private industry to: 1) prevent and prepare for chemical emergencies; 2) respond to environmental crises; and 3) inform the public about chemical hazards that may be present in their community. The CEPPO works closely with several Michigan state agencies to implement and coordinate a number of regulatory and non-regulatory programs designed to protect human health and the environment in Michigan from chemical accidents—including the SARA Title III program.

### Resource Conservation Recovery Act

Not all facilities with hazardous materials fall under the requirements of SARA Title III. The Michigan Department of Environmental Quality (MDEQ) regulates over 8,000 small and large hazardous waste generators under the federal Resource Conservation Recovery Act (RCRA). The RCRA provides MDEQ with the authority to control hazardous waste from "cradle to grave," which includes the generation, transportation, treatment, storage, and disposal of hazardous waste. The high number of RCRA facilities in Michigan is indicative of the widespread prevalence of hazardous materials throughout the state.

### Michigan Chemical Council

The Michigan Chemical Council is the primary trade association representing the chemical and allied industries in Michigan. As such, it works in partnership with the national Chemical Manufacturers Association, the Emergency Management and Homeland Security Division of the Department of State Police (MSP/EMHSD), and

other agencies and local governments to provide educational and community outreach services in the area of chemical awareness and safety. The Council provides an important informational and coordination bridge between Michigan's chemical industries, federal, state and local regulatory agencies, and the public.

Chemical Awareness Week

Each spring, the MSP/EMHSD, in conjunction with several other state agencies, LEPCs, and the Michigan Chemical Council, sponsors Chemical Awareness Week. This annual public information campaign focuses on: 1) the hazards associated with the manufacture, transport, storage, use, and disposal of chemicals; 2) the programs and systems in place to protect the public from accidental chemical releases; and 3) community emergency response procedures for chemical accidents. Informational materials on chemical hazards and safety are disseminated to schools, hospitals, nursing homes, other interested community groups and facilities, and the general public.

***Mitigation Alternatives for Fixed Site Hazardous Material Incidents***

- Compliance with/enforcement of Resource Conservation and Recovery Act (RCRA) standards.
- Elimination of clandestine methamphetamine laboratories through law enforcement and public education.
- Identification of radioactive soils and high-radon areas
- Proper separation and buffering between industrial areas and other land uses.
- Location of industrial areas away from schools, nursing homes, etc.
- Public warning systems and networks for hazardous material releases.
- Increased coverage and use of NOAA Weather Radio (which can provide notification to the community during any period of emergency, including large scale hazardous material incidents).
- Compliance with all industrial, fire, and safety regulations.
- Insurance coverage.
- Enhanced security and anti-terrorist/sabotage/civil disturbance measures.

***Tie-in with Local Hazard Mitigation Planning***

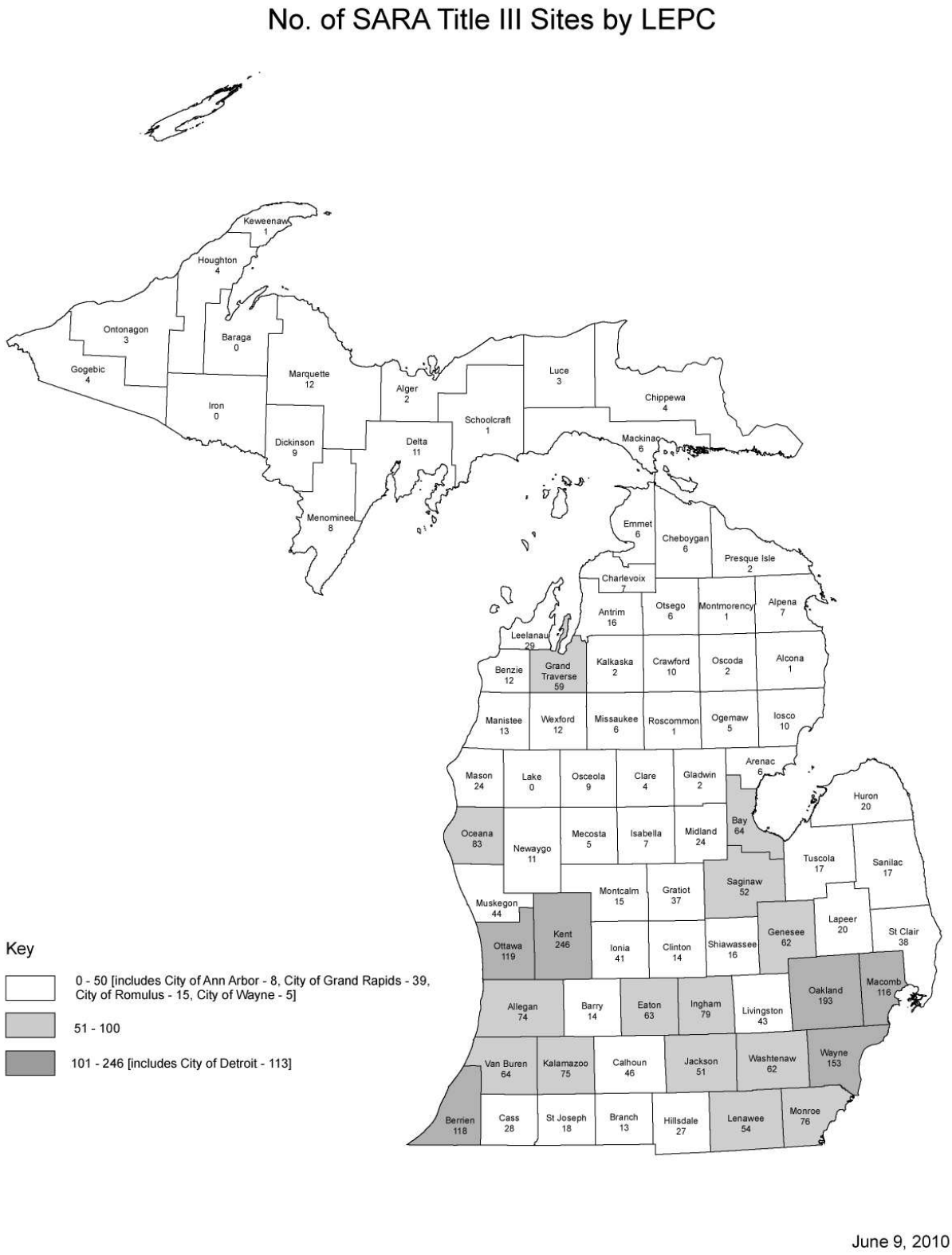
Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that hazardous material incidents were identified as one of the most significant hazards in the county hazard mitigation plan for St. Clair County. (Various communities within other counties may have designated this hazard as significant, but the local concerns do not necessarily make the hazard more serious than other ones faced at the county level.) In the case of the City of Port Huron (and St. Clair County, in which it is located) the key distinction seems to be the proximity of the very large "Chemical Valley" site in Sarnia, Ontario. This site is located just across the St. Clair River, and small-to-moderate scale hazardous material releases are frequently reported from this site, usually going into the waters of the river. According to an online emergency management plan for the City of Sarnia (page 14), a reciprocal aid agreement is in place with the City of Port Huron. The Ontario Hazard Analysis was examined as part of the MHMP update process, and it states that Sarnia has "the largest cluster of facilities that produce or use large quantities of chemicals in Canada."

## SARA Title III Sites in Michigan

Source: Michigan Department of Environmental Quality



# NUCLEAR POWER PLANT EMERGENCIES

*An actual or potential release of radioactive material at a commercial nuclear power plant, in sufficient quantity to constitute a threat to the health and safety of the off-site population.*

***Hazard Description***

Though the construction and operation of nuclear power plants is closely monitored and regulated by the Nuclear Regulatory Commission (NRC), accidents at these plants are considered a possibility, and appropriate on-site and off-site emergency planning is conducted. An accident could result in the release of potentially dangerous levels of radioactive materials into the environment and could affect the health and safety of the public living near the nuclear power plant. A nuclear power plant accident might involve both a release of airborne radioactive materials and radioactive contamination of the environment around the plant. The degree and area of environmental contamination could vary greatly, depending on the type and amount of release, and the weather conditions that are present. Response to a nuclear power plant accident requires specialized personnel who have been trained to handle radioactive materials safely, who have specialized equipment to detect and monitor radiation, and who are trained in personal radiation exposure control.

After a period of decline following the 1979 Three Mile Island accident and the 1986 incident at Chernobyl, there is a recent renewed interest in nuclear energy because it could partially address problems of dwindling oil reserves and global warming, with far fewer emissions of greenhouse gases than the use of fossil fuels. However, the use of nuclear power is controversial because of the problems of storing radioactive waste for indefinite periods, the potential for radioactive contamination by accident or sabotage, and the possibility that its use could in some countries lead to the proliferation of nuclear weapons. As the chart below shows, the United States produces the most nuclear energy of any country in the world, but many other countries actually use nuclear energy as a larger percentage of their overall energy production.

**Nuclear Electricity Generation by Country: 2008**

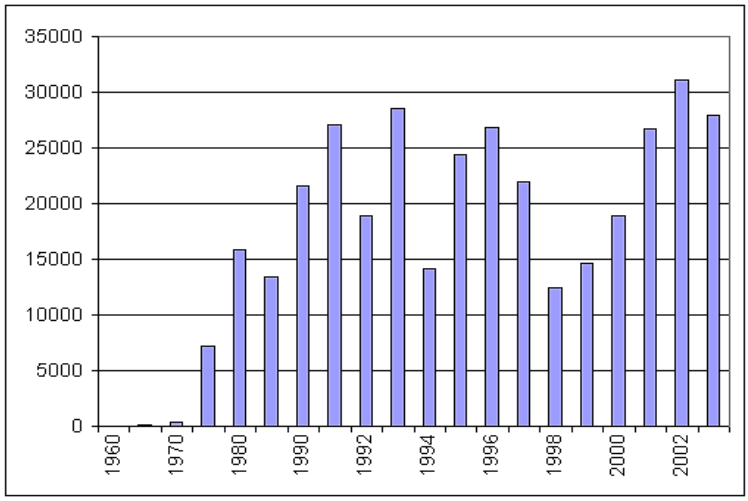
| Country | Production (Billion Kilowatt Hours) | % of Country's Energy | Country | Production (Billion Kilowatt Hours) | % of Country's Energy |
|---|---|---|---|---|---|
| Argentina | 6.9 | 6.2% | Korea RO (South) | 144.3 | 35.6% |
| Armenia | 2.3 | 39.4% | Lithuania | 9.1 | 72.9% |
| Belgium | 43.4 | 53.8% | Mexico | 9.4 | 4.0% |
| Brazil | 13.2 | 3.1% | Netherlands | 3.9 | 3.8% |
| Bulgaria | 14.7 | 32.9% | Pakistan | 1.7 | 1.9% |
| Canada | 88.3 | 14.8% | Romania | 10.3 | 17.5% |
| China | 65.3 | 2.2% | Russia | 152.1 | 16.9% |
| China: Taiwan | 39.3 | 17.1% | Slovakia | 15.5 | 56.4% |
| Czech Rep. | 25.0 | 32.5% | Slovenia | 6.0 | 41.7% |
| Egypt | 0 | 0% | South Africa | 12.8 | 5.3% |
| Finland | 22.1 | 29.7% | Spain | 56.5 | 18.3% |
| France | 419.8 | 76.2% | Sweden | 61.3 | 42% |
| Germany | 140.9 | 28.8% | Switzerland | 26.3 | 39.2% |
| Hungary | 13.9 | 37.2% | Turkey | 0 | 0% |
| India | 13.2 | 2.0% | Ukraine | 84.5 | 47.4% |
| Indonesia | 0 | 0% | United Kingdom | 48.2 | 13.5% |
| Iran | 0 | 0% | **USA** | **806.7** | **19.7%** |
| Israel | 0 | 0% | | | |
| Japan | 241.3 | 24.9% | **WORLD** | **2,597.8** | **14%** |
| Korea DPR (North) | 0 | 0% | | | |

***Hazard Analysis***

With three commercial nuclear power plants currently operating in the state, emergency preparedness is required in all potentially affected jurisdictions. Michigan's three commercial nuclear power plants are 1) the Enrico Fermi-2 plant near Monroe; 2) the Donald C. Cook plant near Bridgman; and 3) the Palisades plant near Covert.

A fourth plant, the Big Rock Point plant near Charlevoix, was closed in 1997 and then decommissioned, but spent fuel is still stored on-site in dry casks and will probably remain there quite a while. The Davis-Besse nuclear power station near Toledo, Ohio has several Michigan counties within its Secondary Emergency Planning Zone (EPZ), requiring coordinated planning between Michigan and Ohio. The commercial power plant facilities are located on the map at the end of this section. The chart below shows the amount of nuclear power that Michigan has generated since 1960.

**Nuclear Generation in Michigan, 1960 through 2003**
(Million Kilowatt Hours)




Source: Energy Information Administration, State Energy Data Report 1999, Electric Power Annual (Volume 1, 2001), and EIA Survey Form 906.

Federal, state and local governments and utility personnel take extensive precautions to ensure that, should a nuclear accident occur, its impact on the safety and well being of the general public and the environment will be minimal. These precautions include the development and continual testing of emergency plans, training of response personnel, coordination of response actions, and development and dissemination of emergency public information. A regular series of large, interagency drills and exercises takes place for each nuclear plant, and each plant has two designated emergency planning zones—primary (within a 10 mile radius) and secondary (within a 50 mile radius)—to handle all possible incidents and response activities that could be anticipated, both in the short-term and the long-term.

Impact on the Public

A nuclear power plant accident would tend to pose limited threats, directly involving the environment and public over a distance typically no greater than 10 miles away, even in the most severe U.S. events. Evacuation and contamination may occur within this limited distance from the plant, and any more far-reaching effects (e.g. food chain contamination) would vary with weather conditions and the extent and type of radioactive release. This hazard has been extensively studied and prepared for, allowing the likely impacts on the public to be efficiently assessed and addressed, should an event occur.

Impact on Public Confidence in State Governance

A nuclear power plant emergency may severely affect public confidence in state government if it results in significant environmental harm, displacement, or casualties. Although the odds of this happening are slim, nuclear power is poorly understood by many U.S. citizens, many of whom may be expected to misinterpret both the nature of the industry as well as the effects of an accident, and to perceive that any significant failures are likely the result of inadequate governmental oversight and regulation.

Impact on Responders

Due to pre-planning, training, and exercising, a nuclear power plant accident offers the opportunity to use planned staging areas, from which to handle equipment, protective clothing, medical treatment, decontamination, provision and sheltering needs. Responder exposure to radiation should not need to exceed amounts that have been mandated by law and by workplace regulations. (Extensive procedures and regulations are in place to minimize those types of risks.)

Impact on the Environment

A nuclear power plant accident could result in the release of potentially dangerous levels of radioactive materials both in the air and around the plant. Contamination may occur from radioactive gases, liquids or particles. Some possible accidents at nuclear power plants pose a risk for severe environmental contamination, and the degree and area of this contamination could vary greatly depending on the type and amount of radioactivity, and on the weather conditions.

An accidental release of large amounts of radioactive contamination could contaminate many areas of land for long periods of time, making it unusable for humans, wildlife species, and natural vegetation. The main reason is due to radioactive materials comprising unstable isotope elements that decay over a long period of time. Some isotopes can decay quickly, while others take a very long time to stabilize. Certain radioactive elements such as plutonium can remain hazardous for thousands of years, making re-use of an area difficult or hazardous. Nuclear reactors produce high level waste (an actual classification) in the reactor core that is highly reactive and thermally hot, presenting handling, transportation, and storage problems. Radioactive contamination may affect nearby water bodies, rivers, etc. and damage the environment and its aquatic life. Radioactive material has the potential to seep deep into the ground and water table.

***Significant Nuclear Power Plant Accidents***

Worldwide, four nuclear power plant accidents rank as most significant in the history of the nuclear power era:

September 29, 1957 – "Kyshtym Disaster" near Chelyabinsk, Russia

The Mayak Nuclear facility, which was a nuclear fuel reprocessing plant located in the sealed-off town that is now called Ozyorsk. (Kyshtym was, at the time, the officially named city that was located nearest to the disaster.) An exploding chemical tank blasted radioactive materials skyward, which drifted with the winds to the northeast. Materials from this blast were scattered for about 200 miles along a line where the winds blew, and contaminated the area with caesium-137 and strontium-90. An estimated 270,000 persons were exposed to radioactive materials as a result, and twenty communities were eventually resettled away from this contamination zone. The full extent of this event was only revealed to the public decades later, starting in the 1970s.

March 28, 1979 – Three Mile Island, Harrisburg Pennsylvania

On March 28, 1979, the most serious nuclear reactor accident ever to occur at a commercial power plant in the United States took place at the Three Mile Island nuclear power plant near Harrisburg, Pennsylvania. This incident resulted from a plant malfunction, combined with operator overrides of automatic safety systems. These errors resulted in a partial meltdown of the reactor core. Utility, state, and local personnel implemented response plans to protect the public in the area around the plant, while on-site efforts were undertaken to cool the reactor and prevent any possible release of radioactive material. While this accident did not result in any off-site health consequences, it had a major impact on emergency planning regulations in the United States.

Following the accident, new federal regulations were written to mandate specific activities by both on-site and off-site emergency response organizations. These more stringent federal regulations aimed at improving emergency planning efforts at nuclear power plants and providing for additional plant safety systems. Among the new regulations was NUREG 0654/FEMA REP-1, which forms the basis for state and local government planning, training, and emergency exercises. The U.S. Environmental Protection Agency (EPA) also issued new guidance on environmental monitoring and protective actions.

April 26, 1986 – Chernobyl, Ukraine (then part of the Soviet Union)

On April 26, 1986 a Soviet nuclear reactor at Chernobyl, Ukraine suffered a steam explosion while conducting experimental testing. This explosion, and the ensuing fire in the graphite core of the reactor, released radioactive debris into the upper atmosphere, where wind currents dispersed it around the world. Other radioactive material was deposited in areas around the plant site, contaminating the land and food. The high levels of radiation on-site killed 32 plant workers and firefighters. The World Health Organization and other public health agencies are still studying the effects of the accident on public health in the Ukraine and nearby areas.

