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Preliminary Evaluation of the Risk of Accidental Spills of Hazardous Materials in Illinois Waterways

Misganaw Demissie
Laura Keefer

Illinois State Water Survey

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Illinois State Water Survey

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Illinois Department of
Energy and Natural Resources

PRELIMINARY EVALUATION OF THE RISK OF ACCIDENTAL SPILLS OF HAZARDOUS MATERIALS IN ILLINOIS WATERWAYS

by

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ABSTRACT

Accidental spills of hazardous materials from various sources into navigable waterways are a major concern because of their frequency in the United States in recent years. Illinois is highly dependent on waterborne commerce, and barge shipments in Illinois account for about 15 percent of the total U.S. barge shipments on inland and intracoastal waterways. Associated with large volumes of waterborne commerce is the risk of accidental spills of hazardous materials into the waterways. The major considerations concerning such spills are likely to be in the areas of waterway ecology and public water supply. This report discusses the historical frequency of accidental spills in Illinois waterways and identifies facilities that store, load, and unload hazardous materials. Information and data gathered from different agencies were processed, checked, and organized into datafiles on facilities and terminals, spills, and water withdrawal points. These datafiles have been incorporated into one database to provide information at the time of future accidental spills and to aid in assessing the potential impacts of accidental spills in the state.

Analysis of the facilities and terminals data shows that there are 418 facilities and terminals in Illinois that load and unload hazardous materials along the navigable waterways. Sixty percent of these facilities are located on the Illinois Waterway. Analysis of the spills data shows that 794 accidental spills of hazardous materials were reported on Illinois waterways from 1974 to early 1989. Even though the largest number of spills occurred on the Mississippi River, the Illinois Waterway has the highest ratio of spills to navigable river miles. The Illinois Waterway in northeastern Illinois and the Mississippi River in the St. Louis - East St. Louis area are the two areas with the highest historical frequency of accidental spills of hazardous materials. Analysis of the water withdrawal data shows that there are 37 water withdrawal points for public water supply on navigable waterways in Illinois. Most of these withdrawal points are located in Lake Michigan and on the Mississippi River. Peoria Water Company, serving Peoria, is the only public water supply system that withdraws water from the Illinois River. Lake Michigan and the Mississippi River are the most important waterways in terms of water supply, and a major spill could disrupt water supply in these waterways for an extended time.

The results of this project illustrate the importance of reconciling, analyzing, and integrating the various data from the different agencies as was done in this project. The investigators recommend that the central computer data system created as a result of this project be maintained, updated, and improved. This system should be made available to all local, state, and federal agencies that prepare for and respond to accidental spills. A standardized reporting protocol should be developed for locations and quantities of materials stored, transported, and spilled. The possibility of expanding the database to include spills and facilities in upstream states and in non-navigable rivers and streams should be explored. The development of a pollutant transport model, and its integration into the present database and the Illinois Geographic Information System (IGIS), will make it possible to track spills as they move downstream and also to identify the sources of spills of unknown origin. The investigators further recommend the establishment of an inter-agency task force to deal with future accidental spills of hazardous materials into Illinois waterways.

EXECUTIVE SUMMARY

Accidental spills of hazardous materials into navigable waterways are a major concern because of their frequency in the United States in recent years. Hazardous material is defined under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §101(14) as any element, compound, mixture, solution, or substance which, when released, may present substantial danger to the public or the environment.

Illinois has access to 1,116 miles of inland waterway that can handle commercial barge traffic with up to 9 feet of draft. The state also has deep-water port facilities at Lake Michigan that can handle ocean-going vessels. The Upper Mississippi River, the Illinois Waterway, and the Ohio River are among the major inland waterway systems that service the state. Because of the access to this relatively inexpensive waterway transport and the locations of the major population centers in the state, waterborne commerce is very significant and important in the state. Barge shipments in Illinois account for about 15 percent of the total U.S. barge shipments on inland and intracoastal waterways. Associated with this relatively large percentage of waterborne traffic for a single state is the potential for accidents in the waterways and at the facilities used to load, unload, and transfer commodities. The initial step in preparing for, responding to, and preventing accidental spills of hazardous materials into the waterways is to build databases necessary to identify the nature of past accidents, potential locations of future accidents, and resources that might be significantly impacted.

This report is based on analyses of facilities and terminals that handle hazardous materials along Illinois waterways, the historical frequency of accidental spills of hazardous materials, and locations of water withdrawal points along Illinois waterways. Relevant information and data gathered from different agencies were organized into datafiles on facilities and terminals, spills, and water withdrawal points. These datafiles have been incorporated into one working database where all the data can be accessed, examined, and analyzed to provide information at the time of future accidental spills and to aid in assessing the potential impacts of accidental spills in the state.

Analysis of the FACILITIES AND TERMINALS datafile shows that there are 418 facilities and terminals in Illinois that load and unload hazardous materials along the navigable waterways. Of these facilities, 256 (60 percent of the total) are located along the Illinois Waterway. Of the remaining facilities, 138 (33 percent of the total) are located along the Mississippi River. More than half of the facilities on the Illinois Waterway (133 out of 256) are located in northeastern Illinois.

Analysis of the SPILLS datafile shows that 794 accidental spills of hazardous materials were reported on Illinois waterways from 1974 to early 1989. Of these spills, 359 (45 percent) occurred in the Illinois Waterway and 371 (47 percent) occurred in the Mississippi River. Northeastern Illinois accounts for 70 percent of the total spills on the Illinois Waterway (248 of 359 spills) and 31 percent of all the spills in the state (248 of 794 spills). Even though the largest number of spills occurred on the

Mississippi River, the Illinois Waterway has the highest ratio of spills to navigable river miles. The Illinois Waterway in northeastern Illinois and the Mississippi River in the St. Louis - East St. Louis area are the two regions with the highest historical frequency of accidental spills of hazardous materials. Each region accounts for one-third of the spills in the state (northeastern Illinois had 248 spills and St. Louis - East St. Louis had 246).

One of the major concerns about accidental spills of hazardous materials into waterways is their impact on public water supply systems. If an accidental spill of hazardous materials occurs in any of the waterways, the water intakes downstream may be affected, as was the case after an oil spill in the Monongahela River in January 1988. Oil subsequently flowed down the Ohio River, necessitating the closure of intakes. Also a fertilizer spill on the Illinois River in January 1988 forced Peoria to close its intake for several weeks.

Analysis of the WATER WITHDRAWAL datafile shows that there are 37 water withdrawal points for public water supply on navigable waterways in Illinois. Most of these withdrawal points are located in Lake Michigan (17 intakes) and on the Mississippi River (12 intakes). Four water withdrawal points are located on the Ohio River, two on the Kaskaskia navigation canal, and one each on the Illinois Waterway and Wabash River. Peoria Water Company, serving Peoria, is the only public water supply system that withdraws water from the Illinois River. Accidental spills in Lake Michigan and the Mississippi River could have the greatest impact on public water supplies in the state.

After all the different tasks required for this project had been performed, it was very clear that the type of work done for this project is greatly needed. Even though a great deal of information and data are available from different agencies, little attempt has been made to reconcile, analyze, and integrate data from the different data sources. The data from different agencies were not consistent with regard to locations and quantities of spills, there was very little duplication of spills reported between agencies, and the data were not always easily accessible. Data on facilities and terminals, spills, and water withdrawals were not available from any one source. All of this information has been incorporated into one database and is now easily accessible as a result of this project.

The investigators recommend that the central computer database created as a result of this project be maintained, updated, and improved. This system should be made available and easily accessible to all local, state, and federal agencies that prepare for and respond to accidental spills. A standardized reporting protocol should be developed for locations and quantities of materials stored, transported, and spilled. The investigators further recommend the possible expansion of the database to include spills and facilities in upstream states and in non-navigable rivers and streams. The development of a pollutant transport model, and its integration into the present database and the Illinois Geographic Information System (IGIS), will make it possible to track spills as they move downstream and also to identify the sources of spills of unknown origin. Finally the investigators recommend the establishment of an inter-agency task force consisting of local, state, and federal agencies to deal more efficiently

with future accidental spills of hazardous materials in Illinois waterways. Among the major problems at the time of accidental spills of hazardous materials are the lack of accurate and reliable information and the uncertainty about where to get information. The establishment of an inter-agency task force will streamline the flow of information and reduce confusion during periods of crisis.

CHAPTER 1. INTRODUCTION

Accidental spills of hazardous materials into the nation's waterways are becoming major environmental concerns not only because of the effects of hazardous materials in the environment but because of the increased frequency and magnitude of major accidental spills in recent years. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Federal Water Pollution Control Act, Resource Conservation and Recovery Act (RCRA), Clean Air Act, and Toxic Substances Control Act all have specific hazardous materials under their jurisdiction. A generally accepted definition of a hazardous material is found under CERCLA § 101(14) as any element, compound, mixture, solution, or substance which, when released to the environment, may present substantial danger to the public or environment (ENSR and Sidley & Austin, 1987). For instance, the rupture of the Ashland Petroleum Company storage tank in Jefferson Borough, Pennsylvania, on January 2, 1988, spilled about 3,850,000 gallons of oil into the Monongahela River, a tributary of the Ohio River (Subcommittee on Environmental Protection, 1988). Four major oil spills have occurred since then in the United States alone. These spills included the worst-ever oil spill in the United States, which occurred when the oil tanker Exxon Valdez ran aground in Alaska on March 24, 1989, spilling 11 million gallons of crude oil along Alaska's coastline. The oil spill spread over an area greater than 50 square miles and affected hundreds of miles of ecologically and economically valuable shoreline.

Within three months of the Exxon Valdez accident, three more major accidents involving oil took place within a period of two days. The first one was in Rhode Island, where a Greek tanker ran aground and spilled an estimated 420,000 gallons of heating oil into Narragansett Bay on June 23, 1989. On the same day, a tow pushing three barges loaded with heavy crude oil collided with a cargo ship, resulting in a rupture in one of the barges that spilled an estimated 250,000 gallons of heavy crude oil in the Houston Ship Channel at Galveston Bay, Texas. The next day, on June 24, 1989, a Uruguayan oil tanker ran aground near Claymount, Delaware, spilling about 307,000 gallons of fuel oil into the Delaware River. All these major spills into the nation's inland and coastal waterways received national media coverage and showed the risk posed to the environment by the transport and storage of hazardous materials.

In Illinois, recent spills of hazardous materials occurred in the Illinois River on January 7, 1984, and January 3, 1988. The January 1984 spill was a pipeline break at Chillicothe, which leaked 600 barrels of crude oil. Oil traveled at least 20 miles downstream to Peoria. The January 1988 spill leaked 622,426 gallons of fertilizer into the river from a broken pipe on a storage tank near Seneca. This spill travelled over 80 miles downstream to Peoria, forcing a water intake shutdown in Peoria for several weeks (Butts, 1988). Such spills do not get national media coverage but are still significant.

The Office of Technology Assessment of the United States Congress (1986b) estimated that more than 1.5 billion tons of hazardous materials were transported nationwide in 1982 by all modes of transportation. All these hazardous materials are also stored before and after transport. In most cases the storage, transport, and transfer of these materials are handled safely. However, accidents do happen, and

when they do their impacts can be significant. Even though two of the spills, the spill into the Monongahela River and the January 1988 spill into the Illinois River, only potentially threatened the residents and resources of Illinois, there is a need for better understanding of past spills. This understanding will further assist the state to be better prepared to deal with and evaluate the impacts of future accidental spills.

The state of Illinois has access to 1,116 miles of inland waterway (Wolf, 1987) that can handle commercial barge traffic with up to 9 feet of draft. Commercially navigable waterways in Illinois include the Illinois Waterway, Illinois River, Des Plaines River, Cal-Sag Channel, Chicago Sanitary and Ship Canal, Chicago River, Calumet Harbor, Calumet River, Little Calumet River, Lake Calumet, Mississippi River, Ohio River, and the Great Lakes/St. Lawrence Seaway System. The state has deep-water port facilities at Lake Michigan that can handle ocean-going vessels. Because of the access to this relatively inexpensive waterway transport and the location of the major population centers in the state, waterborne commerce is very significant and important in the state. Barge shipments in Illinois account for about 15 percent of the total U.S. barge shipments on inland and intracoastal waterways (IDOT, 1987). Associated with this relatively large percentage of waterborne traffic for a single state is the potential for accidents in the waterways and at the facilities used to load, unload, and transfer commodities. The initial step in becoming prepared to handle any accidental spill of hazardous materials into the waterways is to build databases necessary to identify the nature of past accidents, potential locations of accidents, and resources that might be significantly impacted.

Scope of Study

This project is an initial attempt by the Illinois State Water Survey and the Hazardous Waste Research and Information Center to evaluate the historical frequency of accidental spills of hazardous materials in Illinois waterways. Realizing that there might be some problems related to the quantity and quality of available data on the subject, which at the time of proposal preparation were not known, the principal investigators attempted to limit the scope of the project to a manageable area. This project was therefore designed to deal only with accidental spills of hazardous material into navigation-related waterways, including spills at facilities along navigable waterways that are used for loading, unloading, transferring, and storing hazardous materials transported by waterborne traffic. However, because of the difficulty of precisely identifying the sources of accidental spills, the project has included all accidental spills from all sources into navigable waterways. Even with this limitation, the proposal underestimated the difficulty and the time involved in obtaining data from different sources and then checking and verifying the data for completeness, accuracy, and compatibility with other data.

Two major areas of investigation closely related to this project that are not covered within its scope relate to accidental spills into non-navigable streams and rivers, and permitted releases of hazardous materials into navigable and non-navigable streams and rivers. Accidental spills do not take place only in navigable waterways. They happen on highways, at railroad tracks and yards, at industrial

facilities, and at storage facilities away from navigable waterways (OTA, 1986a). In many cases these spills are accidentally or intentionally washed into streams and rivers. Illinois has 14,960 miles of stream and river channels (13,200 interior river miles and 1,760 border river miles) (IEPA, 1988a), as well as thousands of miles of highways and railroad tracks crisscrossing the state. A database needs to be developed on all accidental spills of hazardous materials within the state, no matter where they happen. It would have been unrealistic to include such a task within the scope of this project under its time and funding limitations.

The second major area is related to permitted releases into water bodies. Federal and state permits allow regulated discharges of hazardous materials into the streams and rivers of the state. Even though the permits regulate these releases, it is important to inventory the amount, type, and locations of the releases. This is being done under state and federal regulations under the Superfund Amendments and Reauthorization Act of 1986 (SARA, Title III). The U.S. Environmental Protection Agency (USEPA) and state EPAs have created a database called the Toxic Release Inventory (TRI) for 1987. The results of the initial analysis show that U.S. industry released 22.5 billion pounds of toxic materials into the environment. This breaks down to 9.7 billion pounds into streams and water bodies, 2.7 into the air, 2.4 into landfills, 3.2 injected deep into the ground, 1.9 into municipal wastewater treatment plants, and 2.6 sent to off-site treatment and disposal facilities.

The Illinois Environmental Protection Agency (IEPA) (1989) reports approximately 439 million pounds of toxic releases into the environment in Illinois in 1987. This amount included 217 million pounds released to water; 130 million pounds to land, underground injection, and off-site facilities; and 92 million pounds to air.

It should be realized, however, that Illinois navigable waterways are at greater risk for spills of hazardous materials than are other streams and rivers because of the relatively large percentage of hazardous materials that are transported, transferred, and stored along these waterways. Therefore even though the database and the analysis need to be expanded eventually to include all accidental spills into all streams and rivers in the state, it is appropriate to start with the navigable waterways since they are high-risk locations.

CHAPTER 2. WATERWAY SYSTEMS IN ILLINOIS

Waterborne commerce is very significant and important in Illinois. Illinois has access to 1,116 miles of the nation's 7,000-mile inland waterway system, in addition to its access to the Great Lakes and St. Lawrence Seaway system through Lake Michigan at Chicago (Wolf, 1987). The navigable waterways in and around Illinois are part of three major waterway systems that are generally managed separately by the federal government. The number of miles on the major navigation systems in the United States that are directly accessible from Illinois is given in table 1.

Table 1. Miles of Major Navigable Waterways
That Are Directly Accessible from Illinois (IDOT, 1988)

Waterway system	*Accessible miles*
Great Lakes and St. Lawrence Seaway system	60
Upper Mississippi River navigation system:	
Mississippi River upstream of the Ohio River	581
Illinois Waterway	365
Kaskaskia navigation canal	36
Ohio River navigation system	134

The locations of different navigation systems in relation to the state of Illinois are shown in figure 1. Identification of those directly accessible from Illinois and knowledge of how they are operated and managed are very important in terms of preparing for and dealing with accidental spills in the waterways.

Great Lakes and St. Lawrence Seaway System

Illinois has access to the Great Lakes and St. Lawrence Seaway system through 60 miles of coastline on Lake Michigan. This system extends more than 3,200 miles from the Atlantic Ocean in the east to its farthest western point at Duluth, Minnesota, on Lake Superior, as shown in figure 2 (IDOT, 1987). Shipments from Illinois travel through Lake Michigan to Lake Huron; then to Lake Erie; and then past the Welland Canal (which has 11 locks at 8 locations to provide a lift of 327 feet) to Lake Ontario. Navigation from Lake Ontario to the St. Lawrence River at Montreal is made possible by seven locks that provide a lift of 226 feet. Navigation past Montreal is in tidal water to the Atlantic Ocean.

Two major harbors in Illinois — Lake Calumet Harbor and Waukegan Harbor — handle cargo from the Great Lakes and the St. Lawrence Seaway system. It should also be mentioned that several harbors in Indiana are very close to the Illinois border, and thus any accident in or near these harbors may impact Illinois.

