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Hazardous Materials Risk Assessment

Year Portrait of Hazardous Materials Accidents/Incidents and Impacts

Final Report

Prepared for
Office of Motor Carriers
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16. Abstract

This Hazardous Materials Risk Assessment was designed to assist the FHWA Office of Motor Carrier & Highway Safety in evaluating the Hazardous Materials program as part of the overall motor carrier safety program, and to assist in program development and strategic planning. The long term purpose of the project is to assesses the risk of hazardous materials transportation (by hazard class) as compared to the risk of non-hazardous materials transportation.

This report gives the results of the first phase of the study, which is a comprehensive analysis of the impacts related to the shipment of Class 3 materials for 1 year, 1996. Class 3 materials were chosen for the first phase because these materials make up approximately 52% of Hazardous Materials shipped. The methodology used in this report will serve as the basis for conducting the full comparative risk assessment.

The Hazardous Materials Information System (HMIS) database was used as the baseline database, and was supplemented with other state and federal databases for eight states: six states belonging to the PRISM program: Colorado, Indiana, Iowa, Minnesota, Pennsylvania and Oregon, as well as Ohio and California. An estimate of HM crashes & incidents was developed and then applied nationwide. To derive the estimated of the economic impact of class 3 materials during the study year the following impact categories were selected: Fatalities, Injuries, Cleanup costs, Property Damage, Evacuation, Product Loss, Traffic Incident Delay and Environmental Damage. The results of the one year snapshot are as follows:

* The resulting dollar value for the estimated 3,766 Class 3 accidents and incidents totaled $482 million.
* 88% of crashes and incidents involved cargo tanks.
* 30% ($142.8) million of the costs are associated with the hazardous nature of the cargo.
* For HM Crashes only the comprehensive phase I analysis estimated consequences at approximately $460 million, HMIS indicates only $25 million in consequences.

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YEAR PORTRAIT OF HAZARDOUS MATERIALS ACCIDENTS/INCIDENTS AND IMPACTS

Executive Summary

This project was designed to assist the Department of Transportation (DOT) in achieving their strategic goal of reducing the rate and severity of transportation fatalities and injuries in hazardous materials (HM) transportation and of reducing the dollar loss from high-consequence, reportable transportation accidents. The long-term purpose of this project is to assess the additional risks posed by HM transportation when compared to non-hazardous shipments.

The project has been divided into two phases. The first phase, which has concluded, characterizes the shipment impacts for one year of Class 3 HM shipments and assesses the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments. The characterization of the one-year of Class 3 shipment impacts is contained in this report. The assessment of the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments is contained in the "Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Nonhazardous Materials Movements." The second phase is the actual comparative risk assessment between HM and non-HM truck shipments.

To estimate the percentage of HM out of all national shipments, the National Fleet Safety Survey for 1996 was utilized. For 1996, using a weighted average, 7.2 percent of all trucks surveyed carried HM. To calculate the percentage of Class 3 (flammable and combustible liquids) materials carried by truck for 1996, five regional HM commodity flow surveys were used. Based on the 5 surveys, a figure of 52 percent HM vehicles for the entire country was represented by flammable and combustible liquids.

An initial step in developing a risk assessment is to reliably estimate the number of incidents for a defined period of time. For Phase I, an estimate was developed for Class 3 truck shipment incidents and accidents in 1996. The Hazardous Materials Information System (HMIS) database served as the baseline database. The HMIS represents the only national database of hazardous materials highway transportation incidents with details of the material, packaging and consequences involved. The data found in the HMISs is not comprehensive and was supplemented with data from other federal and state databases. The most important was the Safetynet, Motor Carrier Management Information System (MCMIS) accident database that provides accident information for both spill and no spill accidents.

To effectively supplement the HMIS data, a year, 1996, and a sample of 8 states were selected to focus on for more intensive examination. Six of the states, Colorado, Indiana, Iowa, Minnesota, Pennsylvania and Oregon are part of the Performance and Registration Information Systems Management (PRISM) program; an OMC program designed in part to improve state participation in Safetynet. In addition both Ohio and California were selected because of access to separate state databases to supplement the HMIS data.

Using this method, the U.S. Class 3 accidents and incidents for 1996 were estimated as:

- Spill accidents: 490
- No spill accidents: 953
- Incidents both enroute and associated with loading unloading: 1,961.

Most of the accidents are associated with cargo tank shipments. For the total number of enroute accidents, an estimate of 88 percent involved cargo tanks.

In order to derive an estimate of the annual economic impact of 1996 incidents/accidents involving truck shipments of Class 3 hazardous materials, impact categories were selected which could be compared among the accidents. The impact categories selected were:

- Injuries and Deaths
- Cleanup Costs
- Property Damage
- Evacuation
- Product Loss
- Traffic Incident Delay
- Environmental Damage.

Several sources of information were reviewed in order to establish reasonable estimates of the economic impacts of each consequence. A literature review was conducted, as was an evaluation of the utility of the federal and state databases. Impacts not readily available from the above sources, such as incident delay, were modeled to develop impact estimates. Finally, all impacts were converted to dollars to permit comparison and preparation of total impacts.

The HMIS proved to be an important source of impact costs for product loss, cleanup costs, and property damage. Injuries and deaths were valued to be the amount the DOT would be willing to spend to avoid an injury or death. This averaged out to be $200,000 for accident injuries and $32,000 for incident injuries. Avoidance of a fatality was valued at $2,000,000.

Traffic incident delay was established as the total number of people delayed at an incident or accident multiplied by $15 per hour. Environmental damage was estimated based on the size of an average spill and the value placed on environmental contamination as determined by an average of 30 settlements.

For 1996, the dollar value placed on the impacts for the estimated 3,766 Class 3 accidents and incidents totaled about $482,000,000. The costs for avoiding injuries and fatalities accounted for about 69 percent of the total costs. Carrier damage and incident delay costs together accounted for about 25 percent of the total estimated cost for the year. The cost related to accidents is considerably higher than that for incidents. Both spill related and no spill accidents account for about 95 percent of the estimated costs for 1996.

Impact estimates related to the fact that the cargo is a hazardous material are important for both the current analysis and any future risk assessments or modeling. An analysis of the accident and incident impacts determined which impacts were the result of the hazardous material cargo being shipped. All of the impacts from the incidents were determined to result from the hazardous materials cargo. Only about half of the incident delay and none of the remaining impact from the no spill accidents were placed in the hazardous materials category. Finally, about 37 percent of the injuries and fatalities in the spill accident case and all of the remaining impacts were attributed to hazardous materials. About $142, 800,000 of the impact costs can be related directly to the hazardous nature of the cargo. This represents about 30 percent of the impact costs for the major Class 3 accidents and incidents estimated for 1996.

This report has demonstrated a process to evaluate the full impacts of HM incident/accidents by sampling a single HM class for one year. By characterizing the shipment impacts for one year of Class 3 HM shipments, it demonstrates the implementation of a process which could be applied to determining the impacts of other hazardous materials classes as well as for non-hazardous materials. Specifically the report demonstrates the feasibility of obtaining data and conducting analysis in the following areas:

- Estimation of the number of accidents and incidents for one year
- Estimation of the type and magnitude of impacts from accidents and incidents
- Estimation of data needed for the full risk assessment.

Both the estimates of accident and incident numbers and total impacts provide a profile that can be duplicated for other HM categories and for non-NM shipments. This information will provide an essential ingredient for the risk analysis to be accomplished in the second phase. This report provides a foundation for the second phase. The report shows that data exists which will enable a comparative risk assessment of HM and non-HM shipments.

As is indicated above, this project has two phases. The first characterizes the shipment impacts for one year of Class 3 HM shipments and assesses the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments. The characterization of the one year of Class 3 HM shipment impacts is in this report. The "Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Nonhazardous Materials Movements" is a separate report and provides a detailed plan for the approach that is recommended for the risk assessment in Phase II.

1.0 Introduction

1.1 Purpose and Organization

The United States Department of Transportation's (U.S. DOT) 1997 Draft Strategic Plan recognizes safety as its most important strategic goal and commits to promoting the public health and safety by working towards the elimination of transportation related deaths, injuries, and property damage (U.S. DOT, 1997). This project was designed to assist DOT in achieving this strategic goal by reducing the rate and severity of transportation fatalities and injuries in hazardous materials transportation and by reducing the dollar loss from high-consequence transportation accidents.

The long-term purpose of this project is to assess the additional risks posed by hazardous materials (HM) transportation when compared to non-hazardous materials (non-HM) shipments. Specifically, the project focuses on benchmarking the risk associated with HM transportation as compared to the shipment of non-HM. Additionally, the Office of Motor Carriers (OMC) must be able to break down the HM risk assessment into hazard classes so that a comparison can be made between the costs associated with accidents/incidents for each class. The distinction among hazard classes is based on the regulatory hazard classification systems listed in the Code of Federal Regulations (49CFR).

The project has been divided into two phases.

- The first phase characterizes the shipment impacts for one year of Class 3 HM shipments and assesses the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments. The characterization of the one-year Class 3 HM shipment impacts is contained in this report. The assessment of the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments is contained in the "Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Nonhazardous Materials Movements."

- The second phase is the actual comparative risk assessment between HM and non-HM truck shipments.

For the Phase I portrait of hazardous materials accidents and incidents in terms of death, injury and damages, the project focused on estimating the impacts of one year of HM transportation for only Class 3 (Flammable liquids and Combustible liquids) materials. Class 3 materials were selected because of their relative importance amongst HM shipments in terms of shipment volume and their potential for injury and damages during an accident.

1.2 Hazardous Materials Transportation

A hazardous shipment is where part or all of the cargo is considered hazardous according to the 49CFR. An incident is an event involving the transportation of hazardous material that may or may not result in the release of hazardous material to the environment. An accident is an incident that occurs when the vehicle transporting the goods is involved in a collision. Any incident involving the shipment of HM would be considered as a HM incident regardless of whether any of the material was spilled or was exposed to the atmosphere. Similarly, a non-HM shipment would be considered as non-HM shipments even if fuel from the tractor spilled during an accident.

In 49CFR, Part 172, Table 101, hazardous materials are broken into the following classes:

- Class 1 — Explosives
- Class 2 — Gases
- Class 3 — Flammable liquids (and Combustible liquid)
- Class 4 — Flammable solids; Spontaneously combustible materials and Dangerous when wet materials
- Class 5 — Oxidizers and Organic peroxides
- Class 6 — Toxic (poison) materials and Infectious substances
- Class 7 — Radioactive materials
- Class 8 — Corrosive materials
- Class 9 — Miscellaneous dangerous goods.

1.3 Hazardous Material Flow

An essential element of the characterization of Class 3 shipments for 1996 is a description of traffic flows. Unfortunately, the current data provides only a partial picture of HM flows for 1996. However, the estimate of transportation flows for all truck traffic, and for all hazardous materials, can be derived from several sources.

One source is the Commodity Flow Survey (CFS) (U.S. Department of Commerce, 1996). The (CFS) is a component of the quinquennial Census of Transportation that is designed to sample the economic activity of the transportation of goods by mode of transportation. The 1993 Commodity Flow Survey provides an estimate of ton-miles for all commodities shipped and an approximate estimate of the percentage of HM shipments of this total volume. The report shows that all commodities were shipped an estimated 869,536,000,000 miles in 1993, with hazardous materials comprising about 74,410,000,000 miles of this total. Hazardous materials represent about 8.5 percent of the total ton-miles. Unfortunately, the data for calculating the percentage of the HM which is allocated to the various HM classes is limited, so the Commodity Flow study does not provide a reasonable number in this regard.

Another source for vehicle miles traveled is the Highway Statistics for 1996 which provides annual vehicle miles for 1996. All trucks, which include combination trucks, are at 118,789,000,000 miles, and single unit trucks, with 6 or more tires, are at 63,967,000,000 miles. The total for all trucks is 182,756,000,000 miles (U.S. DOT, 1997b). In order to estimate the percentage of HM, the National Fleet Safety Survey for 1996 was utilized (Star Mountain Inc., 1997). For 1996, using a weighted average, 7.2 percent of all trucks surveyed carried HM. To calculate the percentage of Class 3 materials carried by truck for 1996, five regional HM commodity flow surveys were used. Based on the 5 surveys, a figure of 52 percent of HM vehicles was represented by flammable liquids. Appendix A summarizes the information from these flow studies.

Assuming that the VMT for all trucks in 1996 was 182,756,000,000 miles, HM alone would account for 13,158,432,000 miles and Class 3 flammable liquids would account for an estimated 6,842,384,640 miles traveled in 1996. This analysis assumes that the proportion of VMT attributable to HM vehicles represents the proportion of vehicles carrying HM.

Another source, the Research and Special Program Administration's (RSPA's) Office of Hazardous Materials Safety, provides an estimate for the number of daily shipments of hazardous materials and the number of tons shipped (RSPA 1998). Their estimate, which is based on a number of sources, estimates all hazardous materials truck shipments to account for about 769,000 shipments per day and about 1.4 billion tons shipped annually. Petroleum products, that comprise the major part of the Class 3 shipments, accounted for an estimated 314,000 of these daily shipments and about 1.04 billion annual tons shipped. Chemical and allied products accounted for about 445,000 daily shipments and "other' for about 10,000 daily shipments. The RSPA study calculates that although 43 percent of all HM tonnage is transported by truck, approximately 94 percent of the individual shipments are transported by truck.

2.0 Report Methodology

The methodology for this report is described in this section. Crucial portions of the methodology include the review, selection and analysis of available data sources, the estimation of the number of Class 3 accidents and incidents for 1996, and the measurement of impacts from these accidents and incidents.

2.1 Accident and Incident Data Sources

An initial step in developing a risk assessment is to reliably estimate the number of accidents and incidents for a defined period of time. For Phase I, an estimate of accidents and incidents was developed for Class 3 truck shipments in 1996. The estimate focused on the Hazardous Materials Information System (HMIS) database, and utilized several sources of data to adjust the incidents and accidents reported in the HMIS to more realistically reflect their actual number in a one-year period. The following sections describe the databases used in this effort.

Data identified and reviewed during initial research efforts associated with OMC's hazardous materials risk assessment study were from multiple sources and categories with varying detail. Sources of data reviewed consisted of Federal and state databases as well as research studies and analytical reports. The categories reviewed were numerator data, characterized as hazardous materials accidents/incidents or general commodity highway crashes, and denominator data, consisting of the flow or movement of hazardous materials and general commodities. These data sources will be employed to conduct a risk assessment of a highway accident involving hazardous materials vs. general commodities.

The data that was assembled and reviewed may be categorized as generally being a Federal or state database, with input in some instances by local authorities or private companies. The Federal databases are collected and maintained by multiple administrations within the U.S. DOT as well as the Commerce Department's Census Bureau. These data are collected under different regulations utilizing disparate definitions under programs that have varying missions. The state databases have issues of incompleteness and inconsistency primarily due to jurisdictional reporting variances among the states as well as diversity in data processing capability. A review of the various pertinent databases initially assembled for this project follows.

2.1.1 Federal Databases

Hazardous Materials Information System (HMIS). The HMIS is a system of databases maintained and managed by the Office of Hazardous Materials Safety (OHMS) within the RSPA. The major database in the HMIS and the most pertinent for the OMC risk assessment study is the incident/ accident database. This database dates back to 1971, contains about 280,000 records and currently adds approximately 14,000 reports annually. Although the HMIS is a multi-modal database, about 80 percent of the records are in the highway mode. The HMIS consists of incidents where an unintentional release of a hazardous material in commerce occurs during the course of transportation, or is possibly imminent and results in the closure of a major artery or an evacuation of the general public. Recently the HMIS has received an average of 250 reports annually that represent highway accidents with the great majority (approximately 200) involving cargo tanks.

Motor carriers are obliged to file a HMIS report under the current reporting requirement encompassing motor carriers that have interstate operations and those that transport certain highly hazardous materials interstate. This reporting requirement is due to be extended to intrastate motor carriers on October 1, 1998. In 49CFR, Sections 171.15 and 171.16 provide the specific reporting requirements (49CFR, Part 171). As a result of the distribution practices of some hazardous materials, such as gasoline, fuel oil, propane, and fertilizers, that are distributed in large volumes by intrastate motor carriers, a substantial increase in HMIS reports can be expected. The HMIS is specifically designed to capture information concerning the unintentional release of a hazardous material. Although an accident checkbox is available on the HMIS report form, the only detailed information involving the causation of an accident may be found in the narrative section or in attachments.

For the purposes of OMC's risk assessment study, the HMIS represents the only national database of hazardous materials highway transportation accidents and incidents with details of the material, packaging and consequences involved. This database is mature, well maintained and has been extensively examined; as a result, its limitations can be identified. The consequences associated with an incident are not comprehensive and in many instances the report form may not even be complete. This deficiency, together with the lack of accident information, intrastate carrier incidents and no non-spill incidents, requires input from additional databases whose strengths will complement the HMIS for conducting the risk assessment. Thus, several other databases were analyzed to supplement the 1996 Class 3 database from HMIS.

Registration Database. The registration database for carriers, shippers, and offerors of certain types or quantities of hazardous materials is contained within RSPA's HMIS. An annual registration form must be completed and submitted to RSPA that indicates the company's primary activity, and the states that the company operates in. The registration database contains approximately 26,500 records annually and may be sorted by primary activity, whether the registrant is a carrier, offeror or both and if a carrier operates inter- or intrastate. Recent annual tabulations show that of the 26,500 registrations received by RSPA, 2,820 are intrastate carriers and 731 indicate that they are both carriers and offerors on an intrastate basis. This database may prove useful in estimating the lack of intrastate incidents not currently recorded.

News Clippings Database. The RSPA contracts with a private clipping service to provide nationwide coverage of newspaper reports of hazardous material incidents. Copies of these incidents are forwarded to RSPA for entry into an electronic database. This database supplements HMIS data by compiling hazardous materials incidents not reported to RSPA. Paper copies of this database were obtained from RSPA, and after review, data elements were entered into a separate database for comparison with the HMIS database.

Safetynet MCMIS Database. The Motor Carrier Management Information System (MCMIS) is a system of databases - not unlike RSPA's HMIS- managed by the OMC. The Safetynet database, also known as the accident file, is comprised of police accident reports (PAR) assembled by the states and forwarded to the OMC. Each state has adopted the National Governors Association's (NGA) twenty-two uniform truck accident data elements on their PAR. This database was designed to provide a census of truck accidents nationwide. Among the states there is a wide variance among the local jurisdictions that provide PARs for a state's submittal into Safetynet. Because of this wide diversity of reporting jurisdictions within the states, some states have a more comprehensive data set in Safetynet than others. This database captures the general details of a crash as well as information on the vehicle and hazardous material cargo involved.

For the purposes of the OMC risk assessment study, Safetynet data files were requested for eight selected states (PA, IN, IA, MN, CO, OR, OH, and CA). Six of these states belong to the Performance and Registration Information Systems Management (PRISM) program that links U.S. DOT's information system to the states' systems. The PRISM program began as a mandate from Congress in the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 to explore the potential of linking the commercial vehicle registration process to motor vehicle safety. The PRISM program includes two major processes: the Commercial Vehicle Registration Process and the Motor Carrier Safety Improvement Process (MCSIP). These two processes work in parallel to identify motor carriers and to hold them responsible for the safety of their operations. The six states participating in the PRISM program are also part of an effort to improve the accuracy and timeliness of data reported to the federal government. The two non-PRISM states selected, OH and CA, were chosen because they produce additional state databases that were expected to be useful for the purposes of the OMC risk assessment study. The Safetynet database proved very useful in adjusting the HMIS database, by adding intrastate carrier accidents and non-spill accidents.

Trucks in Fatal Accidents. The Trucks in Fatal Accidents (TIFA) is a database developed by the University of Michigan Truck Research Institute (UMTRI) from the Fatal Accident Reporting System (FARS) compiled by the U.S. DOT. Under contract to the U.S. DOT, UMTRI identifies truck accidents in FARS and does extensive follow up on details of the fatal truck accident including the presence of hazardous materials as cargo. TIFA does not however contain any details on the consequences resulting from a hazardous materials spill.

Commodity Flow Survey (CFS). The CFS is a component of the quinquennial Census of Transportation that is designed to sample the economic activity of the transportation of goods by mode of transportation. The recently completed 1997 CFS sampled 100,000 establishments in manufacturing, wholesaling and other industries. In the 1997 CFS, the respondent was requested to identify by UN/NA number a hazardous material shipment. The addition of the UN/NA number on the CFS report form will allow for the effective aggregation and sorting of CFS hazardous material responses. This is a vast improvement over the coding scheme employed in the 1993 CFS, which utilized railroad STCC codes.

The processing of the 1997 CFS is currently underway. A number of hazardous material products have been proposed that would provide much needed data about the flow of hazardous materials for risk assessment studies. Proposed hazardous materials data from the 1997 CFS include the following tabulations and figures.

- Hazardous material shipments by hazard class/mode
- Bulk/non-bulk shipments by hazard class/mode
- Top ten UN/NA numbers by hazard class/mode
- Poisonous by Inhalation shipments by UN/NA number by mode
- State to state hazardous material shipments by mode
- Interstate vs. intrastate highway shipments by hazard class UN/NA number
- Packing group 1 shipments by mode.