The long-term impacts of this accident are continuing today. The area within a 30 kilometer (20 mile) radius around the plant is heavily contaminated with radioactive material, and most of those who had previously resided there have not returned. Soil contamination does not allow the consumption of crops grown in these areas. Because residents had consumed contaminated crops and milk, studies have indicated significant increases in childhood thyroid cancer in the region around the plant. 4.5 million persons continued to live in less-severely contaminated areas in Ukraine, Russia, and Belarus. One of the major lessons learned from this accident is the need for early impoundment of suspected food and milk that may have been contaminated. The EPA has revised its guidelines for environmental monitoring in affected areas as a result of the Chernobyl experience.

While an event of this nature is not physically possible at a U.S. reactor due to differences in reactor design and safety systems (for example, the Chernobyl reactor did not have a containment building), the event did impact U.S. emergency planning regulations. Lessons learned from this accident have been incorporated into federal guidance (e.g., EPA 400 Ingestion Pathway Protective Action Guidance). Additional emphasis has been placed on the ingestion pathway aspects of nuclear power plant emergency exercises.

### March 11, 2011 – Japan

On March 11, 2011 a 9.0 magnitude undersea mega-thrust earthquake occurred near Tohoku, Japan. The epicenter was approximately 43 miles east of the Oshika Peninsula of Tohoku and the hypocenter was at an underwater depth of approximately 20 miles. It was the most powerful known earthquake to have hit Japan, and one of the five most powerful earthquakes in the world since modern record-keeping began in 1900. There were multiple foreshocks, as well as hundreds of aftershocks of a 4.5 magnitude or greater. The earthquake triggered extremely destructive tsunami waves of up to 40.5 meters high, and in some cases traveling up to 6 miles inland in Tohoku. The Japanese National Police Agency has confirmed (as of 2012) 15,854 deaths, 26,992 injuries, and 3,155 people missing; as well as 129,225 buildings destroyed, and 945,970 damaged. The earthquake and tsunami caused extensive and severe structural damage in Japan, heavy damage to roads and railways, fires in many areas, and a dam collapse. Around 4.4 million households in northeastern Japan were left without electricity. The earthquake also moved Honshu 8 feet east and shifted the Earth on its axis an estimated 4 to 10 inches.

In addition to loss of life and destruction of infrastructure, the tsunami caused a number of nuclear accidents, primarily equipment failures, the release of radioactive materials, and level 7 meltdowns at three reactors in the Fukushima I Nuclear Power Plant complex. The Fukushima I, Fukushima II, Onagawa Nuclear Power Plant, and Tōkai nuclear power stations, consisting of a total of eleven reactors, were automatically shut down following the earthquake. Three nuclear reactors suffered explosions due to hydrogen gas that had built up within their outer containment buildings after cooling system failures. At Fukushima I and II, tsunami waves overtopped seawalls and flooded the entire plant, including low lying generators, electrical switch gears, and external pumps for supplying cooling seawater. The plant's connection to the electrical grid was broken because the tsunami destroyed the power lines. All power for cooling was lost and the reactors started to overheat from the natural decay of the fission products created before shutdown. The flood destroyed diesel backup power systems, leading to severe problems at Fukushima I, including three large explosions and radioactive leakage. Flooding with radioactive water also prevented access to basement areas where repairs where needed. Officials from the Japanese Nuclear and Industrial Safety Agency reported that radiation levels inside the plant were up to 1,000 times normal levels, and that radiation levels outside the plant were up to eight times normal levels. Residents within a 12 mile radius of the Fukushima I Nuclear Power Plant and a 6 mile radius of the Fukushima II Nuclear Power Plant were evacuated. There were associated evacuation zones that affected hundreds of thousands of residents.

An April 7, 2011 aftershock caused the loss of external power to Rokkasho Reprocessing Plant and Higashidori Nuclear Power Plant, but backup generators were functional. Onagawa Nuclear Power Plant lost 3 of 4 external power lines and lost its cooling function for as long as 80 minutes. It was also reported that radioactive iodine and cesium was detected in the tap water in several nearby areas. Radioactive strontium was detected in the soil in some places in Fukushima as well. It was estimated that the release of dangerous radioactive isotopes of iodine and cesium from Fukushima reached almost the same emission levels as those from Chernobyl in 1986. Food products were also found to be contaminated by radioactive matter in several places and food grown in the area was banned from sale. As the nuclear crisis entered a second month, experts recognized that Fukushima I was not the worst nuclear accident ever (compared to Chernobyl, which was worse) but it was the most complicated, due to the multiple reactors involved. Later analysis indicated that three reactors (Units 1, 2, and 3) had suffered meltdowns and continued to leak coolant water three months after the initial events.

Experts have said that a workforce in the hundreds or even thousands would take years or decades to clean up the area. It was announced that the plant would be decommissioned once the crisis was over. Early estimates placed insured losses from the earthquake alone at US$14.5 to $34.6 billion. The overall earthquake and tsunami event cost is estimated by the World Bank to be US$235 billion, making it the most expensive natural disaster on record. Even the United States suffered damage because, in California and Oregon, up to 8 foot high tsunami surges hit some areas, damaging docks and harbors and causing over $10 million in damages.

Michigan experienced a significant nuclear power plant incident in 1966, although nothing along the lines of the Chernobyl, Three Mile Island, and Japan accidents in terms of scope, magnitude, or severity:

### October 5, 1966 – Enrico Fermi-1, Monroe County, Michigan

Although Michigan has never experienced a significant nuclear power plant accident that involved an off-site release of radioactive material, on October 5, 1966, a serious incident did occur at Detroit Edison's then-new Enrico Fermi Atomic Power Plant near Monroe (commonly called Fermi-1). Fermi-1 was an experimental breeder reactor designed to demonstrate the feasibility of liquid fast-metal breeder reactor technology. On October 5, a metal flow guide inside the reactor broke off and blocked the flow of sodium coolant in the space below the reactor core. As a result, approximately 1% of the fuel melted. The fuel damage caused the release of some radiation into the reactor containment building; however, no off-site release occurred. The plant was eventually repaired, and it operated for a short period until it was permanently shut down in 1972. The fuel and related materials were removed and sent to a federal government facility in the mid-1970s. The Enrico Fermi-2 nuclear power plant opened next door in 1988.

### March 5, 2002 – Davis-Besse, Oak Harbor, Ohio

An incident occurred on March 5, 2002 at the Davis-Besse Nuclear Power Station in Oak Harbor, Ohio when maintenance workers discovered that corrosion had eaten a football-sized hole into the plant's reactor vessel head. Although the corrosion did not lead to an accident, the Nuclear Regulatory Commission kept the plant shut down until March 2004. The U.S. Justice Department investigated and penalized the owner of the plant $28 million in fines for safety and reporting violations related to the incident. The NRC also imposed its largest fine ever, more than $5 million, against First Energy for the actions that led to the corrosion.

In February, 2014, the Davis-Besse Plant has temporarily been shut down for maintenance operations. It is not known when the plant will reactivate, but there are plans to spend at least $600 million to upgrade the plant. The plant is currently licensed until 2017, and a successful renewal of that license would be good for an additional 20 years.

### *Programs and Initiatives*

Since the Three Mile Island accident in 1979, federal, state and local governments have developed detailed radiological emergency response plans for each nuclear power plant based on NUREG 0654/FEMA REP-1 and subsequent federal regulations and guidance. These plans are exercised on a biennial basis and are reviewed by the Federal Emergency Management Agency (FEMA) and the Nuclear Regulatory Commission (NRC).

Ownership and use of radioactive materials is strictly regulated by the federal government. Nuclear power plants must follow strict building and safety codes. Material storage, use, and waste management practices are strictly monitored. In 1977, President Carter placed a moratorium on the shipping of spent fuel from commercial nuclear power plants to burial sites or spent-fuel reprocessing centers. Spent fuel is now stored at the plant site in spent fuel pools or dry cask storage facilities until the issue of permanent nuclear waste disposal is resolved.

Response to a nuclear power plant accident in Michigan is the joint responsibility of the plant owner/operator and the federal, state, and local government. State and local governments implement protective actions and other preparedness and response activities, based on the Nuclear Accident Emergency Action Level Classification System. In most cases, the Primary Emergency Planning Zone (EPZ) around a nuclear power plant is 10 miles. Within this zone, plans are developed to protect the public through in-place sheltering and evacuation, in the event of an accident. The area within the Primary EPZ for which protective actions are implemented will depend on the type and amount of radioactive material released, and on weather conditions. The Secondary Emergency Planning Zone, consisting of a 50-mile radius around most plants, exists for planning considerations which aim to prevent radioactive contamination of the food chain.

### International Nuclear Event Scale (INES)

The International Nuclear Event Scale is a seven scale level system that is designed to describe event severity in terms of a logarithmic scale in which each level is ten times more severe than the preceding one. After the zero level classification (denoting no significant threat), there are then three levels of “incident” and four levels of “accident,” with the most serious being classified as a 7 (major accident). The selection of a level for a given event is based on three parameters: effect on people or the environment, loss of protective radiation barriers, and loss of any of the layers of safety systems. There have only been two Level 7 accidents (Chernobyl in 1986 and Japan in 2011) and only one Level 6 accident (Mayak, in 1957, also in the former Soviet Union). Three Level 5 accidents have also been classified—the Windscale Pile (United Kingdom, in 1957), the Three Mile Island accident in 1979, and the Goiânia accident (Brazil, in 1987, which is described in the Terrorism section of this document, within the subsection that assesses radiological attacks).

### Radiological Emergency Preparedness (REP) Program

The Radiological Emergency Preparedness Program is responsible for the development and implementation of Michigan's Nuclear Facilities Emergency Management Plan, and for the nuclear accident aspects of the Michigan Emergency Management Plan, including the Department of Environmental Quality’s radiological responsibilities to respond to accidents or emergencies at any of Michigan's commercial nuclear power plants. These efforts are conducted in cooperation with other state agencies and under the overall emergency response coordination responsibilities of the Michigan Department of State Police. Program staff also interacts with nuclear plant utility staff, and personnel from the U.S. Nuclear Regulatory Commission, concerning the day-to-day operations of nuclear power reactors to ensure radiological protection for the public and the environment.

### Potassium Iodide (KI) Distribution

The possibility that radiation could be released into the environment during a radiation emergency, such as a nuclear reactor accident, has been a concern for years. The major concern with exposure to whole-body radiation or to heat and debris from a radioactive explosion is massive tissue damage and death from the explosion. Radiation-related thyroid cancer is another possible effect of exposure if radioactive iodine (radioiodine) is released by the accident. It can take 10 years or more after exposure for the thyroid cancer to develop, but it may then require surgery or chemotherapy. Taking potassium iodide (KI) pills in the immediate aftermath of radioiodine exposure can reduce the risk of subsequent thyroid cancer. The pills protect the thyroid from radiation poisoning for 24 hours, which is usually enough time to evacuate to safety. Though the pills won't protect against the other harmful effects of radiation exposure, they are so effective at preventing thyroid cancer caused by this type of radiation that many people and organizations have begun purchasing and stockpiling supplies of this over-the-counter tablet as a precautionary step. The federal government has asked states to consider the distribution of

potassium iodide pills to people who live within 10 miles of nuclear plants, as a precaution against a severe nuclear accident. About 220,000 people in Michigan live within 10 miles of the state's three nuclear power plants. People living or working within 10 miles of any of the three nuclear power plants are able to receive a voucher for a 20-pill pack of potassium iodide (KI pills) at nearby pharmacies, free of charge.

***Hazard Mitigation Alternatives for Nuclear Power Plant Emergencies***

- Arrangements for designated shelters and accident warning systems.
- Increased coverage and use of NOAA Weather Radio (which can provide notification to the community during any period of emergency, including plant accidents).

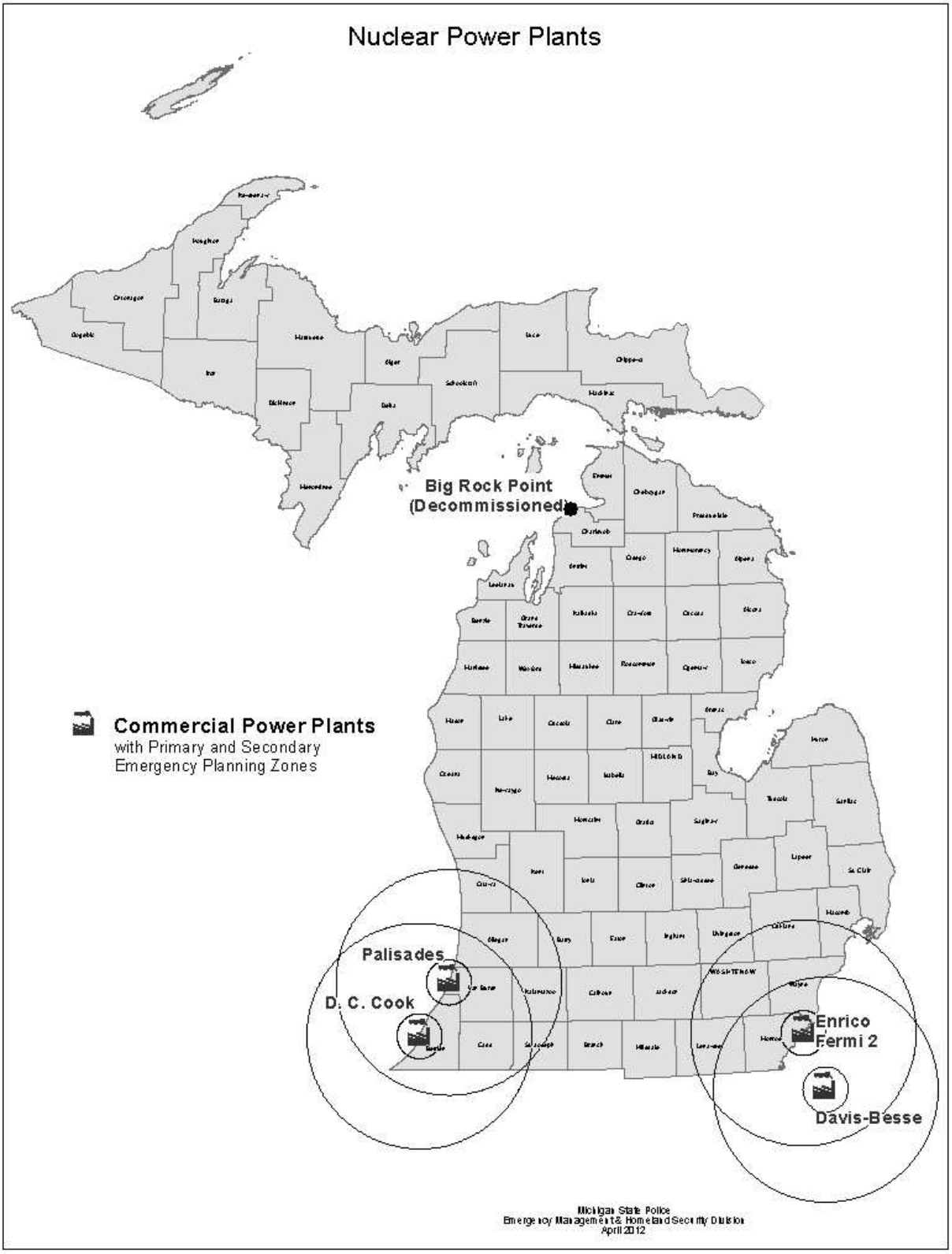
***Tie-in with Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that nuclear plant emergencies were identified as one of the most significant hazards in the local hazard mitigation plan for Cass County.

**Nuclear Power Plants in Michigan**



# HAZARDOUS MATERIAL INCIDENTS: TRANSPORTATION

*An uncontrolled release of hazardous materials during transport, capable of posing a risk to life, health, safety, property, or the environment.*

***Hazard Description***

As a result of the extensive use of chemicals in our society, all modes of transportation – highway, rail, air, marine, and pipeline – are carrying thousands of hazardous materials shipments on a daily basis through local communities. A transportation accident involving any one of those hazardous material shipments could cause a local emergency affecting many people.

***Hazard Analysis***

Michigan has had numerous hazardous material transportation incidents that affected the immediate vicinity of an accident site or a small portion of the surrounding community. Those types of incidents, while problematic for the affected community, are fairly commonplace. They are effectively dealt with by local and state emergency responders and hazardous material response teams. Larger incidents, however, pose a whole new set of problems and concerns for the affected community. Large-scale or serious hazardous material transportation incidents that involve a widespread release of harmful material (or have the potential for such a release) can adversely impact the life safety and/or health and well-being of those in the area surrounding the accident site, as well as those who come in contact with the spill or airborne plume. In addition, damage to property and the environment can be severe as well. Statistics show that almost all hazardous material transportation incidents are the result of an accident or other human error. Rarely are they caused simply by mechanical failure of the carrying vessel.

Being surrounded by the Great Lakes, one of the most dangerous hazardous material transportation accident scenarios that could occur in Michigan would be a spill or release of oil, petroleum or other harmful materials into one of the lakes from a marine cargo vessel. Such an incident, if it involved a large quantity of material, could cause environmental contamination of unprecedented proportions. Fortunately, the Great Lakes states, working in partnership with oil and petroleum companies and other private industry, have taken significant steps to ensure that a spill of significant magnitude is not likely to occur on the Great Lakes. (See the Programs and Initiatives section for more information.)

(Note: Pipeline transportation accident issues are addressed in the Petroleum and Natural Gas Pipeline Accidents section of this document. Refer to that section for specific information on that hazard. For an assessment of the various types of potential impacts from this hazard, please refer to the introductory section on hazardous materials, preceding the section on fixed site hazardous materials, earlier in this document.)

The maps at the end of this section illustrate the major railroads, highways, and Great Lakes ports in the State of Michigan. These transportation links and nodes have the greatest probability of experiencing a hazardous material transportation incident. Although the greatest risk involving hazardous materials comes from highway and rail shipments, a petroleum or chemical spill on the Great Lakes could have disastrous consequences for shoreline communities, recreational areas, tourism, and the environment. Fortunately, only about 3% of all shipments on the Great Lakes involve petroleum or chemicals, and most of those are through the Port of Detroit.

**Significant Hazardous Material Transportation Incidents**

Michigan has been fortunate not to have a large-scale, serious hazardous material transportation incident. However, Michigan has had numerous smaller-scale hazardous material transportation incidents that required a response by local fire departments and hazardous material teams, and many events also required evacuations and other protective actions. As a major manufacturer, user, and transporter of hazardous materials, Michigan will always be vulnerable to the threat of a serious hazardous material transportation incident.

From 1994 through 1998, local fire chiefs in Michigan reported a total of 730 hazardous material incidents on the Michigan Fire Incident Reporting System (MFIRS). Of those 730 reported incidents, approximately 25-30% (about 200 incidents) involved some form of motorized vehicle transportation. That figure represents an average of one reportable hazardous material transportation incident statewide approximately every 9.1 days. (Note: 1998 is the last year for which statewide hazardous material incident response statistics are available.)