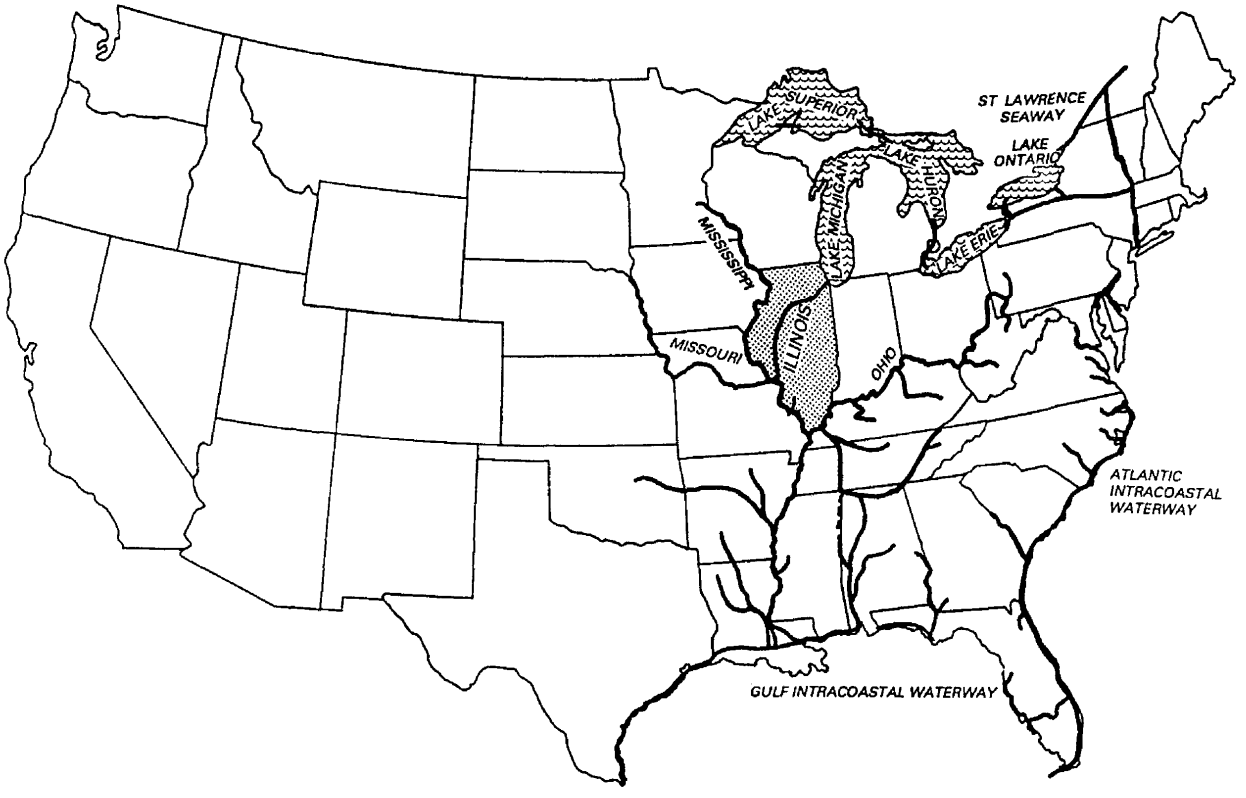


Figure 1. Major navigable waterways that are directly accessible from Illinois (USCOE, 1983)

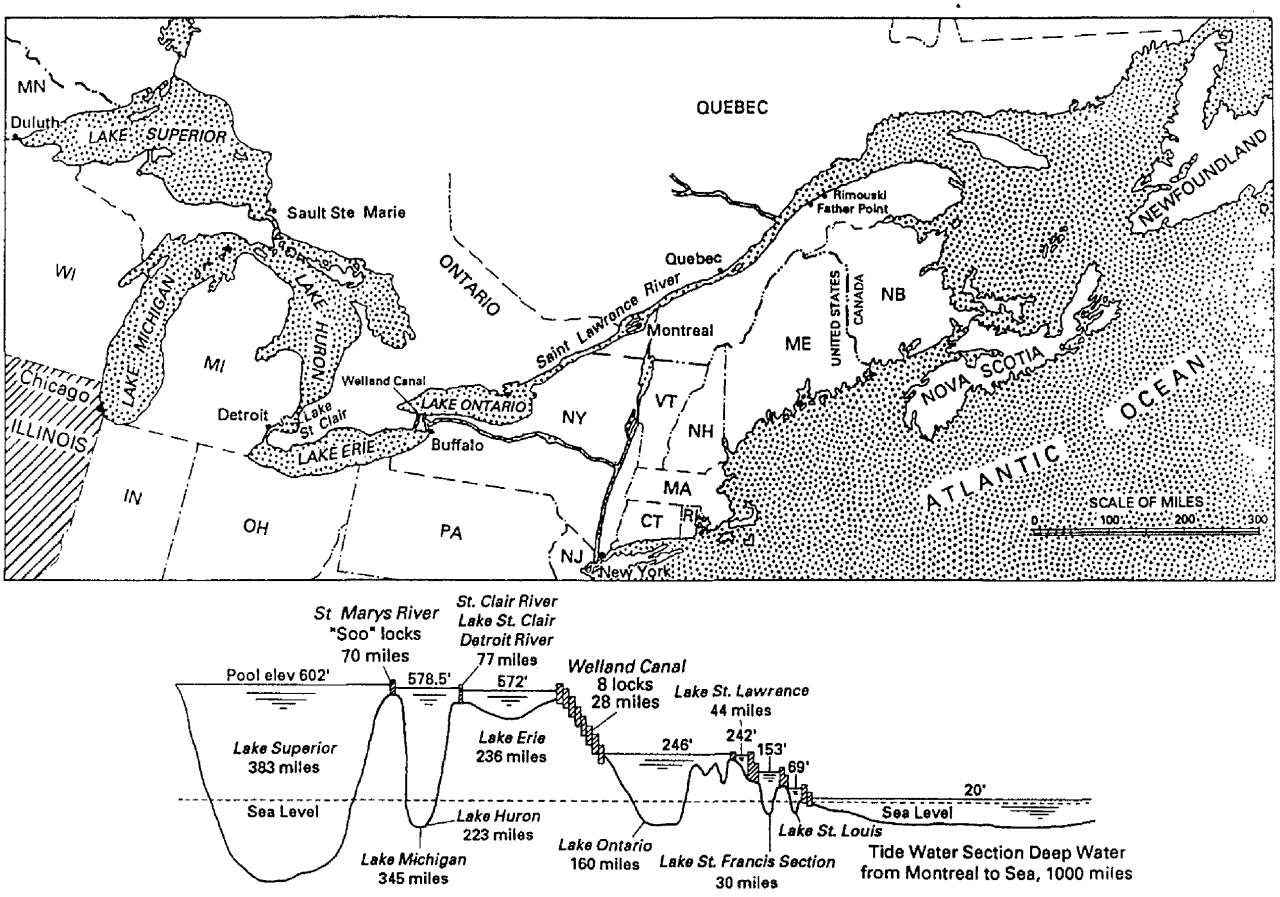


Figure 2. The Great Lakes and St. Lawrence Seaway system (IDOT, 1987)

Upper Mississippi River System

The most significant inland waterway system serving Illinois is the Upper Mississippi River navigation system. This system, which includes all the commercial navigation channels within the Upper Mississippi River System (UMRS), extends from the junction of the Mississippi River with the Ohio River at Cairo, Illinois, to Minneapolis, Minnesota, on the main stem of the Mississippi River (figure 3). It also includes the Illinois Waterway and the Kaskaskia navigation canal in Illinois. As can be seen, Illinois has more access to the Upper Mississippi River navigation system than any other state served by the waterway. Illinois is served by 982 miles of navigable waterway that is part of the Upper Mississippi River system. As given in table 1, this includes 581 miles on the main stem of the Mississippi River, 365 miles on the Illinois Waterway, and the 36-mile Kaskaskia navigation canal.

Navigation in the UMRS is made possible by the construction of a series of locks and dams on the Mississippi River and its tributaries. The purpose of the locks and dams is to maintain an adequate navigation depth during periods of low flow and to make navigation possible in portions of the river that are not naturally navigable as a result of rapids. Construction of the dams creates staircase navigation pools as shown in figure 4, and the locks are used to provide the necessary lifts to move from pool to pool. The Upper Mississippi River has 31 locks located at or near 28 dam sites, of which 15 dam sites with 17 locks are located on that portion of the Mississippi River that forms the Illinois state border. Major Illinois cities and towns located on the Mississippi River include the Quad Cities (Moline, IL; Rock Island, IL; Bettendorf, IA; Davenport, IA), Quincy, Alton, East St. Louis, and Cairo.

The Illinois Waterway is a major part of the Upper Mississippi River. It serves the state of Illinois exclusively and carries more waterborne cargo than the Mississippi River upstream of its junction with the Illinois River. The Illinois Waterway consists of the Illinois River from Grafton to Channahon, the Des Plaines River, the Chicago Sanitary and Ship Canal, the Cal-Sag Channel, and the Calumet River. Eight locks and dams on the Illinois Waterway provide the necessary water depth and lift to make navigation possible from Lake Michigan to the Mississippi River, as shown in figure 5. Most of the locks and dams are located in northeastern Illinois where the natural gradient of the streams is steeper than that of the lower Illinois River. The navigation channel network in the highly populated and congested northeastern part of Illinois is shown in figure 6.

Navigation and waterborne commerce in Illinois have a long history and have played a significant role in the agricultural and industrial development of the state. Most of the major cities of the state are located along these navigable waterways. The greater Chicago metropolitan area, with a population of over 5 million, and the cities of Joliet, Ottawa, LaSalle-Peru, Peoria, Havana, Beardstown, and Grafton are all located along the Illinois Waterway.

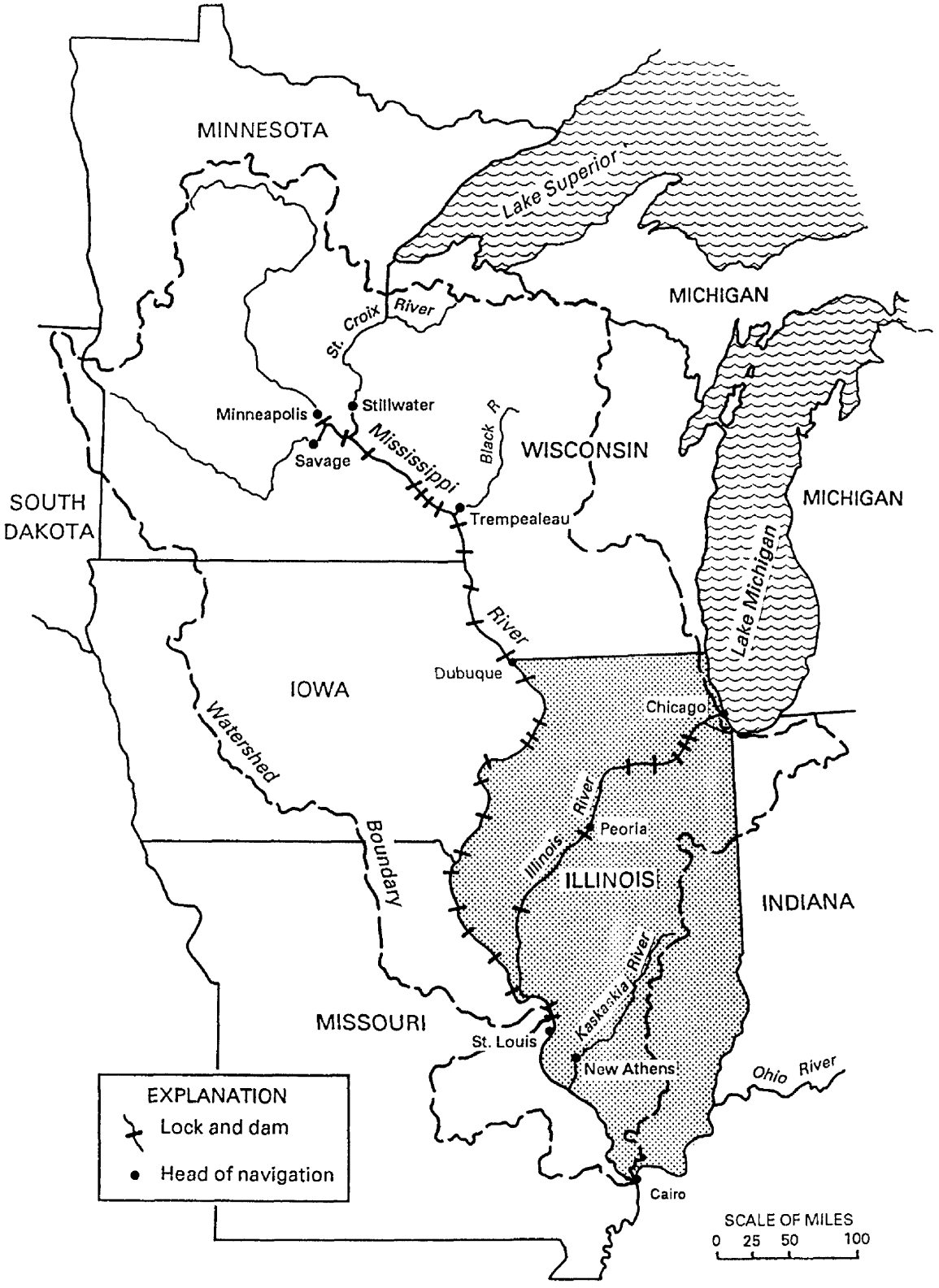


Figure 3. The Upper Mississippi River navigation system (USCOE, 1988)

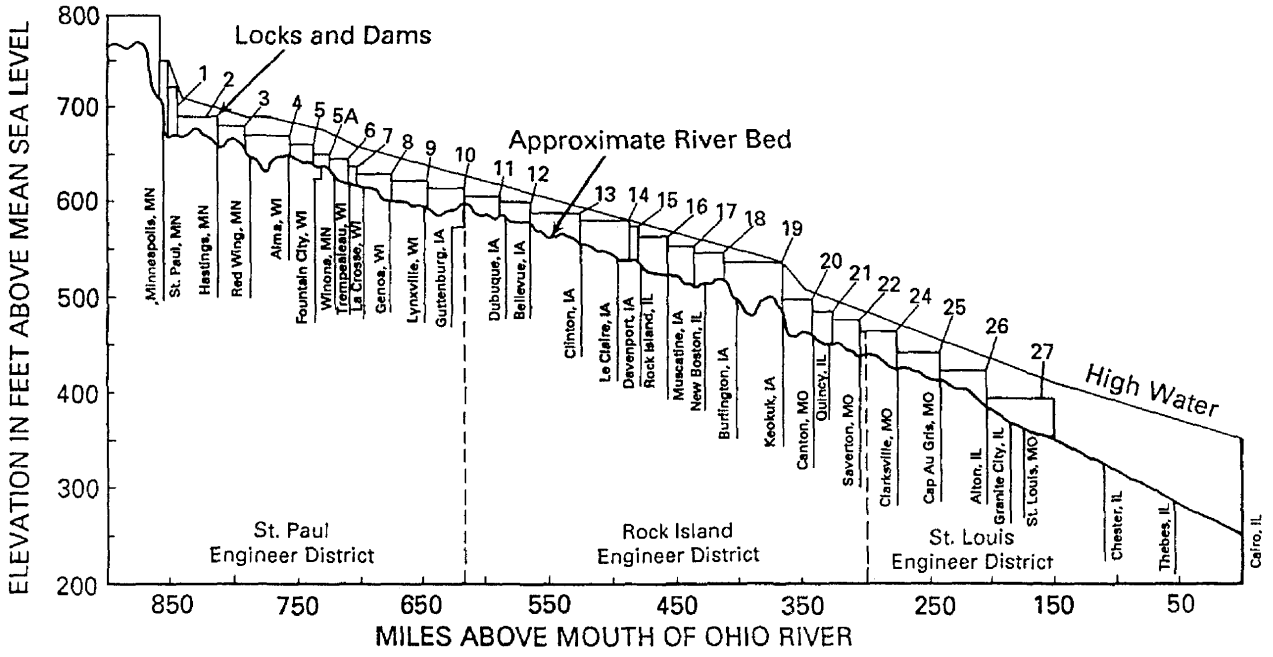


Figure 4. Lock and dam system on the Upper Mississippi River (USCOE, 1988)

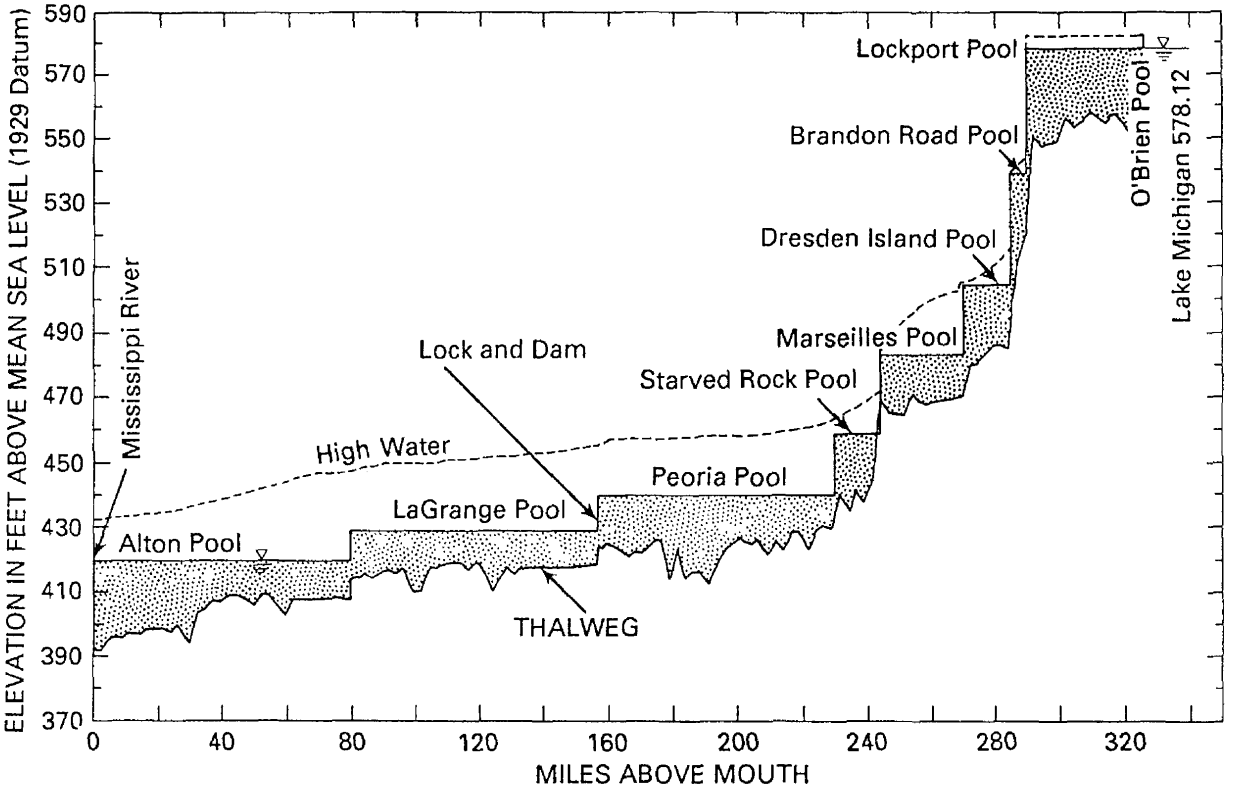


Figure 5. The Illinois Waterway lock and dam system

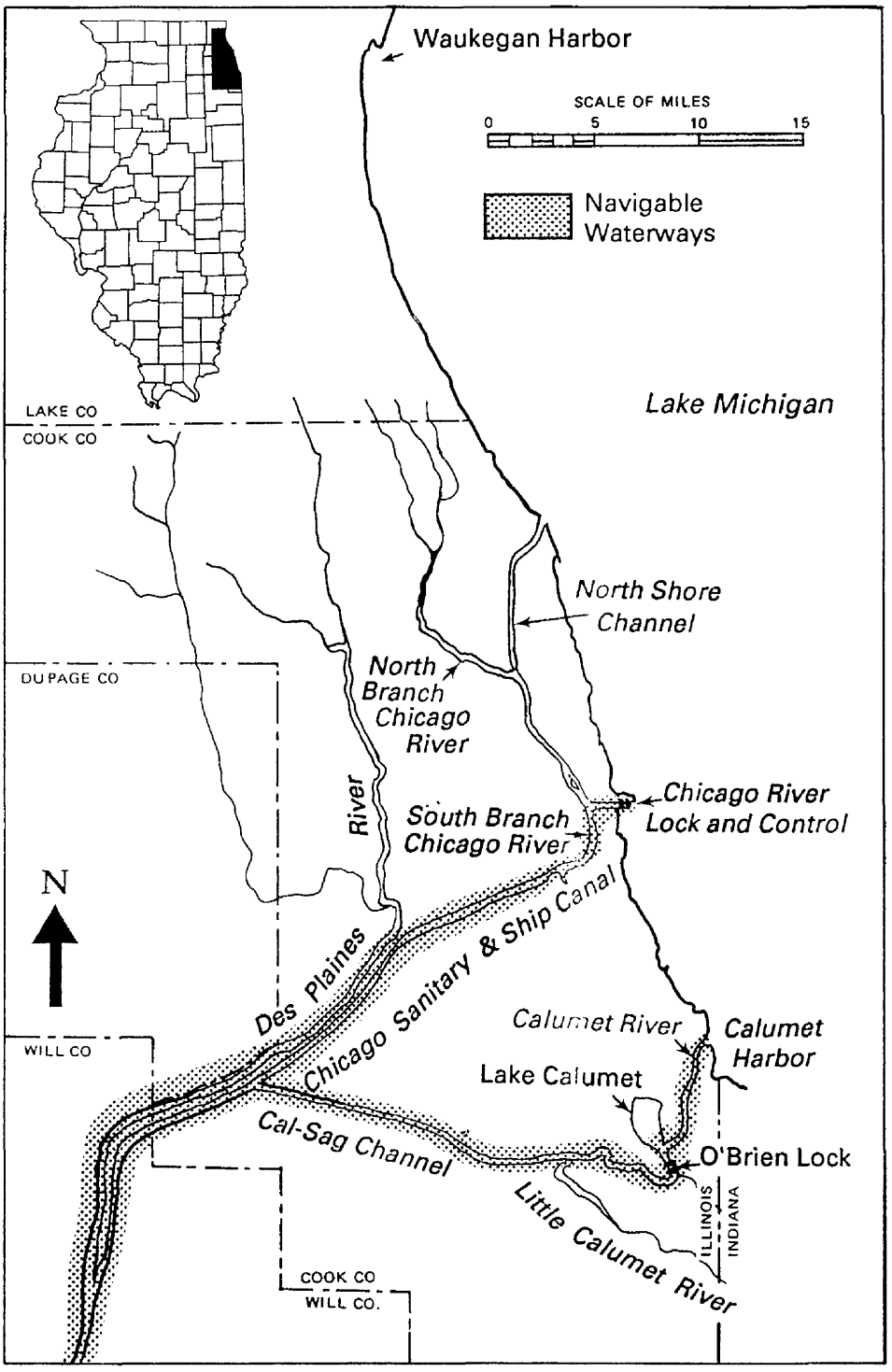


Figure 6. Navigation waterways in northeastern Illinois

The other navigable waterway within the UMRS and Illinois is the Kaskaskia navigation canal, which is controlled by one lock on the Kaskaskia River. The lock makes the lower 36 river miles of the Kaskaskia River accessible to commercial barge traffic. The main commodity transported in the Kaskaskia navigation canal is coal.