The proposed 1997 CFS tabulations listed above assumes a standard CFS breakout by tons, ton miles, average shipment distance and weight. This data, provided it meets the Census Bureau's disclosure tests, should provide data for highway risk assessment studies heretofore unavailable. Census Bureau officials welcome suggestions for additional tabulations of 1997 CFS data.

Truck Inventory and Use Survey (TIUS). The TIUS is a component of the quinquennial Census of Transportation and complements the CFS. The TIUS conducted by the Census Bureau provides data on the physical and operational characteristics of the nation's truck population in the year subsequent to their use. Therefore, the 1997 TIUS data collection is currently underway and will be completed by the end of 1998. The 1997 TIUS is not likely to be available for use in the OMC risk assessment study.

The 1992 TIUS is available for use in the OMC study and was conducted utilizing the same size probability sample as well as the identical collection format for hazardous materials data. The format for hazardous materials data collection in the TIUS involves an indication of whether the truck was used to transport placarded hazardous materials, with a hazard class breakout. A broad breakout of the national percentage of trucks used to transport hazardous materials by hazard class and equipment type is available. Limitations of this database include definitional issues, a truck may also include a pickup, and a placard must be used, as well as a limited sample of 150,000 registered private and commercial trucks to draw on.

2.1.2 State Databases

State reports and databases were utilized for Ohio, California, and Colorado. They included reports from the Public Utility Commission of Ohio and databases from the California Highway Patrol and Colorado State Patrol. These databases focus on hazardous material incidents and provide an independent source of data.

California Highway Patrol (CHP). The CHP maintains a database of all reported hazardous material incidents. A subset of the CHP database was obtained from the CHP for analysis in OMC's risk assessment study. This database includes information on the actual incident, hazardous material, and casualties, but was lacking carrier information, and whether the incident was actually an incident or accident. However, the database was able to provide enough information on 1996 Class 3 accidents to supplement the HMIS database.

Colorado State Patrol. The Colorado State Patrol also maintains a database of all reported hazardous material incidents. The 1996 hazardous material incidents database was obtained for analysis for Phase I of OMC's risk assessment study. The database contains information concerning the actual incident, along with detailed information on the hazardous material, and carrier information. Thus, the database was able to provide enough information to supplement HMIS.

The Public Utilities Commission of Ohio (PUCO) Incident Reports. The PUCO provided copies of HM incident reports from January 1, 1996 to mid 1998. These reports contained information on the incident and carrier along with evacuation and road closure details. The reports were also very valuable in that they typically contained a detailed description of the incident, an item missing in most of the other databases. The PUCO reports were reviewed and data was extracted and entered into a database for comparison to HMIS.

2.1.3 Other Databases

Dialogue (Newspaper Clippings). A search of newspaper clippings from the eight states was completed to identify Class 3 accidents/ incidents in 1996. Those that were identified were included in the adjustment of the HMIS database. Most of the articles also provided additional detailed information on the accident/incident.

2.2 Methodology for Estimating Accidents/Incidents

The following sections describe the methodology used in the effort to estimate accidents/incidents for the one-year period.

2.2.1 Selection of Reference Database

The first step was to select a reference database. For the purposes of OMC's risk assessment study, the HMIS represents the only national database of hazardous materials highway transportation incidents with details of the material, packaging and consequences involved, although these consequences may not be comprehensive. The database is well maintained and carrier participation is required. Deficiencies include a lack of accidents or incidents involving intrastate carriers (although this deficiency is being corrected for FY 1999) and lack of coverage for no spill HM accidents. No spill HM accidents should be included in an analysis because law enforcement and fire protection officials often treat any HM accident as a potential spill even if no release of material is apparent and any accident involving a truck transporting HM should receive serious scrutiny from officials and the DOT.

2.2.2 Selection of Additional Databases

Additional databases whose strengths complement the HMIS for conducting the risk assessment were consulted to supplement HMIS data with data on non-spill accidents and intrastate accidents. In addition, other databases were examined to determine if accidents which should have been included in the HMIS were deemed not reportable or excluded through an oversight. Thus, several other databases were analyzed to supplement the 1996 Class 3 database from HMIS.

As indicated in the previous section, an estimate was developed for 1996 Class 3 truck shipment accidents during Phase I. The estimate relied on the HMIS as the primary source of accident data, but utilized several sources of data to adjust the accidents reported in the HMIS to more realistically reflect the actual number of accidents in a one-year period.

The search criteria used to identify the 1996 Class 3 truck shipments for each database is located in Appendix B. Since each database has it's own field characteristic, individual queries were generated to identify the 1996 Class 3 truck shipments. Criteria used across each database included the following:

- Year = 1996
- Accident (vs. Incident)
- Class = 3
- Placarded vehicle
- Enroute (traveling from origin to destination).

2.2.3 Approach for Estimating Accidents

The specific approach to supplementing the HMIS data involved focusing on the eight-state sample and more intensively on California, Colorado, and Ohio because of additional state database availability. The HMIS data for the eight states was systematically compared with respect to specific accidents, which were found in one or more of the additional databases. By identifying accidents, which appeared in other databases and probably should have also appeared in the HMIS, a portion of those underreported accidents were identified. The Safetynet data proved to be the most useful of the other databases because it included both intrastate and no spill, non-reportable accidents involving HM. After analyzing the data in the various databases described above, the accident count for the eight states was used as a measure to calculate the number of accidents for the nation. This process required four steps:

- First, the number of accidents for the eight states was estimated by supplementing the HMIS data with data from the other databases. Tables 1 through 8 provide the tables for each of the eight states which summarize the accident information used to estimate the number of accidents for 1996. (Note that the three states where state databases and dialogue information were used were weighted heavier for the analysis.)

- Second, a proportion of the national accidents represented by the eight states was calculated. Commodity flow and truck registration data for the eight states were both used to estimate the portion of the total HM traffic represented by the 8 states. The 1993 Commodity Flow Study tabulation of ton-miles provides an estimation of the total commodity ton-miles allocated to HM for each of the eight case study states. The total ton-miles within the eight states represent about 30 percent of the total ton-miles for the United States. California, Ohio, and Pennsylvania alone represent about 19 percent of the total US ton-mileage. (Note that the analysis assumed that the number of HM accidents is proportional to the commodity ton-miles.)

- Third the accident estimates for each of the eight states were totaled.

- Fourth, the total estimated national accident number was calculated by assuming the additional 70 percent of the national accidents occurred at the same rates and types and then by adding the estimate for the remaining 42 states to the eight-state estimate.

2.2.4 Approach for Estimating Incidents

Incidents were estimated in a more direct manner. Because the HMIS is the best source for enroute and loading/unloading incidents, these numbers were used for the fifty states. For loading and unloading incidents, 6 "accidents" were included in this category. They were augmented by the percentage represented by the number of intrastate incidents that would not be covered in the HMIS for the 1996 data. Utilizing the Safetynet data for the eight states the percentage of accidents represented by intrastate carriers was about 22 percent. Thus the incidents for the fifty states were supplemented by 22 percent.

Table 1. 1996, Class 3, Accident Information for Colorado

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Colorado State Patrol + ERNS Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/03/96	Roadway Express Inc	N[1]	✓			Colorado 6 & Colorado 70	Not reported Clear Creek						✓	0	0												
1/08/96	Eveready Freight Service, Inc.	Y	✓			I-70 7600 BLK	Arvada Jefferson						✓	1	0												
1/19/96	Richard Stewart Transport	Y	✓			Colorado 40 & MP 249	Not reported Clear Creek						✓	1	0												
1/25/96	Eveready Freight Co	Y	✓			Colorado 70 & Exit 221	Not reported Clear Creek						✓	1	0												
1/28/96	Basin Western, Inc.	Y[2]	✓			Colorado 40 & MP 161	Not reported Grand						✓	0	0						✓	0	0				
1/30/96	Dooley Oil Transport, Inc.	Y	✓			Colorado I-25 & MP 293	Not reported Larimer						✓	0	0												
2/04/96	Monument Oil Company	Y	✓			Colorado 13 & MP 83	Not reported Moffat						✓	0	0												
2/17/96	Fleischli Oil Co., Inc.	Y	✓			RCR 27 MP 19	Hayden Routt	✓		0	0	✓		0	0					✓		0	0				
2/19/96	James, Inc.	Y	✓			Colorado 40 & MP 161	Not reported Grand					✓		1	0												
3/05/96	DSI Transports, Inc.	Y	✓			Brighton Rd & 77[th] Ave	Not reported Adams						✓	2	0												
3/05/96	NATCO Petroleum, Inc.	Y	✓			Colorado 285 & MP 5	Not reported Conejos						✓	2	0												
3/18/96	Groendyke Transport, Inc.	Y	✓			Colorado 25 & MP 188	Not reported Douglas						✓	10	0												
4/03/96	Sweitzer Oil, Inc.	Y			✓	Colorado 285 .3N MP 168	Not reported Park														✓	0	0				
4/05/96	Palmer Oil Company	Y			✓	C&K Oil Company Hwy 40	Cheyenne Wells Cheyenne													*	*	0	0				
4/19/96	J C Trucking, Inc.	Y	✓			US HWY 40 MP 162	Kremmling Grand	✓		0	0									✓		0	0				
4/30/96	Groendyke Transport, Inc.	Y	✓			Powers Blvd & W Bradley Rd	Not reported El Paso					✓		1	0					✓		1	0				

[1] Van/Enclosed Box
[2] Colorado State Patrol says "tank", not cargo tank
Legend: Y = Yes; N = No; * Not reported

Table 1. 1996, Class 3, Accident Information for Colorado (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Colorado State Patrol + ERNS Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
5/06/96	Monte Vista Coop	Y	✓			Colorado 96 & MP 203	Not reported Kiowa						✓	1	0												
6/10/96	Fleet Transport Co., Inc.	Y	✓			I-70 West 412 MN	Vona Kit Carson	✓		0	0	✓		2	0												
6/13/96	Thomas Bodkin	*	✓			7400 Blk Hwy 85	Commerce City Adams						✓	1	0												
6/22/96	Matlack, Inc.	Y	✓			US 40	Berthoud Falls Clear Creek	✓		0	0	✓		2	0												
7/09/96	Klein Frank C & Co., Inc.	Y	✓			I-70	Idaho Springs Clear Creek	✓		0	0	✓		0	0												
7/18/96	Bogue Construction Co	Y			✓	Colorado 70 EB .9E MP 146	Not reported Eagle														✓	0	0				
7/27/96	Texaco Trading & Transport	Y			✓	Weld CR 390 .2 N Weld CR 136	Not reported Weld													✓		0	0				
7/28/96	Harpel Oil Company, Inc.	Y	✓			I-70 & Colorado 121	Arvada Jefferson						✓	0	0												
7/29/96	Groendyke Transport, Inc.	Y	✓			E Quincy Ave & S Parker Road	Aurora Arapahoe						✓	0	0												
8/04/96	Total Petroleum	Y			✓	I-76 at MM 31	West of Hudson Weld													✓		0	0				
8/19/96	Loco, Inc.	Y	✓			Hwy 133	Paonia Delta	✓		0	0																
8/20/96	Groendyke Transport, Inc.	Y	✓			Colorado 76 & Colorado 25	Not reported Adams						✓	1	0												
9/01/96	Basin Western, Inc.	Y	✓			I-70 B & 31 ½ Road	Grand Junction Mesa	✓		0	0																
9/16/96	Steere Tank Lines, Inc.	Y	✓			I-25 & MP 205	Denver Denver					✓		1	0												
10/03/96	Arkansas Valley Coop	Y		✓		Colorado 10 & CR 2	Not reported Otero						✓	1	0												
10/09/96	Farmland Industries, Inc.	Y	✓			I-70 & MP 283	Aurora Adams						✓	0	0												
11/26/96	Iowa Tanklines, Inc.	Y	✓			Colorado 25 & Colorado 119	Not reported Weld						✓	1	0												
11/27/96	Wright Valley Oil, Inc.	Y	✓			Colorado 160 & MP 273	Not reported Costilla					✓		3	0					✓		0	0				
12/14/96	Ehnle Oil	Y	✓			Colorado 40 & Empire	Not reported Clear Creek						✓	0	0												

Legend: Y = Yes; N = No; * Not reported

Table 1. 1996, Class 3, Accident Information for Colorado (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Colorado State Patrol + ERNS Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
12/16/96	James, Inc.	Y			✓	Colorado 25 .4 Ft N MP 239	Not reported Weld													✓		1	0				
12/17/96	Groendyke Transport, Inc.	Y	✓			6900 Blk I-25 & E Arapahoe	Greenwood Village Arapahoe						✓	1	0												
12/17/96	Iowa Tanklines, Inc.	Y	✓			3805 Kipling	Wheat Ridge Jefferson	✓		0	0																
12/17/96	Unknown	Y			✓	I-25 at Colorado 7	Not reported Adams																		✓	*	*
12/28/96	Peerless Tyre Co	Y	✓			S Sheridan Blvd & W Mississippi	Lakewood Jefferson						✓	0	0												
12/29/96	Basin Western, Inc.	Y	✓			MP 125 Co Hwy 9	Silverthorne Summit	✓		0	0	✓		1	0												

Legend: Y = Yes; N = No; * Not reported

Table 2. 1996, Class 3, Accident Information for Ohio

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				Ohio PUCO Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/02/96	Penske Truck Leasing	Y	✓			MP 006.00	Denmark Township Ashtabula						✓	0	0												
1/03/96	B P Oil Co.	Y	✓			Rt 162	Chatham Medina	✓		0	0																
2/06/96	Preston Trucking Co.	N[1]	✓			2977 Brecksville Road	Richfield Henry	✓		0	0																
4/01/96	Advantage Tank Lines, Inc.	Y	✓			MP 073.00	Somerford Township Madison						✓	0	0												
4/15/96	Suttles Truck Leasing, Inc.	Y	✓			I-71 NB MM63	Columbus Fairfield	✓		0	0																
4/25/96	Dixieland Express	Y	✓			I-71	Symmes Hamilton													✓		0	0				
6/14/96	Consolidated Freightways Corp Del	N[1]	✓			I-71 Northbound	Mount Sterling Madison	✓		0	0																
6/30/96	Lykins Oil Co.	Y	✓			Rt 48 at I-71 Ramp	Not Available Warren	✓		0	0	✓		1	0					✓		0	0				
8/26/96	Safety Kleen	Y			✓	Rt 6/Wapakoneta Rd	Grand Rapids Wood														✓	2	1				
8/29/96	BMI Transportation, Inc.	Y	✓			Rt 519E	Franklin Columbiana	✓		1	0																
9/05/96	Not Available	Y			✓	Route 315	Columbus Franklin																		✓	2	0
9/23/96	Freight Sales, Inc.	Y	✓			MP 005.00	Moorefield Twp Harrison						✓	1	0												
10/29/96	Matlack, Inc.	Y	✓			I-70/MM 122	Kirkersville Licking	✓		0	0	✓		1	0					✓		1	0				
10/30/96	Columbia Oil Co.	Y	✓			State Route 73	Wilmington Clinton	✓		0	0																
11/06/96	Not Available	Y			✓	North Dixie Drive	Harrison Twp Not Available																	✓		1	0
11/07/96	Swifty Oil	Y	✓			Rt 25A	Dayton Montgomery													✓		0	0				
11/18/96	Sun Company	Y	✓			Ohio Turnpike/MM 196	Mantua/Reenna Portage	✓		0	0									✓		0	0				
12/30/96	Premier Tank Lines	Y	✓			SR #138	Clarksburg Ross	✓		0	0	✓		1	0					✓		0	0				

[1] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table 3. 1996, Class 3, Accident Information for California

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/09/96	Pan Pacific Petroleum Co., Inc.	Y		✓		Rt 405/Normandie Ave	Torrance Not Available						✓	0	0												
1/10/96	Chevron USA, Inc.	Y		✓		Rt 118/Chatsworth	Los Angeles Not Available						✓	0	0												
1/12/96	HF Cox	Y	✓			Rt 118/Ruffner Ave	Los Angeles Not Available						✓	0	0												
1/20/96	Pearce Tank Line	Y		✓		Rt 405/Carson	Carson Not Available						✓	2	0												
1/21/96	H F Cox, Inc.	Y		✓		Rt 5/Rye Cyn	Los Angeles Not Available						✓	0	0												
1/23/96	Miller Roy Freight Lines, Inc.	N[1]	✓			Ferguson Road	Gilroy Santa Clara	✓		0	0																
1/30/96	Cool Transports, Inc.	*		✓		Rt 101 Nbon/R/ Pilgrimage	Los Angeles Not Available						✓	1	0												
2/08/96	Shell Oil Products Co.	Y		✓		Rt 17/Glenwood Cut/Off	Santa Cruz Not Available						✓	0	0												
2/24/96	Van Dyk Oil Co., Inc.	Y	✓			Rt 395/Osdick Rd	San Bernardino Not Available						✓	0	0												
2/25/96	Cox Oil Co., Inc.	Y	✓			Rt 91/Woodruff Av	Bellflower Not Available						✓	1	0												
2/26/96	Systems Transport	Y	✓			Rt 91/Orange Av	Long Beach Not Available						✓	0	0												
2/27/96	Cross Petroleum Inc.	Y	✓			Rt 99 Sboff/R/E Park Ave	Chico Not Available						✓	0	0												
3/05/96	Alta	Y	✓			Rt 710 Sbtrn/Rt 405	Long Beach Not Available						✓	1	0												
3/13/96	Atlas Bulk, Inc.	Y	✓			Rt 210/Madre	Pasadena Not Available						✓	0	0												
3/13/96	San Joaquin Helicopters	Y		✓		30 Av/Nevada Av	Kings Not Available					✓		1	0												
3/16/96	Golden Bear	Y	✓			Rt 405/Mulholland Dr	Los Angeles Not Available						✓	0	0												
3/19/96	Jose Toledo	Y	✓			Rt 5/Rt 223	Kern Kern					✓		1	1	✓		3	1								
3/22/96	United Oil Company	Y	✓			Rt 101/Echo Pk	Los Angeles Not Available						✓	0	0												
3/24/96	Vasto Valley Farms	Y	✓			Rt 198/California Aquedct	Fresno Not Available						✓	5	0												

[1] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table 3. 1996, Class 3, Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
3/28/96	Crown Chemical	Y		✓		Rt 5/Las Flores	Carlsbad Not Available						✓	0	0												
4/03/96	Redwood Oil Company	Y		✓		Rt 101/San Antonio Rd	Sonoma Not Available						✓	1	0												
4/10/96	KEC Engineering	N[2]		✓		Rt 60/Gilman Spg Rd	Riverside Not Available						✓	0	0												
4/13/96	Not Available	Y			✓	Avenue 24 East of SR 99	Chowchilla Madera													✓		0	0				
4/22/96	Myers Tank Lines	Y		✓		Rt 8/Severin Dr	LaMesa Not Available						✓	0	0												
5/11/96	Yellow Freight Systems	N[2]	✓			Rt 105/Harris Av	Lynwood Not Available						✓	0	0												
5/13/96	Larry Dee Kothe	Y	✓			Rt 405/120	Los Angeles Not Available					✓		0	0												
5/23/96	R F White Co., Inc.	Y		✓		Main/Placentia Ln	Riverside Not Available						✓	0	0												
5/30/96	BC Stocking Distributing	N[2]		✓		Rt 680/Monument BL UC	Pleasant Hill Not Available					✓		0	0												
6/07/96	J W Myers, Inc.	Y		✓		Rd 16/Av 6	Madera Not Available						✓	0	0												
6/09/96	Arco Products Co.	Y	✓			Rt 5/Zoo Dr OC	Los Angeles Not Available					✓		1	0												
7/04/96	Atlas Bulk, Inc.	Y	✓			Rt 101	Petaluma Sonoma					✓		0	1	✓		0	1					✓		0	1
7/08/96	Atlas Bulk, Inc.	Y	✓			Rt 805/Adams Av OC	San Diego Not Available						✓	0	0												
7/15/96	Beneto, Inc.	Y	✓			Hwy 99 South	Mettler Kern	✓		0	0	✓		1	0												
7/18/96	Jack Griggs, Inc.	Y		✓		Cedar Av/Adams Av	Fresno Not Available						✓	0	0												
7/19/96	Casazza Trucking Co.	Y	✓			Rt 395/1.6 miles N of Buckeye Road	Bridgeport Mono	✓		0	0	✓		0	0					✓		0	0				
7/26/96	Trans Petro of California	Y	✓			Tuxford/San Fernando Road	Los Angeles Not Available						✓	1	0												
7/29/96	Not Available	Y			✓	I15	Ontario San Bernardino									✓		0	1								
7/29/96	Toms Sierra Co., Inc.	N[1]	✓			Hwy 70 Exit	Oroville Butte	✓		0	0																
8/06/96	Redwood Oil Co.	Y		✓		Rt 116/Arnold Dr.	Sonoma Not Available						✓	5	0												