A reportable hazardous material incident is one in which all three of the following conditions apply: 1) a material is present that is suspected to be something other than ordinary combustible by-product material; 2) the material is in such a state, quantity or circumstance that, if left unattended, it is presumed to pose a threat to life, health, property or the environment; and 3) special hazardous material resources were dispatched or used, or should have been dispatched or used, for assessing, mitigating or managing the situation.

***Selected Significant Hazardous Material Transportation Incidents in Michigan since 1978***

February 4, 1978 Woodland Park (Newaygo County)
A freight train derailment caused a chemical spill of ethylene oxide, carbolic acid, methylene chloride, and phropheline oxide. A total of 50 persons were evacuated from the vicinity of the accident scene.

July 31, 1978 Milan (Monroe County)
A fuel tanker accidentally pumped 1,000 gallons of gasoline into Milan's sewer system, resulting in an explosion. A total of 1,500 persons were evacuated from a 50 square block area until the system could be adequately flushed out to prevent the threat of additional explosions.

August 27, 1978 Farmington Hills (Oakland County)
A commercial van containing radioactive material (iridium 192) was involved in an accident. The van caught on fire, prompting fears of a serious radiological incident. Traffic was re-routed around the accident site until it was determined that no leakage of radioactive material had occurred.

January 11, 1979 Frankenmuth Twp. (Tuscola County)
A freight train derailment involving liquid petroleum gas forced the evacuation of 75 persons in the vicinity of the accident site.

June 22, 1979 Newaygo (Newaygo County)
A freight train derailment caused a chlorine leak that eventually sealed itself. A total of 300 persons were evacuated as a precautionary measure.

November 12, 1979 Holland Twp. (Ottawa County)
A freight train derailed, causing a spill of hydrogen fluoride. The accident prompted the evacuation of 1,500 persons.

February 18, 1981 River Rouge (Wayne County)
A freight train derailed, carrying 56,000 gallons of liquid propane gas, and resulted in a precautionary evacuation of over 6,000 persons. Fortunately, a serious spill was averted.

February 27, 1981 Dayton Twp. (Tuscola County)
A freight train derailed, spilling hydrochloric acid, liquid petroleum gas, isobutane, and butylene. The derailment prompted the evacuation of 60 persons living in the vicinity of the accident site.

August 7, 1981 Bridgman (Berrien County)
A freight train derailment resulted in a spill of fluourosulfonic acid, which formed a vapor cloud that forced the evacuation of 1,000 persons. A State Police trooper died as a result of breathing the toxic fumes.

March 15, 1982 Fruitport Twp. (Muskegon County)
A freight train derailment caused a spill of chlorine and caustic acid, forcing 600 persons to evacuate the accident vicinity.

April 11, 1982 St. Joseph (Berrien County)
A freight train derailed near St. Joseph, causing a spill of ethylene benzoil and benzine. The accident prompted the evacuation of 500 nearby residents until the spill could be contained and cleaned up.

December 28, 1982 Chesterfield Twp. (Macomb County)
A tanker truck began leaking nitric acid, which resulted in 12 injuries from product exposure and forced the evacuation of 1,200 persons in the surrounding area, due to the toxic fumes.

February 1, 1983 Coopersville (Ottawa County)
A gasoline tanker truck rolled over on I-96 near Coopersville, resulting in a spill of 9,000 gallons of gasoline. The gasoline then caught on fire, forcing the closure of I-96 for several hours until the fire could be suppressed and the site cleaned up and restored.

October 12, 1983 Fraser (Macomb County)
A tanker truck overturned, spilling 5,000 gallons of methyl amyl ketone. The spill forced the evacuation of 600 persons, and M-97 and 14 Mile Road were closed until the spill could be cleaned up and the site restored.

October 12, 1984 Thompson Twp. (Schoolcraft County)
A gasoline tanker truck swerved to avoid hitting a school bus and rolled over, spilling approximately 7,000 gallons of gasoline and 1,000 gallons of diesel fuel. The accident prompted the evacuation of 30 persons until the spill could be cleaned up and the site restored.

April 25, 1989 Highland Twp. (Oakland County)
A freight train thought to be carrying hazardous materials derailed, prompting the evacuation of residents within one half mile of the accident site (including a high school). It was later determined that the tank cars were not filled and only material substance residue was present in the cars. However, emergency workers at the scene felt the remaining residue posed a danger to the community. The accident site was cleaned up and the evacuees were allowed to return later that day.

### July 22, 1989 Tittabawassee Twp. (Saginaw County)

A freight train carrying a variety of hazardous materials derailed near Freeland, causing two rail cars to catch on fire and forcing a weeklong evacuation of over 1,000 residents. One home near the accident site was destroyed by the fire. After the fire was extinguished one week later, the site was cleared and the contaminated soil surrounding the site was excavated and transported to a hazardous waste landfill. After all hazardous conditions and health concerns were alleviated, the evacuation was lifted and evacuees were allowed to return to their homes.

### July 29, 1989 Otsego/Bailey Twps. (Otsego County)

A semi-trailer carrying acetic acid, potassium hydroxide and ammonium thiocyanate rolled over on I-75, just south of Gaylord. The accident caused the evacuation of approximately 150 people from nearby homes and businesses. Traffic on I-75 had to be rerouted for the duration of the 12-hour event. No injuries were reported.

### January 12, 1990 Buena Vista Twp. (Saginaw County)

A semi-tanker carrying 5,000 gallons of gasoline and 5,000 gallons of diesel fuel overturned due to icy roads and high winds. Approximately 2,500 gallons of diesel fuel spilled into the drain system and traveled an estimated ¾ mile before it could be diked and removed by an environmental cleanup contractor. The spill prompted the evacuation of approximately 520 persons in a half-mile radius. The evacuated area was re-opened 12 hours later, after the cleanup was completed.

### March 12, 1990 Dearborn and Detroit (Wayne County)

A leak of the chemical copper chloride from a delivery truck prompted the evacuation of several homes and businesses on the Dearborn-Detroit border. No injuries were sustained in the incident, but the roadway was closed for several hours while cleanup operations were completed. Copper chloride is a corrosive that is hazardous to touch, and the fumes can cause respiratory problems.

### September 16, 1990 Bay City (Bay County)

The tanker vessel Jupiter exploded and caught fire while moored in Bay City's harbor. The vessel was carrying approximately two million gallons of unleaded gasoline. The fire burned for several days. After the fire was extinguished, the remaining petroleum product had to be pumped out of the cargo hold–a difficult and risky task–and sent to a treatment facility. This incident created a concern for the safety of the residents in the vicinity of the fire, for response personnel who had to extinguish a shipboard fire, and for the river environment. In addition, river commerce was disrupted for an extended period of time because of the incident. A Governor's Emergency Declaration was granted to provide supplemental state assistance in the containment and suppression of the fire, and the required environmental monitoring during the transfer of the remaining gasoline to another tanker vessel.

### March 24, 1993 Sylvan Twp. (Washtenaw County)

A semi truck carrying DCT acid drove off of I-94, one mile west of M-52, and struck a tree. The collision caused approximately 220 gallons of the material to leak from the vehicle onto an area on and near the roadway. Two police officers and two motorists were injured due to exposure to the product, and all were hospitalized for a brief time. Interstate 94 was closed for several hours to avoid any further exposure to the chemical.

### November 16, 1994 Morrice & Perry (Shiawassee County)

A fire aboard a freight train carrying sodium isopropyl xanthate prompted an evacuation of residents in the immediate vicinity of the railroad tracks, on the outskirts of Morrice. The fire burned for approximately 10 hours before it was completely extinguished and area residents were allowed to return to their homes.

### April 5, 1995 Detroit (Wayne County)

A tractor trailer transporting 8,500 gallons of gasoline overturned on a ramp at I-94 and I-75. The driver was killed in the crash and ensuing fire. A one-half mile area around the crash scene was evacuated, due to the risk of explosion from seeping gas that washed down into the sewer.

### June 4, 1999 Whitehall (Muskegon County)

At a tannery, a tanker truck driver unloaded (unknowingly) a shipment of sodium hydrosulfide solution into a storage tank normally used exclusively for ferrous sulfate solution, creating a chemical reaction that produced hydrogen sulfide – a poisonous gas. The truck driver was pronounced dead at the scene after having been overcome by the hydrogen sulfide gas. An employee of the tannery was rendered unconscious by the gas, but regained consciousness in time to avoid lasting, serious injury. Eleven employees at the tannery were evacuated. Total property damage was in excess of $411,000.

### August 29, 1999 Birmingham and Bloomfield Twp. (Oakland County)

More than 40 cars of a 98-car freight train carrying automobiles and some hazardous materials (yellow phosphorous) derailed in Birmingham and Bloomfield Township, causing two rail cars to catch on fire and forcing police and fire officials to warn nearby residents and motorists to stay indoors and keep their windows closed, due to possible toxic fumes. None of the cars containing hazardous materials derailed. Some local roads were closed for several hours. The derailment caused an estimated $6 million in damage.

### September 7, 1999 Ecorse (Wayne County)

A four-car freight train derailment that included a tanker car carrying 23,000 gallons of ethylene oxide forced an evacuation of 600 persons from nearby homes, businesses, and schools on the Ecorse-River Rouge border. The tanker car was inspected and determined not to be leaking. After several hours, the train cars were uprighted and the evacuated residents were allowed to return to the area.

### January 21, 2000 Flint (Genesee County)

A rail car with 33,000 gallons of liquid propane gas caught fire in the CSX rail yard in Flint, forcing the evacuation of 2,600 homes within a one-mile radius of the incident site. The danger of a potential explosion also shut down a section of I-475 and closed two elementary schools near the scene. An estimated 3,500 evacuees were housed in three shelters and local motels until the incident was stabilized the next day. CSX railroad and local fire officials determined that the best course of action was to separate the burning tanker from the 54 other liquid propane tanker cars, vent the tanker, and allow the remaining product to burn off.

### May 27, 2000 Detroit (Wayne County)

A semi-tanker carrying 13,000 gallons of gasoline overturned, ignited, and exploded on I-75 in downtown Detroit, killing the driver and forcing the cancellation of the city's Memorial Day parade that was to be held nearby. The parade was cancelled because officials feared that fuel entering the sewer system could ignite and launch manhole covers into the crowd. Firefighters pumped foam and water into storm drains to prevent further explosions. The stretch of I-75 involved in the accident was closed for several hours to allow for cleanup activities.

### July 14, 2001 Riverview

A pipeline attached to a fitting on the unloading line of a railroad tank car fractured and separated, causing the release of methyl mercaptan, a poisonous and flammable gas. Shortly after, the tank car ignited and sent a fireball 200 feet into the sky. Fire damage to cargo transfer hoses on an adjacent tank car

resulted in the release of chlorine, a poisonous gas that is also an oxidizer. Three plant employees were killed in the accident. About 2,000 residents were evacuated from their homes for about 10 hours.

### November 15, 2001 Springfield Twp. (Oakland County)

Two freight trains – one carrying a tanker of chloride gas – collided head on and derailed in rural Springfield Township, killing two train crewmen and critically injuring two others. The crash ignited the swampland around the accident site as three of the four locomotives derailed and caught on fire. The accident forced the evacuation of 100 homes within a half-mile radius (for several hours) and closed two nearby schools for the day. Fortunately, the tanker of chloride gas did not leak.

### May 27, 2002 Potterville

A horizontal break in a railroad track running through Potterville caused the derailment of 35 cars from a 58-car Canadian National Railroad freight train. Nine cars contained liquid propane, two of which leaked the gas. About 2,200 citizens were evacuated for up to four days. Canadian National Railroad reimbursed residents who could document losses such as missed work, spoiled food, and hotel stays.

### January 29, 2003 Flint

A truck hauling propane gas plunged from a freeway overpass and exploded on top of a set of railroad tracks, killing the driver and cutting off power to 1,100 people. Interstate 69 was closed in both directions for several hours because of this incident.

### February 24, 2003 Holland Twp. (Ottawa County)

Four tanker trucks exploded and burned at an oil company in Holland Township. The blaze injured four people who were rushed to the hospital to be treated for burns and smoke inhalation. A warehouse nearby also reportedly caught fire, but firefighters were able to extinguish the blaze within an hour.

### August 8, 2003 Pittsfield Twp (Washtenaw County)

A stretch of Interstate 94 was closed in both directions due to a chemical leak from a tractor-trailer. Formaldehyde was leaking from a tractor-trailer onto the freeway and hazardous materials officials determined that a cap on the truck was loose and fell off, or had never been placed, causing the spill. Two people were exposed to the vapor when driving through the spill, were treated at the scene, and released.

### August 27, 2003 Barry County

A tanker transporting 13,500 gallons of gasoline overturned and spilled approximately 5,900 gallons. One person was hospitalized, seven homes were evacuated, M-37 was shut down and gasoline threatened to, but did not, seep into a county drain leading to a lake.

### September 16, 2003 Detroit (Wayne County)

A collision between a car and a tanker resulted in an explosion at an I-75 overpass on Detroit's southwest side. The tanker was carrying 22,000 gallons of gasoline, and burned for several hours. The truck's driver had been pulled to safety before the explosion.

### October 6, 2003 Detroit (Wayne County)

A tanker explosion and fire killed the tanker's driver and closed nearby expressway ramps for about six months. The fire was extremely intense (estimated at 2400 degrees Fahrenheit), and gasoline leaked and burned over a stretch of about one mile, causing I-94 to be closed down in that area.

### October 21, 2003 Detroit (Wayne County)

A rollover accident involving a tractor-trailer closed a major freeway interchange. Hazardous materials crews worked to clear the westbound ramp from Interstate 94 to Interstate 75, following the crash. About 40 gallons of fuel spilled and about 40,000 pounds of coiled steel also spilled onto the freeway ramp.

### December 17, 2003 Marysville (St. Clair County)

A stretch of Interstate 94 in St. Clair County was closed after a tractor trailer carrying hazardous materials rolled over. Hazardous materials crews were called because the tractor trailer involved was hauling plastic chemicals.

### January 28, 2004 Van Buren County

A tanker truck collided with a pickup truck, spilling ethyl alcohol onto I-94. About 150 people were evacuated within a half-mile radius of the scene. One person was killed during the incident.

### March 15, 2004 Taylor (Wayne County)

A collision between a pickup and a tanker truck caused an explosion at Telegraph Road and I-75 in Taylor. Flames reached 400 feet in the air, and the driver of the pickup truck was killed. Telegraph Road was closed for several hours as the scene was investigated and cleared.

### August 13, 2004 Coloma (Berrien County)

Hazardous materials crews closed an eight-mile stretch of both lanes of Interstate 94 after two tractor-trailers collided and resulted in several loud explosions. One of the trucks was transporting Drano, which spilled onto the freeway. One of the drivers was injured in the crash and taken to a hospital.

### January 7, 2005 Detroit (Wayne County)

A collision between a jeep and tanker truck resulted in the tanker overturning on northbound I-75. The tanker spilled an estimated 5,000 gallons of flammable xylene and toluene liquid, requiring the freeway to be closed for several hours. The driver of the jeep was injured, but no evacuations were required.

### September 13, 2005 Detroit (Wayne County)

A collision between a car and tanker on I-275 caused the tanker to roll over into the median. Hazardous materials crews responded, due to leaking chemicals that are used in asphalt manufacture. The driver of the car was killed, and the driver of the tanker suffered minor injuries. Lane closures on the freeway continued through the afternoon rush hour.

### July 7, 2006 Tustin (Osceola County)

A semi truck overturned on US-131 in an accident involving ethanol fuel near Tustin in Osceola County. Both lanes of the highway were shut down. Over 2,000 gallons of fuel contaminated the soil, resulting in about 10,000 gallons of sludge being removed by the hazardous materials teams.

### December 14, 2007 Fraser (Macomb County)

A sulfuric acid spill of 550 gallons from a vacuum truck shut down an intersection during rush-hour traffic in Fraser. Some of the chemical leaked into a nearby field and may have gotten into a sewer drain. Several businesses in the area were evacuated.

### August 28, 2007 Wixom (Oakland County)

Approximately 5,000 to 10,000 gallons of nitric acid leaked when the driver was forced to stop quickly, due to a traffic jam. Two buildings were evacuated during the clean-up process.

January 10, 2008 Detroit (Wayne County)

A liquid propane tanker hauling approximately 7,200 gallons of butane plunged through an overpass guardrail. The resulting explosion damaged a section of northbound Interstate 75, set nearby homes on fire, melted a school playground, and killed the driver. One home was completely destroyed, and many others were damaged. Two northbound lanes of I-75 were closed for several weeks, due to severe structural damage to the concrete overpass pillars.

January 31, 2009 Dearborn (Wayne County)

A hazardous materials situation occurred when a tanker truck slid on ice (created by a broken water main) and overturned in Dearborn. Fuel was spilled on the roadway and ran off into storm drains. Crews sprayed the fuel on the road with foam and took several hours to pump fuel out of the drains. About 100 homes were evacuated.

July 15, 2009 Hazel Park (Wayne County)

A collision between a car and a gasoline tanker on I-75 caused an explosion. The gasoline tanker contained 13,000 gallons of fuel, and the explosion caused the Nine Mile Road overpass to collapse, crushing a passing tractor-trailer. The drivers of the three involved vehicles each suffered minor injuries. Thick smoke and flames shot up 150 to 200 feet in the air, melting the overpass structure. Investigators said that the temperatures reached 2300 degrees. MDOT spent 5 months clearing debris, replacing the bridge, and replacing stretches of concrete that had been compromised as a result of extreme heat. The total cost for the repairs was about $12 million.

May 19, 2010 Brighton (Livingston County)

A semi trailer truck carrying a load of hazardous material overturned on Interstate 96, near Brighton, and closed all lanes of traffic around the accident site, leading to significant traffic delays for hours. The 18-wheeler was traveling eastbound and carrying 70 barrels of Monolube 3400, a potentially hazardous lubricant used in tire manufacturing. Monolube 3400, if shaken in unventilated containers, could produce hydrogen gas that could explode. The truck driver had a collision with a passenger car, and the impact of the rollover truck accident spilled several of the barrels of the Monolube 3400 out onto the roadway. The truck driver was sent to the hospital with injuries, and a hazardous materials team was called to handle the clean up at the scene.

