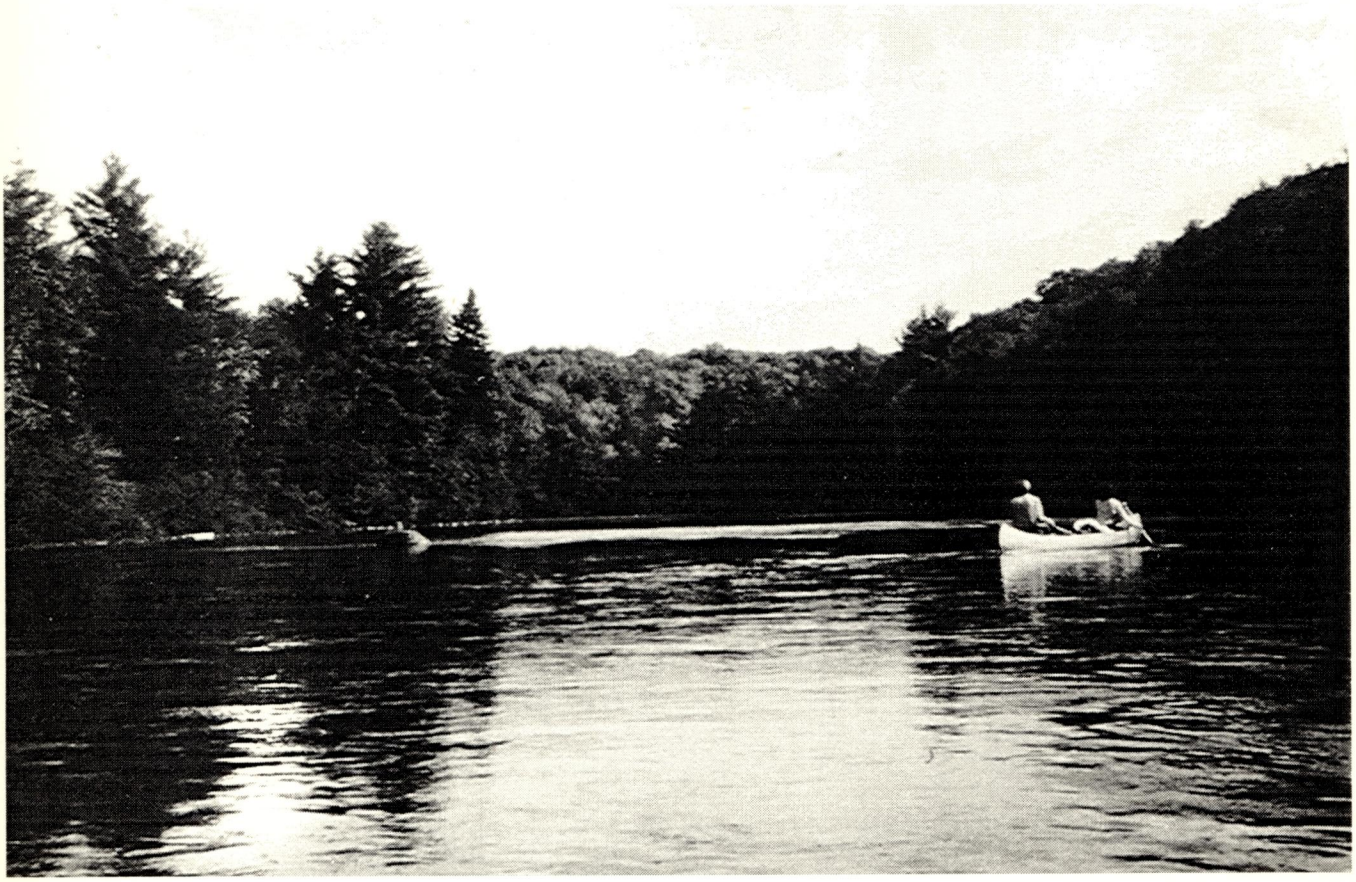
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WATER SUPPLY AND SPILL RESPONSE MANAGEMENT FOR THE MISSISSIPPI RIVER UPSTREAM OF THE TWIN CITIES



PREPARED FOR THE MINNESOTA ENVIRONMENTAL QUALITY BOARD
BY THE ST. PAUL DISTRICT, U.S. ARMY CORPS OF ENGINEERS UNDER
THE SECTION 22 PLANNING ASSISTANCE TO STATES PROGRAM

MAY 1993

136001

EQB

June 1, 1993

Dear Concerned Citizen:

The attached report signals both an end and a beginning. The report, prepared by the U. S. Army Corps of Engineers, culminates a three-year, multi-agency effort to inventory possible spill sources in the upper Mississippi River basin, develop a tool for assessing the movement and strength of spilled material, assess the state of readiness of emergency responders, and identify institutional gaps in the response system. The report also contains recommendations on what can and should be done to minimize the threat that spills present to all who use and appreciate the river.

Many things led to the initiation of this study. In 1990, the Minnesota Pollution Control Agency identified a potential for contamination problems related to river spills because of the time needed to get the responders mobilized and to the site. A 1991 follow-up report on water supply by the Metropolitan Council suggested that a comprehensive, locally-based response network could be the key to river protection. About this same time, the city of Minneapolis proposed a study of the risk associated with spills upstream of its intake at Fridley, and the Minnesota Water Plan called for a systematic program to prevent spills on the Mississippi River. These efforts eventually led to a request by the Minnesota Environmental Quality Board (EQB) for the Corps of Engineers to conduct the following study through the Section 22 Water Planning Program. The EQB asked the Metropolitan Council to serve as study manager on the state's behalf, while the city of Minneapolis provided most of the cost-share needed to match Corps' funds. Other participants include the Minnesota Pollution Control Agency, the St. Paul Water Utility, Northern States Power Company, the National Park Service and Lakehead Pipe Line Company.

Several outstanding products have resulted from this effort. The state now has a computerized inventory of sites where the potential for spillage of contaminating material can occur. This list contains approximately 1250 chemical storage facilities, rail and highway crossings and parallels, and pipeline crossings. A computer model called REMM (Riverine Emergency Management Model) was developed to track flow in the river and advise users of the strength of contamination as it moves in a plume downstream. A geographic information system (GIS) was developed for REMM to identify containment and diversion opportunities along the full length of the river above Minneapolis. Finally, an intensive survey of responders, public officials and industry was done to identify gaps in both the existing institutions and in personnel and equipment available to respond to emergencies.

As a result of these analyses, the project steering committee recommended the establishment of a non-governmental cooperative network, comprised of industry, river users, local responders, state regulatory agencies and those concerned with the general health of the river. The "River Defense Network" would span the several-hundred mile upper river basin. In addition to coordinating first response to spill emergencies, the Network could become a focal point for information on pollution prevention so that emergencies happen less often. Training and education could also be key features of the Network.

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Today, the promise of a river protection network has yet to be fulfilled. The next step for those concerned is to organize and carry the promise forward. In these days of limited budgets and increased demands, taking on additional tasks is difficult to imagine, yet the damage from a single spill could greatly outweigh the costs of some foresightful planning.

The sponsors of this study invite you to read the following document and consider your role in the River Defense Network. No matter what your perspective, we are sure you will agree that the time has come to work together to prevent any contamination of this most important Minnesota resource --- the Mississippi River.

John Wells
Minnesota Environmental Quality Board
Minnesota Section 22 Coordinator

Gary Oberts
Metropolitan Council
State-Designated Study Manager

John Soderlund
Minneapolis Emergency Preparedness
Principal Local Cooperator

ACKNOWLEDGEMENTS

Preparation of this report and development of the REMM computer program has required input from a variety of disciplines. In addition to our colleagues in the St. Paul District, Corps of Engineers, many others from the Upper Mississippi River community provided valuable assistance.

We would like to thank industrial and government agency representatives who responded to our survey and provided us with specific information on numbers of personnel and equipment available for river spill response.

Others who deserve special thanks for providing us information on spill response include Terry Carter and Jeff Van Reese, U.S. Coast Guard; Bill Bruen, State Fire Information, Research, and Education Center; Ed Leier, Division of Emergency Management, and Bob Dahm, State Fire Marshal's Office.

We would like to acknowledge Steve Lee and Daniel Hannan of the Minnesota Pollution Control Agency, and Jack Enblom of the Minnesota Department of Natural Resources for their special contributions to the report. We would like to thank the many Department of Natural Resources fisheries and wildlife managers who shared their remarkable knowledge of local conditions on the Mississippi River with us.

Personnel from the City of St. Cloud, Minnesota, provided valuable insight as to how the REMM program can be used in the field. George Jacobs, City of St. Cloud Civil Defense Director, and Jim Gasser and Tom Hannon of the Fire Department provided suggestions for refining the REMM program.

Finally, we wish to thank Gary Oberts, Metropolitan Council, John Soderlund, Minneapolis Office of Emergency Preparedness, Adam Kramer, Minneapolis Water Works, and John Wells, Minnesota Environmental Quality Board, for their guidance in determining the scope of the study, for arranging the non-Federal funding for the work, for sharing their insights throughout, and for their patience.

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SECTION 22 REPORT
WATER RESOURCES PLANNING ASSISTANCE IN SUPPORT OF MINNESOTA

WATER SUPPLY AND SPILL RESPONSE MANAGEMENT FOR THE MISSISSIPPI RIVER UPSTREAM OF THE TWIN CITIES

EXECUTIVE SUMMARY

Droughts in 1976 and in 1988-1989 focused attention on vulnerability of the water supplies for the cities of St. Cloud, Minneapolis, and St. Paul to oil and chemical spills on the Mississippi River. A major oil pipeline spill into the Prairie River at Grand Rapids, Minnesota, in March 1991 reinforced the concern about the threat of spills to the river. Contamination of the Mississippi River is a particularly serious problem for the cities of Minneapolis and St. Cloud because they would be left without water if their river intakes had to be closed for longer than one day.

Contaminant spills to rivers unfortunately are common in this country. In addition to measures to prevent accidental spills, an effective system for responding to spills is necessary to protect water users and the river ecosystem.

This report, prepared under the Federal Water Resources Development Act of 1974 (Public Law 93-251) Section 22 Program at the request of the State of Minnesota, is a step toward a more effective system for spill response on the Mississippi River from the Twin Cities upstream to the Headwaters area. The study was initiated in April 1991. Total study cost to date has been $309,100, including $92,100 cost-shared by non-Federal sources.

An inventory of potential spill sources to the river was compiled from existing databases, and entered into a geographic information system (GIS). Potential sites along the river for containing and recovering spilled products and for diverting spilled materials away from off-channel habitats were identified and entered into a GIS. A computer software package, the Riverine Emergency Management Model (REMM), was prepared for use by spill response planners and managers. The REMM is a user-friendly program that can be run on almost any personal computer. REMM computes an estimated travel time of spilled materials under a variety of hydrologic conditions, and estimates the concentration and duration of different types of spilled materials passing points downriver. In addition, REMM includes the database of potential spill sources, a river landmarks listing by river mile, and a database on potential spill containment and diversion sites and boat landings. A review of available technologies was conducted, and a system for automated detection and warning of spills to the Mississippi River is recommended.

A survey of participants in river spill response on the Mississippi River was conducted to determine the present range of jurisdictions, responsibilities, capabilities, and organizational structure for spill response. Currently, there is no comprehensive action plan to respond to a major spill in the Mississippi River upstream of Minneapolis-St. Paul. Although some trained personnel and equipment are available, a framework to tie these resources together is lacking.

Establishment of a River Defense Network is recommended. This would involve *cooperative agreements and networks among companies on or near the Mississippi* River, governmental agencies, and other organizations involved in spill prevention and spill response. Preparations for spill response would include a thorough planning and training program, staging response equipment by regions at a limited number of strategic locations along the river, and ensuring that trained personnel are readily available to rapidly deploy the equipment to achieve effective spill response. Also recommended are use of the REMM for spill response planning and management, and implementation of an automated spill detection and warning system. Although not addressed in this study, the first priority for an effective River Defense Network is effective measures to prevent spills to the river system.

INTRODUCTION

AUTHORIZATION

This report summarizes water resources planning for water supply and spill response management for the Mississippi River upstream of the Twin Cities. At the request of and with cost-share funding from the State of Minnesota, the St. Paul District Corps of Engineers is providing water resources planning assistance under the Section 22 program. The Planning Assistance to States Program, also known as the Section 22 program, is authorized by Section 22 of the 1974 Water Resources Development Act. This program authorizes the Corps of Engineers to provide planning assistance to States for the development, utilization, and conservation of water and related land resources within the State.

NEED FOR WATER SUPPLY AND SPILL RESPONSE MANAGEMENT ON THE MISSISSIPPI RIVER UPSTREAM OF THE TWIN CITIES

Spills of petroleum products and other materials into rivers unfortunately are common. In addition to loss of products, spills of materials into rivers threaten water supplies, can interrupt water appropriations for a variety of water users, upset the lives of those living near spill sites, contaminate the aquatic ecosystem, and can kill fish and wildlife. Spill response efforts are costly, are often limited in effectiveness, and are often controversial.

Droughts in 1976 and in 1988-1989 focused attention on the vulnerability of water users to low flows and contamination in the Mississippi River. Contamination of the Mississippi River from spills is a particularly serious problem because the cities of Minneapolis and St. Cloud would be left without a source of water if their municipal water supply intakes had to be closed for longer than one day. The Minneapolis water utility has no backup water supply system and has only about one day of water in off-line storage. A single contaminant spill could shut down water supply to approximately 500,000 people, and to schools, hospitals, industries, commercial buildings, and fire protection in the Minneapolis water works service area.

The City of St. Cloud is similarly vulnerable to contamination of the Mississippi River. The city withdraws between 5 and 9 million gallons per day from the river to serve a population of about 50,000 people. Wells can supplement only about 1 million gallons per day. The St. Cloud water system is presently being expanded, but no alternative source of supply is being developed. St. Cloud has only about one day of water supply in storage within its distribution system.

The St. Paul Water Utility relies on the Mississippi River to meet about 70 percent of its water demand. The remaining 30 percent of the demand is met through a combination of surface water sources in the Vadnais Lake chain (through which Mississippi River water is delivered), the Rice Creek chain of lakes, and four high capacity wells. The St. Paul Water Utility can rely entirely on these alternative sources of supply for up to one month with no adverse effects in the event of contamination or extreme low flow in the Mississippi River. A contamination event on the Mississippi River that occurred without warning could contaminate the lake system that St. Paul relies upon for delivery and storage.

Other water users could be affected by a spill event on the Mississippi River. There are presently about 37 appropriation permits for agricultural irrigation from the Mississippi River upstream of the Twin Cities (Minnesota Department of Natural Resources, Division of Waters, 1991). Six major industries along the river between Grand Rapids and St. Paul withdraw Mississippi River water for cooling and process water. Six electrical generating plants use river water for cooling. These water users could be adversely affected by a contaminant spill on the Mississippi River, depending on the amount and type of material spilled.

The Mississippi River is world-renowned, with abundant fish, wildlife, and aesthetic appeal. Spills to rivers can severely damage aquatic ecosystems, killing fish and wildlife and preventing recreational use. Depending on the amount and type of material, recovery of river ecosystems following spill events can take years.

Contamination of the Mississippi River by accidental spills has occurred and a major spill is a distinct possibility, as evidenced by a series of recent spills to rivers:

- January 1988 - Monongahela River. An 800,000-gallon diesel fuel spill from a tank farm near Pittsburgh, Pennsylvania, in January 1988 fouled the Monongahela and Ohio Rivers and caused a drinking water crisis in three States.

- June 1990 - Minnesota River. 78,000 gallons of diesel fuel spilled from a pipeline into the Minnesota River.

- March 1991 - Mississippi River. 1.7 million gallons of crude oil spilled from a pipeline into the Prairie River (tributary to the Mississippi) at Grand Rapids, Minnesota, in March 1991. The spill fortunately occurred during winter, and the spill was contained within a limited area before it reached the Mississippi River.

- July 1991 - Mississippi River. A train derailed and spilled diesel fuel and butter into the Mississippi River near Fountain City, Wisconsin.

- July 1991 - Sacramento River. A rail tanker spill of herbicide devastated aquatic life in the Sacramento River and Lake Shasta in California.

- June 1992 - Nemadji River. A train derailed and spilled a benzene mixture into the Nemadji River near Superior, Wisconsin, resulting in evacuation of 22,500 people.

Prevention of spills into the Mississippi River must be a first priority. In addition, an effective program for spill response and water supply management is clearly needed to protect water users and the Mississippi River ecosystem.

PLANNING FOR EMERGENCY WATER SUPPLY AND SPILL RESPONSE MANAGEMENT

Minnesota State agencies and Twin Cities municipalities focused on the need for further planning for spill response and water supply management following the 1988 drought. In its evaluation of the Twin Cities metropolitan area water supply, the Metropolitan Council concluded, "The State [Minnesota Pollution Control Agency, 1990] has found that we are ill-prepared to respond to accidental spills on the [Mississippi] river. An evaluation of the programs in place to identify spills and respond to them suggests that some comprehensive basin prevention, detection, and response action is needed...." (Metropolitan Council, 1991).

The Minnesota Environmental Quality Board (EQB) coordinates Section 22 water resources planning for the State of Minnesota. The EQB requested that the St. Paul District, Corps of Engineers provide assistance in planning for spill response and water supply management for the Mississippi River upriver from the Twin Cities in December

1991. The EQB requested that the Metropolitan Council of the Twin Cities Area represent the State's interest in the study and designate a State study manager in a letter dated December 17, 1991.

A series of planning meetings were held with representatives of the Metropolitan Council, the City of Minneapolis, the Minnesota Environmental Quality Board, the Minnesota Pollution Control Agency, and the State Emergency Management Agency. A list of Section 22 planning tasks was prepared to lead toward improved spill response and water supply management capabilities (Table 1). A series of cost-share agreements between the State of Minnesota, the Environmental Quality Board and the St. Paul District, Corps of Engineers were developed as the work progressed. To date, total study costs have been $309,100, of which $92,100 has been contributed as non-Federal cost share.

Table 1. Section 22 planning tasks for emergency water supply and spill response management for the Mississippi River upstream of the Twin Cities.

Phase I - Inventory of Potential Spill Sources

A. Identify roadway, rail, and pipeline crossings and parallel runs near the river and tributaries.

B. Identify major chemical and fuel storage facilities near the river and tributaries.

C. Develop a computer database of potential spill sources that can be readily used by spill response managers, with geographic coordinates and river mile designations for each potential source.

D. Identify physical/chemical character of contaminants and their behavior if spilled to the river under different hydrologic conditions.

E. Provide GIS files of spill sources, database, map products.

Phase II - Potential Impact of Spills

A. Hydraulic Travel Time Model

1. Develop a hydraulic routing model to predict travel time of contaminant spills down the Mississippi River between various points under different levels of river discharge, with and without ice cover.
2. Develop a computer model for predicting spill arrival time that can be readily used by spill response managers.

B. Spill Concentration/Duration Model

1. Further develop the hydraulic routing model to predict the initial arrival time, peak concentration and arrival time, and duration of pulses of spilled floating and entrained materials, at various points downstream under different levels of river discharge, with and without ice cover.
2. Further develop a computer model for predicting spill arrival time, peak concentration and arrival time, and duration that can readily be used by emergency response managers.

C. Impact of Spills on River Ecosystem

1. Evaluate the impact of spills of various types of materials on river water quality and aquatic life.

D. Spill Scenarios

1. Develop a series of potential spill scenarios, including reasonably-foreseeable worst case events for different water users, for use by emergency response managers.

Table 1. (continued)

Phase III River Defense Network A. Detection and Alert System 1. Investigate technologies for automated spill detection and alert. 2. Recommend an automated spill detection and alert system for the Mississippi River upstream of the Twin Cities. B. River Defense Network 1. Identify stakeholders in spill response. 2. Survey stakeholder responsibilities and capabilities for spill response. 3. Evaluate the existing spill response system. 4. Recommend features of a River Defense Network.

STUDY TEAM MEMBERS

An interdisciplinary team of St. Paul District, Corps of Engineers staff was greatly assisted by personnel from the following agencies in the conduct of this study:

City of Minneapolis (Water Works and Office of Emergency Preparedness)
Metropolitan Council
Minnesota Environmental Quality Board
Minnesota Pollution Control Agency

STATE COST SHARE CONTRIBUTORS

The following agencies, industries, and units of government provided management staff assistance and funding for the study:

City of Minneapolis
Metropolitan Council
City of St. Paul
Northern States Power Company
Lakehead Pipeline Company
U.S. Department of the Interior, National Park Service

STUDY AREA

The study area for this Section 22 planning effort extends from the Mississippi River Headwaters to the Minneapolis and St. Paul municipal water intakes on the

north side of the Twin Cities metropolitan area (Figure 1). The Mississippi River flows through or adjacent to 15 counties in its course from the Headwaters to the Twin Cities. The distance from the outlet of Lake Bemidji to the Minneapolis water utility intake at Fridley is approximately 443 river miles.

DEVELOPMENT OF AN INVENTORY OF POTENTIAL SPILL SOURCES

Contaminant spills to rivers can originate from fixed facilities and transportation systems. Fixed facilities are primarily storage tanks for liquid materials such as fuels and industrial process chemicals.

Pipelines carry petroleum products and municipal sewage. Railroads and highway trucks carry almost every fuel and chemical product in commercial use.

Barge transport, another potential spill source to the Mississippi River, was not considered in this study because the Mississippi River 9-foot navigation channel ends slightly downstream of the City of Minneapolis and City of St. Paul water intakes.

A complete inventory of all potential spill sources to the Mississippi River upstream of the Twin Cities would be impracticable to develop and keep current. A complete inventory is not a requirement for water supply planning and spill response management, however. The focus of inventory development, therefore, was on the major potential sources.

INFORMATION SOURCES FOR FIXED FACILITIES

The fixed facilities portion of the potential spill source inventory includes industries, petroleum terminals, water and wastewater treatment plants, and electrical generating plants. Three existing databases on fixed facilities were obtained from Minnesota State agencies.

The primary source of the inventory was the Minnesota Emergency Management Agency (MEMA) database on hazardous materials storage sites, required by Title III of the Federal Superfund Amendments and Reauthorization Act of 1986 (SARA). Owners of facilities that routinely handle significant quantities of hazardous materials are required to file chemical inventory information with the Minnesota Emergency Response Commission (MERC). The hazardous materials inventory maintained by MERC is compiled by county. Each site is assigned an identification number. The materials in storage, container type, container location (above ground or below ground, inside, outside, etc.), range of container volume in pounds (minimum, maximum, and average in storage), storage pressure and temperature, address, facility name, phone number, and contact persons are reported for each site.

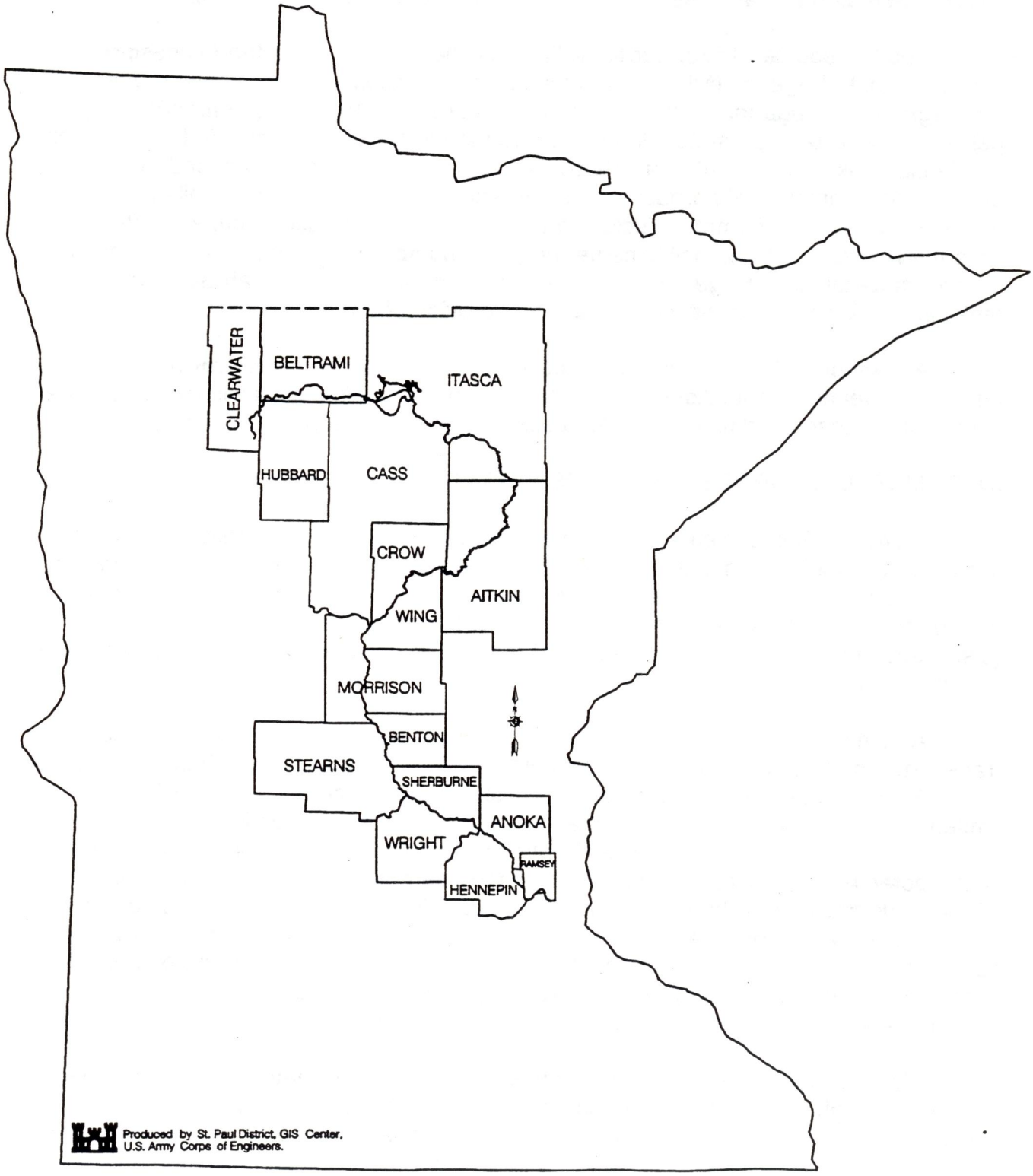


Figure 1 - Study Area

MERC provided the St. Paul District, Corps of Engineers with a computer file of the hazardous materials database for counties in the Mississippi River basin.

Another source of fixed facility listings for the inventory was the Minnesota Pollution Control Agency (MPCA) Tanks and Spills Section listing of above-ground and below-ground storage tanks. Storage tanks larger than 110 gallons containing petroleum or hazardous materials are included in the listing. Not included are farm or residential tanks under 1,100 gallons containing motor fuel, heating oil, and materials used for non-commercial purposes. The storage tanks database is compiled by county. It contains information including an assigned identification number (different from the MERC number), facility name, address, number and volume of tanks (gallons) on site, materials in storage, and average volume in storage. A database for storage tanks in Mississippi River basin counties was provided by the MPCA.