[2] Van/Enclosed Box

Legend: Y = Yes; N = No; * Not reported

Table 3. 1996, Class 3, Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
8/07/96	Not Available	Y			✓	S/B I-5 S/O Obrien	Uninc. Redding Shasta													*	*	0	0				
8/08/96	Marvin, Inc.	Y		✓		Aberdeen Dr/Rt 247	San Bernardino Not Available					✓		0	0												
8/13/96	Columbia Helicopters, Inc.	Y	✓			Rt 20/Walker Ridge Rd	Lake Not Available					✓		0	0												
8/16/96	Mobil Oil Corp.	Y		✓		Rt. 215/Mill UC	San Bernardino Not Available						✓	1	0												
8/30/96	Southwest Trails	Y		✓		Rt 101/Canoga Av.	Los Angeles Not Available						✓	0	0												
8/31/96	Dan Clark	Y		✓		Rt 46/Browns Material Rd	Kern Not Available						✓	0	0												
9/08/96	Desert Propane Service	Y		✓		Rt 91/Long Bch Bl	Long Beach Not Available						✓	0	0												
9/11/96	American Propane LP	Y	✓			Rt 5	Stanislaus Not Available						✓	0	0												
9/11/96	Williams Tank Lines	Y		✓		Rt 14/Puritan Mine Rd UC	Los Angeles Not Available						✓	0	0												
10/01/96	Van Dyk Oil Co., Inc.	*		✓		Rt 15/Rt 138	San Bernardino Not Available						✓	0	0												
10/02/96	Not Available	Y			✓	Rt 98	Not Available Monterey									✓		0	1								
10/08/96	BiState Petroleum	Y	✓			US Hwy 50	Not Available Not Available																	✓		0	0
10/15/96	Desert Propane Service	*		✓		Rt 110/Pico Bl	Los Angeles Not Available						✓	0	0												
10/20/96	Ueta of California, Inc.	Y		✓		Rt 94/Home AV OC	San Diego Not Available						✓	0	0												
10/21/96	H F Cox, Inc.	Y		✓		Rt 14/Placerita Cyn	Los Angeles Not Available						✓	1	0												
11/01/96	Beneto Tank Lines	Y		✓		Rt 15/Franklin OC	Riverside Not Available						✓	1	0												
11/01/96	Coastal Transport Co., Inc.	Y	✓			Rt 78/Town Palo Verde	Imperial Not Available						✓	1	0												
11/05/96	Cross Petroleum Transport, Inc.	Y	✓			Interstate 5 & O'Brien Exit	O'Brien Shasta	✓		0	0									*	*	0	0				
11/11/96	Ramos Oil Co., Inc.	Y		✓		Sievers Rd/Sparks Rch Rd	Solano Not Available						✓	0	0												
11/12/96	Flying J Transportation, Inc.	Y		✓		Worthington Rd/ McConnell Rd	Imperial Not Available						✓	4	0												
11/22/96	Not Available	Y			✓	Rt 78	Not Available Imperial									✓		0	1								

Legend: Y = Yes; N = No; * Not reported

Table 3. 1996, Class 3, Accident Information for California (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City/ County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts				CA Highway Patrol Impacts				Dialog Impacts			
								Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
11/22/96	Arco Products Co.	Y	✓			Reservoir @ Philadelphia	Pomona Los Angeles	✓		0	0																
12/12/96	D L Peterson/West Shore Corp.	N[2]		✓		Rt 5/Buena Vista Cnl Rd	Kern Not Available						✓	2	0												
12/14/96	Arco Products Co.	Y	✓			785 E Stanley Blvd	Livermore Alameda	✓		0	0																
12/16/96	Polyester Chemical Corp	N[2]		✓		Rt 14/Escondido Cyn Rd	Los Angeles Not Available						✓	0	0												
12/22/96	Rinehart Oil, Inc.	Y			✓	Marina Vista and Shell Avenue	Martinez Not Available																	✓		0	0
12/24/96	Cosby Oil Company	Y		✓		Rt 5/Broadway Av	Los Angeles Not Available						✓	0	0												
12/29/96	Williams Tank Lines, Inc.	Y	✓			Rt 99/Carpenter Rd OC	Modesto Not Available						✓	0	0												
12/31/96	California Fresno Trans. Co.	Y	✓			Rt 41/McKinley Av UC	Fresno Not Available						✓	0	0												

Legend: Y = Yes; N = No; * Not reported

Table 4. 1996, Class 3, Accident Information for Indiana

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/03/96	Ashland Chemical Co.	N[1]	✓			I-65 NB 12MM	Sellersburg	Clark						✓	1	0				
1/04/96	Oliver D. Adams	Y	✓			US-231	Cloverdale	Putnam						✓	1	0				
1/22/96	Stahly Cartage Co.	Y	✓			SR-3/SR-205	Laotto	DeKalb					✓		2	0				
1/26/96	Preston Trucking Co., Inc.	N[1]	✓			I-94 WB 29MM	Michigan City	Porter					✓		1	0				
4/05/96	Metropolitan Trucking, Inc.	N[1]	✓			Indiana Toll Rd 59.2MM	New Carlisle	LaPorte						✓	2	0				
4/23/96	Distribution Transportation System	N[1]	✓			US-36 and CR-200 West	Muncie	Randolph						✓	0	0				
5/01/96	R&D Transport, Inc.	Y	✓			US 136 at Dandy Trail	Clermont	Marion	✓		1	0								
5/14/96	Superior Carriers, Inc.	Y	✓			I 80 EB 12MM	Lake Station	Lake	✓		0	0								
6/05/96	Usher Transport, Inc.	Y	✓			I-64 EB 122.5MM	New Albany	Floyd	✓		0	0	✓		2	0				
7/29/96	Crystal Flash	Y	✓			SR-39 & SR-142	Monrovia	Morgan					✓		1	0				
8/26/96	FJ Schilling, Inc.	N[1]	✓			I-465 W 37BMM	Indianapolis	Marion						✓	1	0				
8/27/96	Montgomery Tank Lines	Y	✓			US-52 & US-28	Fickle	Tippecanoe						✓	0	0				
8/29/96	DC Trucking, Inc.	N[1]	✓			I-65 SB 53MM	Seymour	Jackson					✓		2	0				
9/04/96	Preston Trucking Co., Inc.	N[1]	✓			US-41 SB	Shelburn	Sullivan						✓	1	0				
9/07/96	Mid-States Express, Inc.	N[2]	✓			I-94 @ US Route 20	Burns Harbor	Porter	✓		0	0								
9/09/96	Howell Transportation Services, Inc.	Y	✓			I-69 72MM	VanBuren	Grant	✓		0	0	✓		2	0				
9/16/96	Premier AG Coop	Y	✓			SR-32 East of Casey	Westfield	Hamilton					✓		0	1	✓		0	1
9/24/96	Reis Trucking, Inc.	Y	✓			SR-350 & North Hogan Rd	Center Twp.	Dearborn						✓	2	0				
10/08/96	Matlack, Inc.	Y	✓			I-65 NB to I-80 WB	Calumet	Lake						✓	1	0				
10/09/96	Harvey Construction Co., Inc.	*	✓			5579 East 146th Street	Noblesville	Hamilton						✓	1	0				

[1] Van/Enclosed Box
[2] Van Truck/Trailer
Legend: Y = Yes; N = No; * Not reported

Table 4. 1996, Class 3, Accident Information for Indiana (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
10/21/96	American Freightways, Co., Inc.	N[2]	✓			Jefferson Blvd.	Fort Wayne	Allen	✓		0	0								
10/28/96	Fayette County Co-Op	Y	✓			SR-44 WB	Connersville	Fayette						✓	1	0				
10/29/96	R&D Transport	*	✓			I-65 SB 251MM	Merrillville	Lake						✓	0	0				
11/02/96	Ag One Co-Op	Y	✓			CR-500 N West of CR-300N	Lafayette Twp.	Madison						✓	2	0				
11/09/96	USF Holland, Inc.	N[1]	✓			Indiana Toll Rd 136.1MM WB	Orland	Steuben						✓	0	0				
11/20/96	Transwood, Inc.	Y	✓			I-65 NB N of 200MM	Remington	Jasper						✓	0	0				
11/22/96	American Freightways, Inc.	N[1]	✓			Tibbs & Minnesota	Indianapolis	Marion						✓	0	0				
11/27/96	Knox Co. Farm Bureau Co-Op Association, Inc.	Y	✓			Old US-41S	Vincennes	Knox						✓	1	0				
12/02/96	Midland Co-Op, Inc.	N[1]		✓		600 N Indiana Street	Greencastle	Putnam						✓	1	0				
12/12/96	Bork Transport, Inc.	Y	✓			N. Franklin Road & E 34th Street	Indianapolis	Marion						✓	2	0				
12/19/96	Johnson Oil Company, Inc.	Y	✓			I-456 SB 200' South of 42MM	Indianapolis	Marion						✓	4	0				
12/19/96	Luke Oil Company	Y	✓			I-90 WB 12.7MM	Gary	Lake						✓	0	0				
12/29/96	McDaniel Transportation	Y	✓			I-65S 98MM	Greenwood	Johnson					✓		0	0				

Legend: Y = Yes; N = No; * Not reported

Table 5. 1996, Class 3, Accident Information for Oregon

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts: Spill — Yes	HMIS Impacts: Spill — No	HMIS Impacts: Injury	HMIS Impacts: Fatality	SAFETYNET Impacts: Spill — Yes	SAFETYNET Impacts: Spill — No	SAFETYNET Impacts: Injury	SAFETYNET Impacts: Fatality	TIFA Impacts: Spill — Yes	TIFA Impacts: Spill — No	TIFA Impacts: Injury	TIFA Impacts: Fatality
1/20/96	Johnson Oil Company	Y	✓			.2E Woodson Road	Not Available	Columbia						✓	2	2				
1/23/96	Barnes Fuel Oil Service	Y		✓		Sunset St. & Alameda	Not Available	Douglas						✓	0	0				
1/30/96	Hayes, RW Co.	Y	✓			Not Available	Not Available	Lane						✓	0	0				
2/24/96	American Transport, Inc.	Y	✓			Chemaward	Not Available	Marion						✓	2	0				
3/20/96	Tarr, Inc.	Y	✓			2700 Block	Not Available	Washington						✓	1	0				
4/22/96	Staub, Ed & Sons Petroleum, Inc.	Y	✓			.3 N Co. Rd. 2-9	Not Available	Lake					✓		0	0				
5/18/96	Jackson Oil Trucking, Inc.	Y	✓			1.00 S Old Ritter Road	Not Available	Grant					✓		1	0				
5/22/96	Carson Oil Co., Inc.	Y	✓			Wilsonville Road	Not Available	Clackamas						✓	0	0				
6/26/96	Fossil Fuel, Inc.	Y		✓		Hwy 207	Not Available	Wheeler					✓		1	0				
7/18/96	Swift Transportation Co., Inc.	*	✓			.5W Hoyt Road	Not Available	Umatilla						✓	1	0				
7/22/96	Texaco Refining & Marketing	Y	✓			State Hwy 37 MP 13	Holdman	Umatilla	✓		1	0	✓		1	0				
7/30/96	Nationsway Transport Service, Inc.	*	✓			Not Available	Not Available	Union						✓	0	0				
7/31/96	USF Reddaway, Inc.	*	✓			1.5N Sunny Valley	Not Available	Josephine						✓	1	0				
8/21/96	Texaco Refining & Marketing	Y	✓			2.5 E US-30	Not Available	Baker					✓		1	0				
8/22/96	Texaco Refining & Marketing	Y	✓			E 1-84 near MP 289	North Powder	Union	✓		1	0								
8/30/96	Williams Tank Lines	Y	✓			13MM on Sprague River Hwy	Chiloquin	Klamath	✓		0	0								
9/05/96	Tosco Refining & Marketing Company	Y	✓			Broadway & 6th Street	Not Available	Multnomah						✓	0	0				
9/11/96	Rickreall Farm Supply, Inc.	Y	✓			.25 Hwy 22	Not Available	Polk						✓	1	0				
9/12/96	Oil Products, Inc.	Y	✓			Near I-5	Not Available	Marion						✓	0	0				
9/25/96	Viking Freight, Inc.	*	✓			Not Available	Not Available	Jackson					✓		1	0				
10/16/96	Chinkapin, Inc.	Y	✓			40 Ft W Dexter Road	Not Available	Lane						✓	1	0				
11/04/96	Alpha Owens Corning, LLC	*	✓			Barlow RD & Whiskey Hl	Not Available	Clackamas						✓	1	0				
11/05/96	Star Oil Company	Y	✓			Harold Street	Not Available	Multnomah						✓	1	0				
11/19/96	American Transport, Inc.	Y	✓			Not Available	Not Available	Jefferson					✓		1	0				
11/19/96	The Oil House	Y	✓			Williams Hwy	Not Available	Jackson						✓	0	0				

Legend: Y = Yes; N = No; * Not reported

Table 5. 1996, Class 3, Accident Information for Oregon (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
11/20/96	Space Age Fuel, Inc.	Y	✓			Not Available	Not Available	Wasco						✓	0	0				
12/03/96	Werner Enterprises	N[1]	✓			I-84 Mile Post 333	Weatherby	Baker	✓		0	0								
12/23/96	Reese's Oil Co., Inc.	Y		✓		100 Ft S Park	Not Available	Clackamas					✓		4	0				
12/27/96	Harris Transportation Co.	Y	✓			Not Available	Not Available	Sherman						✓	1	0				
12/30/96	Cascade Transfer, LLC	Y		✓		Delta Hwy	Not Available	Lane						✓	1	0				

[1] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table 6. 1996, Class 3, Accident Information for Iowa

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/26/96	Solar Transport Co	Y	✓			B35 and Hwy 65	Mason City	Cerro Gordo						✓	0	0				
2/19/96	Denny Wessel Transport	Y	✓			Hwy 18 & N 60	Cylinder	Palo Alto	✓		0	0	✓		1	0				
2/23/96	Iowa Tanklines Inc	Y	✓			1 1/2 mi North of IA 546	Carlisle	Polk	✓		0	0								
2/23/96	Wynne Transport Service Inc	N[1]	✓			I 80 EB 187.75 MM	not available	Poweshiek						✓	1	0				
3/27/96	Farmland Industries	Y	✓			Army Post Rd Hwy 5	Des Moines	Polk						✓	0	1				
4/29/96	Adm Trucking Inc	Y	✓			I-30, NB Milemarker 46	Urbana	Benton	✓		0	0	✓		1	0				
8/09/96	Dougs Transfer	N[1]	✓			Hwy 65 1/2 mile South of Mason City	Cerro Gordo	Cerro Gordo						✓	3	0				
8/10/96	Wayne Transports Inc	Y	✓			Hwy 9 and 71,327 E Peoria Avenue	Spirit Lake	Dickinson						✓	1	0				
9/21/96	Transwood Inc.	Y	✓			Interstate 35 South	Story City	Story	✓		0	0	✓		1	0				
10/22/96	G & G Express Inc	N[2]	✓			Hwy 30	Grand Mound	Clinton	✓		0	0								

[1] Van/Enclosed Box
[2] Van Truck/Trailer
Legend: Y = Yes; N = No; * Not reported

Table 7. 1996, Class 3, Accident Information for Minnesota

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
1/15/96	Jebro, Inc.	Y	✓			Interstate 90 Mile Marker 35	Dewald	Nobles	✓		0	0								
2/08/96	Independent Diversified Transport	Y	✓			Co. Rd. 14 Co. Rd. 102	Miltona	Douglas	✓		0	0	*	*	1	0				
3/14/96	Dahlen Transport, Inc.	Y	✓			Madison Ave & River Front Drive	Mankato	Blue Earth	✓		0	0								
5/21/96	Jensen Transport Co., Inc.	Y	✓			Hwy 86 MP 4	Lakefield	Jackson	✓		0	0								
8/02/96	Dahlen Transport, Inc.	Y	✓			63 Northbound	Racine	Mower	✓		0	0					✓		1	1
8/23/96	Orton Transport	Y		✓		Hwy 2		Polk					✓		1	0				
8/29/96	Kane Transport Co.	Y	✓			Minnesota Hwy 7	New Germany	Carver	✓		2	0								
9/06/96	Mielke Oil Co.	Y	✓			Concord & 494	South St. Paul	Dakota	✓		0	0								
9/20/96	Roche Oil Co.	Y	✓			CSAH 102	Mountain Iron	St. Louis	✓		0	0								
10/19/96	Wayne Transports, Inc.	Y	✓			Hwy 88 & County LA	New Brighton	Ramsey	✓		0	0								
10/29/96	Dahlen Transport, Inc.	Y	✓			Hwy 101 NB @ Co. Rd. 42	Otsego	Wright	✓		0	0								
12/24/96	Yocum Oil Company	Y		✓		E Co. Rd. E	Vadnais Heights	Ramsey					*	*	1	0				

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania

									HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/02/96	C A Leasing Inc	Y		✓		Route 2004	Hamilton	Monroe					✓		1	0				
01/02/96	Union Fuel Co.	Y		✓		Pierce St	Easton	Northampton						✓	1	0				
01/04/96	AIRCO Industries	Y	✓			Route 0202	Upper Merion	Montgomery						✓	0	0				
01/05/96	Agway Energy Products	Y	✓			Route 1011	Oakland	Butler						✓	0	1				
01/05/96	JJ Skelton Oil Co	Y		✓		Route 1007	Silver Spring	Cumberland						✓	2	0				
01/06/96	Box Gases	Y	✓			East/West Turnpike	Penn	Westmoreland						✓	1	0				
01/06/96	Brinkers Fuels Inc	Y	✓			Perry Auger Rd	Nockamixon	Bucks						✓	0	0				
01/06/96	Joanna Oil Company	Y	✓			Zion Rd	Robeson	Berks						✓	0	0				
01/09/96	Ferrell Gas	Y	✓			Route 0472	Colerain	Lancaster						✓	1	0				
01/09/96	H. L. Meyer Inc.	Y		✓		Horseshoe Pk	South Annville	Lebanon						✓	0	0				
01/09/96	Reed Oil	Y	✓			Lakewood Rd	Hickory	Lawrence						✓	1	0				
01/10/96	Exxon Co USA	Y	✓			Interstate 0079	Cecil	Washington						✓	1	0				
01/10/96	K L Lamborson Inc	Y	✓			Pine St	Mt Union	Huntingdon						✓	1	0				
01/10/96	Russell E Conrad Inc.	Y		✓		Sander Al	Kutztown	Berks						✓	0	0				
01/11/96	Boncosky Services Inc	Y	✓			Lincolnway Rd	New Oxford	Adams						✓	0	0				
01/11/96	Carninal USA Fuel	Y		✓		Providence Rd	Nether Providence	Delaware						✓	0	0				
01/11/96	Creamer Oil Company Inc	Y	✓			Gabler Rd	Hamilton	Franklin						✓	0	0				
01/11/96	Fanelli Bros Trucking & Leasing	N[1]	✓			Interstate 0078	Weisenberg	Lehigh					✓		1	0				
01/11/96	Hutter Inc	Y	✓			Walnut St	Lebanon	Lebanon						✓	1	0				
01/11/96	Peters Gas & Oil Inc	Y		✓		Route 0437	Fairview	Luzerne						✓	0	0				
01/11/96	Seifert Enterprises Inc	Y	✓			William Penn Hw	Whitehall	Lehigh						✓	1	0				
01/12/96	Stahl Oil Co Inc	Y	✓			Buffalo Pittsburgh	Croyle	Cambria						✓	1	0				
01/12/96	Yellow Freight System Inc	N[1]	✓			Interstate 0080	Marion	Centre						✓	0	0				
01/13/96	Amerada Hess Corp	Y	✓			Hanover Rd	Heidelberg	York						✓	0	0				

[1] Van/Enclosed Box

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
01/13/96	Superior Carriers Inc.	N[2]	✓			Interstate 0080	Greene	Clinton						✓	1	0				
01/14/96	J D Sales Inc	Y		✓		Lower York Rd	Solebury	Bucks						✓	0	0				
01/15/96	Joseph D Miller & Sons Inc	*	✓			Ninth St	Philadelphia	Philadelphia						✓	1	0				
01/15/96	Montour Oil Service Co	Y		✓		Old Montoursvillrd	Loyalsock	Lycoming						✓	0	0				
01/15/96	Spartan Express Inc	N[1]	✓			Seventh St	Emmaus	Lehigh						✓	1	0				
01/16/96	Bruceton Farm Services Inc	Y	✓			Route 0051	Perryopolis	Fayette						✓	3	0				
01/16/96	Roadway Express Inc.	N[1]	✓			Interstate 0078	Greenwich	Berks					*	*	1	0				
01/17/96	Overnite Transportation Co	N[1]	✓			William Penn Hw	Greenwood	Perry						✓	1	0				
01/18/96	Best Fuel Oil	Y	✓			Route 0209	Polk	Monroe						✓	0	0				
01/18/96	Supervalu Transportation	N[1]	✓			Route 0366	Washington	Westmoreland						✓	1	0				
01/19/96	Baker Petroleum Trans Co	Y	✓			Funk Rd	Hatfield	Montgomery						✓	1	0				
01/20/96	Michael K Kowalski Incorp	Y	✓			Union St	Corry	Erie						✓	0	0				
01/22/96	Penndot	Y	✓			Route 0026	Hopewell	Bedford						✓	2	0				
01/23/96	Pjax	N[1]	✓			Route 0068	Oakland	Butler						✓	0	0				
01/24/96	L K Burket & Brother	Y	✓			Ithan Av	Radnor	Delaware						✓	1	0				
01/25/96	D E Walker And Sons	Y		✓		Sumneytown Pk	Lower Gwynedd	Montgomery						✓	0	0				
01/26/96	Hillers Inc.	Y		✓		Main St	So Williamsport	Lycoming						✓	1	0				
01/27/96	New Penn Motor Express	N[1]	✓			East/West Turnpike	Rapho	Lancaster						✓	0	0				
01/27/96	Praxair Inc.	Y	✓			Interstate 0079	Jackson	Butler						✓	2	0				
01/30/96	Moyer & Son	Y		✓		Welsh Rd	Horsham	Montgomery						✓	1	0				
01/31/96	Keroscene	Y		✓		Roosevelt Bl	Philadelphia	Philadelphia						✓	1	0				
02/09/96	Action Oil Co	Y	✓			Route 3012	Georges	Fayette						✓	0	0				
02/11/96	Titan Express	N[1]	✓			Interstate 0080	Clarion	Clarion						✓	2	0				
02/12/96	Butler Petroleum Corporation	Y	✓			Route 0224	Mahoning	Lawrence						✓	0	0				
02/12/96	DBA Petroleum Heating Co.	*		✓		Main St	Macungie	Lehigh						✓	1	0				
02/12/96	U S Xpress Leasing Inc	N[2]	✓			Route 0062	Hermitage	Mercer						✓	1	0				

