

**HAZARDOUS SUBSTANCES EMERGENCY EVENTS
SURVEILLANCE
3 YEAR CUMULATIVE REPORT
FOR MINNESOTA**

Larry Souther and Jean Small-Johnson

Minnesota Department of Health

under cooperative agreement with the
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services

SUMMARY

During 1995 to 1997, the Minnesota Hazardous Substances Emergency Events Surveillance (HSEES) recorded 795 events. Of these 795 events, 60 events resulted in injuries to 264 people. These people reported a total of 497 injuries. Of the 60 events with victims, 87% had 3 or fewer victims. There were 99 events with evacuations. These 99 evacuations involved over 5,122 people.

There were 1,010 chemicals released in the 795 events. The most frequently released chemicals were ammonia (anhydrous and aqueous) (10%), sulfuric acid (4%), and PCBs (3%). Most events (92%) involved the release of only one chemical.

Agriculture (27% of all events) uses a large amount of hazardous substances during the spring planting season. There is a corresponding increase in the number of hazardous substances releases during the spring in both fixed-facilities and transportation events.

Non-agriculture events exhibit a typical business cycle both by day of the week and hour of the day. There are twice as many events per day on workdays as on weekends. Most events occur from 6 A.M. to 6 P.M. Transportation events are highest on Tuesday, Wednesday, and Thursday.

Half of the events occurred in the 10 'urban' counties. The other half of the events occurred in the 77 'rural' counties.

TABLE OF CONTENTS

SUMMARY	<u>ii</u>
LIST OF FIGURES	<u>v</u>
LIST OF TABLES	<u>vii</u>
INTRODUCTION	<u>1</u>
METHODS	<u>2</u>
EVENTS	<u>3</u>
EVENTS BY MONTH	<u>4</u>
EVENTS BY WEEK	<u>7</u>
EVENTS BY DAY OF THE WEEK	<u>9</u>
EVENTS BY HOUR OF THE DAY	<u>9</u>
TRANSPORTATION VS FIXED FACILITY	<u>13</u>
VICTIMS, INJURIES, AND EVACUATIONS	<u>28</u>

CHEMICAL CATEGORY	<u>41</u>
CHEMICALS RELEASED	<u>45</u>
GEOGRAPHICAL TRENDS	<u>51</u>
CONCLUSIONS	<u>53</u>

APPENDICES

APPENDIX 1 CHEMICALS RELEASED, MN HSEES 1995-1997	<u>1</u>
APPENDIX 2 EVENTS BY COUNTY, YEAR, AND AGRICULTURE, MN HSEES 1995-1997	<u>1</u>

LIST OF FIGURES

1.	NUMBER OF EVENTS, BY MONTH FOR EACH YEAR	5
2.	NUMBER OF EVENTS, AGRICULTURAL VS NON-AGRICULTURAL, BY MONTH	6
3.	TOTAL, AGRICULTURAL, AND NON-AGRICULTURAL EVENTS, BY WEEK	8
4.	TOTAL EVENTS, BY DAY OF THE WEEK	11
5.	TOTAL EVENTS, BY HOUR OF THE DAY	12
6.	PERCENTAGE OF TRANSPORTATION AND FIXED-FACILITY EVENTS	14
7.	PERCENTAGE OF CHEMICALS RELEASED AT TRANSPORTATION AND FIXED- FACILITY EVENTS	14
8.	PERCENTAGE OF VICTIMS	15
9.	PERCENTAGE OF EVENTS WITH VICTIMS	15
10.	PERCENTAGE OF EVACUEES	16
11.	PERCENTAGE OF EVENTS WITH EVACUEES	16
12.	AREAS OF FIXED FACILITIES INVOLVED IN EVENTS	18
13.	FACTORS REPORTED AS CONTRIBUTING TO THE OCCURRENCE OF FIXED- FACILITY EVENTS	19
14.	TRANSPORTATION EVENTS, BY TYPE	20
15.	FIXED-FACILITY EVENTS, BY MONTH	21
16.	TRANSPORTATION EVENTS, BY MONTH	23
17.	FIXED-FACILITY EVENTS, BY DAY OF THE WEEK	24

18.	TRANSPORTATION EVENTS, BY DAY OF THE WEEK	25
19.	TRANSPORTATION AND FIXED-FACILITY EVENTS, BY HOUR OF THE DAY	27
20.	DISTRIBUTION OF VICTIMS, BY POPULATION GROUP AND TYPE OF EVENT	30
21.	INJURY OUTCOME	31
22.	PERCENTAGE OF VICTIMS, BY EVENT TYPE AND NUMBER OF VICTIMS PER EVENT	33
23.	CUMULATIVE VICTIMS, BY MONTH OF THE YEAR	36
24.	EVENTS WITH VICTIMS, BY MONTH	36
25.	EVACUEES, BY MONTH	37
26.	EVENTS WITH EVACUEES, BY MONTH	37
27.	VICTIMS, BY DAY OF THE WEEK	38
28.	EVACUEES, BY DAY OF THE WEEK	38
29.	VICTIMS, BY HOUR OF THE DAY	39
30.	EVACUEES, BY HOUR OF THE DAY	40
31.	NUMBER OF CHEMICALS RELEASED, BY MONTH	46
32.	CHEMICALS RELEASED, BY DAY OF THE WEEK	48
33.	CHEMICALS RELEASED, BY HOUR OF THE DAY	49
34.	AGRICULTURAL AND NON-AGRICULTURAL EVENTS, BY COUNTY	52

LIST OF TABLES

1.	EVENTS, BY YEAR AND TYPE OF EVENT	3
2.	TOTAL EVENTS, BY DAY AND HOUR	10
3.	DISTRIBUTION OF EVENTS AND VICTIMS, BY TYPE OF EVENT	29
4.	TYPE OF INJURY, BY TYPE OF EVENT	32
5.	EVENTS, BY EVACUATION AND VICTIM	35
6.	CHEMICALS RELEASED, BY CATEGORY AND YEAR	43
7.	CHEMICALS RELEASED, BY CATEGORY AND YEAR W/O THE 99 CHEMICAL EVENT	44
8.	DISTRIBUTION OF THE NUMBER OF CHEMICALS RELEASED PER EVENT	47
9.	TOP 10 MOST FREQUENTLY RELEASED CHEMICALS	50

INTRODUCTION

The Minnesota Department of Health is currently one of 15 state health departments¹ collecting data for the Hazardous Substances Emergency Events Surveillance (HSEES) system. This system is funded by the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR has conducted the HSEES system since 1990. Minnesota has participated in the HSEES system since January 1, 1995.

The HSEES system has four goals:²

- To describe the distribution and characteristics of hazardous substances emergencies.
- To describe the morbidity and mortality experienced by employees, responders, and the general public as a result of hazardous substances releases.
- To identify risk factors associated with the morbidity and mortality.
- To identify strategies that might reduce future morbidity and mortality resulting from the release of hazardous substances.

¹ In 1997 the following states were participating in the HSEES program: Alabama, Colorado, Iowa, Minnesota, Mississippi, Missouri, New York, North Carolina, Oregon, Rhode Island, Texas, Washington, and Wisconsin.

² Hazardous Substances Emergency Events Surveillance (HSEES) Annual Report 1997, U.S. Department of Health & Human Services, Public Health Service, Agency for Toxic Substance and Disease Registry, Atlanta, Georgia, pp. 3-4.

This report summarizes the characteristics of hazardous substances releases and the associated public health consequences of events reported to the Minnesota surveillance system during a 3-year period: 1995, 1996, and 1997³. During this period there were 795 events, 1,010 chemicals were released, 264 people suffered injuries from these releases, and over 5,122 people were evacuated during these events.

METHODS⁴

The data was gathered by a research scientist located within the Minnesota Department of Health using a protocol developed by ATSDR. Information about events was collected on standardized data collection forms. Information about the event, substance(s) released, victims, injuries, and evacuations was collected.

Various data sources were used to obtain information about these events. Reports made to the Minnesota Duty Officer were the primary source of event notification. Other sources, including but not limited to records and oral reports of the Minnesota Pollution Control Agency, Minnesota Department of Agriculture, Minnesota Department of Natural Resources, Minnesota Department of Transportation, police and fire departments, hospitals, and responsible parties, were used to complete the data collection form. Census data were used to estimate the number of residents in the vicinity of the events. All of the data were computerized using an ATSDR provided data entry system and were sent to ATSDR quarterly.

ATSDR cleaned the data and provided translation of several data fields. The description of the responsible party was converted into standardized 'industry code' and 'industry description' fields. Chemicals released were each assigned a 'standardized name' and 'code.' Chemicals were also assigned to a 'chemical category.'

³ Data for 1998 is being reviewed and has not been released by ATSDR.

⁴ HSEES Annual report 1997, p. 4-5

EVENTS

Table 1 shows the number of events by year and the total for all 3 years. Of the 795 events, 780 (98%) involved the actual release of hazardous substances, 9 (1%) involved the threatened release of hazardous substances, and 6 (1%) involved a combination of threatened and released hazardous substances. Most events occurred in fixed facilities (77%) compared to transportation (23%).

Table 1

Year	TYPE OF EVENT				Total No. of Events
	Fixed Facility		Transportation		
	No. of Events	%	No. of Events	%	
1995	193	84.3	36	15.7	229
1996	224	74.4	77	25.6	301
1997	194	73.2	71	26.8	265
Total	611	76.9	184	23.1	795

EVENTS BY MONTH

Figure 1 shows the number of events by month for each year, the monthly averages and the total monthly events over the 3 years. The highest number of events occurring in a single month and averaged over the 3 years occurred in May (45 events/month) followed by June (35 events/month) and April (25 events/month). These 3 months in spring account for 39% of annual events. The months of November and December had the fewest average number of events (15 and 13 events/month, respectively). This annual cycle in events is consistent for all 3 years and appears to be related to agricultural activity.

During the 3-year period, agricultural events accounted for 27 % (218) and non-agriculture events accounted for 73% (577) of all events (795). Figure 2 presents cumulative agricultural vs non-agricultural events by month. Agricultural events were defined as those having an industry description of farm, farm coop, agricultural services/supply, crop duster, lawn care, or fertilizer sales. These events involved fertilizers, pesticides, herbicides, and anhydrous ammonia. Figure 2 clearly shows a spring effect, where 72 % (156) of agriculture events occur from April through June. By contrast, only 27% (158) of non-agriculture events occur from April through June. The largest number of non-agriculture events occurred in August (63 total events over 3 years).

NUMBER OF EVENTS, BY MONTH FOR EACH YEAR, MN HSEES 1995-1997

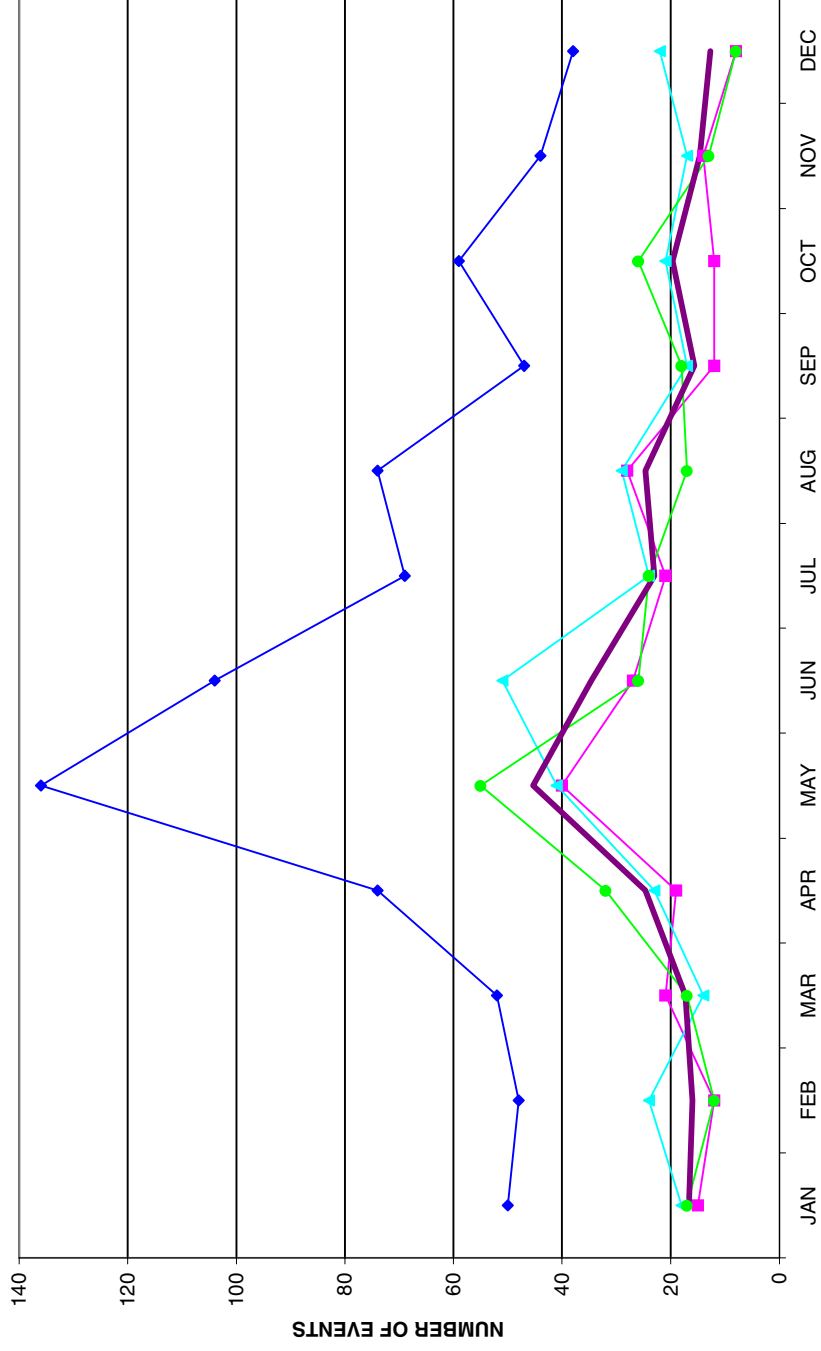


Figure 1

NUMBER OF EVENTS, AGRICULTURAL VS NON-AGRICULTURAL, BY MONTH, MN HSEES 1995-1997

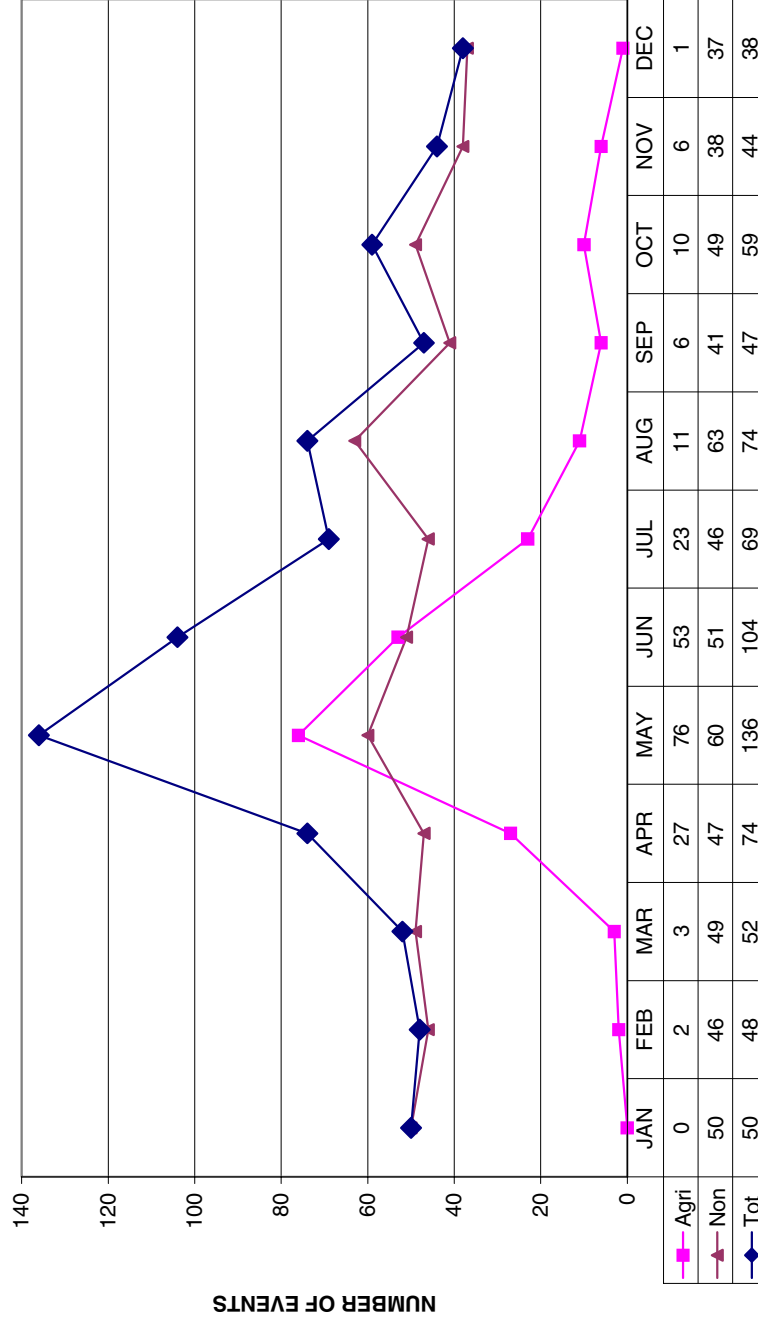


Figure 2

EVENTS BY WEEK

A graph of events by week was used to see if a higher resolution (53 periods vs 12 periods) over the monthly graph would provide better definition of any event cycles (Figure 3). The weeks are 7 day periods starting on January 1. Week 53 is only a partial week, ending the year.

Figure 3 is a radar graph with the weeks represented by radial lines going from the center to the circumference. The distance from the center represents the sum of the events for that week, cumulative for the 3 years. The graph contains polygons representing Total Events, Non-Agriculture Events, and Agriculture Events.

Figure 3 shows that the spring increase in Total Events is from week 15 to week 29. There is a tighter and more significant increase from weeks 18 to 26. The Agricultural Events polygon shows a very strong increase in events from weeks 18 to 23 with a secondary peak at week 26. The main lobe of the agriculture polygon is due to the spring planting. Herbicides, pesticides, and fertilizers are applied before and during planting. After planting, there is a drop in agricultural events until week 26.

Week 26 is in late June when the corn is knee high and the soy bean canopy is about to cover the ground between the rows. Farmers apply the last applications of herbicides and fertilizers at this time because, later in the season, driving the farm equipment through the fields would damage the crops.

**TOTAL, AGRICULTURAL, AND NON-AGRICULTURAL EVENTS, BY WEEK,
MN HSEES 1995-1997**

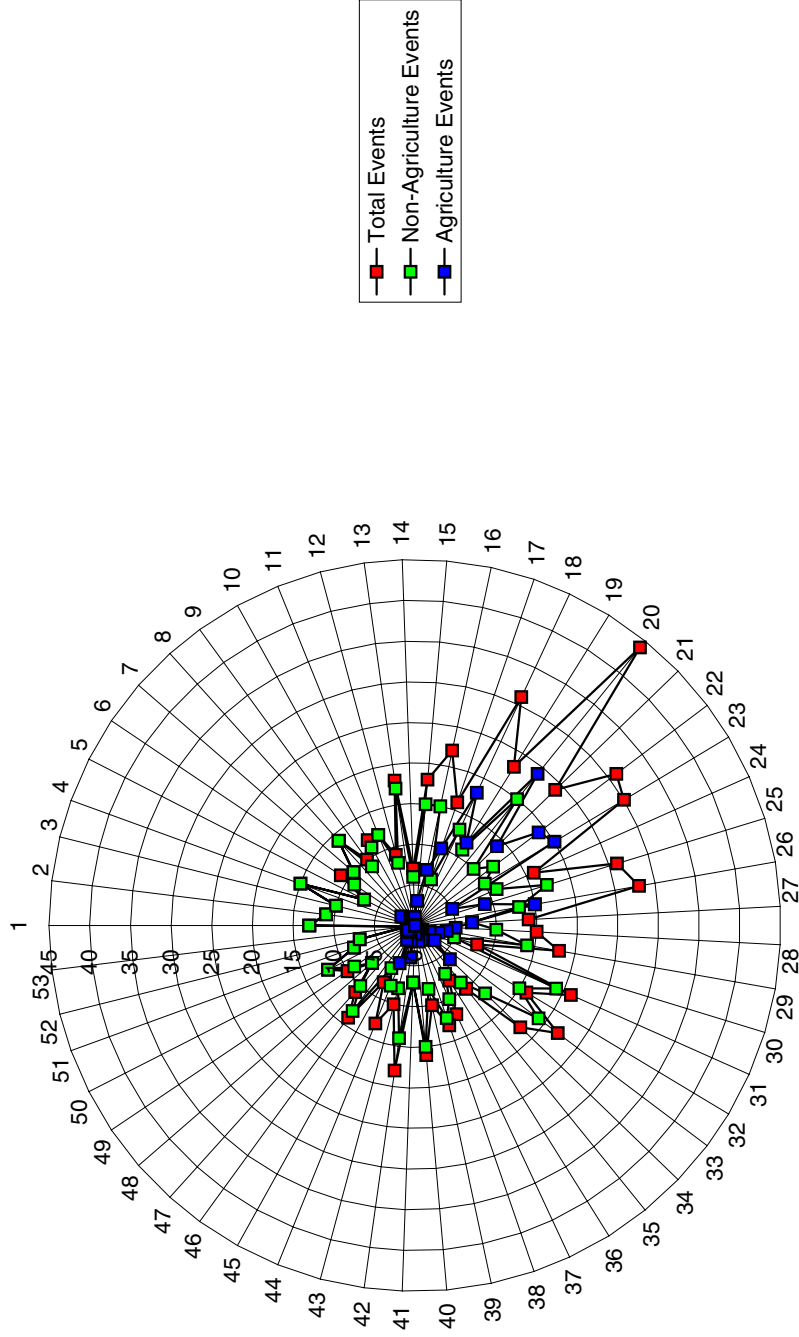


Figure 3

There is no discernable annual pattern in the non-agriculture events. However, Figure 3 does show that the total number of events is driven by agriculture in the spring and non-agriculture during the rest of the year.