A computer file of storage sites for agricultural pesticides was provided by the Minnesota Department of Agriculture. The Department of Agriculture listing includes all Minnesota licensed/certified pesticide applicators and farm supply dealers.

INFORMATION SOURCES FOR TRANSPORTATION SYSTEMS

Transportation systems that are potential spill sources to the Mississippi River upriver of the Twin Cities include highways, railroads, and pipelines. The locations of river crossings and runs parallel to the Mississippi River and tributaries for these transportation systems were obtained from U.S. Census Bureau TIGER digital files (discussed below), and from digital files of pipeline routes from the Minnesota Department of Transportation.

A complete inventory of traffic rates and the types and amounts of materials transported by truck and rail is a practicable impossibility to develop. Shipping records are proprietary, and reporting requirements (except for hazardous materials) are limited. Practically every fuel, industrial chemical, agricultural chemical and waste product is transported by truck or rail in Minnesota. The transportation systems portion of the potential spill source inventory therefore does not include the types and amounts of materials transported by truck and rail. General information on materials carried by truck was obtained from the U.S. Census Bureau Truck Inventory and Use Survey (U.S. Census Bureau, 1987). Information on hazardous materials carried by rail was obtained from the U.S. Department of Transportation (U.S. Department of Transportation, 1991).

Pipeline companies were cooperative in providing information about materials pumped through pipelines. Information on the types and quantities of materials transported through pipelines is included in the potential spill source database.

BASE DATA FOR GIS APPLICATIONS

The digital base map used for all GIS applications for this study was the U.S. Department of Commerce, Bureau of the Census TIGER (Topologically Integrated Geographic Encoding and Referencing) system. The TIGER system provides a framework of cultural and hydrologic data for the geographic analysis of potential spill sources. The decision to use the TIGER system was made because of its availability for the entire study area, good relative accuracy (1:100,000 scale or better), and ease of use.

The Minnesota Department of Transportation (MNDOT) supplied the digital pipeline, road, and railroad data for mapping applications. This data is found on Minnesota General Highway Maps and is organized by county. Pipeline data has not been made available to the public with a high degree of positional accuracy. The pipeline data from the MNDOT was the best regional pipeline data available in a digital format, providing a general framework of the pipelines throughout the study area. Detailed maps of pipeline parallel runs and river crossings with a potential for impact to the Mississippi River were provided by pipeline companies.

SORTING BY SIZE OF STORAGE CONTAINERS AT FIXED FACILITIES

The MPCA tanks database contains a large number of listings for smaller tanks (under 1,000 gallons). We selected 1,000 gallons as a minimum size tank for inclusion in the potential spill source inventory.

SORTING BY GEOGRAPHIC LOCATION

Many of the fixed facilities in the databases obtained are not potential sources of spills to the Mississippi River. Materials spilled from facilities distant from the Mississippi River and tributaries would be contained before reaching the river. A process was employed to eliminate database listings which are not potential spill sources.

In order to view the spatial distribution of fixed facilities in the databases and to sort facilities according to their location, geographic coordinates were needed for each site. Geographic coordinates were not available in the databases obtained. The addresses for each site in the combined database were furnished to a private firm for matching the facility addresses with geographic coordinates in the Census Bureau's TIGER database. Because a number of the site addresses were identified only by post office box or rural route number, coordinates for many sites could not be determined from the TIGER database. Of the 3,582 sites listed in the four databases obtained, 1,196 sites had addresses that could not be matched with the TIGER database and assigned geographic coordinates. A second effort was made to obtain better addresses and locations for sites near the Mississippi River and tributaries. Telephone

directories were initially used to identify more specific addresses. If this failed, the facility was called and an attempt was made to identify its location on a highway or on a U.S. Geological Survey quadrangle map. In some instances, the persons contacted were uncooperative and no specific location was identified. In other cases, the facility was no longer in operation. For 161 of these sites, a specific location suitable for mapping was found. The GIS was used to digitize the location of these sites to obtain the required geographic coordinates.

Three types of buffer zones, or "masks," were created with the GIS to determine which sites would likely affect the river: 1) along the Mississippi River main stem, 2) along tributaries of the Mississippi River, and 3) around urban areas. The sizes of the river buffer zones were determined by consulting with hydraulic engineers familiar with material travel time in river systems and with knowledge of the range of hydrologic conditions of the Mississippi River and its tributaries. The goal was to delineate the buffer zone to include all potential spill sources where spilled material could enter the Mississippi River before measures could be implemented to contain its movement. Spills outside the buffer zone would typically be detected and contained before they reached the main stem of the Mississippi River. This zone was based on professional judgment and should therefore be modified as data is obtained that might better define its boundary.

A buffer zone at a distance of 800 meters (approximately 0.5 mile) along each side of the main river channel was defined, thus forming an approximately one-mile-wide buffer along the Mississippi River main stem. Tributary streams were buffered at a distance of 400 meters (approximately 0.25 mile) from tributary center line, creating an approximately 0.5-mile-wide buffer zone along the tributaries.

Identifying potential spill sources in urban areas was complicated by altered surface drainage, storm drains, and sanitary sewer systems. Obtaining and incorporating detailed information on city drainage networks proved to be impractical, given the number of municipalities involved. Most cities in the study area do not have digital files of their drainage systems. Manually compiling this data was outside the scope of this study. The decision was made to use the "Watersheds for Surface Water Management" map, provided by the Metropolitan Council, and existing city street networks as a basis for buffering the Twin Cities urban area. Urban storm drain systems generally follow watershed surface flow patterns toward outlets to rivers. These watershed boundaries provided information at a regional scale that allowed us to predict potential spill movement.

Analyzing the distribution of spill sites with respect to watersheds and the underlying road network allowed delineation of the urban buffer. Since knowledge of urban drainage was limited, the urban buffers were expanded to include sites on the fringe of the defined potential spill source zone. All potential spill sources with a reasonable chance of reaching the Mississippi River or its tributaries through urban drainage were included.

The GIS allowed use of the river and urban buffers as a spatial mask. Those sites that did not occur within the defined buffered areas were removed from the potential spill source database. This data reduction thus streamlined the database to include only those sites with potential to affect the Mississippi River. The final number of fixed facilities in the potential spill source database is 1,187.

The transportation systems listings in the potential spill source database include the highway, railroad and pipeline crossings and parallel runs within the buffer zones of the Mississippi River and tributaries. A total of 73 potential spill sources from transportation systems were identified within the study area and included in the REMM database (described below).

RIVER MILE NUMBERING SYSTEM

The Mississippi River mile numbers used in the databases and GIS products for this study were created using historically-assigned river miles for gaging stations and landmarks. The mile numbers follow the Upper Mississippi River system, corresponding to river miles upstream of the mouth of the Ohio River. The historically-assigned landmark river miles were interspersed irregularly along the course of the Mississippi River upstream of the Twin Cities. Measuring accurate distances between landmarks was necessary in order to assign a unique river mile designation to each potential spill source. Scanned aerial photos were rectified and measurements made directly using the GIS to compute accurate distance between landmarks. River mile designations were then digitized directly into a file to be used for location analysis. Due to river course changes over time, it should be noted that the distance between landmarks and individual river miles may not reflect absolute distance. The goal of producing a complete river mile numbering system was to provide a guide for locational reference.

ASSIGNMENT OF RIVER MILES TO POTENTIAL SPILL SOURCE SITES

Assigning a unique river mile to all potential spill sources was accomplished by determining the proximity of the site to the main channel, tributary, or urban buffer. This was accomplished on the GIS system with river mile values entered into the potential spill source database and later imported into the REMM model (discussed below). Sites that resided in the main channel buffer were assigned the closest downstream river mile to the site. This determination was based on the assumption that spills occurring within the main stem buffer would flow directly to the Mississippi River.

Sites that occur inside the tributaries buffer were assigned river miles coinciding with the tributary confluence with the Mississippi River.

Urban buffer areas north of the Twin Cities metro area were treated as complete drainage networks. All sites inside these areas were assigned river miles corresponding to the downstream limits of the urban buffers.

Surface watershed boundaries were used in the Twin Cities metro area to delineate the urban buffer. Sites inside a watershed boundary were assigned river miles that coincided with the drainage outlet for that watershed into the Mississippi River. In metro watersheds that did not possess a defined drainage pattern, the watershed was treated as a complete drainage system. All sites inside these areas were assigned river miles that corresponded to the downstream limit of the urban watershed boundary. Assignment of river miles corresponding to the downstream limits of urban buffers with unclear drainage patterns allows use of the REMM software (discussed below) to search for potential spill source sites upstream from a selected river mile in a radius defined by the user.

INFORMATION INCLUDED IN THE POTENTIAL SPILL SOURCE DATABASE

Information in the pipelines database includes: materials (gas, petroleum products, sewage, industrial process materials), river mile, location names, units (daily flow in gallons), diameter (inches), flow rate (gallons/minute), segment volume (gallons), State identification number, and geographic coordinates (UTM easting and northing, (m)). For pipelines running parallel to the river within the buffer zone, the range of river miles and geographic coordinates is provided.

Railroad company names, river miles, location names, State identification number, and geographic coordinates are included in the database. For railroads running parallel to the river within the buffer zone, the range of river miles and geographic coordinates is provided.

Highway name or number, river mile, State identification number, and geographic coordinates are included in the highways database. The range of river miles and geographic coordinates is included for highways running parallel to the river within the buffer zone.

The above- and below-ground storage tanks database includes State identification number, river mile, name, address, geographic coordinates, materials in storage, and range of volume stored.

The agricultural chemicals storage site database includes State identification number, river mile, name, address, geographic coordinates, chemical type code (with key to types), and amount stored (range in pounds).

Database information on SARA Title 3 sites includes State identification number, river mile, name, address, geographic coordinates, materials stored, and amount stored (range in pounds).

Information on spill containment and diversion sites in the database includes river mile, boom length (feet), geographic coordinates, site type, priority ranking for diversion (high, medium, low), access bank (right or left descending bank), site name, township or city on the right bank, township or city on the left bank, county on the right bank, county on the left bank, nearest boat landing, boat landing bank, and road directions to the site.

POTENTIAL SOURCES OF SPILLS TO THE MISSISSIPPI RIVER

The potential spill source inventory developed for the Mississippi River upstream of the Twin Cities contains a total of 1,250 sites within the river buffer zones. The inventory is not complete because it would have to be continuously updated. The inventory, however, does provide a listing of the major potential sources of spills to the river, and much about their characteristics. For geographic distribution analysis, the Upper Mississippi River was divided into 7 reaches as shown in Table 2.

Table 2. Selected Mississippi River reaches.

Reach	River Mileage	Reach Description
1	1183.8 to 1301.3	Lake Bemidji to Lake Pokegama
2	1183.8 to 1003.8	Lake Pokegama to Brainerd
3	1003.7 to 965.3	Brainerd to Little Falls
4	965.2 to 928.4	Little Falls to St. Cloud
5	928.4 to 896.9	St. Cloud to Monticello
6	896.9 to 871.7	Monticello to Anoka
7	871.7 to 853.9	Anoka to Upper St. Anthony Falls Lock and Dam

Underground tanks and hazardous materials storage sites are the most numerous potential spill sources (Figure 2). Potential spill sources are concentrated in two river reaches, from Anoka downriver into the metropolitan area, and in the St. Cloud to Little Falls reach (Figure 3).

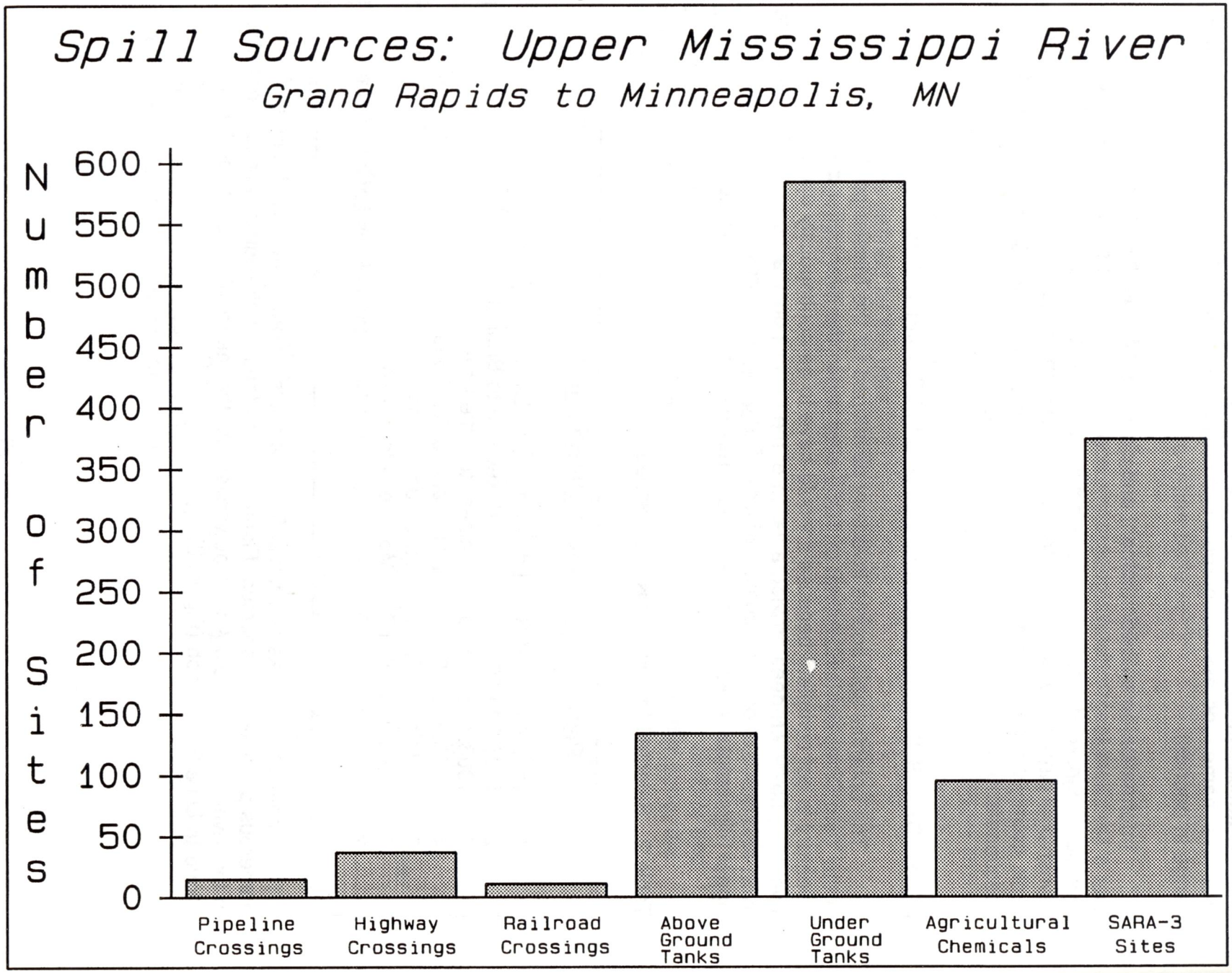

Spill Sources: Upper Mississippi River
Grand Rapids to Minneapolis, MN
Number of Sites
600
550
500
450
400
350
300
250
200
150
100
50
0
Pipeline Crossings
Highway Crossings
Railroad Crossings
Above Ground Tanks
Under Ground Tanks
Agricultural Chemicals
SARA-3 Sites

Figure 2 - Number of potential spill sources by type

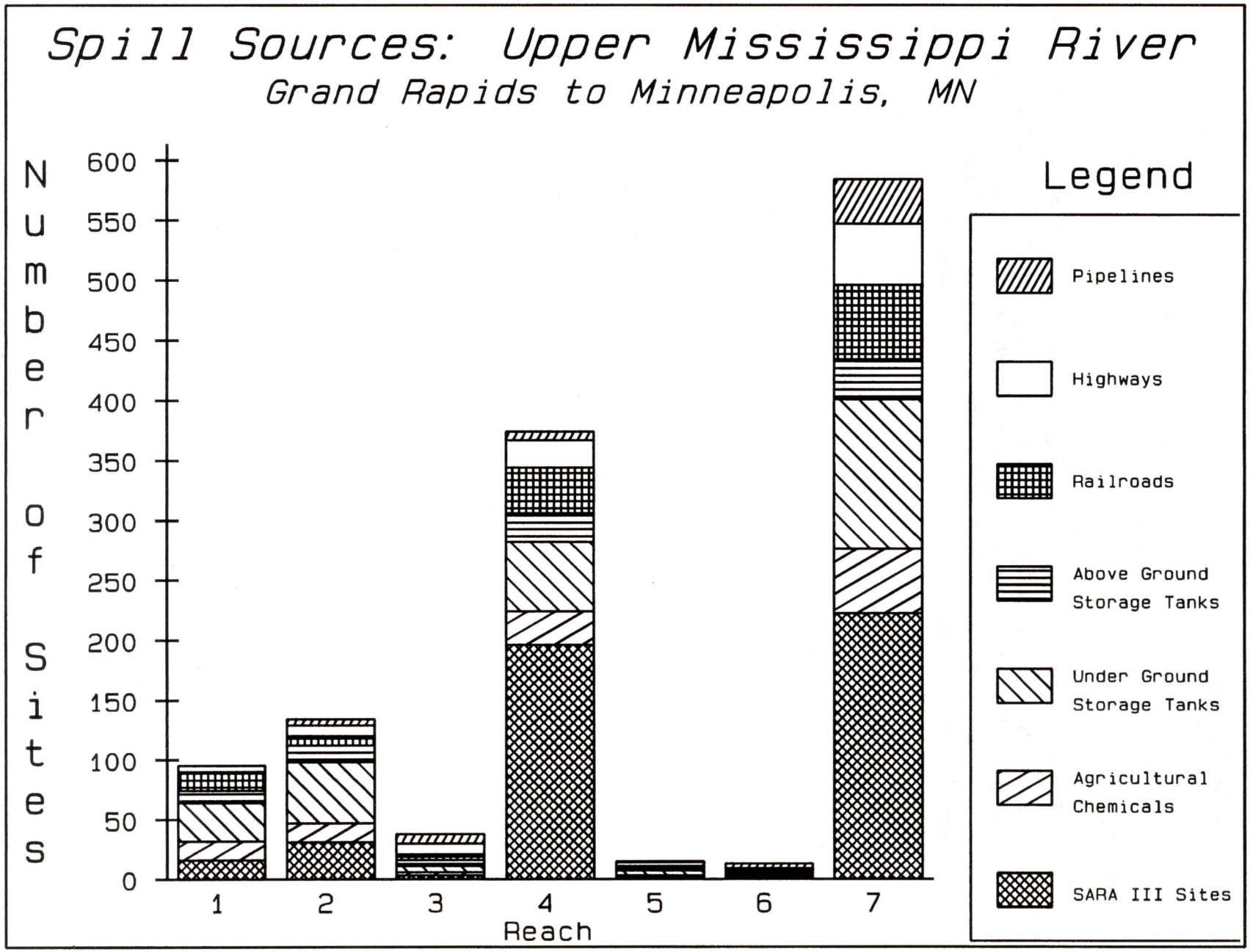


Figure 3 - Distribution of potential spill sources by river reach

FIXED FACILITIES

Fixed facilities consist of aboveground and underground storage tanks, agricultural chemical (pesticides) storage buildings, and SARA Title III hazardous waste storage sites.

The total number of potential spill sources at fixed sites is 1,187. There are 134 aboveground storage tanks, 584 underground storage tanks, 95 agricultural chemical sites, and 374 hazardous waste sites. A geographical distribution of each type of fixed facility is shown on Figures 4, 5, 6, and 7, and in Table 3. Materials and volumes in storage at each site may be found in the databases supported by the REMM model.