[2] Garbage/Refuse

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts: Spill — Yes	HMIS Impacts: Spill — No	HMIS Impacts: Injury	HMIS Impacts: Fatality	SAFETYNET Impacts: Spill — Yes	SAFETYNET Impacts: Spill — No	SAFETYNET Impacts: Injury	SAFETYNET Impacts: Fatality	TIFA Impacts: Spill — Yes	TIFA Impacts: Spill — No	TIFA Impacts: Injury	TIFA Impacts: Fatality
02/12/96	Wilmington Oil Company Inc	Y	✓			Benjamin Frankli HW	Mahoning	Lawrence						✓	1	0				
02/13/96	Mckelvey Oil Co Inc	Y		✓		Sr 0764 Sh	Allegheny	Blair						✓	2	0				
02/14/96	Ho Wolding Inc	N[1]	✓			Interstate 0080	Marion	Centre						✓	0	0				
02/14/96	M Lynch Transportation Inc	Y	✓			Susquehanna Tr	Penn	Snyder						✓	0	0				
02/15/96	Hale Intermodal Trucking Co.	N[1]	✓			East/West Turnpike	Bristol	Bucks						✓	0	0				
02/19/96	Guttman Oil Co	Y	✓			Route 0088	Speers	Washington						✓	0	1				
02/20/96	Pro Oil Co Inc	Y	✓			Route 62	Pine Grove	Warren	✓		0	0	✓		1	0				
02/20/96	Triangle Gasoline Co.	Y	✓			Route 0038	Washington	Butler						✓	0	0				
02/28/96	The Sico Co.	Y	✓			Gap Newport Pk	New Garden	Chester						✓	1	0				
03/02/96	Sank Inc.	*	✓			Interstate 0095	Philadelphia	Philadelphia						✓	0	0				
03/06/96	Heath Oil Inc	N[1,3]	✓			I80	Mercer	Mercer	✓		0	0		✓	2	0				
03/06/96	Penn Mar Oil Co Inc	Y	✓				Guilford	Franklin						✓	0	0				
03/07/96	Atlantic Refining & Marketing Corp	*	✓			McFarland RD	Mt Lebanon	Allegheny						✓	0	0				
03/09/96	V J Belotti Inc	Y		✓		Main St	Avoca	Luzerne						✓	3	0				
03/11/96	Bahn Fuel Oil Co	Y		✓		Snyder Hill Rd	Warwick	Lancaster						✓	1	0				
03/12/96	Pitt-Ohio Express Inc	N[4]	✓			Interstate 80	Milesburg	Centre	✓		0	0								
03/12/96	Sun Refining & Marketing Co	*	✓			Cheyney Rd	Concord	Delaware						✓	1	0				
03/12/96	Zeke's Inc	Y		✓		Telegraph Rd	West Caln	Chester						✓	1	0				
03/13/96	Glassmere Fuel Service Inc	Y	✓			Butler St	Etna	Allegheny						✓	1	0				
03/13/96	Penske Truck Leasing Co	N[1]	✓			Interstate 0078	Tilden	Berks						✓	1	0				
03/13/96	Snapp Brothers	Y		✓		Interstate 0099	Snyder	Blair						✓	3	0				
03/16/96	Roberts Express Inc	Y	✓				Penn Hill	Lancaster	✓		0	0								
03/22/96	Herzog Brothers	Y	✓			Route 0062	Pine Grove	Warren						✓	1	1				
03/25/96	Crossett Inc	Y	✓			Rt 770	Marshburg	Mckean	✓		0	0	✓		1	0				
04/4/96	Zappi Oil & Gas Co Inc	Y	✓			Route 0088	Jefferson	Greene					✓		1	0				

[3] HMIS says yes cargo tank

[4] Van Truck/Trailer

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
04/8/96	Joy Cone Co	N[1]	✓				Findley	Mercer					✓		0	1				
04/9/96	Aero Oil Co.	Y	✓			East/West Turnpike	Lower Swatara	Dauphin						✓	0	0				
04/9/96	Jack A Allen Inc	Y	✓			Fourth Av	Coraopolis	Allegheny						✓	1	0				
04/9/96	Philip Lynn Hershey	N[5]	✓			Route 4011	Allegany	Potter					✓		3	0				
04/10/96	Advanatge Tank Lines Inc.	Y	✓				Robinson	Allegheny						✓	0	0				
04/10/96	Qst Express	*	✓			William Flinn Hw	Shaler	Allegheny					✓		1	0				
04/15/96	Landis	Y	✓			Lincoln Hw	Columbia	Lancaster						✓	0	0				
04/17/96	Tolsdorf Oil Co	N[6]		✓		Chester Rd	East Goshen	Chester						✓	2	0				
04/22/96	G & G Transport Inc Petroleum	*		✓		Chalmers Av	Philadelphia	Philadelphia						✓	1	0				
04/23/96	Reilly & Sons Inc.	Y		✓		Paoli Pk	West Goshen	Chester						✓	1	0				
05/10/96	Ace Fast Freight	N[6]	✓			City Line Av	Philadelphia	Philadelphia					✓		1	0				
05/13/96	Gallagher Truck Salvage	N[6]		✓		Route 0029	Plymouth	Luzerne					✓		0	0				
05/14/96	Conewago Contractord	Y	✓			Windsor Rd	Windsor	York						✓	0	0				
05/15/96	Advantage Tank Line	Y	✓			Bud Shuster Hw	Boggs	Centre						✓	1	0				
05/15/96	Dave Hanly Inc	Y	✓			Sumneytown Pk	Upper Gwynedd	Montgomery						✓	1	0				
05/16/96	Paul C. Emery Co.	Y		✓		Seven Stars Rd	East Vincent	Chester						✓	0	0				
05/24/96	John Cheryl Inc	N[5]	✓			Route 3006	Washington	Erie						✓	1	0				
05/24/96	Ryder Truck Rental Inc	*	✓			Interstate 0095	Chester	Delaware					✓		1	0				
05/25/96	Consolidated Freightways Corp	N[1]	I✓			322	Derry	Mifflin						✓	0	1		✓	1	1
05/29/96	Agway Inc	N[6]	✓			Route 0449	Genesee	Potter						✓	0	0				
06/03/96	Mauger And Co Inc	Y		✓			Aston	Delaware						✓	1	0				
06/04/96	Advantage Tank Lines	Y	✓			Interstate 0079	South Strabane	Washington						✓	1	0				
06/04/96	Carlos R Leffler Inc	Y	✓			Millersville Pk	Lancaster	Lancaster						✓	0	0				
06/05/96	Carlos R Leffler	Y		✓		Main St	Palmyra	Lebanon						✓	1	0				

[5] Dump
[6] Flatbed

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
06/11/96	Hampshire Distributors	Y	✓			Route 0220	Cumberland Valley	Bedford						✓	2	0				
06/18/96	Frenz Petroleum Corp	Y	✓			Rt 422	New Castle	Lawrence	✓		0	0	✓		0	1	✓		0	1
06/19/96	CCCarriers Inc	N[1]	✓			Bernville Rd	Bern	Berks					✓		3	0				
06/21/96	Deimler Trucking	Y	✓			Enola Rd	East Pennsboro	Cumberland						✓	0	0				
06/24/96	Ashbridge Oil Co Inc	Y	✓			Buffalo Pittsburgh	Adams	Cambria						✓	1	0				
06/28/96	Bumgardner And Flasher Oil	Y		✓		Water St	Mt Union	Huntingdon						✓	0	0				
06/28/96	Sun Refining And Marketing Co	Y	✓			Interstate 0076	Lower Merion	Montgomery						✓	1	0				
07/06/96	Molnar Hauling Inc	Y	✓			Route 0060	Brighton	Beaver						✓	2	0				
07/08/96	Arentz Oil Service Inc	Y		✓		Baltimore St	Penn	York						✓	0	0				
07/13/96	C R Dampman Fuel & Concrete Inc	Y	✓			Upper Ridge Rd	Marlborough	Montgomery						✓	0	0				
07/13/96	Foster Oil Co.	Y	✓			Route 0066	Farmington	Clarion						✓	0	0				
07/15/96	Carlos R Leffler Inc	Y	✓			Bud Shuster Hw	Pine Creek	Clinton						✓	1	0				
07/15/96	Montour Oil Sservice Co	Y		✓		Route 0220	Piatt	Lycoming						✓	1	0				
07/16/96	New Penn Motor Express Inc	N[1]	✓			West End Bl	Richland	Bucks						✓	1	0				
07/18/96	Russell Standard Corp	Y	✓			Springfield Pk	Connellsville	Fayette						✓	1	0				
07/19/96	Satterlee Leasing Co	Y	✓			Route 0036	Eldred	Jefferson						✓	0	0				
07/22/96	Joseph V Heenan Jr	N[5]	✓			Preston Rd	Conewango	Warren					✓		1	0				
07/30/96	Gordon Sevig Trucking Co.	N[1]	✓			Route 0011	Liverpool	Perry					✓		3	0				
07/30/96	Houff Transfer Inc.	N[1]	✓			Route 0011	Liverpool	Perry					✓		3	0				
08/02/96	Timmons Oil Inc.	Y		✓		Route 0533	Southampton	Franklin						✓	0	0				
08/09/96	Cleveland Contract Carrier	N[1]	✓			Route 0512	Bushkill	Northampton						✓	3	0				
08/09/96	Guttman Oil Co.	Y	✓			Interstate 0070	Fallowfield	Washington					✓		0	0				
08/12/96	Agway Petroleum Corp	Y	✓			Route 0160	Stonycreek	Somerset						✓	1	0				
08/12/96	The Sico Co.	Y		✓		Furnace Hill Rd	Elizabeth	Lancaster						✓	1	0				
08/17/96	Yellow Freight Systems Inc.	N[1]	✓			Interstate 0080	Washington	Jefferson						✓	0	0				
08/19/96	Pjax Inc	N[1]	✓			Interstate 0079	Robinson	Allegheny						✓	1	1				

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
08/23/96	Taylor Oil Co., Inc.	Y	✓			Blair Mill Rd	Upper Moreland	Montgomery						✓	0	0				
08/25/96	Molnar Inc	Y	✓				New Stanton	Westmoreland	✓		0	1	✓		0	1	✓		0	1
08/27/96	Amerada Hess Corp	N[6]	✓			Interstate 0083	Conewago	York						✓	2	0				
09/04/96	Advantage Tank Lines Ohio	*	✓			Steubenville Pk	Robinson	Allegheny						✓	0	0				
09/05/96	International Petroleum Corp	*	✓			Allegheny Avenue	Philadelphia	Philadelphia						✓	0	0				
09/9/96	Eugene K Martin	*	✓			Route 0419	Cornwall	Lebanon					✓		0	0				
09/9/96	John Glemer Trucking	N[5]	✓			Access Rd	Philadelphia	Philadelphia					✓		1	0				
09/16/96	Compass Enterprises Inc.	N[1]	✓			Marine Corps Leahw	Union	Union						✓	0	0				
09/16/96	Petroleum Product Corp North	Y		✓		Route 2004	Decatur	Mifflin						✓	1	0				
09/17/96	Nittany Oil Company	Y	✓			Route 0522	Beaver	Snyder						✓	0	0				
09/17/96	Pitt Ohio Express Inc	N[1]	✓			Interstate 0080	Mt Pleasant	Columbia						✓	0	0				
09/20/96	Marshall Oil Company	Y	✓			Bud Shuster Hw	Cumberland Valley	Bedford						✓	0	0				
09/23/96	Castleman Enterprise	N[5]	✓			Route 0281	Somerset	Somerset					✓		1	0				
09/23/96	K L Harring	N[1]	✓			Interstate 0081	South Middleton Twp	Cumberland						✓	2	0				
09/24/96	J H Russell Inc	N[2]	✓			Route 4039	Conemaugh	Somerset						✓	0	0				
9/25/96	Seaboard Tank Lines	Y	✓			Lincoln Hw	Manheim	Lancaster						✓	3	0				
09/27/96	Heath Oil Inc	Y	✓			Sr 173 @ T808 Pine Twp	Grove City	Mercer	✓		0	0		✓	4	0				
09/30/96	Abel Oil	Y	✓			Airy St	Norristown	Montgomery						✓	0	0				
09/30/96	Get Inc	Y	✓			Saint Johns St	Titusville	Crawford						✓	0	0				
10/04/96	Con-Way Trans Service Inc	N[1]	✓			Interstate 0080	Liberty	Montour						✓	2	0				
10/07/96	West Penn Laco Inc	N[6]		✓		Fifth Av	Pittsburgh							✓	2	0				
10/08/96	C & K Petroleum Products Inc.	Y	✓			Route 4093	Allegheny	Westmoreland					✓		1	0				
10/08/96	Jeviv Transportation	N[1]	✓			Route 0309	Upper Dublin	Montgomery						✓	0	0				
10/15/96	Viking Freight System Inc	N[1]	✓			Interstate 0081	Antrim	Franklin						✓	1	0				
10/19/96	K L L M Inc	N[1]	✓			I-81 MM 105	Tremont	Fayette	✓		0	0		✓	0	0				
10/24/96	Earl Paddock Trans Inc	N[6]	✓			Interstate 0083	Fairview	York						✓	1	0				

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
10/24/96	Rob-Lu Oil Co., Inc.	Y	✓				Neville	Allegheny						✓	0	0				
10/27/96	Penske Trucking Company	N[1]	✓			Route 0011	Reed	Dauphin					✓		1	0				
11/01/96	Howard E Groff Co	Y		✓		Beaver Valley Pk	Providence	Lancaster						✓	1	0				
11/01/96	W L Roenigk	N[6]	✓			Mayview Rd	Cecil	Washington					✓		0	0				
11/04/96	Sun Company Inc	Y	✓			Interstate 0076	Upper Merion	Montgomery					✓		0	0				
11/06/96	Bernville Quality Fuel	Y		✓		Seventeenth Halfst	Reading	Berks						✓	0	0				
11/08/96	Fuchs	Y	✓			Gap Newport Rd	London Grove	Chester						✓	0	0				
11/08/96	Sun Refining & Marketing	Y	✓			Marple Rd	Marple	Delaware						✓	1	0				
11/09/96	Brinker Fuels Inc.	Y		✓		Lower State Rd	Doylestown	Bucks						✓	0	0				
11/11/96	Petro Chemical	Y	✓			Grand Army Repub HW	Wayne	Erie						✓	1	0				
11/11/96	R L Jehu Gulf Supply Inc	Y	✓			Buffalo Pittsburgh	Henderson	Jefferson						✓	2	0				
11/13/96	Chemical Leaman Tank Lines Inc	Y	✓			Us Route 322 & 522	Lewistown	Mifflin	✓		0	0	✓		1	0				
11/14/96	Welles Mill Co Inc	Y	✓			US Rte 87	Mehoopany	Wyoming	✓		0	0								
11/15/96	Dana Transport Systems Inc	Y	✓			Stenton Av	Philadelphia	Philadelphia						✓	0	0				
11/16/96	R & W Oil Products	Y	✓			Ohio Av	Glassport	Allegheny						✓	1	0				
11/19/96	D J Witman Inc	Y	✓			Antietam Rd	Lower Alsace	Berks						✓	1	0				
11/23/96	Aero Oil Co	Y	✓			Lincoln Hw	Jackson	York						✓	1	1				
11/25/96	Boncosky Services Inc	Y	✓			Interstate 0080	East Lackawannock	Mercer						✓	1	0				
11/28/96	Berks Products	Y	✓			West Shore BP	Cumru	Berks						✓	0	0				
11/29/96	Diamond Materials	Y	✓			Linfield Rd	Lower Pottsgrove	Montgomery						✓	0	0				
11/30/96	BP Oil Co	Y	✓			William Penn Hw	North Fayette	Allegheny						✓	1	0				
11/30/96	Orris Fuel	Y	✓			McCleland Rd	Indiana	Allegheny					✓		1	0				
12/02/96	Ace Robbins Inc	Y	✓			Route 4005	Mehoopany	Wyoming						✓	0	0				
12/04/96	Camerson Coca Cola	N[1]		✓			O'Hara	Allegheny					✓		1	0				
12/04/96	Stevers Trucking		✓			Route 2021	Jenkins	Luzerne					✓		0	0				
12/05/96	Agway Petroleum Corp	Y	✓				Manheim	Lancaster						✓	0	0				

Legend: Y = Yes; N = No; * Not reported

Table 8. 1996, Class 3, Accident Information for Pennsylvania (continued)

Date	Carrier Name	Cargo Tank	Interstate	Intrastate	Unknown	Accident Street	Accident City	Accident County	HMIS Impacts				SAFETYNET Impacts				TIFA Impacts			
									Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality	Spill — Yes	Spill — No	Injury	Fatality
12/06/96	Carlos R Leffler Inc	Y	✓			Hogestown Rd	Silver Spring	Cumberland						✓	0	0				
12/11/96	A S A Trucking Company	N²	✓			Turnpike Ramp Rd	Taylor	Lackawanna					✓		1	0				
12/11/96	Good Oil Co.	Y		✓		Skippack Pk	Whitpain	Montgomery						✓	0	0				
12/13/96	R C Stahlnecker Co	Y		✓		Route 0642	Valley	Montour						✓	1	0				
12/17/96	Bolea Oil Products	Y	✓			Montour St	Coraopolis							✓	1	0				
12/17/96	Export Fuel Co Inc	Y	✓			Route 0021	Masontown	Fayette						✓	0	0				
12/24/96	Glassmere Fuel Service Inc	Y	✓			Route 1013	West Deer	Allegheny						✓	1	0				
12/27/96	Root Oil Co Inc	Y		✓		Route 0414	Morris	Tioga						✓	0	0				

Legend: Y = Yes; N = No; * Not reported

2.3 Impact Methodology

In order to derive an estimate of the annual economic impact of incidents/accidents involving truck shipments of Class 3 hazardous materials, a number of incident/accident consequences must be taken into consideration.

To develop the impacts of class 3 accidents and incidents tallied for 1996, a six-step process was followed.

1. Impact categories were selected which could be compared among the incidents/accidents. The impacts categories selected were:
   - Injuries And Deaths
   - Cleanup Costs
   - Property Damage
   - Evacuation
   - Product Loss
   - Traffic Incident Delay
   - Environmental Damage.

2. Several sources of information were reviewed in order to establish reasonable estimates of the economic impacts of each consequence. A comprehensive literature review was conducted to identify unit costs that have been used in prior economic evaluation studies related to transportation, environmental health and safety. In addition, the HMIS and several state databases were analyzed to the extent that economic consequences have been reported.

3. Impacts reported in federal and state databases were tallied.

4. Impacts derived from the literature sources and interviews with knowledgeable sources were used to supplement the impacts found in the databases.

5. Impacts not readily available from the above sources were modeled to develop impact estimates. For example, incident delay was modeled because HMIS and the other databases do not report this parameter.

6. All impacts were converted to dollar values to enable comparison among the impacts and the preparation of a total impact figure for the sample year of 1996.

Where feasible, an attempt was made to compensate for accidents whose impacts are unlikely to be representative using a single year's data. For example several years of HMIS data were used to estimate average property loss costs.

The following sections will present the parameters and background that was used to calculate impacts for the 1996 sample year. Based on this review and analysis, "ball park" unit costs of hazardous materials transportation events can be established.

2.3.1 Injuries and Deaths

Injuries and fatalities from HM shipments can be attributed to the effects of the hazardous cargo or to other non-hazardous material related causes. This differentiation is sometimes clear-cut. For example, as a result of a traffic accident, a LPG tank rocketed into a trailer park, exploded and the ensuing fire injured and killed several people. They would not have been injured or killed if the material involved in the accident was not hazardous. The place where the differentiation becomes especially difficult is when the traffic accident involves flammable material. For example, if after a truck carrying Class 3 material collides with a car, trapping a person, and a fire ensues burning that individual fatally, can we attribute this death directly to the hazardous cargo? Since there is gasoline associated with the car, the individual might have died in a non-HM accident as well. Or perhaps it was the leaking cargo from the truck that caused the car fuel to burn. Although the HMIS attributes fatalities only to the HM, other databases such as Safetynet do not. For the purpose of this evaluation, injuries and fatalities associated with all Class 3 accidents were tabulated regardless if they were caused by the HM.