EVENTS BY DAY OF THE WEEK

Events were categorized by day of the week, Sunday to Saturday (Figure 4). This figure shows fewer events on Sunday and Saturday. This is expected because of the cyclic work of many businesses. There are also fewer events on Monday and Friday compared with Tuesday, Wednesday, and Thursday. The cause of this effect is explored below in the Transportation vs Fixed Facility section.

EVENTS BY HOUR OF THE DAY

Events were categorized by hour of the day, 00 to 23, in Figure 5. Times are rounded down to the whole hour. Events with an unknown time of release are counted in the ‘??’ Column. This graph shows fewer events outside normal working hours. This is expected because of the cyclic work of many businesses. Of note are the peaks occurring at hour 9 and hour 14 (2:00 PM). These peaks may coincide with hours of peak activity.

Table 2 shows the number of events by day and hour. There are relatively few events before 6 A.M. and after 6 P.M. on all days. There is a lull in events on Monday to Friday around Noon. Otherwise, the events are fairly evenly distributed throughout the workday and work week.

Table 2
TOTAL EVENTS, BY DAY AND HOUR, MN HSEES 1995–1997

Hour/Day	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
0	1	3	1	0	3	2	1
1	0	5	0	2	1	2	0
2	1	2	2	3	1	2	1
3	1	0	2	2	3	3	0
4	3	1	0	4	1	5	1
5	1	3	0	2	1	3	0
6	2	2	1	3	8	3	0
7	3	6	8	6	8	7	1
8	3	5	12	11	17	9	7
9	2	9	14	14	10	14	3
10	2	17	10	8	12	4	2
11	2	8	14	14	8	8	3
12	3	12	8	5	5	6	3
13	3	2	8	5	8	5	6
14	4	8	16	10	13	14	5
15	0	7	9	8	6	10	3
16	1	4	6	5	6	5	7
17	2	4	6	12	10	6	0
18	3	8	5	8	4	1	4
19	3	6	2	4	3	4	3
20	3	4	7	3	4	4	4
21	4	4	3	3	0	3	0
22	0	0	3	0	2	1	3
23	4	4	4	1	0	1	4
??	4	6	2	6	5	2	4

TOTAL EVENTS, BY DAY OF THE WEEK, MN HSEES 1995-1997

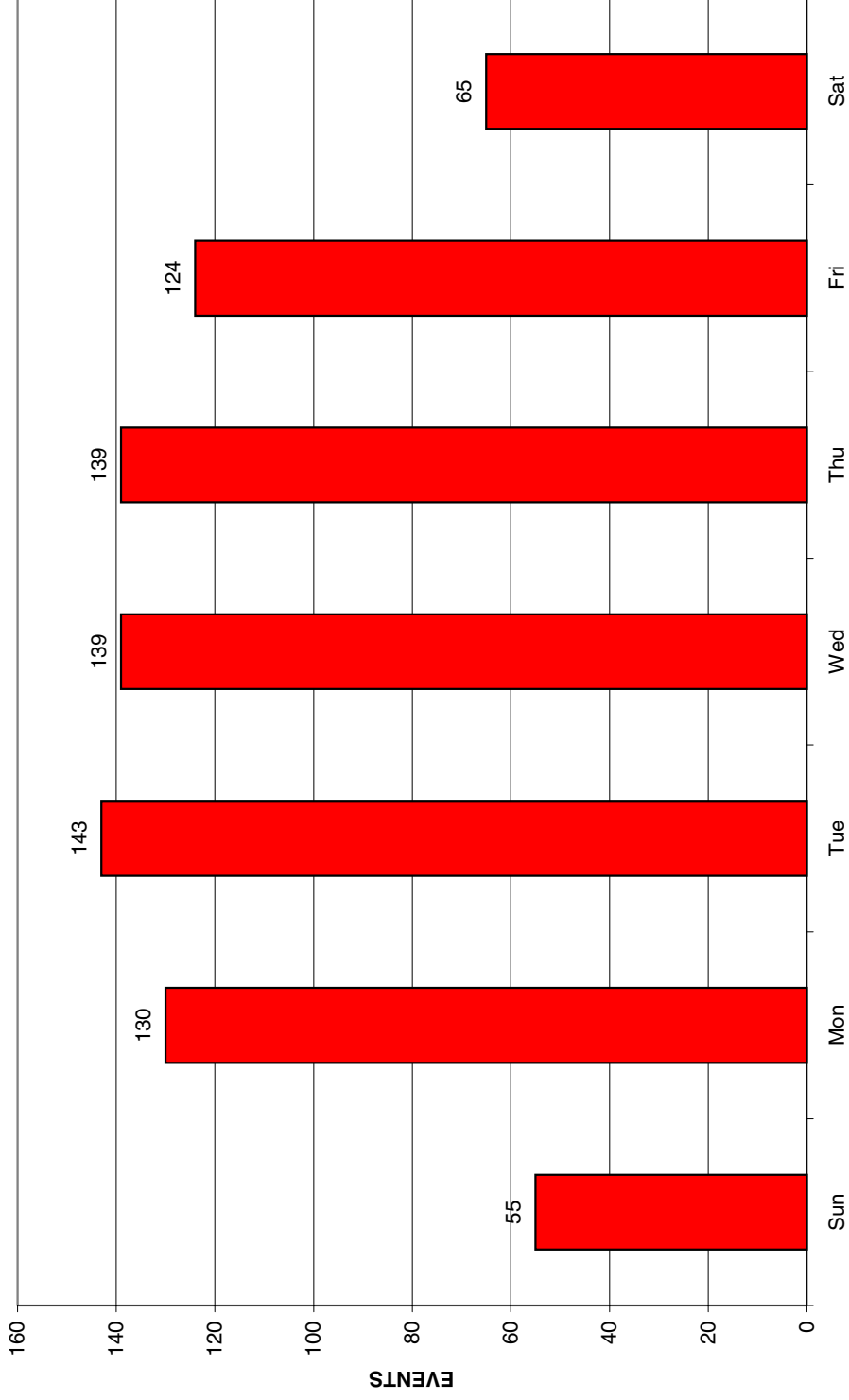


Figure 4

TOTAL EVENTS, BY HOUR OF THE DAY, MN HSEES 1995–1997

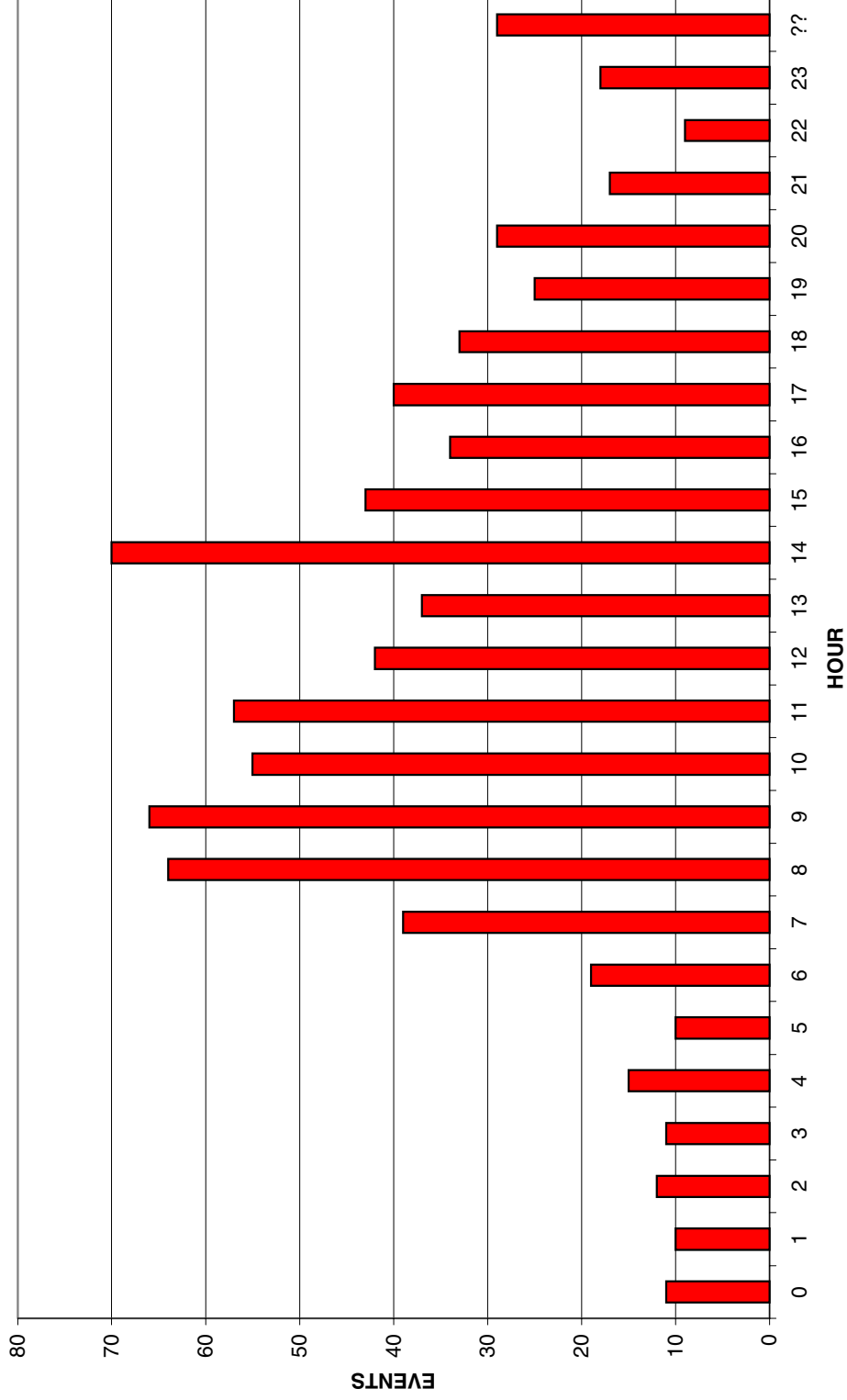


Figure 5

TRANSPORTATION VS FIXED FACILITY

An event was classified as either a transportation event or a fixed-facility event. Transportation events included transportation between fixed facilities, and events at a fixed facility where a transport company was still in possession of the substance released. There were 184 (23%) transportation events and 611 (77%) fixed-facility events (Figure 6).

The number of chemicals (Figure 7) released were in similar proportions; transportation - 213 (21%) chemicals, fixed facility 797 (79%) chemicals. While the percentage of victims (Figure 8) is skewed toward fixed facilities (91%), the percentage of events with victims in fixed-facility (77%) and transportation events (23%) (Figure 9) is similar to the overall percentage of fixed-facility (77%) and transportation (23%) events, as shown in Figure 6. The percentage of evacuees (Figure 10) is even more skewed toward fixed facilities; transportation 1% - fixed facility 99%. The percentage of events with evacuees (Figure 11) is nearly as skewed as the percentage of evacuees; transportation 4% - fixed facility 96%. These ratios make sense given that fixed facilities have more workers near the chemical, while transportation events often occur on open roads with few people near the release.

Comparing fixed-facility and transportation events year to year over the 3 years covered by this report, there does not appear to be any trends. Table 1 shows the 3-year history for fixed-facility and transportation events. Comparisons over the course of a year are discussed below.