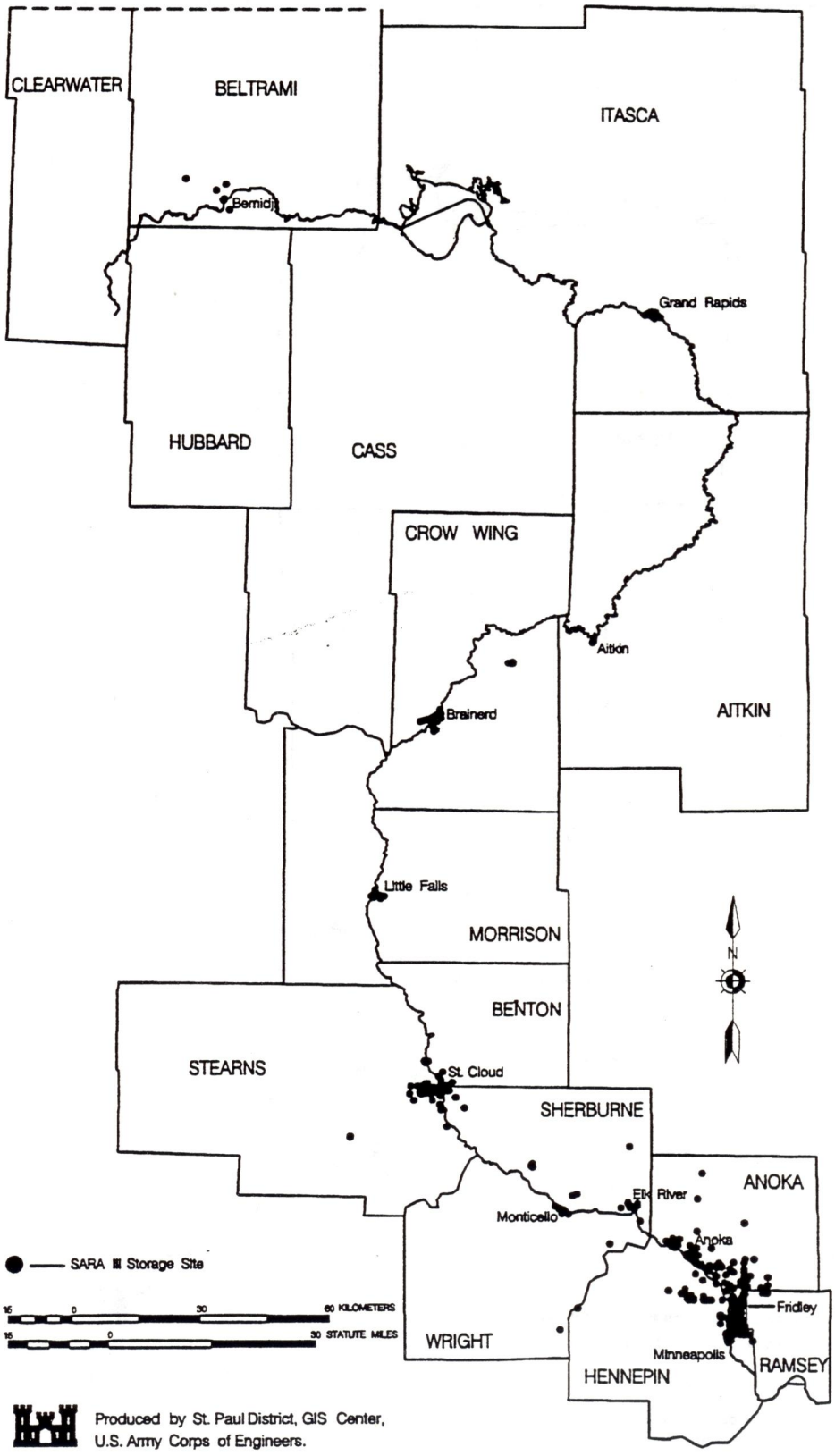


Figure 4 - Location of SARA III hazardous materials storage sites

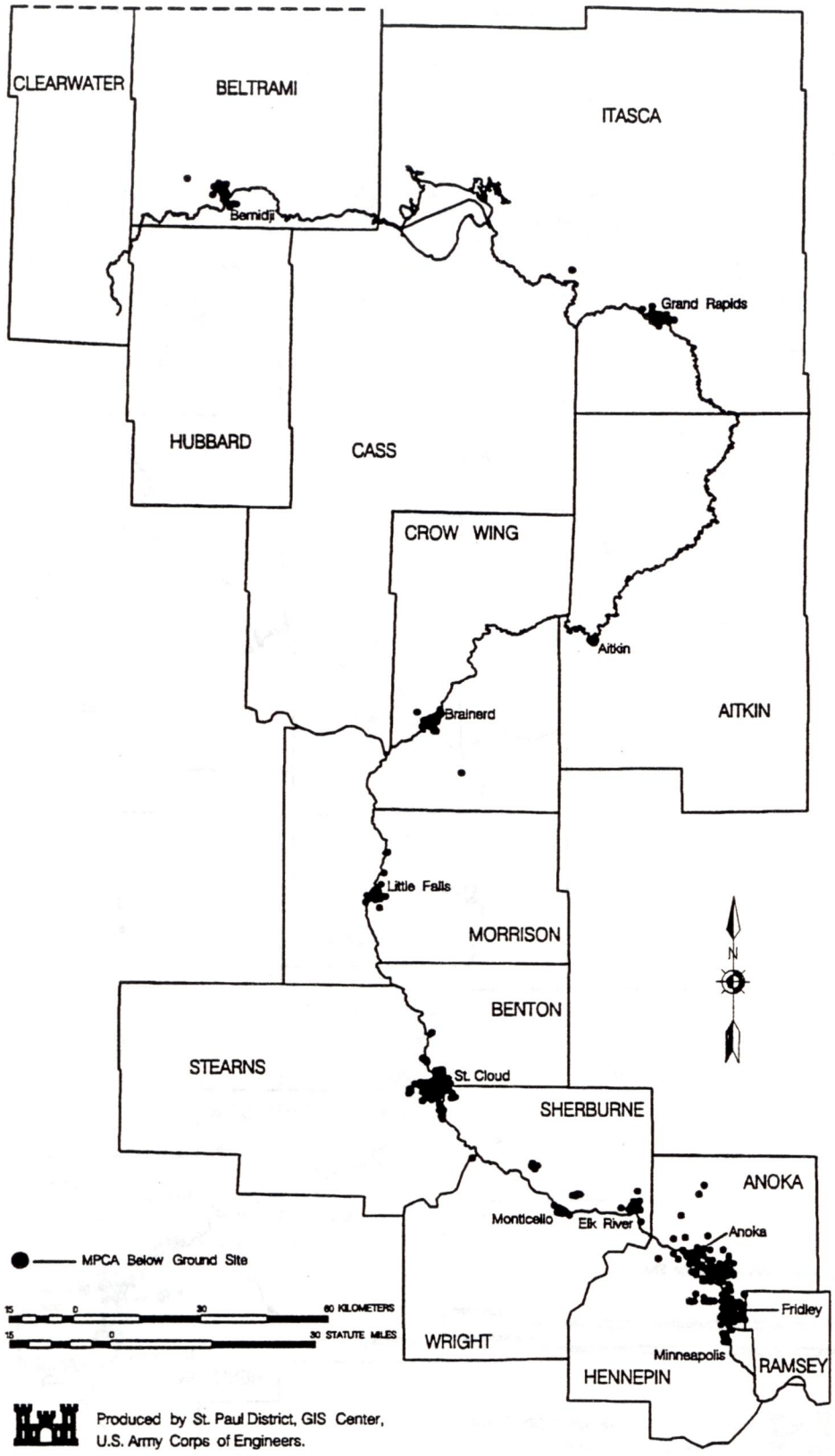


Figure 5. Location of underground storage tanks listed by MPCA

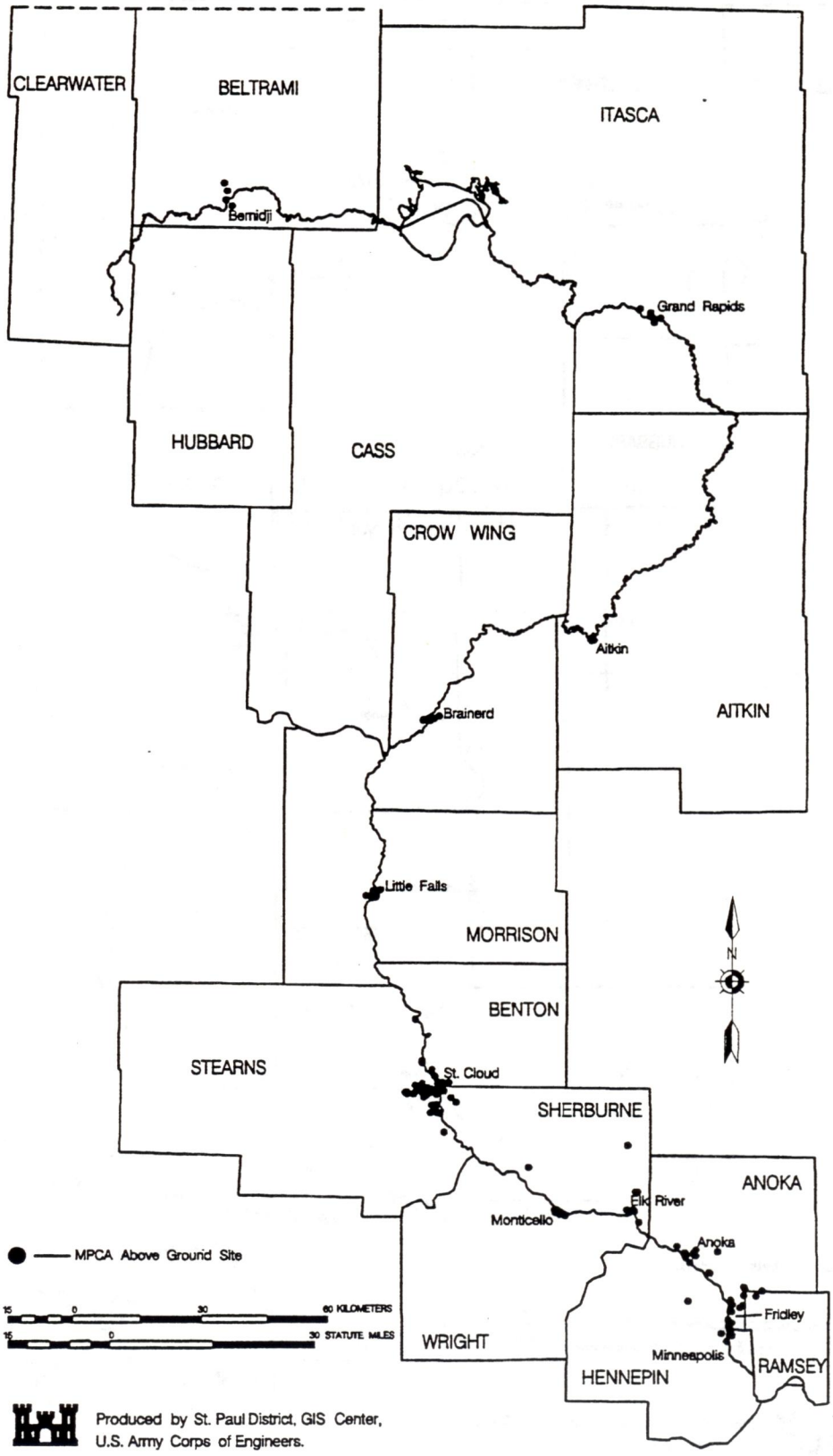


Figure 6. Location of above ground storage tanks listed by MPCA

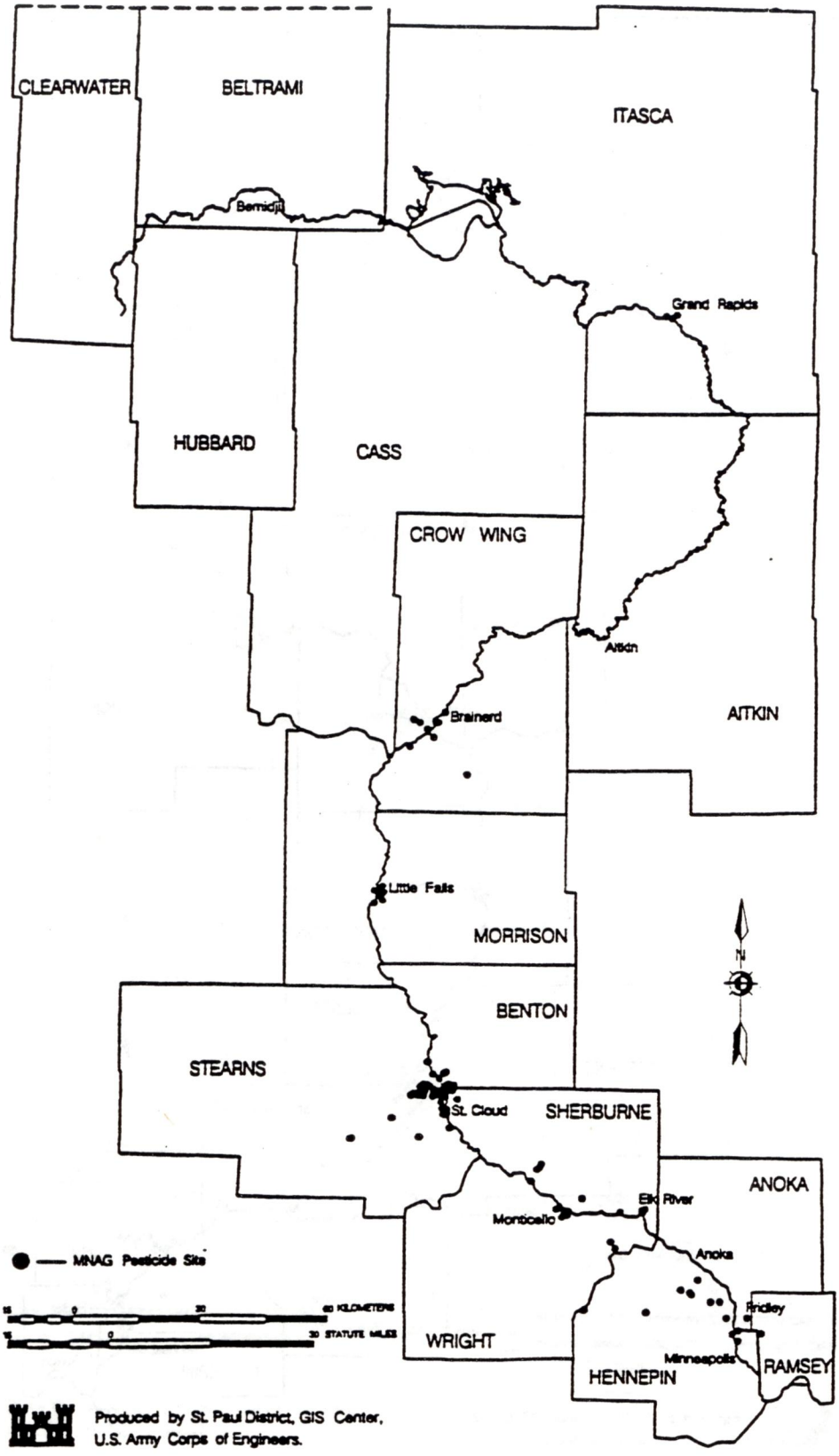


Figure 7. Location of agricultural chemical storage sites listed by the Minnesota Department of Agriculture

Table 3. Distribution of potential spill sources from fixed facilities.

	Reach Number						
Facility Type	1	2	3	4	5	6	7
Agricultural Chemicals	0	5	16	10	32	16	6
Aboveground Tanks	5	9	8	14	51	16	31
Underground Tanks	37	51	62	33	125	54	222
SARA Title III Sites	7	23	38	24	58	28	196

TRANSPORTATION SYSTEMS

Pipelines, highways, and rail lines are potential spill sources. The distribution of transportation system river crossings and parallel runs in the study area is shown in Table 4.

Table 4. Distribution of potential spill sources from transportation systems.

Transportation	Reach Number						
System Type	1	2	3	4	5	6	7
Highway Crossings	8	9	5	5	5	3	3
Pipeline Crossings	1	3	2	2	4	1	2
Railroad Crossings	4	1	3	2	2	0	1

HIGHWAYS

Nearly every material in commercial use and every waste product are carried by truck. The U.S. Highway 694 bridge in Fridley , located just 1.8 miles upstream of the Minneapolis water intake, has the highest traffic rate of bridges in the study area. Table 5 contains a listing of highway crossings over the Mississippi River and traffic rates. Other high traffic bridges are located in Anoka, Elk River, St. Cloud, Brainerd, and Grand Rapids. Unit quantities are about 10,000 gallons, the size of a semi-trailer tank.

Table 5. Highway river crossings and traffic rates (number/day).

Highway	River mile	Total Traffic	Commercial Traffic	Year
I-694 at Fridley	860.5	1,116,000	7,180	1988
State 610 at Coon Rapids	865.0	37,000	1,200	1988
US 169 at Anoka	871.5	32,000	1,330	1988
New State 101 at Elk River	883.6	18,500	1,300	1987
Old State 101 at Elk River	884.6	4,070	-	1988
State 25 at Monticello	896.9	11,910	240	1988
State 24 at Clearwater	914.0	7,515	660	1988
10th Street Bridge at St. Cloud	926.5	12,930	-	1989
US 52/State 23 at St. Cloud	927.4	25,400	-	1989
St. Germain Street Bridge at St. Cloud	927.7	13,925	-	1989
State 152 at St. Cloud	929.4	16,700	-	1989
Local Bridge at Sartell	932.3	9,540	-	1987
Local Bridge at Sartell	932.4	130	-	1987
Local Bridge near St. Stephen	945.2	2,550	-	1987
Local Bridge near Royalton	953.7	1,000	-	1989
State 27 at Little Falls	965.4	3,860	330	1988
US BYP 10 at Little Falls	967.2	5,880	390	1988
State 115 at Camp Ripley	973.5	795	55	1988
Laurel Street Bridge at Brainerd	1001.4	4,000	-	1986
College Drive Bridge at Brainerd	1001.4	3,490	-	1986
State 210/371 at Brainerd	1001.5	22,020	800	1988
State 25 at Brainerd	1004.2	6,835	145	1988
State 6 near Cuyuna	1029.2	2,910	120	1988
2 Local Road Crossings on Flood		280	-	1988
Diversion Channel around Aitkin		155	-	
Local Bridge at Aitkin	1055.9	650	-	1988
US 169 North of Aitkin	1073.7	1,665	130	1988
State 232 at Palisade	1086.6	390	20	1988
State 200 at Jacobson	1137.5	905	70	1988
Local Bridge near Blackberry	1171.7	440	-	1989
7th Avenue SE Bridge at Grand Rapids	1180.4	7,760	-	1985
US 169 at Grand Rapids	1180.4	6,480	230	1988
Local Bridge at Grand Rapids	1182.5	3,450	-	1989
Local Bridge at Cohasset	1186.3	265	-	1989
US 6 West of Cohasset	1196.5	750	80-	1988
Local Bridge, Little White Oak L.	1203.8	150	-	1989
Local Bridge, Ball Club Lake	1223.7	1,800	-	1989
US 2 near Ball Club Lake	1230.8	2,090	510	1988
Local Bridge at Winni Dam	1247.9	540	-	1988

RAILROADS

There are seven actively used railroad bridges over the Mississippi River in the study area, and 106 miles of track run parallel to the river within the study buffer zones. Six rail lines cross Mississippi River tributaries. A wide variety of materials are carried by rail, including hazardous cargoes. During 1986, an estimated 123.9 million net tons of freight was moved by rail in the State of Minnesota. Of this, 1.97 million net tons were hazardous material. The Burlington Northern line along the Mississippi River from Fridley through Brainerd has the highest traffic rates. Table 6 contains a listing of rail lines in the study area and traffic rates.

Table 6. Rail traffic rates within the study area for trains carrying hazardous materials at Mississippi River crossings (1987).

Location	River Mile	Cars/Year	Trains/day
Burlington Northern Bridge at St. Cloud	927.8	10,000-30,000	50
Soo Line Bridge near Royalton	956.5	>300	0.1
Burlington Northern Bridge downstream of Little Falls Dam	965.0	10,000-30,000	50
Burlington Northern Bridge upstream of Little Falls Dam	966.2	10,000-30,000	50
Burlington Northern Bridge at Fort Ripley	973.5	>300	2
Burlington Northern Bridge at Brainerd	1001.4	>300	6
Burlington Northern Bridge at Ball Club	1230.8	>300	8
Burlington Northern Tracks along Mississippi River between Fridley and Coon Rapids	866-850	10,000-30,000	58
Tracks between Coon Rapids and Becker	905-866	10,000-30,000	48
Tracks between Becker and Little Falls	966-905	10,000-30,000	48

The highest-tonnage hazardous materials shipped by rail in Minnesota are: anhydrous ammonia, mixed freight shipments, inhibited styrene monomer, mixed acids, petroleum refined products, propane and liquid petroleum gas, denatured alcohol, methanol, and fuel oil (U.S. Department of Transportation, 1991).

The unit quantity of most railroad tanker cars ranges from about 8,000 to 10,000 gallons. Some "jumbo" tankers carry more, up to about 20,000 gallons and 200,000 pounds in weight of liquid cargo.

PIPELINES

Six petroleum pipeline routes, with pipes ranging in diameter from 8 to 48 inches, cross under the Mississippi River within the study area (Table 7, Figure 8). The gaps in the pipeline routes on Figure 8 result from incomplete digital data on pipelines in the State highway maps (the pipeline routes are continuous). Another oil pipeline route (Lakehead Pipeline Co.) crosses the Prairie River at Grand Rapids about 1.5 miles upstream of its confluence with the Mississippi River. Petroleum pipelines carry crude oil, heating oil, gasoline, aviation fuel, and other refined products. Sewage force mains cross under the river at Grand Rapids, Brainerd, Little Falls, Anoka, and Brooklyn Park. An industrial process wastewater line crosses the river in Grand Rapids. The materials and flow rates for the pipelines may be found in the pipeline database supported by the REMM model.

Table 7. Petroleum pipelines in the study area.

Pipeline	River Mile	Pipe Diameter (inches)
Amoco Pipeline	857.8	8
Amoco Pipeline	879.6	8
Williams Pipeline Co. at Rice Creek Inlet to Long Lake	861.8	8
Amoco Pipeline	914.5	8
Minnesota Pipeline Co. pipeline south of Little Falls	962.5	16
Lakehead Pipeline Co. at Ball Club	1230.5	18,26,34,48
Lakehead Pipeline Co. 1.5 Miles up Prairie River at Grand Rapids	1177.5	18,26,34,48

Valves along pipelines are used to isolate any segment that may begin to leak. The volume contained in a segment depends on the line diameter and the distance between the closed valves or topographic high points. Cross-country pipelines typically have shutoff valves approximately every 10 to 40 miles, enabling the pipeline company to isolate a segment should a leak occur. In accordance with Federal regulations, pipeline companies reduce the normal distance between valves at river crossings to minimize the quantity that could escape from a leaking pipe segment once pumping is stopped.

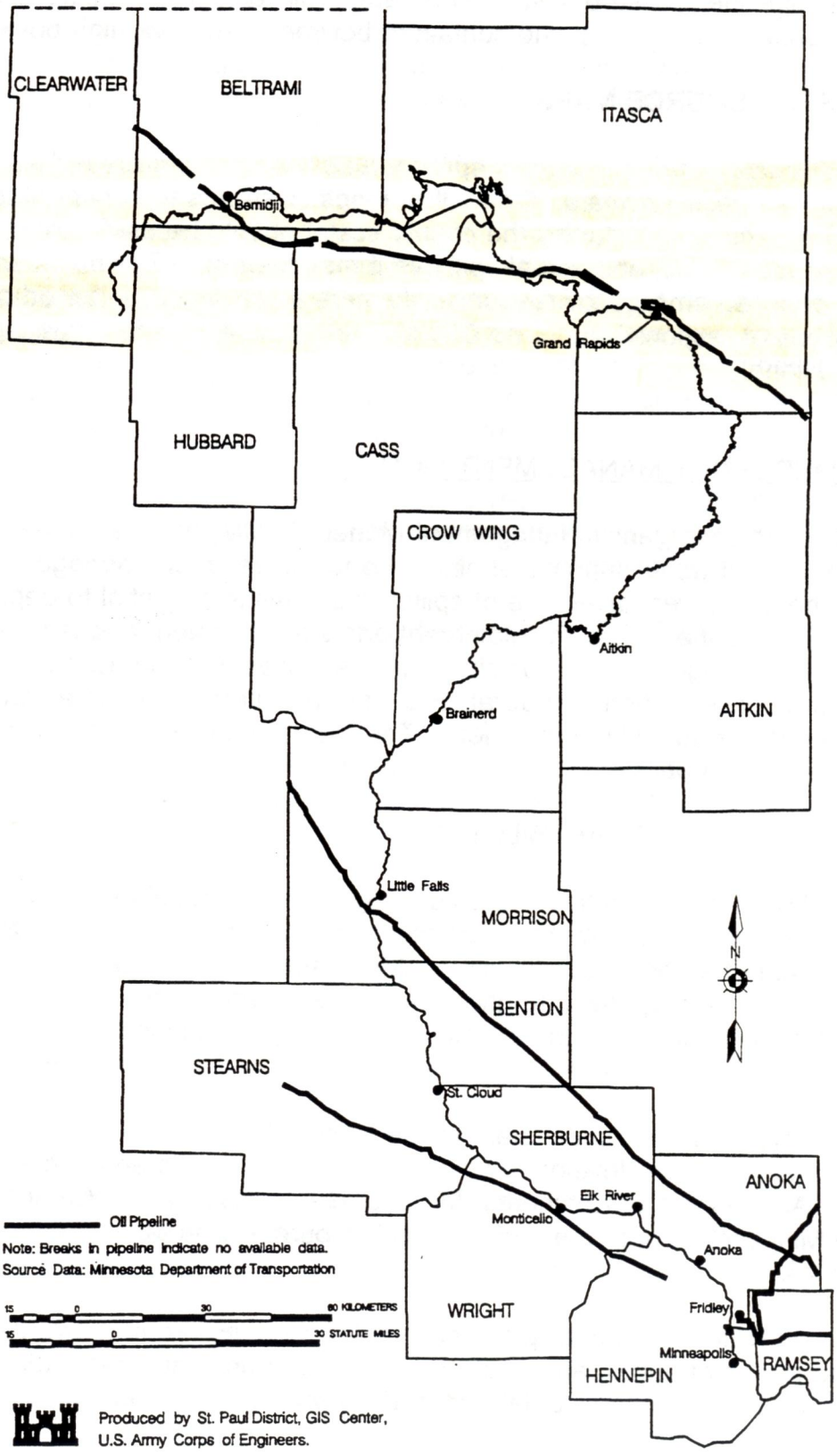


Figure 8 - Petroleum pipelines in the study area

The volume of liquid potentially spilled depends on the size of the pipeline break, pumping rate, pipeline pressure, liquid temperature, air temperature, time until detection and shutdown, and volume contained between valves or high points.

POTENTIAL SPILL SOURCE MAPS

GIS-generated maps of potential spill sources have been prepared at two scales for use by spill response planners. One set of maps illustrates the entire study area, and another set of maps (at roughly the county scale) should be useful for local units of government, practice drills, and actual spill event management. The maps will be distributed to selected emergency response planners and managers, based on their geographic areas of responsibility. The GIS files will be available for updating and plotting of additional maps.

RIVERINE EMERGENCY MANAGEMENT MODEL

The Riverine Emergency Management Model (REMM) was developed as a tool for spill response and water supply planning, and for actual event management. Prediction of the downriver travel time of spilled materials is essential to deployment of equipment and personnel for spill containment and spill diversion, and is critically important for the management of municipal water supplies drawing from the river. Prediction of the concentration and duration of spilled material passing a water intake is also needed for water supply management. The REMM provides these predictive and event management capabilities.

OVERVIEW OF PROGRAM CAPABILITIES

The REMM is an interactive computer program with associated hydraulic, chemical, and geographic information data files which compute the time of travel, and optionally, the fate of a chemical spill, on the Mississippi River for various flow conditions. Its primary purpose is to give emergency planners the capability to make a reasonable determination of the travel time and the fate of chemical spills at locations downriver from a spill site.

A river data file for the main stem of the Upper Mississippi River from Grand Rapids to Minneapolis was developed using available hydrologic and hydraulic data from the U.S. Army Corps of Engineers, the U.S. Geological Survey Water Resources Division, the Minnesota Department of Natural Resources, and other data supplied by private interests.

The basic REMM model for predicting spill travel time requires two data files. One is for the river hydraulics, and another is for geographic landmarks along the river. An additional data file for chemical fate analysis is provided and serves as a lookup table for chemical properties.

In addition to the landmarks, hydraulics, and chemical properties files, REMM also supports other databases. The databases currently supported include: pipeline crossings, highway crossings, railroad crossings, aboveground storage tank sites, underground storage tank sites, agricultural chemical sites, hazardous waste sites, spill containment/recovery sites, spill diversion sites, and boat landings.

The user may optionally select a river data file, use period of record monthly average flow rates or historical monthly flow rates for a particular year, or input stage, discharge, or velocity readings at key locations. The program then computes and displays the month, day, and time, and total event elapsed time that a waterborne contaminant may be expected to arrive at any defined location downstream. If a chemical spill is modeled, the user chooses a chemical, and provides information for the type and volume of the spill. The program will then compute chemical concentrations and plume characteristics as it travels downstream. The program allows the user to get basic help, search databases, run simulations, and view, display, and plot the results.

Program output may be directed to the screen, a printer, or saved to a disc file. Additionally the program produces HPGL plotfile output for the chemical spill simulation which may be displayed on the PC monitor with shareware graphics products.

ENGINEERING OBSERVATIONS NOTED DURING DEVELOPMENT OF THE UPPER MISSISSIPPI RIVER MODEL

During preparation of the hydraulic input file for the Mississippi River above Minneapolis, several observations were made that affect the input data for the REMM model and could have an impact on the effectiveness of emergency responses in the field.

Channel survey data:

Relatively recent valley cross-sections and channel soundings are available in most areas. Areas where data are minimal or nonexistent are the reach from Lake Pokegama to the Aitkin County line and most of Morrison County. Channel geometry data in these areas were derived from some Minnesota Department of Transportation surveys and Upper Mississippi River Basin Commission surveys from the late 1890's.

Gaging stations:

Stream gaging stations on the Upper Mississippi River presently are adequate to forecast flows and stages downstream under normal and high flow conditions. Some additional gaging locations have heen identified as being useful for the following reasons:

a. Jacobson: Monitor low flow and drought conditions.

b. Crosby: Monitor low flow and drought conditions.

c. Libby: Existing site in poor condition; no readings for the last few years. Needed for daily forecasting.

d. Brainerd: Data is available from the dam operator, but is not readily available to those who may need the data on a daily basis.

e. Little Falls: Data is available from the dam operator, but is not readily available to those who may need the data on a daily basis.

f. Elk River: The old gaging site could be re-established. This site would be especially useful for monitoring low flow conditions.

g. Monticello: Monitor low flow and drought conditions.

h. Clearwater: Monitor low flow and drought conditions.

COMPUTER EQUIPMENT REQUIREMENTS

The REMM model program was designed to be portable across different computer operating systems. It has been successfully ported to MS-DOS personal computers, AT&T 3B2s, InterGraph, and SunSPARC Unix based computer platforms.

WATER QUALITY MODELING - FATE OF MATERIALS SPILLED TO RIVERS

Pollutant behavior and fate in rivers depends on hydrologic conditions as well as chemical properties. When a spilled material reaches the river, it can do many things. The material can float, dissolve, sink, volatilize, or go into suspension. Combinations of these are also possible. Floating substances often volatilize and dissolve while moving downstream. Sinking pollutants accumulate on the bottom where they can slowly dissolve into the water column. Suspended pollutants often settle out in areas with slow current such as the inside of river bends, embayments, and backwater areas. Pertinent information is required to permit numerical analysis for predicting the fate of spilled materials in the river. REMM currently includes algorithms to compute the advection, dispersion, and some removal or degradation processes which a waterborne contaminant may undergo. In addition, inferences concerning the fate of a contaminant can be made by an inventory of the contaminant's properties and fate processes. A generalized summary of the fate of a contaminant based on its specific gravity and solubility is included in Table 8.

REMM WATER QUALITY MODELING

Contaminant spills into rivers can have disastrous effects on downstream water users if they are unprepared. REMM includes a chemical spill option (SPILCONC) which computes chemical concentrations resulting from a contaminant spill. The chemical

spill option allows users to estimate the arrival time, maximum concentration, and passage time of a contaminant plume passing a location such as a water intake. SPILCONC also allows the user to identify important fate processes and chemical properties of the spill.

SPILCONC enables the user to model and identify important fate processes for over 100 chemicals included in a chemical data table (CHEMTABL.DAT file). The user can also model the advection and evaporation of a gasoline, fuel oil, or crude oil spill. To run SPILCONC, the user supplies the same information required for a travel time simulation plus the following:

1. Name of chemical spilled.
2. Percentage of channel top width spill covered.
3. Type of spill: Instantaneous or timed duration.
4. The flow rate and duration for timed duration spill, or the amount spilled for an instantaneous spill.
5. Wind speed, air and water temperatures.

The user may optionally model an unlisted chemical by supplying pertinent chemical property data. Program output writes the final concentration versus time curve to an output file. A summary of chemical property and fate information is included for the last landmark location requested.

SPILCONC is designed to model highly soluble point source chemical spills. The model takes into account the advection, dispersion, and some fate processes that waterborne contaminants may undergo. Fate processes included in the computations are volatilization, hydrolysis, and sorption. Spill loadings can either be instantaneous (bulk) or time released (leaky pipe). The program assumes steady-state, one-dimensional flow, complete mixing of the water column and contaminant, and first order decay and transformation processes. Chemical algorithms are based on methods described in Mills et al. (1985). Methods for calculating oil and gas evaporation are from Shen et al. (1991). Additional information concerning model use and development can be found in the REMM Users Manual and Program Documentation.

APPLICATIONS

REMM can be used for spill response and water supply planning through generation of a variety of spill scenarios. Spill response training sessions and on-river drills can make use of REMM for simulating spill events. Spill response and water supply managers can use REMM during actual spill events to obtain reasonable predictions of spill travel time and chemical/physical behavior, enabling more informed decisions about spill response activities and water supply protection.

Table 8. Fate characteristics of materials spilled into rivers based on specific gravity and solubility.