Injuries and deaths were tabulated from the major Federal and state databases and estimated through the analysis of the data for the eight states. To accomplish this, the HMIS data for the eight selected states was used as the reference case and data from the other databases were used to estimate the total fatalities and injuries for those states. As was the case for the accident numbers, the numbers of fatalities and injuries were extrapolated for the entire country. The national estimate for spill and non-spill enroute accidents for Class 3 truck shipments totaled 67 fatalities and 953 injuries. As a check of the reliability of the estimate, TIFA fatalities for 1996 were compared with the estimate of fatalities derived from the "bottom up" estimate. For 1996, there were 139 fatalities recorded by the TIFA system for all placarded HM shipments. Since approximately 52 percent of the HM shipments are Class 3, one would expect 72 of the fatalities to be associated with Class 3 shipments. This number is quite close to 67 and indicates the reasonableness of the estimate.

The value placed on an injury or fatality suffered in an accident varies considerably. Part of this discrepancy can be attributable to different approaches to calculating the value. One approach is to see an injury or fatality in terms of lost income and economic productivity to society. Another more comprehensive approach collects data not only on lost productivity, but also quality of life. This estimate might more closely approximate compensation awarded by the courts for fatalities and injuries in accidents. Finally, a third approach considers the cost of a fatality or injury as the amount of money required preventing it from happening.

The National Highway Transportation Safety Administration (NHTSA) estimated the cost of fatalities and injuries in 1994 and presented these estimates in terms of lost productivity. In 1996 dollars, a fatality would be worth about $913,000 and a critical injury about $780,000 (NHTSA, 1994). An earlier report, The Cost of Highway Crashes, (FHWA, 1991), utilizes a comprehensive approach. In 1996 dollars this report estimates that a fatality would be worth about $3,170,000 and an incapacitating injury about $225,000.

Another source is the National Safety Council. The National Safety Council is a primary source for obtaining estimates of the impacts of deaths and injuries in economic terms (National Safety Council, 1996). One approach presented is based on comprehensive costs, which indicate what people are actually willing to pay to reduce their safety and health risks. The cost estimates include wage and productivity losses (i.e., wages and fringe benefits, replacement cost and travel delays caused by the accident), medical expenses (i.e., doctor fees, hospital charges, cost of medicines, future medical costs and other emergency medical services), administrative expenses (i.e., insurance premiums and paid claims, police and legal costs), motor vehicle damage (i.e., property damage to vehicles), and employer costs (i.e., time lost by uninjured workers, investigation and reporting time, production slowdowns, training of replacement workers and extra costs of overtime for uninsured workers). Comprehensive costs tend to be 3-4 times higher than historical costs for each human health consequence category because of a societal desire to avoid these consequences in the future. The 1996 estimates of comprehensive costs are:

- $2,790,000 per death
- $138,000 per incapacitating injury
- $35,700 per non-incapacitating injury
- $17,000 per possible injury
- $1,700 per non-injury.

It is important to recognize that these estimates are based on motor-vehicle accidents as a whole. As a result, the impact of a truck accident is likely to be more severe across several of the components, which comprise these unit costs. Moreover, a truck accident involving the transport of hazardous materials would add to the economic considerations because of the inherent danger of cargo spill. Therefore, these numbers should be considered low-end estimates of the economic consequences for this portrait.

Finally, a third approach, which estimates the cost of avoiding the fatality or injury, resulted in an estimate of $2,000,000 for a fatality and $400,000 for an injury requiring hospitalization. This estimate is used by some portions of the DOT to estimate the cost of avoiding a fatality or serious injury (Zebe, P., 1998).

For the purposes to this report, this latter estimate of the cost for avoiding the fatality or serious injury is used as a means to estimating the overall cost for the accidents during the sample year of 1996. For minor injuries an estimated value of $4,000 is used. The distribution of major and minor injuries in the HMIS for 1995, 1996 and 1997 was used to determine the ratio of major to minor injuries. During those 3 years the two types of injuries are evenly distributed. Thus an estimated cost of $200,000 is used as the cost of avoiding an accident injury. For incidents during the same three years, approximately 92 percent of the injuries were minor and 8 percent major. An estimated cost of $32,000 per incident/accident injury was used.

2.3.2 Cleanup Costs

Cleanup costs are assumed to encompass the costs of both stopping the spread of a spill and removing spilled materials. Cleanup costs vary widely depending on the size, the type of materials and the location of the spill.

Different approaches exist to placing financial value on these considerations. Clean-up can include initial response costs, soil and groundwater remediation, incineration and restoration. Our literature review surfaced the following relevant statistics:

- A New York State Department of Environmental Conservation Study placed clean-up costs for small trucks at $6,717 per vehicle and large trucks at $13,437 per vehicle (U.S. EPA, 1996). These costs were reported in 1987 dollars and converted to 1996 dollars for this report. They apply only to the removal of the vehicle from the scene.

- The same study reports clean-up costs as $40.38, $57.26 and $78.40 per square meter of impact area if the incident/accident occurs in an urban, suburban or farmland setting, respectively. Furthermore, clean-up costs associated with environmental impairment are estimated to be $131.01, $61.83 and $429.47 per square meter of affected woodland, park, or river/lake respectively. These figures were also reported in 1987 dollars and converted to 1996 dollars.

Private environmental contractors provide yet another source for cleanup estimates. For example, PRO TERRA, a Columbus based environmental contracting company, estimates the average cost of a cleanup at about $14,000. However, their record cost was $102,000 to clean up a jet fuel spill at the Rickenbacker AFB that required 10 men at the site (Hogue, J., 1998). The average cleanup cost is about $1,000 per hour.

The HMIS database includes a field for cleanup costs. Although this data is submitted by the carrier, it should be accurate since the carrier is responsible for paying the cleanup costs. For the three-year period for 1995, 1996, and 1997, cleanup costs averaged $34,000 per enroute accident cleanup, $1,100 per cleanup for an enroute incident spill and $660 for an unloading and loading accident and incident spill cleanup. For the sake of conservatism these figures were applied as the average cleanup cost for all spills.

2.3.4 Evacuation

Evacuation of people and business operators during a HM accident is one important impact of HM transportation that occurs during a small percentage of HM accidents. The HMIS database and the Ohio PUCO are among the few databases which provide evacuation data. Of the two, the HMIS provides a comprehensive picture. For the three years of HMIS data (1995, 1996, 1997), for 498 records of Class 3 shipment accidents, about 8 percent resulted in an evacuation. These evacuations encompassed 1,974 people, which is an average of 51 per evacuation.

For incidents, of the 1320 records about 1 percent resulted in evacuations. Thus a total of 431 people were evacuated with an average of 25 people per evacuation.

The cost of evacuations is very difficult to estimate since there are numerous variables. These costs include the expense for temporary lodging and food, losses due to lost wages and business disruptions, inconvenience to the public and the cost of agencies assisting with the operation. The US Nuclear Regulatory Commission for example, uses a range of from $600 to $1,800 per person evacuated. A reasonable estimate would be $1,000 per person evacuated (Transportation Research Board, 1993). This $1,000 estimate is also used by the Federal Railroad Administration (FRA) to estimate impacts from railroad evacuations.

2.3.5 Product Loss

Product loss refers to the quantity and value of the Class 3 material lost during a spill. The HMIS provides estimates for product loss in its cost estimates. For enroute accident related spills, the average cost of product lost per spill during a three-year period was $3,800. For enroute incident spills, the average cost of product lost during the same three-year period was $130. Incidents and accidents during loading and unloading accounted for average product loss of $80 over the three years.

2.3.6 Public Property Damage

Property damage encompasses damage to other vehicles, which may have been involved in the accident, and damage to both public and private property in addition to the vehicles involved in the accident. For example, this could include damage to a private building, public utilities, and a public roadway and related structures.

Environmental damage to property that results in economic losses, is another category of damage that could be included in this section. However, this topic is addressed in section 2.3.9 under environmental damage.

The HMIS provides estimates of property damage in one of its fields. This estimate appears to be reliable for damage to vehicles involved in the accident but perhaps less reliable when estimating public property damage. However, these estimates have been used as the basis for calculating the impacts to property and the amount of damage. For the three-year period for which the HMIS was analyzed, the average property damage for enroute accidents was $5,900 while the average property damage for enroute incident spills was $90. Property damage for leaks occurring during loading and unloading incidents and accidents was $90.

2.3.7 Carrier Damage

Carrier damage encompasses damage to the truck transporting the Class 3 materials and associated equipment.

A New York State Department of Environmental Conservation study reported the economic loss from damaged vehicle downtime as $7,887 per large truck, expressed in 1996-dollar terms converted for this report from the original 1987 dollars of the study (U.S. EPA 1996).

This estimate provided by the HMIS database is probably the most reliable of the estimates. For the three-year period for which the HMIS was analyzed, the average carrier damage for enroute accidents was $36,000 while the average carrier damage for enroute incident spills was $130 and $130 for spills associated with unloading and loading accidents and incidents.

2.3.8 Traffic Incident Delay

Although an aspect of these costs are embedded in the National Safety Council estimates, it is important to isolate this effect because HM spills (or suspected spills) typically require a different type of emergency response which tends to lengthen traffic delays considerably. To aid in this effort, HM incident delay was extracted from data collected by the states of California and Ohio. This was supplemented by several studies reported in the literature (Agent, K.R, 1995; Grenzeback, L.R., 1990).

Traffic incident delay had no relatively simple method of estimating the costs of incident delay induced by an accident. Consequently, a model was adapted to be able to estimate the number of hours and the cost of incident delay. For Section 2.3.8, all accidents and incidents are referred to as incidents.

Delay Estimation. There are two groups of approaches to estimating incident delays, namely deterministic and stochastic. The former approach is simpler and easier to apply and is intended for after – incident evaluation where information of traffic flow is assumed known. Incident delay is affected by a number of factors, including incident duration, road capacity, arrival pattern, traffic volume, functional class of the road, and the time of day. A deterministic approach developed by Morales (1977) is used in this study because of its simplicity relative to other methods e.g., Fu et al. (1997). Moreover, the data requirements for the deterministic approach can be more easily obtained or derived.

In this study, incident delay is estimated assuming the condition of simple lane closure. This assumption is practical given that HM incidents involve trucks and invariably result in lane or road closures. For this condition, estimates for three types of traffic flow are required:

(i) Demand traffic flow that would have gone through a point if the incident had not occurred, S_2,
(ii) Reduced traffic flow resulting from the incident, S_3,
(iii) The gateway flow after the incident has been cleared, S_1.

This flow is assumed to be equal to the capacity of the roadway. The demand and bottleneck flows are assumed steady state flows for the particular time of day. These are illustrated in Figure 1. In addition to the flows, the duration of the incident, T, is required to estimate the delay.

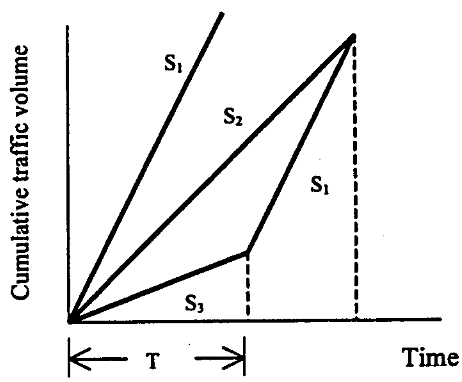

Figure 1. Demand and Bottleneck Traffic Flows

Information on practical capacity was obtained from the Highway Capacity Manual (1994) and actual traffic flow data from 1996 Highway Statistics (U.S. DOT, 1997b). First, the capacity of each functional class was used to estimate the average demand traffic flow for levels of service expressed as traffic volume (v) to service flow (sf) v/sf ratios between 0.5 and 0.9. The demand traffic values are then compared with ADT data in Highway Statistics to establish reasonableness. The v/sf ratio range is chosen to include the threshold value above which congestion occurs i.e., v/sf = 0.80 and free-flow conditions reflecting non-peak flows which occur at v/sf less than 0.80. Bottleneck traffic flow is assumed to be about 60 percent of the actual (demand) flow. This assumption is consistent with earlier observations (Jacobson, 1992) that about 80 percent of incidents reduce capacity by at least one-third regardless of whether a lane was blocked.

Incident delay is estimated as function of level of service offered for four functional highway classes: (i) urban interstate, freeways and expressways; (ii) other urban roads; (iii) rural interstate and (iv) other rural roads. It is important that incident delay be considered within the context of highway functional class because of differences in the level of service, the volume of traffic and the average annual vehicle miles traveled (VMT). VMT is a measure of utilization of the highway facility therefore an indication of the level of exposure or the risk of being involved in an incident.

Incident delay can be estimated from the following equations for simple lane closure condition (Morales, 1977).

$$D = T.\kappa$$

$$\kappa = \frac{(S_1 - S_3)(S_2 - S_3)}{2(S_1 - S_2)}$$

Figure 2 shows the variation of κ with v/sf ratio for the four functional highway classes. For a given demand traffic flow, first calculate the v/sf ratio for the particular highway class and then determine the κ from the graphs in Figure 2. The range of v/sf used in constructing this figure cover the practical range of v/sf values. This value can be multiplied by the incident duration, T, to obtain an estimate of the incident delay in veh-hr on the particular highway class. Figure 3 shows the variation of incident delay in vehicle-hours with incident duration for the congestion threshold v/sf value of 0.80. This v/sf ratio represents a typical operating condition on the interstate system. Data from the 1966 Highway Statistics indicate that 95 percent of the rural interstate, 66 percent of the urban interstate and 75 percent of other freeways and expressways operate at v/sf ratios less than 0.80. As noted in the equation and depicted in the figure, incident delay is a linear function of the duration of the incident. Figures 2 and 3 are developed based on service flows (or capacity) that are considered typical minimum values for each functional highway class as derived from the Highway Capacity Manual (1994). The curves may be considered conservative given the differences in traffic flows, HM types, and type of incident and incident response management.

In order to obtain the user costs for various road users resulting from incident delays, information on the occurrence or probability of occurrence of incidents or the split between trucks and other vehicles on the various highway systems will be required. In this regard, data on VMT for trucks and other vehicles for the various functional highway classes is used to obtain the distribution of incident delay costs between trucks and other vehicles. Table 9 summarizes the percent of VMT by trucks and other vehicles on the four groups of functional highway classes and the distribution of VMT among on the functional classes using both truck VMT data only and total VMT.

Table 9. Distribution of VMT by functional class and vehicle type

	Percent of VMT by vehicle type (%)	
Functional Highway class	**Trucks**	**Other vehicles**
Rural Interstate	18.22	81.78
Other Rural highways	7.97	92.03
Urban Interstate	8.33	91.67
Other Urban highways	4.63	95.37
	Percent of VMT by highway class (%)	
Functional Highway class	**Truck VMT**	**Total VMT**
Rural Interstate	22.6	9.2
Other Rural highways	31.8	29.4
Urban Interstate	15.8	14.0
Other Urban highways	29.8	47.4

Source: 1997 HCAS Base Case VMT data (U.S. DOT, 1997c)

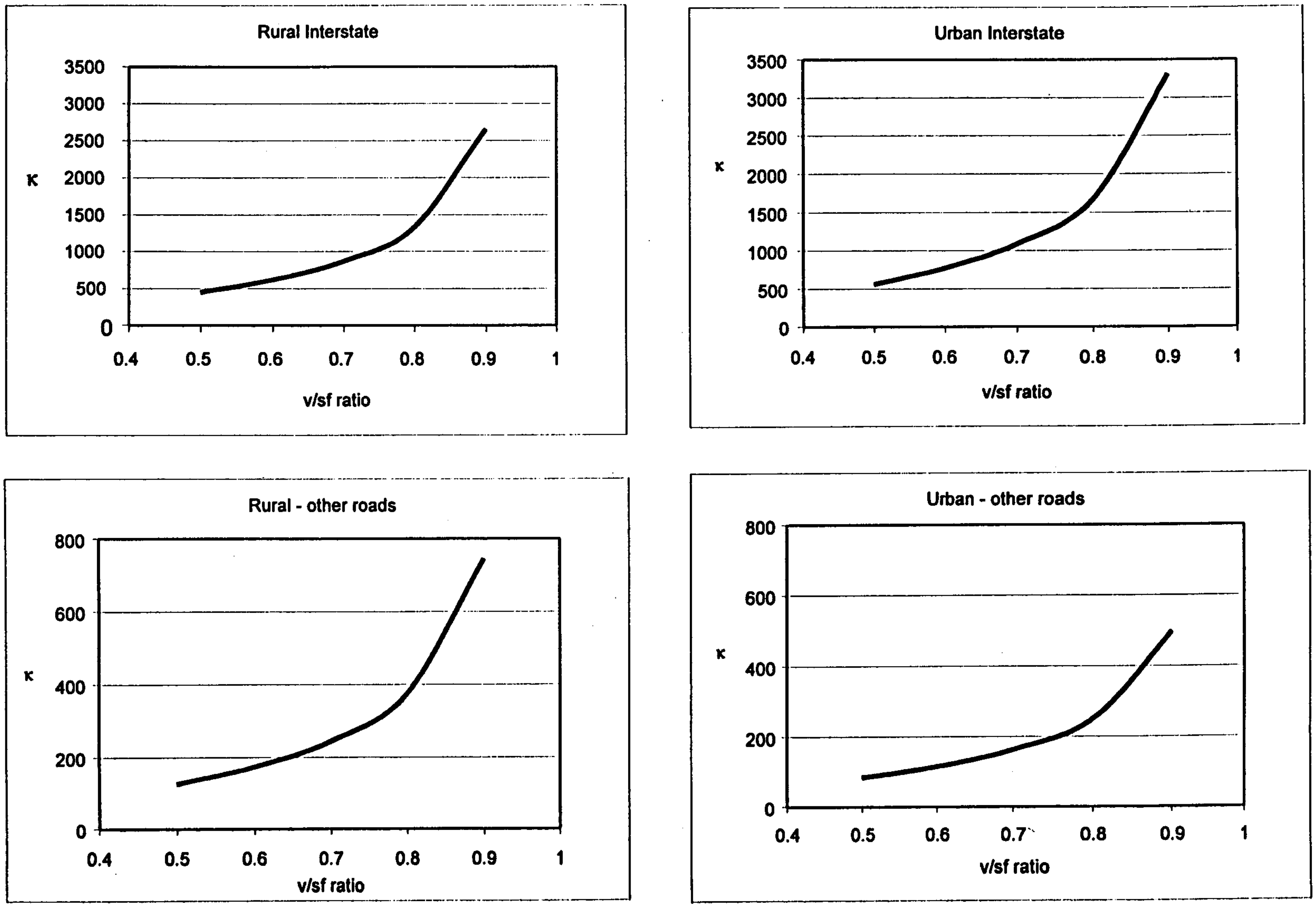

Figure 2. Level of service versus delay traffic volume

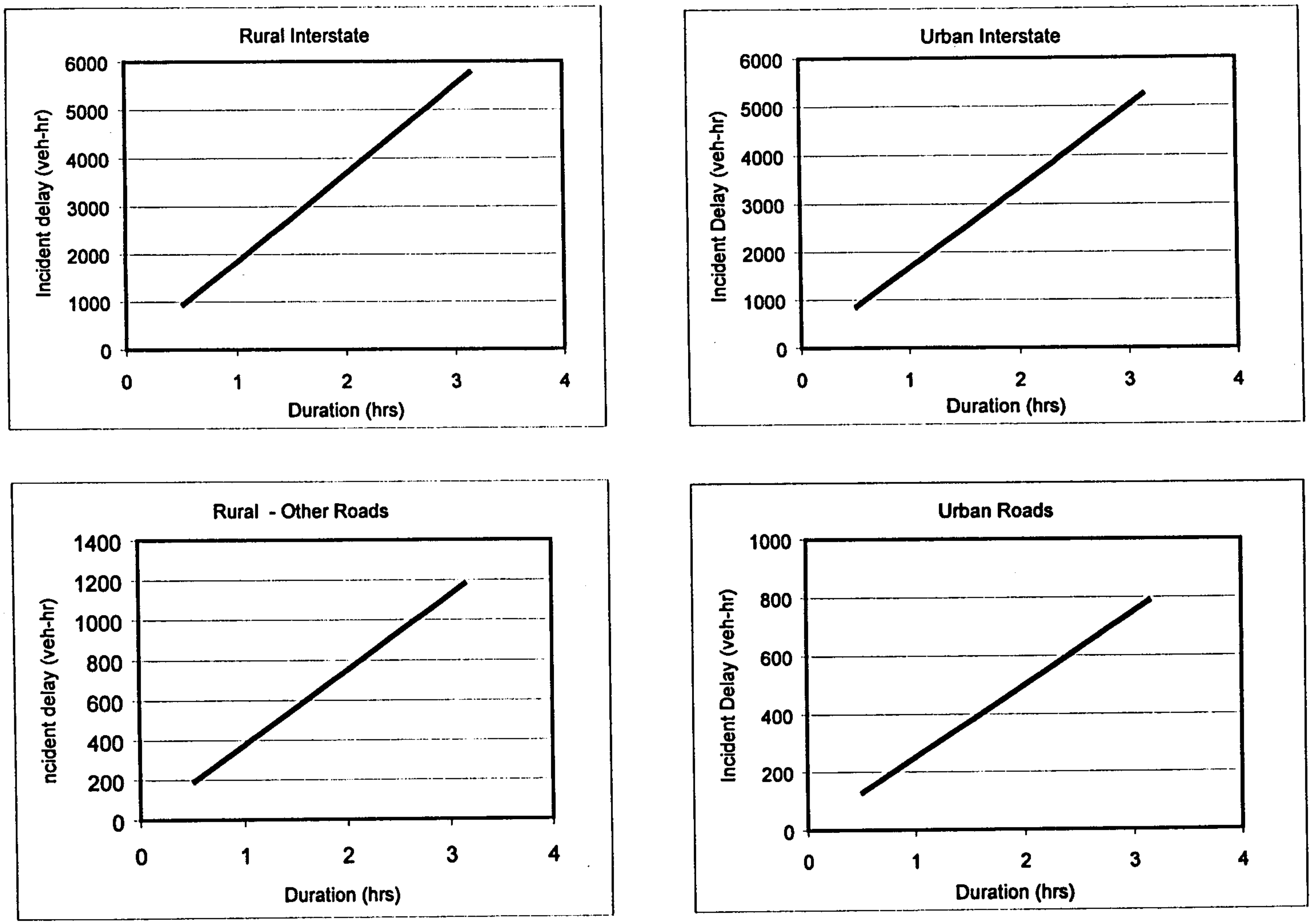

Figure 3. Level of service versus delay traffic volume

Note: These graphs are developed for v/sf = 0.80. Similar graphs can be generated for other v/sf ratio value

Incident Delay Cost. The cost associated with incident delay can be estimated by applying the unit cost of delay by the values obtained from the graphs in Figures 2 or 3. These delay costs due to traffic are based on value of time and do not include the costs of removal of the incident. Earlier studies (Grenzeback, L.R. et al., 1990), assumed the cost of incident delay to be about $20 for trucks and $10 for other vehicles. A study of the congestion costs estimated average unit cost to be $14.43 per vehicle-hour of delay. This is calculated from a unit cost per vehicle hour of $10.92 (1990 dollars) from the Highway Economic Requirements System (HERS) multiplied by a CPI of 1.25 to adjust the figure to 1998 dollars. To account for the increase fuel consumption due to congestion, add [(0.7 gal/hour) * $1.11 per gallon (1998 dollars)]. The unit delay cost includes value of time and fuel costs.