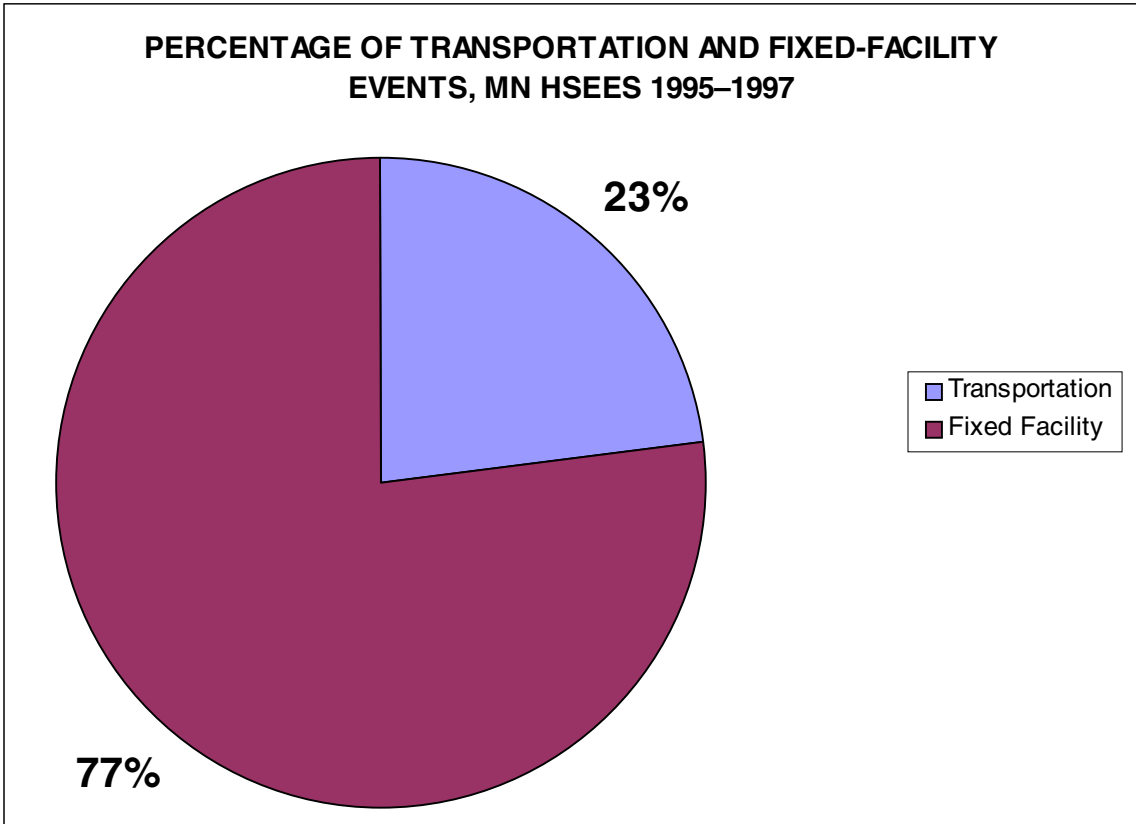


Figure 6

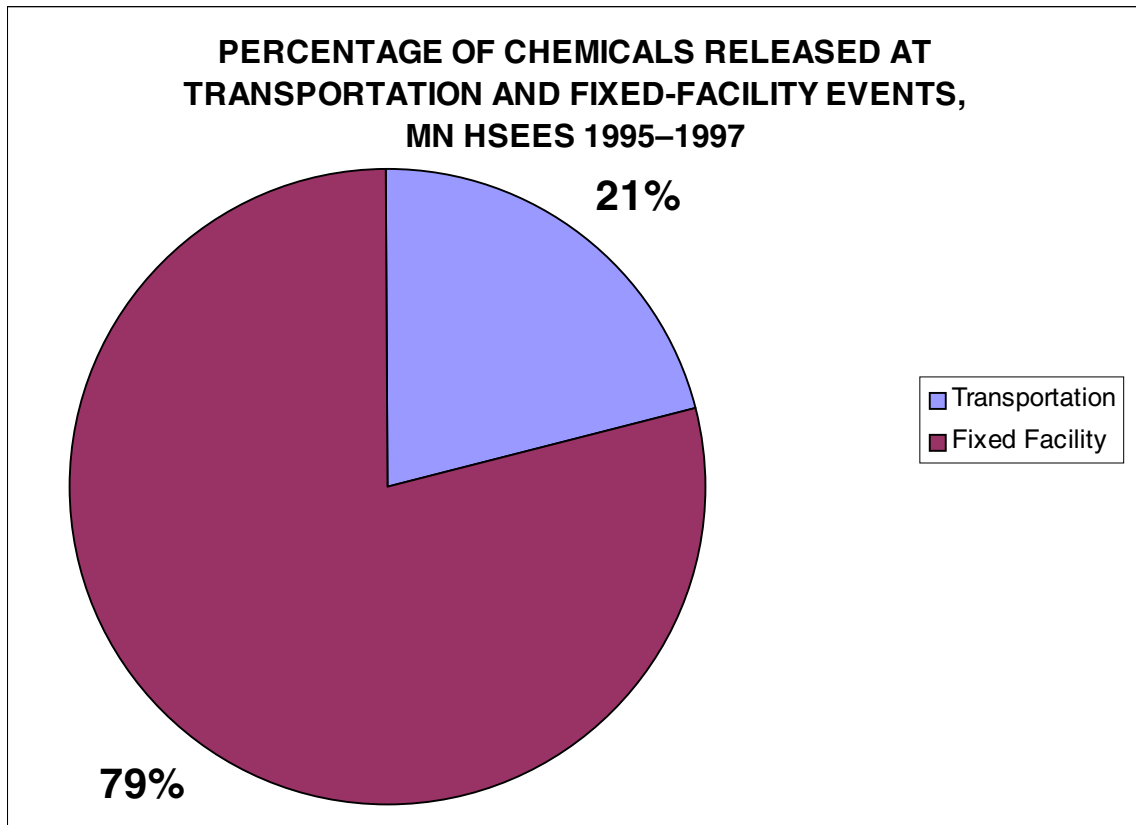


Figure 7

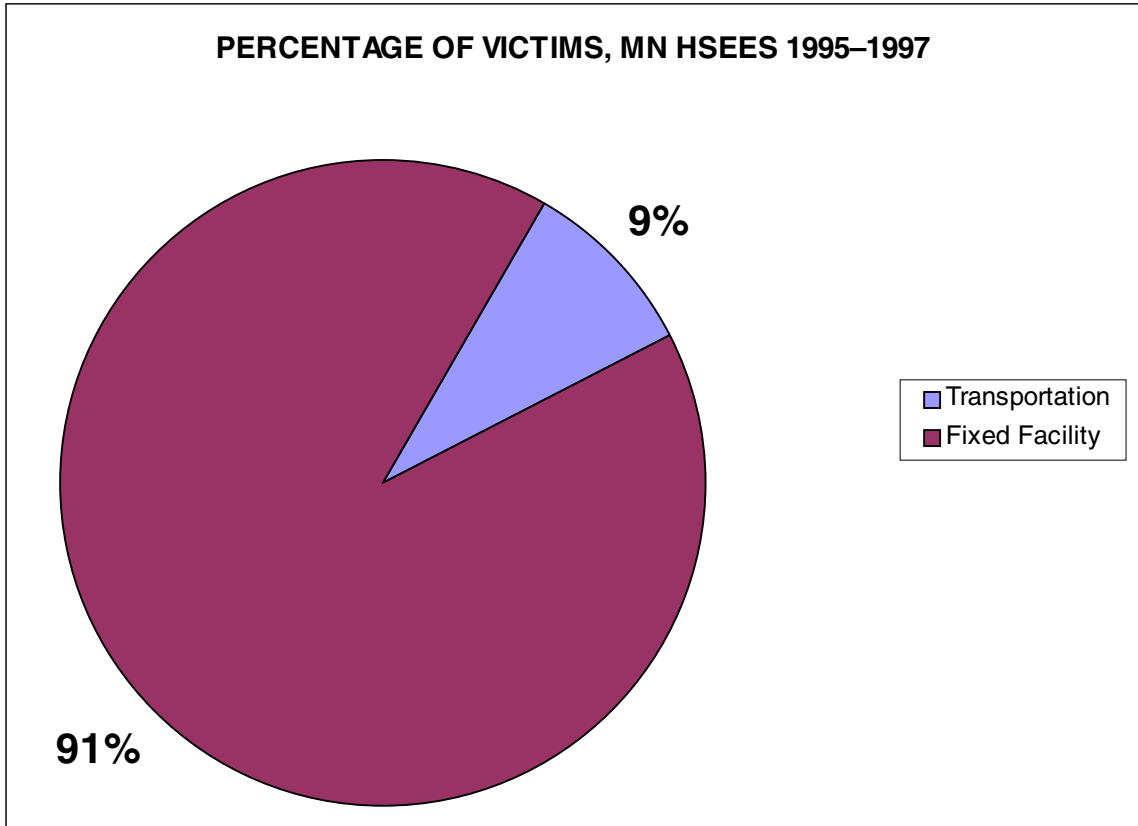


Figure 8

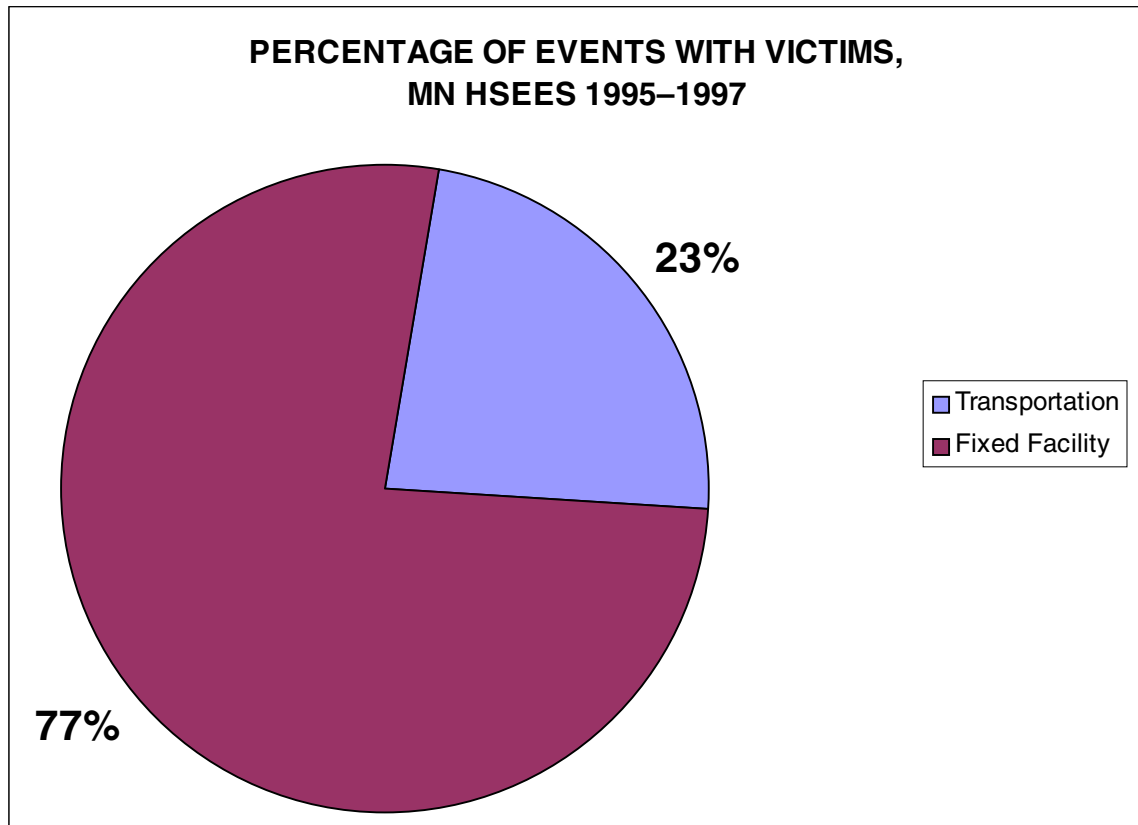


Figure 9

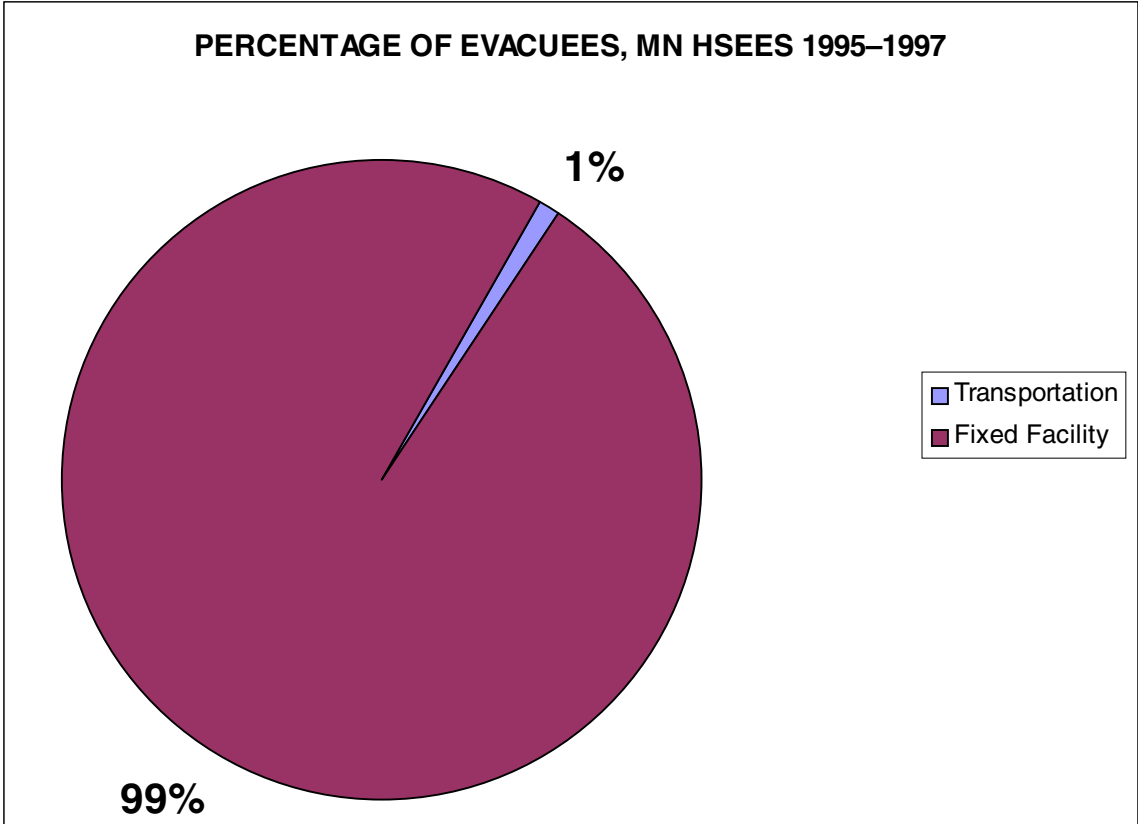


Figure 10

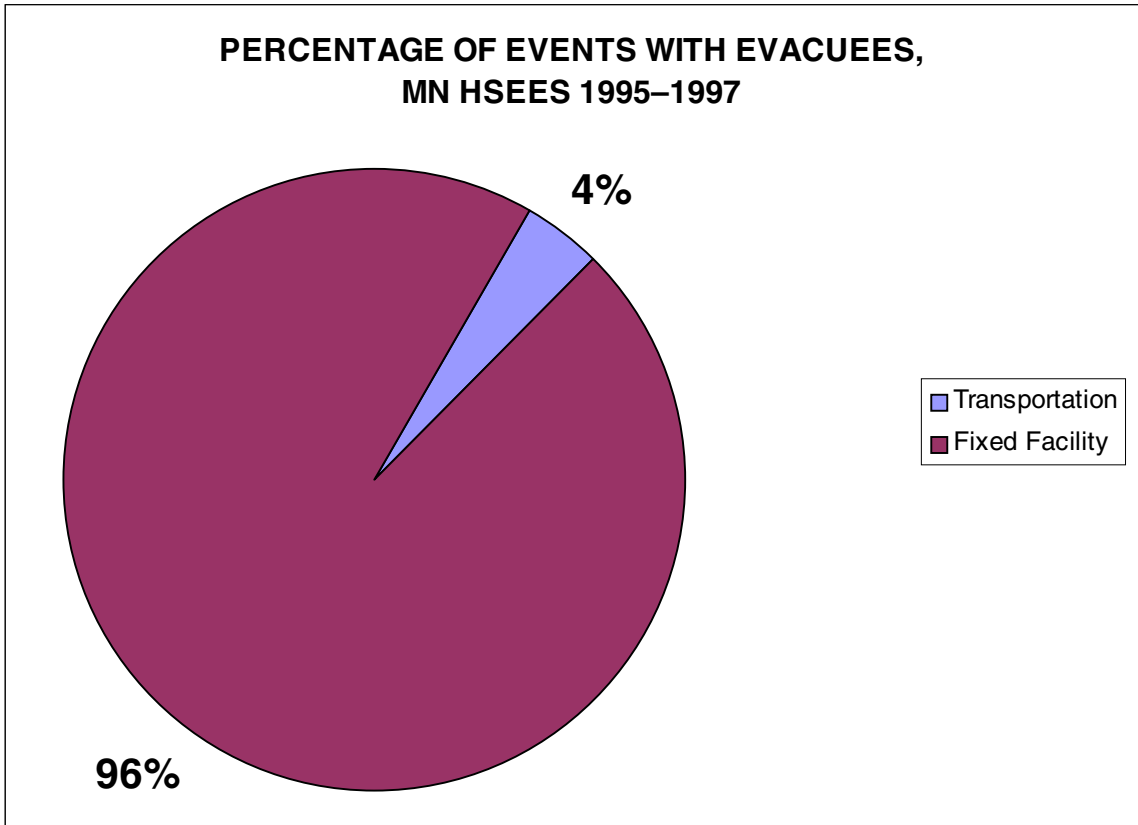


Figure 11

The various areas of fixed facilities involved in events is shown in Figure 12. The most common areas involved in hazardous substances releases were piping, pumps and valves (25%), above ground storage areas (22%), material handling (21%), and process vessels (15%).

Figure 13 shows the primary factors contributing to occurrences of fixed-facility events. Equipment failure (41%) and operator error (23%) accounted for the majority of contributing factors. There were 161 fixed-facility events (26%) for which the primary contributing factor was unknown or was not reported, partly because data for factors was not collected until July 1995.

Figure 14 shows distribution of the types of transportation modes involved with transportation events. Ground transportation, including trucks and cars, accounted for 88% of the transportation events.

Figure 15 shows total, agriculture, and non-agriculture fixed-facility events by month, cumulative for 1995 to 1997. This figure shows an increase in the spring. Removing agriculture events from fixed facilities shows that fixed facility, non-agriculture events show little variation in the number of events per month throughout the year. Similar to all agriculture events, fixed facility agriculture events show a strong spring increase.