HIGHLY SOLUBLE COMPOUNDS	
general	Dissolves to solubility limits in surrounding water Turbulence and mixing increases dissolution rate
specific gravity	
< 1.0	Initially floats; turbulence reduces floating fraction Rapid volatilization of floating fraction is possible
= 1.0	Minimal resistance to mixing
> 1.0	May settle to bottom, dissolve from there Chemical concentration gradients possible, especially in pools If stratification occurs, volatilization is eliminated
LOW SOLUBILITY COMPOUNDS	
general	Under turbulent conditions, may mix with water column Dissolution to solubility limits in surrounding water
specific gravity	
< 1.0	Floats; high volatilization rates possible from floating fraction Turbulence increases emulsification Stratification possible
= 1.0	Turbulence mixes contaminant in water column May remain in concentrated plume under quiescent conditions Dissolution rate increases with mixing
> 1.0	Contaminant settles to bottom in areas of low velocity such as pools Volatilization unimportant for settled fraction Settled contaminant may act as slow leak source for downstream interests Flow stratification of dissolved fraction possible

SPILL SCENARIOS

Spill scenarios can be generated for spill response and water supply management planning purposes and for spill response drills. Criteria can be established to frame scenarios.

CRITERIA FOR SPILL SCENARIOS THAT WOULD THREATEN MUNICIPAL WATER SUPPLIES

For reasonably foreseeable, "worst case" scenarios that would threaten the Minneapolis, St. Paul, and St. Cloud water supplies, the following criteria may be appropriate:

- Large-volume spill sources
- Short travel time from source; short response time
- Material that would pose drinking water health threat, require closing of water supply intakes
- Long-duration spill event that would require intake closure for more than one day

An example of a spill that would threaten the Minneapolis and St. Paul water supplies was simulated using REMM. The scenario involves a relatively small spill of 1,000 gallons of the common organic chemical phenol from a tanker truck accident on the Highway 610 bridge in Coon Rapids. The output of the REMM model simulation is shown in bold below:

Demonstration of 1,000 gallon spill on Highway 610 Bridge in Coon Rapids

Simulation based on Monthly Average flows.
Open water river conditions.

Event Start Date:	**September 10 at 07:30**
Event begins at River Mile:	**865.0**
Event ends at River Mile:	**858.6**

The REMM chemical properties listing for phenol is:

Chemical Name:	**Phenol**
Properties Temperature (Celsius):	**15.0**
Gram Molecular Weight:	**94.11**
Specific Gravity:	**1.070**
Solubility (mg/liter):	**93000**
Octanol-Water Partition Coefficient:	**30**
Henry's Law Constant:	**.454E-06**
Vapor Pressure (millimeters):	**0**
Drinking Water Standard (mg/liter):	**.100E-02**
Sorption important ?	**Probably Not**
Volatilization important ?	**Probably**
Biodegradation important ?	**Probably**

Photolysis important ?	**Probably Not**
Hydrolysis important ?	**Probably Not**
Bio Accumulation important ?	**Probably Not**

The data entered into the REMM model to define the spill was:

Spill duration in hours was:	**2.00**
Release rate in gallons per minute was:	**8**
Percent of channel top width painted:	**10.0**
Quantity spilled in gallons:	**999**
Wind speed in miles per hour:	**1.2**
Air temperature (Fahrenheit):	**65.0**
Water temperature (Fahrenheit):	**58.0**

The REMM output describing the downstream travel of the spilled material is presented by river mile landmark stations (a number of the intervening stations were omitted for brevity):

State Highway 610 Bridge in Coon Rapids

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
865.0	Sep 10 07:30	0	0	0	5650	No
	Sep 10 07:30	0	0	0	1.39	0.00
	Sep 10 07:30	0	0	0	N/A	13200.0380859

USGS Gaging Station near Anoka

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
864.8	Sep 10 07:40	0	0	10	5661	No
	Sep 10 07:42	0	0	12	1.37	0.21
	Sep 10 07:47	0	0	17	3.03	18.1410217

USGS Gage at the St. Paul Water Works Pumping Station, 75th Ave North

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
862.9	Sep 10 09:25	0	1	55	5680	No
	Sep 10 09:47	0	2	17	1.32	1.80
	Sep 10 10:39	0	3	9	N/A	3.8474445

Interstate Highway 694 Overpass in Fridley

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
860.4	Sep 10 11:51	0	4	21	5705	No
	Sep 10 12:40	0	5	10	1.24	5.18
	Sep 10 14:39	0	7	9	N/A	1.7000145

Minneapolis Water Works Intake and Pumping Station (MSPM5)

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
858.6	Sep 10 13:42	0	6	12	5724	No
	Sep 10 14:51	0	7	21	1.19	7.35
	Sep 10 17:43	0	10	13	N/A	1.1094555

End of landmark travel time detail printout.

The REMM model provides output about the chemical concentration calculations:

Chemical Fate Analysis Summary at River Mile: 858.6

Complete mixing has NOT occurred at river mile: 858.6
Complete mixing would occur at river mile: 810.8

If the chemical is not completely mixed, the concentration is not uniform across the river. Maximum concentration is most likely to be at or near the main channel.

Chemical concentration computations began at river mile: 865.0
Chemical concentration computations ended at river mile: 858.6

Maximum concentration time (hours): 7.35
Peak concentration (milligrams/liter): 1.109455585

Drinking Water Standard in milligrams per liter: .100E-02
Total time above the Drinking Water Standard in hours: 22.4

Concentration exceeds Drinking Water Standard at 2.2 hours on the rising limb. The concentration drops below the Drinking Water Standard at 24.6 hours on the recession side of the curve.

Wind speed of 1.2 MPH may be more important than the surface current velocity of 1.4 FPS computed at the downstream limit modeled.

REMM provides a table of calculated maximum chemical concentrations over time as spilled material progresses downriver (see below), and an accompanying graph (Figure 9). REMM calculates the time after a spill when drinking water standards would be exceeded at a downriver point, and the time until contaminant concentrations fall below drinking water standards again. REMM also provides a graph of chemical concentration over time passing a downriver point of interest (in this case, the Minneapolis Water Works intake) (Figure 10).

Chemical Concentration Curve Data at River Mile 858.6:

Time in Hours	Concentration (mg/liter)	Time in Hours	Concentration (mg/liter)	Time in Hours	Concentration (mg/liter)
1.9	.000034866	2.4	.001307937	2.9	.012231024
3.4	.053245153	3.9	.145582646	4.4	.293809414
4.9	.481125474	5.4	.678218782	5.9	.855583966
6.4	.991885424	6.9	1.076730371	7.4	1.109455585
9.4	1.109455585	9.9	1.096137881	10.4	1.046420813
10.9	.970974803	11.4	.879809082	11.9	.781362772
12.4	.682169259	12.9	.586891592	13.4	.498555452
13.9	.418865353	14.4	.348530024	14.9	.287550598
15.4	.235463977	15.9	.191529304	16.4	.154867589
16.9	.124557555	17.4	.099700943	17.9	.079460464
18.4	.063082173	18.9	.049902309	19.4	.039349020
19.9	.030936331	20.4	.024256857	20.9	.018972656
21.4	.014806013	21.9	.011530291	22.4	.008962045
22.9	.006953461	23.4	.005386167	23.9	.004165764
24.4	.003217312	24.9	.002481516	25.4	.001911647
25.9	.001470955	26.4	.001130642	26.9	.000868190
27.4	.000666033	27.9	.000510499	28.4	.000390960
28.9	.000299180	29.4	.000228779	29.9	.000174823
30.4	.000133505	30.9	.000101890	31.4	.000077716
31.9	.000059246	32.4	.000045141	32.9	.000034378
33.4	.000026169	33.9	.000019911	34.4	.000015143
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36.4	.000005048	.0	.000000000	.0	.000000000

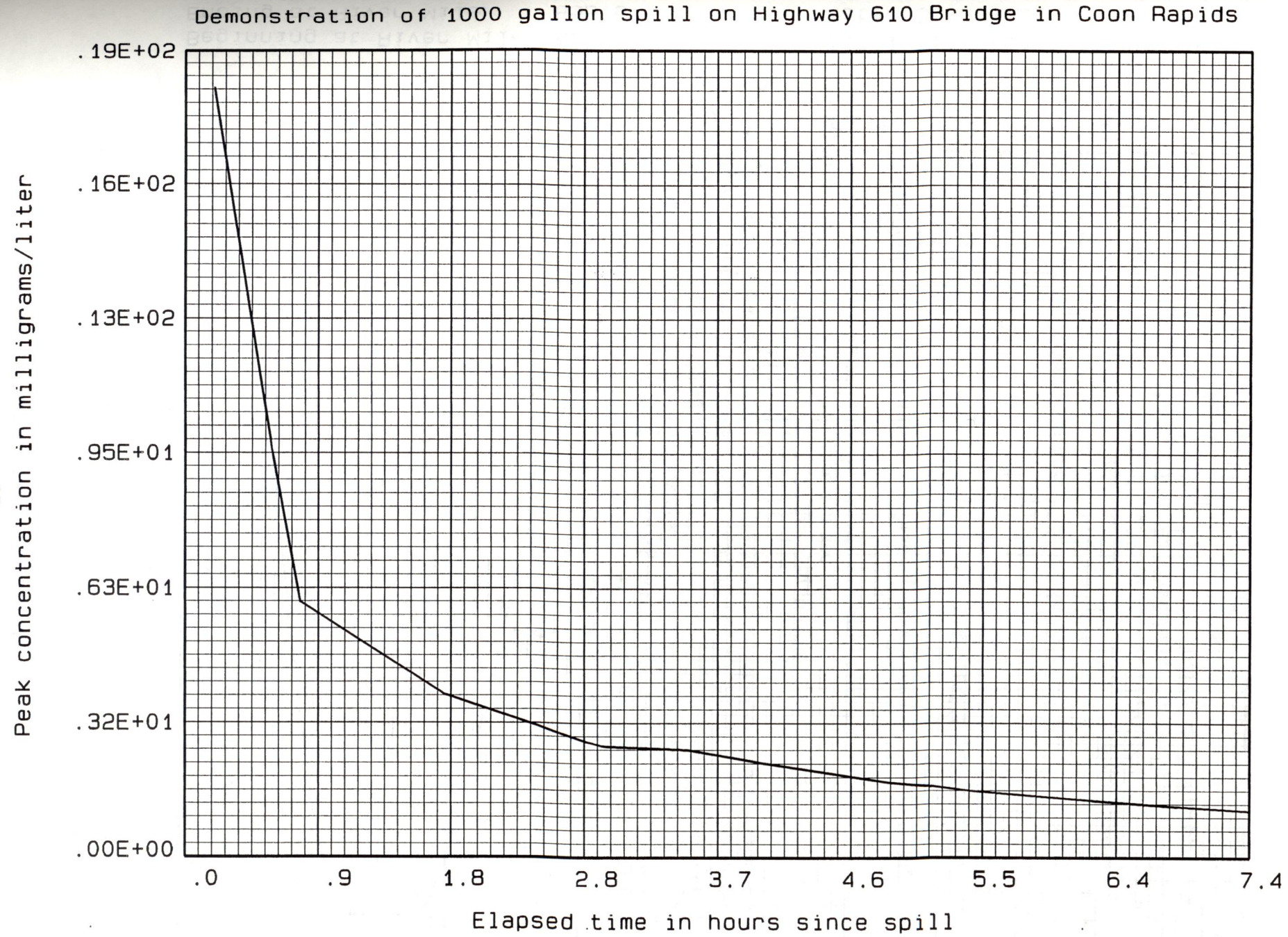


Figure 9. Maximum concentration of phenol in the Mississippi River following a simulated 1000-gallon spill on the Highway 610 bridge in Coon Rapids

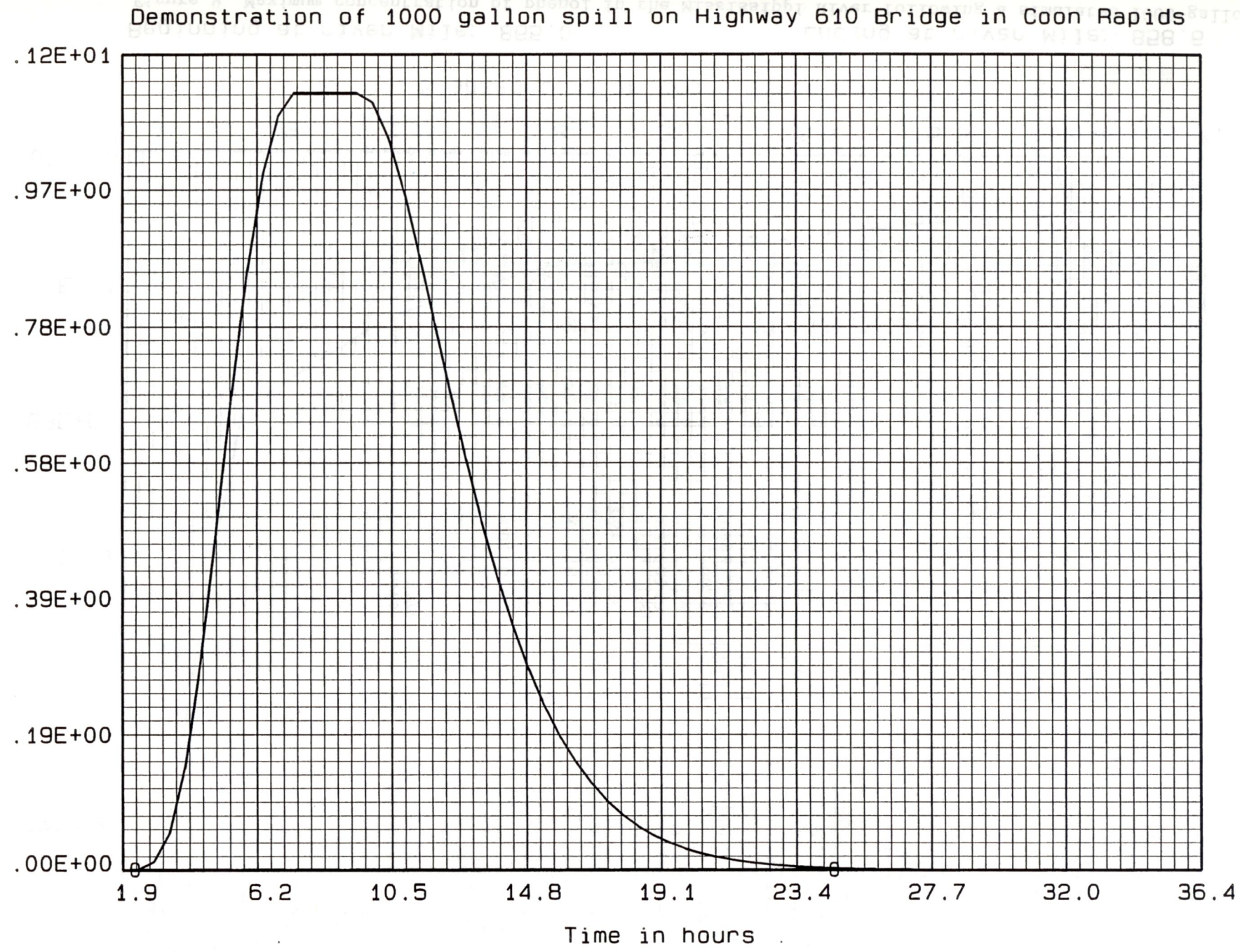


Figure 10. Concentration of phenol in the Mississippi River at the Minneapolis Water Works intake following a simulated 1000-gallon spill on the Highway 610 bridge in Coon Rapids

Figure 10. Concentration of phenol in the Mississippi River at the Minneapolis water works intake following a simulated 1000-gallon spill on the Highway 610 bridge in Coon Rapids

In this scenario, a relatively small (1,000-gallon) spill of the common organic chemical phenol, spilled from a tanker truck into the Mississippi River in Coon Rapids, would arrive at the Minneapolis Water Works intake in 6 hours and 12 minutes. The maximum concentration in the river at the water intake would reach 1.1 mg/l, well in excess of the Federal Drinking Water Standard of 0.001 mg/l. Concentrations of phenol in the river at the Minneapolis Water Works intake would remain above the Federal Drinking Water Standard for 22.4 hours. The model output indicates that the spill would not be completely mixed throughout the river cross section as it passes the Minneapolis Water Works intake.

SCENARIOS OF SPILLS THAT WOULD THREATEN THE RIVER ECOSYSTEM

For spills that would disrupt river ecosystems, criteria which may be considered are:

- o Large-volume spill sources
- o Material that would be highly toxic to aquatic life
- o Material that would be dissolved or suspended in water

An example spill scenario that would threaten the river ecosystem was simulated using REMM. In this case, a relatively small spill of 750 gallons of the hazardous organic chemical acrolein was spilled from a truck at the Highway 169 bridge in Grand Rapids. Acrolein is a herbicide and chemical feedstock that is very toxic to aquatic life. The simulated spill was tracked downriver to Brainerd, through a reach of river that supports a popular sport fishery and is a diverse and productive aquatic ecosystem. The assumed conditions and selected REMM output for the scenario simulation are shown below:

```
Demonstration of 1,000 gallon spill on Highway 610 Bridge in Coon Rapids

Simulation based on Monthly Average flows.
Open water river conditions.

Event Start Date:          September 10 at 07:30
Event begins at River Mile:                865.0
Event ends at River Mile:                  858.6



 Chemical Name:                            Phenol

Properties Temperature (Celsius):           15.0
Gram Molecular Weight:                      94.11
Specific Gravity:                            1.070
Solubility (mg/liter):                     93000
Octanol-Water Partition Coefficient:          30
Henry's Law Constant:                           .454E-06
```

Vapor Pressure (millimeters):	220
Drinking Water Standard (mg/liter):	.000E+00
Sorption important ?	Probably Not
Volatilization important ?	Probably
Biodegradation important ?	Probably
Photolysis important ?	Probably
Hydrolysis important ?	Probably Not
Bio Accumulation important ?	Probably Not

Spill Data Used:

Spill duration in hours was:	.42
Release rate in gallons per minute was:	30
Percent of channel top width painted:	25.0
Quantity spilled in gallons:	749
Wind speed in miles per hour:	1.5
Air temperature (Fahrenheit):	87.0
Water temperature (Fahrenheit):	72.0

US Highway 169 Bridge (Waldeck)

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
1073.7	Jul 4 07:00	0	0	0	2731	No
	Jul 4 07:00	0	0	0	1.81	0.00
	Jul 4 07:00	0	0	0	N/A	13502.2890625

Aitkin Flood Diversion Channel Inlet

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
1064.0	Jul 4 14:14	0	7	14	2851	Yes
	Jul 4 15:36	0	8	36	1.61	8.60
	Jul 4 19:26	0	12	26	N/A	1.9050806

USGS Gaging Station at Aitkin County Highway 1 Bridge

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
1055.9	Jul 4 21:03	0	14	3	2952	Yes
	Jul 4 23:41	0	16	41	1.44	17.70
	Jul 5 07:30	1	0	30	7.05	1.2334359

Confluence of Pine River

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
1023.8	Jul 6 10:18	2	3	18	3494	Yes
	Jul 6 18:22	2	11	22	.90	80.88
	Jul 7 17:37	3	10	37	N/A	0.2081694

Brainerd Dam Pool - Potlatch Paper Company

River Mile Station	Surface Time Average Time Bottom Time	Event total elapsed times Days	Hrs	Mins	Discharge Avg Vel Stage	Fully Mixed ? Peak Time-Hrs Peak Conc
1003.8	Jul 8 03:33	3	20	33	3832	Yes
	Jul 8 13:34	4	6	34	.56	180.58
	Jul 9 17:10	5	10	10	74.00	0.0936194

End of landmark travel time detail printout.

Chemical Fate Analysis Summary at River Mile: 1003.8

Complete mixing occurred at river mile: 1071.7
River reach length for complete mixing: 2.0

Chemical concentration computations began at river mile: 1072.8
Chemical concentration computations ended at river mile: 1003.8

Maximum concentration time (hours): 180.58
Peak concentration (milligrams/liter): .093619354

NOTE: Complete mixing occurs at river mile: 1072.8
due to a tributary, dam, or other feature.

Wind speed of 1.5 MPH may be more important than the surface current velocity of .6 FPS computed at the downstream limit modeled.

The lethal concentration (LC_{50}) of acrolein for bluegills is 0.080 mg/l and the maximum acceptable toxicant concentration of acrolein for fathead minnows is 0.0114 mg/l (Verschueren, 1983). In this scenario, the concentration of acrolein in the river would be sufficient to kill fish through 70 miles of river, from Grand Rapids to Brainerd. In addition to fish, many species of invertebrates would probably be killed. The affected reach of river would probably take more than 5 years to recover. A number of commonly transported chemicals could produce similar effects on the aquatic ecosystem if spilled into the Mississippi River.

Many spill scenarios can be generated with REMM, using a variety of criteria to frame the scenarios. REMM can be used in an exploratory fashion by municipal water utility and emergency response planners to identify what may be "worst foreseeable spill events" for different water users.

SPILL DETECTION AND ALERT SYSTEM

A spill detection and alert system consists of a series of automatic water quality monitoring stations located along the river that continuously monitor important water quality constituents, with direct communication to spill response and water utility managers. The primary purpose is to provide timely warning of a toxic spill, so that appropriate action may be taken to minimize impacts upon municipal and industrial water users, and to the river ecosystem. When a monitored water quality constituent is detected at or above a predetermined action level, an alarm is automatically triggered, with communication notifying authorities of the pollution event and beginning the automatic collection of a series of water samples.

The recommended detection and alert system provides immediate information as to the time and location of the toxic spill, as well as the nature of the contaminant. Real-time water quality information required for emergency decision-making is available with the remote accessing capabilities of the system. The raw water samples collected after an alarm is triggered can be used for detailed time-series analysis to support incident investigation and reporting requirements.

A spill detection and alert system is an integral component of the recommended River Defense Network (see River Defense Network, below). The automatic monitoring stations allow for the detection of unreported spills, and notification of the appropriate authorities. This allows for the River Defense Network to move into action very early in the spill event, alerting downstream water users and mobilizing people and equipment for spill response actions on the river. The detection and alert system must be capable of detecting spilled materials and providing notification in a reliable and timely manner.

REVIEW OF EXISTING SYSTEMS

The importance of comprehensive water quality management is recognized worldwide, and a number of spill detection and alert systems are already in place. Following is a discussion of three such systems located on the Rhine River, Germany; the Seine, Marne, and Oise Rivers, France; and the Ohio River, United States. The discussion highlights strengths and weaknesses of these three systems as they apply to the conditions on the Mississippi River upstream of the Twin Cities.

RHINE RIVER

The Rhine River provides about 20 million people with drinking water. After a significant spill of herbicides and pesticides in November 1986, a River Defense Network for the River Rhine was established. As part of this defense network, a series of water quality monitoring and alert stations was put into place. These stations monitor the temperature, turbidity, acidity, oxygen, ammonium, electro-conductivity, chloride and fluoride. In addition, a biological alarm system of fish and daphnia (a freshwater crustacean) detects general toxins. These monitoring stations are connected to eight alarm stations that are staffed 24 hours per day. Upon reception of an alarm, the other stations are notified, and each station attempts to determine which substances were discharged, where the discharge occurred, how much reached the river, and how long the discharge lasted. As it is gathered, information is prepared for inclusion into the Rhine Alarm Model, a computer model that forecasts the concentration and arrival time of the pollutant at important locations downstream. The model was first released in 1989, and is continuously being upgraded. The model was calibrated and verified using a number of international tracer experiments.

The spill detection and alert system on the Rhine River is very large and sophisticated, more than is required on the Upper Mississippi River. The system provides protection to a much larger population in a significantly more industrialized region. Therefore, the positive features of this system with respect to the needs of the Upper Mississippi region are its automation, alarm capability, data collection, and existence of a calibrated hydraulic river model. Unnecessary features are the continuously staffed alarm stations, and in-line biological alarms.

SEINE, MARNE, AND OISE RIVERS

The 4 million residents of Paris and its surrounding suburbs obtain 95 percent of their water, a production of 1 million m^3 per day, from the Seine, Marne, and Oise Rivers. All of these rivers are vulnerable to accidental spills because of the region's very high population density and industrialization. Since 1978, a series of eight automatic analyzing stations geared to the main areas of risk were put into place upstream of the three regional water treatment plants.

The automatic analyzing stations use self-emptying samplers to monitor for total organic carbon, hydrocarbons, heavy metal, and pesticides, as well as oxygen, temperature, and pH. The stations are set up as self-operating automatic alarm stations connected to the control room of the downstream water treatment facility. The self-emptying samplers provide information that can be used for plume propagation monitoring, detailed analysis after the event, and also an accurate historical record of river water quality.

Once the pollutants have been detected and identified, the information is fed into a mathematical model that allows for the determination of the plume propagation and the environmental impacts. This mathematical model has been calibrated using Rhodamine dye tracing under different river conditions.

The toxic spill detection and alert system on the Seine, Marne, and Oise Rivers is very large and sophisticated; again, more so than is required on the Upper Mississippi River. The system provides protection to a much larger population in a significantly more industrialized region. Therefore, the positive features of this system with respect to the needs of the Upper Mississippi region are its automation, alarm capability, data collection, and existence of a calibrated hydraulic river model. Unnecessary features are the total organic carbon monitors, which have proven to be expensive and difficult to maintain, the hydrocarbon and heavy metal samplers, which have long sample preparation times, and the connection of the alarms directly to the control room of the water utility, rather than to a centralized River Defense Network headquarters.

OHIO RIVER

In 1977, an unreported carbon tetrachloride spill occurred on the Ohio River. Scant stream monitoring facilities meant that little useful or timely data could be generated to aid in management of the spill. In response to this spill, a cooperative monitoring system was established by the Ohio River Valley Water Sanitation Commission (ORSANCO), an interstate water pollution control agency that was established in 1948. Fifteen water utilities, at strategic points along the Ohio River and certain tributaries, perform routine daily monitoring for 23 organic compounds using gas chromatographs equipped with Hall conductivity detectors and flame ionization detectors. It is important to note that this system is not automated, and requires a staff person to perform the required test daily at each of the utilities. ORSANCO serves as a clearinghouse for the daily test results, and provides system-wide communication in the event of a spill.

Test results are regularly reported to ORSANCO for inclusion in a data storage and retrieval system, and summary reports are prepared quarterly. In the event of detection of concentrations greater than the Maximum Contaminant Level for regulated compounds, or 10 micrograms per liter for unregulated compounds, a copy of the chromatograph is sent by facsimile to ORSANCO headquarters. At this time, the additional sampling requirements, estimates of the arrival time of the pollutant at downstream water intakes, and notification of the appropriate authorities all takes place. A time of travel model has been completed for the Ohio River, which allows for prediction of downstream arrival times.

The spill detection and alert system on the Ohio River is not applicable to the Upper Mississippi River. The system is not automated, which requires significant daily labor, and does not provide timely information. The Mississippi River moves too swiftly for a daily sampling regime to provide an early warning. Additionally, the Ohio River time-of-travel model has not been calibrated with actual river testing, and could be inaccurate.