Available Incident Data. Data on HM incidents in the California Highway Patrol database, the Ohio PUCO Incident Reports, and literature indicate the following:

- California data (1994 to 1998)
  - Average duration of HM incidents, specifically DOT Hazard Class 3 (flammable and combustible liquids) is 4.8 hours with a standard deviation of 2.1 hours.
  - Only 4 percent of HM incidents have duration less than 1 hour and about 6 percent have duration greater than 12 hours.
  - 75 percent of HM incidents resulted in partial or full road closures.

- Ohio data (1995-1998)
  - Duration of incidents on rural interstates is 2 to 18 hours with 70 percent lane or road closures
  - Duration of incidents on other rural roads is 3 to 22 hours with 60 percent lane or road closures
  - Duration of incidents on urban interstates is 0 to 4 hours with 100 percent lane or road closures
  - Duration of incidents on other urban roads is 2 to 20 hours with 75 percent lane or road closures.

- Literature
  - Major incidents constitute 5 to 10 percent of all truck incidents (Grenzeback, L.R. et al., 1990). A major incident is one that blocks two or more lanes of the freeway for 2 hr or longer.
  - Average duration of major incidents is 3 hr 39 minutes and it triggers an average of 2,800 veh-hr of delay on freeways around it. Major incidents lasting 10 to 12 hrs triggered 30,000 to 40,000 veh-hr delay (Recker et al., 1988).
  - Average duration of a common incident is 1 hour with an average 1,200 veh-hr delay (Recker et al., 1988).
  - About two thirds of major incidents are the result of overturns, spills, or shifted loads.

Input Data Summary. The following is a summary of inputs for estimating incident delays based on the limited data discussed above. These are for the purposes of obtaining rough estimates of incident delays and associated costs using the process described in *Delay Estimation.*

- Average duration of all incidents – 5 hrs
- Average duration of major incidents (those requiring closure of all lanes) – 12 hours

- Average duration of common incidents - 2 hours
- About 5 percent of all incident can be classified as major incidents
- Average unit cost of delay is $15 per vehicle-hour
- Minimum service flows (or capacities) expressed in vehicles per hour (vph) per direction used in developing the curves are:
  - Rural interstate – 3,200 vph
  - Rural other highways – 900 vph
  - Urban interstate – 4,000 vph
  - Urban other highways – 600 vph

  These values are used to calculate the v/sf ratio and determine κ from Figure 2.

Illustration. The following illustration describes the sequential steps followed to calculate incident delay and the associated cost for a given situation. Assume that average traffic volumes shown above are representative of the respective groups of functional highway classes. Assume average duration of 5 hours per incident regardless of the functional class of highway. The steps in estimating the incident delays are summarized in Table 10 and described below.

Step 1 — Determine the design service flow (vph in each direction of travel) for the functional highway class in question.

Step 2 — Determine the average actual traffic flow (vph) per direction for that highway.

Step 3 — Calculate the v/sf ratio by dividing the value of step 2 by that of step 1.

Step 4 — With the v/sf ratio read off the corresponding κ-value from Figure 2.

Step 5 — Obtain the average duration of incidents for the type of incident and/or highway from historical data.

Step 6 — Multiply the κ-value from step 4 by the duration in step 5. The product is delay in veh-hr per incident on that highway class.

Step 7 — Multiply delay by unit cost of $15 to obtain cost per incident on each highway.

Step 8 — Determine the number of incidents on each highway class for the time period under consideration.

Step 9 — Multiply cost of incident by the number of incidents to obtain the total cost of incidents on the highway class for the given time period.

Step 10 — Sum total cost to obtain the grand total for all highway classes.

Table 10. Example Summarizing the Steps for Incident Delay and Cost Estimation.

Highway class	sf (vph) (1)	v (vph) (2)	v/sf (3)	κ (4)	T (hr) (5)	D (veh-hr) (6)	Cost @ $15 (7)	# of incidents (8)	Total cost $ (9)
Rural Interstate	3200	1900	0.6	615	5	3075	$46,125	408	18,819,000
Rural other	900	450	0.5	125	5	625	$9,375	574	5,381,250
Urban Interstate	4000	3200	0.8	1660	5	8300	$124,500	285	35,482,500
Urban other	600	400	0.7	160	5	800	$12,000	538	6,456,000
							(10)	Grand Total	66,138,750

2.3.9 Environmental Damage

Environmental damage is considered to be damage to the environment that remains after cleanup has been completed. This damage can be calculated in terms of loss of economic productivity as in agricultural production lost and/or in loss of habitat or ecosystem deterioration. Most estimates of environmental damage have been conducted for major ecological disasters such as major oil spills in oceans or large lakes. Some estimates of environmental damage have been assembled for such contaminated sites as superfund and CERCLA sites where penalties have been levied.

Three estimates of environmental damage costs are presented for this section. The loss of agricultural productivity can be estimated as the crops that could not be grown during a 20-year period due to contamination. If wheat was used as an example, a field could produce 35 bushels per acre with a value of $5 per bushel. This wheat crop for an acre would amount to a gross income of $3,500 over a 20-year period. For corn, a field could produce 128 bushels per acre with a value of $2.50 per bushel. Thus, it would be worth $320 for one year and $6,400 of gross income for a twenty-year period. Of course, the net income would be considerably less.

A New York State Department of Environmental Conservation study reported property damage to the incident/accident site as subsequent economic loss of 8.3 percent of the annual net revenue generated per square meter of property impacted, with a corresponding property devaluation of 5 percent of the resale value of property per square meter (EPA, 1996). The same study reported further that economic loss due to environmental impairment was estimated as $7.37 per square meter of impacted area in woodland, park and river/lake settings. This would mean an additional loss of approximately $469 per acre. These figures were reported in 1987 dollars and converted to 1996 dollars for this report.

Natural resource damage settlements were selected as presenting a more conservative estimate of environmental damage. Damages were collected for 18 cases where environmental damage settlements were completed (Battelle Compilation of Environmental Settlements, 1998). These settlements were primarily against companies that had damaged the environment and were now paying a fine. The average per acre settlement price was $3,792. This average per acre settlement price could be for more serious pollution cases than that represented by a spill of Class 3 materials. However, the average figure represents one conservative estimate of environmental damage. This figure was selected as one estimate of environmental damage that could be used as a representative number. A table listing all of the settlements is shown in Appendix C.

In order to calculate the natural resource environmental damage from a truck of Class 3 materials, its necessary to know how much material was spilled, where the spill occurred and what sort of surface it covered. An assumption was made that all of the spills would occur on land and on a dirt surface. In reality, a certain proportion of the spills would occur in water or a paved surface. Furthermore, at least one barrel, or 55gallons, had to escape in order for the spill to be considered. Below this threshold no damage was considered to occur.

HMIS data was consulted to determine spill size and distribution. For 1996, and for enroute accidents resulting in a spill, the average spill greater than 55 gallons was 3,031 gallons, although the largest spill was 9,200 gallons. The data shows that 170 spills took place during an enroute accident and that 69 percent of the spills are represented by the 3,031 figure.

For the material covered and the spill size, a formula was used which assumed that the surface would be dirt and that the spill would spread at about one centimeter in thickness. The area covered by the average spill size of 3,031 gallons would be about .21 acres. For the sake of conservatism, this estimated area of coverage was increased to .7 acres. Thus for an average spill exceeding 55 gallons, $2,654 dollars of environmental damage would occur, calculating this spill as a percentage of the $3,792 figure cited earlier. However, since this estimate was applied to only 69 percent of the enroute spills, all spills over 55 gallons would average about $1,800 of environmental damage. For the 490 spill accidents estimated for the nation in 1996, this represents approximately $882,000 of damage.

For the typical full tanker spill of 8,000 gallons, an estimated $7,000 of environmental damage would be done.

Enroute incidents would result in considerably smaller environmental damage. For 442 enroute incident spills recorded in HMIS for 1996, only 28, or 6 percent, exceeded the 55-gallon minimum. Of these spills, the average spill size was 432 gallons of Class 3 materials. The largest spill was 5,000 gallons.

The area covered by the average spill size of 432 gallons would be about .03 acres. For the sake of conservatism this estimated area of coverage was increased to .1 acres. Thus for an average spill exceeding 55 gallons, $379 dollars of environmental damage would be done. However since this estimate was applied to only 6 percent of the enroute spills, all spills over 55 gallons would average about $20 dollars of environmental damage. For the 362 leaks enroute estimated for the nation in 1996, this represents approximately $7,240 in environmental damage.

2.4 Impact Summary Discussion

The primary objective of this effort is to estimate the annual economic impact of transportation safety involving truck transport of Class 3 hazardous materials. While the goal is to establish a high degree of confidence in these estimates, the reality is that the quality of available data limits the ability to do so. Among the reasons for this are:

- Concerns about the non-reporting of incidents/accidents to HMIS, as well as the accuracy of the reports that have been filed.
- The impacts of catastrophic events on these estimates; the absence or existence of a single catastrophic event can significantly alter the reported estimates.
- The vintage of the literature being used, and its implications in terms of safety investments which may have been made since then, as well as the net present economic value of the reported costs.
- The study sample and its relevance to truck transport of Class 3 hazardous materials on a national level.

Taking these observations into consideration, one should view the results in the context of establishing a general estimate or bound on the financial impact of this problem rather than a precise valuation. As such, it represents a valid attempt to benchmark the financial implications of the problem based on best available data. Consequently, even if the results are within an order of magnitude, we believe that meaningful inferences can be derived for evaluation purposes.

3.0 Accident and Incidents Totals and Impacts

3.1 Accident and Incident Totals

This section summarizes the analysis of the accident and incidents for 1996 and the tabulation of impacts and associated costs. It also includes some specific cases and the estimated impact costs.

Table 11 shows the estimated unique accidents for 1996 for both spill and no spill accidents. The table also shows how these numbers were converted into national numbers.

Table 11. Class 3 Truck Shipments — Estimated Unique Accidents for 1996 (HMIS used as a base)

	Data Source and Accident Numbers							Summary Accident Numbers					
	HMIS and TIFA	SAFETYNET		State		News Clippings		Spills			No Spills		
State		Spill	No	Spill	No	Spill	No	No.	I	F	No.	I	F
Colorado	9	4	21	4	1	0	1	17	10	0	23	21	0
Ohio	10	3	3	2	1	2	2	17	6	0	6	5	1
California TIFA	7 3	8	46	1	1	2	3	21	4	4	50	31	1
Indiana*	6	6	20	3	2	2	1	17	11	1	23	21	0
Oregon*	4	7	19	1	1	1	1	13	11	0	21	13	2
Iowa*	5	0	5	1	1	1	1	7	3	0	7	5	1
Minnesota*	10	1	1	3	1	1	1	15	5	1	3	1	0
Pennsylvania	11	25	151	3	1	1	1	40	35	3	153	104	6
							Totals	147	85	9	286	201	11

I = injuries; F = fatalities

* HMIS spill accidents increased by 26 percent to compensate for no state database. No spills increased 12 percent. News clippings number increased by 10 percent to compensate for Dialogue.

8 states represent 30 percent of the total U.S. accidents.

147 ÷ 0.30 = 490 spills — spill injuries = 283 — fatalities = 30

286 ÷ 0.30 = 953 no spills — no spill injuries = 670 — fatalities = 37

Using this method, the number of U.S. Class 3 accidents with spills for 1996 was estimated at 490 and the number of no spill accidents 953.

Both the estimated accidents and incidents for 1996 are shown in Table 12.

Table 12. Estimated Accidents and Incidents in 1996

1996, Accidents, En Route, Class 3 – Placard	
With Spill	490
No Spill	953
1996 Incidents, Enroute and Loading and Unloading	
Leak Enroute	362
Leak Loading and Unloading	1,961

An analysis was also done to determine the percentage of Class 3 shipments that were cargo tanks or not cargo tanks, in order to better characterize Class 3 shipments. This information appears in Table 13, which shows the percentage of Class 3 materials carried by cargo tanks involved in accidents for each state, Federal, and TIFA databases used for this report. Safetynet has the lowest percentage of 74 percent with the Ohio PUCO and the California database showing 100 percent of the shipments involved in accidents being transported by cargo tank. For the total number of enroute accidents, an estimated 88 percent of listed accidents involved cargo tanks. This does not include the approximately 3.5 percent of accidents where this information is unavailable.

Table 13. Cargo/Non-Cargo Results
Accidents, En Route, 1996, Class 3
(Number of records correspond to Tables 1-8)

		Number of Records	% of Total
HMIS	Cargo	56	81 %
	Not Cargo	13	19 %
	Total	69	
	Not Cargo = Van/Trailer		
Safetynet	Cargo	253	74 %
	Not Cargo	88	26 %
	Total	341	
	Not Cargo = Van/Enclosed Box, Flatbed, Dump, Garbage/Refuse, Other and Blank		
California	Cargo	5	100 %
	Not Cargo	0	0 %
	Total	5	
Ohio PUCO	Cargo	7	100 %
	Not Cargo	0	0 %
	Total	7	
Colorado	Cargo	8	89 %
	Not Cargo	1	11 %
	Total	9	
	Not Cargo = Tank		
TIFA	Cargo	9	90 %
	Not Cargo	1	10 %
	Total	10	
	Not Cargo = Van/Enclosed Box		

3.2 Impact Summary

Table 14 summarizes the impacts in terms of dollars for the estimated Class 3 accidents in 1996. As shown in the table, the cost for the 1996 portrait year was about $481,796,985. The costs for avoiding injuries and fatalities accounted for about approximately 69 percent of the total cost. Carrier damage and incident delay costs together accounted for about 25 percent of the total estimated cost for the year. The cost related to accidents is considerably higher than that for incidents. Both spill related and no spill accidents account for about 95 percent of the estimated costs for 1996. No spill accidents alone account for about 58 percent of the costs. This is primarily because the number of no spill accidents is almost twice the number of spill accidents and results in considerably more injuries and slightly more fatalities. Although there are no cleanup costs for the product or environmental damage costs, the costs are still considerably more than for the spill accidents.

Table 14. 1996 Estimated Accident and Incident Impacts (Costs)

Annual Number	Cleanup	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury	Fatal	Evacuation	Incident Delay
490 Spill Accidents	\$34,000 per[1] \$16,660,000	\$3,800 per[1] \$1,862,000	\$36,000 per[1] \$17,640,000	\$5,900 per[1] \$2,891,000	\$1,800/per spill[3]= \$882,000	\$200,000 per[5] 283 injuries = \$56,600,000	\$2,000,000 per[6] 30 fatalities = \$60,000,000	\$1,000 per[7] 39 evacuations, 50 people each[8] = \$1,950,000	\$15/per person per hour[10] = \$17,954,564
953 No Spill Accidents	NA	NA	\$36,000 per[1] \$34,308,000	\$5,900 per[1] \$5,622,700	NA	\$200,000 per[5] 670 injuries = \$134,000,000	2,000,000 per[6] 37 fatalities = \$74,000,000	NA	\$15/per person per hour[10] = \$34,919,797
362 Leak Enroute (Incident)	\$1,100 per[2] \$398,200	\$130 per[2] \$47,060	\$130 per[2] \$47,060	\$90 per[2] \$32,580	\$20/per spill[4] = \$7,240	NA	NA	\$1,000 per[7] 3 evacuations, 25 people each[9] = \$75,000	\$15/per person per hour[10] = \$13,264,393
1,961 Leak Loading and Unloading (Incident)	\$660 per[2] \$1,294,260	\$80 per[2] \$156,880	\$130 per[2] \$254,930	\$170 per[2] \$333,370	NA	\$32,000 per[6] 3 injuries = \$96,000	\$2,000,000 per[6] 3 fatalities = \$6,000,000	\$1,000 per[7] 20 evacuations, 25 people each[9] = \$500,000	NA
Totals	**\$18,352,460**	**\$2,065,940**	**\$52,249,990**	**\$8,879,650**	**\$889,240**	**\$190,696,000**	**\$140,000,000**	**\$2,525,000**	**\$66,138,750**
								Grand Total	**\$481,796,985**

1 HMIS database, average cost for accident in 1995, 1996, 1997
2 HMIS database, average cost for incident in 1995, 1996, 1997
3 Average per 755 gal. accident spill in HMIS for 1996
4 Average per >55 gal. incident spill in HMIS for 1996
5 Value placed on avoiding injury
6 Value placed on avoiding a fatality
7 Cost of each person evacuated used by FRA
8 Average number evacuated in HMIS accidents
9 Average number evacuated in HMIS incidents
10 Includes passenger vehicles and trucks

The estimated impacts for 1996, which are presented in Table 14, are based on the use of the databases discussed earlier and average costs for the various categories of impacts. In order to compare these costs with the estimated costs for enroute accidents in the HMIS alone, three small tables were prepared. Table 15 presents the total estimated costs for enroute accidents from the HMIS database alone. Cost estimates were assigned for deaths and injuries although the database itself doesn't include them. However, the table did not include estimates for environmental damage. Table 16 shows the 1996 costs for the enroute accidents from the comprehensive analysis. Finally, Table 17 presents comparative costs for enroute accidents for the comprehensive case and for the HMIS together. Note that the comprehensive case includes the impact costs for the HMIS. Table 17 indicates that the enroute accident impact costs associated with the HMIS database alone represent only about 5.3 percent of the impact costs calculated for the comprehensive case.

The discussion above relating to Table 14 does not specifically separate the impacts related directly to the hazardous nature of the cargo. This estimate is important for both the current analysis and any future risk assessments or modeling. The process followed to separate out the impacts directly related to the HM cargo begins with identifying those impacts that are clearly, directly related to the hazardous material. These include impacts due to leaks from unloading and loading and leaks enroute.

The accident categories for spill and no spill are not quite as obvious. The assignment of impacts to the hazardous cargo for the no spill accidents focuses on incident delay. All of the other impact categories would be unrelated to the fact that the truck transported HM. Only incident delay could be assigned to the HM category since first responders often react to an accident with a truck carrying HM as if there was a spill or the potential for a spill even if no spill occurred. The assumption made here is that at least half of the delay cost for no spill accidents can be related to the fact that the cargo is hazardous.

For spill accidents, all of the impact categories except for fatalities and injuries can be directly related to the HM cargo. For fatalities, HMIS only includes fatalities that are known to be caused by the HM. However, for the 1996 estimate, the number of fatality accidents was expanded based on the use of other databases and sources of information. This analysis assumed that the fatalities in the no spill category would provide data that could be used to calculate the probability of a fatality without the influence of hazardous material. About 39 percent of all spill accident fatalities would be unrelated to the cargo. Thus, about 12 of the fatalities could be assumed to be caused by factors other than the hazardous cargo and 18 of the 30 fatalities would be caused by the HM cargo. About 60 percent of the fatalities from spill accidents are estimated to be related to the cargo. Similarly, for the injuries sustained from spill accidents, about 170 could be estimated to be related to the HM character of the cargo.

