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Montgomery County, Kentucky Hazardous Materials Commodity Flow Analysis 1

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MONTGOMERY COUNTY, KENTUCKY HAZARDOUS MATERIALS COMMODITY FLOW ANALYSIS

FINAL REPORT

August 28, 2014



https://www.amherst.edu/offices/enviro_health_safety/polpro/overview/hz_managpol

Prepared by:



**This project was completed by
Western Kentucky University in partnership with
Montgomery County Local Emergency Planning
Committee and Montgomery County
Emergency Management**

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and



<http://www.phmsa.dot.gov/grants-state-programs>

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Chapter 1: Introduction

The results of a Commodity Flow Analysis of Hazardous Materials for Interstate 64 (I-64) conducted by Western Kentucky University in partnership with the Montgomery County Local Emergency Planning Committee (LEPC) are presented within this report. This report specifically focuses on the portion of the I-64 corridor located in Montgomery County, Kentucky. Figure 1.1 shows the location of Montgomery County in relationship to the state of Kentucky.

The purpose of this report is to present information regarding the patterns of hazardous materials transportation along I-64 as observed from July 14, 2014 through August 1, 2014. In addition, this report also summarizes hazardous materials incidents that have occurred over the previous ten years (January 2004-2013). Finally, the report presents and assesses survey information that was collected from fixed facilities within Montgomery County that ship and receive hazardous materials.

The commodity flow analysis was necessary in order to provide the Montgomery County LEPC with information about hazardous materials transport patterns so that they can better prepare for potential incidents and releases of hazardous materials along I-64. The data collected will assist in the emergency planning process by providing valuable information about frequently observed hazardous materials within the duration of the study.

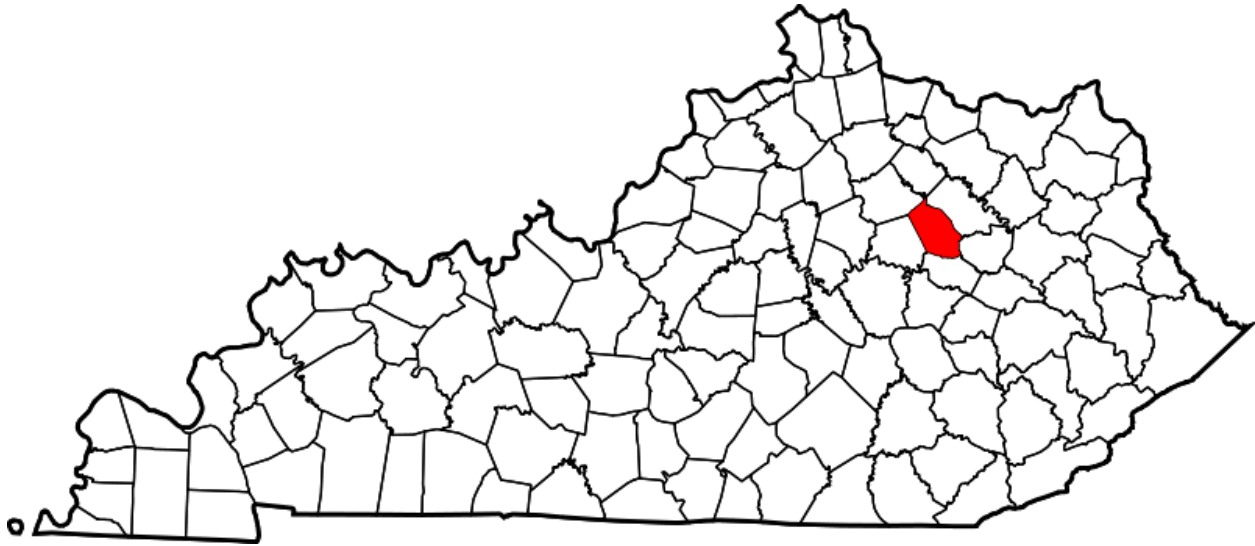
1.1 Background

The purpose of commodity flow studies is to identify the transport of specific goods through the transportation system of a specified area (Taylor et al., 2010). The EPA defines a commodity as any good being moved or transported (U.S. EPA, 2010). The commodities of interest within this study were hazardous materials and Montgomery County is the specified area. Hazardous materials are defined in the following ways:

- US Department of Transportation: “Any substance or material in any form or quantity which poses an unreasonable risk to safety and health and to property when transported in commerce,” (US DOT, 1991).
- US EPA: “Any material, which when discharged into the environment, may be harmful to the public health or welfare of the United States,” (U.S. EPA, 2010).

In addition, according to the EPA, a material is considered hazardous if it displays one or more of the following characteristics (U.S. EPA, 2010):

- Ignitability: Can create fires under certain conditions. e.g. fuels which catch fire, and friction-sensitive substances.
- Corrosivity: Is acidic and capable of corroding metal.
- Reactivity: Can create explosions or toxic fumes, gases, or vapors when exposed or mixed with water.
- Toxicity: Is harmful or fatal when ingested, breathed or absorbed by the skin.



https://familysearch.org/learn/wiki/en/File:Montgomery_County_svg.png

Figure 1.1 Location of Montgomery County, Kentucky

Hazardous material categories include (Transportation):

- Explosive Substances: will release pressure, gas, and heat when exposed to sudden shock, heat, or high pressure. e.g. Explosives, fuel, ammonium nitrate.
- Flammable and Combustible Substances: either liquid or solid, that can be easily ignited. e.g. petroleum substances.
- Toxic Materials (Poisons): can cause injury or death when they enter the bodies of living organisms. Can be classified by chemical nature or toxic action. e.g. heavy metals, cyanides, irritants.
- Oxidizers: supply oxygen to support normally non-flammable materials. e.g. plutonium cobalt.
- Etiological Materials: cause disease or infection. e.g. germs, which cause rabies, botulism, tetanus.

1.2 I-64 Corridor in Kentucky

I-64 is a portion of the Interstate Highway System that runs through the state of Kentucky from east to west for approximately 185 miles (DOT, 2002). I-64 travels through several major cities in Kentucky, including Lexington, Louisville and Frankfort with this route being outlined in Figure 1.2. Specifically marked within Figure 1.2 is Mount Sterling, Kentucky which is the city that I-64 passes through within Montgomery County. The section of I-64 in Montgomery County is approximately 11 miles long beginning at mile marker 104 and ending at mile marker 115 (KYTC, 2013). The speed limit along I-64 in Kentucky is 70 miles per hours (MPH).

As a whole I-64 travels through 6 states, including Missouri, Illinois, Indiana, Kentucky, West Virginia and Virginia, for a total of 938 miles (DOT, 2002). The DOT (2002) also notes major cities impacted by I-64 include St. Louis, Evansville, Lexington, Louisville, Huntington, Charleston, Richmond, Norfolk and Covington, just to name a few. I-64 also intersects with several major interstates throughout all 6 states that it travels through with the intersections in Kentucky including I-264, I-65, I-71, and I-265 near Louisville and I-75 near Lexington.



<https://www.google.com/maps/place/Mt+Sterling,+KY+40353/@38.0619046,-83.9463904,7z/data=!4m2!3m1!1s0x8843bd93b4940699:0x705136d36c5e9c85>

Figure 1.2. I-64 Corridor from Louisville, KY thru Ashland, KY and continuing into West Virginia (Google Maps 2014).