AREAS OF FIXED FACILITIES INVOLVED IN EVENTS, MN HSEES 1995-1997

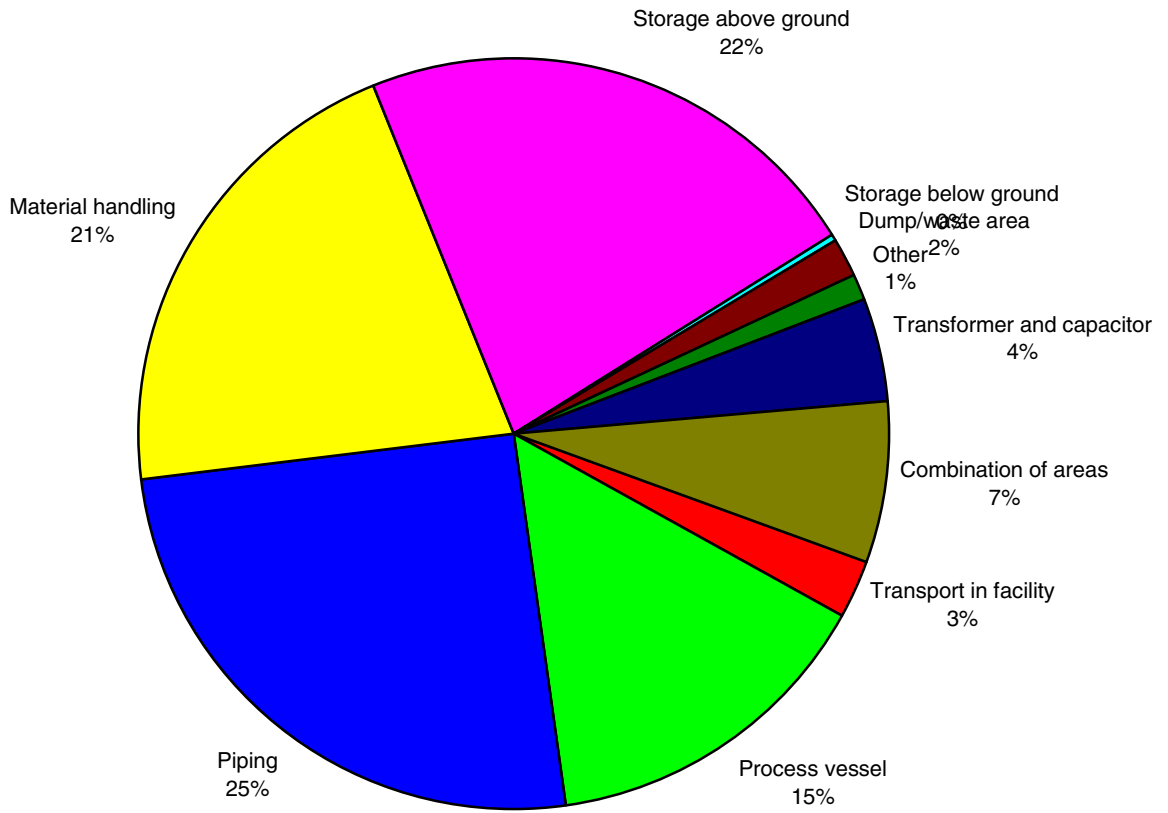


Figure 12

**FACTORS REPORTED AS CONTRIBUTING TO THE OCCURRENCE OF FIXED-FACILITY
EVENTS, MN HSEES 1995-1997**

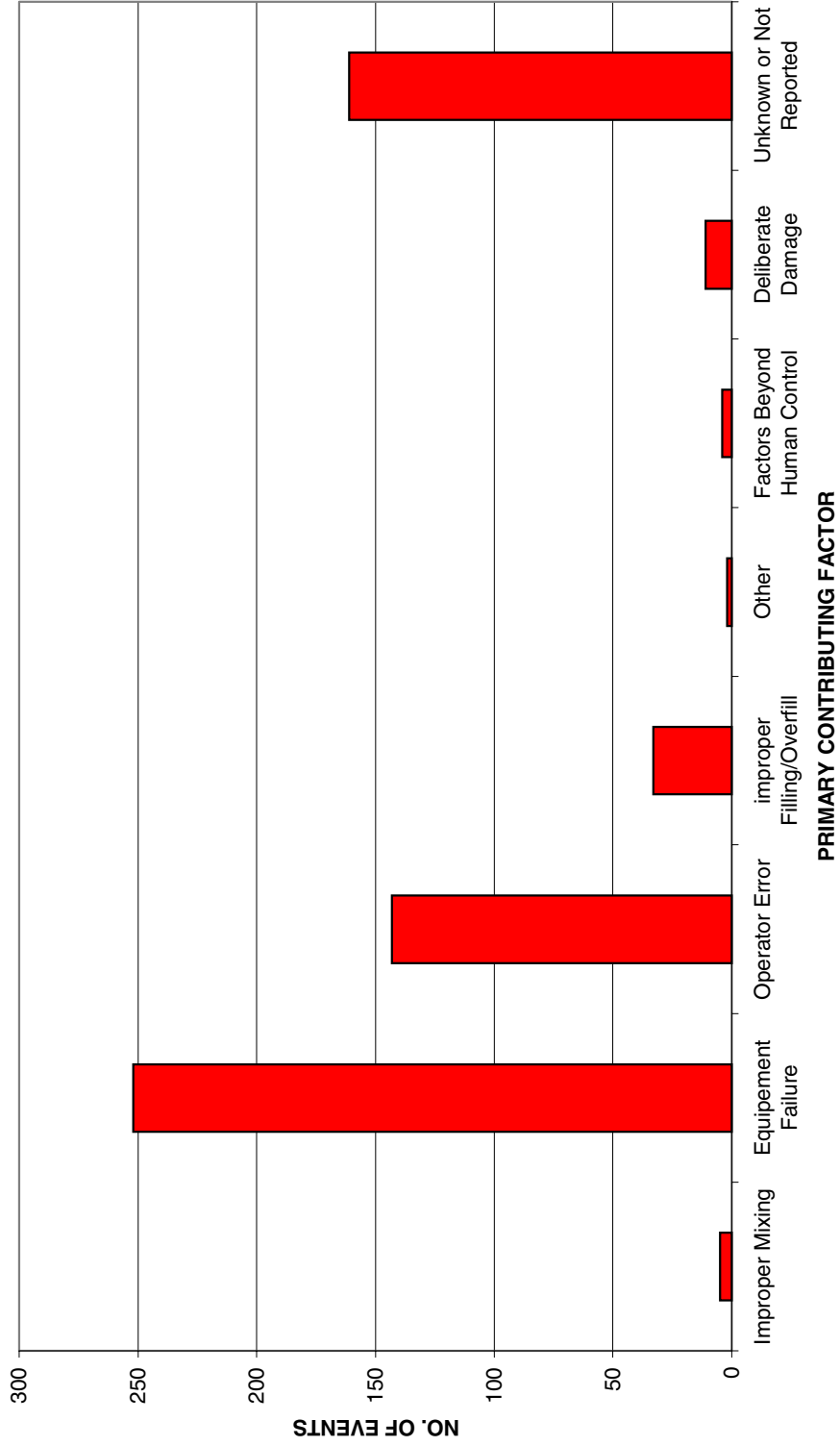


Figure 13

TRANSPORTATION EVENTS, BY TYPE, MN HSEES 1995-1997

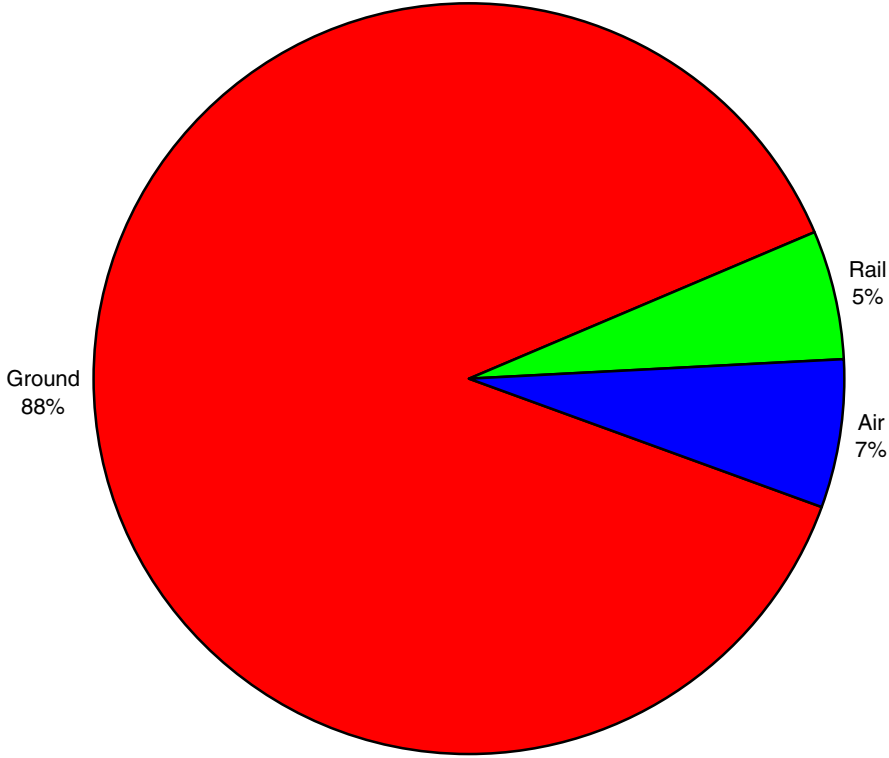


Figure 14

FIXED-FACILITY EVENTS, BY MONTH, MN HSEES 1995-1997

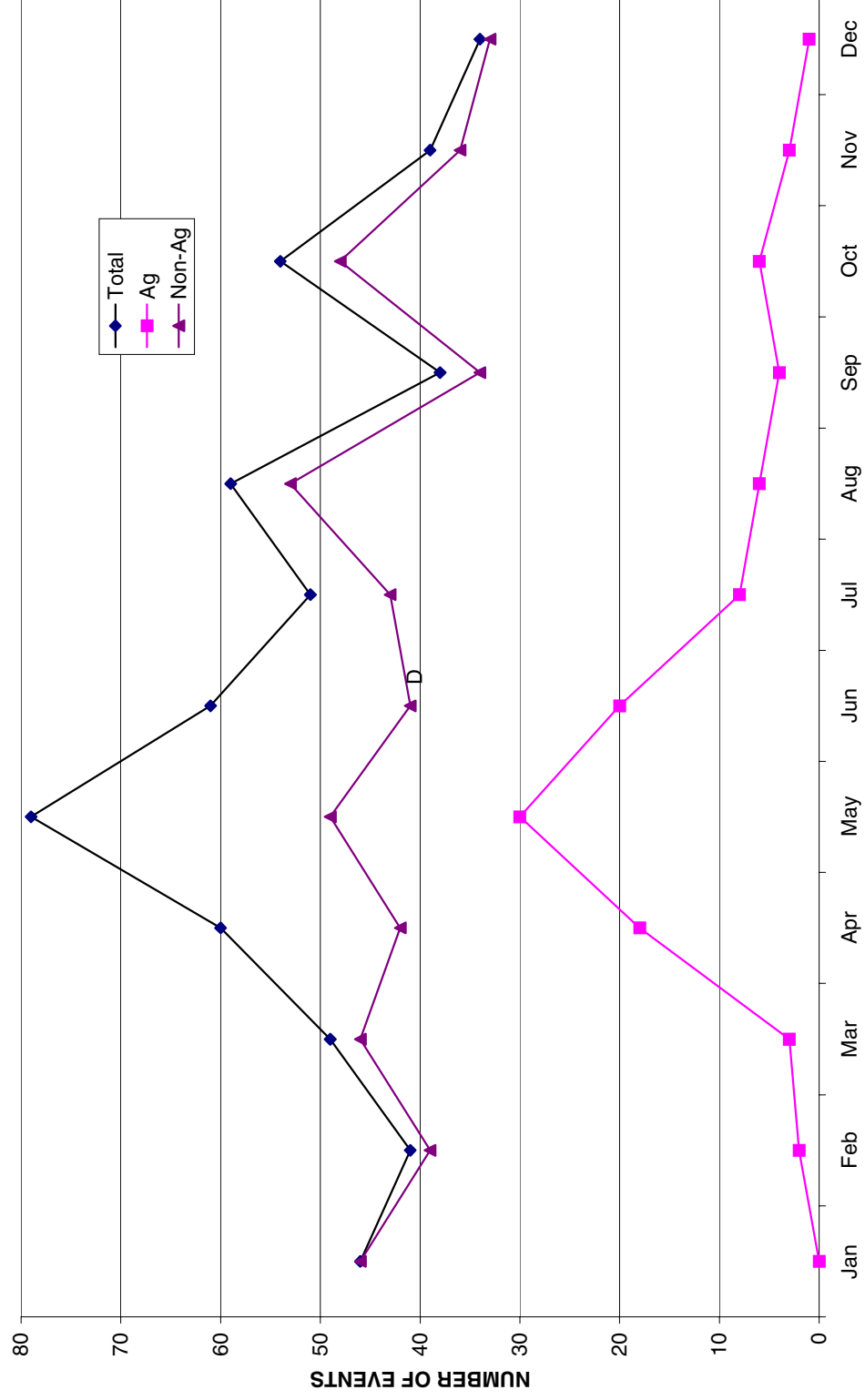


Figure 15

Total, agriculture, and non-agriculture transportation events by month, cumulative for 1995-1997 are shown in Figure 16. There is a strong spring increase in the transportation events. Transportation, non-agriculture events do not have a discernable pattern over the course of a year. Transportation, agriculture events do show a strong spring increase.

Both fixed-facility and transportation events show a significant increase in the number of events during the spring planting season due to the increased use of agricultural products during this time. There is not a monthly pattern in non-agriculture events over the course of a year.

The average number of events in each day of the workweek (135) is 2.3 times larger than the average number of events in each day of the weekend (60) (see Figure 4). For fixed facilities, the average daily number of events on weekdays (103) is 2.2 times the average daily number of events on weekends (47). Figure 17 shows the number of events by day of the week for fixed facilities events. Likewise, Figure 18 shows that, for transportation events, the average daily number of events on weekdays (32) is 2.5 times the average daily number of events on weekends (13). Furthermore, Fixed Facility Events by Day of the Week (Figure 17) shows minor variation in weekday events (range 100 to 107), but Transportation Events by Day of the Week (Figure 18) shows an increase on Tuesday, Wednesday, and Thursday (range 34 to 41) compared to Monday and Friday (range 11 to 15).

TRANSPORTATION EVENTS, BY MONTH, MN HSEES 1995-1997

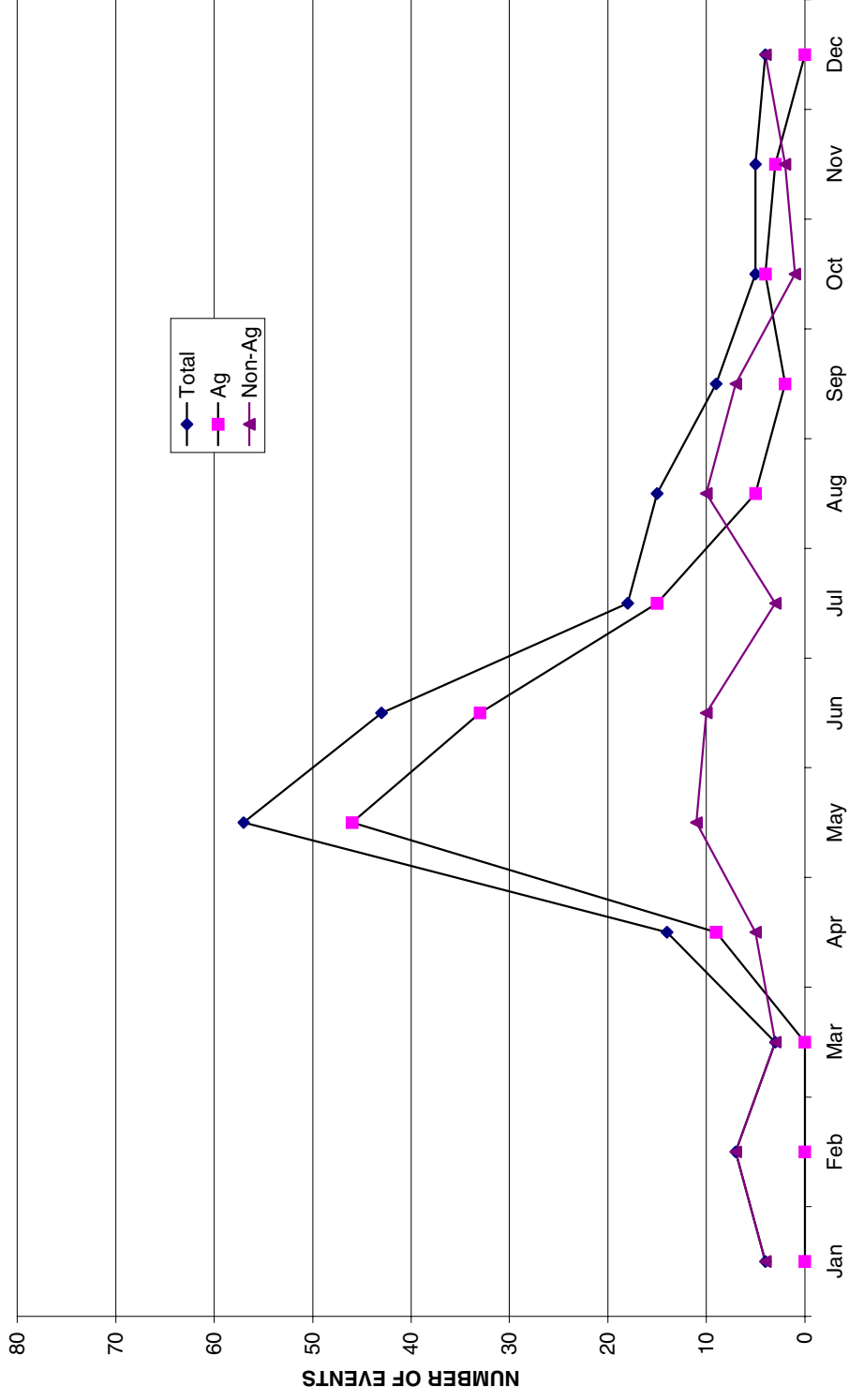


Figure 16

FIXED-FACILITY EVENTS, BY DAY OF THE WEEK, MN HSEES 1995-1997

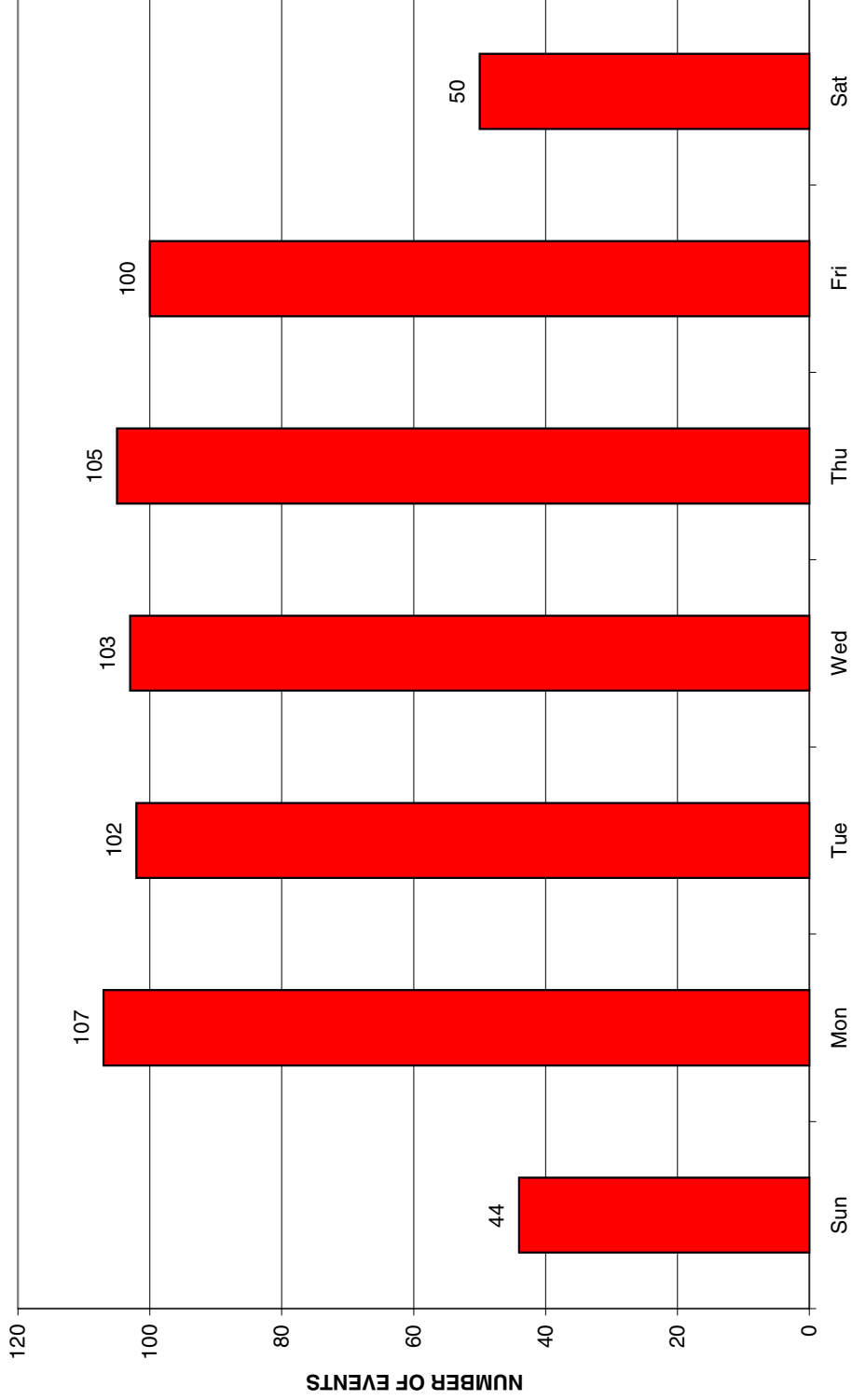


Figure 17

TRANSPORTATION EVENTS, BY DAY OF THE WEEK, MN HSEES 1995-1997



Figure 18

This increase in transportation events raises the total number of events on Tuesday, Wednesday, and Thursday above Monday and Friday (see Figure 4). The cause of the variation in transportation events is most likely related to transportation activity patterns and should be investigated further.

Figure 19 shows fixed facility and transportation events by hour of the day. Events were categorized by hour of the day, 00 to 23. Times are rounded down to the whole hour. Events with an unknown time of release or discovery are counted in the ‘??’ Column. Lines representing the mean average of fixed facility and transportation events are also included in the figure.

For both fixed facility and transportation events, there were few events from 8 P.M. to 6 A.M. There were more events in the morning than in the afternoon.

Assuming the typical business day is from 8 AM to 5 PM, there should be slight variations in the number of fixed-facility events from 8 A.M. to 5 P.M. There should be a drop in the average number of events for the 2nd shift from 6 P.M. to Midnight. The 3rd shift from Midnight to 8 A.M. should have an even lower average number of events.

The fixed-facility curve in Figure 19 does not support this hypothesis. Instead there is a peak at 8 A.M. tapering off toward lunch time. There is a large sharp peak at 2 P.M. The causes of this curve requires further investigation.

**TRANSPORTATION AND FIXED-FACILITY EVENTS, BY HOUR OF THE DAY, MN
HSEES 1995-1997**

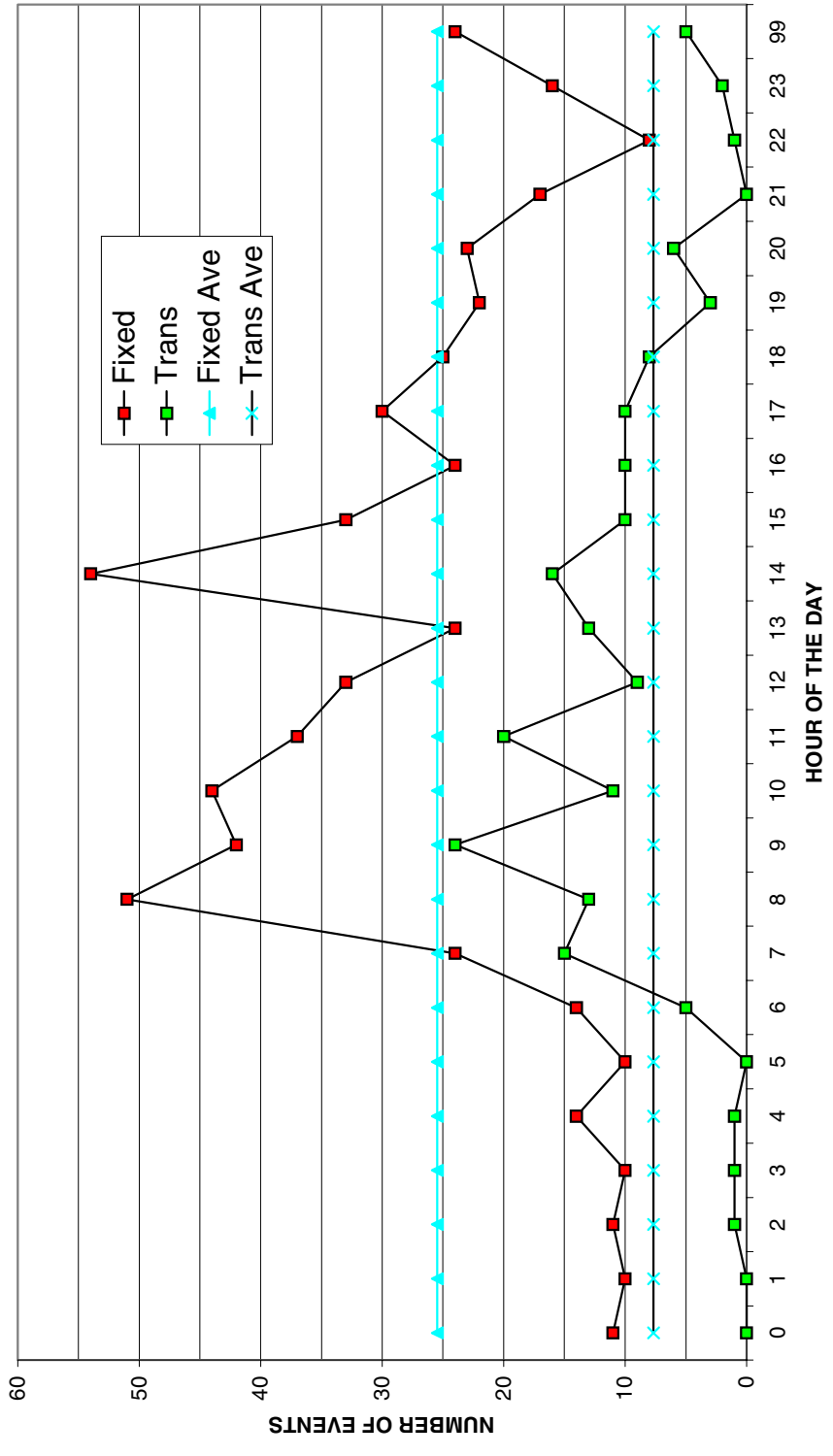


Figure 19

VICTIMS, INJURIES, AND EVACUATIONS

A person is counted as a victim if they suffered an injury(ies) during a hazardous substance emergency event. Because of the difficulty in determining cause and effect, HSEES makes no distinction between injuries sustained because of the emergency event and those sustained incidentally to the emergency event. The HSEES program counts all injuries to a victim reported within 24 hours of the event.

In the 795 events occurring in 1995 to 1997, there were 264 victims with 497 injuries. Of the 60 events with victims, 60% had only 1 victim, 27% had 2 or 3 victims and 13% had 6 or more victims. Fixed facilities had the majority of events with victims (77%). Fixed facilities also had the majority of the victims (91%). However, most events (735) did not result in injuries. Table 3 lists the distribution of the number events and victims by type of event.

Figure 20 shows the distribution of victims by population group and type of event. Employees are the most common victims for both fixed facility and transportation events. Table 4 shows the 497 injuries sustained by the victims. Respiratory irritation is the most common injury (37%), followed by gastrointestinal problems (17%), headache (14%), and eye irritations (14%). Figure 21 reports the level of treatment the victims received. Treatment at a hospital without admission is the most common level of treatment. Only 1 death occurred during 1995-1997 in hazardous substances emergency events.