Ohio River Navigation System

Even though the Ohio River navigation system is not considered as significant to Illinois commerce as the Upper Mississippi River navigation system, Illinois has access to about 134 river miles of navigable waterway on the Ohio River on its southern border. Several small cities and towns such as Cairo, Mound City, Joppa, and Brookport in Illinois are affected by what happens on the Ohio River. For instance, the impact of the oil spill in the Monongahela River in the Upper Ohio River basin (more than 850 river miles upstream of the Illinois border) caused concern at the Illinois border as water supplies were potentially threatened by the oil slick. Therefore, for this study the Ohio River was included as one of the important waterways serving Illinois.

In many respects, the Ohio River navigation system is similar to the Upper Mississippi River navigation system in that locks and dams are used to create navigation pools along the main stem of the Ohio River and its tributaries. A map of the Ohio River basin and the profile of the main stem of the Ohio River, showing the navigation locks and dams, are presented in figure 7 (Hahn, 1988). Sixty locations in the Ohio River basin have locks and dams for navigation purposes. These include 20 locations on the main stem of the Ohio River, 8 on the Allegheny River in Pennsylvania, 9 on the Monongahela River in Pennsylvania and West Virginia, 3 on the Kanawha River in West Virginia, 4 on the Kentucky River, 2 on the Green River in Kentucky, 4 on the Cumberland River in Kentucky and Tennessee, and 10 on the Tennessee River in Kentucky, Tennessee, and Alabama. All these locks and dams combined create 2,584 miles of navigable waterway in the Ohio River basin (Hahn, 1988).

Illinois Port Districts

Since 1951, 13 port districts have been established in Illinois to engage in planning, developing, operating, and promoting water freight transportation (IDOT, 1989). These port districts are also important local units of government in the planning and implementation of emergency responses for accidental spills. The names of the port districts and their locations on the different waterways are given in table 2.

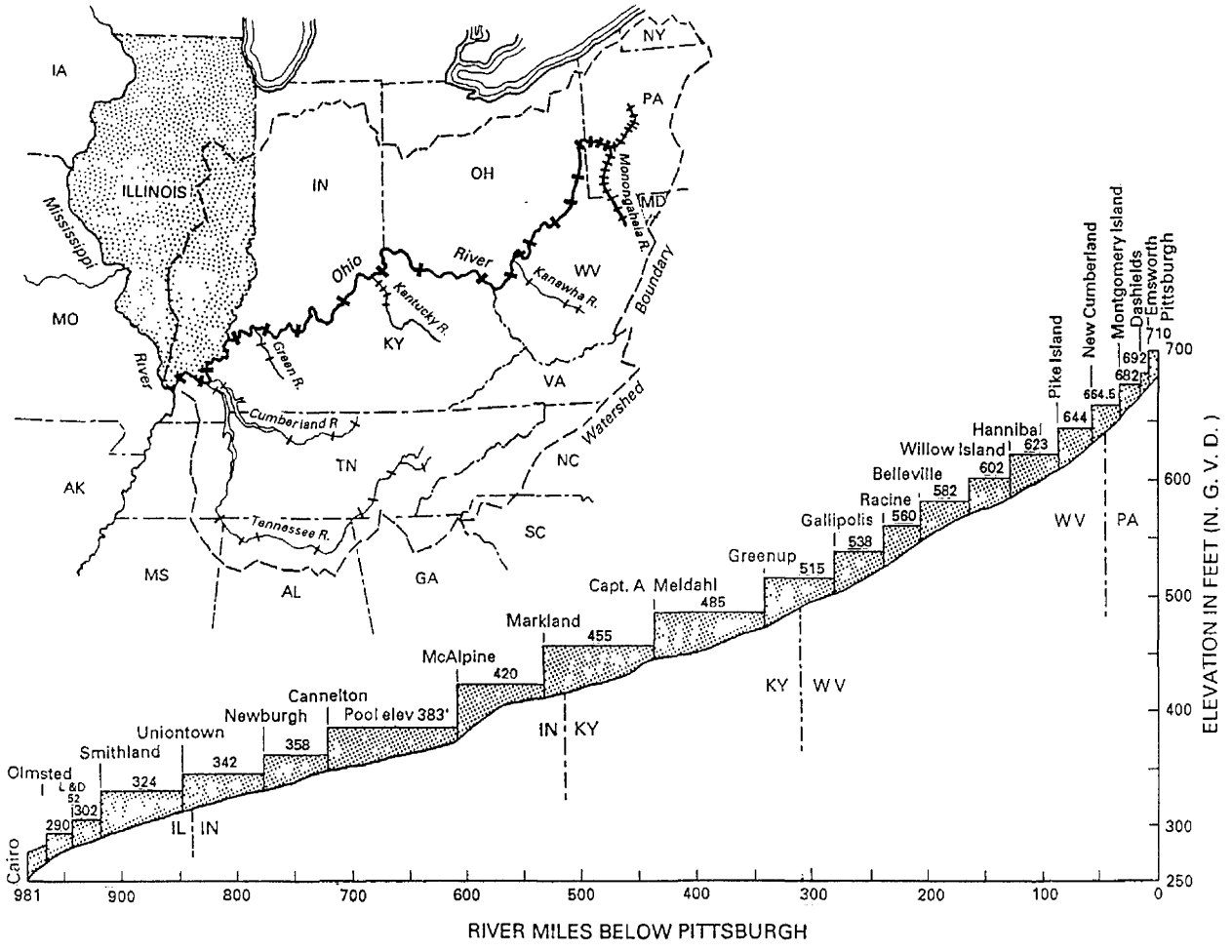


Figure 7. The Ohio River navigation system (Hahn, 1988)

Table 2. Port Districts in Illinois

Waterway	*Port district*
Lake Michigan	Waukegan Illinois International
Illinois River	Joliet Seneca Illinois Valley Havana
Mississippi River	Tri-City Southwest Jackson-Union Counties
Kaskaskia navigation canal	Kaskaskia
Ohio River	Shawneetown
Wabash River	White County Mt. Carmel

CHAPTER 3. COMMODITIES TRANSPORT

Detailed data and analysis regarding transportation of commodities and the amounts transported on the major waterways are available in various publications from the Corps of Engineers and the Illinois Department of Transportation (USCOE, 1981, 1987a, 1987b, 1988, 1989; IDOT, 1987, 1989). We have not tried to reproduce much of the material they have printed, but a brief summary of those data is presented to provide a general idea of the trends in commodity transportation and the important commodities transported.

Illinois plays a large role in barge shipments on inland and intracoastal waterways in the United States. Table 3 shows a comparison of the annual tonnage for Illinois and the United States. Illinois waterways carry an average of about 15 percent of the U.S. barge shipments.

Some of the leading commodities carried on the Illinois waterway systems are grain, coal, petroleum products, and minerals (IDOT, 1989; Soyke, 1987). These bulk products are especially suited to the low-cost, large-volume capability of water transport. The total barge shipments and the shipments of leading commodities in Illinois are shown in figure 8. In recent years, an average of 80 million tons of goods have been shipped by barge on Illinois waterways. According to figure 8, between 1970-1983, grains and coal have been the dominant commodities shipped, at 35 and 25 percent, respectively, of the total Illinois shipments. Petroleum is next at 16 percent, followed by chemicals (6 percent) and metals (2 percent). In Illinois, grain tonnage has steadily increased since the 1970s, while shipments of coal, petroleum, and metals either have been steady or have slightly decreased.

Of all commodity tonnage transported annually on Illinois waterways, the Illinois Waterway carries about 60 percent, the Mississippi about 25 percent, the Ohio about 12 percent, and the Kaskaskia navigation canal 3 percent.

Figures 9 through 12 show the total tonnage for all commodities and for coal, petroleum, and grain in the Mississippi River, Illinois Waterway, Ohio River, and Great Lakes, respectively. Metals were added to figure 12 for the Great Lakes because of their significance. Coal and petroleum are dominant commodities on the Mississippi River, Ohio River, and Great Lakes. Grain is the leading commodity on the Illinois Waterway.

The Mississippi River shows a decline in petroleum transportation from 1974-1983 and an increase in transportation of grains from 1970-1983 (figure 9). The commodities transport on the Illinois Waterway appears to be holding steady (figure 10). Transport on the Ohio River has shown a steady increase in coal and a slight downward trend in petroleum and grain; however, an overall increase in commodities transport has occurred (figure 11). The Great Lakes has experienced a decline in shipments since 1970 (figure 12) as a result of changing economic factors that favor ocean ports rather than the inland ports of the St. Lawrence Seaway. This has resulted in a 60 percent decline from 1970 to 1984 at Illinois lake ports.

Table 3. Illinois Inland Waterway Barge Shipments as a Percent of Total U.S. Barge Shipments on Inland and Intracoastal Waterways, Calendar Years 1970-1983 (IDOT, 1987)
(Thousands of tons)

Year	*Illinois*	*U.S.*	*Illinois % of U.S.*
1970	70297.0	511602.4	13.7
1971	69599.4	521997.1	13.3
1972	82971.4	558658.0	14.9
1973	81123.5	559474.9	14.5
1974	85208.4	556830.3	15.3
1975	90675.1	542326.4	16.7
1976	89997.6	564966.0	15.9
1977	84811.7	567847.9	14.9
1978	78753.3	581602.0	13.5
1979	78918.7	583967.0	13.5
1980	89447.6	583331.9	15.3
1981	80200.7	573516.5	14.0
1982	79267.2	538140.3	14.7
1983	81572.2	530383.8	15.4