Similar studies have been conducted in the past such as Madison County, Kentucky Hazardous Materials Commodity Flow Analysis (Golla et al., 2011) and Warren County, Kentucky Hazardous Materials Commodity Flow Analysis (Taylor et al., 2010) and were the basis on which this study was conducted. Data collection sources for this study included a placard survey, fixed facility survey, and transportation incidence reports. Data were used to evaluate the hazardous materials being transported by trucks via I-64 (East and West bound lanes). Each of these primary sources of data collection are summarized below.

1.3 Data Collection Methods

ROADWAY PLACARD SURVEY

WKU faculty selected a monitoring station in conjunction with the Montgomery County Local Emergency Planning Committee (LEPC). This station was near I-64 East and West bound lanes passing through Montgomery County. Both lanes were monitored from the station established at Exit 110 in Montgomery County.

With all necessary safety precautions in place, a team of two observers monitored each site for a total of fourteen days, with one observer being responsible for East bound lanes and one responsible for West bound lanes. A monitoring day consisted of an 8-hour observation period lasting from 7:00 AM to 3:00 PM (7:00 – 15:00). This created a total of 224 hours of observation for I-64 with 112 hours for each lane (East-West bound).

1.4 Organization of the Report

The first section of the report provides an introduction to the study, a description of the methods used, and other important information. The second section of the report provides information regarding the analysis of the placard survey for the I-64 corridor. The third, and final, section of the report summarizes the results and gives recommendations based on these results. In the appendices a list of placard IDs observed during the placard survey has been provided.

Chapter 2: Analysis of I-64 Placard Survey

The placard survey consisted of 224 monitoring hours within the I-64 corridor, with 112 hours occurring on the East bound side and 112 hours occurring on the West bound side. This monitoring took place in 8-hour increments between July 14, 2014 and August 1, 2014 with all of the monitoring occurring on week days (Monday-Friday). This monitoring schedule was set up in order to ensure that daily and temporal differences could be recorded in hazardous material transport. Observers, located at each monitoring site, were undergraduate students from Western Kentucky University's Environmental Health Science program. Each observer recorded information that included: date, time, type of truck, and all placard identification information.

2.1 Aggregate Truck Frequencies in the I-64 Corridor

In order to ensure that the focus of the study remained on hazardous material transport, student observers were asked to only collect data on placarded trucks. This allowed students to focus more thoroughly on the placarded data and helped to ensure that all placarded trucks were properly recorded. Information about traffic frequency in the I-64 corridor was collected from the Kentucky Transportation Cabinet (KYTC). In 2013, the annual average daily traffic (AADT) flow at mile marker 108 in Montgomery County was 22,587 vehicles with 18.96% of this traffic being the single and combination truck volume as a percentage of AADT (KYTC, 2013). This translates to roughly 4,282 trucks as the average daily traffic flow.

The total number of placarded trucks on I-64 during the study period, as shown in Figure 2.1, was 1405, with 717 recorded for the East bound lane and 688 recorded for the West bound lane. An average of approximately six placarded trucks were recorded per hour, as shown in Figure 2.2, which can be extrapolated to 144 placarded trucks daily on I-64. This means that on a daily basis hazmat trucks made up roughly 3.36% of the daily truck traffic or 0.64% of the total daily traffic in Montgomery County. When comparing the total placarded truck traffic and the average hourly placarded truck traffic for East and West bound lanes there is only a very small difference (29, 0.26 respectively) in the number of trucks.