TABLE 3
DISTRIBUTION OF EVENTS AND VICTIMS, BY TYPE OF EVENT,
MN HSEES 1995-1997

FIXED FACILITY EVENTS									
	95			96			97		
No. of Victims	No. of Events	%	Total Victims	No. of Events	%	Total Victims	No. of Events	%	Total Victims
1	6	31.6	6	8	50.0	8	10	90.9	10
2	3	15.8	6	7	43.8	14	1	9.1	2
3	4	21.1	12	0	0.0	0	0	0.0	0
4	0	0.0	0	0	0.0	0	0	0.0	0
5	0	0.0	0	0	0.0	0	0	0.0	0
≥ 6	6	31.6	144	1	6.2	38	0	0.0	0
Total	19	100.0	168	16	100.0	60	11	100.0	12
TRANSPORTATION EVENTS									
	95			96			97		
No. of Victims	No. of Events	%	Total Victims	No. of Events	%	Total Victims	No. of Events	%	Total Victims
1	4	100.0	4	4	80.0	4	4	80.0	4
2	0	0.0	0	0	0.0	0	0	0.0	0
3	0	0.0	0	0	0.0	0	1	20.0	3
4	0	0.0	0	0	0.0	0	0	0.0	0
5	0	0.0	0	0	0.0	0	0	0.0	0
≥ 6	0	0.0	0	1	20.0	9	0	0.0	0
Total	4	100.0	4	5	100.0	13	5	100.0	7
CUMULATIVE 1995-1997									
	Fixed Facility			Transportation			All Events		
No. of Victims	No. of Events	%	Total Victims	No. of Events	%	Total Victims	No. of Events	%	Total Victims
1	24	52.2	24	12	26.1	12	36	60.0	36
2	11	23.9	22	0	0.0	0	11	18.3	22
3	4	8.7	12	1	2.2	3	5	8.3	15
4	0	0.0	0	0	0.0	0	0	0.0	0
5	0	0.0	0	0	0.0	0	0	0.0	0
≥ 6	7	15.2	182	1	2.2	9	8	13.3	191
Total	46	100.0	240	14	100.0	24	60	100.0	264

**DISTRIBUTION OF VICTIMS, BY POPULATION GROUP AND TYPE OF EVENT,
MN HSEES 1995-1997**

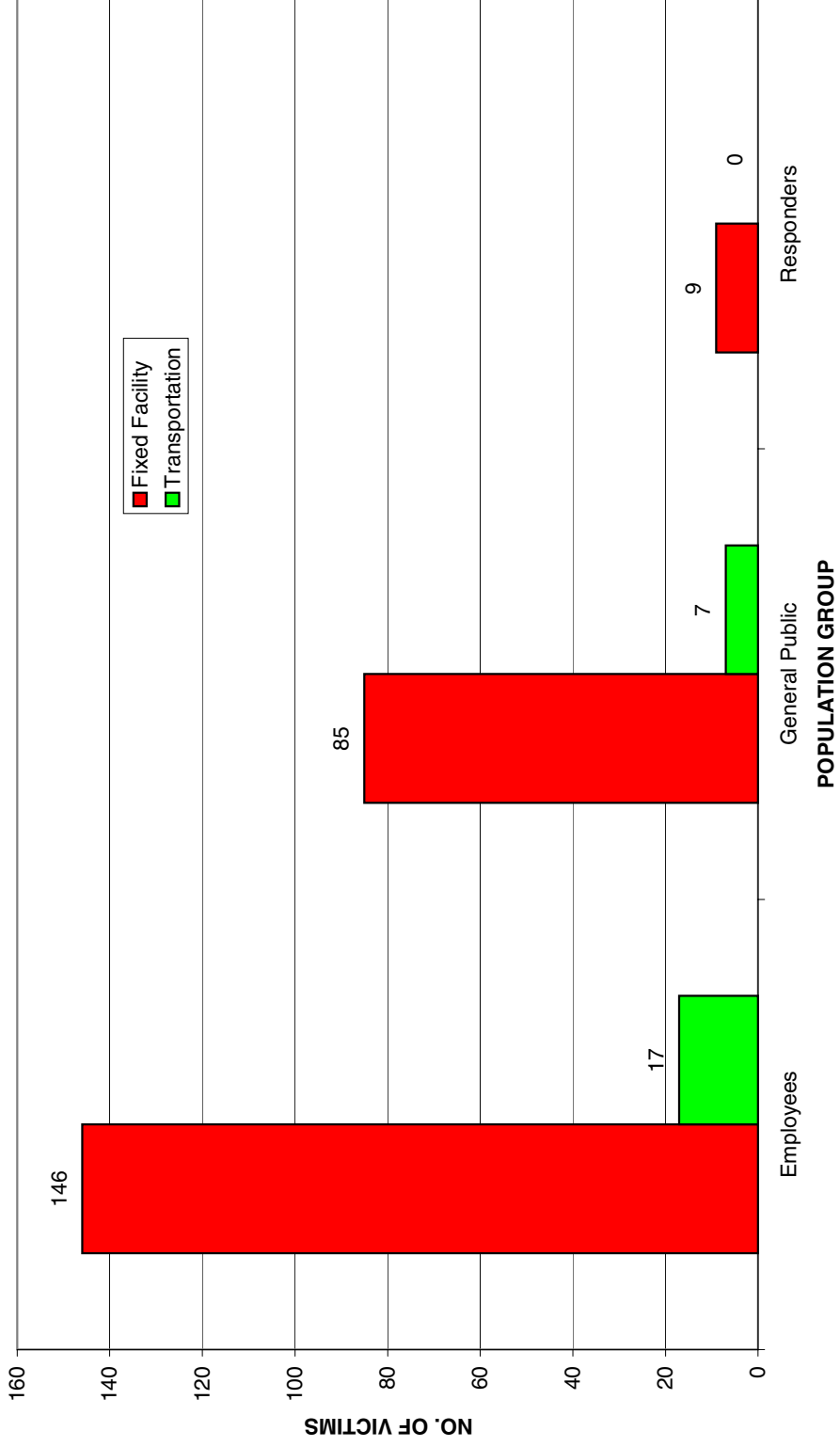


Figure 20

INJURY OUTCOME, MN HSEES 1995-1997

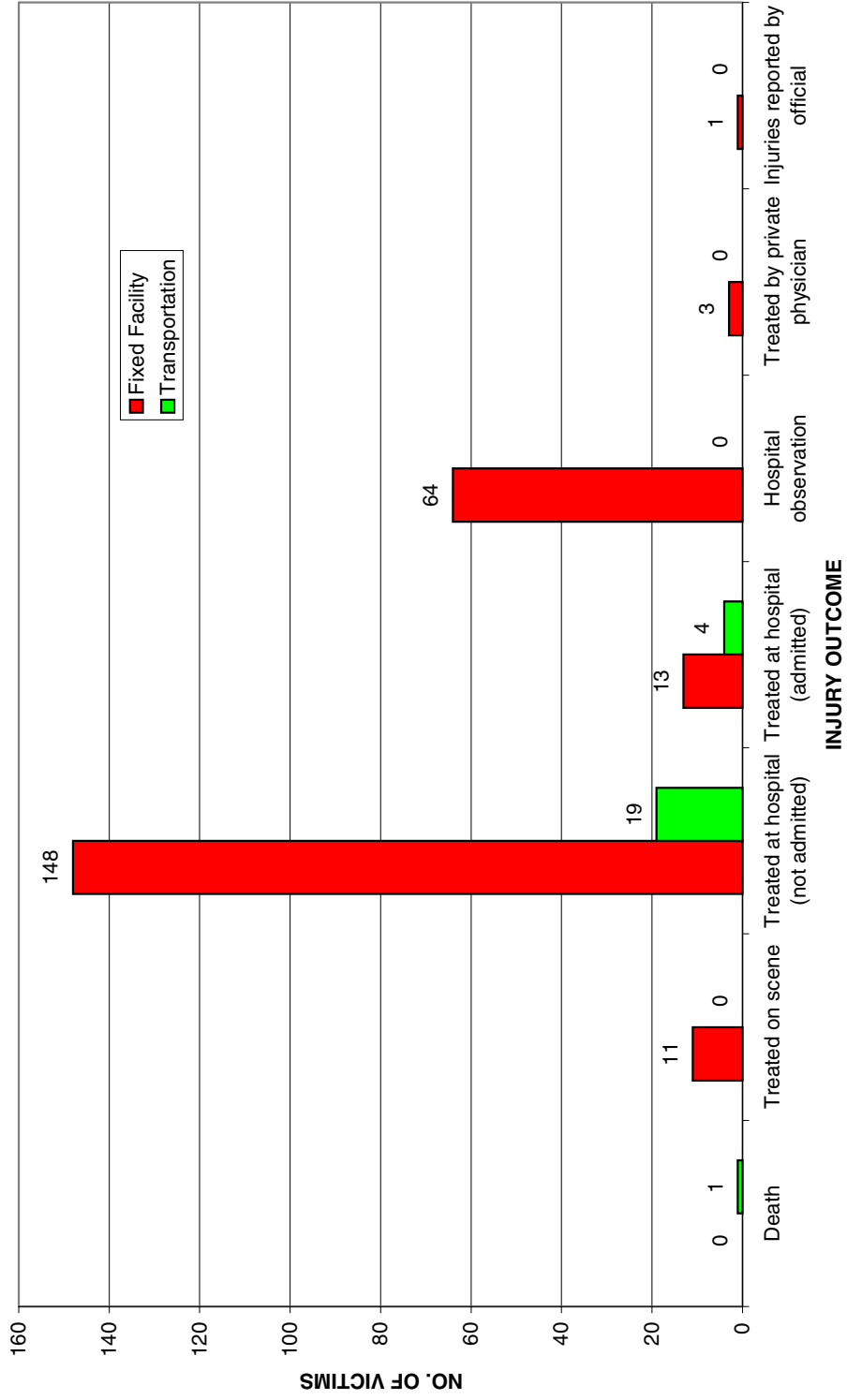


Figure 21

TABLE 4

TYPE OF INJURY, BY TYPE OF EVENT, MN HSEES 1995-1997

TYPE OF INJURY	TYPE OF EVENT					
	FIXED FACILITY		TRANSPORTATION		ALL EVENTS	
	No. of Injuries	%	No. of Injuries	%	No. of Injuries	%
Chemical Burns	19	4.1	0	0.0	19	3.8
Dizziness or other CNS	12	2.6	3	8.1	15	3.0
Eye Irritation	65	14.1	5	13.5	70	14.1
Gastrointestinal Problems	81	17.6	3	8.1	84	16.9
Headache	68	14.8	3	8.1	71	14.3
Other	2	0.4	0	0.0	2	0.4
Respiratory Irritation	174	37.8	12	32.4	186	37.4
Skin Irritation	32	7.0	0	0.0	32	6.4
Thermal Burns	3	0.7	1	2.7	4	0.8
Trauma	3	0.7	10	27.0	13	2.6
Vomiting	1	0.2	0	0.0	1	0.2
TOTAL	460	100.0	37	100.0	497	100.0

Figure 22 shows the percentage of victims by event type (described by the number of victims per event). A large percentage (76%) of victims in fixed-facility events were injured during events with multiple victims (6 victims). In transportation events, 50% of victims were injured during events with only 1 victim.

A brief description of the 3 events with the largest number of injuries is provided below. Victims for these 3 events totaled 149, accounting for over half (56%) of all the victims.

**PERCENTAGE OF VICTIMS, BY EVENT TYPE AND NUMBER OF VICTIMS PER EVENT,
MN HSEES 1995-1997**

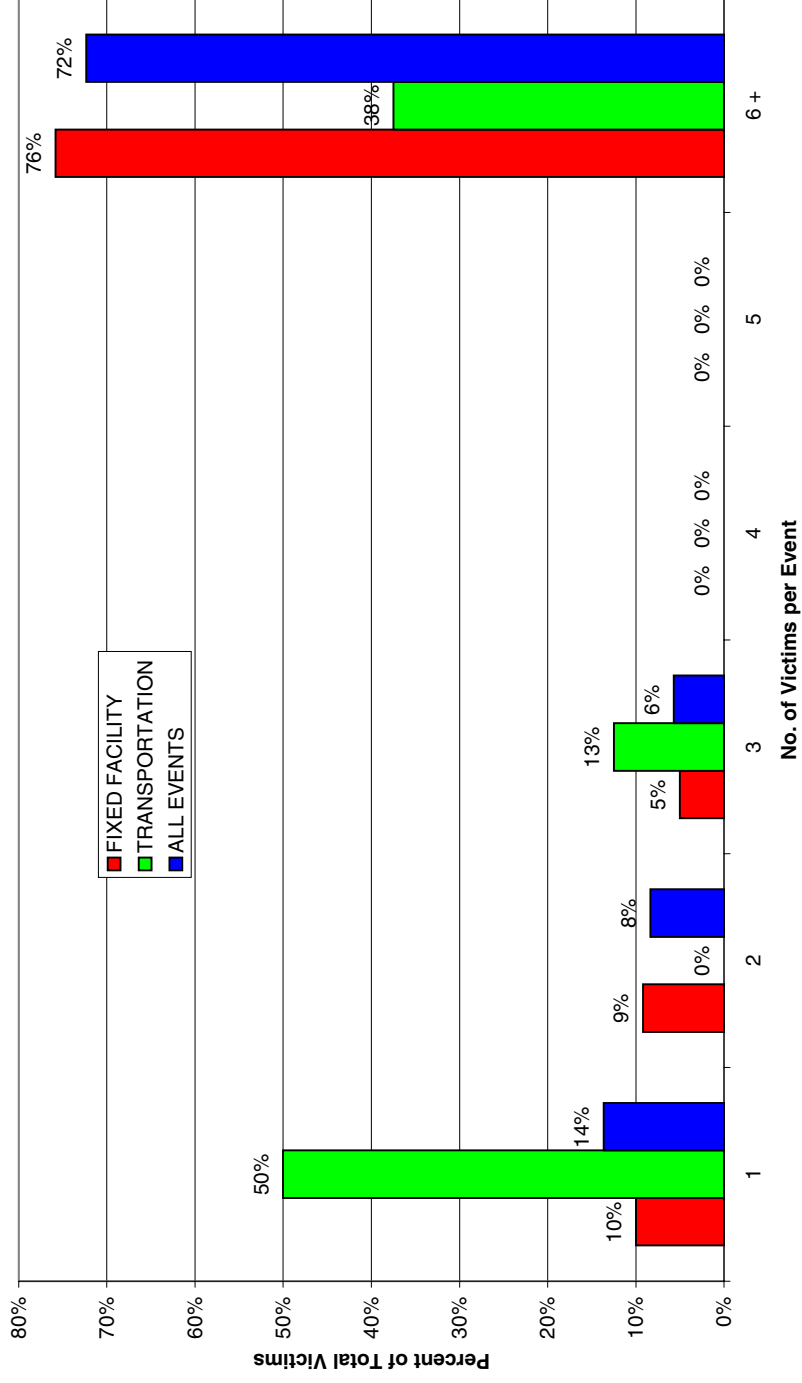


Figure 22

64 victims - A company dealing with hazardous wastes released some methyl mercaptan in mid afternoon. The methyl mercaptan entered a nearby school's ventilation system before it was shut down for the day. The next day, the ventilation system was started up and it distributed the methyl mercaptan throughout the school. Students and faculty started complaining early in the morning. An evacuation of the school, 650 people, was ordered at 10:00. A total of 64 students and staff reported respiratory irritation, nausea, and/or headaches.

46 victims - A grain elevator was using sulfur dioxide as a fumigant. A construction crew broke the pipe from the sulfur dioxide source to the elevator. A total of 46 workers suffered respiratory irritation and/or eye irritation. An evacuation of 110 people was ordered as a result of this event.

38 victims - A student sprayed pepper mace in a school. A total of 38 students and staff reported various symptoms. An evacuation of 1000 people was ordered in this event.

There were 795 events in the 3-year period. Of these 795, 99 events (12%) had evacuations ordered with over 5,122 people evacuated during these events.

In these 99 events with evacuations, 72 (73%) events had no victims. However, 27 of the 99 events had a total of 222 victims. Of the 696 events without an evacuation, 664 (95%) events had no victims, and 32 events had a total of 41 victims. Twenty five of the 32 events had 1 victim, 5 had 2 victims, and 2 had 3 victims. A comparison of events with evacuations with victims and events without evacuations with victims (Table 5) shows that events with evacuations are 5.9 times more likely to have victims than events without evacuations.

TABLE 5
EVENTS, BY EVACUATION AND VICTIM

		Events with Evacuations		
		Yes	No	Total
Events with Victims	Yes	27	32	59
	No	72	664	736
	Total	99	696	795

Figure 23 shows the number of victims by month for 1995-1997. Figure 24 shows the number of events with victims by month for 1995-1997. Figures 25 and 26 show the number of evacuees and the number of events with evacuees by month for 1995-1997. Figure 27 shows the victims by day of the week and Figure 28 shows evacuees by day of the week. In these 6 graphs the numbers are skewed because there are relatively few events with victims or evacuees and those with large numbers of victims or evacuees overshadow the other events. Therefore no conclusions can be drawn from these 6 graphs.

In contrast to the previous 6 graphs, Victims by Hour of the Day (Figure 29) and Evacuees by Hour of the Day (Figure 30) exhibit an expected business day effect. Even so, these numbers are skewed because there are relatively few events with victims or evacuees and those with large numbers of victims or evacuees overshadow the other events.