NATURAL HAZARD ALERT SYSTEMS

In recent years, there has been a substantial increase in the use of automated monitoring in preparedness planning for natural hazards such as earthquakes, hurricanes and floods. The National Weather Service (NWS), in particular, has faced growing demands from communities that need to develop local flood warning systems. There are two general types of these systems, manual and automatic. The NWS presently provides specific flood forecast and warning services for over 3,000 communities in the United States.

The Automated Local Evaluation in Real Time (ALERT) system was developed by the NWS California-Nevada River Forecast Center in Sacramento, California, to meet the need for the automated warning systems. The ALERT system consists of automated event-reporting river and precipitation gages, automated data collection and processing equipment, a hydrologic model, hydrometeorological analysis software, and communications and display software. ALERT system hardware and software are now principally available through private vendors. The ALERT system is now so widely used that a number of associations such as the Southwest Association of ALERT Systems and the ALERT Users Group have formed and meet regularly to exchange information and to promote continued development and applications of the system.

Although the ALERT system and other local flood warning systems are generally not designed for river spill preparedness, the demand for ALERT hardware, software, and design concepts has created a competitive market for products that can be used for a wide range of environmental monitoring, data logging, and telemetry systems. Many of these products have application to a spill detection and alert system for the Upper Mississippi River.

PERFORMANCE CRITERIA

Selection of a system requires that performance criteria be established to compare the ability of competing systems to perform as needed. Generally, it is important that the selected system be automated, and operate reliably with a minimum of maintenance. The required components must be off-the-shelf items ready for use with a minimum of modification, the equipment must not react with any of the pollutants that could potentially be found in the watercourse, the detection capability must remain even under adverse conditions, and finally the system must be cost effective. It is important to consider the power requirements of the spill detection and alert stations for both monitoring and communication. The following sections discuss the specific criteria associated with detection capability, communication, and location.

DETECTION CAPABILITY

There are two important considerations for this category. First is the determination of which pollutants are likely to be found in the area protected by the detection and alert system, and second is the ability of monitors to reliably measure these pollutants.

Pollutants likely to be spilled to the river are highly regional. This is dependent upon the types of fixed facilities and transportation systems that are present in the region. An inventory of these potential contaminant sources has been developed and described in an earlier section of this report. The inventory shows that the pollutants of greatest concern along the Upper Mississippi River are anhydrous ammonia, petroleum products, acids, food products, and agricultural chemicals (pesticides/herbicides/fertilizers).

After determination of which pollutants are of greatest concern, it is necessary to define the ability of current technology to detect these pollutants reliably. It is important to consider both the number of false alarms and the number of missed alarm situations. Additionally, it is important to consider the sampling precision of the instrument, so that the action level for the measured pollutant is within the range of detection of the instrument.

COMMUNICATION

The communication component of the toxic spill detection and alert stations is very important and requires special consideration. The communication component consists of the system selected for notification of the appropriate authorities, and the system used to maintain a record of the readings both during a spill event and in the day-to-day operation of the detection and alert system. It is important that the communication system operates reliably, does not require maintenance any more frequently than the detection components, and is available off-the-shelf with a minimum of modification.

LOCATION

The location of permanent monitoring stations is probably the most critical design factor in the establishment of the spill detection and alert system. The samples collected and monitored must be representative of the water mass, or the resulting data is inconsequential. Considerations in the selection of the monitoring station locations include:

- Location, quantity, and likelihood of a spill of potential contaminant sources upstream
- Location, travel times to, and water usages at downstream water intakes
- Areal coverage of the monitoring station
- Ability to obtain samples representative of the spatial variation within the stream
- Accessibility of the monitoring station site
- Location of existing river monitoring stations (automated discharge measurement stations)
- Availability of reliable power supply
- Availability of responders and equipment

All of these factors must be considered in the selection of a monitoring station location. The three most important considerations are first, the travel time to the

downstream water intakes, as enough time must be provided for an effective response; second, the type and location of potential contaminant sources upstream, as it is ineffective to monitor in areas where the potential for contamination is very low; and third, the ability to obtain spatially representative samples, so that the contamination does not pass the monitoring station without presenting the opportunity for detection.

RECOMMENDED SPILL DETECTION AND ALERT SYSTEM

The following is a description of the recommended system for a spill detection and alert system on the Mississippi River upstream of the Minneapolis and St. Paul water intakes in Fridley, Minnesota. Figure 11 is a pictorial description of the recommended system. The detection and communication components and the station locations are detailed in the following sections.

DETECTION

The following in-situ detection components are recommended for the spill detection and alert monitoring stations.

- o Multiple parameter sonde unit for basic field parameters - Allows for measurement and data reporting of dissolved oxygen, pH, specific conductance, and temperature. These are general water quality parameters, and would be used in the decision-making after an alarm. Additionally, low dissolved oxygen could indicate an oxygen consuming contaminant, a pH change could signal an acid or base anomaly, and specific conductance could indicate the presence of dissolved solids and/or salinity.

- o Fluorometer with Short Wavelength Optical System - Allows for the detection of polynuclear aromatic hydrocarbons (PNAs) that are commonly associated with petroleum products.

- o Turbidity Sensor with Nephelometer Probe - Allows for continuous monitoring of water clarity.

- o Hazardous Gas Air Quality Sensor - Allows for the detection of volatile organics that could be present in the air phase in the vicinity of a spill.

- o Specific Electrodes - Allows for the detection of ammonia, nitrites, chloride, fluoride, and others.

- o Alarm-Activated Sequential Water Sampler - Would allow discrete samples to be collected at a user-specified interval after an alarm has been activated. These samples would be collected for more detailed analysis. It provides a historical record of the water passing the station for a period after an alarm is triggered.

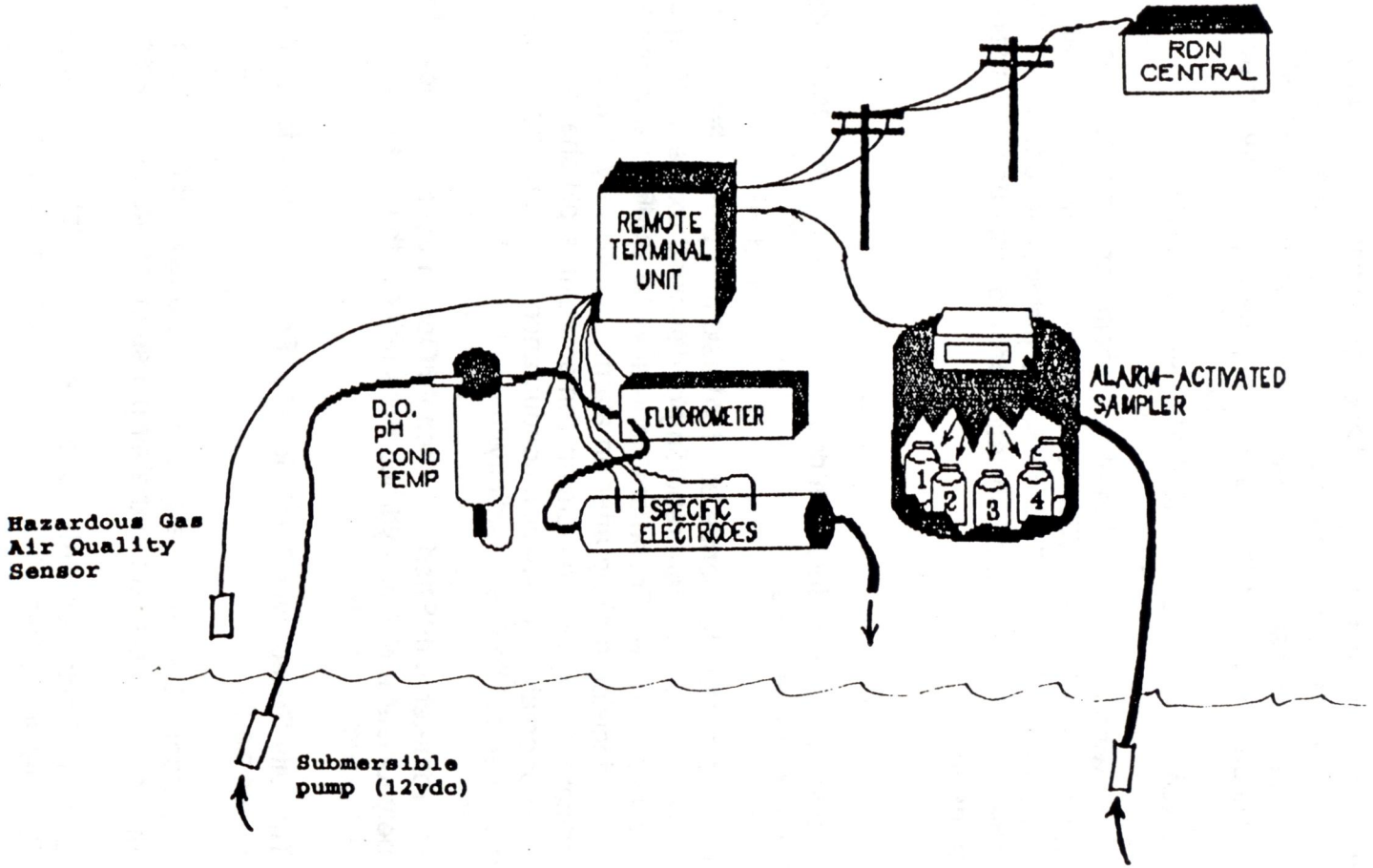


Figure 11. Recommended spill detection and alert system

To provide the sensors with a continuous supply of water to sample, a submersible pump is recommended. A submersible pump uses positive rather than negative pressure to move the water through the monitoring station. This minimizes the loss of dissolved gases in the water. Because the pump runs continuously, it is necessary to provide the stations with line power rather than batteries. Also, a noninterruptible power supply should be used to insure continuous operation.

Additional monitoring capabilities could be added as new technologies become available, and new potential contaminants are introduced to the region.

COMMUNICATION

The recommended communication system is a field data logging and telemetry unit. The telemetry unit should have multiple analog and digital input ports, and multiple digital output ports, which allows for all the monitors to be connected and also the output lines to a central reporting location. The unit must have alarm-activated reporting via a modem, as well as interrogated data reporting via a modem. The unit must have alarm activation of the field station automatic sampler. Finally, the unit must have sufficient memory for several days of data logging, and user-friendly operating system software.

The communication system should be established to contact the appropriate authorities (i.e., State Duty Officer of the Division of Emergency Management) in the event of an action level detection.

LOCATION

Specific locations for monitoring stations are not recommended at this time; however, important considerations are defined for monitoring station siting.

The Minneapolis and St. Paul water intakes near Fridley, and the St. Cloud water intake are the primary utilities to protect with a spill detection and alert system. Therefore, it is important to locate monitoring stations downstream of as many of the potential spill sources as possible and, at the same time, far enough upstream to provide sufficient time to react in the event of an alarm.

The locations selected for monitoring stations must be readily accessible for maintenance and sample retrieval purposes. The stations must be either floodproofed or above the flood level to insure continued operation during high water events.

SYSTEM ESTABLISHMENT

ESTIMATED COSTS AND FUNDING

Funding for the establishment of the spill detection and alert system will most likely be a jointly funded project at the local, State, and Federal levels, as all parties stand to

gain from an effective river defense network. An estimate for the recommended monitoring stations is $20,000 per station for the equipment only, with additional costs for the establishment of the station, ongoing maintenance, operation, testing, and upgrading.

MAINTENANCE AND OPERATION

Maintenance and operation of the toxic spill detection and alert system can be delegated according to the most effective method of operation of the River Defense Network. Ongoing maintenance would most likely be performed by the agency physically *closest to the monitoring station. Maintenance is estimated at 4 hours per week per* station.

INVENTORY OF POTENTIAL SPILL CONTAINMENT/RECOVERY AND DIVERSION SITES

In addition to a detection and alert system, and the ability to estimate the downriver movement of material spilled to the Mississippi River, spill response managers must have information available to decide where to deploy equipment and personnel on the river. Field spill response activities can include efforts to contain and recover spilled product and to divert spilled materials to protect water intakes and the river environment.

Containment/recovery sites are locations where spilled product can be contained and removed from the river. This involves deploying floating booms to direct floating material to the shore where it can be pumped out or otherwise recovered.

Spill diversion sites are locations along the river where spilled product can be kept out of off-channel areas, through deployment of booms, floating curtain wall, or temporary fill. The purposes of spill diversion are to protect valuable off-channel aquatic habitat and to protect industrial or municipal water supply intakes.

STUDY RIVER REACH FOR SPILL CONTAINMENT/RECOVERY AND DIVERSION SITES

Because of the low density of potential spill sources, and the series of lakes through which the Mississippi River flows in the Headwaters area, the study reach for identifying spill containment/recovery and diversion sites was limited to downriver from Winnibigoshish Dam to the Twin Cities.

CRITERIA FOR SELECTION OF SPILL CONTAINMENT/RECOVERY AND DIVERSION SITES

Criteria for selection of spill containment/recovery and diversion sites were identified through consultation with Minnesota Pollution Control Agency and Minnesota Department of Natural Resources personnel who have extensive river spill response experience. The criteria for diversion sites in Table 9 are for selecting sites for protecting off-channel aquatic habitat, rather than criteria for selecting water intakes (industrial, cooling water, municipal water supply, irrigation, etc.) for spill diversion.

Table 9. Criteria for selecting spill containment/recovery and diversion sites.

CONTAINMENT/RECOVERY SITES	DIVERSION SITES
Good Access	**Narrow side channel opening
**Road access to riverbank	**Off-channel habitat to be protected
Low head (<20ft to water)	**Inside of river bend
Gradual bank	Slow current
Hard ground to support vehicles	Anchor points for booms
Anchor points for booms	River deep enough to navigate
Slow current	Habitat quality
**Outside of river bend	Area afforded protection
**Multiple containment sites nearby	
**Distant from populated area	
River deep enough to navigate	
Adequate water depth at site	
Embayment	
Habitat quality	

**Conditions discernible from aerial photographs. Other site conditions require on-site inspection.

Considerations for selection of spill containment sites primarily involve physical characteristics of the site for access and containment and recovery of spilled product. River currents tend to move floating material toward the outside of river bends. Land access for trucks and pump-out equipment is needed. Embayments along the river can serve as temporary ponding areas for spilled product. Because floating materials tend to become mixed with the river or emulsified when passing over turbulent rapids or dams, it is desirable to locate spill containment/recovery sites upstream of these hydraulic features.

Practical considerations were also at the forefront of identifying criteria for spill diversion sites for protection of off-channel habitat, rather than identification of "ecologically sensitive areas" as the primary criteria. Comparing the relative value of different river habitats to select out "ecologically sensitive areas" is difficult. There may be specific areas in the Mississippi River upstream of the Twin Cities that provide

habitat for threatened and endangered species. Information on the presence of such areas was not available for this study, but if areas of river habitat critical for threatened and endangered species exist, they would definitely be "ecologically sensitive areas."

Rather than attempt to identify "ecologically sensitive areas" along 389 miles of river, the assumption was made that all river habitat is deserving of protection, and that the selection of diversion sites would be based on practical considerations such as the potential for closing off a side channel with a floating boom or temporary fill. Because there are numerous off-channel areas along the river upstream of the Twin Cities, spill response managers need to know the sites that are most important to protect with limited staff and equipment available. Relative importance rankings were assigned to diversion sites, based on the area of off-channel habitat that could be afforded protection, along with the knowledge of fisheries and wildlife managers familiar with their respective reaches of river.

SELECTION OF POTENTIAL SPILL CONTAINMENT/RECOVERY AND DIVERSION SITES

Seventy-two National Aerial Photography Program (NAPP) and National High Altitude Photography (NHAP) air photos were used in determining potential diversion and containment sites. These photos were obtained from the U.S. Geological Survey, Sioux Falls, South Dakota, and Horizon's Inc., Minnetonka, Minnesota. Imagery was obtained for the entire stretch of river from downtown Minneapolis north to the Lake Winnibigoshish Dam. These photos were converted to digital raster form by scanning them using a TIFF (tagged image file format) or COT (continuous tone) format at a resolution of 200 dots per inch. The photo raster files were rectified to the base TIGER data in order to provide geographic coordinates and distance measurements. Once rectified, the raster data was extracted along with its base vector map to produce a composite image of aerial photography with the road and rail network, and river mile numbers superimposed. The TIGER vector data was color coded so that different road classes and railroads were easily identifiable, for aid in site selection. These images were then printed at an enlarged scale to give the interpreters a series of clear images of the river.

Spill response managers from the Minnesota Pollution Control Agency and the Minnesota Department of Natural Resources selected the potential spill containment/ recovery and diversion sites by interpreting the GIS-produced images, and marking the sites on the hard copies. The location and approximate length of booms were also indicated for each site. Selection of the sites was based on information that could be discerned from the scanned aerial photos (Table 9). A database of potential spill containment/recovery and diversion sites was prepared, with fields shown in Table 10. Information for the database was limited to that available from the aerial photos and other maps. The approximate boom length for each site was made by digitally measuring the distance along the marked lines.

Table 10. Database fields - potential spill containment/recovery and diversion sites.

River mile
Boom length
Easting (m)
Northing (m)
Site type (diversion or containment/recovery)
Riverbank (right or left descending)
Site name
Diversion site importance ranking (1 to 3)
Township/city (for both right and left banks)
County
Nearest boat landing
Boat landing bank (right or left descending)
Road directions to site

A second stage of review of the potential spill containment/recovery and diversion sites was conducted with the assistance of Minnesota Department of Natural Resources area fisheries and wildlife managers who are very familiar with river reaches within their areas of responsibility. The resource managers reviewed the initially-selected sites and the associated database, eliminated some of the sites based on knowledge of local conditions, added other sites, and corrected the database. The resource managers also ranked the relative importance of the potential spill diversion sites, based on size, type of habitat, and other knowledge of local conditions.

Following the second stage of site selection, the database was updated, and the GIS files were modified to clearly show the spill diversion and containment/recovery sites. A folio of 72 scanned aerial photo maps was produced, with each image clearly showing the potential spill containment/recovery and diversion sites, the road and rail network, and river mile numbers. Copies of the GIS images have been produced for distribution to Mississippi River spill response managers. A total of 193 spill containment/recovery and diversion sites were selected, mapped, and included in the database. The sites are fairly evenly distributed along the entire river from Winnibigoshish Dam to the Twin Cities (Figure 12). The database for the potential spill containment sites was incorporated into the REMM software.

APPLICATION

The folio of GIS images provides spill response managers with a "bird's eye" view of the river, with potential sites for deploying personnel and equipment clearly marked. The containment/recovery and diversion site database, coupled with the REMM software, provides ready information on the sites, including road directions to the containment/recovery sites, and nearest boat landings. The inventory and maps of the potential spill containment/recovery and diversion sites can be used for spill response planning, training exercises, and management of actual spill response activities.

RIVER DEFENSE NETWORK

In the last few years, there have been many chemical and oil spills on or near the Mississippi River and its tributaries which have threatened municipal water intakes and the river ecosystem. Although individuals have suffered from contamination of land and water as a result of these spills, communities as a whole have escaped the disastrous effects of a major spill.

Unfortunately, communities are still vulnerable because there are too many potential spill sources along the river and tributaries and too many problems with the current system of response. Generally, agencies' roles and responsibilities in spill response are not clear to those outside the agencies. Industries along the Mississippi River are not prepared to adequately respond, and communication among spill responders is lacking during emergencies when it is most needed.

If a large oil or chemical spill were to occur on the Mississippi River, there could be severe impacts on public safety and the natural environment. Cities and industries that draw their water from the Mississippi River could be forced to close off their intakes, leaving thousands of people without water for domestic use, manufacturing, and fire protection. A major spill could contaminate the river ecosystem and result in long-term environmental damage.

The Mississippi River is a world-renowned precious resource. We cannot afford the consequences of serious spills to the river. We must take responsibility for the river and develop a plan of action to protect it.

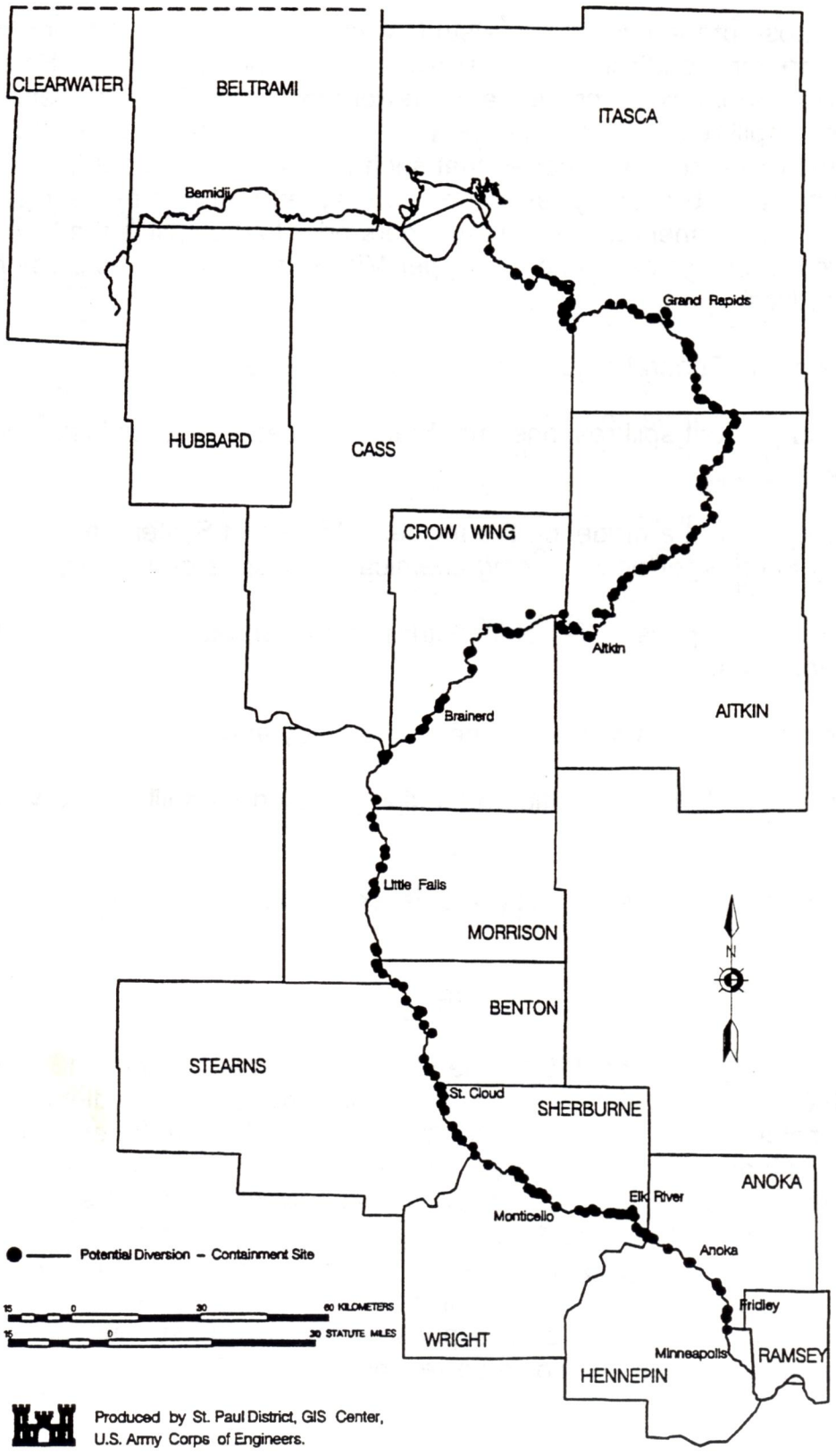


Figure 12. Distribution of potential spill containment/recovery and diversion sites

PURPOSE AND OBJECTIVES

The purpose of the river defense study was to develop a framework for a River Defense Network for the Mississippi River from Minneapolis to Bemidji. Establishing a River Defense Network would provide a framework for prevention and response planning among spill responders. The network would bring together people, equipment, and resources. It is hoped that such a network would the bridge the gap between immediate public safety response and long-term environmental cleanup. Networking among planners and spill responders prior to the spill is the key to creating an effective response system along the Upper Mississippi River. The study had the following objectives:

1. Identify State and Federal regulations for spill response.

2. Describe and present spill response notification procedures for industries in the event of a spill.

3. Describe and present a model on the Incident Command System, a procedure used for responding to emergencies including chemical or oil spills on the river.

4. Define roles and responsibilities of industries and local, State, and Federal government agencies.

5. Assess the number of trained personnel in the study area.

6. Determine the number and location of equipment used for spill recovery in the study area.

7. Recommend a framework for a River Defense Network.

STATE AND FEDERAL SPILL RESPONSE REGULATIONS

With the passage of the 1990 Federal Oil Pollution Act and the 1991 Minnesota Spills Bill (Chapter 115E), Federal and State regulations require handlers of oil or hazardous substances to prepare emergency response plans in the event of a spill. These regulations apply to fixed facilities as well as to railroads, pipelines, trucking companies, and vessels. Emergency response plans were due to be submitted to the Federal Government by February 1993. They will be reviewed by the EPA or Coast Guard (not yet determined) and implemented thereafter. In developing their response plans, industries must identify individuals in charge of facilities, trained personnel, and equipment that would be used in spill response, plan for a worst case scenario, and protect critical habitat areas that could be reached within 48 hours.

Currently, fixed facilities that store or transport hazardous substances are the only industries required by the EPA to submit Material Safety Data Sheets (MSDS) which list hazardous substances that are used on-site. They must also submit Spills Prevention Control and Countermeasures (SPCC) plans which outline prevention and containment measures (40 CFR 112).

EXISTING SPILL NOTIFICATION AND RESPONSE SYSTEM

SPILL RESPONSE NOTIFICATION

It is the responsibility of the spiller to report the spill to either the State or National Response Center (NRC) according to the Federal Oil Pollution Act of 1990 and the Minnesota Spills Bill of 1991. The current system and channels for reporting spills are not well defined. Industries and water utilities along the Mississippi River are not formally notified of spills through the present notification system. The path of notification often depends upon which governmental agency receives the call. If the fire or police departments receive a call reporting a spill through 911, they will notify local community officials or the State Duty Officer. If the State is the first to be notified, they will notify the NRC, other State agencies, and local public safety agencies and officials. If the EPA or Coast Guard receives the call through the NRC, they will notify the State, Regional Response Team and National Response Team Members (Figure 13).