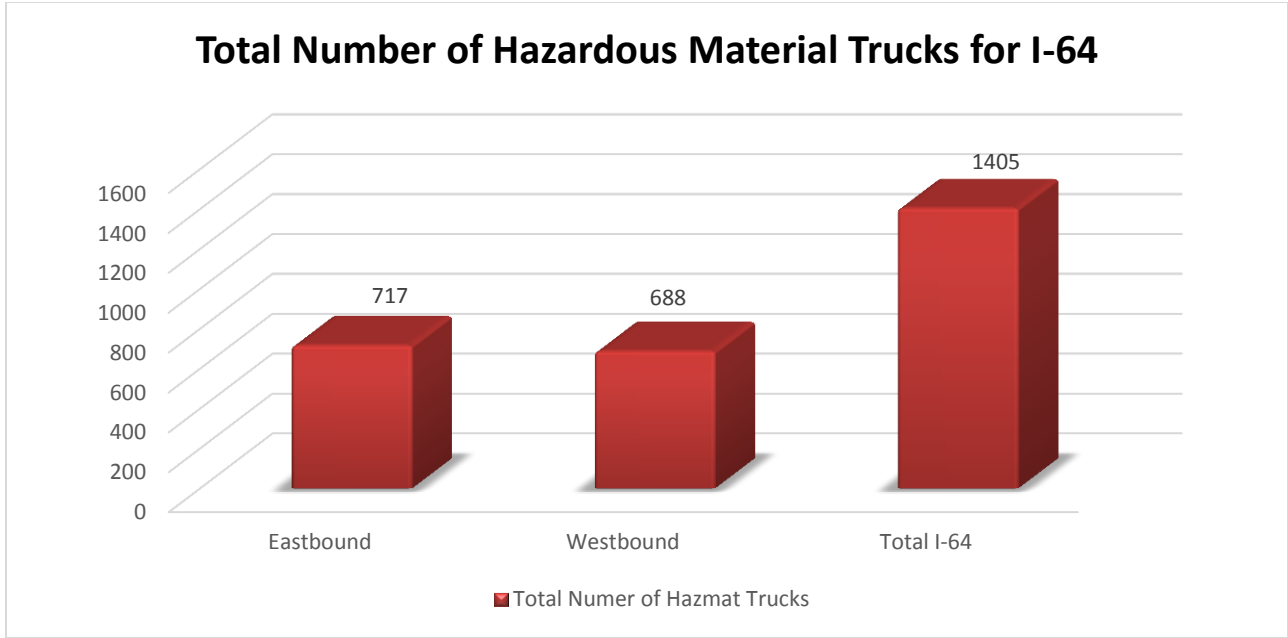


Figure 2.1 Placarded commercial trucks observed in the I-64 corridor

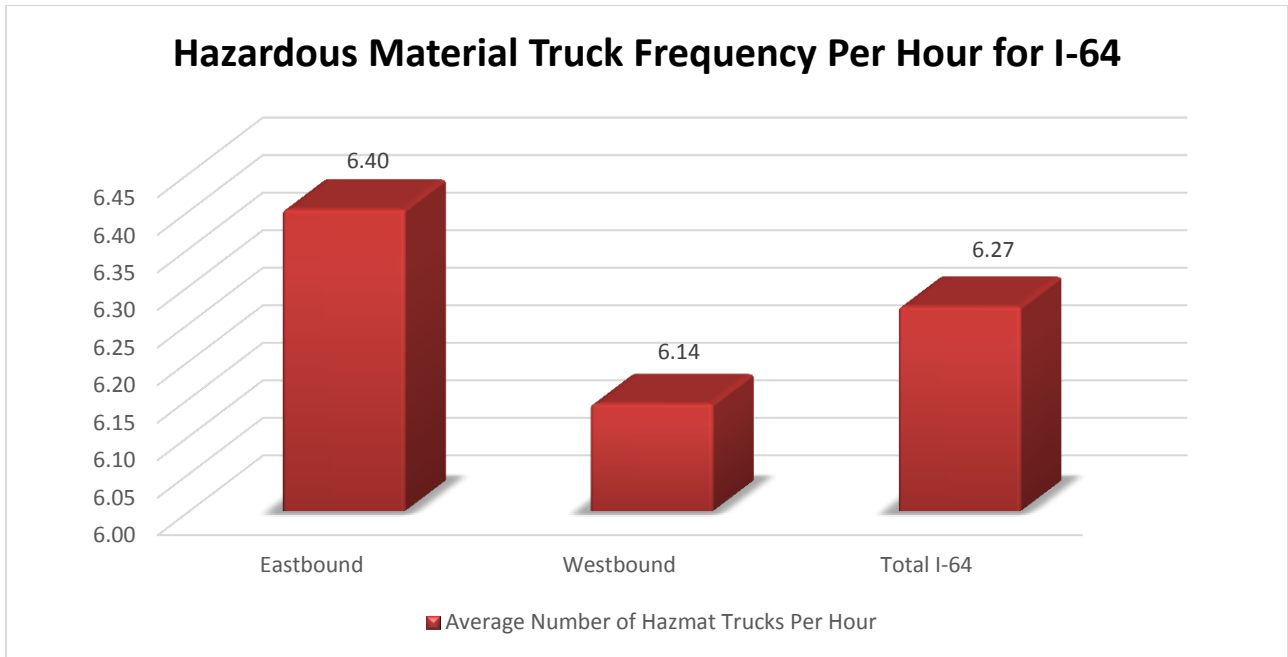


Figure 2.2 Placarded commercial trucks observed per hour on I-64

2.2 Truck Frequencies by Day of the Week

Monitoring hours on I-64 were scheduled on all five week days (Monday-Friday) in order to determine if differences existed in the placarded truck traffic depending on the day of the week. A total of two Mondays, three Tuesdays, three Wednesdays, three Thursdays, and three Fridays were included within the study period.

As shown in Figure 2.3, noticeable differences did exist based on the day of the week when observations were made. Friday had the lowest average of approximately eight trucks per hour, while Tuesdays had the highest average of approximately 15 trucks per hour. Mondays and Wednesdays both had an average of approximately 13 trucks per hour, while Thursday's average was slightly higher at approximately 14 trucks per hour. This difference can be seen on both the East and West bound lanes of I-64 as displayed in Figure 2.4. Average placarded truck traffic was highest on Tuesdays for West bound lanes and Thursdays for East bound lanes, with 60.0 average trucks per day and 58.3 average trucks per day respectively. The lowest truck traffic was recorded on Friday for both East and West bound lanes with 34.0 and 33.7 average trucks per day respectively.

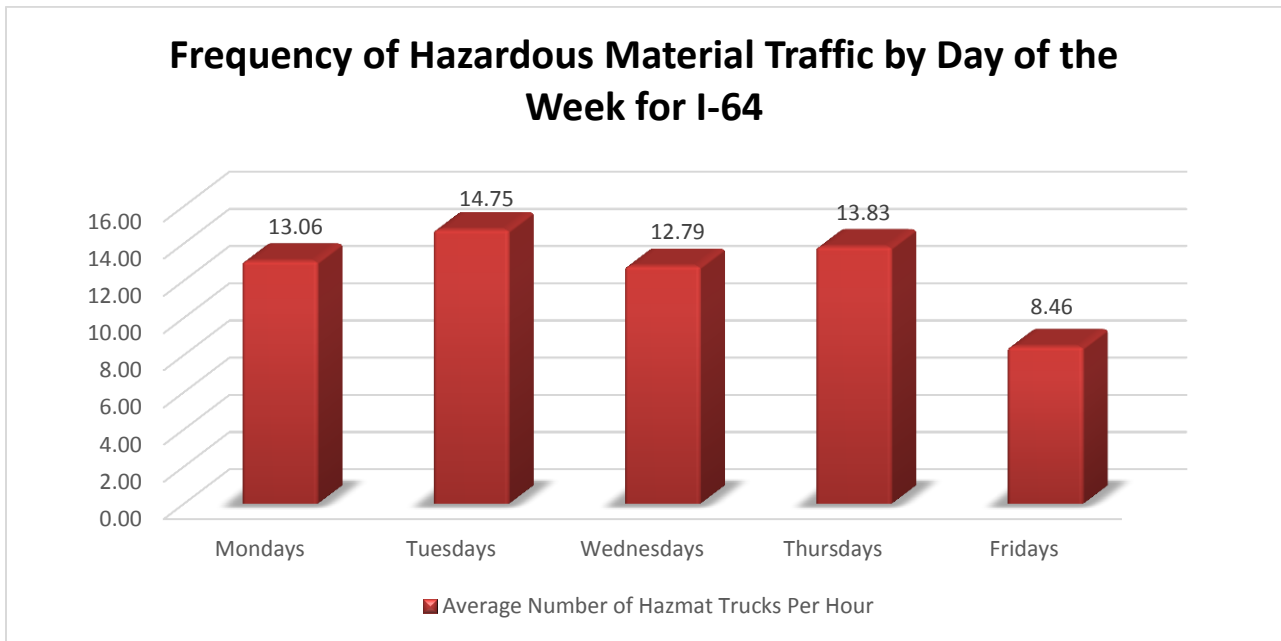


Figure 2.3 Placarded commercial truck traffic hourly averages by day of the week

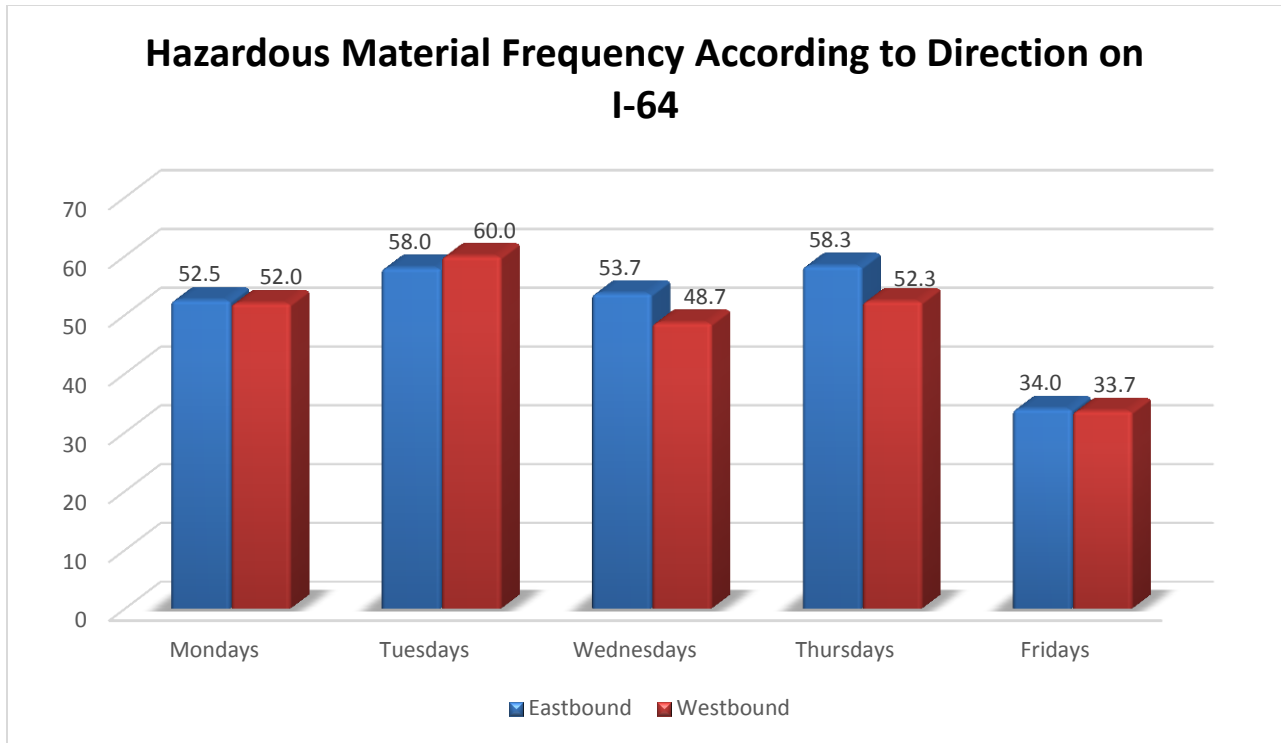


Figure 2.4 Average placarded commercial truck traffic on East and West bound lanes of I-64 by day of the week