CUMULATIVE VICTIMS, BY MONTH OF THE YEAR, MN HSEES 1995-1997

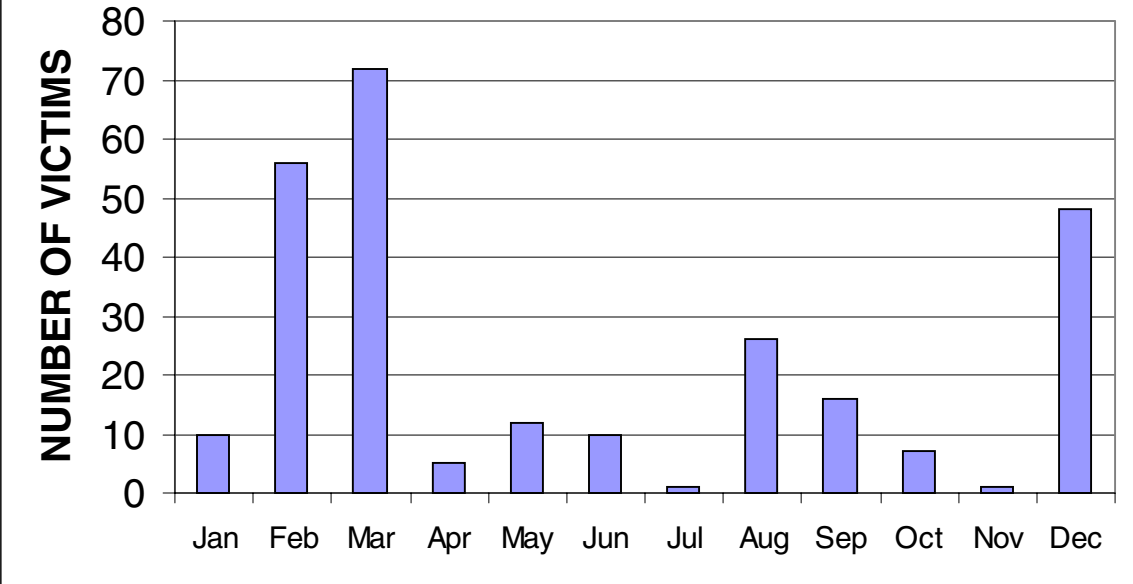


Figure 23

EVENTS WITH VICTIMS, BY MONTH, MN HSEES 1995-1997

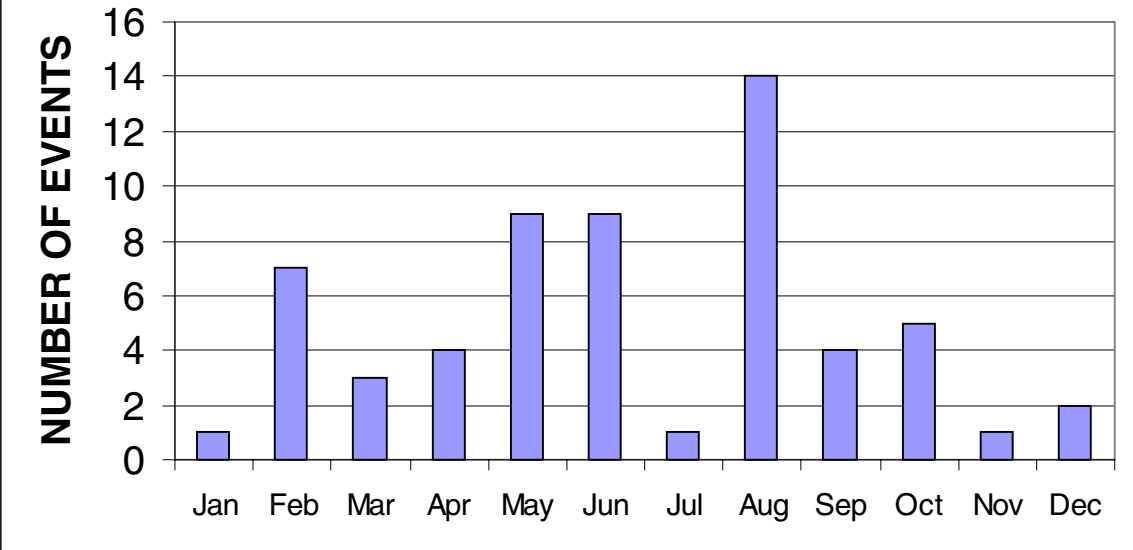


Figure 24

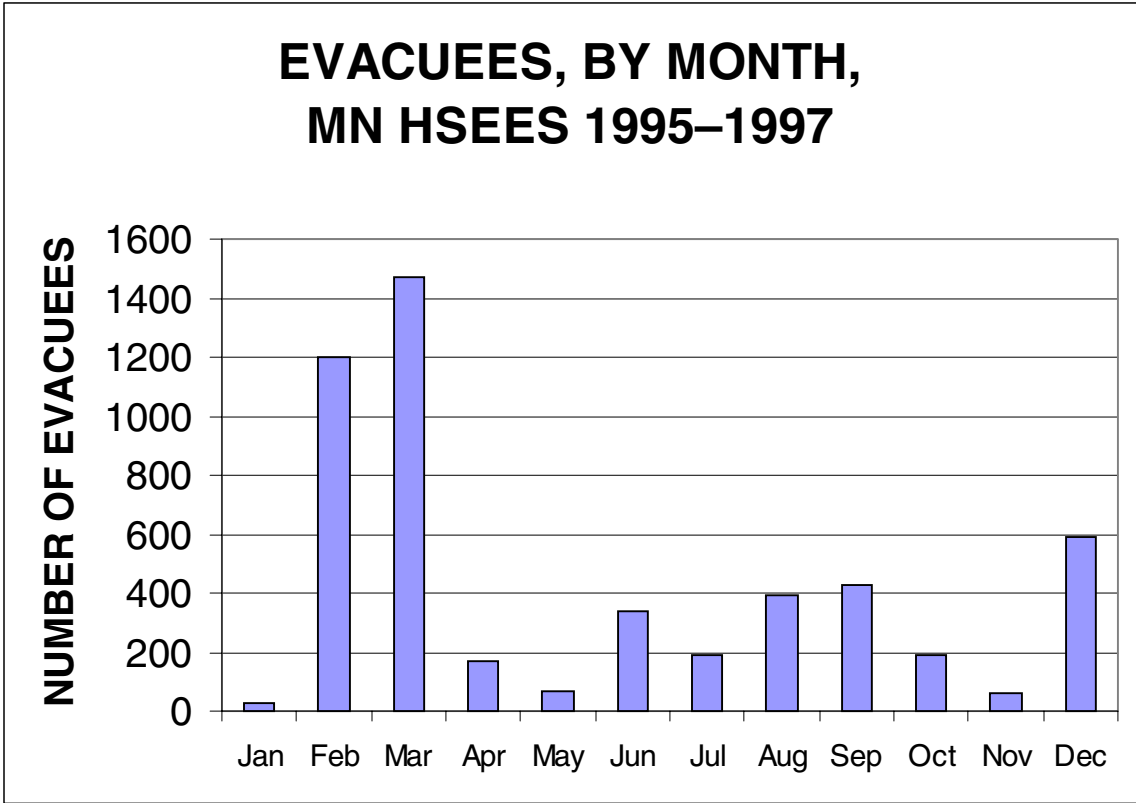


Figure 25

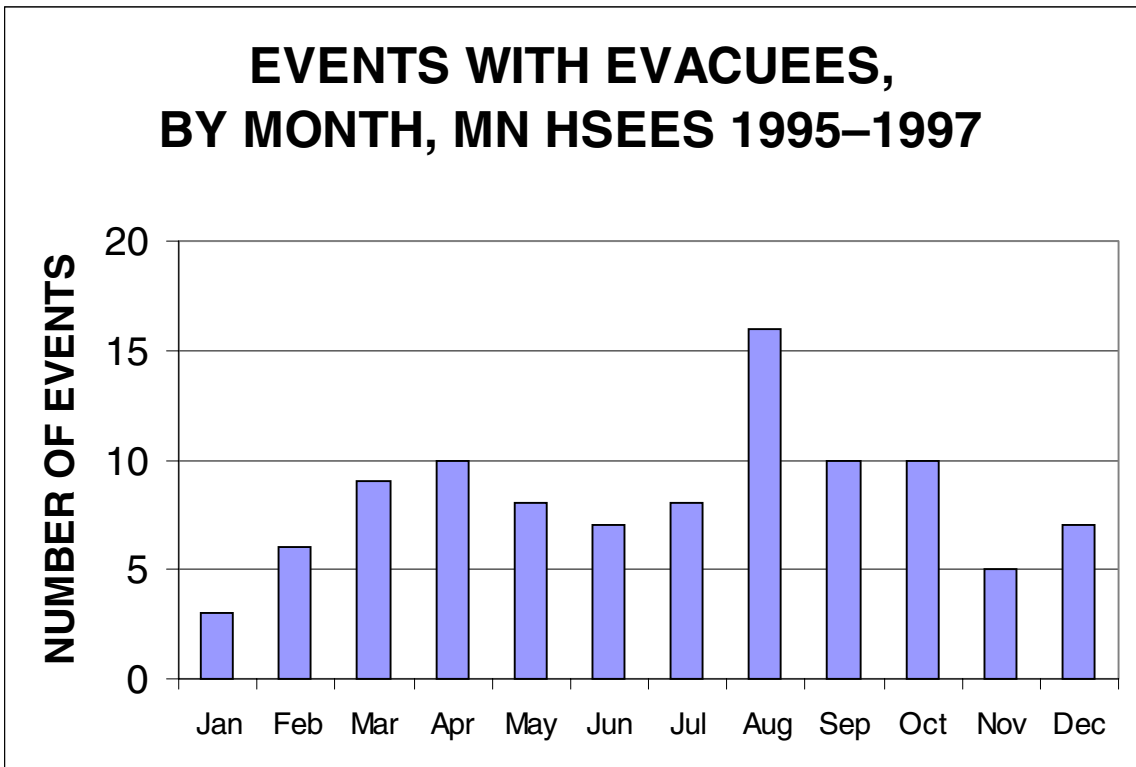


Figure 26

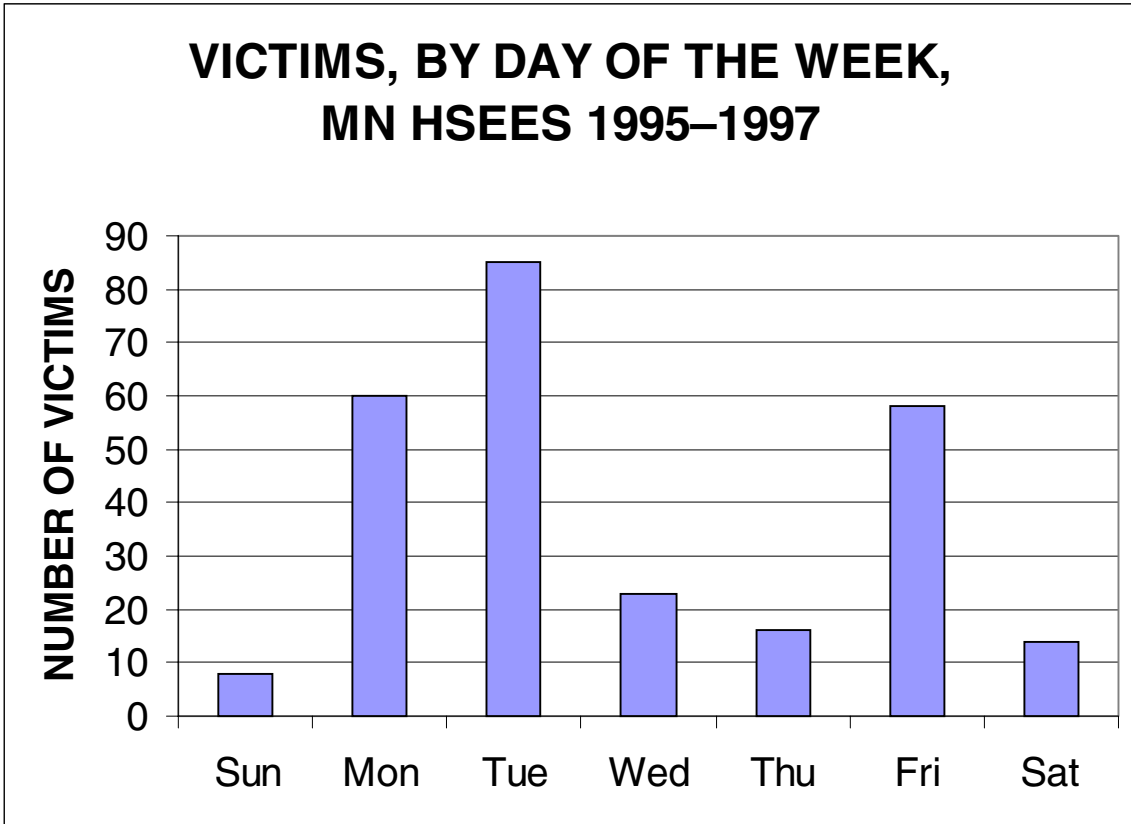


Figure 27

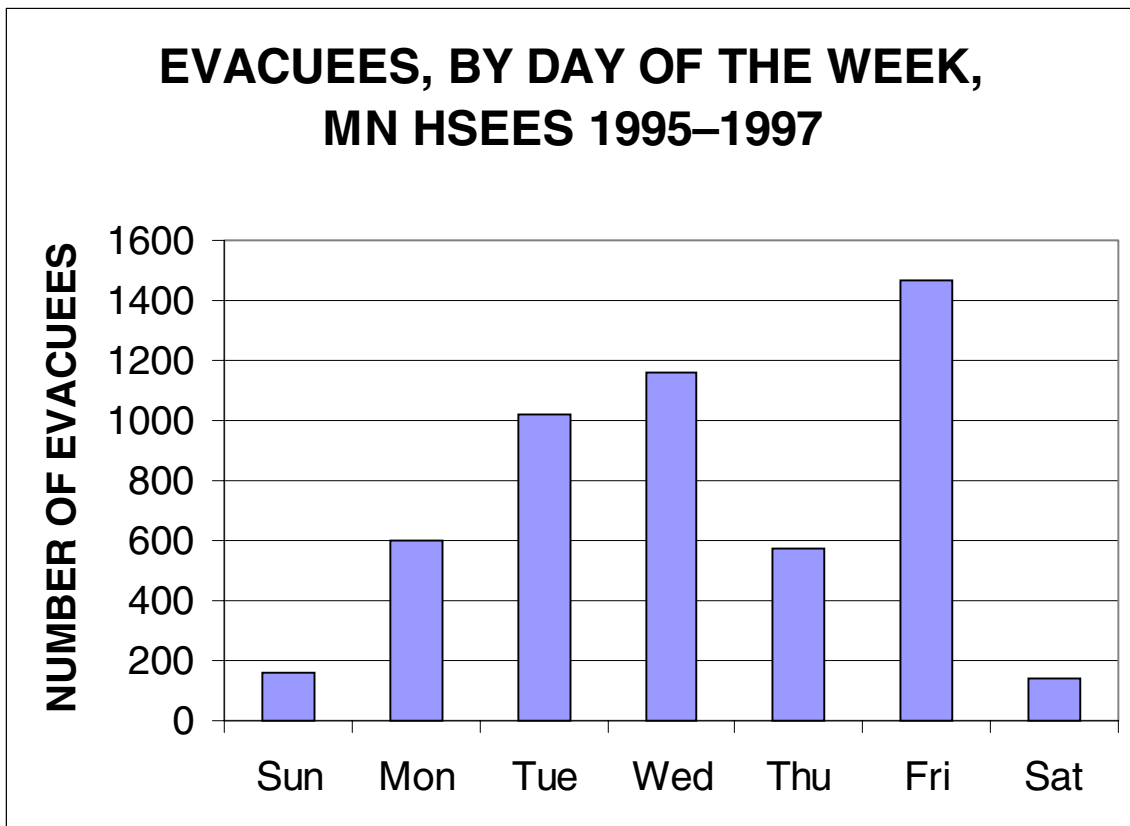


Figure 28

VICTIMS, BY HOUR OF THE DAY, MN HSEES 1995-1997

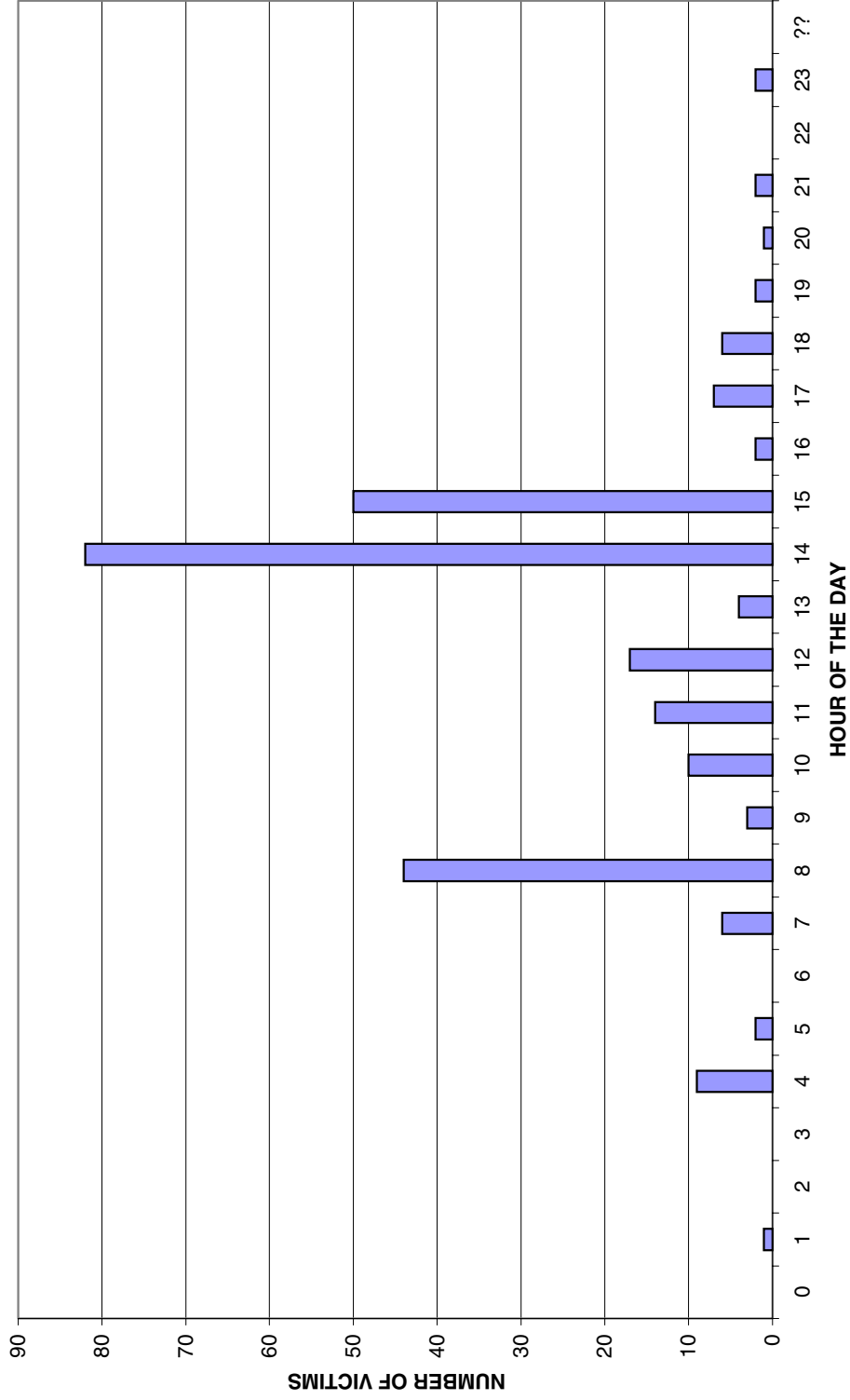


Figure 29

EVACUEES, BY HOUR OF THE DAY, MN HSEES 1995-1997

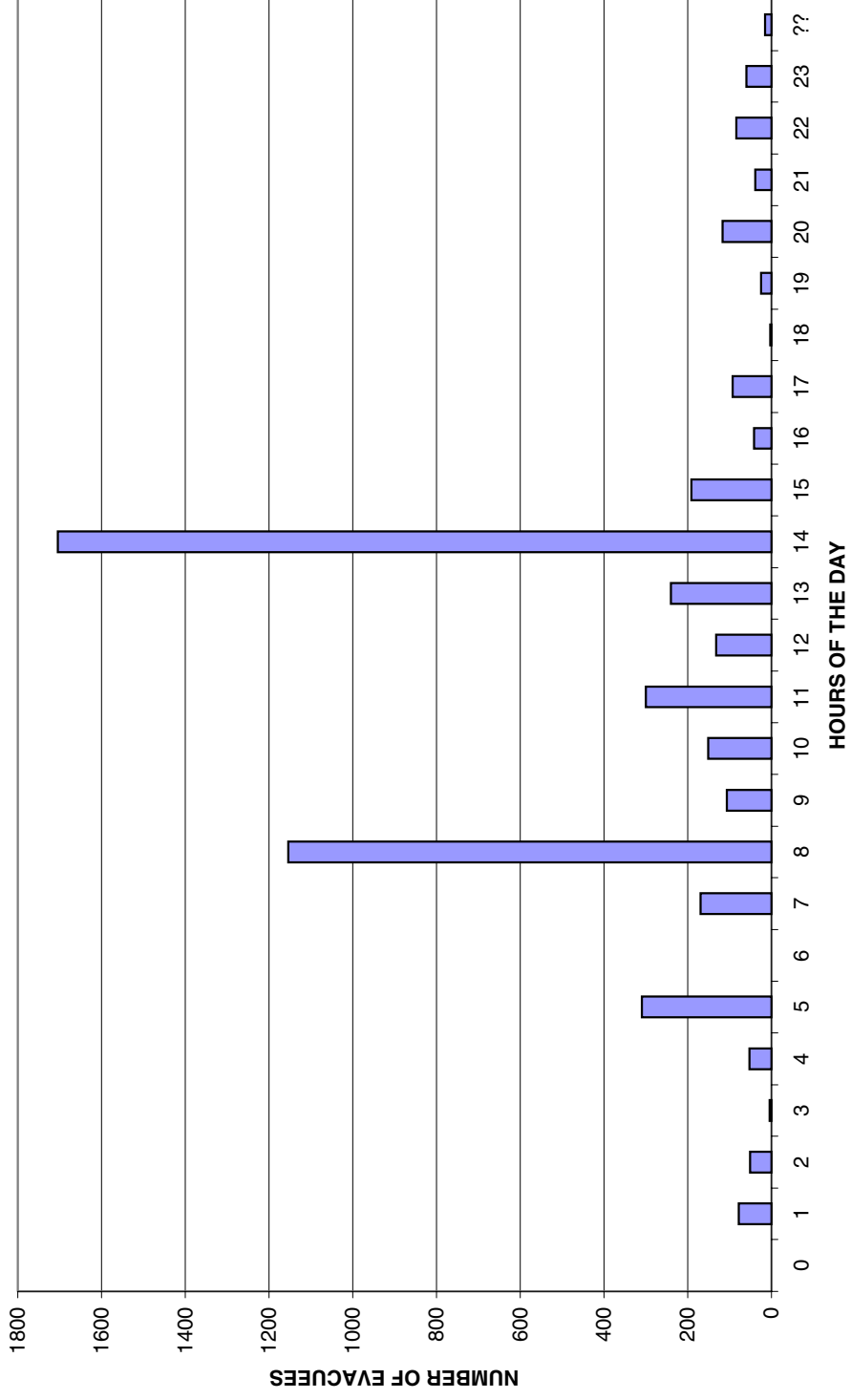


Figure 30

CHEMICAL CATEGORY

There were 1,010 chemicals released during the three years covered by this report. Table 6 shows the breakdown of these chemicals by category. The HSEES program divides chemicals into 11 categories. The category 'mixture' consisted of mixtures of substances from different categories. The category 'other' consisted of substances that could not be placed in one of the other 10 substance categories. The category 'other inorganic substances' comprised all inorganic substances except for acids, bases, ammonia, and chlorine.

The number of chemicals released by chemical category for the 3-year period and by each year is shown in Table 6. Comparing the number of events by category over the 3-year period shows trends in 5 of the categories. There is an increase in the number of 'Ammonia' releases. There is a decrease in the number of 'Other Inorganic Substances' (OISs) releases. The number of 'Volatile Organic Compounds' (VOCs) releases decreases. 'Other' releases also decrease. And there is an increase in the number of 'Mixtures Across Categories' releases. Analysis was done to determine the cause, if any, for these trends.

One event involved 99 chemicals. Removal of this one event, see Table 7, explains some of the trends identified above. Specifically, the decrease in OISs between 1995 and 1996, some of the decrease in VOCs releases, and some of the decrease in 'Other' releases.

The increase in ammonia events is believed to be due to improved reporting of releases and not due to an actual increase in ammonia releases. The increasing use of ammonia for refrigeration may result in increases of ammonia releases. A study of refrigeration ammonia releases should be conducted.

Hydrogen Sulfide (6 in 1995, 17 in 1996, and 6 in 1997), and Sulfur Dioxide (16 in 1995, 7 in 1996, and 4 in 1997) are major contributors to the variation of OISs. The large jump in Hydrogen Sulfide (H₂S) releases in 1996 was due to one facility. This facility has since upgraded their pollution control equipment and has fewer releases. This explains about 1/3 of the drop from 1996 to 1997.

A change in reporting requirements (by MPCA) resulted in Petroleum Refining facilities reporting fewer (15 in 1995, 3 in 1996, and 3 in 1997) releases of Sulfur Dioxide. The reduction in releases of these 2 chemicals accounts for most of the reduction in OISs from 1995 to 1997.

There is no obvious reason for the rest of the trends. Further research is needed to determine the cause of these trends.