July 3, 2010 Flint (Genesee County)

A semi-tanker and a motorcycle collided on southbound I-475 and the tanker exploded shortly afterwards. The heat from the explosion was so intense that it melted construction barrels and damaged the concrete. The tanker explosion sent a huge fireball into the sky and flames could be seen for miles. The man riding the motorcycle was killed, but the truck driver survived the explosion. Both sides of the expressway were shut down as hazardous materials teams were called to deal with the toxic spill.

July 14, 2010 Romulus (Wayne County)

A vehicle exiting I-275 North at westbound Interstate 94 clipped a semi truck, causing the semi to lose control and roll on its side. The truck was hauling several different chemicals that are used to make detergent, but one of the chemicals leaking was hydrogen peroxide. Many frustrated motorists experienced long waits in traffic, because of delays in transferring the remaining materials to another vehicle. High heat and humidity were also a challenge for the two hazardous materials teams, but there were only minor injuries.

February 1, 2012 – Blackman Township (Jackson County)

An Amtrak train collided with a semi truck, resulting in spilled acid and diesel fuel, as well as the derailment of the train. Ten persons were injured.

July 19, 2012 Lake Huron (2 miles southeast of Lakeport, St. Clair County)

A dredge sank in about 22 feet of choppy water around 4:35 am on July 19, 2012, spilling diesel fuel that caused airborne odors and shut down about a dozen beaches in St. Clair County. Officials organized a shoreline monitoring system, and reported that the sheen of fuel stretched across an area 1 mile wide and 2 miles long. Although the odor was unpleasant enough to encourage people to stay indoors with their windows and doors shut, the fumes were not sufficient to cause serious health concerns. No one reported any illnesses from these fumes, and the spill did not have any known effects upon downstream water plants. About 800 feet of absorbent boom were used to collect the fuel, with an additional 1200 feet of boom made available as a backup in case it might be needed for shoreline protection. Although the dredge had between 1500 and 2000 gallons of fuel on board, it wasn't known how much went into the lake. The limited amount of fuel that reached the shore had mostly dissipated by the next day.

June 11, 2013 Alanson (Emmet County)

A tanker truck accident took place on US-31 south of M-68, causing about 12,000 gallons of cooking oil to spill out. The oil traveled through drains into the Crooked River, requiring extensive efforts to clean up.

January 2, 2014 Davison Township (Genesee County)

A truck crash and explosion caused I-69 to be closed down for much of the day, area citizens within a 1-mile radius were advised to shelter-in-place, and an evacuation of some nearby homes and businesses also took place. About 12,000 gallons of oil had been transported by the crashed truck, which went over a guard rail, crashed into Irish Road, and exploded. The bridge there was damaged, and the driver of the truck had some minor injuries.

### *Programs and Initiatives*

Note: Many of the programs and initiatives designed to mitigate, prepare for, respond to, and recover from fixed-site hazardous material incidents have the dual purpose of also protecting against hazardous material transportation incidents. As a result, there is some overlap in the narrative programs and initiatives descriptions for each respective hazard. This redundancy allows each hazard section to stand alone, eliminating the need to refer to other hazard sections for basic information.

<u>Federal Hazardous Material Transportation Regulations</u>

The transportation, manufacturing, storage, and disposal processes for hazardous materials are highly regulated by federal and state agencies in order to reduce risk to the general public. At the federal level, the U.S. Department of Transportation, Office of Hazardous Materials Safety (USDOT/OHMS), is the regulating agency for all modes of hazardous material transportation. In addition to enforcing federal hazardous material transportation

regulations, the USDOT/OHMS is also involved in a number of other areas aimed at improving the safety of hazardous material shipping. Those areas include: 1) the research and development of improved containment/packaging and other technological aspects of hazardous material shipping; 2) interagency coordination efforts in hazardous material transportation planning and standards setting; 3) management of data information systems pertaining to hazardous material transportation; and 4) development of hazardous material safety training policies and programs. The USDOT regulations specify the type and size of container that can be utilized for shipping each hazardous material, the label that must be on the container, the placards that must be shown on the carrying vessel, how much of the material can be shipped in one vessel, and in some cases how the contents should be organized or loaded. Many hazardous materials are assigned a unique four-digit identification number that is located on the placard or container. In addition, the regulations also require a company involved with hazardous material transport to maintain a manifest that details what material is being transported, its quantity, a list of emergency contact numbers in case of an uncontrolled release, where the material is from, and its intended destination. In Michigan, the Motor Carrier Division of the Department of State Police oversees, coordinates, and implements the commercial truck safety aspects of the USDOT regulations. The Michigan Department of Transportation oversees programs aimed at enhancing railroad safety and improving the rail infrastructure (which helps reduce the likelihood of a hazardous material rail transportation accident).

### Hazardous Materials Transportation Uniform Safety Act

The federal Hazardous Materials Transportation Uniform Safety Act (HMTUSA), enacted in 1990, provides funding for the training of emergency responders and the development of emergency response plans for both fixed site facilities and transportation-related incidents. (This funding mechanism under the HMTUSA is referred to as Hazardous Material Emergency Preparedness [HMEP] grants.) In Michigan, the HMTUSA/HMEP program is coordinated and implemented by the Emergency Management and Homeland Security Division, Department of State Police. Since the program's inception, over $3 million in grants have been allocated to 80 Michigan communities for hazardous material planning and training activities.

### Transportation Community Awareness and Emergency Response

Many industry groups are involved in an outreach program, coordinated by the Chemical Manufacturers Association, called Transportation Community Awareness and Emergency Response (TRANSCAER). This program is a nationwide community outreach program that addresses community concerns about the transportation of hazardous materials, through planning and cooperation. The program provides assistance to communities to develop and evaluate their emergency response plan for hazardous material transportation incidents. In Michigan, TRANSCAER activities and initiatives are coordinated by the Michigan Chemical Council.

### Hazardous Material Response Training

The Emergency Management and Homeland Security Division, Department of State Police, provides a wide array of hazardous material response training programs through the Michigan Hazardous Material Training Center. The Center provides training courses for individuals and companies responsible for planning, inspection, response, mitigation, and cleanup activities involving hazardous materials. Specific subjects include: 1) computer-aided management; 2) hazardous material chemistry; 3) hazardous materials emergency response; 4) hazardous waste worker compliance; 5) incident management; 6) hazardous materials monitoring/sampling; and 7) other specialized hazardous materials-related courses such as highway and rail cargo tanker handling, confined space entry, emergency medical services, and technical rescue. Courses are conducted at the Center in Lansing and at various other locations throughout the state.

### Federal/State Hazardous Material Response Resources

There are numerous groups at the federal, state, and local levels, and in private industry, that are trained to deal with hazardous material fixed-site and transportation incidents. These groups include the National Response Team (NRT), Regional Response Teams (RRTs), and state and local hazardous material response teams. The Chemical Manufacturers Association established the Chemical Transportation Emergency Center (CHEMTREC) to provide 24-hour technical advice to emergency responders. The National Response Center (NRC), which

operates much like CHEMTREC, was established to provide technical advice and coordinate the federal response to a hazardous material incident. In Michigan, a 24-hour statewide notification system called the Pollution Emergency Alerting System (PEAS) was established for reporting chemical spills to the Department of Environmental Quality. As a companion to the PEAS, the Michigan Department of Agriculture and Rural Development (MDARD) has established a 24-hour Agriculture Pollution Emergency Hotline for use by agri-chemical users to report fertilizer and pesticide spills. Callers to the MDARD hotline gain immediate access to appropriate technical assistance, regulatory guidance for remediation, and common sense approaches for addressing the problem.

U.S. EPA Chemical Emergency Preparedness and Prevention Office

The U.S. Environmental Protection Agency's Chemical Emergency Preparedness and Prevention Office (CEPPO) provides leadership, advocacy and assistance to states, local governments, and private industry to: 1) prevent and prepare for chemical emergencies; 2) respond to environmental crises; and 3) inform the public about chemical hazards that may be present in their community. The CEPPO works closely with several Michigan state agencies to implement and coordinate a number of regulatory and non-regulatory programs designed to protect human health and the environment in Michigan from chemical accidents—including the SARA Title III program.

National Transportation Safety Board

The National Transportation Safety Board (NTSB) investigates all significant transportation accidents that occur nationwide and issues safety recommendations (to the transporter and to government regulators) aimed at preventing future accidents. To date, five hazardous material transportation accidents in Michigan—the November 15, 2001 freight train accident in Springfield Township, the June 4, 1999 cargo transfer accident in Whitehall, the September 16, 1990 Jupiter tanker fire in Bay City, the July 22, 1989 train derailment in Freeland, and the August 2, 1975 propane pipeline accident in Romulus—have resulted in an NTSB investigation. The NTSB also publishes a list of "most wanted" safety improvements for all modes of transportation, for nationwide implementation by appropriate entities. Although these safety improvement recommendations are not mandatory, and the NTSB has no regulatory or enforcement powers, it nonetheless has been successful in getting more than 80% of its recommendations adopted. Many safety features currently incorporated into the various hazardous material transportation vessels had their genesis in NTSB recommendations. The NTSB works directly with the USDOT on most hazardous material transportation accident issues.

Michigan Chemical Council

The Michigan Chemical Council is the primary trade association representing the chemical and allied industries in Michigan. As such, it works in partnership with the national Chemical Manufacturers Association, the Emergency Management and Homeland Security Division, Department of State Police, and other agencies and local governments to provide educational and community outreach services in the area of chemical awareness and safety. The Council provides an important informational and coordination bridge between Michigan's chemical industry, federal, state and local regulatory agencies, and the public.

Chemical Safety Board (CSB)

The CSB (www.csb.gov) is an independent federal agency charged with investigating industrial chemical accidents. Headquartered in Washington, DC, the agency's board members are appointed by the President and confirmed by the Senate. The CSB conducts root cause investigations of chemical accidents at fixed industrial facilities. Root causes are usually deficiencies in safety management systems, but could be any factor connected with causing or preventing the accident. Accident causes often involve equipment failures, human errors, unforeseen chemical reactions, or other problems. The agency does not issue fines or citations, but does make recommendations to plants, regulatory agencies such as the Occupational Safety and Health Administration (OSHA) and the Environmental Protection Agency (EPA), industry organizations, and labor groups. Congress designed the CSB to be non-regulatory and independent of other agencies so that its investigations might, where appropriate, review the effectiveness of regulations and regulatory enforcement.

Chemical Awareness Week

Each spring, the Emergency Management and Homeland Security Division, Department of State Police, in conjunction with several other state agencies, Local Emergency Planning Committees (LEPCs), and the Michigan Chemical Council, sponsors Chemical Awareness Week. This annual public information campaign focuses on: 1) the hazards associated with the manufacture, transport, storage, use and disposal of chemicals; 2) the programs and systems in place to protect the public from accidental chemical releases; and 3) community emergency response procedures for chemical accidents. Informational materials on chemical hazards and safety are disseminated to schools, hospitals, nursing homes, other interested community groups and facilities, and the general public.

Final Rule on Reflectorization of Rail Freight Rolling Stock

The Final Rule requires railroads and other companies owning rail cars to install yellow or white reflective materials on locomotives over a five-year timeframe and on freight trail cars over a 10-year period. The reflective materials will be installed on all newly constructed locomotives and freight rail cars, and on existing ones, during periodic maintenance repair, unless alternate implementation plans have been developed that meet the deadlines. Nearly one quarter of all highway-rail at-grade crossing collisions involve motor vehicles running into trains occupying crossings. This new rule is the most recent effort by the Federal Railroad Administration (FRA) to increase the visibility of trains at highway-rail at-grade crossings.

***Hazard Mitigation Alternatives for Hazardous Material Transportation Incidents***

- Improved design, routing, and traffic control at problem roadway areas.
- Long-term planning that provides more connector roads for reduced congestion of arterial roads.
- Railroad inspections, maintenance and improved designs at problem railway/roadway intersections (at grade crossings, rural signs/signals for RR crossing).
- Proper planning, design, maintenance of, and enhancements to designated truck routes.
- Public warning systems and networks.
- Increased coverage and use of NOAA Weather Radio (which can provide notification to the community during any period of emergency, including large scale hazardous material incidents).
- Use of ITS (intelligent transportation systems) technology.
- Locating schools, nursing homes, and other special facilities away from major hazardous material transportation routes.

***Tie-in with Local Hazard Mitigation Planning***

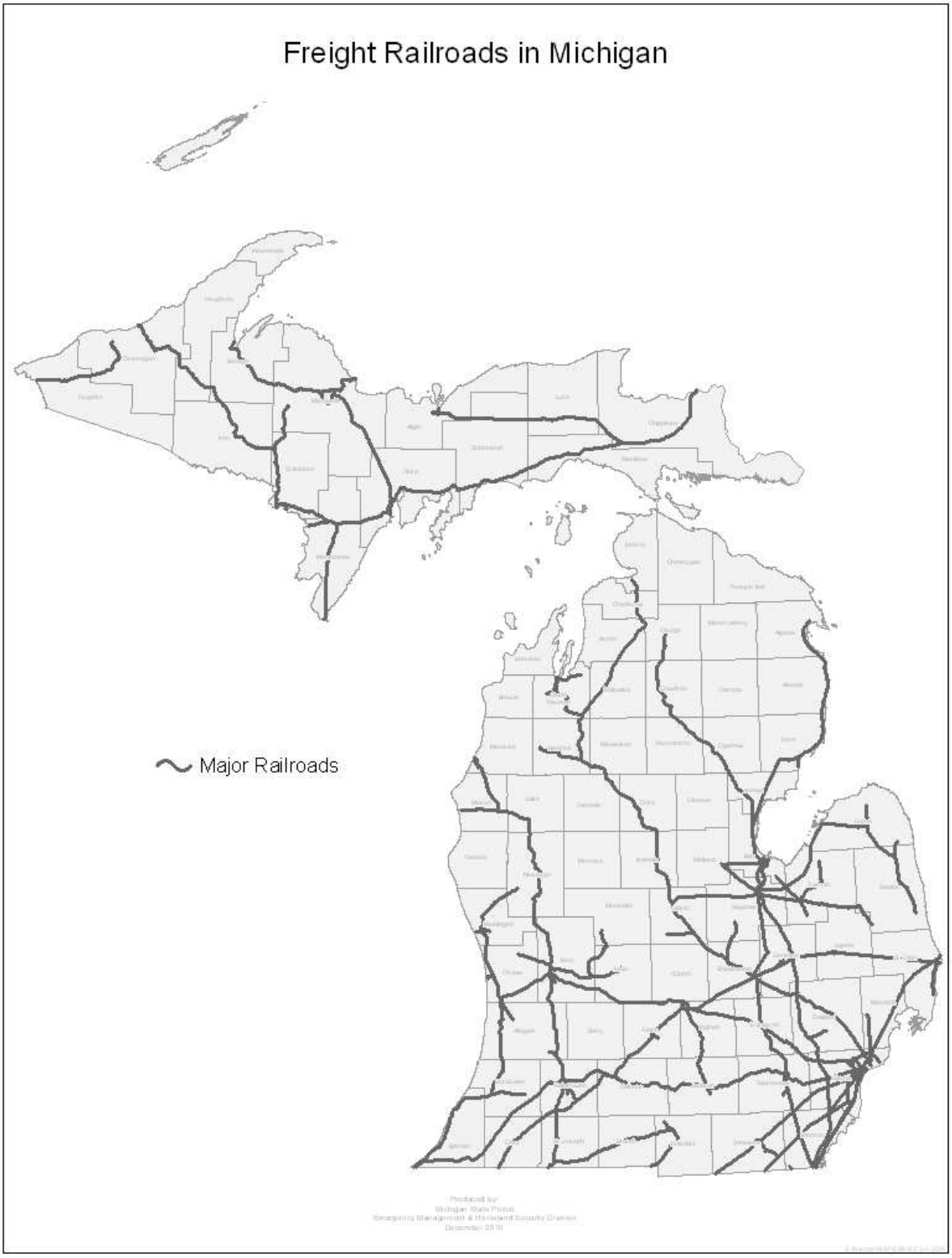
Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that hazardous materials transportation incidents were identified as one of the most significant hazards in local hazard mitigation plans for the following counties: Cass, Saginaw, St. Clair, Schoolcraft, and Tuscola.

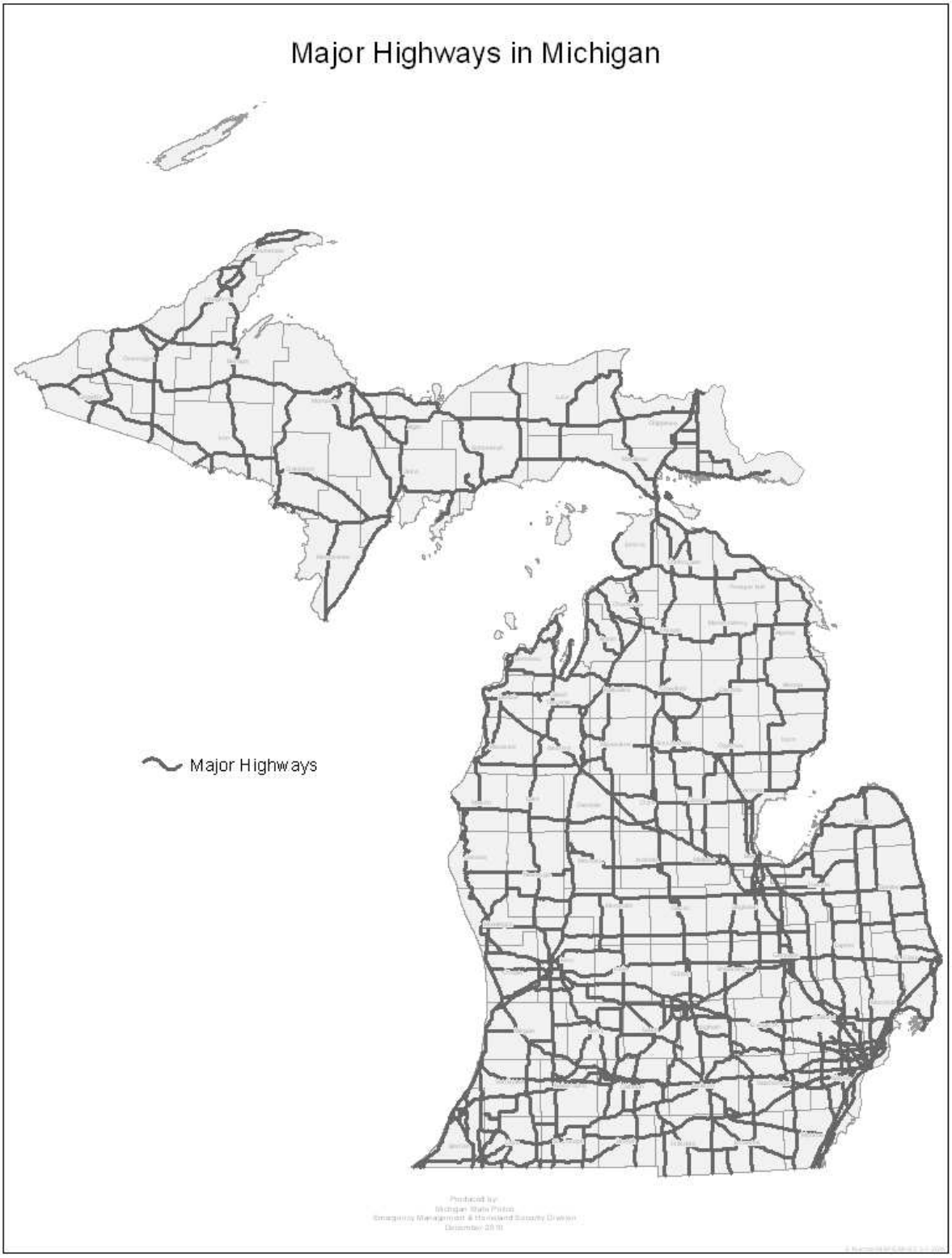
## Freight Railroads in Michigan

Source: Michigan Department of Transportation



## Major Highways in Michigan

Source: Michigan Department of Transportation



## Great Lakes Commercial Ports in Michigan

Source: Michigan Department of Transportation

# PETROLEUM AND NATURAL GAS PIPELINE ACCIDENTS

*An uncontrolled release of petroleum or natural gas, or the poisonous by-product hydrogen sulfide, from a pipeline*

***Hazard Description***

Though often overlooked, petroleum and natural gas pipelines pose a real threat in many Michigan communities. Petroleum and natural gas pipelines can leak or fracture and cause property damage, environmental contamination, injuries, and even loss of life. The vast majority of pipeline accidents that occur in Michigan are caused by third party damage to the pipeline, often due to construction or some other activity that involves trenching or digging operations. Many structures are located right next to pipelines and thus may be at risk. Pipelines can also cross through rivers, streams, and wetlands, thus posing the possibility of extensive environmental damage in the event of a major failure.