2.3 Truck Frequencies by Time of Day

Time of day was recorded for each placarded truck observed so that comparisons could be made to determine if differences existed based on this. In order to analyze differences in placarded truck traffic based on time of day, the observation hours were split into four groups. These divisions were the same for both West and East bound lanes and are as follows:

- Period 1 (Early Morning): 7:00 – 9:00
- Period 2 (Late Morning): 9:01 – 11:00
- Period 3 (Early Afternoon): 11:01 – 13:00
- Period 4 (Late Afternoon): 13:01 – 15:00

As shown in Figure 2.5 the highest truck volume for the study period was observed in the late morning and early afternoon hours, 395 and 383, respectively, with the lowest volume being observed in the early morning hours, 287. Both the East and West bound lanes follow this same pattern, with the highest being in the late morning and early afternoon hours and the lowest being observed in the early morning hours. East bound lanes were slightly higher than West bound lanes during the late morning, early afternoon and later afternoon periods and West bound lanes were slightly higher in the early morning period.

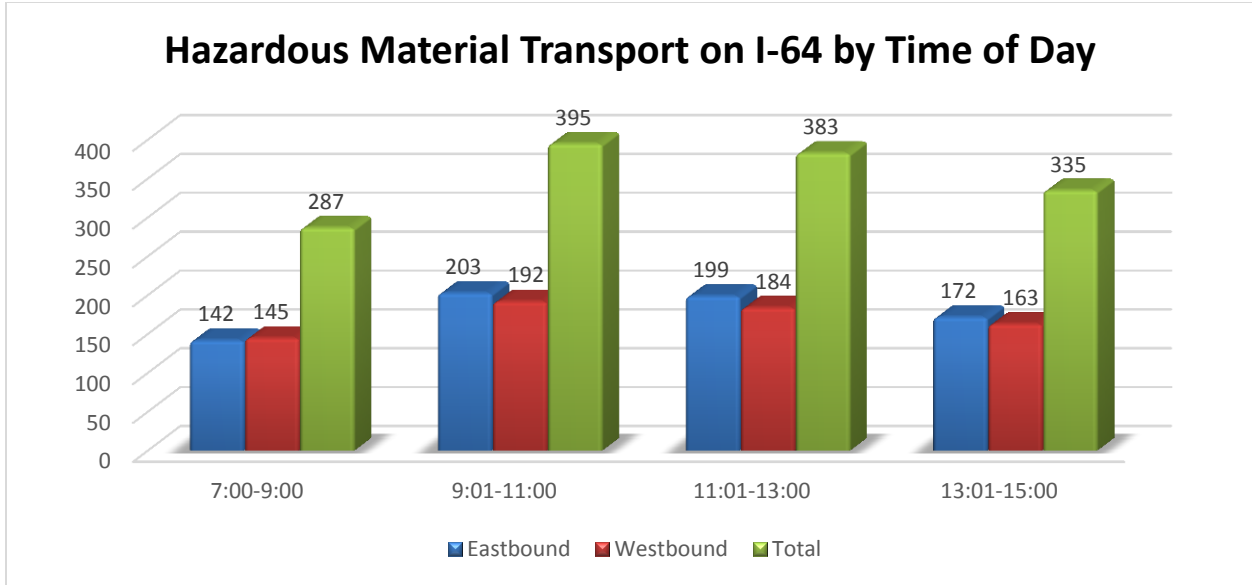


Figure 2.5 Placarded commercial truck traffic observed in the I-64 corridor by time of day

2.4 Composition of Hazardous Materials Being Transported

Analysis of the placard data was performed to assess what materials were being transported within the I-64 corridor. Based on Figure 2.6, the most frequently transported hazmat was Petrol / Gasoline (ID no. 1203) for the East bound lanes. Other frequently transported hazmats on the East bound lanes included Flammables, Corrosives, Flammable Gases / Propane (ID no. 1075) and Petroleum crude oil (ID no. 1267). Figure 2.6 also identifies all of the top ten most common placard IDs for I-64 East bound lanes, and the number of each that was seen during the study period. Figure 2.7 goes further into detail and gives the total distribution of placard IDs for the East bound lanes as percentages of all identified East bound placards in the study. As illustrated in Figure 2.7, 23.73% of the placards were categorized as other, while 18.88% of the placards were identified as Gasoline (ID no. 1203).