TABLE 6
CHEMICALS RELEASED, BY CATEGORY AND YEAR, MN HSEES 1995–1997

YEAR	1995				1996				1997				Cumulative		
	Fixed	(%)	Trans	(%)	Fixed	(%)	Trans	(%)	Fixed	(%)	Trans	(%)	Fixed	Trans	Total
Acids	25	10.4	0	0.0	28	11.0	7	8.0	28	13.7	7	8.9	91	14	105
Ammonia	19	7.9	3	6.4	32	12.6	5	5.7	35	17.2	7	8.9	86	15	101
Bases	5	2.1	1	2.1	12	4.7	1	1.1	7	3.4	2	2.5	28	4	32
Chlorine	6	2.5	0	0.0	7	2.8	0	0.0	3	1.5	0	0.0	16	0	16
Mixture across categories	2	0.8	1	2.1	9	3.5	0	0.0	13	6.4	6	7.6	25	7	32
Other	56	23.3	5	10.6	66	26.0	13	14.9	35	17.2	4	5.1	195	22	217
Other Inorganic Substances	57	23.8	3	6.4	52	20.5	7	8.0	26	12.7	9	11.4	167	19	186
Paints and Dyes	2	0.8	0	0.0	6	2.4	3	3.4	2	1.0	0	0.0	12	3	15
Pesticides	36	15.0	33	70.2	16	6.3	51	58.6	31	15.2	40	50.6	89	124	213
Polychlorinated Biphenyls	9	3.8	1	2.1	8	3.1	0	0.0	14	6.9	1	1.3	31	2	33
Volatile Organic Compounds	23	9.6	0	0.0	18	7.1	0	0.0	10	4.9	3	3.8	57	3	60
TOTAL	240	100.0	47	100.0	254	100.0	87	100.0	204	100.0	79	100.0	797	213	1010

TABLE 7
 CHEMICALS RELEASED, BY CATEGORY AND YEAR
 W/O THE 99 CHEMICAL EVENT, MN HSEES 1995-1997

SUBSTANCE CATEGORY	1995				1996				1997				Cumulative		
	Fixed	(%)	Trans	(%)	Fixed	(%)	Trans	(%)	Fixed	(%)	Trans	(%)	Fixed	Trans	Total
Acids	25	10.4	0	0.0	28	11.0	7	8.0	28	13.7	7	8.9	81	14	95
Ammonia	19	7.9	3	6.4	32	12.6	5	5.7	35	17.2	7	8.9	86	15	101
Bases	5	2.1	1	2.1	12	4.7	1	1.1	7	3.4	2	2.5	24	4	28
Chlorine	6	2.5	0	0.0	7	2.8	0	0.0	3	1.5	0	0.0	16	0	16
Mixture across categories	2	0.8	1	2.1	9	3.5	0	0.0	13	6.4	6	7.6	24	7	31
Other	56	23.3	5	10.6	66	26.0	13	14.9	35	17.2	4	5.1	157	22	179
Other Inorganic Substances	57	23.8	3	6.4	52	20.5	7	8.0	26	12.7	9	11.4	135	19	154
Paints and Dyes	2	0.8	0	0.0	6	2.4	3	3.4	2	1.0	0	0.0	10	3	13
Pesticides	36	15.0	33	70.2	16	6.3	51	58.6	31	15.2	40	50.6	83	124	207
Polychlorinated Biphenyls	9	3.8	1	2.1	8	3.1	0	0.0	14	6.9	1	1.3	31	2	33
Volatile Organic Compounds	23	9.6	0	0.0	18	7.1	0	0.0	10	4.9	3	3.8	51	3	54
TOTAL	240	100.0	47	100.0	254	100.0	87	100.0	204	100.0	79	100.0	698	213	911

CHEMICALS RELEASED

The total number of chemicals released for the 3 year period, 1995 – 1997, and for each year is plotted by month in Figure 31. The peak in February, 1995, is due to one event with 99 chemicals. The rest of the graph appears similar to Figure 1. The peak in August is more pronounced than the August peak in Figure 1. There were more events in August (74) than July (69) or September (47). Also, 6 of the 28 (21%) events in August of 1995 had more than 1 chemical released. Therefore, the number of chemicals released in August is higher than that of July or September. Table 8 shows that only 8 % of all events have multiple chemicals released.

Figure 32 (Chemicals Released by Day of the Week) shows similar trends as Figure 4, except Saturday is skewed because of one event with 99 chemicals. Removing this one event drops the number of chemicals to 73. Again, Monday and Friday have fewer chemical releases than Tuesday, Wednesday, and Thursday.

Figure 33 (Chemicals Released by Hour of the Day) shows similar trends as Figure 5, except Hour 23 is skewed by an event with 99 chemicals. Removing this one event leaves 26 chemicals for that hour. Lunch time also shows fewer chemicals released than the rest of the business day.

Table 9 lists the top 10 chemicals released during 1995 to 1997.

NUMBER OF CHEMICALS RELEASED, BY MONTH, MN HSEES 1995-1997

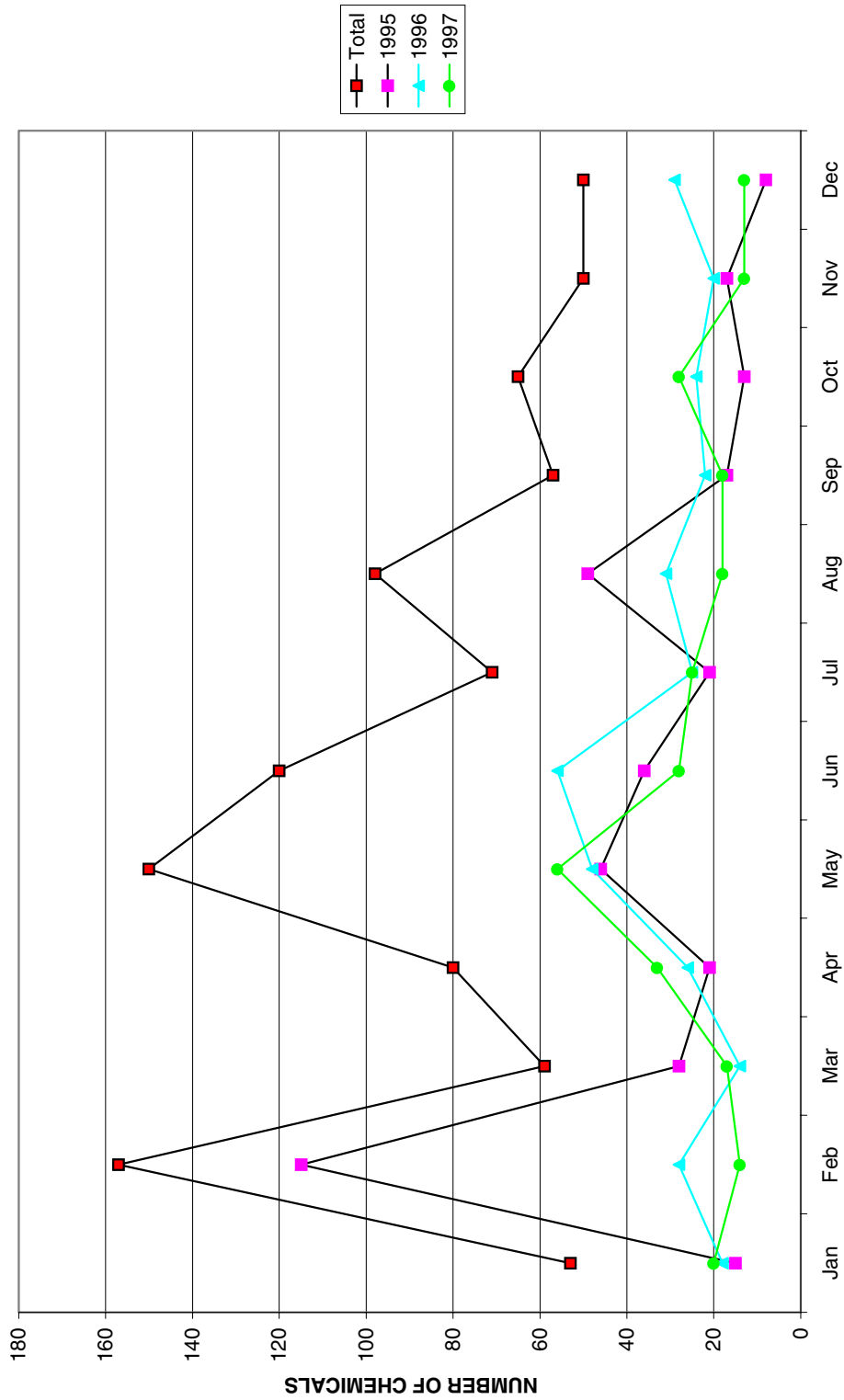


Figure 31

TABLE 8

DISTRIBUTION OF THE NUMBER OF CHEMICALS RELEASED PER EVENT

MN HSEES 1995-1997

NO. OF SUBSTANCES RELEASED	TYPE OF EVENT				ALL EVENTS	
	FIXED FACILITY		TRANSPORTATION			
	NO. OF EVENTS	(%)	NO. OF EVENTS	(%)	TOTAL NO. OF EVENTS	(%)
1	560	91.7	168	91.3	728	91.6
2	34	5.6	8	4.3	42	5.3
3	6	1.0	5	2.7	11	1.4
4	3	0.5	1	0.5	4	0.5
5	4	0.7	2	1.1	6	0.8
≥6	4	0.7	0	0.0	4	0.5
TOTAL	611	100.0	184	100.0	795	100.0

CHEMICALS RELEASED, BY DAY OF THE WEEK, MN HSEES 1995-1997

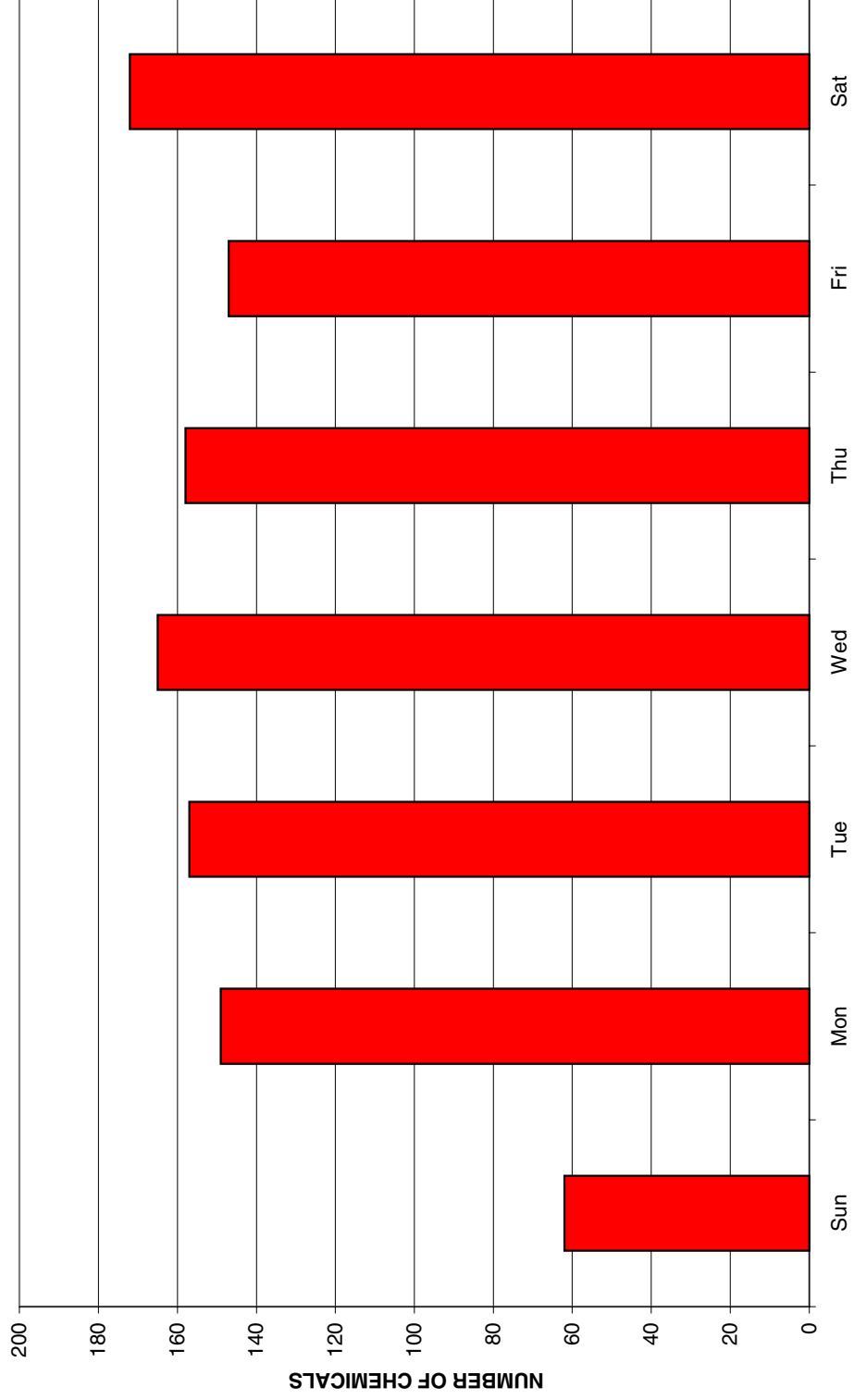


Figure 32

CHEMICALS RELEASED, BY HOUR OF THE DAY, MN HSEES 1995-1997

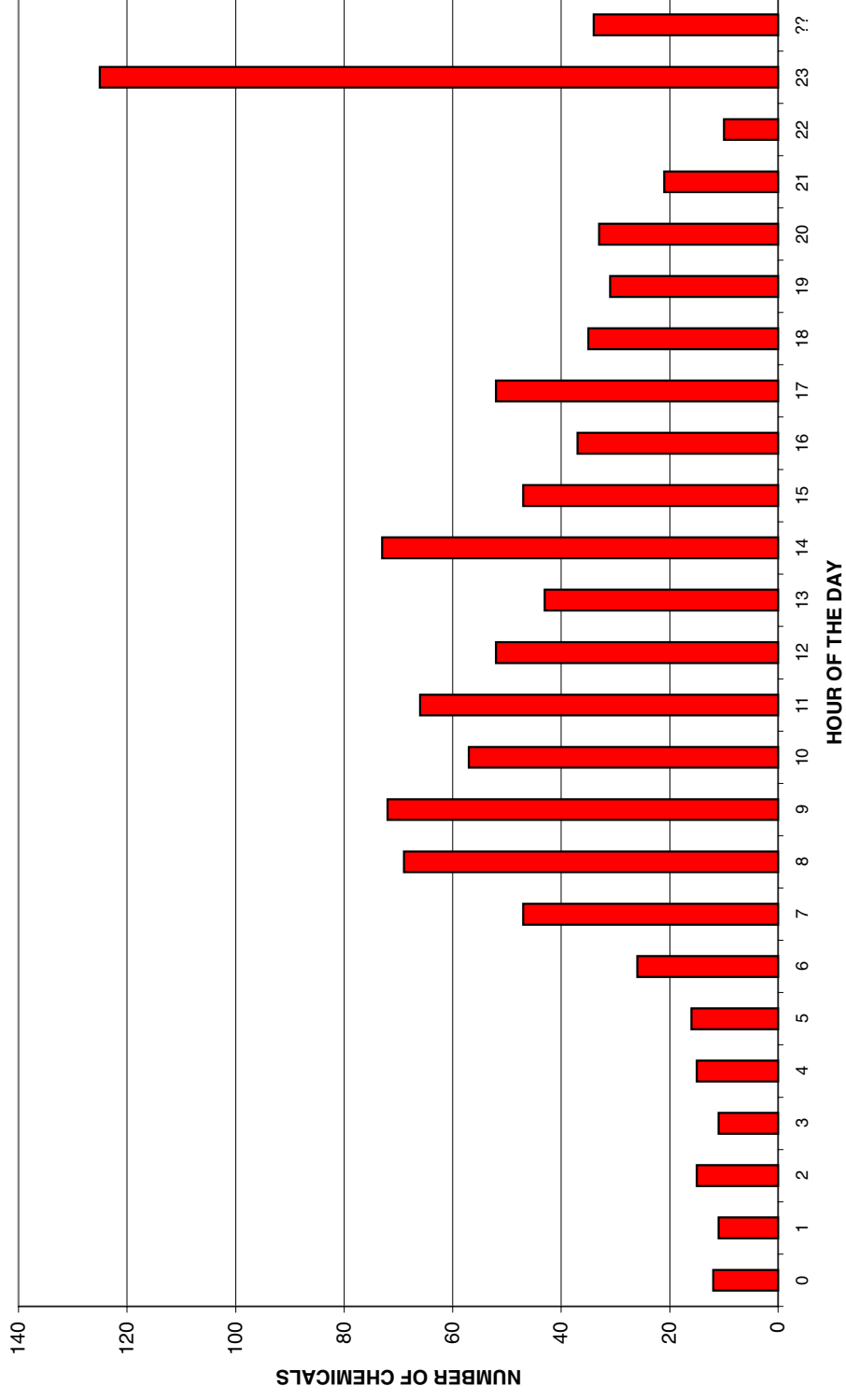


Figure 33

TABLE 9
 TOP 10 MOST FREQUENTLY RELEASED CHEMICALS
 MN HSEES 1995-1997

<u>Standard Chemical Name</u>	<u>Number of Releases</u>	<u>Percentage of all Releases</u>
Ammonia	98	9.7
Sulfuric Acid	38	3.8
Polychlorinated Biphenyls	33	3.3
Hydrogen Sulfide	29	2.9
Ethylene Glycol	27	2.7
Sulfur Dioxide	27	2.7
Pendimethalin	26	2.6
Hydrochloric Acid	25	2.5
Indeterminate	25	2.5
Sodium Hydroxide	23	2.3
TOTAL FOR TOP 10	351	34.8

Appendix 1 lists the Standard Chemical Name used by the HSEES program and the number of releases for that chemical from 1995 to 1997.

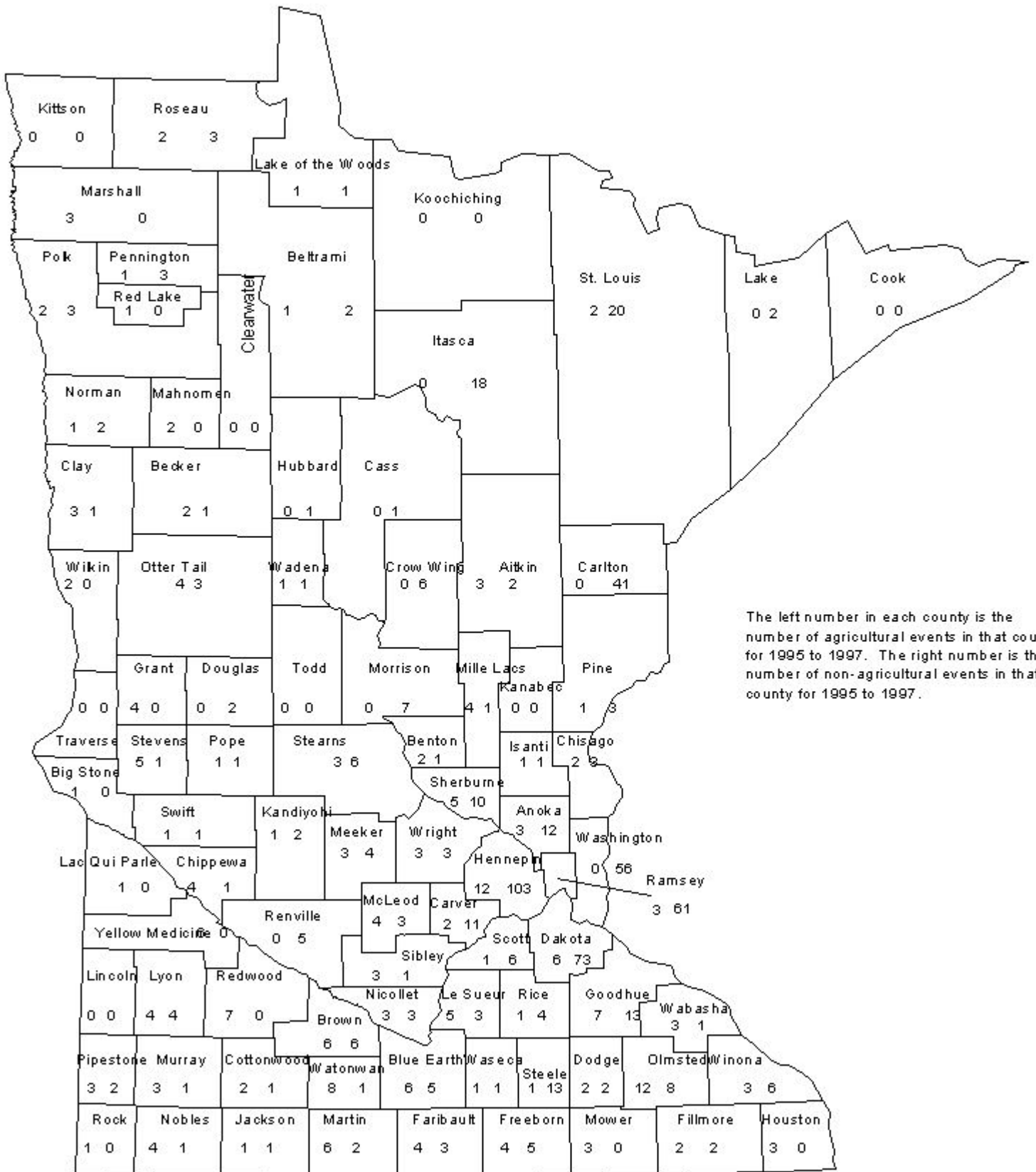
GEOGRAPHICAL TRENDS

Approximately half (400) of all events occurred in the 10 counties with major metropolitan centers. The other half (395) occurred in the 77 rural counties. The counties of Anoka, Carver, Dakota, Hennepin, Olmsted, Ramsey, Scott, St. Louis, Stearns, and Washington comprise the urban counties. Including fertilizer, pesticide, and herbicide releases from lawn care services, the 10 urban counties had 44 agricultural spills. This is 11% of the total number of spills in those counties. The rural counties had 174 agricultural releases, 44% of the total rural spills.