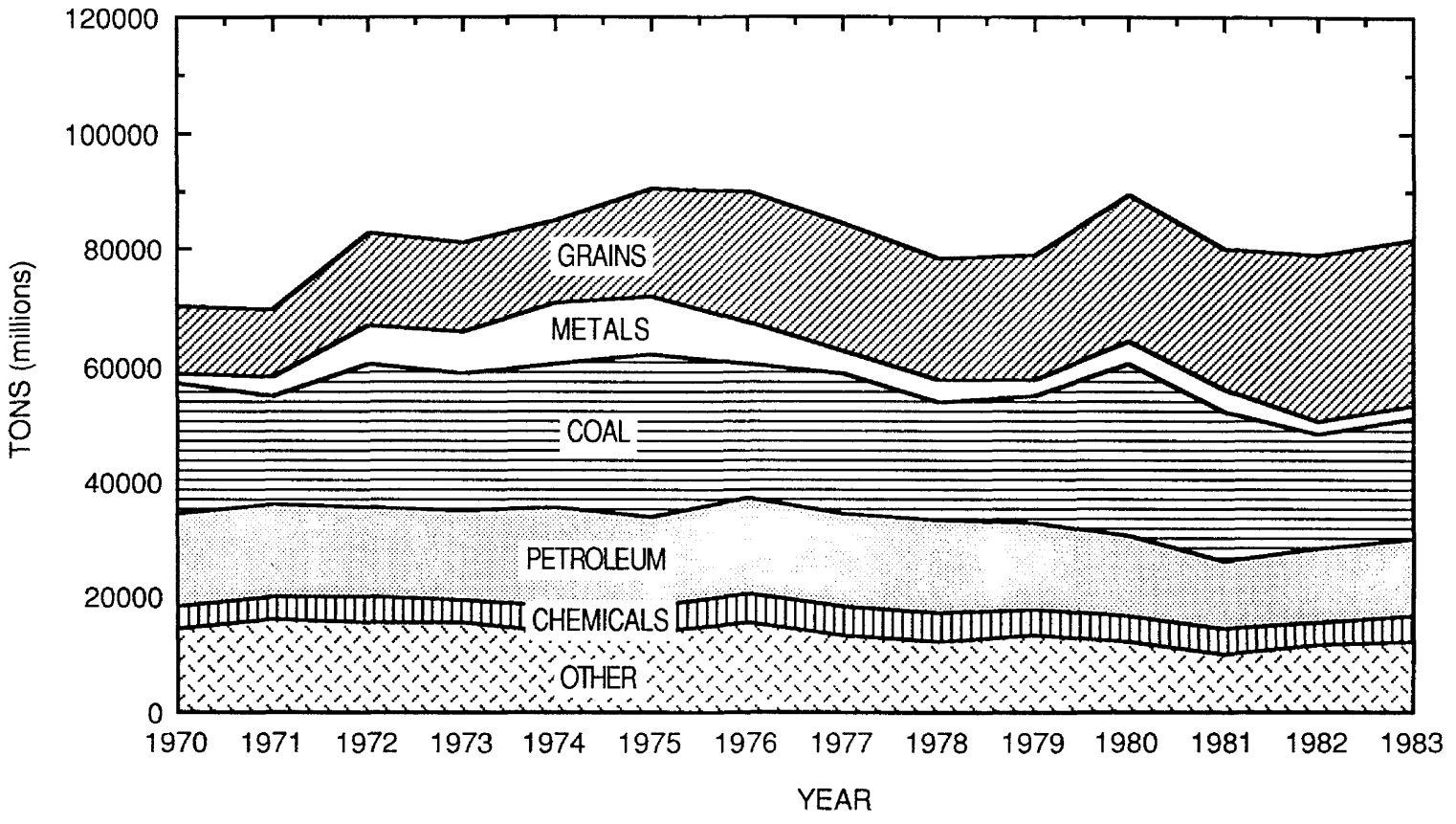


Figure 8. Barge shipments for selected commodities in the state of Illinois

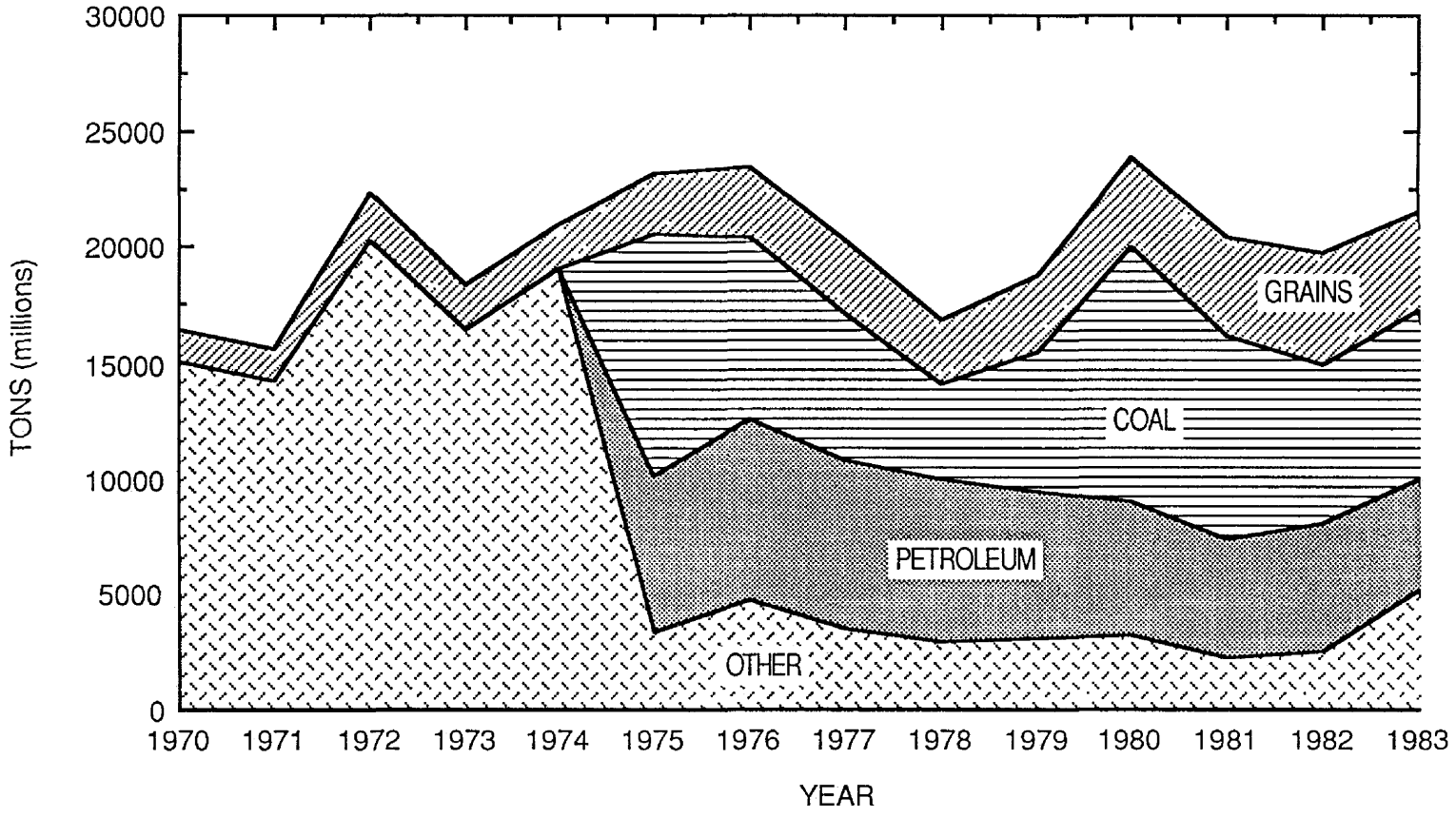


Figure 9. Barge shipments for selected commodities on the Mississippi River

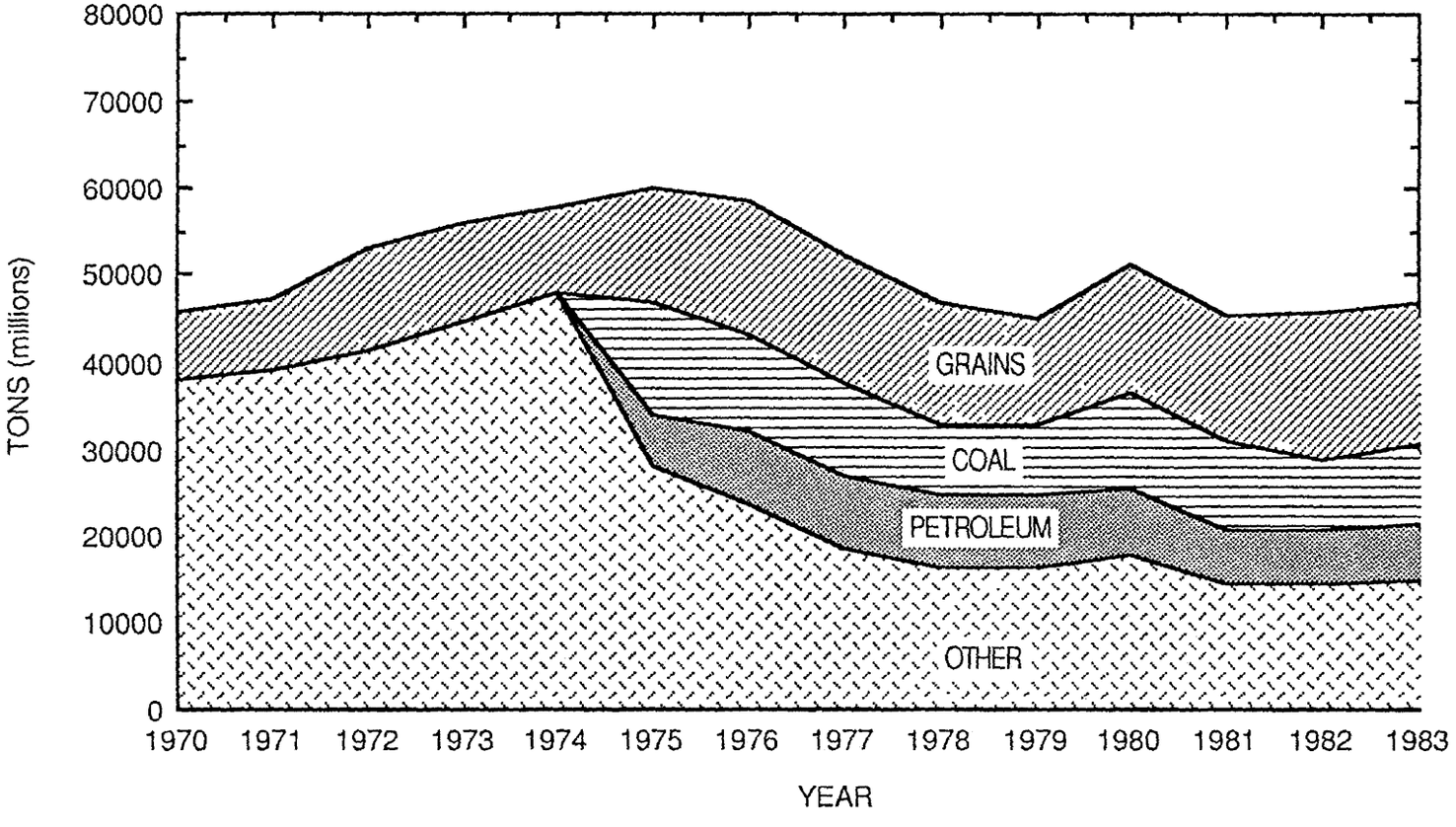


Figure 10. Barge shipments for selected commodities on the Illinois Waterway

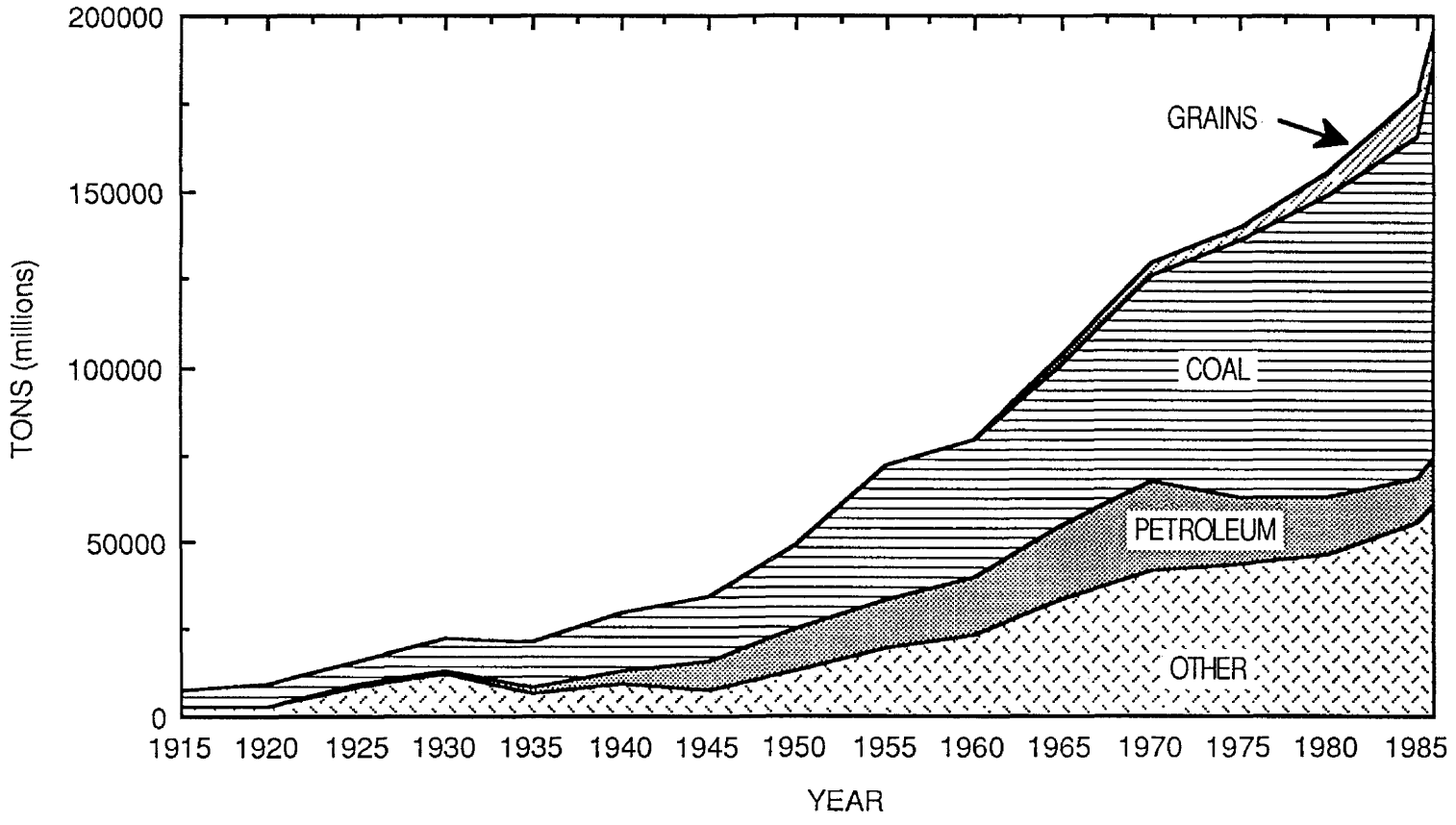


Figure 11. Barge shipments for selected commodities on the Ohio River

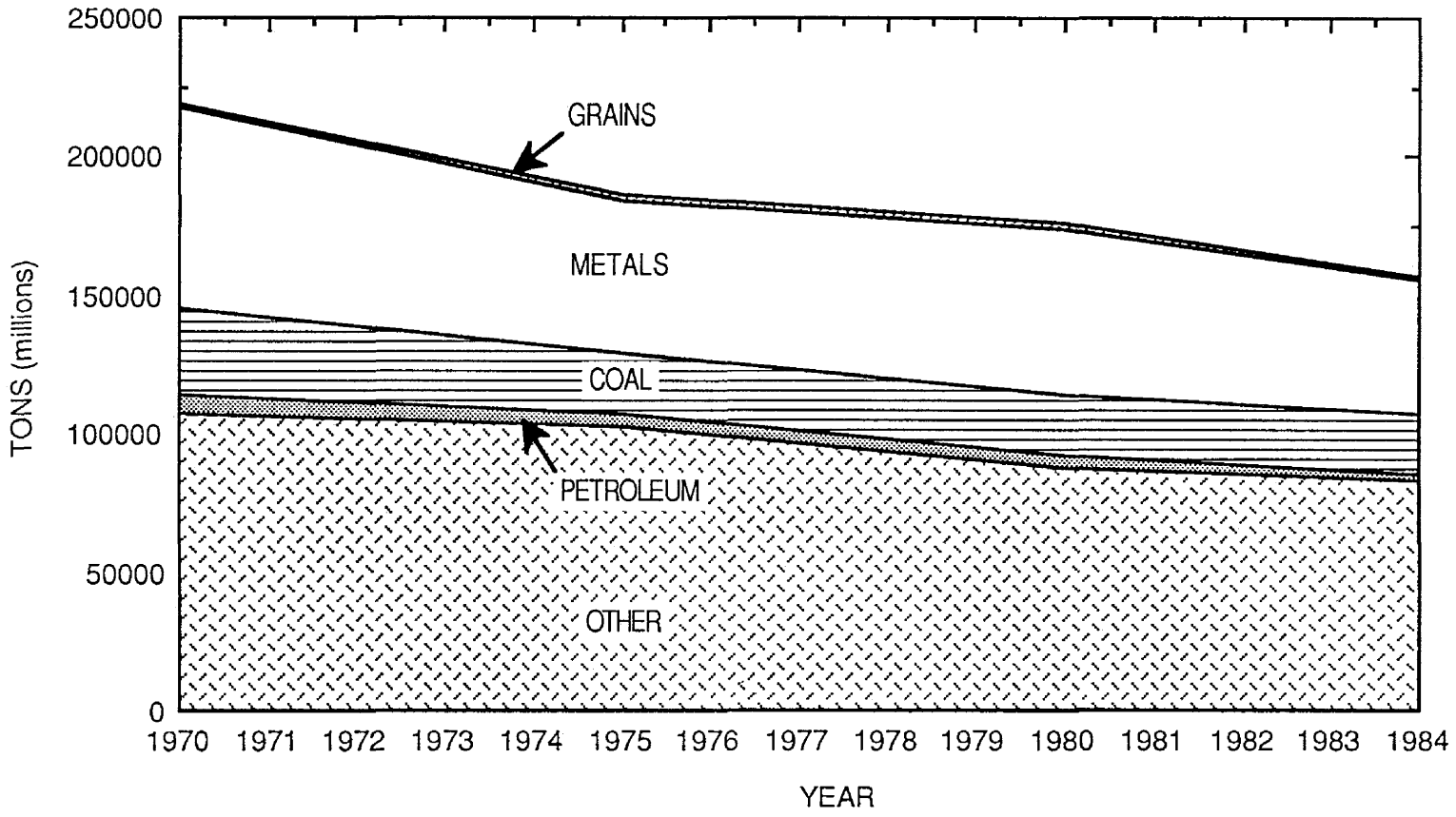


Figure 12. Barge shipments for selected commodities on the Great Lakes

CHAPTER 4. ROLES OF AGENCIES IN EMERGENCY RESPONSES TO ACCIDENTAL SPILLS

This chapter discusses the local, state, and federal agencies that may be involved in cases of accidental spills into navigable waterways in Illinois. Knowledge of this aspect of emergency response during accidental spills will facilitate the exchange of information among different agencies.

When a spill occurs, several steps must be taken when reporting to government officials. The federal agency to be contacted is the National Response Center (NRC) at U.S. Coast Guard (USCG) Headquarters in Washington, DC. They in turn contact the appropriate federal agency offices in the vicinity of the spill, such as the USEPA and USCG. Reporting a spill does not end with the NRC. Illinois also requires notification by the liable party to the Illinois Emergency Services and Disaster Agency (also designated as the State Emergency Response Commission, or SERC) in Springfield, which notifies local emergency planning commissions (LEPC), fire departments, and appropriate state agencies such as the IEPA Emergency Response Unit (IEPA, 1984, 1988b, 1989; IHMAB, 1988). Figure 13 shows the state requirements for telephone notifications of releases. The following sections briefly describe the roles of each of the federal and state agencies involved in responding to accidental spills.

Federal Agencies

Four federal agencies are primarily involved with major accidents in navigable waterways. These agencies are the U.S Army Corps of Engineers (COE), the U.S. Coast Guard (USCG), the U.S. Environmental Protection Agency (USEPA), and the U.S. Department of Transportation (DOT).

U.S. Corps of Engineers (COE)

The COE is the primary federal agency responsible for management, operation, and maintenance of the navigable waterways; however, the other agencies are involved in regulating safety and responding to emergencies. It is not easy to determine which COE District or Division is responsible for which waterway. Therefore a brief discussion of how the navigable waterways in and around Illinois are subdivided among the different Divisions and Districts of the Corps of Engineers is presented here.

The COE is subdivided into major administrative units known as Divisions, which are responsible for different parts of the country. The Divisions are further subdivided into Districts, which are the main offices that manage, operate, and maintain the different waterway systems. Navigable waterways in Illinois are managed by five COE districts within three Divisions: the North Central Division in Chicago, Illinois; the Lower Mississippi Valley Division in Vicksburg, Mississippi; and the Ohio River Division in Cincinnati, Ohio. The five Districts are the Chicago and Rock Island Districts in the North Central Division, the St. Louis and Memphis

Illinois Requirements
for
Telephone Notification
of
Releases

A "Release" is usually defined as "any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping or disposing into the environment" in the various laws and regulations which require immediate or expeditious reporting of releases. Following is a list of the sources of those reporting requirements and a brief description of what is to be reported, how soon and to whom:

Federal

1.CERCLA, Section 103(a) - any release equal to or greater than a reportable quantity of a "hazardous substance" (the CERCLA list) from a vessel or an offshore or onshore facility, immediately to the National Response Center (1-800-424-8802).

2.40 CFR 110.9 - any "discharge" (essentially defined the same as "release") from a facility of oil into navigable waters of the United States immediately to the National Response Center.

3.SARA, Title III, Section 304 - any release equal to or greater than a reportable quantity of a "hazardous substance" (the CERCLA list) or an "extremely hazardous substance" (from SARA, Title III, Section 302 - basically the old "air toxics" list) from a facility, immediately to 1) The "community emergency coordinator" of the "local emergency planning committee" (these are Title III terms which essentially mean the designated person in every county , and in each city which petitions to be a planning district, who coordinates emergency response operations); and 2) the "State emergency response commission" (again a Title III term, which is Illinois Emergency Services and Disaster Agency (IESDA) in this case (1-800-782-7860 or 1-217-782-7860). "Facility" includes vehicles.

State

1.35 Ill. Adm. Code 723.130(c) (Hazardous Waste Regulations) - any "discharge" of a "hazardous waste" (the CERCLA list) by an air, rail, highway or water transporter, (no time frame given) to 1) the National Response Center, and 2) to IESDA.

2.29 Ill. Adm. Code 430.40 and 430.50 (Rules for Telephone Notification of Hazardous Material Incidents IESDA) - Any incident or accident involving the actual or potential release of a "hazardous material" (the CERCLA list), a radioactive material, an etiologic (disease-causing) agent or oil from a facility or equipment, at the earliest practicable moment following discovery of the incident or accident to IESDA.

Figure 13. "Illinois Requirements for Telephone Notification of Releases," Illinois Environmental Protection Agency, Emergency Response Unit, Springfield, Illinois

Districts in the Lower Mississippi Valley Division, and the Louisville District in the Ohio River Division.

The Chicago District deals mainly with Lake Michigan shorelines. The Rock Island District manages the Mississippi River from Lock & Dam 22 to Lock & Dam 10, and the Illinois Waterway from the LaGrange Lock & Dam to the O'Brien Lock & Dam in Chicago. The St. Louis District manages the Mississippi River from Cairo to Lock & Dam 22, the Kaskaskia navigation canal, and the Illinois River up to the LaGrange Lock & Dam. The Louisville District manages the part of the Ohio River that forms the Illinois state boundary.

U.S. Coast Guard (USCG)

The USCG has marine safety offices in Chicago, Illinois; St. Louis, Missouri; and Paducah, Kentucky. The Chicago office deals mainly with the navigation channels in the Chicago area and the Illinois Waterway above river mile 187.3. The St. Louis office covers the upper Mississippi River (river miles 55.3 to 853.0) and the Illinois River (river miles 0.0 to 187.3). The Paducah office deals with the Ohio River (river miles 867.2 to 981.0) and the upper Mississippi River (river miles 0.0 to 55.3).

The U.S. Coast Guard operates the National Response Center (NRC) in Washington, DC. The spill-reporting requirements of CERCLA 103(a) specify that: "A vessel or an offshore/onshore facility, must immediately notify the NRC at U.S. Coast Guard Headquarters in Washington, D.C., when a facility or vessel releases a hazardous substance (other than a federally permitted release) if the release is greater than or equal to the reportable quantity (RQ) for that substance" (ENSR and Sidley & Austin, 1987). The NRC provided their reports of spills in Illinois for use in this study.

U.S. Environmental Protection Agency (USEPA)

Most Illinois waterways are within Region V of USEPA, whose headquarters are in Chicago. Some portions of the Mississippi River, however, are under Region VII, headquartered in Kansas City. In addition to dealing with health and water quality problems that might arise from accidental releases, USEPA has some regulatory power for the transportation and handling of hazardous materials under the Resource Conservation and Recovery Act (RCRA) and the Toxic Substance Control Act (TSCA).

U.S. Department of Transportation (DOT)

The U.S. Department of Transportation "is the lead agency for establishing and enforcing regulations regarding safe transportation of hazardous materials" (OTA, 1986b). The DOT also has the authority to issue regulations pertaining to hazardous material containers, to enforce these regulations, and to collect data on hazardous material shipments.

State Agencies

Three state agencies in Illinois are primarily involved in monitoring and emergency response in cases of accidental spills. They are the Illinois Emergency Services and Disaster Agency (IESDA), Illinois Environmental Protection Agency (IEPA), and Illinois Department of Transportation (IDOT).

Illinois Emergency Services and Disaster Agency (IESDA)

The Illinois Emergency Services and Disaster Agency (IESDA) is the designated state emergency response commission. IESDA operates and receives emergency reports on the 24-hour state hotline. IESDA also develops the state's hazardous materials emergency response plan and state disaster plan and coordinates the resources of other state agencies in times of disaster (IHMAB, 1987).

Illinois Environmental Protection Agency (IEPA)

The Illinois Environmental Protection Agency's (IEPA) Emergency Response Unit (ERU) is a member of the emergency state response team. ERU's responsibilities are "to initiate, coordinate, and manage Agency actions in response to incidents involving immediate chemical hazards to public health or the environment. These incidents involve a sudden and generally unexpected and unintentional release or potential release of a hazardous or toxic material . . ." (IEPA, 1988b). ERU also assesses the environmental damage and coordinates "clean-up" operations (IEPA, 1988b; IHMAB, 1987).

Illinois Department of Transportation (IDOT)

The Illinois Department of Transportation (IDOT) has several responsibilities. It administers the Illinois Hazardous Materials Transportation Act, promulgates transportation regulations, and provides manpower, equipment, and material support to mitigate the effects of spills. The Water Resources Division (WRD) of the Illinois Department of Transportation deals with waterborne transportation in Illinois. The Ports Management Section of the Division has developed the Illinois Waterborne Shipping Database, which was very helpful in this study (IHMAB, 1987).

Other State Agencies

Other state agencies that also cooperate to best handle hazardous material spills are the Illinois Commerce Commission (ICC), Illinois Department of Agriculture (IDOA), Illinois Department of Conservation (IDOC), Illinois Department of Energy and Natural Resources (ENR), Illinois Department of Mines and Minerals (IDMM), Illinois Department of Nuclear Safety (IDNS), Illinois Department of Public Health (IDPH), Illinois Department of State Police (IDSP), Illinois Attorney General's Office (AG), and Illinois Office of the State Fire Marshal (OSFM) (IHMAB, 1987).

CHAPTER 5. FACILITIES AND TERMINALS

Locations for potential accidental spills of hazardous materials in navigable waterways can be classified into two major categories: facilities that load and unload cargo, and the waterway between the loading and unloading facilities. The waterway systems in and around Illinois were discussed previously. The locations and number of facilities that handle hazardous materials are discussed in this chapter. Because of the importance of these facilities in relation to potential accidental spills, a separate datafile, the FACILITIES AND TERMINALS datafile, was created for them. A brief discussion of the datafile and the sources of the data is presented here.

FACILITIES AND TERMINALS Datafile

The term "facilities" is used to describe sites that are used to store, load, and unload waterborne cargo on Illinois navigable waterways. These sites are usually located at shipping terminals; consequently the datafile containing the information on these facilities has been designated the FACILITIES AND TERMINALS datafile. Four different databases with information on these facilities were obtained from four agencies. All four were analyzed and merged into the FACILITIES AND TERMINALS datafile. The four databases are the Directory of Lake and River Terminals in Illinois from IDOT; the IEPA Toxic Chemical Release database (which is compiled under the SARA, Title III mandate); a list of addresses of petroleum facilities in Illinois from the USEPA, Region V; and a facilities database from the U.S. Coast Guard. Brief discussions of each database follow.

IDOT Directory of Lake and River Terminals in Illinois

One of the most important databases to this project was the Directory of Lake and River Terminals in Illinois from the Ports Management Section of the Division of Water Resources, Illinois Department of Transportation (IDOT, 1988). This database was developed by IDOT for waterway development planning. It contains locational information on each facility: name, address, city, state, zip code, county, waterway, and bank (left or right). It also contains data on the types of materials handled, approximate on-site storage capacity, and method of transferring materials to and from barges.