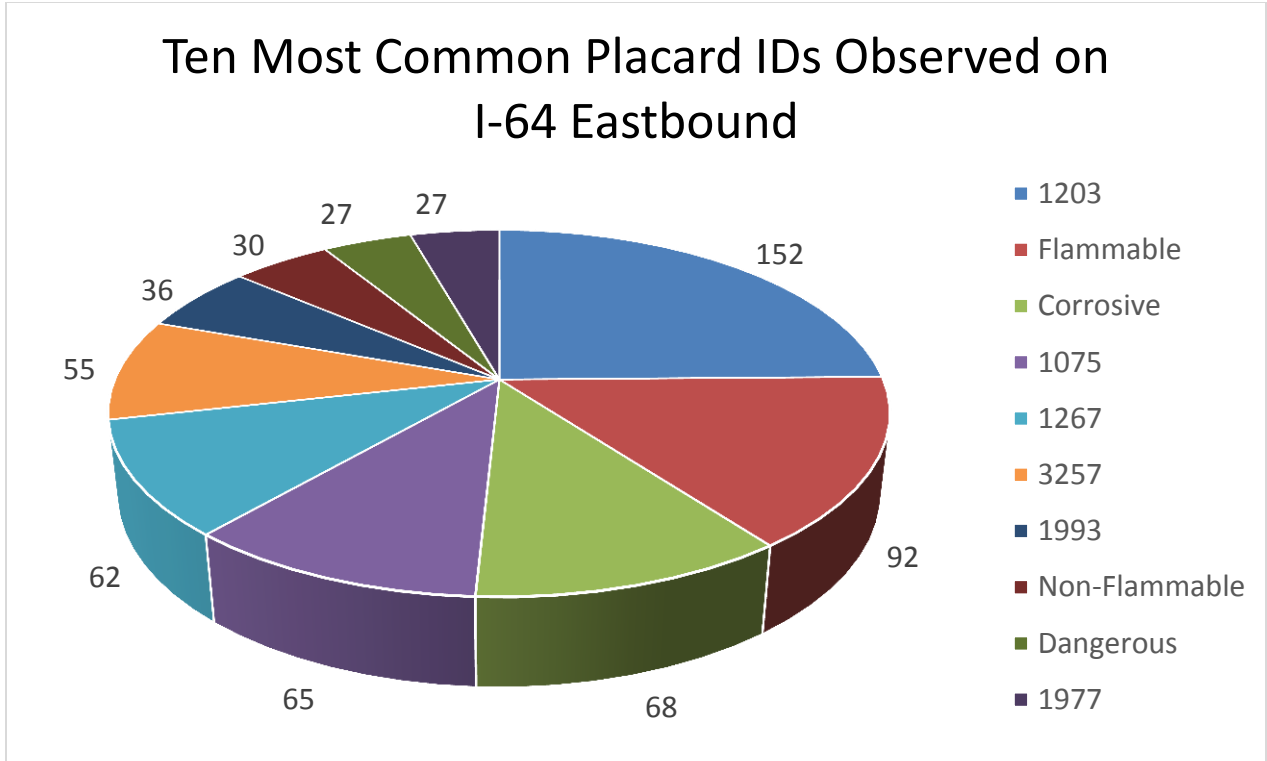


Figure 2.6 Top ten most common placard numbers observed on I-64 East bound

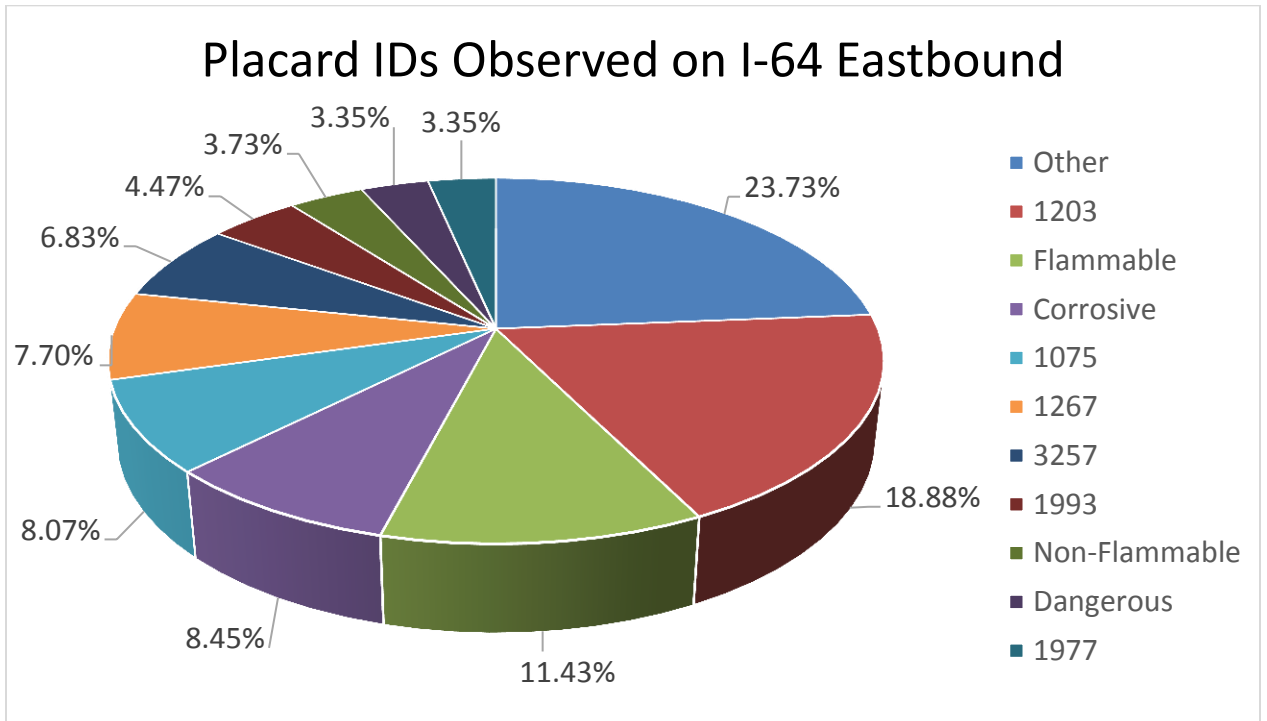


Figure 2.7 Distribution of placard numbers on I-64 East bound as percentages of the grand total

Analysis of the West bound lanes of I-64 were performed the same way as the analysis for the East bound lanes. Based on Figure 2.8, the most frequently transported hazmat was Petrol / Gasoline (ID no. 1203) for the West bound lane. Other frequently transported hazmats on the West bound lanes of I-64 included Flammable Gases / Propane (ID no. 1075), Petroleum crude oil (ID no. 1267), Flammables, and Elevated Temperature Liquids (ID no. 3257). The rest of the top ten most common placard IDs for the West bound lanes of I-64 can be seen in Figure 2.8, along with the number of that placard ID that were observed during the study period. Figure 2.9, explains the placard data in greater detail by identifying the percentage of the grand total for all observed placards on West bound lanes of a specific placard ID. As seen in Figure 2.9, 31.90% of placards were identified as other while 18.10% were identified as Gasoline (ID no. 1203).