Table 15. 1996, Class 3, U.S. Transportation Accident Impacts (Costs): HMIS

Annual Number	Cleanup	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury	Fatal	Evacuation	Incident Delay
179 Spill Accidents	$6,552,972 (Decon Damage)	$547,789	$6,155,936	$1,572115	NA	$3,000,000 (dollars not in HMIS)	$6,000,000 (dollars not in HMIS)	$647,000 (dollars not in HMIS)	NA
								Total	$24,475,812

Table 16. 1996, Class 3, U. S. Transportation Accident Impacts (Costs): Phase I Comprehensive (HMIS, Safetynet, State Databases, TIFA, News Clippings)

Annual Number	Cleanup	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury	Fatal	Evacuation	Incident Delay
490 Spill Accidents	$16,660,000	$1,862,000	$17,640,000	$2,891,000	$882,000	$56,600,000	$60,000,000	$1,950,000	$17,954,564
953 No Spill Accidents	NA	NA	$34,308,000	$5,622,700	NA	$134,000,000	$74,000,000	NA	$15/per person per hour = $34,919,797
Totals	**$16,660,000**	**$1,862,000**	**$51,948,000**	**$8,513,700**	**$882,000**	**$190,600,000**	**$134,000,000**	**$1,950,000**	**$52,874,357**
								Grand Total	**$459,290,057**

Table 17. Comparison of HMIS Transportation Accident Impacts and Phase I Comprehensive Accident Impacts

Data source	Cleanup	Product Loss	Carrier Damage	Property Damage	Environmental Damage	Injury	Fatal	Evacuation	Incident Delay	Total Costs
HMIS	$6,552,972	$547,789	$6,155,936	$1,572115	NA	$3,000,000	$6,000,000	$647,000	NA	$24,475,812
Phase I Comprehensive	$16,660,000	$1,862,000	$51,948,000	$8,513,700	$882,000	$190,600,000	$134,000,000	$1,950,000	$52,874,357	$459,290,057

Table 18 presents the impact costs related to the nature of the hazardous material. About $122,800,000 of the impact costs can be related directly to the hazardous nature of the cargo. This represents about 30 percent of the impact costs for the major Class 3 accidents estimated for 1996.

Table 18. Impact Costs Related Directly to Hazardous Materials Cargo

Accident or Incident Category	Incident Delay Costs	Fatality Avoidance Costs	Injury Avoidance Costs	Other Impact Costs	Total HM Related Costs
Enroute Leak	$13,264,343	NA	NA	$607,140	$13,871,483
Leak from loading or unloading	NA	$6,000,000	$96,000	$2,539,440	$8,645,440
No Spill Accident	$17,459,899	NA	NA	NA	$17,459,899
Spill Accident	$17,954,564	$22,000,000	$21,000,000	$41,885,000	$102,839564
Total Incidents and Accidents	$48,678,806	$28,000,000	$21,096,000	$45,031,580	$122,816,386

The data clearly indicates that impact costs covered in the HMIS are considerably higher for cargo tanks than for non-cargo tank Class 3 shipments. Tables 19 through 27 show the distinctions in impact costs between cargo and non-cargo tank Class 3 accidents and incidents. The data in the tables indicate this greater cost is attributable to the far fewer number of accidents involving non-cargo tank shipments. For example, for cargo tanks, 273 accidents over the three-year period caused $12,803,912 of carrier damage. Non-cargo tank accidents accounted for $915,260 from only 30 accidents. Average cost per accident is also lower for non-cargo with the numbers being $46,901 and $30,509, respectively, for carrier damage. For both product loss and cleanup costs, however, the costs per accident are both lower for cargo tank shipments than for non-cargo tank shipments.

For enroute incidents, the non-cargo tank total costs are higher than cargo tank costs in most cases because of the greater number of incidents. However, carrier damage, property loss and cleanup costs are considerably higher per incident for cargo tanks as compared to incidents for non cargo tanks as shown in Tables 21 and 22.

Table 19. Accident, Cargo Tank, En Route, 1995–1997, Class 3.

	Number of Accidents	Total Cost	Average Cost per Accident
Product Loss	279	$931,741	$3,340
Carrier Damage	273	$12,803,912	$46,901
Public/Private Property Damage	119	$2,063,536	$17,341
Decontamination/ Cleanup	258	$10,849,580	$42,053
Other Damages	39	$362,215	$9,288
Total Damages	316	$27,010,984	$85,478

Table 20. Accident, Non-Cargo Tank, En Route, 1995–1997, Class 3.

	Number of Accidents	Total Cost	Average Cost per Accident
Product Loss	37	$518,025	$14,001
Carrier Damage	30	$915,260	$30,509
Public/Private Property Damage	12	$192,010	$16,001
Decontamination/ Cleanup	37	$2,179,673	$58,910
Other Damages	10	$44,129	$4,413
Total Damages	43	$3,849,097	$89,514

Table 21. Incident, Cargo Tank, En Route, 1995-1997, Class 3.

	Number of Incidents	Total Cost	Average Cost per Incident
Product Loss	69	$16,251	$236
Carrier Damage	17	$103,243	$6,073
Public/Private Property Damage	11	$45,139	$4,104
Decontamination/ Cleanup	96	$339,098	$3,532
Other Damages	12	$10,375	$865
Total Damages	129	$514,106	$3,985

Table 22. Incident, Non-Cargo Tank, En Route, 1995-1997, Class 3.

	Number of Incidents	Total Cost	Average Cost per Incidents
Product Loss	307	$101,835	$332
Carrier Damage	23	$12,620	$549
Public/Private Property Damage	11	$32,076	$2,916
Decontamination/ Cleanup	345	$633,689	$1,837
Other Damages	53	$23,256	$439
Total Damages	445	$803,476	$1,806

Table 23. Incident, Cargo Tank, Loading/Unloading/ Temporary Storage/Terminal, 1995-1997, Class 3.

	Number of Incidents	Total Cost	Average Cost per Incident
Product Loss	1,397	$191,884	$137
Carrier Damage	39	$464,001	$11,897
Public/Private Property Damage	64	$760,929	$11,890
Decontamination/ Cleanup	1,010	$2,347,793	$2,325
Other Damages	40	$26,984	$675
Total Damages	1,552	$3,791,591	$2,443

Table 24. Incident, Non-Cargo Tank, Loading/Unloading/ Temporary Storage/Terminal, 1995-1997, Class 3.

	Number of Incidents	Total Cost	Average Cost per Incidents
Product Loss	1,592	$165,169	$104
Carrier Damage	43	$25,003	$581
Public/Private Property Damage	5	$11,210	$2,242
Decontamination/ Cleanup	1,559	$583,590	$374
Other Damages	597	$173,104	$290
Total Damages	1,924	$958,076	$498

Table 25. Accident, En Route, 1995-1997, Class 3 (Cargo + Non-Cargo).

	Number of Accidents	Total Cost	Average Cost per Accident
Product Loss	316	$1,449,766	$4,588
Carrier Damage	303	$13,719,172	$45,278
Public/Private Property Damage	131	$2,255,546	$17,218
Decontamination/ Cleanup	295	$13,029,253	$44,167
Other Damages	49	$406,344	$8,293
Total Damages	359	$30,860,081	$85,961

Table 26. Incident, En Route, 1995-1997, Class 3 (Cargo + Non-Cargo).

	Number of Incidents	Total Cost	Average Cost per Incidents
Product Loss	376	$118,086	$314
Carrier Damage	40	$115,863	$2,897
Public/Private Property Damage	22	$77,215	$3,510
Decontamination/ Cleanup	441	$972,787	$2,206
Other Damages	65	$33,631	$517
Total Damages	574	$1,317,582	$2,295

Table 27. Accidents and Incidents, Loading/Unloading/ Temporary Storage/Terminal, 1995-1997, Class 3 (Cargo + Non-Cargo).

	Number of Incidents	Total Cost	Average Cost per Incident
Product Loss	3,001	$373,100	$124
Carrier Damage	89	$609,154	$6,844
Public/Private Property Damage	74	$800,639	$10,819
Decontamination/ Cleanup	2,579	$3,125,693	$1,212
Other Damages	638	$200,388	$314
Total Damages	3,490	$5,108,974	$1,464

3.3 Impact Case Examples

This section of the report presents impact summaries for four actual class three accidents in 1996. The examples were selected to provide an indication of the range of impacts for Class 3 accidents. Field values were obtained from newspaper clippings and different Federal and state databases. However, estimations of some impact costs were added when data was unavailable. These values are annotated with an asterisk. For example, if a tractor and trailer were destroyed, an estimated value for the equipment was added even if HMIS reported the value as $0. The case examples indicate that there is considerable variability among the particular accidents, but that serious injuries can dominate the cost, even in the case of the Kirkersville, Ohio, accident, where impact delay costs are high where a major interstate was affected. Tables 28 to 31 provide a summary of the impacts for each case.

3.3.1 Impact Case Example 1

October 29, 1996, 4:50 a.m., Near Kirkersville, OH. A tanker truck, traveling east bound on I-70, went into the median and rolled onto its side. The cargo tank was carrying 6,800 gallons of acetone. Less than 100 gallons of the hazardous cargo was released through the tank's pressure relief valve. The driver apparently had fallen asleep and lost control of the vehicle. He was taken to the hospital for injuries. Both the east- and westbound lanes of I-70 were closed starting at 5 a.m., and were expected to open by 2 p.m. An environmental contractor was called to clean up the spill.

Table 28. Kirkersville, OH.

	Field	Value*
HM Information	Commodity	Acetone
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	Less than 100 gallons
Accident Information	Location	I-70 Eastbound, 122 MM, East of SR158, near Kirkersville OH (Rural community)
	Fatalities	0
	Injuries	1 person = $400,000
	Evacuation	0
Damages	Product Loss	$500
	Carrier Damage	$2,000
	Public/Private Property Damage	$0
	Decontamination/ Cleanup	$1,500
	Incident Delay	$83,025
	Environmental Damage	$88
Total Estimated Cost		$487,113

* Values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

3.3.2 Impact Case Example 2

Thursday, March 14, 1996, 12:00 p.m., Mankato MN. A tractor-semi-tanker, carrying 8,500 gallons of gasoline, tipped while turning off Riverfront Drive onto Madison Avenue. The tanker was punctured, spilling approximately 235 gallons of gasoline onto Riverfront Drive. Approximately 25 gallons went into a storm sewer, while none appeared to flow into the river or contaminate any ground or soil. Although the driver was only traveling at 10 mph, speed may have been a factor in the accident. Parts of Riverfront Drive and Madison Avenue were closed from noon to 10 p.m. Several businesses and families were evacuated along the 700, 800 and 900 blocks of Riverfront Drive and one side of 2nd Street for approximately six hours. The only injury involved the driver, who was treated at the scene of the accident. An environmental contractor was called to drain the remaining fuel from the tanker. The city billed the trucking company $13,212 for the spill clean up, which included police and fire personnel hours, equipment and supplies; the trucking company paid this bill in May of 1996.

Table 29. Mankato, MN.

	Field	Value*
HM Information	Commodity	Gasoline
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	235 gallons
Accident Information	Location	Riverfront Dr. and Madison Ave., Mankato MN (Suburban community)
	Fatalities	0
	Injuries (Minor)	1 person = $4,000
	Evacuation	75 people for 6 hours = $75,000
Damages	Product Loss	$425
	Carrier Damage	$60,000
	Public/Private Property Damage	$1,000
	Decontamination/ Cleanup	$6,000
	Other Damages	$13,212 City bill
	Incident Delay	$12,000
	Environmental Damage	$208
Total Estimated Cost		$171,846

* Values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

3.3.3 Impact Case Example 3

June 22, 1996, 5:15 a.m., Berthoud Falls, CO. A tanker truck traveling along U.S. 40 and carrying 8,200 gallons of diesel fuel ran off the road and rolled approximately ¾ times, before catching fire. The first person at the scene, a passerby, was able to safely pull the two injured passengers from the tractor before flames engulfed it. The tanker had melted due to the heat of the fire. The spilled fuel and fire traveled down the roadside ditch and proceeded to burn out a car and home; fortunately there were no injuries due to the spreading fire. The fire continued to burn 50 – 60 yards of the surrounding area. Approximately 50 residents were evacuated from the rural community, and the road was closed for approximately 2 hours. Colorado State Highway Patrol noted that the road surface was wet from rain, and that the driver's condition appeared normal. The truck was reported as traveling at 35 mph. An environmental contractor was called to clean up the spill.

Table 30. Berthoud Falls, CO.

	Field	Value*
HM Information	Commodity	Diesel Fuel
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	8,200 gallons
Accident Information	Location	U.S. 40 & milepost 249, Berthoud Falls, CO (Rural community)
	Fatalities	0
	Injuries	2 people $400,000
	Evacuation	50 people $50,000
Damages	Product Loss	$8,000
	Carrier Damage	$107,000 (assumes total damage)
	Public/Private Property Damage	$60,000
	Decontamination/ Cleanup	$30,000
	Incident Delay	$46,125
	Environmental Damage	$3,597 (assumes half of leaked cargo burned)
Total Estimated Cost		$704,722

* Values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

3.3.4 Impact Case Example 4

Saturday, September 7, 1996, 3:30 p.m., Burns Harbor, IN. A tractor-trailer rig was exiting I-94 onto U.S. 20 via a full circular exit ramp, traveling at 30 mph, when the contents of the trailer shifted to the left, causing the tractor-trailer to roll over onto its left side. The trailer contained ten, 600-gallon containers of a flammable resin solution. Three of the containers ruptured at the seams, spilling 1,200 gallons of the resin solution. No other vehicles were involved in the accident, however the driver of the vehicle and his two children traveling with him were hospitalized for minor injuries, and released Saturday evening. The resin solution was also thought to be toxic if inhaled in large quantities. Thus, three homes and a fireworks warehouse were evacuated shortly after the spill. Evacuees were allowed to return late Sunday afternoon. The resin solution spilled onto U.S. 20, closing the road from Ind. 149 to just east of the I-94 interchange until 5 p.m. on Sunday. The solution also contaminated some of the surrounding land. By nightfall a dump truck with sand was brought to the site to construct a dike to contain the resin, which had been covered with foam. At least 30 firefighters, hazardous materials experts and paramedics remained at the scene through Saturday night. To remove the containers and tractor-trailer from the highway the vehicle's owner hired an environmental contractor.

Table 31. Burns Harbor, IN.

	Field	Value*
HM Information	Commodity	Resin Solution
	Class	3; Flammable – Combustible Liquid
	Quantity Spilled	1,200 gallons
Accident Information	Location	U.S. Route 20 at I-94, Burns Harbor, IN (Rural community)
	Fatalities	0
	Injuries	3 people $96,000
	Evacuation	Three households and a fireworks warehouse.
Damages	Product Loss	$1,200
	Carrier Damage	$28,419
	Public/Private Property Damage	$0
	Decontamination/ Cleanup	$74,059
	Other Damages	$2,179
	Incident Delay	$46,875
	Environmental Damage	$1,053
Total Estimated Cost		$265,785

* Values based on data and assumptions in Section 2.3 and an assessment of likely costs for this case.

4.0 Conclusions

4.1 Estimation of Class 3 Shipment Accident and Incident Numbers and Impacts

This report has demonstrated a process to evaluate the full impacts of HM incident/accidents by sampling a single HM class for one year. By characterizing the shipment impacts for one year of Class 3 HM shipment impacts, it demonstrates the implementation of a process which could be applied to determining the impacts of other hazardous materials classes as well as for non-hazardous materials. Specifically the report has demonstrated the feasibility of obtaining data and conducting analysis in the following areas:

- Estimation of the number of accidents and incidents for one year
- Estimation of the type and magnitude of impacts from accidents and incidents
- Estimation of data needed for the full risk assessment

4.1.1 Number and Type of Accidents and Incidents

The report has demonstrated the usefulness of a methodology for effectively estimating the number of accidents and incidents for a one-year or longer period. This methodology focuses on the use of existing national databases and the selection of sample states that can be used to provide data to supplement national databases. The methodology uses the HMIS database and the Safetynet database supplemented by state databases and news clippings to put together an annual number of accidents from an eight-state sample. The state sample was selected because six of the states are participants in an OMC demonstration project or had other good supplemental sources of state data. This eight-state accident count was then assigned a likely proportion of the national accidents and extrapolated to the national level to develop a national estimate of accident and incident numbers.

The number of incidents were estimated with greater reliance on the HMIS database since the Safetynet database and most state databases don't include incidents. The eight-state sample was used to tally HMIS incidents and the shortfall of incidents representing intrastate carriers was added to the HMIS numbers. National incident totals were extrapolated in a similar manner as for the accidents.

The application of this methodology for this report shows that a similar approach can be used both for estimating the annual number of accident and incidents for the other HM classes as well as for estimating the number of accidents for non-hazardous material shipments.

4.1.2 The Type and Magnitude of Impacts from Accidents and Incidents

The report has estimated the number and type of impacts for Class 3 accidents and incidents. Impact estimates were made for the following impacts:

- Injuries And Deaths
- Cleanup Costs
- Property Damage
- Evacuation
- Product Loss
- Traffic Incident Delay
- Environmental Damage.

Based on available data, impact magnitudes were estimated in terms of dollar cost for each of the impact categories and translated into a per accident or incident cost. Then the total cost for the impact was calculated based on the number of accidents or incidents.

As stated earlier in this report, these observations should be viewed in the context of establishing a general estimate or bound on the financial impact of this problem rather than a precise valuation. This is a valid attempt to benchmark the financial implications of the problem based on best available data. Consequently, even if the results are within an order of magnitude, meaningful comparisons can be derived for evaluation purposes.

This approach can also be used to estimate the impacts for the other HM classes and for non-HM shipments. Impact measures can be refined for second phase work through the supplementing of estimates through additional impact estimates from private sector sources such as insurance companies and trucking companies.

4.1.3 Estimation of Data Needed For the Full Risk Assessment

The report provided an opportunity to evaluate the range of data available for conducting the full risk assessment in phase II. As indicated above, the data for estimating the number and impacts of incidents and accidents is good as long as several databases can be used to assemble a reliable picture. Unfortunately, the same does not apply to the description of traffic flows for Class 3 HM shipments. Although there is some representative data in regional studies, there is no good national source of traffic flow data comparable to HMIS and Safetynet for accidents and incidents. The regional studies as well as estimates from trucking companies will be able to be used to provide traffic flow estimates for the phase 2 studies. However, the best data should result from the 1997 Commodity Flow Survey. That data should be available for use during 1999.

4.2 Numbers of Accidents and Incidents and Magnitude of Impacts

For 1996, there were an estimated 3,766 accidents and incidents for Class 3 HM materials in the United States. Of these, 1,443 were enroute accidents (490 spill accidents and 953 no spill accidents), 362 were enroute incidents and the remainder, 1,961, were incidents associated with loading and unloading. Enroute accidents accounted for about 38 percent of the total accidents and incidents.

The magnitude of impacts for enroute accidents in 1996 show that these impacts are considerably greater than those for both enroute incident and incidents associated with loading and unloading. In fact, the impact costs of enroute accidents accounted for 95 percent of all incidents and accidents. Impact costs also indicated that the no spill accidents exceeded the spill accidents in costs due to the greater number of injuries for the larger number of no spill accidents. Of the total costs for the 1996 portrait year of about $481,796,985, the costs for avoiding injuries and fatalities accounted for about approximately 69 percent. Carrier damage and incident delay costs together accounted for about 25 percent of the total estimated cost for the year.

About $142,800,000 of the impact costs can be related directly to the hazardous nature of the cargo. This represents about 30 percent of the impact costs for the major Class 3 accidents and incidents estimated for 1996.

Both the estimates of accident and incident numbers and total impacts provide a profile that can be duplicated for the other HM categories and for non-NM shipments. This information will provide an essential ingredient for the risk analysis to be accomplished in the second phase.

4.3 Recommendation to Proceed with Phase II

The project has been divided into two phases. The first phase characterized the shipment impacts for one year of Class 3 HM shipments and assesses the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments. The characterization of the one-year of shipment impacts is contained in this report. The assessment of the feasibility of conducting a comprehensive risk assessment of HM and non-HM shipments is contained in the "Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Nonhazardous Materials Movements." This report provides a solid beginning for the comparative risk assessment scheduled for the second phase. The data and descriptions included here indicate that a substantial quantity of data exists which will enable a comparison of risks between HM and non-HM shipments. The "Plan for Assessing the Feasibility for Conducting a Comparative Risk Assessment on Hazardous Materials and Nonhazardous Materials Movements," which has been prepared under a separate cover, provides a detailed plan for the approach that is recommended for the risk assessment in Phase II. The Plan recommends the development of a model that will be able to be periodically updated for the comparison of risks.

Appendix A

State Hazardous Material Flows

Appendix A
State Hazardous Material Flows

Truck Transportation of Hazardous Materials: Traffic and Commodity Flow

This appendix summarizes the results of the regional HM flow studies that have been conducted in recent years and some of the data from the national databases.

Summary of State and Local Flow Studies

Colorado

Mesa County Local Emergency Planning Committee. *Hazardous Materials in Mesa County.* August 1997

A survey was conducted on two major roadways through Mesa County, which is located in western Colorado. Two inspection stations were set up on I-70 and Highway 6 & 50 for two days (12 hours/day) in August, where each truck was classified by hazard class.

For both survey locations, HM vehicles comprised 7 percent of observed vehicles. Commodities in Hazard Class 2 (Gases) and Class 3 (Flammable Liquids) accounted for 43 percent and 36 percent of HM vehicles.