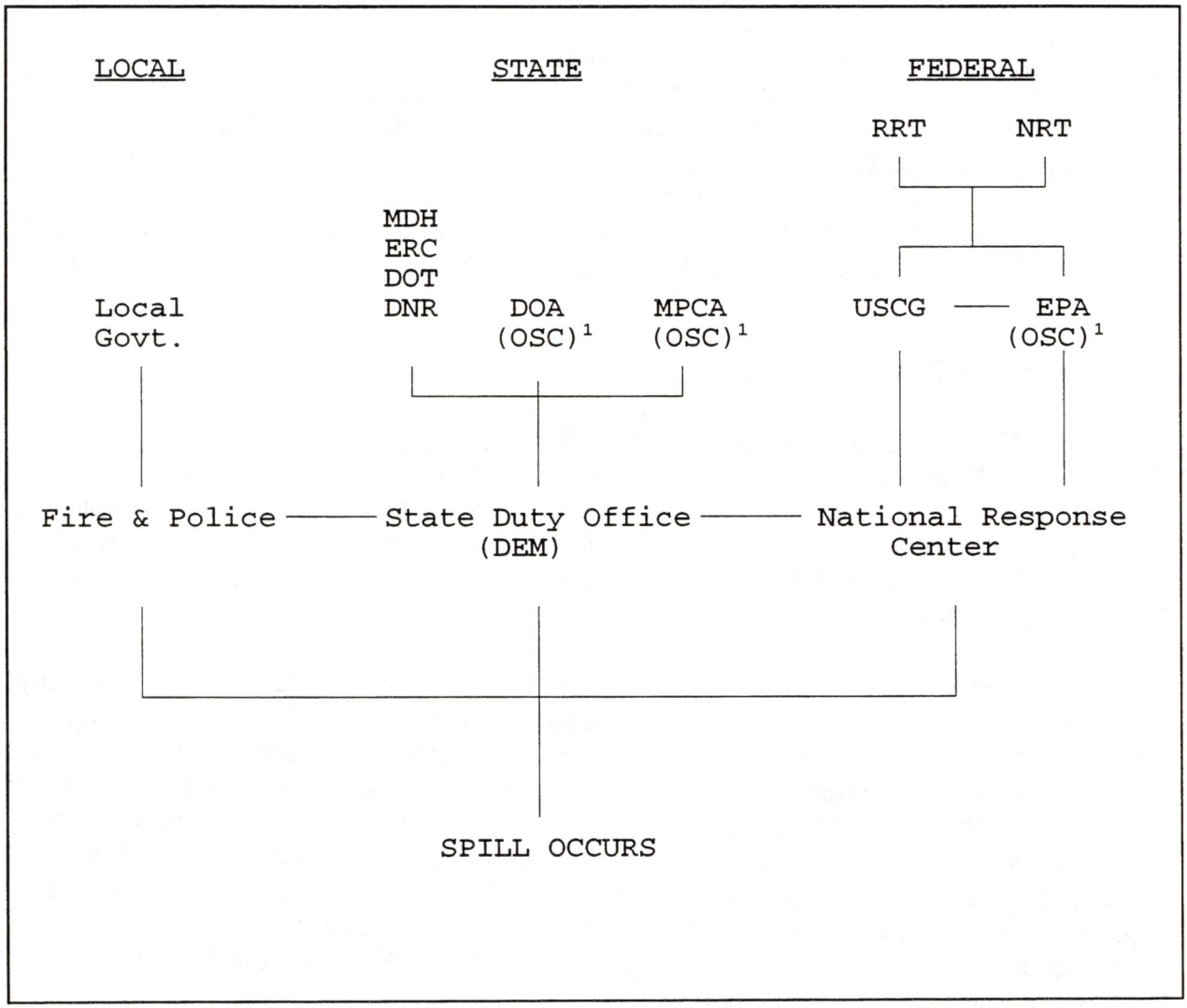
State Response Center

The Minnesota Department of Public Safety, Division of Emergency Management (DEM) and Minnesota Pollution Control Agency (MPCA) are the primary notification and communication centers. Recently, the State of Minnesota established a single point of contact to report a hazardous materials spill. This 24-hour spills line is staffed by the State Duty Officer of the Division of Emergency Management (612-296-8100 or 612-649-5451).

In the event of a spill on the Mississippi River, the State Duty Officer will notify the Minnesota Pollution Control Agency, Department of Natural Resources (DNR), State Emergency Response Commission (ERC), Minnesota Department of Agriculture (DOA), Minnesota Department of Transportation (DOT), National Response Center, or U.S. Coast Guard, depending upon the nature of the spill. If the spill is near a public water source, the Minnesota Department of Health (MDH) would also be contacted. If a spill occurs on a body of water bordering more than one State or county, the State or county receiving the call would notify the other State. The call is made as a courtesy to the bordering State or county. This protocol was developed by the Upper Mississippi River Basin Association.

National Response Center

The National Response Center (NRC), staffed by the U.S. Coast Guard, is the single point of contact for reporting discharges or hazardous materials release to the Federal Government (National Hazardous Substance Pollution Plan, 1990). In the event of an oil or hazardous chemical spill, notification should be made to the NRC Duty Officer at 1-800-424-8802. Calls received at the NRC are evaluated and forwarded to the appropriate predesignated Federal On-Scene Coordinator. The purpose of the National Response System is to ensure Federal readiness to handle a response which may exceed local or State capabilities. The National Response Team (NRT) and Regional Response Teams (RRT), staffed by Federal and State agencies, are available for advice and assistance in emergency situations.



1 (OSC) is defined as the On-Scene Incident Commander

Figure 13. Agencies involved in spill notification

EXISTING SPILL RESPONSE SYSTEM

Spill response is a complex issue: there are numerous scenarios that could occur when materials are spilled into the Mississippi River. These scenarios are dependent upon such variables as the physical and chemical characteristics of the substance, how and where it enters the river, and weather and river conditions. Potential spill sources can either float, mix, sink, suspend, congeal, evaporate, or ignite upon entering a waterway. The success of river recovery depends not only on these variables, but on the existence of a spill response system in which trained personnel respond quickly to the emergency with the proper equipment to contain and clean up the spill. Even under ideal conditions, an effective recovery rate is estimated to be 30 percent of the materials spilled (MPCA, 1990).

INCIDENT COMMAND SYSTEM

The procedure currently used by some agencies and industries for responding to chemical or oil spills is known as the Incident Command System (ICS). ICS was originally implemented by municipal fire departments for responding to fires and other emergencies. Agencies like the Minnesota Pollution Control Agency and industries have begun to apply incident command to spill response. Under ICS, the senior response official responding to the emergency is the individual in charge of the incident, referred to as the On-Scene Incident Commander. All emergency response and communications are controlled through the command post. The Incident Command System provides a structure for persons and organizations to work within when responding to a small or large spill. ICS can enlarge or contract depending upon the incident. ICS defines roles and responsibilities for spill responders, establishes lines of communication, and promotes use of common terminology.

An emergency which poses both public safety and environmental threats may require setting up a "unified command" system (Figure 14). With unified command, senior members of each major response organization jointly set objectives and priorities and perform command functions. The components of a Unified Command System are command, planning, operations, logistics, and finance. Offshoots of the unified command always include the safety officer and sometimes include the public information officer. The one problem with a Unified Command System is that it does not take into account the regulatory relationship between industry and government, especially during long-term cleanup operations. But the system can be modified to an industrial cleanup incident command center and governmental cleanup oversight command center which better reflects this relationship (MPCA, 1992).

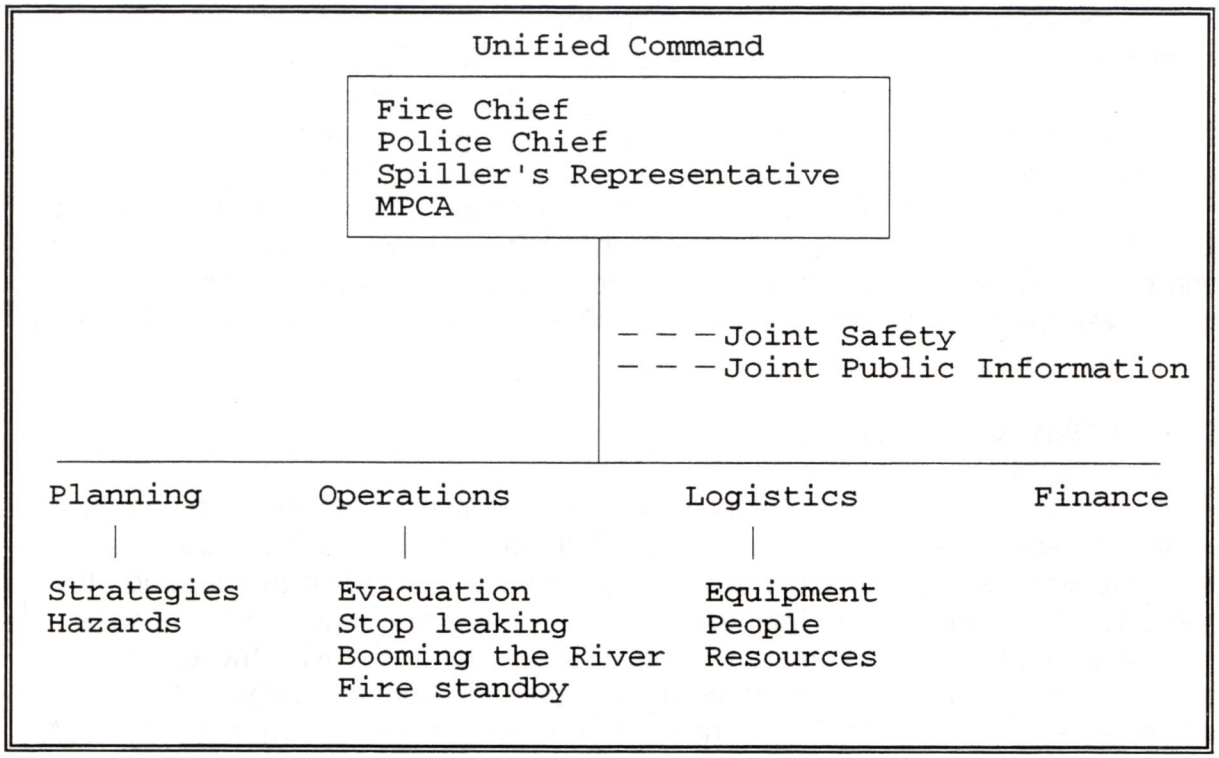


Figure 14. Unified command model

TRAINING AND EQUIPMENT

Proper training and equipment are crucial for effective response. The following discussion on training focuses on specific levels necessary and types of equipment needed to respond effectively to a chemical or oil spill in the river. The training described below is required by the Occupational Safety and Health Administration (OSHA) for all hazardous emergency responders (29 CFR 1910.120). Responders are not required to have training in booming or recovering hazardous materials from the river. But they are not able to deploy a boom or operate equipment without some hazardous materials training. OSHA training requirements focus on cleaning up on-land spills, not river spills. All spill responders are required by OSHA to have a minimum of 4 hours emergency response training. The five training levels are listed and described below.

First Responder Awareness Training

First responders at the awareness level are responsible for initiating emergency response by notifying the proper authorities of the spill when they witness or discover a hazardous substance release. Individuals with first responders awareness training do

not take any action beyond notifying authorities. The 4-hour training focuses on the following items.

1. Understanding hazardous materials and identifying them, and knowing the risks associated with hazardous materials in an incident.

2. Recognizing the presence of hazardous materials in an emergency and understanding potential outcomes.

3. Understanding the role of the first responder awareness level in emergency response plans for site security and control.

4. Realizing the need for additional resources and notifying the appropriate authorities.

First Responder Operations Training

First responders at the operations level respond to the incident by protecting persons, property, and the environment. The primary function of individuals with first responder operations training is shore-based public safety. This includes containing the spill, keeping it from spreading, and preventing exposures. The 4-hour training includes the following items.

1. Knowing the basic hazardous risk assessment techniques and basic hazardous materials terms.

2. Knowing how to select and use proper personal protective equipment provided to the first responder operations level.

3. Knowing how to perform basic control, containment, or confinement operations within the capabilities of the resources and equipment in the unit.

4. Knowing how to implement decontamination procedures.

Hazardous Materials Technician Training

Hazardous materials technicians respond to a spill by stopping, plugging, or patching the release. Hazardous materials technician training does not include instruction on strategically placing a boom or on-site recovery training. The 24-hour training includes the following items.

1. Knowing how to implement the employer's emergency response plan.

2. Knowing the classification and verification of known and unknown materials by using field survey instruments, equipment, and personal protective equipment.

3. Understanding risk assessment, decontamination procedures, termination procedures, and chemical terminology and behavior.

4. Knowing how to function within assigned roles in the Incident Command System.

5. Knowing how to perform advance control, containment, and/or confinement operations within capabilities of resources and equipment available in the unit.

Hazardous Materials Specialist Training

Hazardous materials specialists have duties similar to those of the hazardous materials technicians. The only difference is that hazardous material specialists have more specific knowledge of substances they may be called on to contain. The 32-hour training includes the following and other items listed under hazardous materials technicians training.

1. Knowing how to implement the local emergency response plan.

2. Knowing about the State emergency response plan.

On-Scene Incident Commander Training

On-scene incident commanders are in charge of the hazardous materials spill scene and provide direction to others involved. The 40-hour training consists of the following items.

1. Knowing how to implement the employer's incident command system and emergency response plan.

2. Understanding the hazards and risks associated with employees working in chemical protective clothing.

3. Knowing how to implement the local emergency response plan, and knowing about the State emergency response plan and the Regional and National Response Teams.

4. Understanding the importance of decontamination procedures.

EQUIPMENT NEEDED FOR RESPONSE

Too often, spill response is haphazard, ill-planned, and slow. First responders on the scene are often not properly trained or equipped for initial containment activities. First response is usually shore-based public safety, not environmental cleanup. Besides cleanup contractors, few spill responders have had proper training or experience in strategically placing booms on the river and removing the hazardous

substances at a designated collection point. Adequate response on the river requires specific equipment and persons skilled in hazardous materials and boom deployment under a variety of conditions. Containment efforts seek to prevent further spreading of a spill by using barriers. Diversion efforts seek to protect valuable off-channel habitats and water intakes. Containment and recovery of a substance on the main stem of a major river like the Mississippi requires from several hundred to a thousand feet of containment boom per collection location. Removing oil or chemicals from the river requires specialized equipment including pumps, skimming devices, and vacuum trucks. Hundreds and thousands of feet of absorbent boom and pads/pillows are also needed to clean up substances and debris from the river. Other river recovery equipment includes boats to deploy the boom, generators for power, plug and patch kits to stop leaks from tanks or lines, and protective chemical clothing to avoid exposure to hazardous materials. Straw and hay have been used in the past as adsorbents, but currently they are not used much due to problems with disposal.

SURVEY OF THE EXISTING SPILL RESPONSE SYSTEM

DATA COLLECTION

Given the complexity of spill response, information on roles and responsibilities, trained personnel, and equipment was collected from a variety of sources:

1. State and Federal laws on spill response protocol and roles and responsibilities of industries and agencies.

2. Hazardous material training session presented by the Minnesota Pollution Control Agency for information on spill response generally and the Incident Command System.

3. Informal telephone conversations with representatives from Federal and State agencies, spill response contractors, and spill response cooperatives.

4. A spill response questionnaire surveying municipal fire departments, county emergency management divisions, and industries in the study area (see Appendix A).

SPILL RESPONSE QUESTIONNAIRE

A total of 66 representatives from government agencies and industries (32 agencies and 34 industries) completed the survey in September 1992. The response rate for agencies was 94 percent and the response rate for industries was 76 percent. The response rate was lower for industries, specifically fixed facilities and trucking companies, due to relocation of businesses, disconnected telephone numbers, and lack of interest in the study.

The questionnaire was designed to measure industrial and agency representatives' knowledge of the following items:

1. Roles and responsibilities in spill response.

2. Emergency response plans specific to the Mississippi River.

3. Availability of computer resources for spill response planning.

4. Type and number of hazardous materials trained personnel and teams.

5. Type and number of equipment available to respond.

Only questions on roles and responsibilities, trained personnel, and equipment are discussed in the findings section of this report (see Appendix A). The remainder of the report will focus on the findings and present a River Defense Network framework.

FINDINGS

INDUSTRIES AND GOVERNMENT AGENCIES - ROLES AND RESPONSIBILITIES

Public safety agencies (fire departments), county emergency managers, and industrial representatives were asked if they have responsibility for the following activities:

1. maintaining chemical databases
2. notifying response personnel or officials
3. providing public warning and safety
4. coordinating spill response
5. containing the spill
6. cleaning up the spill

The following discussion focuses on roles and responsibilities of industries and government agencies according to the State and Federal law as well as the responders' knowledge and perception of roles and responsibilities.

ROLES AND RESPONSIBILITIES OF INDUSTRIES

It is the responsibility of industries who spill oil or chemicals into the river to report the spill and recover the materials spilled, either doing it themselves or hiring a cleanup contractor (Minnesota Spills Bill of 1991 and Oil Pollution Act of 1990). See Table 11 for industries' roles and responsibilities. If an industry does not respond, the State and/or Federal Government may hire a cleanup contractor depending upon the industries' response and the magnitude of the spill. The data shows that most

industries know and understand their responsibility for spill response, but they do not have the capabilities to respond adequately.

Fixed Facilities

Over 75 percent of the representatives from fixed facilities reported being responsible for maintaining chemical databases, notifying response personnel or officials, providing public warning and safety, coordinating spill response, and containing and cleaning up the spill. Only 8 percent of the representatives stated that they were not responsible for containing or cleaning up the spill. It seems that most fixed facilities know that if hazardous material substances are released from the plant or storage container into the river, they are responsible for cleaning up the spill.

Railroads

All three of the railroad representatives interviewed reported responsibility for notifying response personnel and officials, providing public warning and safety, coordinating spill response, and containing and cleaning up the spill. But only two of the three railroads reported responsibility for maintaining chemical databases and public warning and safety. Railroad representatives seem to understand that it is their responsibility to clean up a spill.

Pipelines

All four of the pipeline company representatives interviewed reported responsibility for notifying response personnel and officials, providing public warning and safety, coordinating spill response, and containing and cleaning up the spill. Two out of four reported responsibility for maintaining chemical databases. Like railroad representatives, pipeline representatives are aware of their responsibility to clean up the spill.

Trucking Companies

Two trucking company representatives were interviewed. One reported responsibility for maintaining chemical databases, providing public warning and safety, containing the spill and cleaning up the spill. Both of the representatives interviewed stated that they are responsible for notifying personnel and officials as well as coordinating spill response. Not all trucking company representatives stated that they are responsible for cleaning up the spill. Since only two representatives were interviewed, these results are not conclusive.

Table 11. Industry roles and responsibilities.

INDUSTRIES	ROLES	RESPONSIBILITIES
Fixed Facilities	Initial and long-term spill response	Notification of the spill and cleanup of hazardous materials from the facility
Railroad Companies	Initial and long-term spill response	Notification of the spill and cleanup of hazardous materials from the railcar
Pipeline Companies	Initial and long-term spill response	Notification of the spill and cleanup of hazardous materials from the pipeline
Trucking Companies	Initial and long-term spill response	Notification of the spill and cleanup of hazardous materials from the truck

ROLES AND RESPONSIBILITIES OF LOCAL GOVERNMENT

Local Public Safety Agencies

Consistent with their role as public safety agencies, local fire and police departments have primary responsibility for public safety and evacuation of an area affected by a chemical or oil spill (Table 12). Neither fire departments nor police departments have responsibility for cleaning up an oil spill or preventing it from getting to a water body. However, where possible, local fire departments will provide initial containment of a spill in order to minimize risk to the public since they are usually the first to respond to the scene. The ability to respond to hazardous spills depends on the resources of the department.

All of the fire chiefs stated that it is the responsibility of the fire department to warn the public of a spill and ensure their safety. Seventy-four percent of the fire chiefs reported that they are responsible for maintaining chemical databases, 90 percent reported notifying response personnel and officials, and 84 percent coordinated spill response. Sixty-three percent of the fire chiefs reported being responsible for containing a spill, but none reported responsibility for cleaning up an oil or chemical spill. It seems that most public safety agencies know that it is their primary responsibility to protect the public and coordinate response, usually implementing the Incident Command System.

County Emergency Management Divisions

County emergency management divisions are required to prepare county emergency response plans which include the following information (National Contingency Plan, 1990):

1. Listing of hazardous facilities and transportation routes
2. Methods and procedures to be followed by facility owners
3. Designation of community and facilities emergency coordinator
4. Procedures for notification of hazardous substance release
5. Description of equipment
6. Evacuation plans
7. Emergency response training programs
8. Methods and schedule for exercising emergency response.

County Emergency Management Divisions are also required to maintain a listing of facilities in their county that routinely handle or transport hazardous chemicals under SARA Title III (40 CFR 300). In many small counties, county emergency response managers are also responsible for other jobs such as Veterans Affairs Coordinators or Civil Defense Directors. County Emergency Management Divisions do not have responsibility for direct spill response; rather, it is their role to plan for emergency response (Table 12).

Eighty-five percent of the county emergency management divisions stated that they are responsible for maintaining chemical databases, 92 percent reported being responsible for notifying response personnel and officials, and providing public warning and safety, and 85 percent reported that they are responsible for coordinating spill response. However, 54 percent stated that they are not responsible for containing the spill and 85 percent reported that they do not have responsibility for cleaning up the spill. Clearly, emergency managers know that they are responsible for planning and coordinating response in their county, not cleaning up spills. But there seem to be differing opinions among emergency managers on whether or not they are responsible for containing spills.

ROLES AND RESPONSIBILITIES OF STATE AGENCIES

Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency is the primary State agency responsible for overseeing cleanup operations throughout the State for oil or chemical spills. State On-Scene Coordinators from MPCA oversee cleanup of the spills and provide advisory and technical assistance in containing hazardous materials (Table 12).

Minnesota Department of Agriculture

The Department of Agriculture is the lead State agency in supervising the cleanup of a pesticide or fertilizer spill. Like MPCA, the Department of Agriculture provides advisory or technical assistance on long-term cleanup of an incident (Table 12).

Minnesota Division of Emergency Management

The role of the Division of Emergency Management (DEM) is to provide planning assistance and support to counties and local units of government by maintaining resource lists including response contractors and agencies to contact in the event of a spill (Table 12). DEM is also responsible for maintaining the 24-hour spill notification hotline through the State duty office.

Minnesota Emergency Response Commission

The Emergency Response Commission (ERC) is responsible for appointing and supervising local emergency planning committees, reviewing local emergency response plans, and responding to public requests for information on hazardous substances under SARA Title III, known as Community Right-to-Know. ERC is not directly involved in spill response; rather, its role is preplanning in the event of a spill (Table 12).

Minnesota Department of Natural Resources

The role of the Minnesota Department of Natural Resources is to investigate and document the effects of the chemical or oil spills on fish and wildlife and to survey river habitats. (Table 12).

ROLES AND RESPONSIBILITIES OF FEDERAL AGENCIES

The Federal Government will not become involved in spill response unless the spill is beyond the response capabilities of the State and additional resources are needed. There are no specific guidelines on how the response escalates from local to Federal levels according to the National Contingency Plan. In most cases, Federal agencies play a supportive role by providing expertise and additional funding for response (see Table 13). The primary Federal responders for the study area include the Environmental Protection Agency (EPA), U.S. Coast Guard, Federal Emergency Management Agency (FEMA), and U.S. Fish and Wildlife Service (FWS).

Table 12. Local and State government roles and responsibilities.

GOVERNMENT AGENCY	ROLES	RESPONSIBILITIES
Fire Department	Lead for public safety Assist MPCA	Control fire and other hazards to ensure public safety and assist in the initial containment of the spill.
County Emergency Management	Assist fire departments Assist MPCA	Maintain a list of facilities that store or transport hazardous substances. Prepare emergency response plans.
Pollution Control Agency	Lead for environment Assist fire departments	Identify the spill source and oversee cleanup operations.
Division of Emergency Management	Assist local government	Assist in coordinating and managing response with local units. Provide technical assistance and funding for equipment if necessary.
Emergency Response Commission	Assist county government	Maintain chemical databases and provide advisory assistance. Review emergency response plans.
Department of Natural Resources	Assist MPCA	Evaluate the level of damage to fish and wildlife.
Department of Agriculture	Lead pesticide agency	Supervise the cleanup of pesticides and fertilizers.

When the Federal Government becomes involved, the EPA usually assumes the role of the On-Scene Coordinator (OSC). Recently, EPA and the Coast Guard signed a Memorandum of Understanding which designates the Coast Guard as the On-Scene Coordinator for port areas such as Minneapolis-St. Paul. Under this Memorandum of

Understanding, the Coast Guard and EPA assist each other in areas where the other is the predesignated OSC. FEMA may provide advice or assist the lead agency in coordinating relocation of area residents if needed. FEMA is not directly involved in cleanup efforts but may provide additional funding for emergency recovery. FWS would respond to an oil or chemical spill to assess the effects on fish, birds, and other river wildlife.

If further Federal assistance is needed, the Regional Response Team or National Response Team may respond to the situation. Regional and National Response Teams consist of representatives from government agencies. Regional Response Teams also include State and local representatives. A number of Federal agencies may be called in for additional assistance and expertise upon the request of the Federal OSC. These agencies and their responsibilities are as follows:

Department of Defense

The Department of Defense can provide locally deployed oil spill equipment from the United States Navy specifically designed for salvage-related and open sea pollution incidents and assistance to other Federal agencies. However, some of the equipment could not be used in the study area since the Mississippi River is not navigable upstream of the Twin Cities.

Department of Energy

The Department of Energy can provide advice and assistance on radiological hazards.

Department of Agriculture

The Department of Agriculture is responsible for providing technical expertise to measure and monitor soil, water, wildlife, and vegetation as a result of hazardous material releases and other disaster situations.

Department of Commerce

The Department of Commerce can provide scientific and contingency planning in coastal and marine areas through the National Oceanic and Atmospheric Administration.

Department of Health and Human Services

The Department of Health and Human Services is responsible for providing assistance on health hazards to spill responders and the public.

Department of Justice

The Department of Justice may provide legal advice on complicated questions regarding hazardous substance release and represent Federal agencies in litigation.

Department of Labor

The Department of Labor has the authority to conduct safety and health inspections of hazardous waste sites through the Occupational Safety and Health Administration.

Department of Transportation

The Department of Transportation can provide advice on regulations regarding the packaging, handling, and transporting of hazardous materials.

Department of State

The Department of State is responsible for developing international joint contingency plans and assisting in the coordination of international response when discharges cross international boundaries.

Nuclear Regulatory Commission

The Nuclear Regulatory Commission is responsible for responding to radioactive releases and monitoring the actions of spillers to ensure the protection of public health and the environment.

Department of the Interior

The Department of the Interior may provide advice on the national park system, national wildlife refuges, fish hatcheries, public lands, and certain water projects in western States.

INDUSTRIES AND AGENCIES TRAINING AND EQUIPMENT

Industries and agencies were asked how many employees have hazardous materials training (29 CFR 1910.120). The hazardous materials levels include:

1. First responders awareness (4-hour training course)
2. First responders operations (8-hour training course)
3. Hazardous materials technician (24-hour training course)
4. Hazardous materials specialist (32-hour training course)
5. On-scene incident commander (40-hour training course)

Table 13. Primary Federal Government roles and responsibilities.

GOVERNMENT AGENCY	ROLES	RESPONSIBILITIES
Environmental Protection Agency	Federal On-Scene Agency (most of inland zone)	Supportive role by providing expertise or assisting MPCA. May take control of major spills if requested by State.
Coast Guard[1]	Assist EPA or MPCA	Respond to spills in port areas. Specialized staff and equipment for river response.
Federal Emergency Management Agency	Advisory role	Advisory/technical assistance. Not involved in direct response. Provide funding for equipment if necessary.
Fish and Wildlife Service	Technical role	Minimize and assess the damage to birds, fish, and wildlife on the river. Prepare rehabilitation plans.

[1] U.S. Coast Guard is the Federal on-scene coordinator from Minneapolis to Bemidji.