IEPA Toxic Chemical Release Database

This database is the product of federal and state laws created during the last three to four years. The Superfund Amendments and Reauthorization Act of 1986 (SARA, Title III) and Illinois Senate Bill 1498 enable IEPA to collect data and to make data available to the public. Pertinent descriptions are presented below (IEPA, 1988b):

> Title III was designed to develop state and local government's emergency response and preparedness capabilities through coordination and planning. . . .
>
> In 1987, Senate Bill 1498, amending the Illinois Environmental Protection Act, designated IEPA as the agency responsible for administration of certain provisions of Section 313 of Title III. Section 313 requires facilities to submit annual reports identifying release of specified chemicals. Senate Bill 1498 directs IEPA to receive and make these reports available to the public and to develop a computer database as a repository for the information contained in the annual reports.
>
> The Section 313 annual release reports (FORMR) must be submitted . . . by facilities having Standard Industrial Classification (SIC) codes 20-39, having ten or more full-time employees, and which manufacture, import, process or otherwise use in excess of specified threshold amounts of certain individual chemicals and chemical categories listed in the law.
>
> The database will be set up on IEPA's minicomputer and the system will be managed by the Office of Chemical Safety of the IEPA.

Along with the facilities located on navigable waterways, the database includes identification of chemicals present at these facilities and the maximum storage capacity.

USEPA Petroleum Facilities Database

The USEPA database is a list of addresses of petroleum companies in Illinois. The information consists of the company name, address, city, state, county, and zip code. This information was used to confirm address information in the other databases.

USCG Facilities Database

The United States Coast Guard (USCG) is required to inspect facilities along navigable waterways. Therefore the USCG has developed records of each site containing the following information: company name, address, city, state, location along waterway, and fire safety equipment. All this information is available in hard copy only.

Analysis of FACILITIES AND TERMINALS Datafile

One of the main components of this datafile is the IDOT Directory of Lake and River Terminals in Illinois, which contains information on the materials that are

loaded and unloaded at individual terminals. This database groups commodities into 13 major categories. Table 4 shows the number of terminals in this database that handle each commodity group. Many of the terminals handle several commodity groups.

Table 4. Commodity Groups and Number of Terminals That Handle Each Group According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

	Commodity	*Number of terminals*
1.	Grain	90
2.	Petroleum and petroleum products	56
3.	Coal and coke	55
4.	Sand, gravel and rock	46
5.	Iron and steel	38
6.	Dry fertilizer	33
7.	Liquid chemicals, except fertilizers	34
8.	Liquid fertilizer	31
9.	Grain products	29
10.	Salt	18
11.	Dry chemicals, except fertilizers	7
12.	Cement	7
13.	Other cargoes	47

Five of the 13 commodity groups (petroleum and petroleum products, dry fertilizer, liquid chemicals, liquid fertilizer, and dry chemicals) come under the Standard Industrial Classification codes 20-39 and were classified as hazardous materials for the purpose of this project. Tables 5 through 13 show the terminals in the IDOT Directory of Lake and River Terminals that handle these five groups, by waterway.

After all the source databases were merged into the FACILITIES AND TERMINALS datafile, an analysis was made to determine the total number of facilities on navigable waterways and harbors. This number is given in table 14. A large percentage are located along the Illinois River and channels and harbors in northeast Illinois.

Identification of the facilities that handle hazardous materials as defined by this study was especially important in this project. The number of facilities within each waterway and harbor that handle hazardous materials is given in table 15.

Of the 434 facilities in Illinois, 418 handle hazardous materials. Sixty-two percent of these facilities (261 out of 418) are located along the Illinois and Mississippi Rivers. Northeastern Illinois has 133 facilities (32 percent of the total) that handle hazardous materials.

Table 5. Names and Locations of Terminals on the Mississippi River According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	9
Dry fertilizer	12
Liquid chemicals	6
Dry chemicals	3
Petroleum	10

Terminal	*River mile*	*County*
Southern Illinois Sand Co.	107.8	Randolph
Mobil Oil Corp.	176.0	St. Clair
Pillsbury Co.	177.7	St. Clair
Cahokia Marine Service Inc.	178.2	St. Clair
Petroleum Fuel & Terminal Co.	180.0	St. Clair
APC Warehouse Co.	185.7	Madison
APC Warehouse Co.	185.7	Madison
Bulk Service Corp.	186.1	Madison
Petroleum Fuel & Terminal Co.	186.4	Madison
Conoco Inc.	194.9	Madison
Wood River Pipe Line Co.	195.2	Madison
Phoenix Terminal Co.	195.4	Madison
Marathon Pipeline Co.	196.5	Madison
Petroleum Fuel & Terminal Co.	197.2	Madison
Shell Oil Co.	197.3	Madison
Amoco Oil Co.	197.8	Madison
ADM/Growmark	203.9	Madison
Quincy Municipal Barge Terminal	326.0	Adams
Celotex Corp.	326.3	Adams
Phoenix Chemical Co.	385.1	Hancock
Twomey Co.	409.5	Henderson
Rock Island Terminal Corp.	480.8	Rock Island
Westway Trading Corp.	508.6	Rock Island
C.F. Industries Inc.	509.8	Rock Island
Agrico Chemical Co.	519.4	Whiteside
Fulton River Terminal	520.4	Whiteside
Phoenix Chemical Co.	572.9	Jo Daviess
Cargill Inc.	574.4	Jo Daviess

Total number of terminals: 28

Table 6. Names and Locations of Terminals on the Illinois River According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	15
Dry fertilizer	15
Liquid chemicals	8
Dry chemicals	1
Petroleum	12

Terminal	*River mile*	*County*
Cargill Inc.	055.3	Pike
Consolidated Grain & Barge Co.	064.6	Scott
Kaiser-Estech Inc.	069.3	Morgan
Meredosia Terminal Inc.	071.8	Pike
Illinois Power Co.	118.6	Mason
J. D. Streett & Co. Inc.	119.0	Mason
ADM/Growmark	119.2	Mason
C.F. Industries Inc.	145.4	Peoria
C.F. Industries Inc.	146.7	Peoria
Midwest Grain Products of Illinois Inc.	151.4	Tazewell
Shell Oil Co.	152.7	Peoria
Cargo Carriers Inc.	154.0	Peoria
Petroleum Fuel & Terminal Co.	155.0	Peoria
Agrico Chemical Co.	157.3	Tazewell
Amoco Oil Co.	158.1	Tazewell
Hicks Oil & Hicksgas Inc.	158.3	Tazewell
Central Illinois Dock Co.	158.4	Tazewell
ADM/Growmark	160.3	Peoria
Caterpillar Inc.	162.1	Tazewell
Midwest Sand & Gravel Co.	189.7	Marshall
W.R. Grace & Co.	197.6	Marshall
Consolidated Grain & Barge Co.	207.4	Bureau
C.F. Industries Inc.	221.3	La Salle
ST Services	221.4	La Salle
Mertel Gravel Co.	222.0	La Salle
ADM/Tabor Grain Co.	223.2	La Salle
Huntsman Chemical Corp.	223.2	La Salle
Utica Terminal Inc.	228.5	La Salle
Garvey International Inc.	243.3	La Salle
Borg Warner Chemicals Inc.	244.0	La Salle
Kaiser-Estech Inc.	248.7	La Salle
Black Marine Inc.	253.0	La Salle
Shipyard Terminal & Indust. Park Inc.	253.6	La Salle
Seneca Port Operating Co.	253.8	Grundy
Commonwealth Edison Co.	265.8	Grundy
Quantum Chemical Co.	269.9	Grundy

Total number of terminals: 36

Table 7. Names and Locations of Terminals on the Chicago Sanitary & Ship Canal According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	2
Dry fertilizer	1
Liquid chemicals	13
Dry chemicals	0
Petroleum	19

Terminal	*River mile*	*County*
UNOCAL Chemicals Division	296.7	Will
UNOCAL Chicago Refinery	297.5	Will
Tri-Central Marine Terminal	300.4	Cook
Scarpelli Materials Inc.	300.9	Cook
Quantum Chemical Co.	301.0	Cook
K. A. Steel Chemicals Inc.	301.1	Cook
Powell Duffryn Terminals Inc.	303.2	Du Page
Hannah Marine Terminal	303.8	Cook
Rowell Chemical Corp.	305.7	Cook
Ashland Chemical Co.	308.5	Cook
Shell Oil Co.	310.7	Cook
Great Lakes Terminal & Transport Corp.	310.8	Cook
GATX Terminals Corp.	311.6	Cook
Trumbull Asphalt Div.	312.5	Cook
Lake River Corp.	314.1	Cook
Amoco Oil Co.	314.2	Cook
Petroleum Fuel & Terminal Co.	314.5	Cook
Whitewater Petroleum Terminals	316.7	Cook
Koppers Co. Inc.	316.8	Cook
Olympic Oil Ltd.	316.9	Cook
Koch Refining Co.	317.1	Cook
CITGO Petroleum Corp.	317.4	Cook
Mobil Oil Corp.	317.5	Cook
Triangle Refineries Inc.	318.8	Cook
Apex Motor Fuel Co.	319.5	Cook

Total number of terminals: 25

Table 8. Names and Locations of Terminals on the Calumet River
According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	0
Dry fertilizer	0
Liquid chemicals	1
Dry chemicals	0
Petroleum	3

Terminal	*River mile*	*County*
C-I-L Corp. of America	327.3	Cook
Marathon Pipe Line Co.	327.6	Cook
Horsehead Resource Development Co.	329.6	Cook
Rail To Water Transfer Corp.	331.3	Cook

Total number of terminals: 4

Table 9. Names and Locations of Terminals on the Des Plaines River
According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	1
Dry fertilizer	1
Liquid chemicals	4
Dry chemicals	1
Petroleum	5

Terminal	*River mile*	*County*
Dow Chemical Co.	275.8	Will
Exxon U.S.A., Inc.	277.2	Will
Mobil Chemical Co.	277.7	Will
Mobil Oil Corp.	278.0	Will
Spivey Terminals, Inc.	278.6	Will
Stepan Co.	280.1	Will
Amoco Chemical Co.	280.3	Will
Pitman-Moore Inc.	281.1	Will
Olin Ammonia Terminal	281.2	Will
Canal Barge Co.	281.3	Will

Total number of terminals: 10

Table 10. Names and Locations of Terminals on Lake Calumet
According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	0
Dry fertilizer	0
Liquid chemicals	1
Dry chemicals	1
Petroleum	0

Terminal	*River mile*	*County*
3Mississippi Lime Co.	327.5	Cook
Stolt Terminals, Inc.	327.9	Cook

Total number of terminals: 2

Table 11. Names and Locations of Terminals on the Ohio River
According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	2
Dry fertilizer	4
Liquid chemicals	0
Dry chemicals	1
Petroleum	1

Terminal	*River mile*	*County*
Delta Materials, Inc.	858.2	Gallatin
Metropolis River Terminal	942.5	Massac
Consolidated Grain & Barge Co.	972.8	Pulaski
Bulk Service Corp.	973.4	Pulaski
J. D. Streett & Co., Inc.	975.6	Alexander

Total number of terminals: 5

Table 12. Names and Locations of Terminals on the Cal-Sag Channel According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	0
Dry fertilizer	0
Liquid chemicals	0
Dry chemicals	0
Petroleum	3

Terminal	*River mile*	*County*
First Brands Corp.	315.9	Cook
Martin Oil Marketing Ltd.	316.5	Cook
Petroleum Fuel & Terminal Co.	316.8	Cook

Total number of terminals: 3

Table 13. Names and Locations of Terminals on the Little Calumet River According to IDOT's Directory of Lake and River Terminals in Illinois, 1988

Commodity	*Number of terminals that handle commodity*
Liquid fertilizer	1
Dry fertilizer	0
Liquid chemicals	1
Dry chemicals	0
Petroleum	3

Terminal	*River mile*	*County*
Liquid Terminals, Inc.	320.0	Cook
Pacific Molasses Co.	322.3	Cook
Fina Oil and Chemical Co.	324.9	Cook

Total number of terminals: 3

Table 14. Number of Facilities in Illinois on Different Waterways

Waterway	*Number of facilities*	*Percent of facilities*
Illinois Waterway		
Cal-Sag Channel	6	1.4
Calumet Harbor	2	0.5
Calumet River	32	7.4
Chicago River	18	4.1
Chicago Sanitary and Ship Canal	44	10.1
Des Plaines River	17	3.9
Illinois & Michigan Canal	1	0.2
Illinois River	99	22.8
Lake Calumet	13	3.0
Lake Michigan	5	1.2
Little Calumet River	5	1.2
Waukegan Harbor	3	0.7
Kaskaskia River	3	0.7
Mississippi River	169	38.9
Ohio River	17	3.9
Total	434	

Table 15. Number of Facilities in Illinois That Handle Hazardous Materials

Waterway	*Number of facilities*	*Percent of facilities*
Illinois Waterway		
Cal-Sag Channel	5	1.2
Calumet Harbor	0	0.0
Calumet River	29	6.9
Chicago River	12	2.9
Chicago Sanitary and Ship Canal	44	10.5
Des Plaines River	17	4.1
Illinois & Michigan Canal	3	0.7
Illinois River	123	29.4
Lake Calumet	13	3.1
Lake Michigan	5	1.2
Little Calumet River	5	1.2
Waukegan Harbor	0	0.0
Kaskaskia navigation canal	2	0.5
Mississippi River	138	33.0
Ohio River	22	5.3
Total	418	

CHAPTER 6. ACCIDENTAL SPILLS

One of the main components of this project was to search for, obtain, and organize records of accidental spills of hazardous materials into Illinois waterways. Before discussing the data and presenting the results there is a need for defining what is meant by an accidental spill of hazardous materials. Such a spill is defined as "a release that occurs unintentionally, for example, as a result of malfunctioning equipment or an act of God" (29 Illinois Administrative Code Sec. 430.20). Other causes are defective packaging for transport, lack of training of tankermen, collisions, and barges running aground (OTA, 1986b; USEPA, 1977). One example is the ruptured storage tank at the Ashland facility in Jefferson Borough, Pennsylvania.

Existing data were identified and obtained from three agencies: IEPA, National Response Center (NRC), and U.S. Coast Guard's three offices in Chicago, St. Louis, and Paducah. These agencies have regulations as to what is to be reported depending on the type and quantity of material spilled.

The information contained in the three different databases was merged and screened for duplication to form the SPILLS datafile. Some of the information was available only in hard copy, in which case the data had to be entered into a computerized database. Because of the inconsistency of units used to describe amounts of material spilled and the difficulty in actually determining the amount when a source is unknown, quantities were not uniformly reported in the databases received. The following pages provide brief discussions of the different databases and how they were processed to create the SPILLS datafile.

1) Illinois Environmental Protection Agency (IEPA) Toxic Chemical Release Database. The IEPA's Emergency Response Unit (ERU) is a member of the emergency state response system. ERU receives notification of these emergencies from the Illinois Emergency Services and Disaster Agency (IESDA), which is the central contact in the state response system. Their database covers the period from 1972 to December 1989 and includes data obtained from the IESDA Field Reports. This database was received in soft-copy form from IEPA. It included water-related accidental spills in Illinois, so it was searched and sorted to select spills on navigable waterways.

2) National Response Center (NRC), Washington, DC. This database was created under the spill-reporting requirements of CERCLA 103(a): "A vessel or an offshore/onshore facility, must immediately notify the NRC at U.S. Coast Guard Headquarters in Washington, D.C., when a facility or vessel releases a hazardous substance (other than a federally permitted release) if the release is greater than or equal to the reportable quantity (RQ) for that substance" (ENSR and Sidley & Austin, 1987). "Reportable Quantity" is defined as "any hazardous material that equals or exceeds the reportable quantity listed in Appendix A of Title 40 Code of Federal Regulations (CFR) Part 355, for any extremely hazardous substance, and that equals or exceeds the reportable quantity listed in Table 302.4 of Title 40 Code of Federal Regulations (CFR) Part 302 dated July 1, 1987" (29 Illinois Administrative Code Soc. 430.40,

430.50). The data cover the period from 1982 to May 1989. The NRC provided hard-copy reports of all spills in Illinois that were reported to them. A total of 837 records were examined to identify the spills on Illinois navigable waterways.

3) U.S. Coast Guard (USCG). The USCG responds to all reports of spills in navigable waterways. The NRC or IESDA are potential sources of these reports, as well as the public and liable parties.

Chicago District, Marine Safety Office (MSO), Chicago, Illinois. This district deals mainly with the navigation channels in the Chicago area and the Illinois Waterway from mile 187.3 up. The database covered 1986 through 1989 and was sent as a hard copy.

St. Louis District, Marine Safety Office (MSO), St. Louis, Missouri. This district covers the upper Mississippi River (miles 55.3 to 853.0) and the Illinois River (miles 0.0 to 187.3). The data covered the period from 1986 through 1989. Since the Coast Guard database mainly pertains to navigable waterways, the searching and sorting of the hard-copy records was less time-consuming than for the other databases.

Paducah District, Paducah, Kentucky. This district deals with the Ohio River (miles 867.2 to 981.0) and the upper Mississippi River (miles 0.0 to 55.3). The database covered 1986 through 1989 and was also sent as a hard copy.

Data from NRC and USCG had to be screened and entered into the database. The screening of the NRC and USCG databases resulted in 245 and 252 entries, respectively.

Entering Hard-Copy Data into the Computer

The hard copies of the NRC and USCG databases are shown in figures 14 and 15, respectively. As can be seen in these figures, the data fields in each database use different names but overlap in content. The NRC database contains more fields than the USCG database. The NRC and USCG databases were merged by using dBase IV's capability of creating two input forms that look very similar to the hard copies of each database. These input forms are shown in figures 16 and 17. The fields in the input forms are linked to the main SPILLS datafile structure. The merging of these two input forms for the two data sources created the NRC-USCG database, which has 25 fields in its structure.

Date: 01/07/1988 Time: 1742 D.O.: HLO Report#: 00235

(A) Reporting Company: ILLINOIS POWER CO Type: PE Spiller? T
Address: 500 S 27TH ST
City: DECATUR State: IL Zip: 62525

(B) Suspected Discharger: Type:
Address:
City: State: Zip:

Spill Date: 01/06/1988 Spill Time: 900 Location:

City: HENNEPIN County: PUTNAM State: IL
Description: HENNEPIN POWER PLANT

Chris Code	Material Name	Total Qty	Units	In Water	Units
SFA	SULFURIC ACID WASTE 0.7%	28,000.00	GAL	28,000.00	GAL
SHD	SODIUM HYDROXIDE WASTE 6.4%	5,220.00 0.00	GAL	5,220.00 0.00	GAL

Source/Cause: SUMP/SUMP LINE WAS CLOGGED WITH ICE AND DISCHARGED IN TO THE RIVER.
Transportation Mode: FIXED
Affected Medium: Water
Medium Description: ILLINOIS RIVER

Injuries: 0 Fatalities: 0 Evacuation? F Damage? F Amount: $ 0.00

Caller Notified: WILL CALL EPA

Remedial Action / Additional Information

THE DISCHARGE WAS AN INTERMITTEN DISCHARGE. SHD OCCURRED FOR 8 HOURS, AND SFA 4 HOURS.