Michigan is both a major consumer and producer of natural gas and petroleum products. According to the federal Energy Information Administration, Michigan's consumption of petroleum products, particularly liquefied petroleum gases (LPG) is high; Michigan is the largest residential LPG market in the nation, due mostly to high residential and commercial propane consumption. The state has a single petroleum refinery but a large network of product pipelines. More than 78% of the overall home heating market uses natural gas as its primary fuel. With over one-tenth of U.S. capacity, Michigan has the greatest underground natural gas storage capacity in the nation and supplies natural gas to neighboring states during high-demand winter months. Driven largely by the residential sector, Michigan's natural gas consumption is high. Nearly four-fifths of Michigan households use natural gas as their primary energy source for home heating.

The State Energy Data System (SEDS) released data in August 2009 that describes energy consumption by source and total consumption per capita. Michigan ranks 13th in the nation in production of natural gas, with 264.9 billion cubic feet, and 7th in consumption, at 847.8 billion cubic feet. These figures underscore the fact that vast quantities of petroleum and natural gas are extracted from, transported through, and stored in the state, making many areas vulnerable to petroleum and natural gas emergencies. Michigan's gas and petroleum networks are highly developed and extensive, representing every sector of the two industries—from wells and production facilities, to cross-country transmission pipelines that bring the products to market, to storage facilities, and finally to local distribution systems.

While it is true that the petroleum and natural gas industries have historically had a fine safety record, and that pipelines are by far the safest form of transportation for these products, the threat of fires, explosions, ruptures, and spills nevertheless exists. In addition to these hazards, there is the danger of hydrogen sulfide ($H_2S$) release. These dangers (fully explained in the Oil and Natural Gas Well Accidents section) can be found around oil and gas wells, pipeline terminals, storage facilities, and transportation facilities where the gas or oil has a high sulfur content. Hydrogen sulfide is not only an extremely poisonous gas, but is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above.

In 2010, Michigan suffered what may be the largest inland oil release in the country, when a pipeline in Calhoun County failed and released large quantities of crude which ended up in the Kalamazoo River and flowed downstream for many miles. Although a description of this event appears later in this section, it must be noted here that because the recovery activities for this disaster are still ongoing, an after-action report was not yet available for use in this analysis, to efficiently relay "lessons learned" and the final results of the extensive cleanup activities.

***Hazard Analysis***

The map at the end of this section shows the location of major petroleum and natural gas pipelines within Michigan. It is apparent from the map that petroleum and natural gas pipelines crisscross the entire state, from well heads to storage sites, through distribution to consumers. Major compressor stations that receive and redistribute natural gas are located at key points along the pipelines (but are not shown on the map). These stations monitor and maintain pressure levels within the pipelines. In the event of a pipeline rupture, the compressor stations shut down to stop the flow of product. Many smaller compressor stations are located across the state to complete the distribution process to consumers.

The state's major natural gas storage facilities are located in the central part of the Lower Peninsula. Natural gas is piped into those storage facilities from Michigan wells, and from large transmission pipelines that originate in Canada, the southwestern United States, and the Gulf of Mexico area.

Petroleum pipelines carrying crude oil, fuel oil, propane, butane, gasoline, and other petroleum products have their heaviest concentrations in central Lower Michigan and between Detroit and Toledo. Many of the refineries, terminals, and storage areas are located in urban areas where the potential for extensive damage, and threat to lives and property, is greatest. The largest concentration of these facilities is found in the Detroit metropolitan area.

Petroleum and natural gas pipeline accidents are on the rise, due to the aging of the underground infrastructure (much of which was laid over 50 years ago) and an increase in construction excavation. According to studies conducted by the General Accounting Office (GAO), an average of 22 people died annually from 1988 to 1998, when the number of accidents was increasing by four percent per year. The GAO also found that the USDOT/OPS has not adequately enforced many safety regulations passed by Congress since 1988 and is instead relying more on industry self-regulation as an enforcement tool.

Increased pipeline safety regulations again came to the forefront in 2000, after deadly pipeline explosions occurred in Bellingham, Washington in June 1999 (three deaths) and Carlsbad, New Mexico in August 2000 (11 deaths). In 2004, the Pipeline and Hazardous Materials Safety Administration (PHMSA) was signed into law. The purpose of the Act was to provide a more focused research organization and establish a separate operating administration for pipeline safety and hazardous materials transportation safety operations.

The Pipeline Safety Improvement Act of 2002 mandated significant changes and new requirements in the way that the natural gas industry ensures the safety and integrity of its pipelines. The law applies to natural gas transmission pipeline companies. The law places requirements on each pipeline operator to prepare and implement an “integrity management program” that, among other things, requires operators to identify so-called “high consequence areas” (HCA) on their systems, conduct a risk analysis of these areas, perform baseline integrity assessments of each pipeline segment, and inspect the entire pipeline system. Companies were required to identify all HCAs and submit specific integrity management programs to the Office of Pipeline Safety (OPS), the Research and Special Projects Administration, and the U.S. Department of Transportation. All pipeline segments within HCAs were to be inspected and remediation plans completed by December 17, 2008, while non-HCA segments must be inspected by 2012. All segments must be re-inspected on a 7-year cycle, with certain exceptions.

Because petroleum and natural gas pipeline accidents will occur eventually, affected local communities must be prepared to respond to the accident, institute necessary protective actions, and coordinate with federal and state officials and the pipeline company emergency crews to effectively manage and recover from the accident. That can best be accomplished through the collaborative planning, training, and exercising of emergency procedures with all potentially involved parties.

Impact on the Public
Severe events may cause shortages of, and higher prices for, petroleum and other fuels. Some residents with low incomes or fixed budgets may find higher prices to be unaffordable, and may face problems involving heating and other energy needs being used to maintain their homes and health. Transportation and fuel costs may become too expensive to allow business profits to be maintained, when such businesses rely on fuel-driven transportation or functions. Those in the vicinity of the pipeline break itself may suffer from health problems, unpleasant odors, evacuations, and damage/contamination of their property. Some pipeline accidents result in explosions that cause extensive damage, injury and even loss of life. Gas leaks in particular can cause surprising amounts of damage from sudden explosions, without any advance warning to those nearby.

Impact on Public Confidence in State Governance
As with the oil and gas well hazard, there may be a sense that inadequate regulation, authorization, or oversight was maintained by the state, if there is an event of significant size or impact. The nature of the transported materials also causes concern about environmental and health impacts.

Impact on Responders
Special expertise is often needed, and the cooperation of the utility provider is often critical to an efficient and successful response. Enclosed areas may be involved in these incidents (e.g. those occurring in a densely populated urban area), and thus may require special equipment, personnel, and training in search and rescue.

Impact on the Environment
Petroleum and natural gas pipelines pose a real threat in many Michigan communities because they can lead to leaks, fractures, fires, explosions, ruptures, and spills that cause environmental contamination. The danger of hydrogen sulfide ($H_2S$) release can occur where the gas or oil has a high sulfur content. Hydrogen sulfide is not only an extremely poisonous gas, but is also explosive when mixed with air at temperatures of 500 degrees Fahrenheit or above. Atmospheric concentrations of greenhouse gases, especially carbon dioxide, methane, and nitrous oxide, can contribute to climate change, both regionally and globally. Adverse local consequences to ecological and socio-economic systems can result from a major petroleum or natural gas pipeline accident. Particulate pollutants may consist of metals, soot, or similar small substances. Soft sloping ground near waterway crossings can be susceptible to erosion or lateral spreading, which may cause significant pipe displacement or rupture.

***Significant Petroleum and Natural Gas Pipeline Accidents***
Petroleum and natural gas pipeline accidents occur with regularity, but they usually have a limited impact and are quickly and adequately handled by pipeline company emergency crews and by local and state responders. According to figures released by the U.S. Department of Transportation's Office of Pipeline Safety (USDOT/OPS), in 1998 (the latest year for which complete data are available) Michigan gas companies had to repair 9,300 leaking underground gas lines. That figure is double the 4,400 reported breaks in 1991. It is estimated that three-quarters of gas line breaks are caused by excavation damage. Many more gas line breaks go unreported, according to regulators from the Michigan Public Service Commission (MPSC). National estimates rank Michigan second only to Texas in the number of repairs to damaged or leaking natural gas pipelines.

Michigan has had numerous petroleum or natural gas pipeline accidents in recent years that resulted in injury, loss of life, or significant property damage. Since 1996, the MPSC has investigated over 100 incidents involving pipelines, and at least half of those incidents involved injury, loss of life, or significant property damage. The pipeline accidents described in this section include the worst in recent Michigan history, which required a combined emergency response effort by pipeline companies and state and local officials.

In 2003 the U.S. Department of Transportation, Research and Special Programs Administration, Office of Pipeline Safety conducted a survey of Natural gas distribution pipeline accidents per state. The state of Michigan

was third overall with 11 recent accidents, trailing only Pennsylvania and California for the highest in the nation. The weighted average for all states was only 2.8 accidents during that time period.

A ten year survey was conducted by the PHMSA of its Pipeline Safety Program Filtered Incident Files, and several other pipeline mileage data sources, to compile a report of significant and serious Michigan incidents involving pipeline accidents from 1999-2008. The results are provided in the table below:

**Michigan Pipeline Incidents (all pipeline systems, 1999-2008)**

| Year | Number | Fatalities | Injuries |
|---|---|---|---|
| 1999 | 16 | 6 | 4 |
| 2000 | 5 | 2 | 4 |
| 2001 | 5 | 0 | 3 |
| 2002 | 5 | 0 | 4 |
| 2003 | 13 | 0 | 4 |
| 2004 | 5 | 0 | 0 |
| 2005 | 7 | 0 | 2 |
| 2006 | 9 | 1 | 0 |
| 2007 | 1 | 0 | 0 |
| 2008 | 7 | 2 | 5 |
| Totals | 73 | 11 | 26 |
| 3 Year Average (2006-2008) | 6 | 1 | 2 |
| 5 Year Average (2004-2008) | 6 | 1 | 1 |
| 10 Year Average (1999-2008) | 7 | 1 | 3 |
| 20 Year Average (1989-2008) | 7 | 1 | 3 |

***Recent Significant Petroleum and Natural Gas Pipeline Accidents in Michigan***

NOTE: Natural gas leaks are also a common cause of structural fires, but only some of those incidents (residential house explosions) have been listed here, since most do not rise to the level of community-wide emergency events.

September 7, 1950 Big Rapids (Mecosta County)

A newly installed natural gas pipeline exploded near Big Rapids because of a flaw in the line. Two barns were destroyed and many windows were shaken. The ensuing fire was seen from 50 miles away.

September 26, 1952 Mt Pleasant (Isabella)

Four men were injured in a gas pipeline fire. They had been raising the eight-inch pipeline for reconditioning, when it broke.

May 16, 1967 Dearborn (Wayne County)

A pile driver ruptured a gas line near an underground storage cavern, trapping seven men in a pit with fire at Ford Motor Company's River Rouge Plant. Two of the men were killed and four more were injured. Fire fighters took two hours to bring the blaze under control, and police routed traffic away from the area.

August 2, 1975 Romulus (Wayne County)

On August 2, 1975, an 8-inch pipeline owned by the Sun Pipeline Company ruptured in Romulus. Propane escaped from the rupture, sprayed into the air, vaporized, and then ignited. Flames 500 feet high engulfed an area 600 feet in diameter. The blast created a 12-foot diameter, 7-foot deep hole in the ground. The fire injured nine persons, destroyed four houses and damaged three others, burned 12 vehicles, and consumed 2,389 barrels (100,338 gallons) of propane. The National Transportation Safety Board (NTSB) investigated this accident and determined that the probable cause was the propagation of surface cracks on the pipe, caused by abnormally high pressure within the pipeline at the leak site. The NTSB further found that inadequate inspection during construction had contributed to the accident.

February 22, 1986 Muskegon (Muskegon County)

A Muskegon County pipeline break occurred when an 8-inch high-pressure Marathon Oil pipeline ruptured, spilling thousands of gallons of gas into streams feeding Ruddiman Creek. Gas vapors also caused some minor house explosions that forced dozens of Lakeside-Glenside residents to flee. No one was injured in the incident, although the environment suffered damage.

February 23, 1989 Gratiot County

On February 23, 1989, a Michigan Consolidated Gas Company (MICHCON) underground natural gas pipeline in rural Gratiot County exploded and caught on fire, releasing a vast quantity of gas into the atmosphere. The huge fire necessitated the evacuation of several families from the immediate area. No deaths or injuries occurred. Company officials shut off valves on either side of the break and allowed the remaining gas to burn off.

### July 17, 1991 Freeland (Saginaw County)

Workers were removing a corroded segment of a Consumers Power Company's 10-inch-diameter transmission line pipeline. As a segment of the pipeline was being removed, natural gas at 360-psig pressure exerted about 12 tons of force on an adjacent closed valve (H-143), causing it and a short segment of connected pipe to move and separate from an unanchored compression coupling. The force of the escaping gas killed one worker, injured five other workers, and collapsed a steel pit that housed valve H-143. Fortunately, there was no explosion from the natural gas leak.

### May 20, 1992 Rochester (Oakland County)

On May 20, 1992, a natural gas explosion occurred in a two-story commercial building in Rochester, killing one person and injuring 17 others. Estimated property damage was nearly $1 million. The explosion occurred when the gas service line to the building was damaged during excavation of a sidewalk. The service line separated under the sidewalk and gas migrated into the building, where it was ignited by an unknown source, causing the explosion.

### February, 1996 Napoleon (Jackson County)

In February 1996, a house exploded in Napoleon, resulting in two fatalities. The cause of the explosion was a natural gas build-up.

### December 15, 1998 Galesburg (Kalamazoo County)

A natural gas leak caused an explosion in downtown Galesburg in the early morning hours of December 15, 1998, destroying two businesses and damaging a third. One person in an automobile sitting at a nearby red light was slightly injured when a Christmas tree and other debris flew through his windshield. Fortunately, the downtown area was not crowded when the explosion occurred. An eight square block area was evacuated as a precaution, in case of further explosions, but utility workers were able to shut off the gas supply to avert further damage.

### January 15, 1999 Whitmore Lake (Livingston County)

A natural gas explosion at a home on January 15, 1999 in Green Oak Township, Livingston County, killed one person, injured four others, and forced the evacuation of 17 residents. The explosion and resulting fire destroyed two homes and damaged several other homes and a business. Subsequent investigation of the incident indicated that a steel gas main in the area was dented, bent, and cracked by a third-party excavation a number of years before it failed.

### January 18, 1999 Leslie (Ingham County)

On January 18, 1999, a leaking gas main in Leslie forced the evacuation of two schools (over 1,000 students) and approximately 75 other nearby residents for several hours, until utility workers were able to cap the leak.

### March 7, 1999 Plainwell (Allegan County)

On March 7, 1999, a ruptured natural gas transmission line near Plainwell caused an explosion and fire that could be seen for 20 miles away. The explosion and fire occurred in a primarily rural area two miles southeast of Plainwell and about 10 miles north of Kalamazoo. Fortunately, there were no structures nearby, and the explosion and fire did not cause any injuries. The fire, which spread to over 400 feet wide and 100 feet high, burned for nearly two hours before utility workers were able to shut down the gas supply to the line.

### June 15, 1999 Battle Creek (Calhoun County)

A natural gas pressure surge caused fires in 24 homes in a 20 block area in Battle Creek on June 15, 1999, resulting in major damage to eight structures and injuries to two persons. The fires forced gas service to be shut off to approximately 1,500 homes for two to three days. Construction work by the natural gas utility caused the gas surge.

### June 23, 1999 Lake County

A broken gas main near the intersection of US-10 and M-37 in Pleasant Plains Township, Lake County, forced the evacuation of nearby residences (including senior and low-income housing complexes) until the main could be repaired.

### June 25, 1999 Howell (Livingston County)

On June 25, 1999, a ruptured gas main set off an explosion and fires in Howell, destroying one business, severely damaging three homes, and forcing the evacuation of more than 60 homes. Three firefighters were injured while responding to the fires. The explosion was caused by a contractor who accidentally bored through the gas main and the sewer line.