Industries and agencies were also asked what equipment was available to respond to a spill on the Mississippi River or tributaries. Only fixed facilities were asked what special precautions had been taken to prevent hazardous materials from reaching the Mississippi River or tributaries to the river through drains, pipelines, storage containers, or cars. The equipment includes the following list:

1. absorbent boom
2. containment boom
3. pillows/pads
4. straw/hay
5. skimming devices
6. pumps
7. boats
8. vacuum trucks
9. generators
10. plug and patch kits
11. spill response trailers

The results of the survey are listed below. See Appendix B for a listing of industries and agencies with hazardous materials training and Appendix C for a listing of industries and agencies with spill response equipment.

Fixed Facilities

Less than 50 percent of the companies have employees with first responder awareness and operations training. Fewer than 25 percent of the companies have employees with hazardous materials technician, specialist, and incident commander training. It seems that fixed facilities have employees trained to contain or clean up small spills within the facility. But many stated that if the spill were large enough, a response contractor would be hired to clean it up.

Most fixed facilities are not well equipped to respond to a major spill on the Mississippi River. But most state that they have taken some precautions to prevent leakage from storage containers or transfer areas by covering or sealing off storm drains, constructing dikes or berms, and installing double-walled containers. These facilities do not have the proper equipment to adequately respond if a spill were to reach the river. Upwards of 75 percent of the fixed facilities have no absorbent boom or containment boom, straw/hay, skimming devices, pumps, vacuum trucks or trailers with spill response equipment. Approximately 60 percent have one or more boats, generators, plug and patch kits, and cases of pillows/pads to respond to a spill on the river. Two facilities, namely, Minnesota Power's Clay Boswell Electric Station and Federal-Hoffman, report having trailers equipped with some river recovery materials located in Little Falls and Anoka (Table 15).

Railroads

Many of the railroads have a number of trained employees available for spill response in Minnesota. All of the railroads report having two or more employees trained at the first responder awareness and operations training, hazardous materials specialist, and technician training. They also report having one or more employees trained at the on-scene incident commander level. The Soo Line Railroad reports having a hazardous materials team that is capable of recovering a chemical or oil spill from the Mississippi River (Table 14). But too often, hazardous materials teams are used for getting the train back on the track, not for cleaning up materials that have spilled into the river, as observed by Minnesota Pollution Control Agency officials (MPCA, 1992).

Of the three railroads in this study, only the Soo Line Railroad reports having booms, pillows/pads, boats, skimming devices, pumps, vacuum trucks, and generators housed in a bluebox (4' x 4' x 8') in Minneapolis (see Table 15). However, the exact quantities of these materials were not given. Neither of the other railroads reports having any river response equipment. Burlington Northern Railroad reports having absorbent boom, pillows/pads, and two plug and patch kits.

Pipelines

Most of the pipeline companies list employees trained to respond across several States. It is estimated that 75 percent of the pipeline companies have 26 or more employees trained at the first responders awareness and operations levels. All of the pipeline companies have four or more employees trained at the hazardous materials technician and incident commander levels. In addition, 75 percent of the pipeline companies have two or more employees trained at the hazardous materials specialist level. Lakehead Pipeline and Amoco Pipeline have a hazardous materials response team available for spill response in Minnesota. Although the pipeline companies report having hazardous materials teams, much of the response is shore based public safety response (Table 11). Many of these teams do not have the training to use boats to deploy booms across the river.

Of all the industries in the study, pipeline companies have the greatest amount of spill response equipment. All of the pipeline companies report having at least 300 feet of absorbent boom, 600 feet of containment boom, nine cases of pillows/pads, one or more boats, and one or more generators. Seventy-five percent of the pipeline companies have one or more skimming devices, pumps, or vacuum trucks. None of the pipeline companies report having any straw/hay or plug and patch kits but state that the proper patching equipment is available to repair the line. Three of the four pipeline companies have trailers containing spill response equipment situated along the study area. Lakehead Pipeline has a trailer located in Bemidji, Amoco Pipeline has a trailer in Osseo, and Williams Pipeline has a trailer located in Roseville. The pipeline companies in this study are also members of the Miss-Ota-Croix cooperative which maintains a spill response trailer in St. Paul (Table 15).

Trucking Companies

Of the trucking companies interviewed, few have employees with hazardous materials training. Only one trucking company reported having two employees trained at the first responder awareness level. Trucking employees are the least trained of all the industries to respond to a hazardous spill.

Unlike pipeline companies, trucking companies have absolutely no equipment to respond to a spill on the river. The two trucking company representatives interviewed indicated that neither company had any booms, boats, pumps or other equipment necessary for river response.

Public Safety Agencies

Most of the fire departments have a number of employees trained at the first responders awareness and operations levels. Few employees are trained as hazardous materials technicians and specialists. Ninety-five percent of fire departments have employees trained at the first responders awareness level, and 82 percent at the first

responders operations level. Seventy percent have two or more employees trained as on-scene incident commanders, 47 percent have two or more trained at the hazardous materials technician level, and 26 percent have one or more trained at the hazardous materials specialist level. The St. Cloud Fire Department has a hazardous materials team in operation which conducts practice drills on a yearly basis (see Table 14). Most of the training pertains to on-land containment and public safety protection. Few firefighters have adequate training or experience on the river.

Fire departments have some spill response equipment, but such equipment is dependent upon the size and location of the fire department. Ninety-five percent report having two or more generators, 53 percent have one or more boats, and 27 percent have one or more plug and patch kits. Most fire departments are not equipped with a boom. Only 22 percent of the fire departments have absorbent boom and 11 percent have containment boom. None of the fire departments report having any skimming devices, straw/hay, or response trailers equipped with river recovery materials. A hazardous materials truck equipped to respond to small on-land spills or leaks is located at the Fridley Fire Department. This truck is shared by fire departments in St. Anthony, Spring Lake Park, Columbia Heights, Coon Rapids, and Fridley.

County Emergency Management Divisions

County Emergency Management Divisions are often quite small and do not have many employees trained in hazardous materials because they do not have responsibility for cleaning up spills. Most emergency management divisions have fewer than five people on staff. Over one-third of the employees, namely, the emergency managers, are trained at the 40-hour incident commander level. Less than one-fourth of the employees in emergency management have hazardous materials technician and specialist training.

In terms of equipment, county emergency management divisions are not prepared to respond to an oil or chemical spill on the river because their role is primarily spill planning, not spill response. None of the counties in the study area have any absorbent or containment boom, cases of pillows or pads, skimming devices, plug and patch kits, or trailers. Nearly 50 percent of the counties, particularly larger counties, have one or more boats, pumps, and generators available through the other county departments such as the sheriff, public works, or highway department. Hennepin County reports having two vacuum trucks available for cleaning up the river. Equipment owned by counties is scattered throughout various departments and is not located at a centralized area. Determining specific equipment available from county government would require further follow-up with each of these departments.

Table 14. Hazardous materials teams by region.

REGION[1]	AGENCY/INDUSTRY	LOCATION
1	Lakehead Pipeline	Bemidji, MN
2	St. Cloud Fire Dept.	St. Cloud, MN
3	Soo Line Railroad	Minneapolis, MN
4	Amoco Pipeline	Brooklyn Park, MN

[1] Refer to Figure 15 for regional boundaries

Table 15. Spill response trailers by region[1].

REGION[2]	AGENCY/INDUSTRY	LOCATION
1	Lakehead Pipeline Trailer	Bemidji, MN
2	Minnesota Power Trailer	Little Falls, MN
3	Federal-Hoffman (Limited river response materials)	Anoka, MN
4	Amoco Pipeline Trailer	Osseo, Mn
	Williams Pipeline Trailer	Roseville, MN
	Soo Line Railroad Trailer	St. Paul, MN
	Soo Line Bluebox (4' x 4' x 8')	Minneapolis, MN
	Miss-Ota-Croix Trailer	St. Paul, MN

[1]The contents of the trailers varies widely
[2] Refer to Figure 15 for regional boundaries

LOCAL SPILL RESPONSE CONTRACTORS

Many companies have contracts with spill response companies or hire them to clean up a hazardous materials spill for which they are responsible. The primary spill contractors available for response in the study area include Bay West in St. Paul, Minnesota, OM Materials in New Hope, Minnesota, and OSI Environmental in Virginia, Minnesota. These cleanup companies are equipped to respond to spills that occur in plants, aboveground storage tanks, underground storage tanks, and waterways. They provide chemical analysis, monitoring and sampling, spill containment and spill or waste excavation, transportation of waste, and waste disposal. Emergency response services are available 24 hours a day from all spill contractors. General response time in the study area is approximately 3 to 6 hours. Response time is dependent upon many factors that include location, type, and size of the spill.

Many response firms have subcontracts with other spill response companies to supplement personnel and equipment and provide emergency response training to companies (Environmental Information, LTD, 1991). Unfortunately, many companies depend heavily on contractors to respond to all spill emergencies. A spill larger than 20,000 gallons would require out-of-state resources or multiple contractors. The Pollution Control Agency estimates that individual local contractors could only contain and clean up a river spill of approximately 10,000 to 15,000 gallons under favorable conditions (a single railcar could contain 20,000 to 30,000 gallons). The following describes some of the spill response companies available to respond to spills on the Mississippi River in Minnesota.

Bay West

Bay West has been in operation since 1974 and serves the Midwest and Canada. Bay West has a contract with the Minnesota Pollution Control Agency for emergency response to State requests. Bay West has 45 emergency response trained personnel at the 40-hour Incident Command level. Specific equipment owned by Bay West includes 3,000 feet of absorbent/containment boom, 270 cases of absorbent pillows/pads, 3 skimming devices, 5+ pumps, 3 boats, 2 vacuum trucks, and 4 generators available for immediate response. Other equipment such as personnel protective suits, hats, gloves, loaders, excavators, cranes, and transport trucks is also available.

OH Materials

OH Materials has been in spill response since 1969 and serves the United States and Canada. OH Materials has 23 trained employees in Minneapolis, 20 trained employees in St. Louis, and 40 trained employees in Chicago. A total of 83 personnel are trained at the hazardous materials specialist level and 27 are trained at the 40-hour Incident Command level in the Midwest. Specific equipment located in the Twin Cities includes 2,440 feet of absorbent/containment boom, 93 cases of pillows/pads, 99 bales

of straw/hay, 2 skimming devices, 33 pumps, 6 boats, 1 vacuum truck, 2 generators, and 2 plug and patch kits. Other equipment available for spill response includes protective clothing, dozers, graders, and dump trucks.

OSI Environmental

OSI Environmental has been in operation since 1988 and serves Minnesota, Iowa, North Dakota, Wisconsin, Ontario, and elsewhere in Canada. OSI Environmental has 20 employees trained at the 40-hour Incident Command level. Equipment includes 1,000 to 1,200 feet of absorbent/containment boom, 5 cases of absorbent pads/pillows, 2 skimming devices, 3 pumps, 1 boat, 3 vacuum trucks, and 2 generators available for spill response. Other equipment includes personnel protective gear, tank trucks, dozers, and dump trucks.

MISS-OTA-CROIX SPILL RESPONSE COOPERATIVES

The MISS-OTA-CROIX (**MISS**issippi-Minnes**OTA**-St. **CROIX**) oil spill response cooperative was formed in the late 1960s to fill a need in the Twin Cities for immediate response oil spill control equipment. The mission of the group is to maintain an emergency response trailer that can be used during the initial spill response.

The members of MISS-OTA-CROIX refiners, distributors, and transporters of petroleum products equip a semi-trailer and govern its use. See Appendix D for a list of cooperative members and Appendix E for a list of equipment owned by the cooperative. The trailer is stored in a central St. Paul location to minimize transport time to the point of need. Materials such as safety equipment, containment boom, pumps, absorbent pads, lights, shovels, and generators are stored in the trailer, ready for immediate use.

On a monthly basis, representatives of the cooperative check equipment stored in the trailer. The following is a check list use by the cooperative:

1. Check inventory sheet to make sure nothing is missing.

2. Check that everything is tied down and secure.

3. Check flashlights, spare batteries, fire extinguishers, and first aid kit to make sure they are working properly.

4. Pull the starter ropes on pump and generator motors a couple of times to keep engines and pumps free.

5. Run the engines on the pumps and function test the generators at least two times a year.

While the primary purpose of the group is to maintain the trailer, the group also exchanges information on spill prevention techniques, new regulations, and training opportunities. With the implementation of the Oil Pollution Act of 1990 and Minnesota's new spill legislation, the cooperative is evaluating a mutual aid response organization to supplement members' capabilities.

NEED FOR RIVER DEFENSE NETWORKS

This study has found that individual industries and agencies are not adequately prepared to respond to a spill on the Mississippi River. Much of the trained personnel and equipment is not adequate for river response. With the exception of the pipeline companies, other industries and public safety agencies are not properly trained or equipped to recover hazardous substances from the river. But together industries and agencies have the capability to combine their resources to more effectively respond to spills and lessen the impact on nearby communities and environmentally sensitive areas along the Mississippi River. The formation of regional cooperatives along the Mississippi River for the purpose of preplanning, training personnel, and prepositioning of equipment will help reduce environmental damage and minimize the cost of cleaning up a spill. To illustrate this, consider the case of the pipeline spill in Grand Rapids. It is estimated that the Grand Rapids spill cost Lakehead Pipeline $8 million for cleanup, $4 million in soil and water testing, a $250,000 settlement with MPCA, and a $40 million lawsuit filed by 30 Grand Rapids residents that is pending in U.S. District Court. An investment in a cooperative is worthwhile and can save money in the long run.

The MISS-OTA-CROIX is an example of a cooperative set up by gas and oil transporters to minimize costs to individual companies. Establishing cooperatives like this requires a total investment of $30,000 to $60,000 for the members. Cooperative agreements like the MISS-OTA-CROIX would bridge the time gap between first responders and the arrival of the cleanup contractor or staff personnel.

We propose a framework for creating river defense network cooperatives along the study area. The cooperatives would bring together people, resources, and equipment and promote interaction among spill responders.

RIVER DEFENSE NETWORK FRAMEWORK

I. CREATION OF REGIONAL RESPONSE NETWORKS FROM MINNEAPOLIS TO BEMIDJI

To develop the River Defense Network, it is recommended that existing equipment and hazardous materials teams of industries and agencies be coordinated and organized by regions along the Mississippi River. It is suggested that four regional response areas be established that include trained hazardous materials personnel and trailers equipped with response gear strategically placed in each designated region.

The networks would have several functions that include spill prevention, interaction of spill responders, planning, training, and responding to spills.

As members of regional networks, partners would either provide trained personnel, equipment, or a financial contribution to the network. The money would be used to purchase additional equipment and to train personnel. The amount of the contribution would depend upon the network's need for training and response capacities. The cooperatives were designed so that each region has trained personnel and equipment available for use on the Mississippi River.

II. STRUCTURE OF REGIONAL RIVER DEFENSE NETWORKS

The River Defense Network would provide an opportunity for all participants involved in spill prevention and response to interact with one another on the basis of regional designations. A coordinator would be needed to implement the networks and organize monthly or quarterly cooperatives meetings. The possible structure of the River Defense Network and roles of participants are described below and presented in Table 16.

Industries

It is recommended that industries in each regional designation be involved in the training and response aspects of networks since it is their responsibility to clean up any spills from their facilities.

Local Public Safety Agencies

Municipal fire departments could provide support to the industries through technical expertise in responding to emergencies. It is recommended that fire fighters also provide expertise on the Incident Command System since many departments have implemented the Incident Command System for emergency response.

City and County Emergency Management Divisions

It is suggested that city and county emergency managers assist the coordinator in planning, organizing, and coordinating the networks since they are responsible for protecting municipal water supplies through spill response planning.

State Government

Participation of the Minnesota Pollution Control Agency as State On-Scene Coordinator is recommended in all regional designations to ensure consistency among regional networks. It is also suggested that representatives from other State agencies who have experience in spill response participate in regional networks. Representatives from the State would participate as regional planners to the networks.

Federal Government

Participation of the U.S. Coast Guard as the Federal On-Scene Coordinator in the networks is recommended in regional networks to provide expertise in spill response planning and training. Participation would also ensure consistency among regional networks in the event of a major disaster in which the Federal Government may become involved.

Quasi Government

Due to the involvement of the Upper Mississippi River Basin Association (UMRBA) and the Mississippi Headwaters Board (MHB) in spill response issues along the Mississippi River, it is suggested that both organizations participate in the network. One possible way UMRBA or MHB could participate is by hiring a full-time coordinator to organize the regional networks and help plan activities.

Cleanup Contractors

It is suggested that representatives from cleanup contractors be involved in regional networks due to their technical expertise in spill response and long-term environmental cleanup. They also have expertise in training spill responders in hazardous materials and could be involved in network training sessions.

Water Users

It is recommended that water using industries, citizen/environmental groups and other organizations concerned about the Mississippi River participate in the network.

III. PARTNERS IN THE RIVER DEFENSE NETWORKS

Most of the respondents indicated support for establishing a network, provided the legal department or superiors approved such participation. Each of the participants in the network would fulfill a role similar to their present responsibility of spill response described above. The regional designations are based upon the location of the company, equipment, and personnel (Figure 15).

All of the industries and agencies interviewed have been included in the regional networks, even those that responded late in the research process. An exception is the Chicago Northwestern Railroad, which was interviewed, but excluded from the network since they do not have any tracks in the study area. Possible regional response partners are listed in Table 17.

Table 16. Structure and roles of networks.

AGENCY/COMPANY	ROLES
Industries	Training, equipment, and response
Local Public Safety Agencies	Training, equipment, and response
City and County Government -County Emergency Management	Planning and organizing
State Government -Minnesota Pollution Control Agency -Minnesota Division of Emergency Management -Minnesota Emergency Response Commission -Minnesota Department of Agriculture -Minnesota Department of Natural Resources	Planning and response management
Federal Government -Coast Guard -Environmental Protection Agency	Training and planning, and response management
Quasi Government -Upper Mississippi River Basin Association -Mississippi Headwaters Board	Planning and organizing
Cleanup Contractors -Bay West -OH Materials *-OSI Environmental*	Training and response
Water Users -Industries -Environmental groups -Other organizations	*Planning and organizing*

IV. GOALS OF REGIONAL RIVER RESPONSE NETWORKS

Listed below are possible goals and objectives to be achieved in each response network.

GENERAL GOALS

1. Increase communication and interaction among government and industrial spill responders to discuss spill prevention techniques, emergency response plans, and new regulations and requirements.

2. Define specific roles and responsibilities of all spill responders in networks.

3. Develop response protocol to notify the appropriate responding government agencies and organizations for the region in accordance with State and national communication centers procedures.

TRAINED PERSONNEL

1. Determine the number of hazardous materials trained personnel and the need for additional training in cooperatives.

2. Draft Memorandums of Understanding to share trained personnel within regional cooperatives in the event of a spill.

3. Conduct spill prevention training of network participants.

4. Sponsor and participate in training sessions for local spill responders in the networks.

5. Participate in annual refresher training to maintain competency at current hazardous materials level.

6. Form hazardous materials response teams in each region capable of initial and intermediate response.

7. Draft Memorandums of Understanding to share hazardous materials teams with other river defense cooperatives.

8. Promote and use the Incident Command System when responding to spills on the Mississippi River or tributaries.

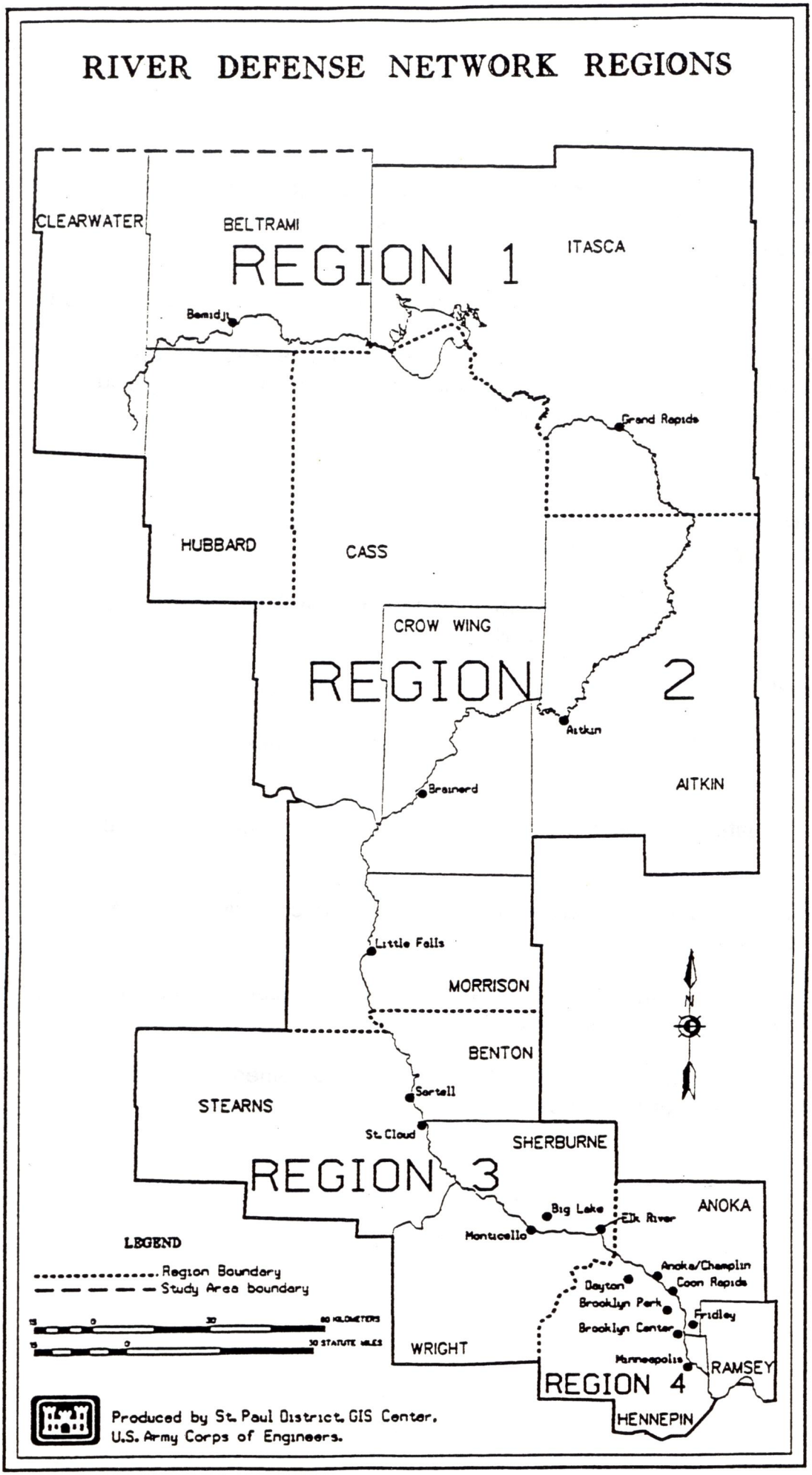


Figure 15 - River Defense Network Regions

Table 17. River Defense Network partners by region.

REGION	PUBLIC SAFETY AGENCIES (Total=19)	COUNTY EMERGENCY MANAGEMENT (Total=14)	COMPANIES (Total=28)
1	Bemidji Grand Rapids	Beltrami Itasca Hubbard Clearwater	Georgia Pacific Minnesota Power Blandin Paper Mill Lakehead Pipeline
2	Aitkin Little Falls Brainerd	Morrison Crow Wing Aitkin Cass	Potlatch Paper Mill Mn Power (Trailer) Hennepin Paper Mill Larson Boats Koch Pipeline
3	Rice/Watab St. Cloud St. Augusta Sartell Monticello Big Lake Elk River	Stearns Sherburne Wright Benton	NSP-Sherco Plant NSP-Monticello Plant Maxwell Communications Champion International United Power Association
4	Anoka/Champlin Minneapolis Dayton Coon Rapids Brooklyn Center Fridley Brooklyn Park	Anoka Hennepin	Naval Systems Cenex/Land O' Lakes Murphy Warehouse Conagra/Cropmate Dowbrands Federal-Hoffman Lakehead Chemical Burlington Northern Soo Line Railroad Amoco Pipeline Williams Pipeline Wayne Transports Indianhead Trucking Ruan Trucking

EQUIPMENT

1. Establish a specific list of existing equipment and determine the need for additional resources in regional networks to adequately respond to spills on the Mississippi River.

2. Draft Memorandums of Understanding to share existing equipment within regional designations.

3. Draft Memorandums of Understanding to share river equipment with other river defense cooperatives.

4. Determine placement of equipment along the Mississippi River and type of security.

5. Conduct regional response drills to practice boom deployment under different weather and river conditions and mobilization of equipment on the Mississippi River.

6. Check and test equipment to ensure proper functioning.

RESOURCES

1. Promote and use computer resources such as the REMM model to estimate the travel time of a contaminant along the river and plan for response downstream of the spill.

2. Use scanned aerial photographs detailing spill containment/recovery and diversion sites as planning tools for deployment of people and equipment for spill response efforts on the river.

3. Network with river defense cooperatives along the Mississippi River and other river systems.

4. Coordinate with the development of State Response Teams and Strategic Chemical Assessment Teams (SCAT) in the State of Minnesota established by recent legislation.

ESTABLISHING REGIONAL RIVER DEFENSE NETWORKS

The framework presented and outlined in this report serves as a guide for the development of river defense networks. Bringing together a number of organizations with different roles and responsibilities for spill response and creating regional networks is no small task. It will require several regional meetings with interested public safety agencies, county emergency management divisions, industrial representatives, State and Federal agencies, and cleanup contractors to discuss interest, roles, structure, and goals of the networks and to build consensus among partners.

To implement regional network cooperatives, it is recommended that a full-time coordinator be hired. Implementing regional response networks can be accomplished in a variety of ways. Coordination of equipment and personnel is a starting point from which to build river defense cooperatives. Existing cooperatives like the MISS-OTA-CROIX can provide a model for creating these networks. The recommendations on the

structure, partners, roles, and goals of the networks are a possible framework for implementing a River Defense Network. Throughout the implementation process, differences among participants and organizational perspectives may abound, but the larger goal of protecting the Mississippi River from hazardous spill must not be forgotten. The potential for a spill disaster is real.

CONCLUSIONS AND RECOMMENDATIONS

Based on study findings, the following conclusions have been reached and recommendations offered.

GENERAL

1) The Mississippi River upstream of the Twin Cities is a world-renowned, invaluable resource deserving of an effective program of spill prevention and an effective program of response to accidental spills.

2) The consequences of a major contaminant spill on the Mississippi River upstream of the Twin Cities would be very costly to water users and the river ecosystem.

3) Accidental spills to the Mississippi River upstream of the Twin Cities will continue to occur. A major, damaging spill is a distinct possibility.

4) Even an effective spill response program cannot completely remove all types, and especially large volumes, of contaminants from the river. Spill responders are powerless to affect the downstream flow of many potential contaminants.

5) The approach used in this study, and the tools developed, have application for planning spill response and water supply management on downriver reaches of the Mississippi River and on other large rivers.

POTENTIAL SPILL SOURCE INVENTORY

1) The potential spill source inventory and database contains the majority of the larger potential spill sources along the Mississippi River.