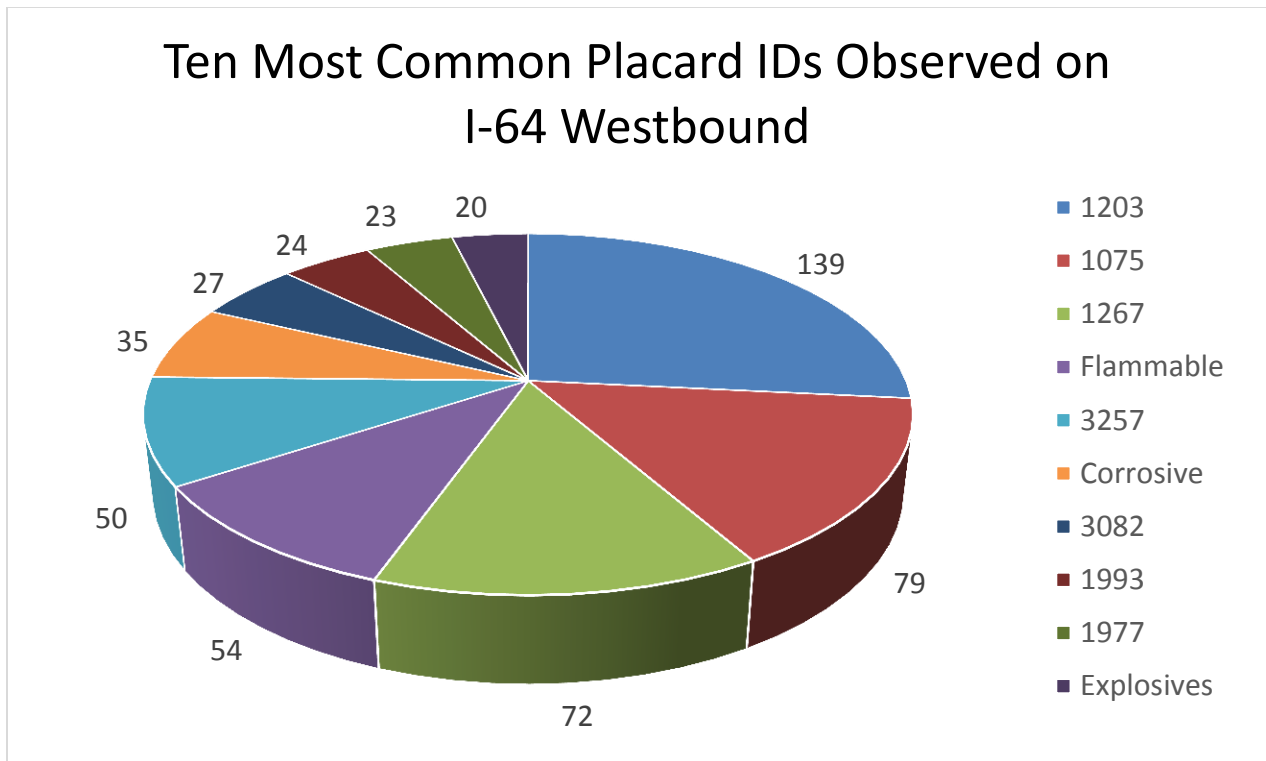


Figure 2.8 Top ten most common placard IDs observed on I-64 West bound

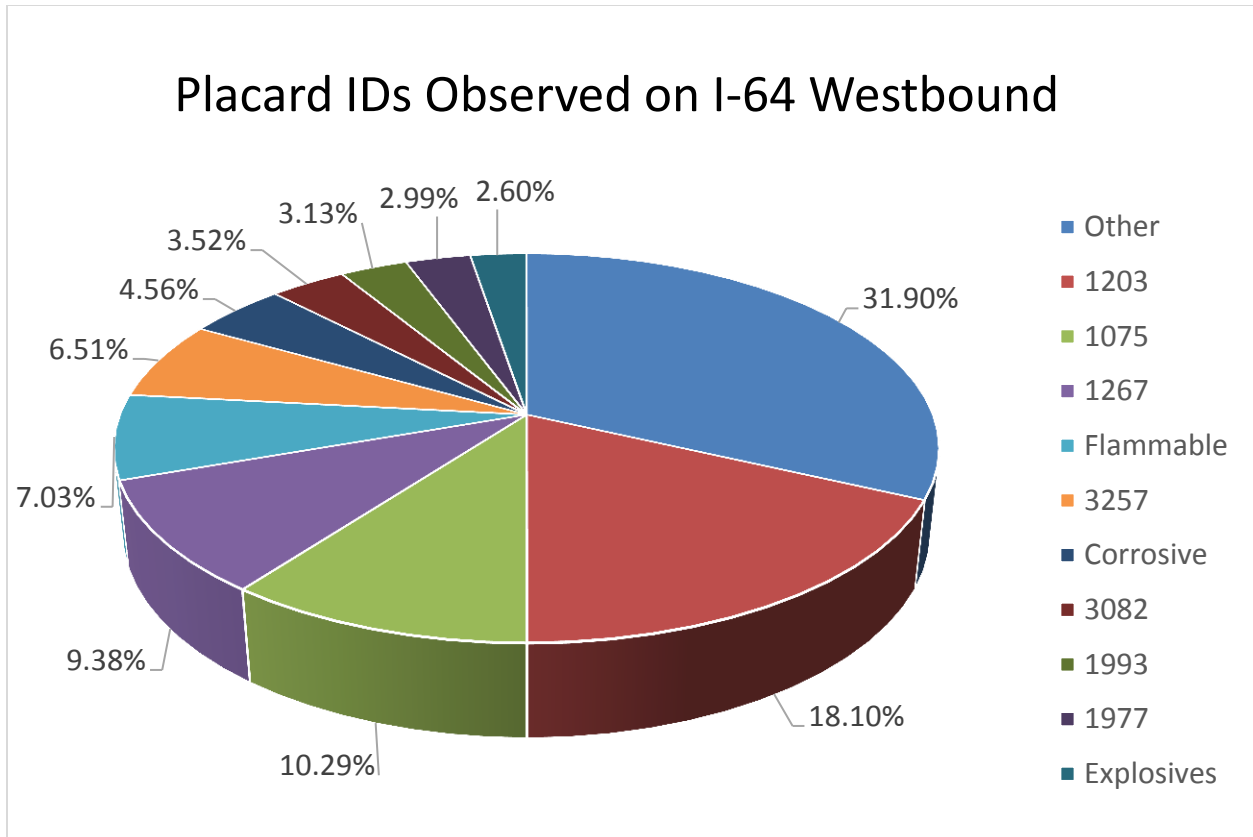


Figure 2.9 Distribution of placard numbers on I-64 West bound as percentages of grand total

2.5 Recommended Responses to the Frequently Transported Hazardous Materials

By observing the most common placard identification numbers it is possible to determine the most frequently recurring guide number that would be needed if an accident were to take place. A significant number of trucks only contained labels which indicated the ‘nature’ or ‘Class’ of the hazardous material being transported instead of containing a four digit placard number. In order to ensure accuracy of the guide numbers only placard numbers were considered and labels were eliminated. The guide number, retrieved from the US DOT (2012) Emergency Response Guide, will help in preparing for hazmat accidents and training the emergency response teams.

The most frequent guide number for the East bound lanes of I-64 in Montgomery County is 128 (Flammable Liquids, Water Immiscible) as shown in Figure 2.10. This guide number encompassed 37.88% of the top ten placard numbers. Other frequent guide numbers according to the top ten most common placard IDs include 115 (Gases – Flammable) and 120 (Gases – Inert).

All three of the recommended guide numbers for I-64 East bound lanes were also seen for the West bound lanes, as illustrated in Figure 2.11, with 128 (37.12%) still being the most frequently used followed by 115 (10.29%) and 120 (2.99%). In addition to these, guide numbers 171 (Substances – Low to Moderate Hazards) was also seen for Westbound lanes.

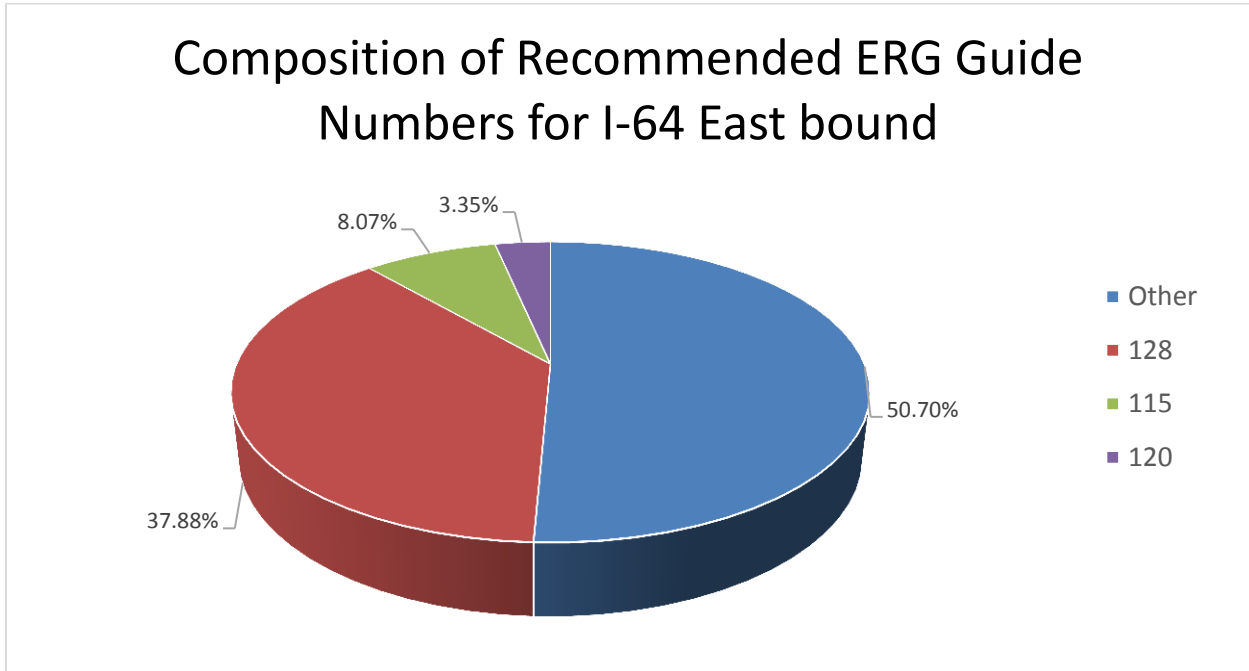


Figure 2.10 Distribution of placard numbers on I-64 West bound as percentages of grand total