National Response Center Notifications

Time	Agency
1805	EPA Region 5

Figure 14. Example of NRC spills database hard copy

```
MPIR                                          MARINE  POLLUTION  INCIDENT  REPORT
08MAY89

CASE NUMBER../ MP88003439 PORT/ SLMMS  OSC AGENCY/ USCG  EPA REGION..../
DATE CLOSED../ 24AUG88 VALIDATAED(X)/ X CTF/  INV/ SLMMS NOTIFY../

SUBJECT...../ BARGE EXPLOSION
REPORTED BY../ USCG         NAME/ UNK                      PHONE/ 314-425-4614
DATE REPORTED/ 27MAY88   TIME REPORTED/ 0510
DATE OF SPILL/ 27MAY88 K TIME OF SPILL/ 0510    CASUALTY CASE REF/
               NRC NOTIFICATION? (Y/N)/ N       NRC CASE REF...../

                          ---INCIDENT LOCATION---
BODY OF WATER/ UPPER MISSISSIPPI RIVER
RIVER MILE.../ 170.6         (OR)        LATITUDE...../      -  .
                                         LONGITUDE..../      -  .
CITY...../ ST. LOUIS                     STATE...../ MO
CLEAN UP ACT./ CLEAN-UP PERF             REMOVAL PARTY/ RESP PARTY

                        ---FEDERAL COST INFORMATION---
PROJECT NUMBER./                 PROJECT TYPE/
AUTH CEILING($)/            FUNDS EXPENDER($)/          TOT COST($)/

                        ---GENERAL CASE DESCRIPTION---
  BARGE EXPLOSION OF APEX 3516, DISPERSING APPROX. 1,000 GLS OF CRUDE OIL AND
  #6 OIL INTO THE MISSISSIPPI RIVER A NAVIGABLE WATER OF THE U.S. AT MILE
  170.6 CREATING A LARGE, VISIBLE SHEEN.

                    ---SUPPLEMENTAL DETAILS REPORTED---
                KEY            TYPE                    NUMBER
                 1   VESSEL SOURCES           (MPVS)     1
                 2   NON-VESSEL SOURCES       (MPNS)
                 3   CG UNIT RESPONSE REPORTS (MPRC)     1
                 4   NON-CG  RESPONSE REPORTS (MPRN)     1
```

Figure 15. Example of USCG spills database hard copy

Report #1: _____

Reporting Company: _____

City: _____ State: _____ Zip: _____

Spill Date: ____/____/____ Spill Time: _____

City: _____ County: _____ State: _____

Description:

_____

Chris Code: _____ Material Name: _____

In Water: _____ Units: _____

Source/Cause: _____

_____

Transportation Mode: _____

Medium Description: _____

River Mile: _____

Figure 16. Input form used for NRC spill reports

Case Number: _____ **Name:** _____

Subject: _____

Spill Date: ____/____/____ **Spill Time:** _____

Body of Water:

_____

River Mile: _____ **Latitude:** _____ **Longitude:** _____

Other Location:

_____

City: _____ **State:** _____

AMT_REL: _____ **Description:**

Units: _____ _____

TRANS_MODE: _____ _____

Figure 17. Input form used for USCG spill reports

Merging the NRC-USCG Database with the IEPA Database

As mentioned above, the NRC-USCG database has 25 fields. The IEPA database has 16 fields that are pertinent to spills into navigable waterways (table 16). Therefore there was a need to merge the two. Another feature of dBase IV is that it allows the merging of two structurally different databases. It was not necessary to make the IEPA database have the same 25 fields as the NRC-USCG database. The only requirement was that the field names, types, and widths be the same. When the two different databases are merged, dBase recognizes only those fields that match. The fields in the IEPA database were modified in name, type and width to match their counterparts in the NRC-USCG database, and new fields were added to the NRC-USCG database that were unique to the IEPA database. The merging of these databases resulted in the 26 fields of the SPILLS datafile shown in table 17.

Screening for Duplicate Records

After all three databases (IEPA, NRC, and USCG) were merged, it was necessary to search for duplicate records. A query was created in dBase IV to produce all records that shared the same date and waterway. Eighty-two records (41 pairs) were found to have the same date and waterway. These 82 records were checked carefully, both in the computer database and in the original hard copy data, to verify whether they were actual duplicates or two different events that occurred on the same date and waterway. Upon inspection of these records, only eight records (four pairs) were determined not to be duplicates. The remaining 37 pairs were then combined into one record each. This procedure resulted in a total of 794 reported spills of hazardous materials in Illinois waterways from 1974 to 1989.

Each agency has its own mandates, responsibilities, needs, and capabilities regarding data related to hazardous material spills. These mandates and responsibilities have been clearly defined, resulting in few duplications of the spill records. This confirms that the laws that dictate the kind of information collected and who collects it result in little duplication of effort. However, this also shows that there is not a single agency that can be contacted to get the complete history of spills in the state. The SPILLS datafile makes it possible for the first time to access records of historical accidental spills in Illinois from one source.

Analysis of Data

A total of 794 accidental spills of hazardous materials were reported in Illinois waterways from 1974 to early 1989. The annual distribution of these spills is shown in figure 18. The number of accidental spills reported has increased over the years as more stringent spill-reporting regulations have been implemented. Each of the databases started in different years. The IEPA's data started in 1974, NRC's in 1982, and USCG's in 1986. The reason for the jump between 1978 and 1979 is unknown. The average annual number of spills is 11 for the 1974-1981 period, 57 for the 1982-

Table 16. IEPA Spills Database Structure

Field	*Field name*	*Type*	*Field width (columns)*
1	LOGNUM	Numeric	6
2	RDATE	Date	8
3	ICITY	Character	15
4	ICOUNTY	Character	12
5	ILOCATION	Character	40
6	WATERWAY	Character	30
7	RIVER_MILE	Numeric	9
8	MATERIAL	Character	25
9	SIC	Numeric	4
10	CAS_NO	Numeric	9
11	AMT_REL	Numeric	6
12	UNITS	Character	3
13	LIABLE	Character	25
14	L_ADD	Character	25
15	L_CITY	Character	15
16	L-ZIP	Numeric	5
		Total	237

Table 17. SPILLS Datafile Structure

Field	*Field name*	*Type*	*Field width (columns)*
1	LOGNUM	Numeric	6
2	CODE	Character	12
3	REPORT_NO	Numeric	6
4	CASE_NO	Character	10
5	LIABLE	Character	30
6	L_ADD	Character	25
7	L-CITY	Character	20
8	L_STATE	Character	2
9	L-ZIP	Character	5
10	RCOUNTY	Character	12
11	RDATE	Date	8
12	RTIME	Numeric	4
13	RCITY	Character	20
14	RSTATE	Character	2
15	WATERWAY	Character	30
16	RIVER_MILE	Numeric	9
17	LATITUDE	Numeric	7
18	LONGITUDE	Numeric	7
19	OTHER_LOCA	Character	50
20	CHRIS_CODE	Character	3
21	MATERIAL	Character	25
22	CATEGORY	Character	25
23	AMT-REL	Numeric	7
24	UNITS	Character	7
25	TRANS_MODE	Character	6
26	SOURCE	Memo	10
		Total	349

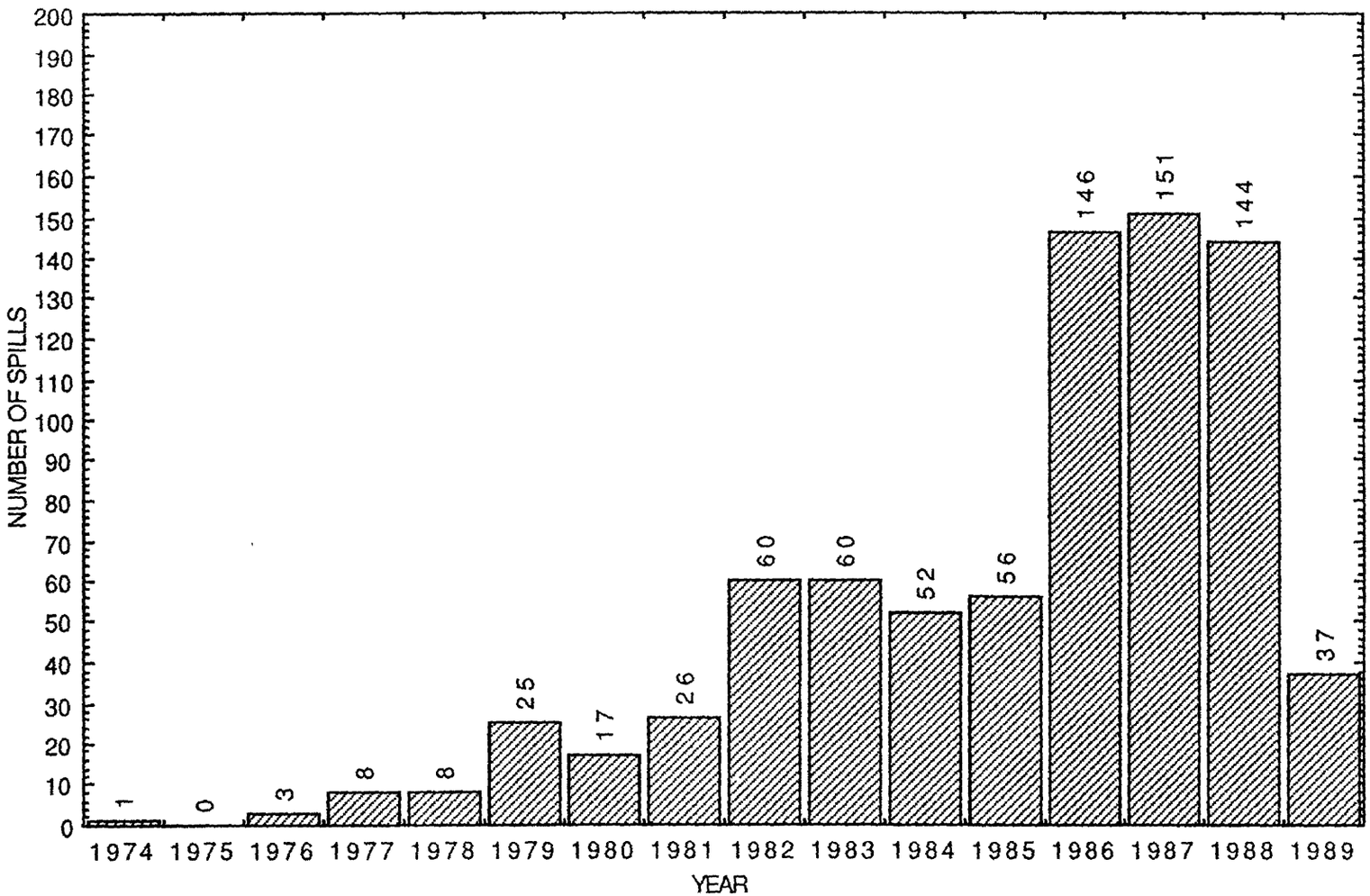


Figure 18. Total spills in Illinois waterways reported annually (1989 data incomplete)

1985 period, and 147 for the 1986-1988 period. The 1989 data were not complete when these totals were prepared.

One of the important tasks of this project was to identify the locations of accidental spills. The distribution of spills of hazardous materials in each waterway for each year in the period of record is summarized in table 18. The total number of spills in different Illinois waterways is shown graphically in figure 19a. The percentages of the total number of spills that occurred in each of these waterways are shown in figure 19b.

As can be seen in figure 19, the largest number of accidental spills in Illinois waterways took place in the Mississippi River, with a total of 371 spills, which is 47 percent of the total number of reported spills. The second largest number of spills is in the Illinois Waterway (359). This breaks down to the Illinois River with 111 spills (14 percent of the total), followed by the Des Plaines River with 73 spills (9 percent), the Chicago Sanitary & Ship Canal with 61 spills (8 percent), and the other water bodies in northeast Illinois.

Another important consideration in the data analysis is the characterization of the accidental spills. The data on accidental spills pertain to spills of approximately 70 different types of hazardous materials, including approximately 123 spills of materials identified as "unknown." To make a generalized analysis, it is necessary to group the materials into a manageable number of categories. The following categories (with the exception of the first one) were developed by using the Standard Industrialization Classification (SIC) Manual (OMB, 1972) as a guide:

Bilge contents
Chemicals and associated products
Coal
Food products (including grains)
Metals
Petroleum products
Unknown material

A list of the materials included in each category is given in table 19.

The number of accidental spills and the corresponding percentages for each category are shown in figure 20. As can be seen clearly from the figure, petroleum and petroleum products have been involved in the largest number of accidental spills, with a total of 579 spills (73 percent) in Illinois waterways. The second largest group (123 spills, or 15.5 percent) belongs to the "unknown" category, which consists of all types of spills where the material was identified as unknown. The third largest category is chemicals with 73 spills (9 percent).

Table 18. Number of Hazardous Material Spills Reported for Each Year and Waterway

Waterway	*1974*	*1975*	*1976*	*1977*	*1978*	*1979*	*1980*	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1988*	*1989*	*Total*
Cal-Sag Channel						1	1	1	2	4			1				10
Calumet River				2		2		3	1	2	1	3	3	5	3	1	26
Chicago River											2		1	3	4		10
Chicago Sanitary & Ship Canal			1	1	1	1	1		6	8	3	1	7	14	13	4	61
Des Plaines River				2	1		3	3	9	14	8	3	11	13	5	1	73
Illinois River	1				2	9	5	4	9	7	14	13	14	14	16	3	111
Illinois & Michigan Canal														2			2
Indiana Harbor Canal														1			1
Kaskaskia navigation canal									2								2
Lake Calumet												1	1				2
Lake Michigan						1		4	4	1	4	2	7	14	11	3	51
Little Calumet River										2				1	4	1	8
Mississippi River			1	3	1	8	3	9	21	18	15	29	90	73	81	19	371
Ohio River			1		2	1	4	2	2	3	5	2	6	9	4	4	45
Wabash River					1	2			3	1		2	4		3	1	17
Waukegan Harbor									1					2			3
Wilmette Harbor													1				1
Total	1	0	3	8	8	25	17	26	60	60	52	56	146	151	144	37	794

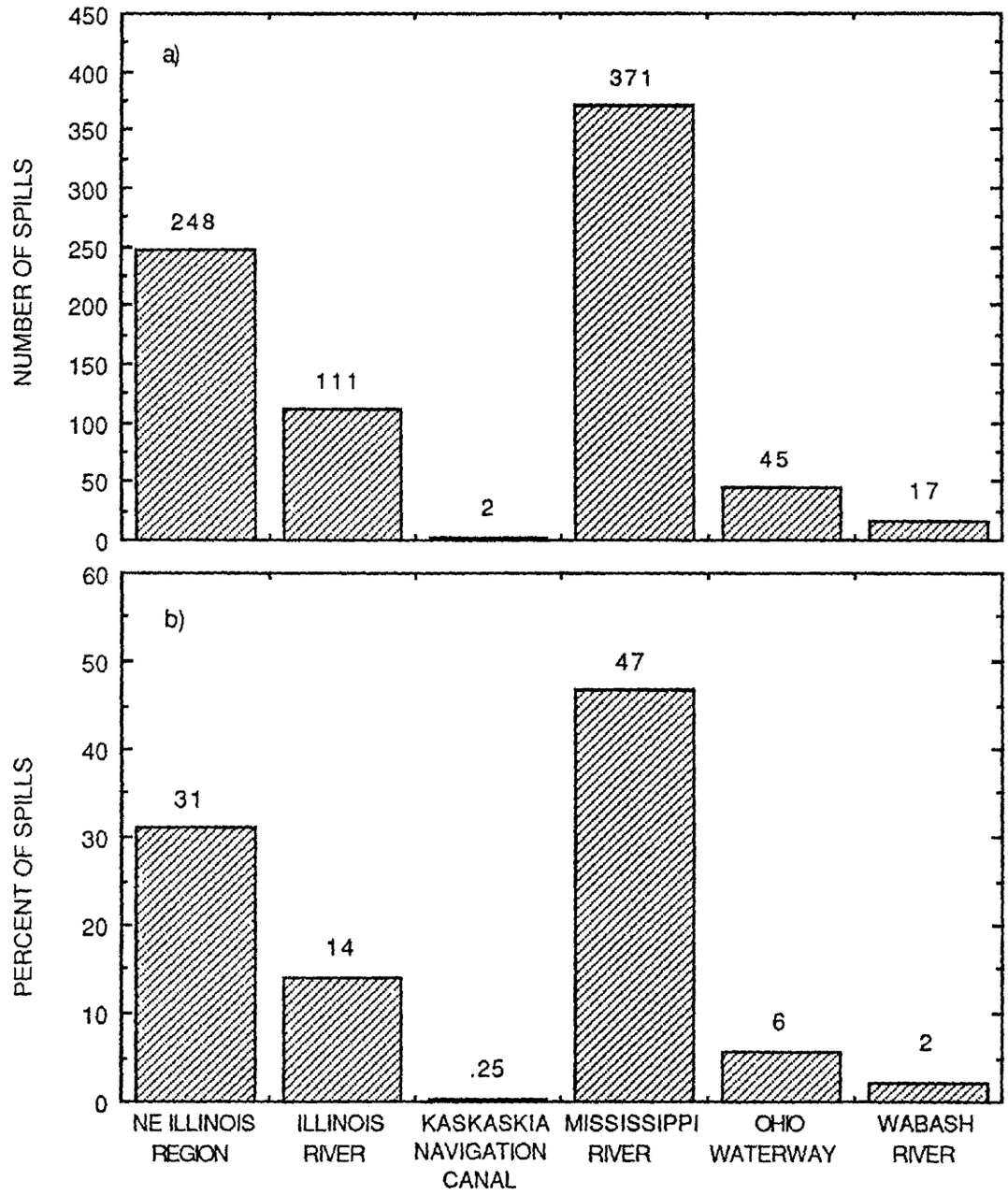


Figure 19. Spills reported for various regions, rivers, and waterways in Illinois

Table 19. Materials Involved in Accidental Spills in Illinois, Grouped According to Category

Category	*Material*
Bilge contents	Bilge oil
	Bilge slop
	Bilge water
	Palm oil
Chemicals	ABS resin
	Ammonium nitrate
	Anhydrous ammonia
	Atrazine
	Butadiene
	Caustic soda
	Chlorine
	Coal tar
	Cycolac resin
	Bichloromethane
	Ethanol
	Ethyl alcohol
	Ethylene glycol
	Fertilizer
	Hexane
	Hydrochloric acid
	Lasso
	Leather finish
	Methanol
	Molten sulphur
	Nickel chloride
	O-xylene
	Organic solvents
	PCB
	Pesticides
	Poly terg detergent
	Potash
	Propylene tetramer
	Soda ash
	Sodium cyanide
	Sodium hypochlorite
	Solvents
	Special naphtholite
	Caustic soda
	Styrene
	Sulfuric acid
	Toluene
	Waste alkali
	Waste water/paint
	Xylene
Coal	Coal
	Coal dust
Food	Biodegradable vegetable matter and coal tar
	Grain
	Grain and talo
	Spent pickle liquor
	Vegetable oil
Metals	Crude coke oven tar
Petroleum	#1 fuel oil
	#2 diesel fuel
	#4 fuel oil
	#6 fuel oil
	Asphalt
	Benzene
	Benzene raffinate
	Bunker oil
	Carbon black (heavy oil)
	Coal, tar, fert, oil
	Crude
	Crude oil
	Decant oil
	Fuel oil
	Furnace oil
	Gasoline
	Grade 4 crude oil
	Heavy creosote oil
	Heavy oil
	Hydraulic oil
	Jet fuel
	Kerosene
	Liquid asphalt
	Lubricating oil
	Motor oil
	Naphtha
	Oil
	Oil-based paint
	Turbine oil
Unknown	