### July 24, 1999 Lake Orion (Oakland County)

On July 24, 1999, a natural gas explosion heavily damaged a house in Lake Orion, but caused no injuries or fatalities. The explosion was believed to be caused by contractors who had accidentally broken a nearby gas main.

### January 13, 2000 Madison Heights (Oakland County)

A natural gas explosion destroyed a Madison Heights home on the morning of January 13, 2000, shortly after a utility service person had visited the home to check on a report of a possible natural gas leak. The service person corrected what was believed to be the problem and then left the home. Less than three hours later, the home was completely destroyed by the blast. No one was home at the time of the explosion and no injuries were reported.

### February 11, 2000 Detroit (Wayne County)

A natural gas explosion at a Detroit home on February 11, 2000 blew out one wall and scattered bricks onto a neighboring home. No one was home at the time of the explosion and no injuries were reported.

### June 7, 2000 Jackson County

On the morning of June 7, 2000, a Wolverine Pipeline Company gasoline pipeline ruptured in Jackson County's Blackman Township, releasing 75,000 gallons of gasoline into the environment and forcing the evacuation of more than 500 homes in a one square mile area around the spill. The leak was detected when a drop in pressure was recorded at a metering station along the 80-mile pipeline that runs through Blackman Township from Joliet, Illinois to Detroit. The spill caused significant environmental and public safety problems and shut down 30% of the state's gasoline supplies for nine days. (The pipeline carries approximately seven million gallons of gasoline per day.) Most of the evacuees were allowed to return to their homes within five days of the accident. Wolverine Pipeline Company worked with affected federal, state, and local regulatory agencies to develop and implement a plan to complete the pipeline repair, cleanup and restore contaminated sites, and provide for long term environmental monitoring. Wolverine Pipeline Company expended in excess of $10 million in response to this pipeline accident.

### August 7, 2000 Canton Township (Wayne County)

A Canton Township home was destroyed in an August 7, 2000 natural gas explosion caused by a broken pipe that fed natural gas to the furnace. Two homeowners were hospitalized for injuries sustained in the blast, which also caused significant fire damage to two neighboring homes.

### August 8, 2000 Redford Township (Wayne County)

On August 8, 2000, a Redford Township couple was killed and their home destroyed by a natural gas explosion, caused by a broken connection leading to the kitchen range.

### September 7, 2000 St. Clair (St. Clair County)

On September 7, 2000, a propane explosion destroyed a house in downtown St. Clair and killed an elderly occupant and a repairman who was working on the house. A second repairman was thrown across the street by the explosion, and sustained injuries. The explosion damaged neighboring homes, but no other injuries were reported.

### October 21, 2000 Woodland Park (Newaygo County)

A propane explosion on October 21, 2000, demolished a summer home in Woodland Park and killed 4 members of a family, just minutes after they had arrived at the home for a weekend visit. Two other family members survived the blast, which may have originated in the basement of the home.

### March 18, 2001 Warren (Macomb County)

An apparent natural gas explosion destroyed a portion of a plastics factory in Warren on March 18, 2001. Fortunately, the building was empty at the time of the explosion, which collapsed the roof and blew out parts of the wall at the loading dock, causing significant damage.

### December 18, 2001 Waterford (Oakland County)

An apparent natural gas explosion destroyed a Waterford home on December 18, 2001, and injured two family members. The blast hurled one of the injured persons more than 60 feet across the street.

### December 20, 2001 Southfield (Oakland County)

A 12-inch, high-pressure natural gas main ruptured near a commercial strip in Southfield on the evening of December 20, 2001, injuring one person and forcing the evacuation of several businesses in the area. The explosion was apparently caused by a leak in the pipeline.

### March 15, 2002 Crystal Falls (Iron County)

On March 15, 2002, a pipeline break occurred in Crystal Falls, resulting in a half hour of rerouted traffic and two months of pipeline shut-down. The cost of repair was around 4 million dollars.

### August 31, 2002 Dansville (Ingham County)

An apparent natural gas explosion destroyed an apartment complex on August 31, 2002, killing a woman who was moving into the building and injuring four others. The explosion forced a nearby road to be closed for several days while debris was removed.

### September 15, 2002 Bangor Township (Van Buren County)

An apparent natural gas explosion destroyed a farm house and killed five family members. The one-story home was flattened by the blast. Small pieces of debris were scattered up to a quarter-mile away.

### November 20, 2002 Rose Township (Oakland County)

An apparent propane leak caused a house in Wayne County to explode. Houses up to 1,000 feet away were shaken as well. Amazingly, the man in the destroyed house made it out alive, with only a few cuts on his forehead.

### September 20, 2003 Detroit (Wayne County)

A natural gas explosion destroyed three houses and caused minor damage to nearly 10 others. The explosion at a vacant house resulted in fires that destroyed occupied homes on both sides of it. Residents escaped with only minor injuries. Cars parked on the street nearby were also destroyed.

### April 14, 2004 Taylor (Wayne County)

A natural gas leak caused a house in Taylor to explode, shooting debris 100 feet in all directions. Remains from the house were discovered in yards five lots away, and houses up to a mile away were shaken by the explosion.

### September 3, 2005 Caledonia Township (Shiawassee County)

Over Labor Day weekend in 2005, a Shiawassee County home exploded while relatives were gathered for a family reunion. A total of six children were killed, and three more were seriously injured from the blast. Witnesses claimed that they felt the blast up to 10 miles away. Analysis showed that there was something wrong with the copper tubing that had carried propane gas to the Copas Road home. It was reported that the copper tubing was too thin and that proper tests had not made certain that the tubing wouldn't leak. Large amounts of liquid propane seeped into the ground, gas filled the basement, and the smallest spark could therefore trigger the blast.

### December 12, 2006 Mason Township (Cass County)

On December 12, 2006 a natural gas pipeline explosion occurred at US-12 and Tharp Lake Road in Mason Twp. Homes within a half mile of the incident were evacuated, and traffic was also diverted. The explosion had occurred when a Midwest Energy employee was operating a trencher and struck the pipeline, resulting in one fatality.

### July 17, 2007 Mayville (Tuscola County)

A man was trying to light his home's propane-fueled water heater when an apparent gas leak caused an explosion. The man was sent to the hospital in critical condition. Firefighters didn't have much of a fire to battle because the explosion was one big flash. The house collapsed in on itself and required demolition.

### August 28, 2007 Muskegon (Muskegon County)

A house exploded after a contractor accidentally struck a natural gas line. Fortunately, no one was inside the home when the incident occurred. The explosion also caused damage to a neighbor's house.

### November 20, 2007 Canton Township (Wayne County)

Natural gas leaks at 8am on November 20, 2007 led to a house exploding in Canton Township. One woman was injured and was pulled from the rubble by neighbors.

### February 26, 2008 Grand Rapids (Kent County)

A natural gas explosion occurring at 3:30pm on February 26, 2008 resulted in the collapse of a two story building. Seven persons were injured, and five neighboring businesses suffered damage. A fire burned well into the night, due to an inability to shut off the natural gas until 9:30pm because the fire wouldn't allow access. Three quarters of the city's firefighters were involved in the effort, with neighboring departments covering calls in the city. A gas leak was also detected under the road.

### February 28, 2008 Flint (Shiawassee County)

Around noon on February 28, 2008, a man was injured in a house explosion that was an apparent suicide attempt. The man disconnected a gas line in his house and then intentionally sparked the blast, resulting in the explosion of his Linden Place manufactured home. The park's maintenance manager kicked in the door to the home and pulled the man to safety just before a major fire broke out, and fire fighters later rescued a pet cat safely.

March 29, 2008 Lake Ann (Benzie County)

A man was injured as a result of a propane explosion that destroyed a house. Debris was sent flying more than 1,600 feet, and the explosion and fire had been triggered by a relief valve blocked by snow falling off the house's roof.

June 25, 2008 Yankee Springs (Barry County)

One person died during an overnight fire in a lake house at Gun Lake, followed by an explosion caused by a gas line rupture which then took place.

July 14, 2008 Allegan (Allegan County)

On July 14, 2008 a two story house exploded during the night in Lee Township. Nobody was injured because no one was home at the time of the incident.

August 6, 2008 Hastings (Barry County)

A house explosion near Hastings blew out the home's windows and caused severe structural damage. Two teenage boys were inside the home but managed to leave without injury. An investigation found that the explosion was a result of a build-up of leaking propane gas that ignited in the home's basement. The explosion did not cause a fire but the explosion blew the house about 6 inches off of its foundation.

December 5, 2008 Colon (St Joseph County)

A man was killed in a one-car crash that ruptured a gasoline pipeline valve and caused a massive explosion and fire in St Joseph County. The pipeline, which spilled 14,322 gallons of oil, was shut down for more than a week, and authorities routed traffic around the area as the fire continued to burn out.

December 13, 2008 Maple Grove (Saginaw County)

A natural gas leak caused an explosion and fire that burned down a Saginaw County home. Two residents escaped without injury. Freezing winds, icy conditions, poor accessibility, and a lack of water made it difficult for neighborhood fire fighters to stop the blaze. The gas was shut off at the meter and a 3,000 gallon tanker was sent in to help eliminate the hazard.

August 4, 2009 Clio (Genesee County)

In the afternoon of August 4, 2009, an employee reported a small fire at an electrical meter outside one of the buildings at the White Oil Co. Storage Facility plant in Clio when a massive fire broke out and shot heavy plumes of black smoke into the air. Several 50 gallon oil barrels created explosions over 50 feet in the air. Twenty-five fire departments responded, sending over 100 fire fighters to battle the blaze. There were no reported major injuries, and only two minor injuries, but emergency officials contacted about 4,000 residential and business telephone numbers to notify them of the evacuation within a 2 mile radius. Around 150 people were sent to a shelter, and motorists were asked to avoid the area as well.

September 17, 2009 St. Clair Shores (Macomb County)

A gas leak was the reason for a home to explode in St. Clair Shores that resulted in the death (the following day) of the home's 83-year-old owner.

October 2, 2009 Tallmadge Township (Ottawa County)

A natural gas buildup in the afternoon of October 2, 2009 was the cause of a rental house explosion in Ottawa County. Nobody was injured at the time because the previous tenant had moved out the day before, but the debris also destroyed the neighboring houses' windows.

May 16, 2010 Kentwood (Kent County)

A natural gas leak caused a four-unit apartment to explode on May 16, 2010, resulting in 4 injuries. The gas leak occurred in a vacant apartment in the complex. The scene resembled that of a tornado, with debris scattered nearby, shards of broken window glass littered on the ground, lumber lodged into a neighbor's garage, and siding propelled through a neighbor's window.

May 29, 2010 Constantine (St Joseph County)

On May 29, 2010 a gasoline pipeline rupture spilled 89,000 gallons of fuel on farmland west of Constantine. The underground leak sprayed a two- to three-foot-high plume of gasoline into the air and saturated the ground of a newly planted corn field. BP Oil, the owner of the 12-inch gasoline distribution pipeline, drilled 70 temporary monitoring wells and set up 40 water extraction points, in an effort to keep the spilled fuel from contaminating groundwater in the areas in southern St. Joseph County. Thousands of gallons of contaminated water were "vacuumed" daily from underground aquifers. No injuries were reported, but 12 people from four nearby homes were evacuated from the area for nearly 48 hours.

June 21, 2010 Oshtemo Township (Kalamazoo County)

A natural gas leak caused an explosion that destroyed a house near Kalamazoo. Fortunately, there were no injuries because the owner of the home was at work and his wife and kids were out of town.

July 2, 2010 Wixom (Oakland County)

A natural gas line leak caused an explosion that destroyed 22 units in an apartment complex. Only one person was injured.

July 21, 2010 Ravenna (Muskegon County)

A man was killed in a propane leak explosion that destroyed his mobile home. The man had attempted to convert a kitchen stove from natural gas to propane, but a leak later occurred, resulting in the explosion while he was sleeping.

July 26, 2010 Calhoun & Kalamazoo Counties Enbridge Pipeline Disaster

On July 26, 2010, an oil spill was discovered by the owners of an oil pipeline, Enbridge Energy Partners L.P., during a maintenance activity at a pumping station located on the south edge of the City of Marshall. The 30-inch pipeline normally transported 190,000 barrels per day from Griffith, Indiana, to Sarnia, Ontario, and passes through Calhoun County and several other Michigan counties. Oil from the pipeline leaked into the Talmadge Creek and then into the Kalamazoo River and began to flow downstream toward Lake Michigan. Enbridge Energy officials shut down the pipeline pumps and closed valves located upstream and downstream from the leak site to stem the flow of additional oil and try to contain the spill. Based on company estimates, up to 19,500 barrels of crude oil had leaked from the pipeline (approximately 800,000 gallons).

Calhoun County declared a local state of emergency and several downstream communities, including Kalamazoo County, took emergency response actions in coordination with Calhoun County. The State Emergency Operations Center in Lansing was activated and a number of state departments and support organizations convened there to monitor the incident and coordinate state response activities with involved governmental agencies and company officials. Representatives of the U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Transportation Safety Board, U.S. Department of Transportation and other federal agencies quickly convened at the incident site and began working with company, local and state officials (under a Unified Command structure) to develop and implement a spill containment, recovery, and clean-up plan and protection strategy for the environment and affected local residents.

A coordination facility was established in the City of Marshall and contractors where brought in for environmental restoration and product recovery. Aggressive product recovery efforts were instituted to expedite oil containment and environmental clean-up. Wildlife rescue and rehabilitation operations were also implemented to aid in protecting animals and aquatic life from harm, and saving wildlife that had been adversely impacted by the spill. Health

advisories were issued to protect the public from harm, and some of the nearby residents were evacuated for a time until the air quality improved within the area. A number of contracted cleanup crews were brought in to perform clean-up and product recovery work.
On September 27, the repaired oil pipeline was restarted by company officials, with the approval of the U.S. Department of Transportation. New oil again flowed through the pipeline, initially at a reduced pressure level but then at full capacity again. The unified command center remained operational for an extended period of time, due to the long-term nature of product recovery and environmental clean-up operations. Clean-up and product recovery efforts are still ongoing in 2014, with more than 1.5 million gallons of water treated and huge quantities of material processed off-site to remove and recover the oil.

December 29, 2010 Wayne (Wayne County)

An aging natural gas pipeline exploded under a furniture store, destroying the building and resulting in two fatalities and one injury. Rescue workers spent all day and into the night combing through the pile of crumpled drywall, twisted metal, and broken bits of furniture. The explosion also shattered windows at nearby businesses and hospitalized one person who had been driving by when the building exploded. Police evacuated homes and businesses near the store, and a local state of emergency was declared. Residents in the area had reported the smell of gas to the utility company three hours before the explosion. A second leak was discovered in the same area after the explosion, but was successfully capped before exploding.

January 10, 2011 Grand Rapids (Kent County)

A house exploded as a result of a natural gas leak, causing one fatality and leaving another person critically injured.

January 12, 2011 Columbus (St. Clair County)

One person was hurt during a natural gas explosion at a facility in Columbus. Residents within a five-mile radius of the gas storage company said they first heard a loud boom and then saw a fireball. The company sells natural gas, and stores it in a two-mile-long cavern underground. The explosion occurred during a separation of gas and oil, and then the facility's safety valve kicked in, preventing the fire from spreading until it burned out.

April 13, 2011 White Oak Township (Ingham County)

A gas leak occurred on April 13, 2011 when between 294,000 and 462,000 gallons of gasoline leaked from a faulty Marathon Pipe Line LLC pipeline in mid-Michigan. Marathon originally estimated that 126,000 gallons had leaked into the soil before it was detected by a man in Ingham County's White Oak Township whose 16-acre farm backs up to four fuel storage tanks. Environmental experts said the Ingham County gasoline leak didn't harm residents' drinking water. They also said it was unlikely that contamination from the leak had affected the Red Cedar River watershed and neighboring communities.

May 4, 2011 Warren (Macomb County)

A natural gas explosion in a commercial Laundromat in Detroit's northern suburbs leveled the building and injured two passers-by. The blast was felt several miles away and nearby residents reported seeing a large cloud of smoke.

February 27, 2013 Royal Oak (Oakland County)

A natural gas leak caused an explosion that killed a man and destroyed three homes. The explosion also resulted in the evacuation of two streets in the neighborhood for multiple days. The utility company was fined $340,000 by the Michigan Public Service Commission, since their work crew was aware of the leak but left the scene prior to the blast. Multiple employees related to the incident were also terminated. In addition to the fines, the utility company will give $1 million to a new fund that will help victims of natural gas disasters and fund improved training and safety practices for utility workers.

The relatively small number of deaths and injuries associated with these petroleum and natural gas pipeline accidents is a testament to the emergency preparedness efforts of the pipeline companies and local communities, as well as the regulatory oversight of the Michigan Public Service Commission and the U.S. Department of Transportation's Office of Pipeline Safety. The possibility is always there for a significant accident to occur, since Michigan is crisscrossed by several major petroleum and natural gas pipelines. Pipelines could rupture at any time, resulting in severe explosion, fire, property damage, environmental contamination, and casualties.

***Programs and Initiatives***

Pipeline jurisdiction and oversight in Michigan is complex, determined primarily by the type and function of a pipeline and its location. Agencies involved include (1) the MPSC Gas Safety Office, (2) the USDOT/OPS in Kansas City, Missouri, and (3) the Michigan Department of Environmental Quality, Office of Geological Survey (MDEQ/OGS). The table below is a breakdown of jurisdictional and inspection responsibilities for the various types of pipelines present in Michigan:

**Pipeline Safety Regulation in Michigan**

| Pipeline Type | Jurisdiction | Applicable Code | Inspected By |
|---|---|---|---|
| Inter-state Natural Gas | USDOT/OPS | 49 CFR Part 192 | MPSC Gas Safety |
| Intra-state Natural Gas | State of Michigan/MPSC | Michigan Gas Safety Standards | MPSC Gas Safety |
| Liquid Petroleum | USDOT/OPS | 49 CFR Parts 193/195 | USDOT/OPS |
| Gathering Lines* | MDEQ/OGS | Oil/Gas Administrative Rules under Part 615, 1994 PA 451 | MDEQ/OGS |

*Note: Gathering lines run from a production facility (i.e., a well) to a pre-processing plant (i.e., dehydration facility, or separator, compression station).
Source: Michigan Public Service Commission, Gas Safety Office.

The issue of gathering line jurisdiction is even more complex. Gathering lines in non-rural areas fall under the jurisdiction of the Michigan Gas Safety Standards. Gathering lines that serve as common carriers fall under the

jurisdiction of the MPSC, but may not necessarily fall under the Michigan Gas Safety Standards. All other gathering lines fall under the jurisdiction of the MDEQ/GSD. (Note: Even though gathering lines in rural areas do not fall under the direct jurisdiction of the Michigan Gas Safety Standards, the MPSC requires all common carrier pipelines to be designed, constructed and operated under the requirements of the Standard.)