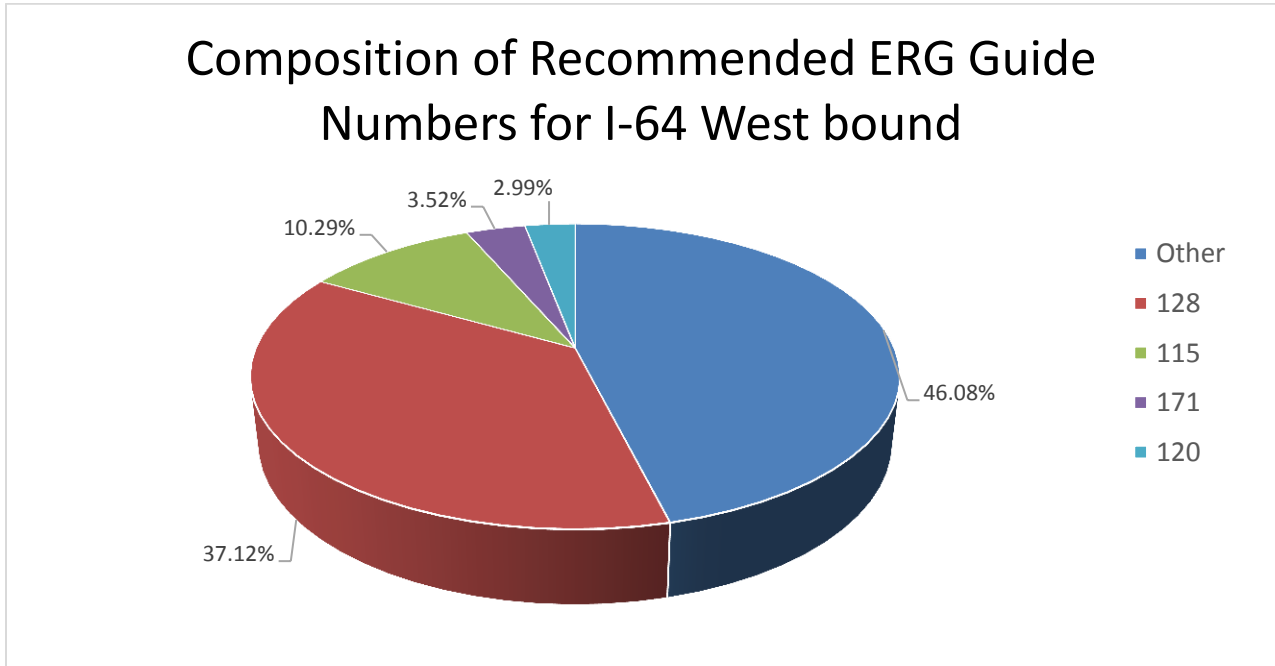


Figure 2.11 Composition of the most frequently used ERG's for West bound lanes

Chapter 3: Analysis of Hazmat Incident Reports

Analysis of Hazmat incident reports indicated trends of incidents that took place between 2005 and July of 2014. This includes the patterns of occurrence and identification of challenges in incident preparedness. Results of this analysis provide local emergency management personnel, emergency responders, and stakeholders with information regarding the location and types of hazardous materials commonly involved in commercial motor vehicle incidents in Montgomery County. A point density map of the data utilizing ESRI ArcGIS Spatial Analyst software (2011), was created to elucidate areas that have reoccurrence of incidents. Lastly, the evaluation of incident data enables emergency managers and LEPCs to evaluate areas or highways with greater risks in conjunction with the hazardous materials detected during the Hazmat commodity flow survey.

i. Hazmat incidents from 2005 -- 2014

Data consisted of incidents, which were reported between 2005 and 2014 in Montgomery County. A total of 14 incident reports were provided to WKU and these were used in the analysis. From these reports, it was determined that 12 of the reports were for hazmat incidents. Data indicated that the incidents primarily represented spills. A map was produced through of the incidents that were reported (Figure 3.1).

As shown in Figure 3.1, greater incident densities, areas with multiple incidents, were detected along the I-64 corridor. South of Mt. Sterling two hazmat incidents were reported along Highway 11. Areas of greater occurrence of incidents indicate a record of multiple incidents and an increased risk of future incidents. It is highly suggested that Montgomery County Emergency Management and LEPC develop response plans and exercises to increase preparedness along the I-64 corridor.