Appendix 2 lists the number of events by county. It also lists the events by year by county. Finally, the table shows the number of agricultural events, non-agricultural events and the percentage of agricultural events.

Figure 34 shows some of the same information as Appendix 2 but in a different way. The left number in each county is the number of agricultural events in that county for 1995 to 1997. The right number is the non-agricultural events.

AGRICULTURAL AND NON-AGRICULTURAL EVENTS BY COUNTY, MN HSEES 1995-1997



The left number in each county is the number of agricultural events in that county for 1995 to 1997. The right number is the number of non-agricultural events in that county for 1995 to 1997.

CONCLUSIONS

In Minnesota there are several factors that determine when and where hazardous chemicals are released. The use of agricultural products during the spring planting season greatly increases the number of events occurring in April, May, June, and July. During these 4 months, 82 % of all agricultural events occur. Agricultural events account for 27 % of all events recorded by the HSEES program.

Transportation events peak on Tuesday and taper off the rest of the week. Fixed-facility events do not vary much during the work week. The weekends days have half as many events as workweek days. Occurrence of events on a day by day basis follow the business work week.

Occurrence of events follow the business work day on an hour by hour basis. The normal work hours have the most events. Second shift, 4 P.M. to Midnight, has fewer events. Third shift has the fewest events. Most events occur when most people are at work.

Fixed-facility events are 77% of all events, and affect more people than transportation events do. They account for 79% of the chemicals, 91% of the victims, and 99% of the evacuees. Transportation events account for 21% of the chemicals, 9% of the victims, and 1% of the evacuees. Most of the victims are facility employees. There typically are more people around a fixed-facility event, and therefore, these numbers makes sense.

In all, there were 795 events. Of these, 264 events resulted in people being injured. These victims reported 497 injuries. Of the events with victims, 87% had 3 or fewer victims.

The HSEES program divides chemicals into 11 categories. Excluding one event which released 99 chemicals, the most commonly released chemical category is pesticides. Ammonia and Sulfuric Acid are the most commonly released chemicals.

The most common injuries are respiratory irritation, gastrointestinal problems, headache, and eye irritation.

Further research needs to be done to determine which chemicals are resulting in the most injuries and what can be done to minimize the injuries from these chemicals.

APPENDIX 1

CHEMICALS RELEASED, MN HSEES 1995-1997

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
1,1,1,2-Tetrafluoroethane	1
1,1,1-Trichloroethane	2
1,3-Dichloro-1,1,2,2,3-Pentafluoropropane	1
1-Bromo-3-chloro-5,5-dimethyl-2,4-imidazolidinedione	1
1-Hydroxyethylidene-1,1-Diphosphonic Acid	1
2,4-D	9
2-Butoxyethanol	1
2-Ethylhexanol	1
2-Phosphono-1,2,4-Butanetricarboxylic Acid	1
Acephate	4
Acetic Acid	3
Acetochlor	6
Acetone	3
Acid NOS	1
Acrylic NOS	1
Adhesive NOS	3
Aero Foam	1
Alachlor	2
Alkane NOS	1
Alkyd Resin	1
Alkyl Dimethyl Benzyl Ammonium Chloride	1
alpha-Methyl Styrene	1
alpha-Pinene	1
Aluminum Oxide	1
Aluminum Phosphide	1
Aluminum Sulfate	5
Ammeline	1
Ammonia	98
Ammonium Hydroxide	3
Ammonium Nitrate	1
Ammonium Picrate	1
Ammonium Sulfate	4

Standard Chemical NameNumber of Releases

Atrazine	7
Barium Sulfate	1
Benomyl	1
Bentazone	1
Black Liquor	10
Boron Trifluoride	1
Bromine	1
Bromine NOS	1
Bromophenol Blue	1
Bromoxynil	1
Butyric Acid	1
Calcium Carbonate	1
Calcium Chlorate	1
Calcium Chloride	2
Calcium Hydroxide	1
Calcium Hypochlorite	5
Calcon	1
Carbaryl	4
Carbon Black	1
Carbon Monoxide	1
Carboxin NOS	2
Cellosolve Solvent	1
Cesium 137	1
Charcoal	1
Chlorine	16
Chlorine Dioxide	1
Chloroform	1
Chlorothalonil	4
Chlorpyrifos	4
Choline Chloride	1
Chromic Acid	3
Chromic Acid NOS	1
Chromium NOS	2
Citric Acid	2
Clarity	1

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
Cleaning Agent NOS	2
Copper Carbonate	1
Copper Chloride	1
Copper Sulfate	1
Creosote	1
Cyanazine	4
Cyanuric Acid	1
Cyclomethicone	1
Cyfluthrin	1
Diallate	1
Dicamba	4
Dicamba NOS	1
Dichloroisocyanuric Acid	1
Dicyclopentadiene	1
Dienochlor	1
Diethylene Glycol	1
Dimethenamid	5
Dimethoate	1
Dimethylformamide	1
Dinitrophenol	1
Dipotassium Phosphate	1
Dipropylene Glycol Methyl Ether	1
Diuron	1
Dodecylbenzenesulfonic Acid	1
Dowtherm	1
d-trans-Allethrin	1
Dye NOS	1
EDTA NOS	1
Electrolyte NOS	1
EPTC	1
Esfenvalerate	1
Ethalfuralin	1
Ethanol	14
Ethanolamine	2
Ethyl Acetate	2

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
Ethyl Benzene	1
Ethylene Glycol	27
Explosives	1
Extrazine	4
Fenitrothion	1
Ferric Chloride	2
Ferrous Chloride	1
Ferrous Sulfate	3
Fiberglass Resin	1
Fire Fighting Foam NOS	1
Flumetsulam	1
Flumiclorac Pentyl Ester	1
Fluorosilicic Acid	1
Flutolanil	1
Formaldehyde	4
Formaldehyde NOS	1
Formalin	1
Freon 11	1
Freon 22	7
Freon NOS	1
Glycol Ether NOS	1
Glyphosate Isopropylammonium	5
Hexavalent Chromium NOS	1
Hydrazine	4
Hydrochloric Acid	25
Hydrochloric Acid NOS	1
Hydrofluoric Acid	6
Hydrofluosilicic Acid	2
Hydrogen Peroxide	1
Hydrogen Sulfide	29
Hydroxylamine Hydrochloride	1
Hypochlorite NOS	1
Imazamethabenz-methyl	1
Imazethapyr	5
Indeterminate	25

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
Isobutyric Acid	1
Isocyanate NOS	1
Isopropanol	2
Isopropylamine	1
L.P.G. (CAS 68476-85-7)	1
Lacrimating Agent NOS	3
Limonene	1
Lindane	2
Lithium	1
Lithium Carbonate	1
Lithium Chlorate	1
Lithium Chloride	1
Lithium Fluoride	1
Lithium Hydroxide	1
Lithium Hypochlorite	1
Lithium Sulfate	1
Magnesium Carbonate	1
Magnesium Chloride NOS	1
Malathion	6
Malic Acid	2
Mancozeb	1
MCPA	1
Melamine	1
Mercaptan NOS	1
Mercury	10
Methanol	5
Methyl Bromide	1
Methyl Ethyl Ketone	2
Methyl Ethyl Ketone Peroxide	2
Methyl Ethyl Ketone Peroxide NOS	1
Methyl Mercaptan	22
Methylene Bisphenyl Isocyanate	2
Methylene Chloride	2
Metolachlor	2
Mineral Oil	1

Standard Chemical NameNumber of Releases

MIX: 2,4-D/Dicamba/Mecoprop/MCPA/Pendimethalin	1
MIX: 2,4-D/Dicamba/Mecoprop/NPK Fertilizer/Pre-M	4
MIX: 2,4-D/Fenoxaprop-p-methyl/MCPA	1
MIX: 2-Butoxyethanol/Ethanolamine/KOH NOS/Sodium D	1
MIX: Acephate/Dicofol	1
MIX: Acetic Acid/HCL/Nitric Acid	3
MIX: Acetochlor/EPTC	1
MIX: Acetone/Hexane/Ink Solids NOS	1
MIX: Acetone/MEK/Xylene	1
MIX: Aciflourfen-Sodium/Bentazone/Sethoxydim	1
MIX: Acifluorfen/Bentazone	1
MIX: Acrolein NOS/Bromine	1
MIX: Acrylate/Benzene	1
MIX: Alachlor/Trifluralin	3
MIX: Alcohol NOS/Pyrethrins	1
MIX: Ammonia/Oil NOS	1
MIX: Ammonium Chloride/Ammonium Hydroxide	1
MIX: Ammonium Hydroxide/Carbon Black NOS/Ethanol	1
MIX: Ammonium Hydroxide/Cupric Chloride	1
MIX: Atrazine/2,4-D	1
MIX: Atrazine/Bromoxynil/Nicosulfuron	1
MIX: Atrazine/Clarity/Dicamba/Pendimethalin	1
MIX: Atrazine/Clarity/Rimsulfuron/Thifensulfuron-methyl	1
MIX: Atrazine/Cyanazine/Dicamba/Pendimethalin	1
MIX: Atrazine/Dicamba	5
MIX: Atrazine/Dicamba/Nicosulfuron	1
MIX: Atrazine/Dimethenamid	1
MIX: Atrazine/Metolachlor	2
MIX: Barium Stearate/Lead Stearate	1
MIX: Benefin/Trifluralin	1
MIX: Calcium Oxide/Sulfur	1
MIX: Calcium Sulfate/Potassium NOS	1
MIX: Carboxin/Thiram	1
MIX: Chloroform/MEK/Toluene/Xylene	1

Standard Chemical NameNumber of Releases

MIX:	Copper Sulfate/H2SO4/NAOH/NITROGEN NOS/PHOSPHORIC ACID	1
MIX:	Copper Sulfate/Triethanolamine	1
MIX:	Cyanazine/Pendimethalin	1
MIX:	Diammonium Phosphate/Potash/Urea	1
MIX:	Dicamba NOS/Pre-M	3
MIX:	Dicamba NOS/Pre-M/Triclopyr	3
MIX:	Dicamba NOS/Triclopyr	3
MIX:	Dicamba/MCPA/Mecoprop	1
MIX:	Dicamba/Pendimethalin/Triclopyr	2
MIX:	Dichloroisocyanuric Acid/Trichloroisocyanuric Acid	1
MIX:	Diethanolamine NOS/Ethylene Glycol/Formaldehyde	1
MIX:	Dipentaerythritol NOS/Naphthol NOS	1
MIX:	EDTA NOS/Sodium Hydroxide	1
MIX:	EPA D001/D002	1
MIX:	EPA F003/F005	1
MIX:	Ethanol NOS/Methyl Ethyl Ketone	1
MIX:	Ethyl Acetate/MEK/Xylene	1
MIX:	Fertilizer NOS/Pendimethalin	1
MIX:	Fomesafen/Thifensulfuron-Methyl	1
MIX:	Formaldehyde/Methanol	1
MIX:	Formaldehyde/Phenol NOS	1
MIX:	H2SO4/Nickel/Nitric Acid	1
MIX:	H2SO4/Nitric Acid	1
MIX:	H2SO4/Phosphoric Acid/Sodium Hypochlorite	1
MIX:	HCL/Oil NOS	1
MIX:	HCL/Phosphoric Acid	1
MIX:	Heptane/Isopropanol/Naphtha	1
MIX:	Hydrofluoric Acid/Phosphoric Acid	1
MIX:	Hydrogen Cyanide/MEK/Methanol	1
MIX:	Imazethapyr/Pendimethalin	1
MIX:	Imazethapyr/Quizalofop-ethyl	1
MIX:	Imazethapyr/UAN Solution	1
MIX:	Isopropanol/n-Propyl Acetate/Toluene	1

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
MIX: MEK/Toluene/Xylene	1
MIX: NAOH/Potassium Hydroxide/Tin	1
MIX: NAOH/Sodium Hypochlorite	1
MIX: Nicosulfuron/Pendimethalin/Primisulfuron-methyl/Prosulfuron	1
MIX: Nicosulfuron/Primisulfuron-methyl	1
MIX: Nitric Acid/Phosphoric Acid	1
MIX: Polyester Resin/Styrene	1
MIX: Potassium Chlorate/Sulfur	1
MIX: Sodium/Xylene	1
MIX: Sulfuric Acid/tert-Butylamine	1
Naphtha	1
Naphtha NOS	1
Nicosulfuron	2
Nitric Acid	3
Nitric Oxide (NO)	2
Nitrogen Fertilizer	2
Nitrous Oxide	3
Nonylphenol Ethoxylate	1
NPK Fertilizer	1
NPK Fertilizer NOS	1
Oil NOS	3
Organic NOS	1
Oxadiazon	1
Oxides of Nitrogen NOS	1
Oxidizer NOS	1
Paint or Coating NOS	13
Pendimethalin	26
Pentachlorophenol	1
Peracetic Acid	2
Peracetic Acid NOS	1
Permethrin	3
Pesticide NOS	5
Phenol	2
Phenolsulfonephthalein NOS	1
Phosphonic Acid	1
Phosphoric Acid	3

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
Phosphoric Acid NOS	1
Phosphorus	1
Phosphorus-32	1
Picloram	1
Picric Acid	3
Piperonyl Butoxide	1
Plastic NOS	1
Poly(oxyethylene(dimethyliminio)ethylene(dimethyliminio)ethylene d	1
Polybutene NOS	1
Polychlorinated Biphenyls	33
Polyester Resin	2
Polymer NOS	1
Polymethylenepolyphenyl Isocyanate	1
Polypropylene	1
Polyurethane Foam	1
Potash	2
Potassium Acid Phthalate	1
Potassium Bisulfate	1
Potassium Chloride	2
Potassium Hydroxide	4
Potassium Iodide	1
Potassium Perchlorate	1
Potassium Peroxymonosulfate	1
Potassium Sulfate	1
Pre-M	1
Prodiamine	1
Propylene Glycol	5
Pyrethrins	1
Pyrethrins NOS	1
Quizalofop-ethyl	1
Radioactive Material NOS	3
Silver Nitrate	1
Simazine	1
Sodium	2
Sodium 2-Mercaptobenzothiazole	1

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
Sodium Acetate	1
Sodium Bicarbonate	1
Sodium Bisulfate	1
Sodium Bromide	1
Sodium Carbonate	2
Sodium Chloride	1
Sodium Dichloroisocyanurate	1
Sodium Hydrosulfide	1
Sodium Hydrosulfite	3
Sodium Hydroxide	23
Sodium Hydroxide NOS	2
Sodium Hypochlorite	12
Sodium Hypochlorite NOS	1
Sodium Metabisulfite	1
Sodium Metasilicate	1
Sodium Molybdate	1
Sodium Nitrite	1
Sodium Polyphosphate	1
Sodium Propionate	1
Sodium Sulfate, Anhydrous	1
Sodium Sulfite	1
Sodium Thiosulfate	1
Sodium Tolytriazole	1
Sodium Tripolyphosphate	1
Solvent NOS	5
Steel	1
Strontium Chloride	1
Styrene	4
Sulfamic Acid	1

<u>Standard Chemical Name</u>	<u>Number of Releases</u>
Sulfide NOS	3
Sulfur	2
Sulfur Dioxide	27
Sulfur NOS	1
Sulfur Trioxide	2
Sulfuric Acid	38
Technetium-99	1
Tetrahydrofuran	1
Thifensulfuron-methyl	1
Thioglycolic Acid	1
TNT	1
Toluene	2
Toluene NOS	1
Toluene-2,4-Diisocyanate	2
Trichloroisocyanuric Acid	1
Triethanolamine	1
Trifluralin	19
Trisodium Nitrilotriacetate	1
Trisodium Phosphate	1
Uranium	1
Urea	2
Vinyl Chloride	1
VOC NOS	1
Xylene	3
Xylene NOS	2
Zinc	1
Total	1010

APPENDIX 2

EVENTS BY COUNTY, YEAR, AND AGRICULTURE

MN HSEES 1995-1997

COUNTY	CUMULATIVE	1995	1996	1997	Agricultural Events	Non-agricultural Events	% Agricultural Events
Aitkin	5	0	4	1	3	2	60.0
Anoka	15	5	6	4	3	12	20.0
Becker	3	1	2	0	2	1	66.7
Beltrami	3	2	1	0	1	2	33.3
Benton	3	2	0	1	2	1	66.7
Big Stone	1	0	0	1	1	0	100.0
Blue Earth	11	4	4	3	6	5	54.5
Brown	12	1	3	8	6	6	50.0
Carlton	41	3	19	19	0	41	0.0
Carver	13	1	8	4	2	11	15.4
Cass	1	1	0	0	0	1	0.0
Chippewa	5	1	1	3	4	1	80.0
Chisago	5	0	3	2	2	3	40.0
Clay	4	1	1	2	3	1	75.0
Clearwater	0	0	0	0	0	0	
Cook	0	0	0	0	0	0	
Cottonwood	3	0	1	2	2	1	66.7
Crow Wing	6	0	4	2	0	6	0.0
Dakota	79	31	28	20	6	73	7.6
Dodge	4	1	0	3	2	2	50.0
Douglas	2	0	1	1	0	2	0.0
Faribault	7	3	2	2	4	3	57.1
Fillmore	4	2	1	1	2	2	50.0
Freeborn	9	3	5	1	4	5	44.4
Goodhue	20	3	11	6	7	13	35.0
Grant	4	3	0	1	4	0	100.0
Hennepin	115	33	45	37	12	103	10.4
Houston	3	1	0	2	3	0	100.0
Hubbard	1	1	0	0	0	1	0.0

COUNTY	CUMULATIVE	1995	1996	1997	Agricultural Events	Non-Agricultural Events	% Agricultural Events
Isanti	2	0	2	0	1	1	50.0
Itasca	18	6	6	6	0	18	0.0
Jackson	2	0	1	1	1	1	50.0
Kanabec	0	0	0	0	0	0	0.0
Kandiyohi	3	3	0	0	1	2	33.3
Kittson	0	0	0	0	0	0	0.0
Koochiching	0	0	0	0	0	0	0.0
Lac Qui Parle	1	1	0	0	1	0	100.0
Lake	2	0	1	1	0	2	0.0
Lake of the Woods	2	2	0	0	1	1	50.0
Le Sueur	8	3	2	3	5	3	62.5
Lincoln	0	0	0	0	0	0	0
Lyon	8	2	4	2	4	4	50.0
Mahnomen	2	1	1	0	2	0	100.0
Marshall	3	1	1	1	3	0	100.0
Martin	8	3	4	1	6	2	75.0
McLeod	7	3	3	1	4	3	57.1
Meeker	7	1	3	3	3	4	42.9
Mille Lacs	5	2	1	2	4	1	80.0
Morrison	7	3	3	1	0	7	0.0
Mower	3	1	1	1	3	0	3.0
Murray	4	0	2	2	3	1	75.0
Nicollet	6	1	3	2	3	3	50.0
Nobles	5	2	0	3	4	1	80.0
Norman	3	1	0	2	1	2	33.3
Olmsted	20	6	7	7	12	8	60.0
Otter Tail	7	3	1	3	4	3	57.1
Pennington	4	1	3	0	1	3	25.0
Pine	4	2	1	1	1	3	25.0

COUNTY	CUMULATIVE	1995	1996	1997	Agricultural Events	Non-Agricultural Events	% Agricultural Events
Pipestone	5	0	3	2	3	2	60.0
Polk	5	3	1	1	2	3	40.0
Pope	2	0	1	1	1	1	50.0
Ramsey	64	13	32	19	3	61	4.7
Red Lake	1	1	0	0	1	0	100.0
Redwood	7	1	1	5	7	0	100.0
Renville	5	0	0	5	0	5	0.0
Rice	5	3	2	0	1	4	20.0
Rock	1	1	0	0	1	0	100.0
Roseau	5	1	2	2	2	3	40.0
Scott	7	2	3	2	1	6	14.3
Sherburne	15	6	7	2	5	10	33.3
Sibley	4	1	0	3	3	1	75.0
St. Louis	22	6	9	7	2	7	9.1
Stearns	9	2	4	3	3	6	33.3
Steele	14	5	6	3	1	13	7.1
Stevens	6	1	1	4	5	1	83.3
Swift	2	0	1	1	1	1	50.0
Todd	0	0	0	0	0	0	0.0
Traverse	0	0	0	0	0	0	0.0
Wabasha	4	1	1	2	3	1	75.0
Wadena	2	1	0	1	1	1	50.0
Waseca	2	0	1	1	1	1	50.0
Washington	56	21	17	18	0	56	0.0
Watsonwan	9	2	4	3	8	1	88.9
Wilkin	2	1	1	0	2	0	100.0
Winona	9	2	2	5	3	6	33.3
Wright	6	4	1	1	3	3	50.0
Yellow Medicine	6	0	1	5	6	0	100.0
TOTALS	795	229	301	265	218	577	