The following are major programs and initiatives in place to help ensure petroleum and natural gas pipeline safety in Michigan.

Michigan Gas Safety Standards

Pipeline operators are regulated under the Michigan Gas Safety Code, 1969 PA 165 and its implementing Administrative Rules - the Michigan Gas Safety Standards, to ensure that public safety is protected to the extent that is possible in the industry. Under the Code (which is administered by the MPSC), gas pipeline companies (operators) must develop and maintain written procedures to minimize the hazards resulting from a gas pipeline emergency. The procedures must provide for the following: 1) identification and classification of events; 2) notification of and communication with local response agencies and public officials; 3) response to all types of gas emergencies, including emergency shutdown and pressure reduction procedures; 4) coordination of response actions with the local jurisdiction(s); and 5) restoration of service. Operators must also ensure that personnel are properly trained and knowledgeable about emergency procedures. If an incident occurs, the operator must review response actions to determine whether procedures were followed, and if necessary, take samples of the failed facility or equipment for laboratory examination to determine the cause of the failure. Mitigation actions are taken as necessary to minimize the possibility of a recurrence. The latest edition of the Michigan Gas Safety Standards was filed with the Secretary of State and became effective on April 17, 2009.

Consumers Energy has stated that it will give $1 million to a new fund that will help victims of natural gas disasters and fund improved training and safety practices for utility workers.

U.S. Department of Transportation, Office of Pipeline Safety

Additional pipeline safety requirements are contained in the Federal Safety Standards (Parts 191, 192, 193 and 195), as administered by the USDOT/OPS. Interstate gas and liquid petroleum pipeline operators must develop and maintain written emergency procedures similar to those required under the Michigan Gas Safety Standards. In addition, they are required to coordinate both planned and actual response actions with local officials and response agencies. There is also a Federal Grant Program authorized to reimburse a state agency up to 80 percent of the actual cost for carrying out its pipeline safety program. The actual amount of Federal reimbursement depends upon the availability of appropriated funds and state program performance (and the formula used to allocate funds includes performance factors). The Natural Gas Grant Allocation and Hazardous Liquid Grant Allocation participate in the program. The OPS provides grant funding to Michigan to improve communication among excavators and owners of underground facilities. The PIPES Act of 2006 also authorizes grants to Michigan state authorities, designated by the Governor, to create or maintain effective State damage prevention programs.

Part 195 also has a continuing education requirement to keep local officials and the general public informed about the risks associated with the transportation of hazardous liquids via pipeline. OPS and Michigan partners regularly participate in joint government-industry-public committees and task forces to discuss and address concerns related to risk management, compliance, emerging technology, damage prevention, and environmental protection. Current initiatives include the Risk Management Demonstration Program, the Local Distribution Company Feasibility Study, Technical Pipeline Safety Standards Committees, Best Practices for One-Call Centers, and the National Pipeline Mapping System (GIS-based).

MPSC Pipeline Safety Inspections

MPSC safety engineers are certified by the USDOT/OPS to conduct inspections on natural gas pipelines to ensure the structural and operational integrity of the systems. If violations are found, the pipeline company can be

ordered to take corrective actions, and the pipeline operator may be fined. The MPSC safety engineers also respond to accidents involving natural gas or petroleum pipelines (to ensure compliance with federal and state law, and to offer technical assistance to emergency responders).

The Protection of Underground Facilities Act / MISS DIG Program

Michigan's first line of defense against pipeline (and other utility line) breaks from construction excavations is the "MISS DIG" Program established with the passage of 1974 PA 53 – The Protection of Underground Facilities. MISS DIG System, Inc., is a 24-hour utility communications system that helps contractors comply with the state law (Act 53) that requires the notification of utilities at least three working (but not more than 21 calendar) days before starting the excavation, tunneling, demolishing, drilling or boring procedures, or explosive discharges for a project. When properly administered and followed, the MISS DIG safety system does an excellent job of minimizing pipeline and utility line accidents.

National Transportation Safety Board

The National Transportation Safety Board (NTSB) investigates all significant pipeline accidents in the U.S., and provides pipeline company and government regulators with safety recommendations aimed at preventing future accidents. The NTSB also publishes a list of "most wanted" safety improvements, for pipelines and other modes of transportation, for nationwide implementation by appropriate entities. Although these safety improvement recommendations are not mandatory, and the NTSB has no regulatory or enforcement powers, it nonetheless has been successful in getting more than 80% of its recommendations adopted. Many safety features currently incorporated into pipelines and other transportation modes had their genesis in NTSB recommendations.

Local Emergency Capability

Communities that may be affected by petroleum or natural gas emergencies should have adequate procedures in their Emergency Operations Plans to address the special types of problems associated with this hazard, including specific functions such as rescue and evacuation. Affected communities must work closely with company officials and surrounding jurisdictions to ensure a fast, coordinated response. Mitigation possibilities include the use of community zoning regulations to provide suitable open, unoccupied "buffer" areas around pipelines, storage fields, refineries, and compressor stations.

American Petroleum Institute (API) Recommended Practice (RP) 1162

The American Petroleum Institute (API) Recommended Practice (RP) 1162, "Public Awareness Programs for Pipeline Operators" has regulations for pipeline operators to provide the affected public with information about how to recognize, respond to, and report pipeline emergencies. The importance of using the one-call notification system prior to excavation is to be emphasized for all stakeholders. Emergency officials and local public officials must be provided with information about the location of transmission pipelines, to enhance emergency response and community growth planning. Affected municipalities, school districts, businesses, and residents must be advised of pipeline locations. Of particular significance is the requirement that operators must periodically review their programs for effectiveness, and enhance the programs as necessary.

This industry consensus standard provides guidance and recommendations to pipeline operators for the development and implementation of enhanced public awareness programs. It addresses multiple elements of such programs, including the intended audiences, the kinds of information to be communicated, frequencies and methods of communicating the information, and evaluation of the programs' effectiveness.

Michigan Propane Gas Association (MPGA)

The Michigan Propane Gas Association was created to promote the proper handling and use of propane, to work for a favorable environment for propane distribution and marketing, and to increase its use by demonstrating propane's value as a clean energy source. The MPGA is a trade and membership service organization that represents propane marketers throughout the state. The MPGA's primary purpose is to maintain high standards of

practice within the industry and, in so doing, protect and expand the ability of its members to compete in the marketplace.

Interstate Natural Gas Association of America (INGAA)

The Interstate Natural Gas Association of America (INGAA) is a trade organization that advocates regulatory and legislative positions of importance to the natural gas pipeline industry in North America. Its members transport over 95 percent of the nation's natural gas through a network of 200,000 miles of pipelines. The interstate natural gas pipeline industry has two principal federal regulators: the Federal Energy Regulatory Commission (FERC) is responsible for the economic regulation of pipelines, while the U.S. Department of Transportation (DOT) Office of Pipeline Safety oversees the industry's safety efforts. INGAA's primary mission is to create a regulatory and legislative climate that allows interstate natural gas pipeline companies to optimize efficient and profitable operations.

Nonprofit Pipeline Safety Organizations

There are several nonprofit organizations and agencies that provide information encouraging pipeline safety in Michigan. These organizations can work to educate the public by organizing meetings, seminars, and workshops to improve pipeline reliability, operational efficiency, and the regulatory environment. These organizations can support the safe delivery of pipeline products; research pipeline operational problems; act as a common ground forum where members can discuss and seek solutions to industry problems; promote underground facilities, damage prevention, and implementation of damage prevention best-practices to all stakeholders; and represent industry interests before Congress, federal agencies, and other energy-related stakeholders by developing regulatory and legislative policies. These particular organizations include the National Association of Pipeline Safety Representatives (NAPSR), Association of Oil Pipe Lines (AOPL), American Public Gas Association (APGA), Pipeline Research Council International, Inc. (PRCI), the Common Ground Alliance (CGA), etc.

***Analysis and Impact***

The map at the end of this section shows the location of major petroleum and natural gas pipelines within Michigan. It is apparent from the map that petroleum and natural gas pipelines crisscross the entire state, from well heads to storage sites to distribution to consumers. Major compressor stations that receive and redistribute natural gas are located at key points along the pipelines (but are not shown on the map). These stations monitor and maintain pressure levels within the pipelines. In the event of a pipeline rupture, the compressor stations shut down to stop the flow of product. Many smaller compressor stations are located across the state to complete the distribution process to consumers.

The state's major natural gas storage facilities are located in the central part of the Lower Peninsula. Natural gas is piped into those storage facilities from Michigan wells, and from large transmission pipelines that originate in Canada, the southwestern United States, and the Gulf of Mexico area.

Petroleum pipelines carrying crude oil, fuel oil, propane, butane, gasoline and other petroleum products have their heaviest concentrations in central Lower Michigan and between Detroit and Toledo. Many of the refineries, terminals, and storage areas are located in urban areas where the potential for extensive damage, and threat to lives and property, is greatest. The largest concentration of these facilities is found in the Detroit metropolitan area.

Petroleum and natural gas pipeline accidents are on the rise, due to the aging of the underground infrastructure (much of which was laid over 50 years ago) and an increase in construction excavation. According to studies conducted by the General Accounting Office (GAO), an average of 22 people died annually from 1988 to 1998 when the number of accidents was increasing four percent per year. The GAO also found that the USDOT/OPS has not adequately enforced many safety regulations passed by Congress since 1988 and is instead relying more on industry self-regulation as an enforcement tool.

Increased pipeline safety regulations again came to the forefront in 2000 after deadly pipeline explosions occurred in Bellingham, Washington in June 1999 (three deaths) and Carlsbad, New Mexico in August 2000 (11 deaths). In 2004, the Pipeline and Hazardous Materials Safety Administration (PHMSA) was signed into law. The purpose of the Act was to provide a more focused research organization and establish a separate operating administration for pipeline safety and hazardous materials transportation safety operations.

The Pipeline Safety Improvement Act of 2002 mandated significant changes and new requirements in the way that the natural gas industry ensures the safety and integrity of its pipelines. The law applies to natural gas transmission pipeline companies. The law places requirements on each pipeline operator to prepare and implement an "integrity management program" that, among other things, requires operators to identify so-called "high consequence areas" (HCA) on their systems, conduct a risk analysis of these areas, perform baseline integrity assessments of each pipeline segment, and inspect the entire pipeline system. Companies were required to identify all HCAs and submit specific integrity management programs to the Office of Pipeline Safety (OPS), the Research and Special Projects Administration, and the U.S. Department of Transportation. All pipeline segments within HCAs were to be inspected and remediation plans completed by December 17, 2008, while non-HCA segments must be inspected by 2012. All segments must be re-inspected on a 7-year cycle, with certain exceptions.

Because petroleum and natural gas pipeline accidents will occur eventually, affected local communities must be prepared to respond to the accident, institute necessary protective actions, and coordinate with federal and state officials and the pipeline company emergency crews to effectively manage and recover from the accident. That can best be accomplished through the collaborative planning, training, and exercising of emergency procedures with all potentially involved parties.

***Hazard Mitigation Alternatives for Pipeline Accidents***

- Locating pipelines away from dense development, critical facilities, special needs populations, and environmentally vulnerable areas whenever possible.
- Increasing public awareness and widespread use of the "MISS DIG" utility damage prevention service (800-482-7171).
- Proper pipeline design, construction, maintenance and inspection.

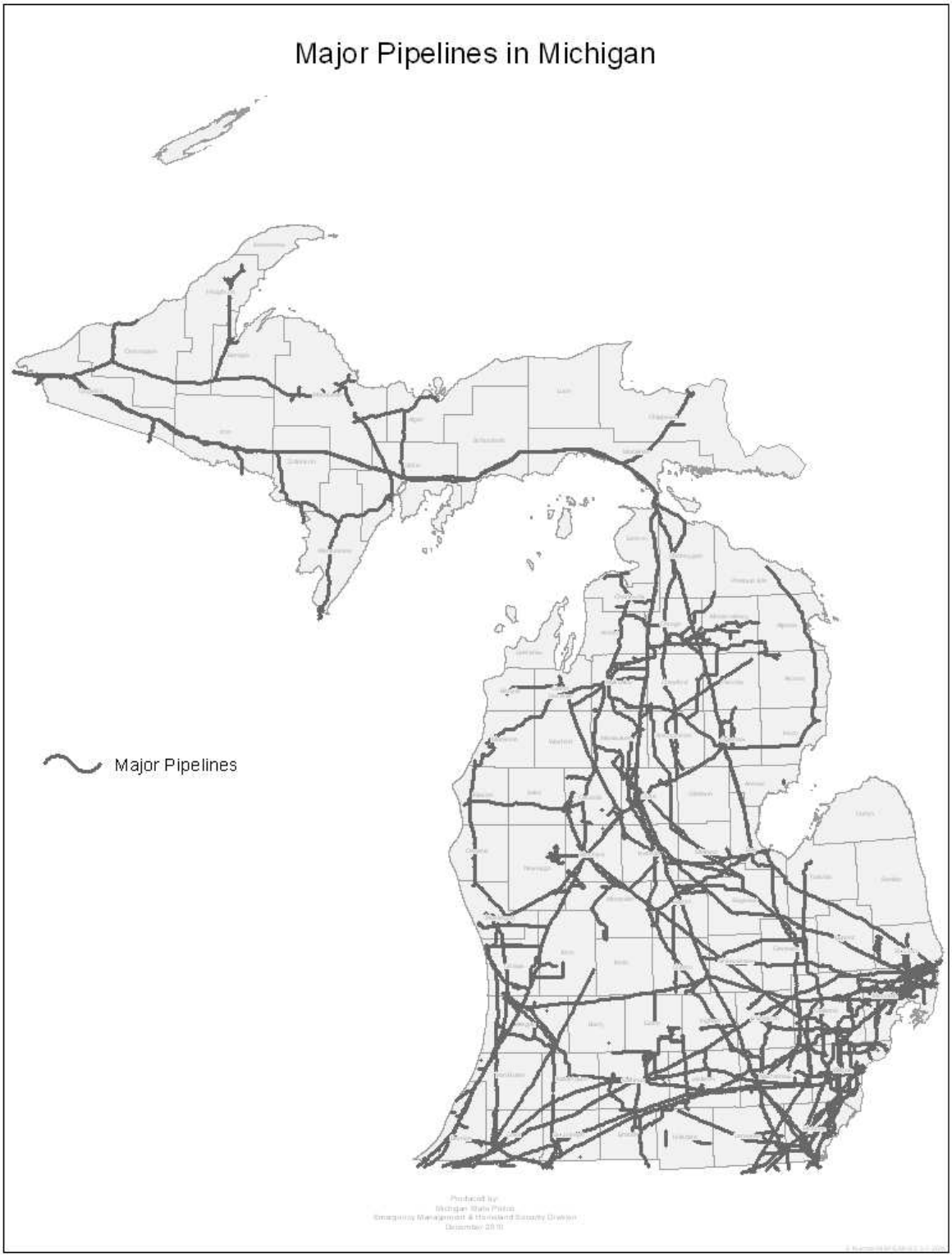
***Tie-in with Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that pipeline accidents were considered to be a significant hazard in the local hazard mitigation plan for St. Clair County.

**Major Petroleum and Natural Gas Pipelines in Michigan**
Source: Michigan Public Service Commission; pipeline company maps



# OIL AND NATURAL GAS WELL ACCIDENTS

*An uncontrolled release of oil or natural gas, or the poisonous by-product hydrogen sulfide, from production wells.*

***Hazard Description***

Oil and natural gas are produced from fields scattered across 63 counties in the Lower Peninsula. From 1927 to January 2009, there have been 56,525 oil and natural gas wells drilled in Michigan, of which roughly half have produced oil and gas. To date, Michigan wells have produced over 1.4 billion barrels of crude oil and 6 trillion cubic feet of gas.

The petroleum and natural gas industry is highly regulated and has a fine safety record, but the threat of accidental releases, fires and explosions still exists. In addition to these hazards, many of Michigan's oil and gas wells contain extremely poisonous hydrogen sulfide ($H_2S$) gas. Hydrogen sulfide is a naturally occurring gas mixed with natural gas or dissolved in the oil or brine and released upon exposure to atmospheric conditions. Over 1,300 wells in Michigan have been identified as having $H_2S$ levels exceeding 300 parts per million (ppm).

As the table below indicates, at concentrations of 700 ppm, as little as one breath of hydrogen sulfide can kill. Although hydrogen sulfide can be detected by a "rotten egg" odor in concentrations from .03 ppm to 150 ppm, larger concentrations paralyze a person's olfactory nerves so that odor is no longer an indicator of the hazard. Within humans, small concentrations can cause coughing, nausea, severe headaches, irritation of mucous membranes, vertigo, and loss of consciousness. Hydrogen sulfide forms explosive mixtures with air at temperatures of 500 degrees Fahrenheit or above, and is dangerously reactive with powerful oxidizing materials. Hydrogen sulfide can also cause the failure of high-strength steels and other metals. This requires that all company and government responders be familiar not only with emergency procedures for the well site, but also with the kinds of materials that are safe for use in sour gas well response.

**Physiological Response to $H_2S$**

| | |
|---|---|
| 10 ppm | Beginning eye irritation |
| 50-100 ppm | Slight conjunctivitis and respiratory tract irritation after 1 hour exposure |
| 100 ppm | Coughing, eye irritation, loss of sense of smell after 2-15 minutes. Altered respiration, pain in the eyes and drowsiness after 15-30 minutes, followed by throat irritation after 1 hour. Several hours of exposure results in gradual increase in severity of these symptoms and death may occur within the next 48 hours. |
| 200-300 ppm | Marked conjunctivitis and respiratory tract irritation after 1 hour of exposure. |
| **500-700 ppm** | **Loss of consciousness and possibly death in 30 minutes to 1 hour.** |
| **700-1000 ppm** | **Rapid unconsciousness, cessation of respiration, and death.** |
| **1000-2000 ppm** | **Immediate unconsciousness, with early cessation of respiration and death following within a few minutes. Death may occur even if the individual is removed to fresh air at once.** |

Source: American National Standards Institute, Standard: 237.2-1972

An unplugged abandoned well, also known as an orphan well, can be a hazard to the health and safety of the surrounding people and environment. There are many situations where an unplugged well can become dangerous. For example, a rusted-out casing in a gas well can let natural gas flow underground and accumulate in the basement of a nearby building, possibly causing an explosion. Occasionally, gas leaking from an old well can contaminate a nearby water well. An old well might also be a conduit for salt brine from deeper formations to pollute fresh groundwater, or to discharge at the surface. In some cases, oil leaks from abandoned wells, polluting soil and water. In the vicinity of a coal mine, an old well can be a conduit for explosive gas to enter the mine, a

serious mine safety problem. Also, where coal mining has occurred, an old well can allow acidic mine water to discharge at the surface.