Delaware

State Emergency Response Commission. *Delaware Hazardous Material Transportation Flow Study.* June 1994

The Delaware Hazardous Material Transportation Flow Study consisted of statewide survey of HM trucks on highways in March of 1994. Trucks were classified by placard/hazard class and counted during a 4-day (8 hours/day) survey at eighteen intersections on Interstate or Principal Arterials.

For all sites, the results of the highway truck survey showed that HM vehicles accounted for 6 percent of the total truck traffic. Petroleum products, specifically gasoline, fuel oil and propane, consisted of more than 55 percent of all HM vehicles observed. Furthermore, 59 percent of all HM vehicles were carrying flammable liquids.

Kentucky

Kentucky Emergency Response Commission. *Corridor Commodity Flow Analysis Final Reports.*
I-24, January 1998
I-71, December 1997
I-75, November 1995
I-65, September 1995
I-64, June 1995

Each corridor study consisted of 600 hours of observations at weigh stations along the Interstate highway. Each survey recorded placard information for HM vehicles.

For all 5 corridors, HM vehicles consisted of 3.4 percent of total truck traffic. Most frequently observed placards were for gasoline and motor fuel and for flammable materials consisting of approximately 17 and 12 percent of HM trucks respectively. Trucks carrying flammable liquids consisted of 57 percent of all HM vehicles.

Ohio

"Growth Fuels Talk or Route Review". Columbus Dispatch. July 21, 1996

Observations at I-70 and I-71 interchanges with I-270 through Columbus showed that 47 percent of placarded trucks were carrying flammable liquids. No information regarding date, time and duration of the observation period was specified.

Oregon

Public Utility Commission of Oregon and the Oregon Department of Transportation. *Hazardous Material Movements on Oregon Highways.* 1987

A statewide survey was conducted at 11 truck weigh scale locations for 3 days in both March and August. The survey recorded the hazard class, the specific material's shipping name and identification number of each HM truck.

For all sites combined, hazardous materials were being carried by 6 percent of the trucks observed. Fifty-four percent of placarded trucks carried goods in the flammable or combustible hazard class. Gasoline and fuel oil, followed by paint and hazardous wastes, were the most common materials being transported.

Summary of State and Local Flow Studies

Table A-1. Traffic Statistics

	Hazardous Materials Percentage of total traffic	Flammable Liquids Percent of HM vehicles
Colorado	7.1	43.0
Delaware	6.0	59.4
Kentucky	3.4	56.6
Columbus, Ohio	-	47.5
Oregon	4.9	52.9
National Fleet Safety Survey	7.2	—

Summary of National Commodity Flow Sources

National Fleet Safety Survey
Office of Motor Carriers
Federal Highway Administration, March 1997.

This survey randomly sampled over 10,000 trucks in 11 states to assess the level of compliance with Federal Motor Carrier Safety Regulations and with Hazardous Materials Regulations. The survey found 5.6 percent of all sampled trucks to be carrying hazardous materials.

The national weighted estimate of the percentage of operating trucks carrying HM was determined to be 7.2 percent. The weighting procedure considered the location of the inspections along with VMT by state and by highway functional class.

1993 Commodity Flow Survey (CFS)
Census of Transportation, Communications and Utilities
U.S. Department of Commerce, Bureau of the Census.

The CFS provides data on the movement of goods by mode of transportation. Information regarding volumes and ton-miles of hazardous commodities transported by truck was taken from Table 6 (Shipment Characteristics by Commodity and Mode of Transportation) compiled for the United States. The HM volumes and ton-miles were under estimated because data for crude petroleum, and natural gas shipment was lacking. As well, the major commodity groupings (two digit codes) did not readily disaggregate into detailed commodity types (three digit codes) that would be considered solely hazardous but that would also include materials that were not hazardous. Similarly, the determination of flammable liquids was inaccurate. Detailed commodity information was not available at the state level.

1987 and 1992 Truck Inventory and Use Survey (TIUS)
Census of Transportation
U.S. Department of Commerce, Bureau of the Census.

TIUS measures the operational characteristics of the nation's truck fleet. The study consisted of a mail survey of about 154,000 selected trucks including large trucks and small trucks (pickups and vans). Published information is reported as national totals and by state of registration. The unaggregated database is available as a microdata file. The information is a result of the number of trucks and truck-miles reported during 1992. TIUS reports only the number of vehicles used to transport various commodities rather than the amount of commodity moved over a distance (ton-miles for example). As well, the trucks reported may be used to transport more than one hazardous commodity.

The 1992 survey showed that 2 percent of all trucks including small trucks carried HMs. Of the HM carriers, 35 percent carried commodities that could be considered flammable liquids. Analysis showed that 18 percent of large trucks carried HMs and that 20 percent of them were placarded as flammable.

Truck Transportation of Hazardous Materials: A National Overview

Transportation Systems Center
US DOT, December 1987.

The report presents and overview of HM transport on highways. Information and estimates of truck traffic divisions are derived from the U.S. Department of Commerce (Bureau of the Census). The report develops truck flows and traffic patterns using commodity and truck operating characteristics from the CFS and TIUS of 1977.

The study reported that HM commodities accounted for 17 percent of truck ton-miles. Of that, 28 percent of HM ton-miles could be considered flammable liquid movements.

Table A-2. Selected National Commodity Flow Statistics

Commodity Statistics

	Hazardous Materials Percentage of total commodity	Flammable Liquids Percent of Hazmat commodity
1992 CFS		
Ton-miles (excludes petroleum products)	4.9	13.7
1992 TIUS		
All registered trucks (includes large and small trucks)	2.2	13.7
Large trucks	17.8	20.0
Truck-miles of HM	-	2.2
1987 TIUS		
All registered trucks (includes large and small trucks)	2.9	15.3
Large trucks	12.1	29.8
Truck-miles of HM	-	8.8
Truck Transportation of Hazardous Materials (1977)		
Ton-miles (factored volumes)	16.4	27.5

Appendix B

Database Search Criteria

Appendix B
Database Search Criteria

Appendix B includes a set of tables that summarize the search criteria used to identify the 1996 Class 3 truck shipments for each database. Since each database has its own field characteristics, Tables B-1 to B-6 each cover a database.

Table B-1. HMIS

Field	HMIS Field Name and Criteria
Accident	ACCDR = YES
Source	HMIS
Interstate	Assumed Yes
Spill	Assumed Yes
Date	IDATE = */*/96
Time	ITIME
Accident Street	IROUTE
Accident City	ICITY
County	ICOUNTY
Accident State	IST = CA, CO, OR, IA, IN, MN, OH, PA
Carrier Name	CARRI
Census Number	CRPNO
Carrier State	CARST
HZMT Placards	Assumed Yes
HZMT Name	COMOD
HZMT Trade	TRADE
HZMT 4-Digit #	UNNUM
HZMT 1-Digit #	CMCL = 30 (Class 3)
Cargo	Cargo = Yes or No
# Fatalities	DEAD
# Injuries	INJURY: [MJING+MNING]
Phase	PHASE = 261 (Enroute Between Origin and Destination)
Others	VANTRL (= Yes or No)

Table B-2. Safetynet

Fie[redacted]d	Safetynet Field Name and Criteria
Acc[redacted]dent	Assumed Yes
Sou[redacted]ce	State
Inte[redacted]state	Interstate (= Yes or No)
Spil[redacted]	Hazardous Material Release of Cargo (= Yes or No)
Dat[redacted]	Accident Date/Year = 96; Accident Date/Month; Accident Date/Day
Tim[redacted]	Accident Time/ Hour : Accident Time/ Minute
Acc[redacted]dent Street	Accident Street Location
Acc[redacted]dent City	Accident/ City Name
Cou[redacted]nty	Accident County Code
Acc[redacted]dent State	Accident State
Car[redacted]er Name	Carrier Name
Cen[redacted]us Number	Census Number
Car[redacted]er State	Carrier Address/ State
HZ[redacted]T Placards	Hazardous Material Placard = Y
HZ[redacted]T Name	Hazardous Material Name
HZ[redacted]T Trade	N/A
HZ[redacted]T 4-Digit #	Hazardous Material 4-Digit Number
HZ[redacted]T 1-Digit #	Hazardous Material 1-Digit Number = 3
Car[redacted]o	Cargo Body Type
# F[redacted]talities	Number of Fatalities
# In[redacted]uries	Number of Injuries
Pha[redacted]e	N/A
Oth[redacted]rs	Truck/Bus = t (truck)

Table B-3. California Highway Patrol

Field	California Highway Patrol Field Name and Criteria
Accident	Assuming Yes (Since all Property Use is Highway) [1]
Source	CA
Interstate	Cannot determine if Interstate or Intrastate [2]
Spill	Extent of Release and Release Factor
Date	Indate = */*/96
Time	Time Notified
Accident Street	Address
Accident City	City
County	County
Accident State	CA by default
Carrier Name	Not available
Census Number	Not available
Carrier State	Not available
HZMT Placards	Placards Required = -1 (Yes)
HZMT Name	Chemname
HZMT Trade	N/A
HZMT 4-Digit #	DOTID
HZMT 1-Digit #	DOT Hazard Class = 3
Cargo	Container Type
# Fatalities	Fatality
# Injuries	Injury
Phase	N/A
Others	Surrounding Area (Property Use Description) Property Use code = 961, 962, 963 (freeway, county/city road, private road)
	Mobile Property (Description) Code/mobile = 20, 99, 00 (Freight Vehicle/road, Other, Undetermined)
	Equipment Type (Description) Code, equipment = Not 97 (not Vehicle Fuel System)
	ConDescribe = not 1 (not fixed).
	Contype = not 41 (not vehicle fuel tank).
	Conlevel = not 40 (not below ground).

1. Assuming all records pulled are accidents since all occurred on highways.
2. Cannot determine if Interstate of Intrastate carrier.

Table B-4. Public Utilities Commission of Ohio (PUCO)

Field	PUCO Field Name and Criteria
Accident	Accident = Yes
Source	OH PUCO
Interstate	Interstate (= Yes, No, or Unknown)
Spill	Released (= Yes or No)
Date	Date = */*/96
Time	Time
Accident Street	Route/Milepost
Accident City	City
County	County
Accident State	OH by default
Carrier Name	Carrier name
Census Number	Not available
Carrier State	Carrier State
HZMT Placards	Not available – Assumed Yes
HZMT Name	Materials Involved
HZMT Trade	N/A
HZMT 4-Digit #	Not available
HZMT 1-Digit #	Not available [1]
Cargo	Cargo = Yes or Unknown and Packaging
# Fatalities	Fatalities
# Injuries	Injuries
Phase	N/A
Others	Enroute = Yes
	Gallons
	Carrier City

1. Materials Involved: Using the 1996 North America Emergency Response Handbook, the Materials Involved field was analyzed to see if was Class 3. If not class 3, then the entry was deleted from the search.

Table B-5. Colorado State Patrol

Field	Colorado State Patrol Field Name and Criteria
Accident	Assuming Yes (Since all Property Use is Highway) [1]
Source	CoSP
Interstate	Can not determine if Interstate or Intrastate
Spill	Relfact: 71, 94, 98, or Is Null (Collision/Overturn, Fire/explosion, No Release, Null) [2]
Date	Incident Date (All 1996 records)
Time	Incident Time
Accident Street	Location
Accident City	City/Town
County	County
Accident State	CO by default
Carrier Name	Carriers/Facility Name
Census Number	Not available
Carrier State	Carr/Facil St
HZMT Placards	Placds Reqd = Y (1st & 2nd HZMT Entries)
HZMT Name	Chem/TradeName
HZMT Trade	N/A
HZMT 4-Digit #	DOT ID No (1st & 2nd HZMT Entries)
HZMT 1-Digit #	DOT HZRD Class = 3 (1st & 2nd HZMT Entries)
Cargo	Container Type
# Fatalities	Fatality: [responders killed + others killed]
# Injuries	Injury: [responders injured + others injured]
Phase	N/A
Others	Property Use = 961, 962, 963, 098 or Is Null (freeway, county/city road, private road, other or Null)
	Type of Incident = Transportation or Null
	Veh Type = 20 or Is Null (Freight Veh/Road)
	Container Type (1st & 2nd HZMT Entries)
	Extent of Release (1st & 2nd HZMT Entries)
	Car/Facil City
	US DOT #

1. Assuming all records pulled are accidents since all occurred on highways
2. Spill field manually entered as y/n based on Relfact field plus other information.

Table B-6. Trucks Involved in Fatal Accidents (TIFA)

Field	TIFA Field Name and Criteria
Accident	Assuming Yes
Source	TIFA
Interstate	Can not determine if Interstate or Intrastate [1]
Spill	Spill/Spill
Date	Date: [Accident Month, Accident Day, Accident Year]
Time	Time: [Accident Hour, Accident Minute]
Accident Street	Case Street
Accident City	Case City
County	Case County/ Name
Accident State	Case State/ ABBREV
Carrier Name	Not available
Census Number	Not available
Carrier State	Not available
HZMT Placards	HZMT Placard/ Has Placard
HZMT Name	Spec Cargo
HZMT Trade	N/A
HZMT 4-Digit #	Not available
HZMT 1-Digit #	Determined by User [2]
Cargo	V132/Cargo Body Type
# Fatalities	Fatalities
# Injuries	Injuries
Phase	N/A
Others	Hazardous Cargo = 1 PU HZMT Cargo/ PU Has Cargo 1T HZMT Cargo/ 1T Has Cargo 2T HZMT Cargo/ 2T Has Cargo 3T HZMT Cargo/ 3T Has Cargo

1. Cannot determine if Interstate or Intrastate carrier.
2. Looked up HZMT Name in 1996 North American Emergency Response Handbook to determine which HZMT Names were class 3. Deleted non-class 3 entries and no placard entries.

Appendix C

Natural Resource Damages Settlements

Appendix C
Natural Resource Damages Settlements

The following table (C-1) presents 30 natural resource settlements from sites around the country. The settlements are representative of the magnitude of settlement characteristic of sites where environmental damage has occurred. The settlements are often the result of complex environmental damage that would likely be more serious than that anticipated from a HM spill after cleanup has occurred. However the damages provide a useful conservative estimate of damage associated with specified acreage.

Table C-1. Natural Resource Damage Settlements by Habitat Type and Location

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Bay & estuary (saline)	WA: central Puget Sound	Elliott Bay, Seattle, WA	Seattle (city and metropolitan area)	5189	$24,000,000	$4,625	ac.	Cr, Cd, Cu, Pb, Zn, & PCBs in sediments
Bay & estuary (saline)[e]	WA: southern Puget Sound	Commencement Bay	Port of Tacoma; Simpson Tacoma Kraft Co.	37.9	$13,300,000	$350,923	ac.	variety of hazardous substances
Dune & swale	IN: northern	Midco I & II	Midco	?	$304,567	?	ac.	VOCs, PCBs, & metals
Estuary sediments (saline)	MA: Achushnet River, near Buzzards Bay	New Bedford Harbor	5 companies	18000	$20,200,000	$1,122	ac.	PCBs & heavy metals in biota & sediments
Grassland & oldfield	IN: Laporte Co.	Fisher-Calco Chemical Superfund Site	Fisher-Calco Chemical Company and Solvents Corp.	150	$200,000	$1,333	ac.	Bleach, sulfur dioxide, chloride, ammonia, VOCs, & PCBs
Grassland & oldfield[f]	IN: St. Joseph Co., Mishawaka	Douglas Road/Uniroyal, Inc. Landfill	Uniroyal, Inc.	19	$163,035	$8,581	ac.	hydrocarbons in groundwater
Grassland & oldfield[f]	IN: Whitley Co., Columbia City	Wayne Reclamation & Recycling	Wayne Waste Oil division of Wayne Reclamation & Recycling, Inc.	35	$73,474	$2,099	ac.	VOCs: benzene, TCE, vinyl chloride, & toluene
Grassland with wetlands; dump in river floodplain	IN: Allen Co., Fort Wayne in floodplain of Maumee River	Fort Wayne Reduction Dump	Fort Wayne Reduction; National Recycling Corp.; Service Corp. of America	35	$5,000	$143	ac.	VOCs, PCBs, PAHs, phenols, & heavy metals in soil & groundwater
Industrial site	PA: Crawford Co., Saegertown	Saegertown Industrial Area	General American Transfer; Saegertown Mfg. Co.; Spectrum Control, Inc.; Lord Corp.	100	$94,510	$945	ac.	VOCs & PAHs in soil and pond sediments

Table C-1. (continued)

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Industrial site in floodplain of river	PA: Berks Co., near Shoemakersville in flood-plain of Schuylkill River	Brown's Battery Breaking	Brown's Battery Breaking	14	$24,217	$1,730	ac.	Pb, Ni, Zn
Industrial site with stream	PA: Mifflin Co., Maitland; Jacks Creek flows through site	Jacks Creek/ Sitkin Smelting & Refining, Inc.	Joseph Krentzman and Son, Inc.; C.I.T. Corp.; Alabama Bankruptcy Court	115	$136,465	$1,187	ac.	PCBs & heavy metals (primarily Pb) in soil and water
Industrial site with streams and wetlands	PA: Adams Co., Fred Shealer Property	Hunterstown Road	several local corporations	3	$3,000	$1,000	ac.	VOCs in surface & ground water; heavy metals and asbestos in soil
Industrial site; peregrine falcons nest near site	PA: Philadelphia Co., Southeast Philadelphia	Publicker Industries	Bruga Corp.; AAA Warehousing, Inc.; Publicker Industries; Cuyahoga Wrecking/ Overland Corp.	40	$547,000	$13,675	ac.	toxic, flammable, & reactive gases; PCBs; VOCs; asbestos
Ocean floor	CA: offshore Los Angeles Co.	"Montrose" Offshore Los Angeles County	10 industrial companies	?	$42,200,000	?	ac.	DDT & PCBs in soil & sediments
River (fish spawning & rearing habitat)	OR: North Fork of John Day River; north-central OR	John Day River	Thatcher Trucking Co.	?	$275,000	?	mi.	hydrochloric acid
River (trout fishery)	CA: Sacramento River near Dunsmuir	Cantara Loop	?	42	$14,000,000	$333,333	mi.	herbicide metam sodium
Stream (salmon rearing habitat)	ID: Panther Creek Water-shed; Salmon Nat'l Forest	Blackbird Mine	PRPs associated with Haynes Stellite Adit	37	$4,700,000	$127,027	mi.	Au, Cu, & Co in streams
Wetland & upland[c]	MA: Massachusetts Military Reservation	Massachusetts Military Reservation[d]	National Guard Bureau	3,900	$500,000	$128	ac.	VOCs: TCA, TCE, & dichloroethylene
Wetland (forested)	MA: Dartmouth	Bristol County Board of Corrections[d]	Commonwealth of MA & Dimeo Construction Co.	11.5	$150,000	$13,043	ac.	wetland filled in for construction
Wetland (forested)	MN: north of Bemidji	Kummer Sanitary Landfill	Kummer Sanitary Landfill	6.7	$22,000	$3,284	ac.	chlorinated organics

Table C-1. (continued)

Habitat	Location	Site Title	Potentially Responsible Parties (PRPs)	Area Affected	$ Settlement	$/Unit	Unit	COCs[e]
Wetland (prairie)	IN: Laporte Co.	Fisher-Calco Chemical Superfund Site	Fisher-Calco Chemical Company and Solvents Corp.	8	$16,000	$2,000	ac.	Bleach, sulfur dioxide, chloride, ammonia, VOCs, & PCBs
Wetland (river)	DE: 1.3 mi. NW of Cheswold	Cokers Sanitation Service Landfills	Cokers Sanitation Service	25	$80,000	$3,200	ac.	acrolein, ethylbenzene, & Zn from latex sludge
Wetland (saline to brackish marsh)	TX: Harris Co.	French Limited	French Limited Task Group	25	$60,000	$2,400	ac.	PCBs & heavy metals in groundwater & subsoil
Wetland (saline)	NY: Nassau Co.; peninsula off Long Island Sound	Applied Environmental Services Site	Shore Realty	?	$50,000	?	ac.	PCBs & VOC (toluene)
Wetland (saline, intertidal)	TX: Pasadena; Cotton Patch Bayou	Mobil Mining and Minerals	Mobil Oil Corporation	17	$67,022	$3,942	ac.	acidic process water from fertilizer plant
Wetland (stream) & reservoir	IN: Finley Creek Watershed & Eagle Creek Reservoir, Boone Co.	Envirochem, Sanitary Landfill, & Asphalt Sites	Envirochem Corp., Northside Sanitary Landfill, Inc., Great Lakes Asphalt	?	$80,730	?	mi.	VOCs, PCBs, & metals
Wetland (stream)[b]	DE: New Castle Co.;Army Creek tributary to Delaware River	Army Creek Landfill	New Castle County	225	$600,000	$2,667	mi.	landfill leachate
Wetland (stream, freshwater)	TX: Pasadena; Cotton Patch Bayou	Mobil Mining and Minerals	Mobil Oil Corporation	16	$63,080	$3,943	ac.	acidic process water from fertilizer plant

(a) Includes vegetated shallows, mudflats, tidal marshes and creeks, off-channel sloughs and lagoons, naturalized stream channels, and adjacent upland buffer areas
(b) Also includes 60 ac. uplands and 1.5 mi. stream habitat
(c) Percent upland versus wetland not stated
(d) From EPA (1955) Enforcement Report
(e) COC = contaminants of concern
(f) Acreage listed is area where material was dumped, not the area contaminated, which may be larger

Appendix D

References

Appendix D
References

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