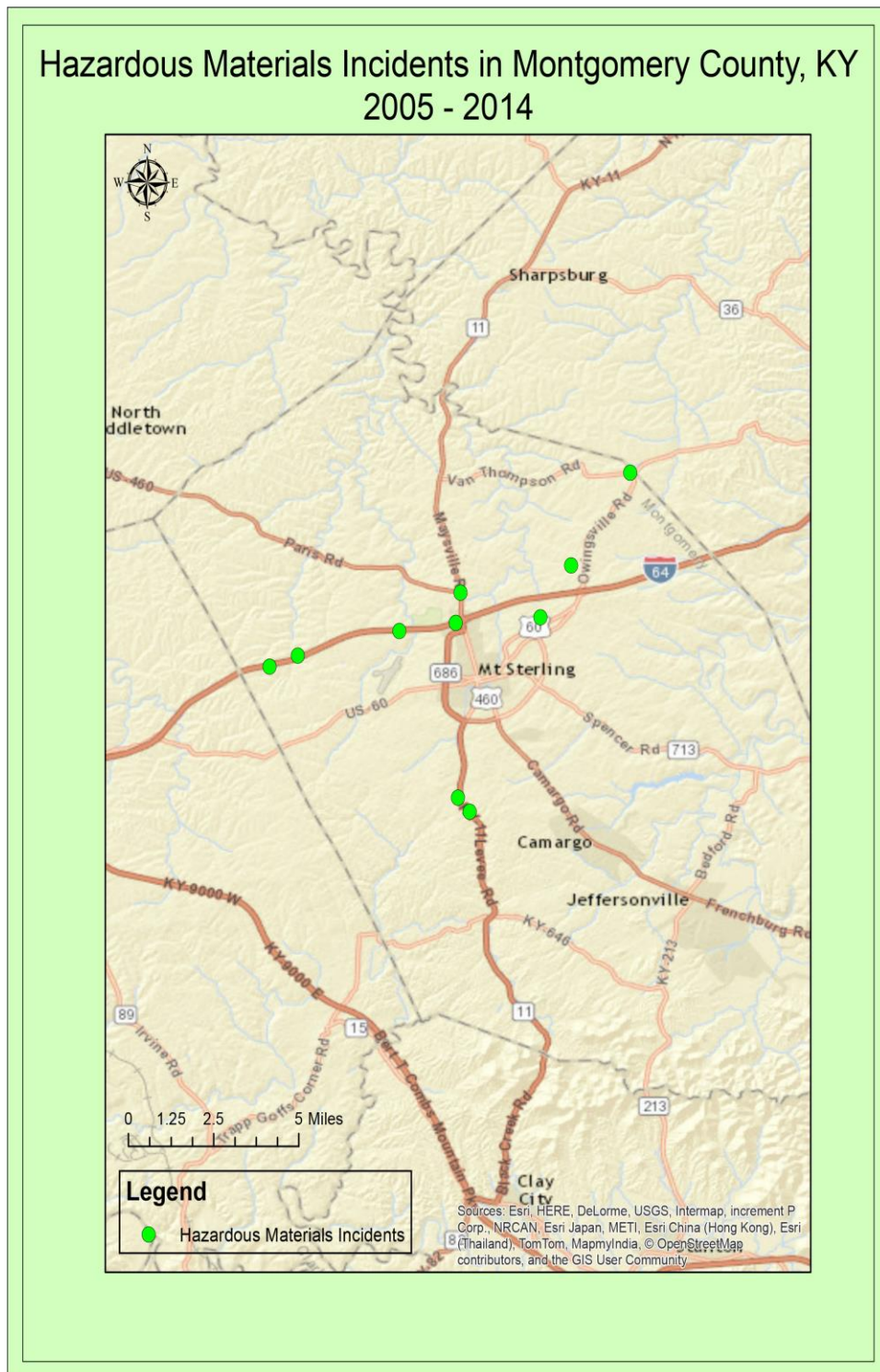


Figure 3.1 Hazmat incidents reported for Montgomery County from 2005 – 2014. Data reported by Montgomery County Emergency Management.

Chapter 4: Summary

Hazardous materials are an important and necessary part of the American society. In order to produce needed resources hazardous materials have to be produced, transported, stored, used and discarded. This poses a threat to the environment and human health when incidents occur and hazardous materials are released. Incidents with hazardous materials can occur at any time in their lifecycle, from production to disposition. This study helps to give an accurate account of the quantities and types of hazardous materials being transported in the Montgomery County area of Kentucky. In addition, timing of transport is also provided to the LEPC which is essential for emergency preparedness.

Both communities large and small must be educated about the care that needs to be taken when working with hazardous materials. Hence, it is critical to construct a knowledge base that concerns certain types of hazardous materials that are transported into, out of, and through a certain jurisdiction. In addition to the frequencies of hazmats it is also important to determine the timings and routes that are taken in order to further prepare for emergency response. The Emergency Response Planning committee must be based on an adequate account of these elements of hazmat movements. The sufficiency of emergency response organization schemes, equipment inventories and purchases, and personal training can only be assessed with the knowledge of this type of information.

This report works to create an accurate starting point, and begins to develop the necessary knowledge base about the transportation of hazardous materials through the Montgomery County jurisdiction. An initial line of incident response before an event can be established by communicating this information to emergency responders. Emergency response coordination will be essential to adequately protect human health and the environment from the potential impacts of the documented hazardous materials. The results and recommendations of this report will hopefully prove to be a useful guide in preparing emergency responders.

This study focuses on highway transportation of hazardous materials. The empirical results that are summarized below are based on the commodity flow data collected by placard surveys I-64 East and West bound. The following section summarizes the results obtained in chapters 2 and 3 and gives recommendations which can be used as a guidance tool for emergency preparedness:

Result 1:

The frequency of hazardous materials was recorded to be highest on Tuesdays and Thursdays, for both East and West bound lanes, as compared to the other week days. Also it was noted that the busiest time of day for both East and West bound lanes was the late morning and early afternoon periods (9:01 – 11:00, 11:01 – 13:00).

Recommendation 1:

It is essential for emergency responders to be familiar with peak days and times with reference to hazardous materials transport. This will ensure better alertness and preparedness in case of an incident occurring during these time periods. Extra emergency responders within these areas should be on call during the aforementioned peak timing in order to ensure efficient response. One potential problem in areas with volunteer emergency responders is that these responders are usually working other jobs during these peak times. A system needs to be created to improve incident response in these areas.

Result 2:

The most commonly transported hazardous material on I-64 East and West bound lanes was Petrol / Gasoline (ID no. 1203). This demonstrates the increased transportation of fuel products within this area and between states.

Recommendation 2:

This indicates an increased need for developing emergency response for fuel related products in case of an incident. It is important to train emergency responders with reference to these products and to provide annual training for incidents involving ID 1203.

Result 3:

The second most commonly transported hazardous material for both East and West bound lanes of I-64 was Flammable Gases / Propane (ID no. 1075). This demonstrates the increased transportation of propane products within this area and between states.

Recommendation 3:

This indicates an increased need for developing emergency response for propane related products in case of an incident. It is important to train emergency responders with reference to these products and to provide annual training for incidents involving ID 1075. In addition, the ERG guide number for these products is 115. Annual training for emergency responders should include a refresher on application of response guide 115 under various scenarios.

Result 4:

The most common ERG guide number recorded for both East and West bound lanes of the I-64 corridor was 128.

Recommendation 4:

It is important for Local Emergency responders to be properly trained for response to Guide no. 128. They should be updated with any changes that are made to this guide. Annual training for emergency responders should include a refresher on application of response guide 128 under various scenarios.

Result 5:

As shown in Figure 3.1, greater incident densities, areas with multiple incidents, were detected along the I-64 corridor. South of Mt. Sterling two hazmat incidents were reported along Highway 11. Areas of greater occurrence of incidents indicate a record of multiple incidents and an increased risk of future incidents.

Recommendation 5:

It is highly suggested that Montgomery County Emergency Management and LEPC develop response plans and exercises to increase preparedness along the I-64 corridor. Site plans for areas of multiple incidents can be developed to assess potential impacts to human health and environment.

Chapter 5: References

- Environmental Protection Agency (2010, March 10). *Wastes-Hazardous Wastes*. Retrieved July 20, 2010, from: <http://www.epa.gov/osw/hazard/>.
- Department of Transportation (2002, October 31). *Federal highway administration route log and finder list*. Retrieved from: <https://www.fhwa.dot.gov/reports/routefinder/table1.htm>.
- Department of Transportation (2012). *Emergency response guidebook*. Retrieved from: http://phmsa.dot.gov/pv_obj_cache/pv_obj_id_7410989F4294AE44A2EBF6A80ADB640BCA8E4200/filename/ERG2012.pdf
- Golla, V., Taylor, R., Stanam, A., Chavan, P., & Ellis, C. (2011, August). *Madison county hazardous materials commodity flow analysis*. Retrieved from digitalcommons.wku.edu/public_hlth_fac_pub/1/.
- Kentucky Transportation Cabinet (2013). *KYTC traffic count reporting system*. Retrieved from: http://datamart.business.transportation.ky.gov/EDSB_SOLUTIONS/CTS/Default.aspx.
- Taylor, R. (2010). *Warren County, Kentucky Hazardous materials commodity flow analysis*. Retrieved August 12, 2010 from digitalcommons.wku.edu/public_hlth_fac_pub/1/.
- Department of Transportation (1991). U.S. Department of Transportation Federal Motor Carrier Safety Administration. Retrieved July 20, 2010, from DOT: <http://www.fmcsa.dot.gov/safety-security/hazmat/complyhmregs.htm#hm>.