***Hazard Analysis***

Over the years, Michigan has experienced periodic upward and downward trends in oil and natural gas production as new reservoirs were discovered and older ones became depleted. However, oil production has been declining at 5-8% per year since 1990. Natural gas production peaked in 1998 and has also begun to indicate a decline in production. As the table and map indicate at the end of this section, a large number of Michigan's oil and natural gas wells are located in the western counties bordering on Lake Michigan, and in the central part of the Lower Peninsula. A thin band of fields also runs from Calhoun County to St. Clair County in the southern Lower Peninsula, and across the northern Lower Peninsula from Manistee County to Presque Isle County. Oil and natural gas wells are scattered around other Lower Peninsula counties, but the Upper Peninsula contains few productive oil and gas wells.

Michigan reaps tremendous economic and social benefits from oil and natural gas production. As with all industrial and commercial activities, along with those benefits come some risks as well. Despite the best efforts of the MDEQ Office of Geological Survey and the drilling companies to minimize oil and natural gas well accidents, it is inevitable that such accidents will occur from time to time. When they do, the affected local communities must be prepared to respond to the accident, institute necessary protective actions, and coordinate with state officials and drilling company emergency crews to effectively manage and recover from the accident. That can best be accomplished through collaborative planning, training, and the exercising of emergency procedures with all potentially involved parties.

Using revenues from oil and gas production taxes, the Michigan Department of Environmental Quality has plugged and restored at least 200 wells. Out of the 62,376 oil and gas wells drilled in Michigan since the 1920s, 26 orphan wells remain to be plugged as of 2012.

It can be difficult to accurately assess incident probabilities for oil and gas wells, but some indications might be gained from existing OSHA data. As related in the section on hazard identification, information about the location of wells is available since permits needed to be issued before they are dug or drilled. If permit sites are near developed or potentially sensitive areas, specific inquiries can then be made with MDEQ to see if the permit actually resulted in a well being created, whether the well is still open or has been capped, and whether open wells have been known to contain hydrogen sulfide. Wells that are open and potentially hazardous should be reconsidered if they are located very near to vulnerable populations or densely developed areas.

More than one agency has requested that this plan include more specific information about any risks associated with hydraulic fracturing methods of extraction (also known as “fracking”). Concerns have been expressed about reports of water and air pollution in other states, but the situation in Michigan can be seen to differ in more than one way. Michigan has a history of hydraulic fracturing that dates back to 1952, involving more than 12,000 wells without any resultant environmental damage. Michigan has many impermeable formations in its bedrock, which provide extensive separation between these wells and the location of groundwater, therefore meaning that groundwater contamination is prevented (unlike the formations in some other states where evidence of such contamination has been detected). These geological conditions and Michigan’s greater regulatory system, combined with a scale of extraction that is much less than several other states (in which problems have been widely publicized), means that there is no reason to consider that this method of extraction poses any greater risk within the state. As with wells that have been dug through other means, the primary sources of risk from any well are the two that have already been identified in previous editions of this plan: (1) the ability of a well to “sour” by producing poisonous hydrogen sulfide gases, and (2) the risk that an accidental explosion may occur. Both of these risks do happen from time to time, but usually do not strongly affect areas outside of the well site itself. Please refer to the list of Michigan events, for more detail about the extent (and limits) of actual and recent historical cases in Michigan. Extraction technology (and safety) has been improving over time.

Impact on the Public
Those who are in or near a well site during a hazardous event (workers, inspectors, trespassers) may face severe injury or death. Those living in the close vicinity of such a well may potentially be affected by gases and thus require temporary evacuation, but these cases would be extremely rare.

Impact on Public Confidence in State Governance
An event of significant size or impact may provoke a perception that inadequate regulation, authorization, or oversight was maintained by the state.

Impact on Responders
Wells may contain poisonous hydrogen sulfide gas, and thus require responders to use special equipment when nearby. Special search and rescue skills may be needed for victim extraction. In this regard, the oil and gas well hazard may be considered to be similar to a fixed site hazardous materials incident (q.v).

Impact on the Environment
The process of getting oil and natural gas from underground to the end user has the potential to be environmentally destructive. The environmental impacts of oil and natural gas well accidents include the emission of air pollutants, leaks and spills, groundwater contamination, and the effects of well "blowouts." Many of Michigan's oil and gas wells contain extremely poisonous hydrogen sulfide ($H_2S$) gas. Productive natural gas wells and their associated utilities and access roads also "eat up" natural land, and many areas where gas is found are natural areas where drilling puts industrial facilities into rustic settings.

An unplugged abandoned well (orphan well) can be a hazard to the environment. For example, a rusted-out casing in a gas well can let chemical substances flow underground, and gas leaking from an old well could contaminate a nearby water well. An old well might also be a conduit that allows salt brine from deeper formations to pollute fresh groundwater, or to discharge at the surface. In some cases, oil leaks from abandoned wells may cause the pollution of soil and water.

***Significant Oil and Natural Gas Well Accidents***
To date, Michigan has been fortunate not to have an oil or natural gas well accident that resulted in loss of life (other than to company employees) or caused significant property damage. However, significant oil and natural gas well accidents have occurred that required an emergency response by the drilling company and by state and local officials:

April 1973 Williamsburg (Grand Traverse County)
The drilling of oil and natural gas wells may result in another type of hazard, as demonstrated by an incident near Williamsburg in Grand Traverse County during April 1973. Gas pressure in a well forced gas through porous rock formations to the surface. This eruption of natural gas caused craters of bubbling muddy water that flowed into nearby streams and into the Grand Traverse Bay. Due to the threat of an explosion, the townspeople of Williamsburg were evacuated, but an explosion did not occur. Damage was confined to building foundations (which settled) and environmental damage to trees and streams. Fortunately, the Williamsburg incident was resolved without death or injury. The Michigan Department of Natural Resources subsequently imposed improved well casing and sealing requirements to prevent this type of occurrence.

April 16, 1984 Bay County
On April 16, 1984 a sour gas well in Hampton Township (Bay County) developed a leak at its surface casing, emitting sour gas for several hours. Residents within a half-mile radius were evacuated for approximately 24 hours until the well could be completely repaired. There were no injuries or property damage.

February 24, 1988 Buckley (Wexford County)
On February 24, 1988 a gas leak occurred in a well located near the village of Buckley in Wexford County. Several children in a nearby school complained of nausea from the strong odor, so the school was evacuated as a precaution. After a short investigation, the well site was located and it was determined that the site had suffered a deck blow-off and was emitting gas directly into the atmosphere. The well was subsequently shut down until permanent repairs could be made.

January 9, 1989 Arenac County
On January 9, 1989 a natural gas well blew out in Au Gres Township, Arenac County. Although there was no fire, methane, butane, and hydrogen sulfide leaked from the wellhead. The surrounding area was evacuated while attempts were made to seal the leak with mud and concrete and to replace the wellhead. On January 11, a new valve was successfully installed and the community resumed its normal activities.

February 17, 1989 Grand Traverse County

On February 17, 1989 a Shell Western oil well in Mayfield Township (Grand Traverse County) blew out, resulting in an evacuation of nearby residents and the cancellation of local school classes. The well was eventually capped, later that night.

June 15, 1993 St. Clair County

On June 15, 1993 a natural gas explosion occurred at a Michigan Consolidated Gas Company (MICHCON) underground storage facility in Columbus Township, St. Clair County. One worker was injured in the explosion, two vehicles were burned, and several homes in the immediate vicinity of the facility were evacuated.

February 3, 1994 Ogemaw County

On February 3, 1994 an explosion and fire occurred when a pipe released gas under pressure at an American Oil Company (AMOCO) production facility in Ogemaw County. One service company employee was killed and another employee was injured. The situation was immediately brought under control with no additional injuries, damage, or threat to public safety.

May 13, 1994, and August 1996 Manistee and Mason Counties

An accident occurred when a blown gasket released hydrogen sulfide emissions after a seal in a compressing station in Mason County's Victory Township failed. The incident resulted in 11 people requiring emergency hospital treatment (four of them children) and the death of 10 cattle. Another similar incident occurred two years later when a release of 5,500 cubic feet of natural gas containing 900 ppm of poisonous $H_2S$ occurred in Manistee Township. The release, which occurred while workers were attempting to plug a well, caused several citizens in the neighborhood to lose consciousness and collapse. Eleven victims were treated at the hospital; at least one of them sustained serious lung damage. Others were being treated for symptoms of asthma, skin irritations and neuropsychological problems. From 1980 to 1998, other injuries and evacuations have occurred in Manistee and Mason Counties as a result of $H_2S$ releases. At least 10 separate accidental releases of $H_2S$ from pipelines and processing plants caused at least 262 people in Manistee and Mason Counties to evacuate their homes (five since 1995), caused at least 22 people to have been injured and seek medical treatment since 1994, and caused 35 cattle to be killed in Mason County since 1994. Many more have suffered respiratory and skin complications, and all are bearing the psychological burden of repeated evacuations.

December 2006 Mecosta County

In December, 2006 a gas well burst into an explosion in Mecosta County, resulting in the evacuation of several nearby residents. The issue was later resolved, with no additional threat to public safety.

June 12, 2013 Leoni Township (Jackson County)

An explosion at an oil well placed a man in extremely critical condition and he was airlifted to University of Michigan hospital. Investigators believed that a truck had struck some piping in the oil well, causing an explosion and natural gas fire. The fire was extinguished with foam and water, and did not affect surrounding areas outside of the facility.

### *Programs and Initiatives*

Oil and Natural Gas Well Regulatory Authority

Part 615 of the Natural Resources and Environmental Protection Act, 1994 PA 241, as amended, regulates oil and natural gas well drilling in Michigan. Revisions to this “Supervisor of Wells” statute, in 1999, clarified the Supervisor’s authority to address public health and safety issues. The Administrative Rules for Part 615 were most recently updated in September, 1996. These Rules require the classification of wells using the concept of radius of exposure (RoE). A simple formula is used to calculate the distance, in feet, from the point of release at which the $H_2S$ concentration in air reaches 100 ppm. This is the 100 ppm RoE. Wells with more than 300ppm $H_2S$ in the gas stream are classified according to the 100 ppm RoE. Part 616 deals with an Orphan Well Fund created within the State Treasury for the purpose of plugging the abandoned or improperly closed oil or gas wells, or for response activity, and/or for site restoration at oil or gas wells. The fund can be used when no owner or operator is known, when all owners or operators are insolvent, or when the supervisor determines there is an imminent threat to public health and safety.

Michigan Oil and Gas Association (MOGA)

The Michigan Oil and Gas Association (MOGA) represents the exploration, drilling, production, transportation, processing and storage of crude oil and natural gas in the State of Michigan. The organization has over 1,000 members, which include major oil companies, independent oil companies, and the exploration arms of various utility companies. The MOGA monitors the pulse of the Michigan oil and gas industry as well as the political, regulatory, and legislative interest in the state and the nation's capital as well. The organization has been described as the collective voice of the petroleum industry in Michigan, speaking to the problems and issues facing the various companies involved in the state’s crude oil and natural gas business. One of the ongoing issues of concern to the MOGA is oil and natural gas well safety.

Interstate Oil and Gas Compact Commission (IOGCC)

Michigan is a member of Interstate Oil and Gas Compact Commission (IOGCC) that represents the governors of oil and natural gas producing states. In 1935, six states endorsed and Congress ratified the Interstate Compact to

Conserve Oil and Gas, resulting in the formation of the unique governmental entity now known as the Interstate Oil and Gas Compact Commission. The IOGCC has helped states (including Michigan) to establish effective regulation of the oil and natural gas industry through the gathering and sharing of information, technologies, and regulatory methods. The IOGCC advocates for environmentally sound ways to increase the supply of American energy. This can be accomplished by providing governors of member states with a clear and unified voice to Congress, while also serving as the authority on issues surrounding these vital resources. The unique structure offers a highly effective forum for states, industry, Congress, and the environmental community to share information and viewpoints to advance our nation's energy future. The organization is dedicated to securing resources needed to ensure our nation's energy, economic, and national security.

### Michigan Oil & Gas Producers Education Foundation (MOGPEF)

MOGPEF was created in 2003 to assist in supporting educational projects and programs about the industry. It is a tax-exempt organization under Section 501(c) (6) of the United States Internal Revenue Service code. Its mission is to provide financial support for programs that will inform the people of Michigan about the importance of the local oil and natural gas industry and about the environmental safeguards that are employed. Materials and programs developed by MOGPEF are available for use by members of petroleum, energy, and allied industries and by the general public.

### Contingency Planning

Contingency plans for public protection are required for wells at which the 100 ppm RoE is greater than 100 feet. The plans are divided into two parts. Part I contains general procedures that must be implemented by company personnel in an emergency when $H_2S$ is released. This includes emergency contacts and their assigned duties and responsibilities, notification and evacuation procedures for the general public, and procedures for igniting the well. Part II contains site-specific information and must be filed with an application for a drilling permit. Well owners have the option of working with the local Emergency Management Coordinator instead of preparing a required site map and list of residences. This option can be used in highly populated areas. Other $H_2S$ Administrative Rules address special equipment requirements for the drilling, testing, and production of $H_2S$-bearing wells. The Rules are intended to provide for public protection and nuisance odor mitigation.

### Local Emergency Capability

Communities that may be affected by oil or natural gas well accidents should have adequate procedures in their Emergency Operations Plans to address the types of problems especially associated with this hazard, including rescue and evacuation. Affected communities must work closely with company officials and surrounding jurisdictions to ensure the compatibility of procedures for a fast and coordinated response. Mitigation possibilities include the use of community zoning regulations to provide suitable open, unoccupied "buffer" areas around refineries and compressor stations. Michigan Department of Environmental Quality regulations provide for buffer zones around wells and around treatment and storage facilities.

### Oil and Gas Advisory Committee

The Oil and Gas Advisory Committee advises the MDEQ on matters of regional or state-wide significance relating to oil and gas exploration and production. The Committee provides input on policy, rules, orders, instructions, technical reviews, and hearings. The Committee is composed of members from the oil and gas industry and the public, with background or expertise in oil and natural gas, and related environmental and resource issues.

### Michigan Department of Environmental Quality - GeoWebFace online

The Michigan Department of Environmental Quality now provides many GIS layers, along with an online interface called GeoWebFace, which allows users to view oil and gas well information in an interactive map. Its web address is http://ww2.deq.state.mi.us/GeoWebFace/.

***Hazard Mitigation Alternatives for Oil and Natural Gas Well Accidents***

- Using buffer strips to segregate wells, storage tanks, and other production facilities from transportation routes and adjacent land uses, in accordance with state regulations, and consistent with the level of risk.
- Adherence to all regulations and best industry practices, especially for relatively new techniques of hydraulic fracturing, in order to preserve Michigan's environmental quality and public confidence in the industry.

***Tie-in with Local Hazard Mitigation Planning***

Because many means of implementing mitigation actions occur through local activities, this updated MHMP places additional emphasis on the coordination of State-level planning and initiatives with those taking place at the local level. This takes two forms:

1. The provision of guidance, encouragement, and incentives to local governments by the State, to promote local plan development, and
2. The consideration of information contained in local hazard mitigation plans when developing State plans and mitigation priorities.

Regarding the first type of State-local planning coordination, MSP guidance has included the "Local Hazard Mitigation Planning Workbook" (EMD-PUB 207), which is currently being updated for release by 2015. For the second type of State-local planning coordination, a section later in this plan summarizes hazard priority information as it has been reported in local hazard mitigation plans. Here, it will merely be noted that the oil and gas well hazard has not yet been identified as one of the most significant hazards in any of Michigan's local hazard mitigation plans.

**Michigan's Oil and Gas Wells, by County**
(As of 2012)

| County | Wells | County | Wells | County | Wells |
|---|---|---|---|---|---|
| Alcona | **478** | Gratiot | **1** | Missaukee | **164** |
| Alger | **0** | Hillsdale | **29** | Monroe | **2** |
| Allegan | **196** | Houghton | **0** | Montcalm | **32** |
| Alpena | **894** | Huron | **2** | Montmorency | **2,539** |
| Antrim | **1,706** | Ingham | **31** | Muskegon | **15** |
| Arenac | **241** | Ionia | **0** | Newaygo | **33** |
| Baraga | **0** | Iosco | **7** | Oakland | **19** |
| Barry | **20** | Iron | **0** | Oceana | **48** |
| Bay | **393** | Isabella | **170** | Ogemaw | **326** |
| Benzie | **48** | Jackson | **40** | Ontonagon | **0** |
| Berrien | **0** | Kalamazoo | **0** | Osceola | **56** |
| Branch | **0** | Kalkaska | **268** | Oscoda | **450** |
| Calhoun | **79** | Kent | **145** | Otsego | **3,652** |
| Cass | **4** | Keweenaw | **0** | Ottawa | **155** |
| Charlevoix | **218** | Lake | **8** | Presque Isle | **39** |
| Cheboygan | **28** | Lapeer | **18** | Roscommon | **81** |
| Chippewa | **0** | Leelanau | **0** | Saginaw | **54** |
| Clare | **123** | Lenawee | **19** | St. Clair | **86** |
| Clinton | **0** | Livingston | **32** | St. Joseph | **0** |
| Crawford | **346** | Luce | **0** | Sanilac | **0** |
| Delta | **0** | Mackinac | **0** | Schoolcraft | **0** |
| Dickinson | **0** | Macomb | **9** | Shiawassee | **5** |
| Eaton | **9** | Manistee | **565** | Tuscola | **106** |
| Emmet | **0** | Marquette | **0** | Van Buren | **7** |
| Genesee | **18** | Mason | **21** | Washtenaw | **5** |
| Gladwin | **184** | Mecosta | **21** | Wayne | **7** |
| Gogebic | **0** | Menominee | **0** | Wexford | **13** |
| Gd. Traverse | **164** | Midland | **110** | **STATEWIDE** | **14,539** |

Source: Michigan Department of Environmental Quality Office of Geological Survey

## Michigan's Oil and Gas Fields

Source: Michigan Department of Environmental Quality, Geological Survey Division