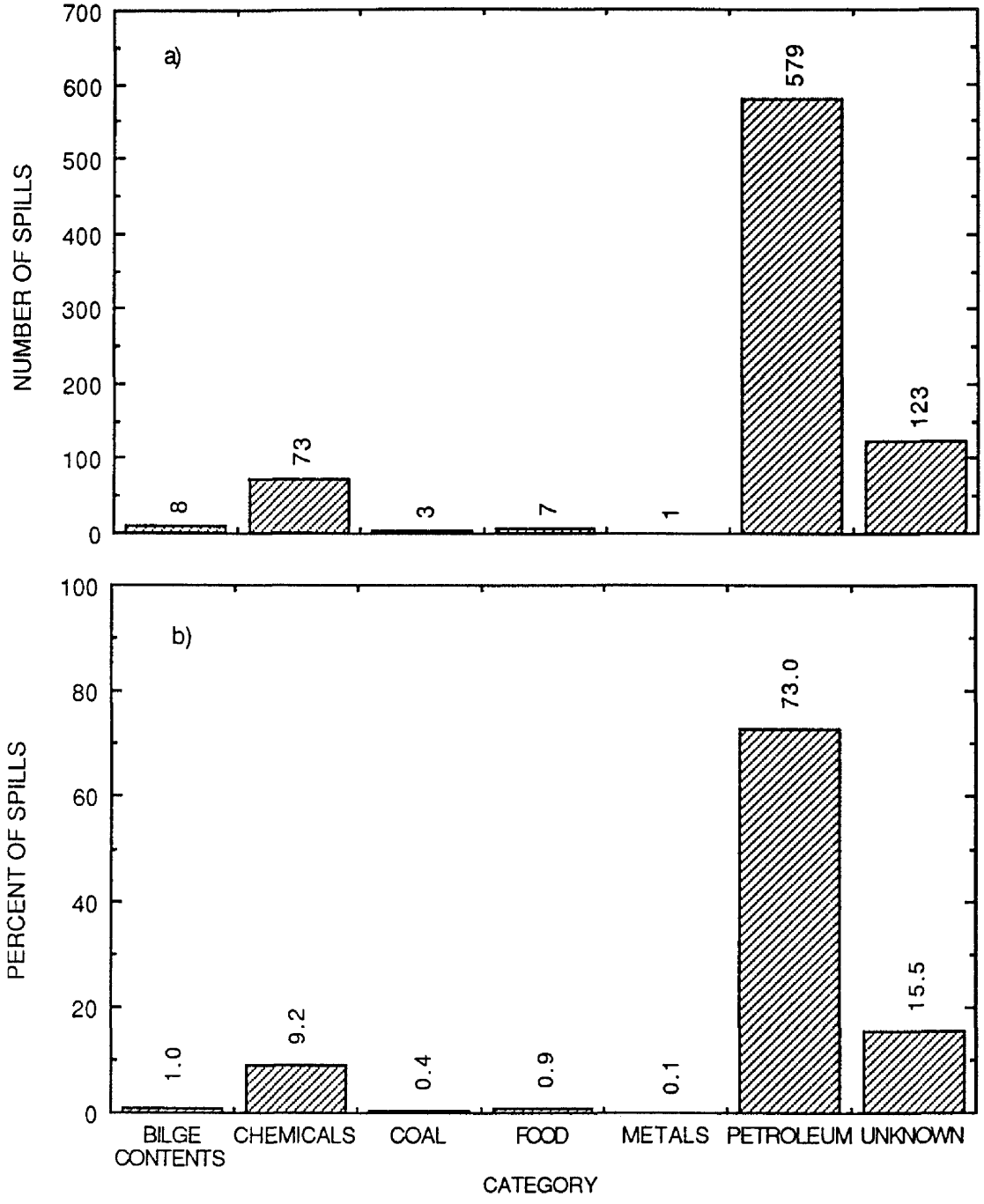


Figure 20. Spills reported in Illinois for each commodity category

CHAPTER 7. WATER SUPPLY AND ENVIRONMENTAL CONSIDERATIONS

Water Supply

One of the major concerns regarding accidental spills of hazardous materials into waterways is their impact on and disruption of public water supply systems. If an accidental spill of hazardous materials occurs in any of the waterways, the water intakes downstream may be affected. This was the case with the January 1988 oil spill in the Monongahela River, after which oil flowed down the Ohio River, forcing the shutdown of intakes. An intake shutdown also was necessary at Peoria in January 1988 after a fertilizer spill on the Illinois River. How far downstream a spill may impact water supply sources depends on flow conditions, weather and climate, the material spilled, the quantity of material spilled, and the location and design of the water intake. Therefore it is important to identify the locations of water withdrawal points on all the navigable waterways. Furthermore, facilities and terminals are potential point sources for accidental spills, so it is appropriate to identify facilities and terminals that are located upstream of or in the vicinity of the water withdrawal points. It is also desirable to have the capability to identify potential areas that might be impacted by accidental spills as quickly as possible after an accident occurs.

To enable us to make all these identifications, a separate datafile on water withdrawal points along navigable waterways was created. The WATER WITHDRAWALS datafile is linked to the FACILITIES AND TERMINALS datafile and the SPILLS datafile. Most of the information needed to create the database was obtained from the Illinois State Water Survey water-supply database, which contains information on all surface-water-supply withdrawals in the state. For this project, information was needed only for withdrawal points on navigable waterways.

Analysis of the datafile shows that 37 water withdrawal points are located on navigable waterways in Illinois. A listing of all public water supply systems in Illinois that withdraw water from navigable waterways, including Lake Michigan, is given in table 20 (IEPA, 1983; Kirk, 1987). The locations of all the water withdrawal points on navigable waterways in Illinois are shown in figure 21. Most of these points are located in Lake Michigan (17 intakes) and on the Mississippi River (12 intakes). Four water withdrawal points are located on the Ohio River, two on the Kaskaskia navigation canal, and one each on the Illinois and Wabash Rivers. Peoria Water Company, serving Peoria, is the only public water supply system that withdraws water from the Illinois River.

Biological Resources

River valleys, backwater lakes, and wetlands are valuable assets to Illinois. Among their many uses, they serve as sites for recreation and fish hatcheries, as thoroughfares for commercial traffic, and as areas with great aesthetic appeal. However, these areas are affected by the subtle or sudden introduction of pollutants and hazardous materials. Accidental spills of petroleum in the Ohio River, Delaware River, and Prince William Sound in Alaska have shown that the effects can be

Table 20. Public Water Supplies on Illinois Waterways
(IEPA, 1983; Kirk, 1987)

Source	*County*	*Public water*
Illinois River	Peoria	Peoria Water Co.
Kaskaskia navigation canal	St. Clair	New Athens
Kaskaskia navigation canal	Randolph	Evansville
Lake Michigan	Cook	Evanston
Lake Michigan	Lake	Great Lakes Naval Training Center
Lake Michigan	Lake	U.S. Army Fort Sheridan
Lake Michigan	Cook	Glencoe
Lake Michigan	Lake	Highland Park
Lake Michigan	Lake	Highwood
Lake Michigan	Cook	Kenilworth
Lake Michigan	Lake	Zion Benton Treatment Plant - Lake County PWD
Lake Michigan	Lake	Lake Forest (2)
Lake Michigan	Cook	Northbrook
Lake Michigan	Lake	North Chicago (2)
Lake Michigan	Lake	Waukegan
Lake Michigan	Cook	Wilmette (2)
Lake Michigan	Cook	Winnetka
Mississippi River	Madison	Alton Water Co.
Mississippi River	Randolph	Chester
Mississippi River	Hancock	Dallas City
Mississippi River	Rock Island	East Moline
Mississippi River	Hancock	Hamilton
Mississippi River	St. Clair	Belleville
Mississippi River	Rock Island	Moline
Mississippi River	Hancock	Nauvoo
Mississippi River	Adams	Quincy
Mississippi River	Rock Island	Rock Island
Mississippi River	Randolph	Menard Correctional Center
Mississippi River	Hancock	Warsaw
Ohio River	Alexander	Cairo Water Co. (2)
Ohio River	Pope	Golconda
Ohio River	Hardin	Rosiclare
Wabash River	Wabash	Mt. Carmel

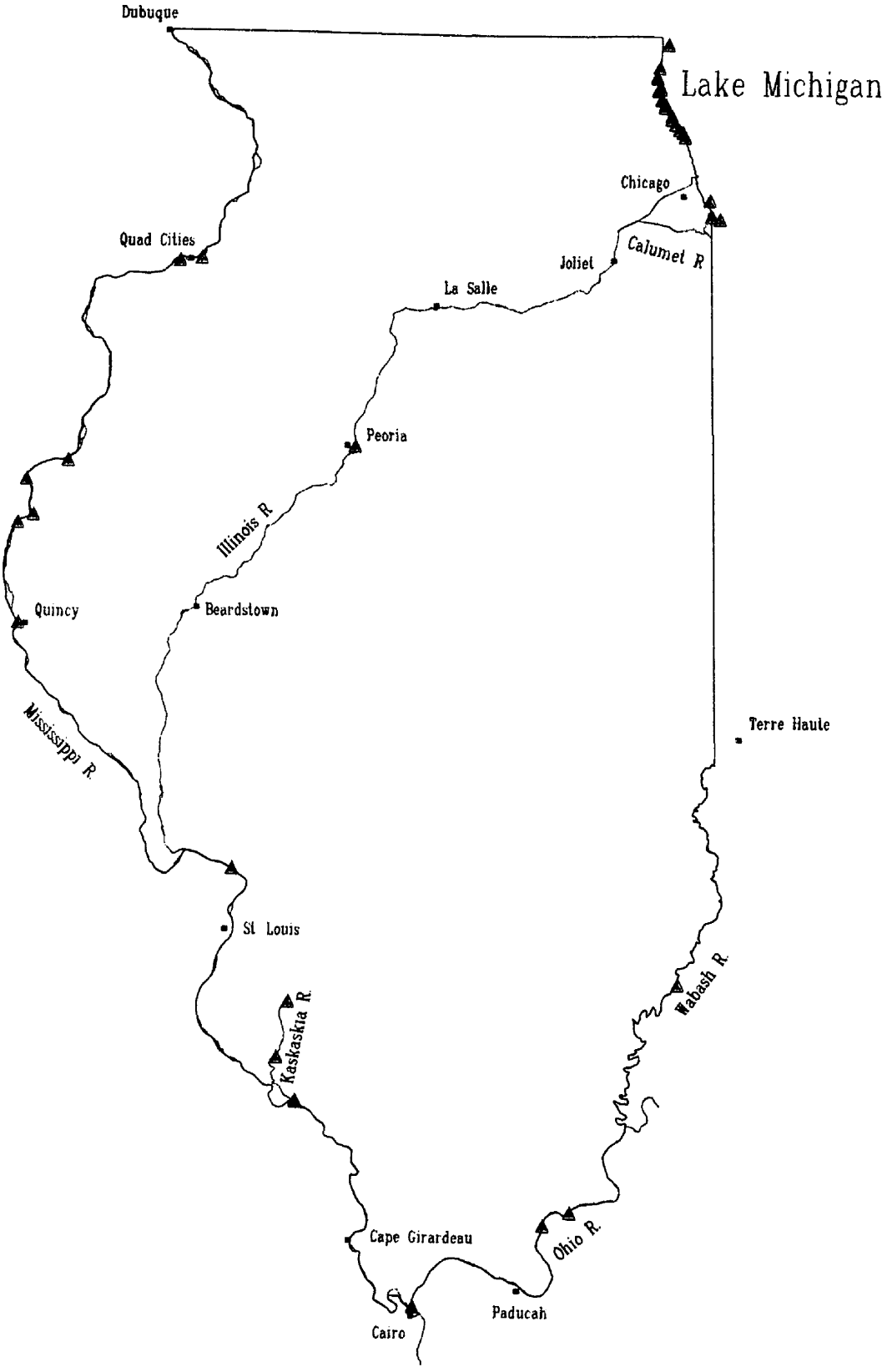


Figure 21. Surface water withdrawal points for public water supplies along Illinois navigable waterways

tremendously detrimental. The short-term effects of spills of hazardous materials such as petroleum are well known. After an oil spill, rivers are dotted with oil slicks, and trees and bushes are coated. Birds get oil in their feathers and drown, fish suffocate, aquatic plants are coated or hidden from light and unable to photosynthesize, and sediments are contaminated and their ability to support life is reduced. Depending on the type and amount of material spilled, some bodies of water can deteriorate severely.

Some research has been done in Illinois on the environmental effects of accidental spills (Butts, 1988). Other studies conducted in the United States and Europe include those by Capel et al. (1988), Deininger (1987), Guiney et al. (1987), IEPA (1988a), Mossman et al. (1988), Ross et al. (1988), and Solsberg (1987). More recent documentation on some of the recent spills in the United States is now becoming available. Information from all of the studies could be helpful in planning for the effects of an accidental spill in Illinois.

Studies show that sometimes the environment possesses its own removal processes for hazardous materials, if the concentrations do not exceed this removal threshold. These processes are either physical, chemical, biological or a combination (Capel et al., 1988). The obvious physical removal process involves the dispersion and diffusion of the material. This immediately changes its concentration and reduces the toxicity. The material can be transferred to the atmosphere, sediments, or organisms by volatilization, sorption, or accumulation. Other aspects of the environment can also assist in the removal processes. Water chemistry, sunlight intensity, air and water temperatures, biota, and residence times of the chemicals in the water are among the factors that influence these processes (Capel et al., 1988).

Capel and others (1988) illustrated these removal processes in their study of a spill that dumped 30 to 40 tons of chemicals and pesticides into the Rhine River near Basel, Switzerland (Deininger, 1987). The short-term impacts of the spill were evidenced by the appearance of approximately 500,000 dead fish and eels for a distance of almost 400 km downstream (Capel et al., 1988; Deininger, 1987). Some of the pesticides were quickly made harmless because of their hydrolytic half-life in water with a normal pH (7.0). Some were transported intact but eventually were broken down by photolysis. The pesticide plume was washed out of the Rhine and dispersed into the North Sea in approximately 12 days. Any pesticides that were sorbed by the sediments were scoured down-river naturally and dispersed into the North Sea. It was feared that the Rhine would become a dead river after this accident, but in some incidents nature can help itself.

A two-year study of pollution of freshwater by petroleum (Guiney et al., 1987) again demonstrates the ability of a stream to self-cleanse. About 1,310 barrels of aviation kerosene (a petroleum hydrocarbon) were spilled into a small trout stream in central Pennsylvania in October 1982. The researchers focused on the concentrations of hydrocarbons two years after the spill and found that after 21 months, kerosene-range hydrocarbons could no longer be detected in fish tissue and sediments. During the study, elevated concentrations of hydrocarbons were detected in sediments and fish tissue in areas that were primary boom recovery sites. It seems that some of the

kerosene escaped the initial recovery, was sorbed by the sediment, and was then ingested by the fish in the area.

Many natural removal processes were involved in the recovery of the trout stream. Some of the lighter hydrocarbons were affected by evaporation and solubilization processes, and photochemical oxidation had an effect on the aromatic hydrocarbon components. Constant influxes of freshwater from upstream helped in the cleansing process. Sorption by the sediment and subsequent leaching were apparent from the appearance of kerosene-range hydrocarbon concentrations coming from a small spring downstream of the spills site.

Some long-term effects of spills in the environment show up in the bottom sediments. Toxic materials, such as crude oil, fertilizers, and chemicals, can become entrapped in these sediments and become part of the aquatic food chain. This can cause a decrease or change in the fish that consume the affected food. Depending on the kind of contaminant, an overabundance of algal growth can cut off oxygen supplies for other aquatic life.

Illinois has designated many locations along navigable waterways as conservation areas and wildlife refuges. These areas are diverse in plants, animals, and aquatic life. Most of these areas are backwater lakes, wetlands, and swamps. They support wildlife like the Great Blue Heron, catfish, largemouth bass, and crappie, as well as numerous types of trees and plants. Approximately 40 percent of the threatened and endangered species in Illinois rely on these areas (Lake County Health Department, 1989). Therefore, any major accidental spill that would affect these important resources may have a long-lasting impact on the quality of life and the economy of the state.

CHAPTER 8. ANALYSIS OF ACCIDENTAL SPILLS

This chapter summarizes the available data on accidental spills of hazardous materials in Illinois waterways and identifies areas of highest risk on the basis of the total number of spills reported in the different areas. We will not assess the health risk associated with any of the spills, since that was not part of the scope of the project and is outside the expertise of the investigators. It is hoped that the identification of areas of higher numbers of accidental spills will lead local, state, and federal agencies toward detailed investigations of the causes for the large number of accidental spills and toward possible remedial actions to reduce the number of spills in those areas.

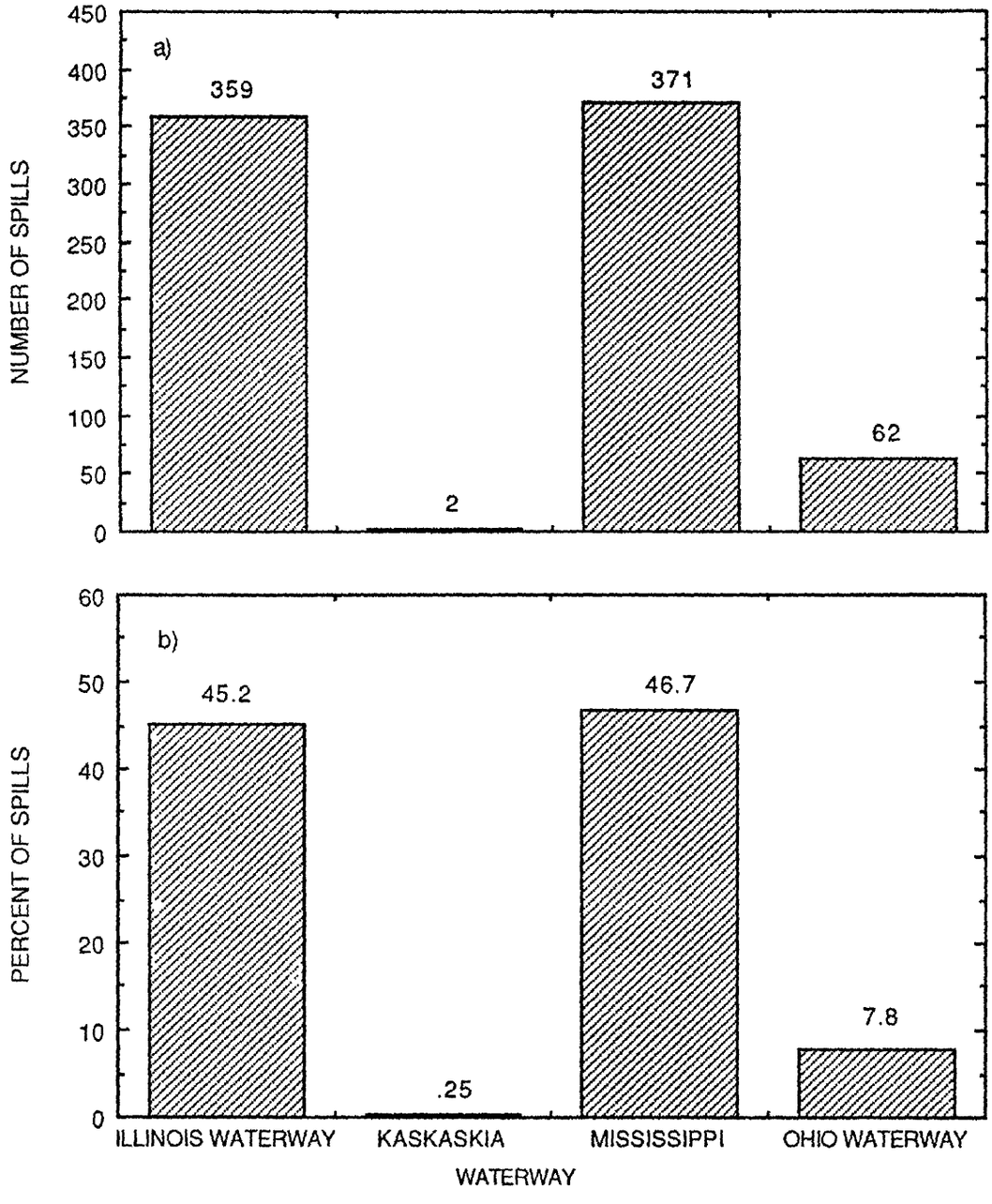
Chapter 6 stated that 794 spills in Illinois waterways were reported from 1974 to early 1989. The distribution of the spills over the different waterways was also presented. The same data are presented in a slightly different form in table 21 and are plotted in figure 22 for the major waterways in Illinois. The table shows that the largest number of spills took place along the Mississippi River with 371 spills (47 percent of the total), followed by the Illinois Waterway with 359 spills (45 percent). This implies that the Mississippi River is at a slightly higher risk for accidental spills than the other waterways. However, when the total number of navigable river miles for each waterway are taken into consideration, the order changes, as can be seen in table 21. More spills per navigable waterway mile occur on the Illinois Waterway (0.98 spills per navigable river mile) than on the Mississippi River (0.64 spills per navigable river mile) or the Ohio River (0.46 spills per navigable river mile). Therefore, based on spills per river mile, it can be initially concluded that the probability of accidental spills is higher on the Illinois Waterway than on the other navigable waterways in Illinois.

Table 21. Distribution of Accidental Spills of Hazardous Materials among the Major Waterways in Illinois

Waterway	*River miles*	*Number of spills*	*Spills per river mile*
Mississippi	581	371	0.64
Illinois Waterway	365	359	0.98
Ohio Waterway	134	62	0.46
Kaskaskia navigation canal	36	2	0.06

However, accidental spills are not uniformly distributed along the waterways. At selected areas along the waterways, the probability for accidental spills is higher than at other areas. Analysis of the locations of the accidental spills along the waterways shows that there are primarily two major regions where accidental spills are more frequent than in the rest of the state. These areas are the northeastern Illinois region on the Illinois Waterway (Lake, DuPage, Cook, and Will Counties), and the St. Louis - East St. Louis region (Madison and St. Clair Counties) on the Mississippi River. The percentages of the spills in these regions as compared to the

Figure 22. Spills reported for each major Illinois waterway system



total are shown in figure 23. The northeastern Illinois and St. Louis - East St. Louis regions account for 31 percent of the spills each. The two locations combined therefore account for nearly two-thirds of the total number of accidental spills in Illinois.

Figures 24 and 25 show the results of a more detailed analysis of the locations of the highest number of accidental spills in the two high-risk regions. In the northeastern Illinois region, the highest number of accidental spills took place in Chicago with 69, followed by Joliet with 37 and Lemont with 22 (figure 24). Other cities with moderate numbers of spills for the region include Waukegan (14 spills), Romeoville (12), and Channahon (11). For the St. Louis - East St. Louis region the highest number of spills took place in Hartford with 87, followed by St. Louis with 67, Wood River with 52, and Alton with 20 (figure 25).

One of the major concerns regarding accidental spills of hazardous materials is the threat they pose to public water supplies. For this reason, the WATER WITHDRAWALS datafile was created to aid in determining which water supplies may be impacted in case of serious accidental spills. The relative importance of the different waterways in terms of water supply considerations is indicated in figure 26, which shows the amount of water withdrawn and the population served by each waterway. As can be concluded from the figures, Lake Michigan and the Mississippi River are the most important water bodies in terms of water supply. Therefore any major spill in these waterways for an extended time may have a major impact on Illinois citizens because of the high-density population dependent on these supplies.

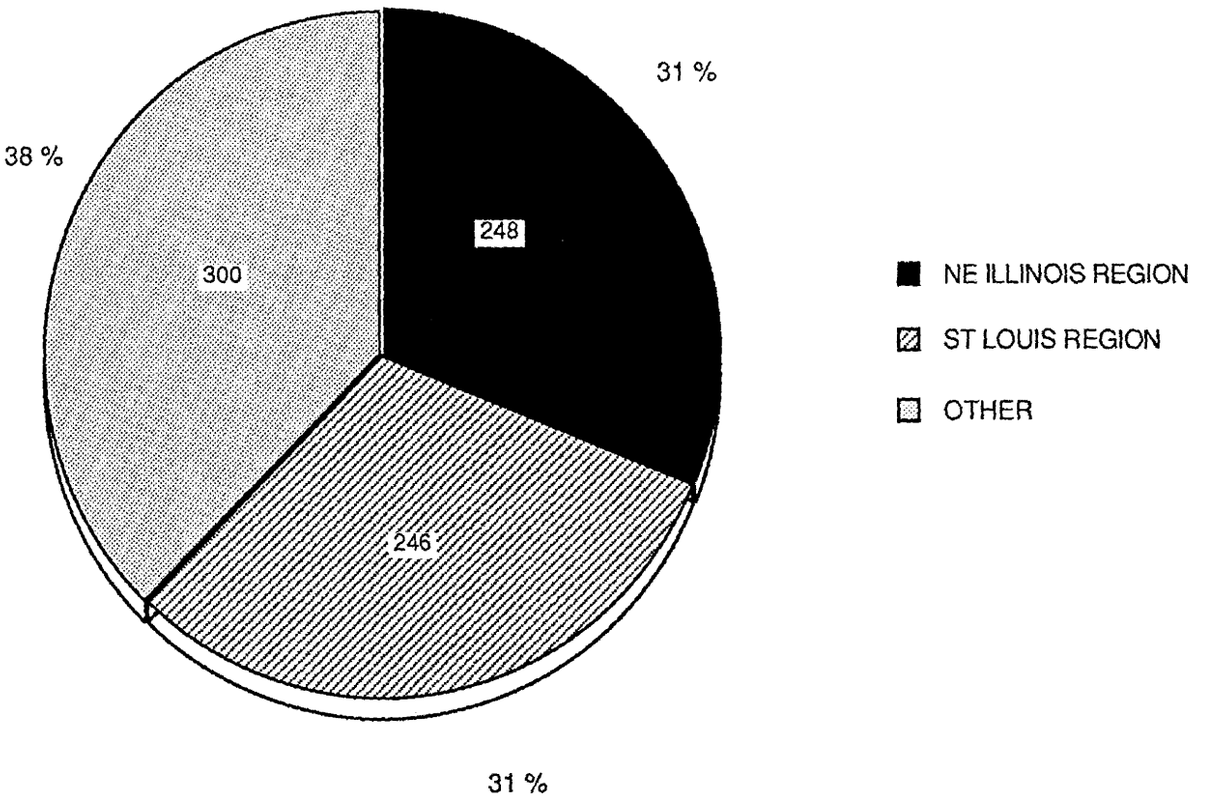


Figure 23. Percent of spills for each major Illinois waterway system

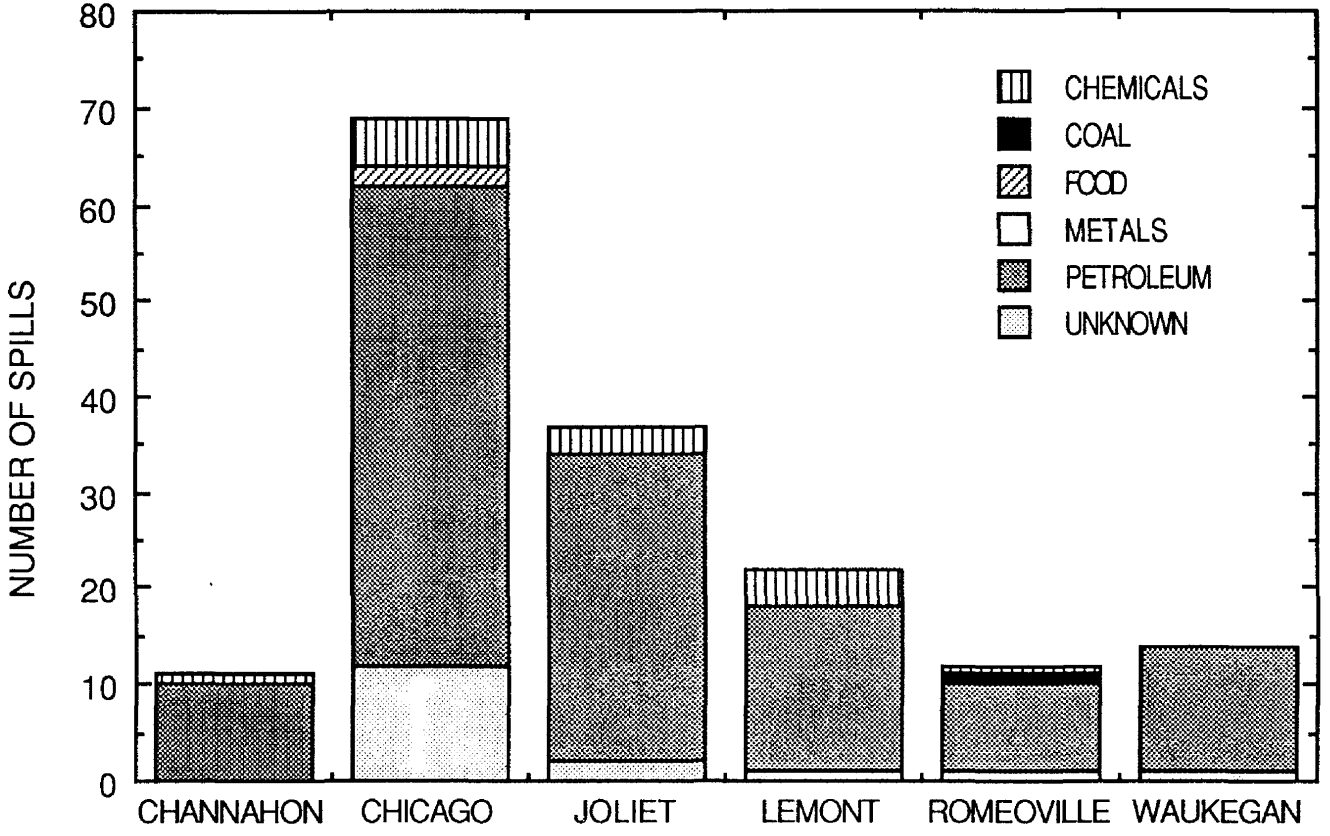


Figure 24. Locations of high numbers of accidental spills per commodity category in the northeastern Illinois region

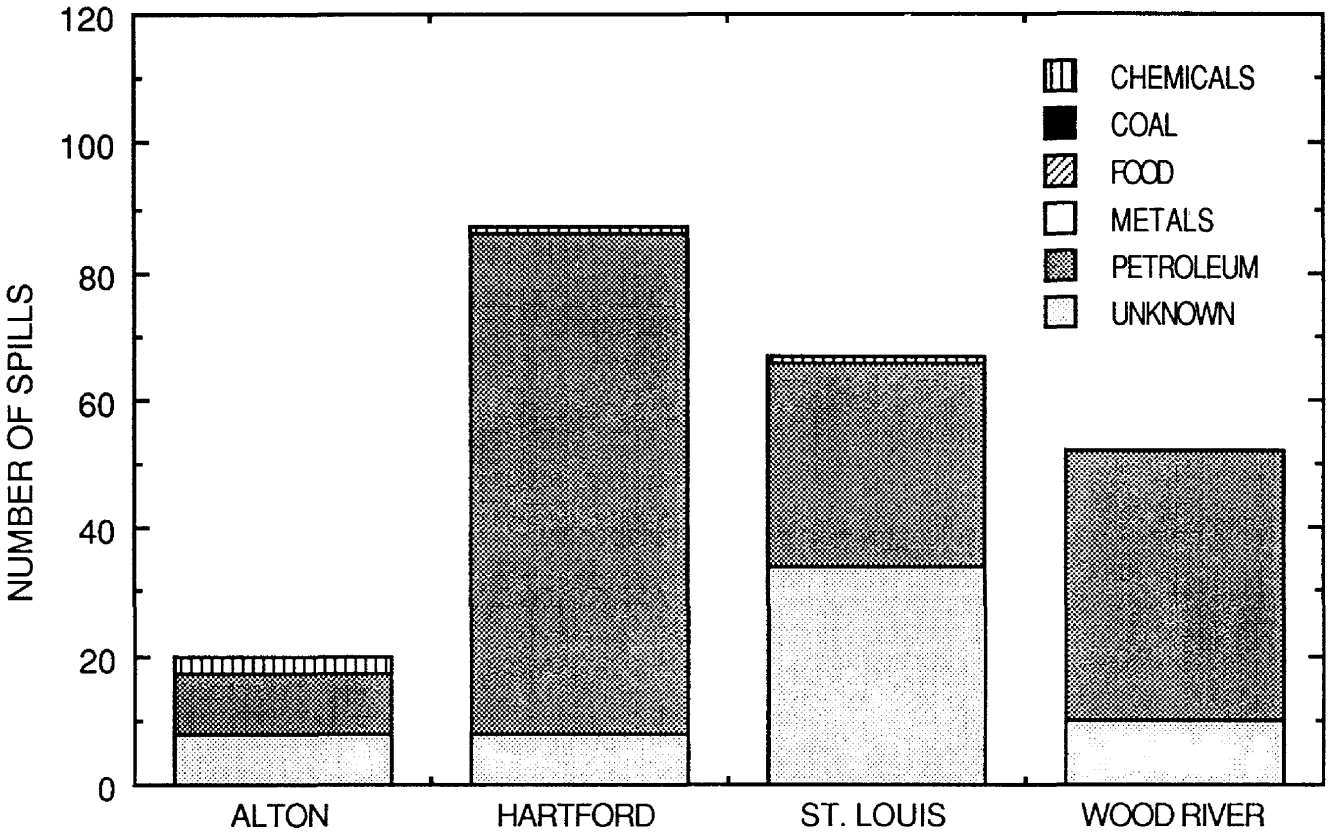


Figure 25. Locations of high numbers of accidental spills per commodity category in the St. Louis - East St. Louis region

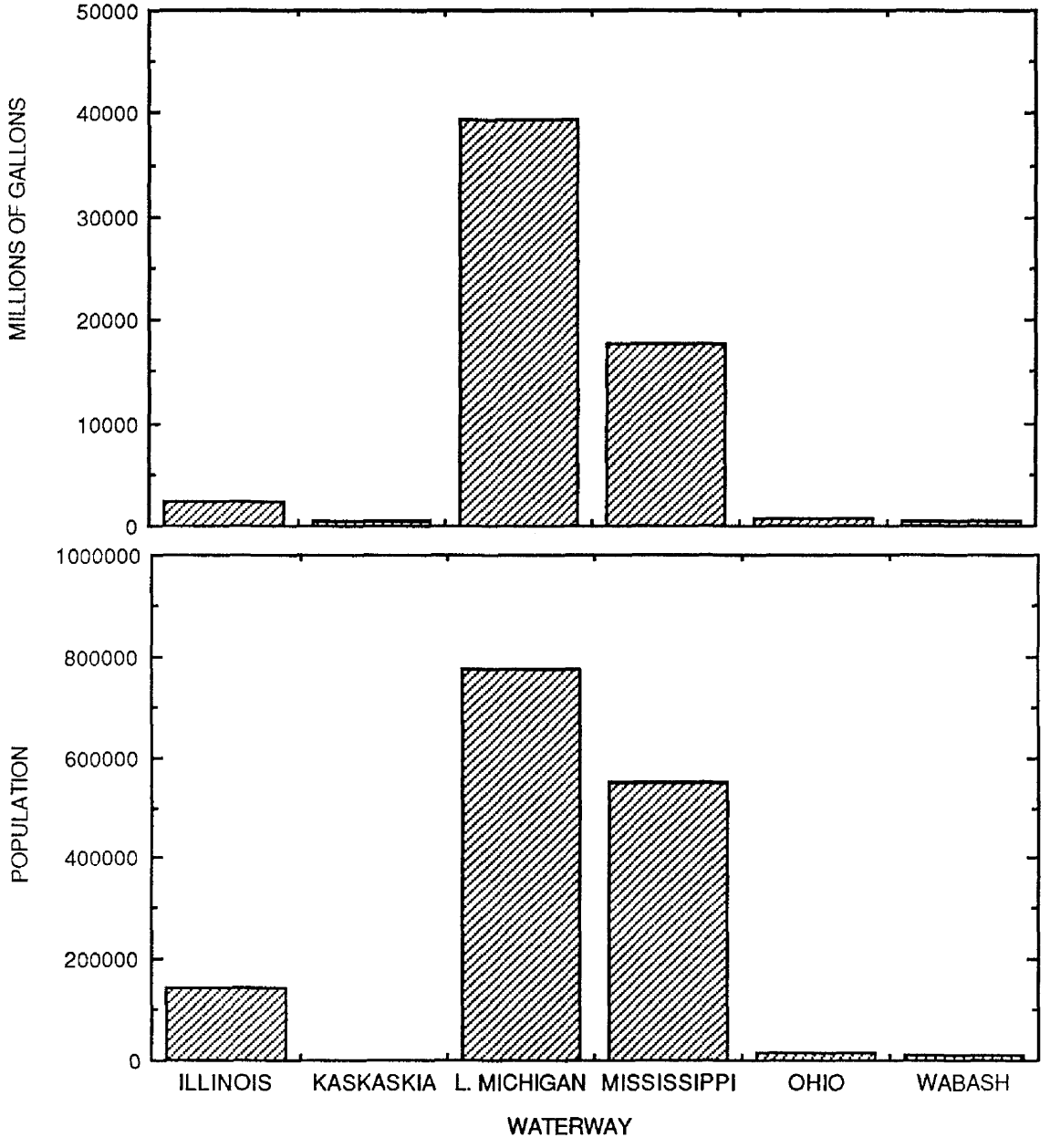


Figure 26. Water withdrawals for public water supplies in Illinois, and populations served by different waterways

CHAPTER 9. CONCLUSIONS AND RECOMMENDATIONS

Most of the information and data used for this project had to be obtained from several state and federal agencies. The collection of all the data needed for the project was extremely difficult because so many state and federal agencies are involved in matters related to navigable waterways; storage, transfer, and transport of hazardous materials; and water supply. If the process of obtaining information is as difficult for private citizens and local organizations as it was for a data collection and research agency, then there is a great need for additional information processing and transfer so that the citizens of Illinois can be better served and informed. Each agency has its own mandates, responsibilities, needs, and capabilities regarding data related to hazardous materials and waterways. In some respects, agency mandates and responsibilities were clearly defined, resulting in few duplications of records. This was the case for the SPILLS datafile, in which only 37 accidental spills were recorded by more than one source. In other respects, agency responsibilities overlap, resulting in similar data being stored at different agencies, such as was found for the FACILITIES AND TERMINALS datafile. The quality of data and the way the records are kept vary from agency to agency. Therefore gathering, reconciling, and integrating the data from different sources was difficult and time consuming.

The following conclusions and recommendations are the results of the experience gained while performing the necessary tasks for this project, and of the analysis and interpretation of the data compiled for the project.

The major conclusions are:

- The type of work done for this project was greatly needed. Even though a great deal of information and data are available from different agencies, little attempt had been made to reconcile, analyze, and integrate data from the different sources. The data from different agencies were not consistent with regard to locations and quantities of spills, there was very little duplication of spills reported between agencies, and the data were not always easily accessible. Data on facilities and terminals, spills, and water withdrawals were not available from any one source. As a result of this project, it is now possible to access information on facilities and terminals, accidental spills from 1974 to 1989, and water withdrawal points from one database.

- Waterborne transport of commodities is very important in Illinois, and the trend shows that it will continue to be important in the foreseeable future.

- Illinois has been fortunate not to have had major accidental spills of hazardous materials in its waterways, even though a large number of accidental spills have occurred in the state at many locations.

- The risk of a major accidental spill in Illinois waterways exists (although it is small) because of the large volume of hazardous materials transported in the waterways.

- Historical trends indicate that the Illinois Waterway is at higher risk for accidental spills of hazardous material than the other waterways.

- Northeastern Illinois and the St. Louis - East St. Louis area are the two regions with the highest risks for accidental spills.

- Accidental spills in Lake Michigan and the Mississippi River will have the greatest impact on public water supply in the state.

After evaluating existing data from other agencies and the results of this project, we make the following recommendations so the state can be better prepared to deal with and evaluate the impacts of future accidental spills.

- The central computer database created as a result of this project should be maintained, updated, and improved. This system should be made available and easily accessible to all local, state, and federal agencies that prepare for and respond to accidental spills. This system will make it possible for the first time to access data on facilities and terminals, records of historical accidental spills, and public water supply withdrawal locations from one database.

- A standardized reporting protocol is needed for locations and quantities of materials stored, transported, or spilled to improve the compatibility of data from different agencies.

- Consideration should be given to expanding the present database to include spills and facilities in upstream states and in non-navigable rivers and streams. This database also needs to include all surface water public water supply points in the state. It should be organized according to drainage systems and watersheds.

- As a follow-up to this project and to make the database more useful and applicable to potential accidents, we recommend the development of a pollutant transport model and its integration into the present database and the Illinois Geographic Information System (IGIS). This will make it possible to track spills as they move downstream from the location of an accident and will also help to identify the sources of spills of unknown origin.

- An inter-agency task force is needed to deal more efficiently with future accidental spills of hazardous material into Illinois waterways. Agencies involved in issues related to navigable waterways, hazardous materials, and emergency response include the IDOT, IESDA, IEPA, IDOC, ENR, HWRIC, ISWS, State Fire Marshal, USEPA, USCOE, and United States Coast Guard. Among the major problems at the time of accidental spills of hazardous materials are the lack of accurate and reliable information and the uncertainty about where to get information. At present it is not well known where to get information and whom to contact in case of an accidental spill.

The establishment of an inter-agency task force would lead to a more coordinated response in case of an accident and would streamline the flow of information and reduce confusion that generally occurs during a period of crisis.

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