2) The spill source inventory should be updated periodically.

3) River mile assignments to urban sites should be improved using digitized urban drainage maps.

4) Geographic coordinates should be determined for additional potential spill source sites for inclusion in the REMM database and on GIS-generated maps.

INVENTORY OF POTENTIAL SPILL CONTAINMENT/RECOVERY AND DIVERSION SITES

1) The site selection process employed was effective and practical. Experienced spill response managers and resource managers with knowledge of local conditions along the river were invaluable in the site identification process.

2) The use of preselected sites for spill containment/recovery and diversion, and an advance importance ranking of potential spill diversion sites for protecting off-channel habitats should greatly aid spill response managers in decisions about deployment of personnel and equipment.

3) The site inventory should be field-checked, and the database should be updated.

4) Additional database fields describing site-specific conditions (ground hardness in access areas, actual length of boom needed, boom anchoring points, access notes, water depths) and site landowner name and telephone number should be added to the database.

AUTOMATED SPILL DETECTION AND ALERT SYSTEM

1) An automated spill detection and alert system is needed for the Mississippi River upstream of the Twin Cities.

2) The technology exists to implement an effective and reliable spill detection and alert system at relatively low cost.

3) An automated spill detection and alert system is recommended for implementation.

REMM

1) The REMM software system, with the hydraulic travel time model, water quality modeling routines, spill source database, containment/recovery and diversion site database, and river mile/landmarks list, is a valuable tool for spill response and water supply management. The software can be run on almost any personal computer, and is user-friendly.

2) REMM can be used for spill response and water supply planning, for training, and for spill event management.

3) A programmer's manual should be developed to provide information on how to prepare input data files. The programmer's manual should also contain an adequate discussion of the numerical models and hydraulic theories employed.

4) The REMM software should be modified to include detection stations as an automated spill detection and alert system is implemented.

5) A field dye study should be conducted to measure actual water travel time and calibrate the model. At this time, lateral and longitudinal dispersion coefficients are not well-defined, and a dye study would greatly enhance predictability of the model.

6) The chemical fate algorithms should be reviewed to see if they can be made more robust, handle additional river processes, and reduce computing time requirements.

7) Version 2.0 of REMM terminates chemical fate analyses when the chemical routing reaches the downstream end of impoundments on the river. The model should contain additional algorithms to route chemical plumes through dams.

RIVER DEFENSE NETWORK

1) A River Defense Network, as described above, should be established for the Mississippi River upstream of the Twin Cities, including:

o Develop response protocols to notify the appropriate agencies and industries.

o Promote the use of computer resources and GIS mapping to plan spill response.

o Develop River Defense Network structures that would provide effective spill response.

o Conduct spill prevention training for network participants.

o Determine available personnel trained in handling hazardous materials and response equipment.

o Draft Memorandums of Understanding to share trained personnel and response equipment.

o Form spill response teams capable of effective spill response on the river.

o Pre-position spill response equipment at strategic locations.

o Develop training and response programs for the River Defense Network.

LITERATURE CITED

Cheng, H.D. 1978. Pollution forecast in streams. University of Missouri, Columbia. Report prepared for the U.S. Office of Water Research and Technology, Washington, D.C. PB-291 440.

Coleman, W.E., J.W. Munch, R.P. Streicher, H.P. Ringhand, and F.C. Kopfler. 1984. The identification and measurement of components in gasoline, kerosene, and No. 2

fuel oil that partition into the aqueous phase after mixing. Environmental Contamination and Toxicology 13:171-178.

Cronk, J.K., W.J. Mitsch, and R.M. Sykes. 1990. Effective modeling of a major inland oil spill on the Ohio River. Ecological Modeling 51:161-192.

Environmental Information, Ltd. 1991. Environmental Services Directory, Vol. III-EPA-Region V. Minneapolis, Minnesota.

Fier-Ticker, D. 1990. Fire department response to fuel spills. Minnesota Fire Chief. 27:32-35.

Fingas, M. and M. Sydor. 1980. Development of an Oil Spill Model for the St. Lawrence River, Environment Canada Technical Bulletin No. 116, Inland Waters Directorate, Water Planning and Management Branch, Ottawa, Canada.

Goodrich, J.A., and R.M. Clark. 1984. Predicting toxic waste concentrations in community drinking water supplies: analysis of vulnerability of upstream waste discharges. Report prepared for the U.S. Environmental Protection Agency U.S. Municipal Environmental Research Laboratory, Cincinnati, Ohio.

Green, J., and M.W. Trett. 1989. The Fate and Effects of Oil in Freshwater. Elsevier Science Publishers, New York, New York..

Have, M.R. 1991. Selected Water Quality Characteristics in the Upper Mississippi River Basin, Royalton to Hastings, Minnesota. U.S. Geological Survey, Water Resources Investigations Report 88-4053. St. Paul, Minnesota.

Herbes, S., and G. Yeh. 1985. Hazard assessment: a transport model for water-soluble constituents of synthetic oil spills in rivers. Environmental Toxicology and Chemistry 4: 241-254.

Kreamer, D.K., and K.L. Stetzenbach. 1990. Development of a standard, pure-compound base gasoline mixture for use as a reference in field and laboratory experiments. Ground Water Monitoring Review pp. 135-145.

Macbeth, E. 1990. Assessment of Wisconsin's Spill Prevention and Preparedness on the Mississippi River. Minnesota-Wisconsin Boundary Area Commission. Hudson, Wisconsin.

Mills, W.B., D.B. Porcella, M.J. Ungs, S.A. Gherini, K.V. Summers, L. Mok, G.L Rupp, G.L Bowie, and D.A. Haith. 1985. Water Quality Assessment: A Screening Procedure for Toxic and Conventional Pollutants in Surface and Groundwater, Parts 1 and 2. Reports PB86-122496 and PB86-122504, prepared for the U.S. Environmental Protection Agency Environmental Research Laboratory, Athens, Georgia.

Minnesota Pollution Control Agency. Undated. Detailed hazardous waste manifest report stored by waste code. Hazardous Waste Division. St. Paul, Minnesota.

Minnesota Pollution Control Agency. Undated. Listing of aboveground storage tanks. Minnesota Pollution Control Agency Tanks and Spills Section. St. Paul, Minnesota.

Minnesota Pollution Control Agency. 1990. Protecting the Mississippi River: A Blueprint for Spill Prevention and Preparedness. St. Paul, Minnesota.

Minnesota Pollution Control Agency. 1992. Upper Mississippi River spill response training materials. August 1992 training session at Onalaska, Wisconsin. St. Paul, Minnesota.

Minnesota State Legislature. 1991. Spills Bill. H.F. No. 977. Chapter 115E.
Oil Pollution Act. 1990. H.R. 1465. Title IV.

Shen, H.T., P.D. Yapa, D.S. Wang, and X.Q. Yang. 1991. A mathematical model for oil slick transport and mixing in rivers. Report No. 91-1. Department of Civil and Environmental Engineering. Clarkson University. Potsdam, New York.

Schmidt, P. 1985. Fuel Oil Manual. Industrial Press Inc., New York, New York.

SRI International. 1982. Aquatic fate processes data for priority pollutants. Report PB87-169090 prepared for the U.S. Environmental Protection Agency.

Stolzenbach, K.D. 1977. A Review and Evaluation of Basic Techniques for Predicting the Behavior of Surface Oil Slicks. Ralph M. Parsons Laboratory for Water Resources and Hydrodynamics. Report No. 222. Marine Assessment Division, National Oceanic and Atmospheric Administration.

Tennant, P.A. and L.H. Betscher. 1990. Improving strategies for chemical spills. Water Engineering & Management 137(10):32-34.

Tetra Tech, Inc. 1985. Rates, constants, and kinetics formulations in surface water quality modeling. Report prepared for the U.S. Environmental Protection Agency Environmental Research Lab, Athens, Georgia.

U.S. Bureau of the Census. 1990. Census of transportation for 1987, truck inventory and use survey, Minnesota. U.S. Bureau of the Census Report No. TC87-T-24. 12pp.

U.S. Bureau of the Census. 1983. Commodity transportation survey 1983 - tabulation text. U.S. Bureau of the Census Business Division, Washington, D.C.

U.S. Department of Labor. 1990. Occupational Hazardous Health and Safety. 29 CFR 1910.120.

U.S. Department of Transportation. 1991. Flow of selected hazardous materials by rail. Report No. DOT-UNTSC-RSPA-90-1. Washington, D.C.

U.S. Environmental Protection Agency. 1990. National Oil and Hazardous Substances Pollution Contingency Plan. 40 CFR 300.

U.S. Environmental Protection Agency. 1991. National Primary Drinking Water Regulations. 40 CFR 141.

Upper Mississippi River Basin Association. 1991. Upper Mississippi River Spill Response Plan and Resource Manual. St. Paul, Minnesota.

Upper Mississippi River Basin Association. 1988. Hazardous Materials Spills Reporting. St. Paul, Minnesota.

Verschueren, K. 1983. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Company, New York, New York.

Voznesensky, G. 1979. Oil spills in a river: a one-dimensional model. Hydrological Sciences Bulletin.

APPENDIX A

River Defense Questionnaire

Company/Agency _____

Contact Person _____

_____

Address _____

_____

Phone Number _____

Interviewer _____

Introduction Statement

Hello, may I speak with _____.

Hello, my name is _____. I am calling from the Army Corps of Engineers in St. Paul, Minnesota. The Corps, in conjunction with the State of Minnesota, local cities, and industrial sponsors, is currently involved in a study to assess the preparedness and response capabilities of government agencies and industries in the event of spill on the Upper Mississippi or tributaries. The study area of this project is from the Headwaters in Lake Itasca to Minneapolis. In the last few years, there have been many chemical and oil spills on or near waterways in Minnesota and growing concern about the roles, responsibilities, and capabilities of public agencies and private industries to respond to these spills. In order to get an accurate assessment of response capabilities on the river, we need your help. Due to your location on or near the river, your company/county/city was chosen to participate in this study. I have some questions on staff training capabilities, emergency response plans, and equipment available that will take approximately fifteen minutes of your time.

Role and Responsibilities

First, I am interested in knowing your company's/county's/city's role in responding to chemical or oil spills on or near the Mississippi River or its tributaries. For these questions, please answer yes or no.

1. Do you have responsibility for (READ LIST BELOW)...

	No	Yes	Don't Know
a. Maintaining chemical databases	1	2	8
b. Notifying response personnel or officials	1	2	8
c. Public warning and safety	1	2	8
d. Coordinating spill response	1	2	8
e. Containing the spill	1	2	8
f. Cleaning up the spill	1	2	8

2a. Have you ever responded to spills potentially or actually affecting the Mississippi River in the last year or two?

1. no (GO TO #3)
2. yes
8. don't know

b. IF YES, what was your responsibility during the emergency?

Emergency Plans and Resources

Now I am going to ask you some questions about your emergency response plans and resources. Please answer yes or no.

3. Does your company/county/city have emergency response plans which specifically contain action plans and identify names of persons to contact in the event of a spill on the Mississippi?

1. no (GO TO #6a)
2. yes
8. don't know

4. Do your response plans specifically detail environmentally sensitive areas or water intakes downstream of your location?

1. no
2. yes
8. don't know

5. How often are your response plans updated?
   1. never
   2. quarterly
   3. semi-annually
   4. yearly
   5. every two years
   8. don't know

6a. Is your company/county/city required to have emergency response plans which specifically include chemical or oil spills on or near the Mississippi River?
   1. no (GO TO #7)
   2. yes
   8. don't know

b. IF YES, are your response plans reviewed by a government agency?
   1. no (GO TO #7)
   2. yes
   8. don't know

c. IF YES, what is the name of the agency?
   1. Minnesota Pollution Control Agency
   2. State Emergency Management
   3. State Emergency Response Commission
   4. Environmental Protection Agency
   5. other

   _____
   (write in agency)

   8. don't know

7. Does your company/county/city have the following computerized emergency management programs? Please answer yes or no.

Do you have...

	No	Yes	Don't Know
a. Automated Resources for Chemical Hazard Incident Evaluation (ARCHIE) program	1	2	8

b. Computer Aided Management of Emergency Operations (CAMEO) program	1	2	8
c. Other computer resources program	1	2	8

_____

(list program name)

Staff Training Capabilities

For the next series of questions, I would like to know about your staff training capabilities.

	Number of employees
8a. How many employees do you have in your department?	0 1 2 3 4 5 6 7 8 9 10+

How many employees do you have trained in ... (READ LIST BELOW)

	Number of employees
b. Containment operations	0 1 2 3 4 5 6 7 8 9 10+
c. Cleanup operations	0 1 2 3 4 5 6 7 8 9 10+

9. Have any employees received hazardous materials training?
   1. no (GO TO #12a)
   2. yes (GO TO #10)
   8. don't know

10. IF YES, how many employees have (SEE TRAINING LIST) training?

	Number of employees
a. First responder awareness (4 Hrs) (notify authorities of chemical release)	0 1 2 3 4 5 6 7 8 9 10+

b. First responder operations (8 Hrs) 0 1 2 3 4 5 6 7 8 9 10+
(public safety & basic containment)

c. Hazardous materials technician (24+ hrs) 0 1 2 3 4 5 6 7 8 9 10+
(containment of hazardous releases)

d. Hazardous materials specialist (24+ hrs) 0 1 2 3 4 5 6 7 8 9 10+
(containment & decontainment of chemicals)

e. On scene incident commander (24+ hrs) 0 1 2 3 4 5 6 7 8 9 10+
(coordinate response and implement plans)

f. Completed refresher training 0 1 2 3 4 5 6 7 8 9 10+
(receive annual refresher training)

g. Other training 0 1 2 3 4 5 6 7 8 9 10+

_____
(List & describe training)

11a. Do you have a hazardous materials team capable of recovering a spill from the Mississippi River?

1. no (GO TO #12a)
2. yes
8. don't know

b. IF YES, how often do you conduct spill response practice drills?

1. never
2. yearly
3. quarterly
4. monthly
5. weekly
6. daily
8. don't know

12a. Do you have a response contractor for cleaning up potentially hazardous spills?

1. no (GO TO #13)
2. yes
8. don't know

b. IF YES, what is the name of your contractor?
(circle more than one if needed)

1. Bay West, St. Paul, Mn
2. OH Materials, Findlay, Ohio
3. OSI Environmental Inc, Virginia, Mn
4. other _____
   (write in name and address of contractor)
8. don't know

CleanUp Equipment

Next I would like to know what equipment your company/county/city has to respond to a spill on the Mississippi River or tributaries?

13. How many feet of (SEE EQUIPMENT LIST) do you have?

	Size (measured in feet)	Location (city, state, zip)
a. absorbent boom	_____	_____
b. containment boom	_____	_____

How many cases/bales of (SEE EQUIPMENT LIST) do you have?

	Number of cases/bales	Location (city, state, zip)
c. absorbent pillows/pad	0 1 2 3 4 5+	_____
d. straw/hay	0 1 2 3 4 5+	_____

How many (SEE EQUIPMENT LIST) do you have?

	Number of equipment	Location (city, state, zip)
e. skimming devices	0 1 2 3 4 5+	_____
f. pumps	0 1 2 3 4 5+	_____
g. boats	0 1 2 3 4 5+	_____
h. vacuum trucks	0 1 2 3 4 5+	_____
i. generators near river	0 1 2 3 4 5+	_____
j. plug and patch kits	0 1 2 3 4 5+	_____
k. other equipment		
_____ (List equipment)	0 1 2 3 4 5+	_____
_____ (List equipment)	0 1 2 3 4 5+	_____

River Defense Network
Finally, I would like to know ...

14a. Do you have mutual aid/cooperative agreements to share spill response equipment with other industries, counties, or cities?

1. no (GO TO #15a)
2. yes
8. don't know

b. IF YES, who do you share equipment with?

_____
(write in name, address, city, state, zip)

15a. Do you have mutual aid/cooperative agreements to share personnel trained in spill response with other companies, counties, or cities?

1. no (GO TO #16)
2. yes
8. don't know

b. IF YES, who do you share personnel with?

_____

(write in name, address, city, state, zip)

16. If a Mississippi River Response Cooperative was created in your area for the purpose of planning, training, and exchanging information, equipment, and personnel among government agencies and industries, would you be interested in participating?

1. no
2. yes
8. don't know

These are all the questions that I have. Would you like to make any additional comments?

_____

_____

Thank you very much for your time and effort.

INSERT COMPANY ONLY

17. What special precautions has your company taken to prevent hazardous materials spills from reaching the Mississippi or tributaries to the river through drains, pipelines, storage containers, or cars?

1. have not taken any precautions
2. inspect equipment and facilities on a weekly basis
3. construct dikes and berms around storage or transfer areas
4. install valves or have plugs available for storm sewer drainage
5. preposition equipment along transportation routes

6. other _____

_____

(write in precautions taken)

8. don't know

APPENDIX B
LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL
ON THE UPPER MISSISSIPPI RIVER

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Bemidji Fire Department Bemidji, MN (218) 751–8001	1	14	14	2		4	14
Clearwater Cty Emerg Mgt Bagley, MN (218) 694–6266	1	1	1	1		1	1
Grand Rapids Fire Dept. Grand Rapids, MN (218) 327–2807	1	25	25				
Itasca Cty Emerg Mgt Grand Rapids, MN (218) 327–2878	1	2	1	1	3	2	2
Lakehead Pipeline Co. Superior, WI (715) 394–1400 Personnel gathered from across the state	1	90	90	110	4	15	
Minnesota Power Cohasset, MN (218) 328–5711	1	35	35	35		1	3
Total for Region 1		167	166	149	7	23	20

LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL
ON THE UPPER MISSISSIPPI RIVER (CONTINUED)

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Aitkin Fire Department Aitkin, MN (218) 927–2954	2	25	10	3		6	4
Brainerd Fire Dept. Brainerd, MN (218) 829–7144	2	41	2			5	41
Cass Cty Emerg Mgt Walker, MN (218) 547–3300	2	1	1			1	
Crow Wing Cty Emerg Mgt Brainerd, MN (218) 829–1711	2	3					
Koch Pipeline Cottage Grove, MN (612) 458–4844	2			24		3	
Little Falls Fire Dept. Little Falls, MN (612) 632–4461	2	5	5			2	2
Morrison Cty Emerg Mgt Little Falls, MN (612) 632–9233	2	1					
Potlach Corporation Brainerd, MN (218) 828–3200	2	20	20	4	4	2	20
Total for Region 2		96	38	31	4	19	67

LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL
ON THE UPPER MISSISSIPPI RIVER (CONTINUED)

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Big Lake Fire Dept. Big Lake, MN (612) 295–4111	3	10				2	
Champion Intl. Corp. Sartell, MN (612) 251–6511	3	25	25	25	1	1	15
Monticello Fire Dept. Monticello, MN (612) 295–4111	3	25					
Rice/Watab Fire Dept. Rice, MN (612) 393–2180	3	18	18			4	
St. Augusta Fire Dept. St. Augusta, MN (612) 255–7210	3	30					
St. Cloud Fire Dept. St. Cloud, MN (612) 255–7213	3	50	50	10	3	10	50
Sartell Fire Dept. Sartell, MN (612) 253–2067	3	20	3	3	3		3
Sherburne Cty Emerg Mgt Elk River, MN (612) 441–2522	3	1				1	

LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL
ON THE UPPER MISSISSIPPI RIVER (CONTINUED)

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Stearns Cty Emerg Services St. Clould, MN (612) 259–3940	3	1				1	1
Wright Cty Civil Defense Buffalo, MN (612) 682–3900	3	1				1	1
Total for Region 3		181	96	38	7	20	70

LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL
ON THE UPPER MISSISSIPPI RIVER (CONTINUED)

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Amoco Pipeline Co. Brooklyn Park, MN (612) 425–4750	4	26	26	26	2	2	26
Anoka Cty Emerg Mgt Anoka, MN (612) 421–4760	4	2	2			1	2
Anoka Fire Dept. Anoka, MN (612) 421–6631	4	30	30	2		12	30
Brooklyn Center Fire Brooklyn Center, MN (612) 569–3360	4	40	30				
Brooklyn Park Fire Brooklyn Park, MN (612) 424–8000	4	60+	60+	4	4	20	10+
Burlington Northern St. Paul, MN (612) 490–6105	4	60	30	30	15	15	60
C & NW Trans. Co. Chicago, IL (312) 559–6233	4	3	3	2	2	1	
Coon Rapids Fire Dept. Coon Rapids, MN (612) 780–6429	4	47		3	3		

LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL ON THE UPPER MISSISSIPPI RIVER (CONTINUED)

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Elk River Fire Dept. Elk River, MN (612) 441–2582	4	30	30			5	30
Federal–Hoffman Anoka, MN (612) 323–2300	4	45	45	10			15
Food–N–Fuel Arden Hills, MN (612) 633–7863	4	10+					
Fridley Fire Dept. Fridley, MN (612) 571–3450	4	34	34	10		34	34
Hennepin Cty Emerg Mgt Hopkins, MN (612) 930–2613	4	5	3	1	1	3	
Indianhead Truck Line St. Paul, MN (612) 633–2661	4	2					
Minneapolis Fire Dept. Minneapolis, MN (612) 673–2536	4	470	470	70	5	30	8
Naval Systems Division of FMC Fridley, MN (612) 572–6938	4	105		40	3	3	40

LOCATION AND TYPE OF SPILL RESPONSE PERSONNEL
ON THE UPPER MISSISSIPPI RIVER (CONTINUED)

Facility Name Location Telephone Number	Region	First Responder Awareness	First Responder Operations	Hazardous Materials Technician	Hazardous Materials Specialist	On Scene Incident Commander	Completed Refresher Training
Soo Line Railroad Minneapolis, MN (612) 347–8000	4	12	12	12	12	12	
Super America Twin Cities, MN (606) 329–3333	4	20	20				
Williams Pipeline Co. Minneaplis, MN (612) 633–1555	4	30	30	4	4	4	30
Total for Region 4		1031	825	214	51	142	285

APPENDIX C
LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Bemidji Fire Department Bemidji, MN (218) 751–8001	1							3	26 Scuba Gear 2 Protective
Blandin Paper Grand Rapids, MN (218) 327–6322	1	218' absorbent	100 Pads						
Clearwater Cty Emerg Mgt Bagley, MN (218) 694–6266	1	* at County Highway Department – Bagley, MN						6*	
Grand Rapids Fire Dept. Grand Rapids, MN (218) 327–2807	1	30' absorbent	3			1		2	
Itasca Cty Emerg Mgt Grand Rapids, MN (218) 327–2878	1	* at DNR Fire Rescue Center – Grand Rapids, MN			10*	2		7	5+ bales straw/hay
Lakehead Pipeline Co. Superior, WI (715) 394–1400	1	200' absorbent 800' containment	5 bales–pads (50 per bale)	4	4	2	1	2	1 – 1800 Gal. Portable Storage Tank
Equipment located in Bemidji, MN also have equipment in Thief River Falls, MN and Superior, WI									
Minnesota Power Cohasset, MN (218) 328–5711	1	600' absorbent 400' containment	15 Cases (100 per case)		20	2	1	4	2 Equip. Trailers (located in Duluth & Little Falls)

LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER
(Continued)

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Aitkin Fire Department Aitkin, MN (218) 927–2954	2					1		3	
Brainerd Fire Dept. Brainerd, MN (218) 829–7144	2		1 case (20 pads)		1			8	20 Bags Kitty Litter (25 lbs. per bag)
Crow Wing Cty Emerg Mgt Brainerd, MN (218) 829–1711	2					1		1	
Hennepin Paper Co. Little Falls, MN (612) 632–3684	2		3		3	3		1	
Koch Pipelines Cottage Grove, MN (612) 458–4844 Equipment located in Little Falls, MN	2	300' absorbent 600' containment	30 bales–pads	2		2		2	
Little Falls Fire Dept. Little Falls, MN (612) 632–4461	2	200–300' absorbent			3			4	
Minnesota Power Little Falls, MN (612) –	2	400' sorbent 300' containment	12 Cases	1 (with a manual pump)		1 (with 9.9 motor)			. 300 Ft Sorbent Roll
Potlach Corporation Brainerd, MN (218) 828–3200	2		6	2	3	1		1	500 Tons Wood Fiber 1 Absorbent Blanket 6 Personal Prot. Equip. 12 Scuba

LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER
(Continued)

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Benton Cty Emerg Mgt Foley, MN (612) 968–6254	3				3	3		1	
Big Lake Fire Dept. Big Lake, MN (612) 295–4111	3				3			3	
Champion Intl. Corp. Sartell, MN (612) 251–6511	3	200' containment	2		2	1			12 Protective Suits 14 Scuba 12 Barrels/Salvation
Monticello Fire Dept. Monticello, MN (612) 295–4111	3		1					3	1 – 4,000 gallon sludge truck
NSP Monticello, MN (612) 295–1056	3	8 bales absorbent 3 absorbent sweeps	12			1	1	2	
NSP – Sherco Plant Becker, MN (612) 330–7682	3	160' absorbent	5+			3	2	1	
Rice/Watab Fire Dept. Rice, MN (612) 393–2180	3				3	1		2	
St. Cloud Fire Dept. St. Cloud, MN (612) 255–7213	3	80' absorbent	2		1	3		4	
St. Augusta Fire Dept. St. Augusta, MN (612) 255–7210	3				1			2	

LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER
(Continued)

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Sherburne Cty Emerg Mgt Elk River, MN (612) 441–2522	3	* at Water Patrol Storage Barn – Elk River, MN				10*		3*	
Stearns Cty Emerg Services St. Clould, MN (612) 259–3940	3				6	3		6	2000 Sandbags
Amoco Pipeline Co. Brooklyn Park, MN (612) 425–4750	4	650' absorbent 2800' containment	9 bales–pads (250 per bale)	2	2	2	1	1	3 Trailers (With spill control equipment located in Osseo, MN)
Anoka Cty Emerg Mgt Anoka, MN (612) 421–4760	4	* at Sheriff's Department – Anoka, MN				6*			
Anoka Fire Dept. Anoka, MN (612) 421–6631	4		6			1		6	
Brooklyn Center Fire Brooklyn Center, MN (612) 569–3360	4				3	2		8	
Brooklyn Park Fire Brooklyn Park, MN (612) 424–8000	4	200' containment				2		5+	
Burlington Northern RR Northtown Shop Fridley, MN (612) 782–3300	4	320' absorbent 160' pigs	41 cases/bales						2 plug and patch kits

LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER
(Continued)

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Burlington Northern RR Bridle Veil Shop Fridley, MN (612) 782–3300	4	320' absorbent 160' pigs	41 cases/bales						2 plug and patch kits
Burlington Northern RR Northtown Wastewater Treatment Facility Fridley, MN (612) 782–3300	4	320' absorbent 160' pigs	41 cases/bales						2 plug and patch kits
Conagra/Cropmate DBA The Howe Co. Brooklyn Center, MN (612) 535–1030	4		20						10 Tons Kitty Litter
Coon Rapids Fire Dept. Coon Rapids, MN (612) 780–6429	4							6	
Dayton Fire Dept. Dayton, MN (612) 420–4274	4					1		2	
Elk River Fire Dept. Elk River, MN (612) 441–2582	4							7	

LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER
(Continued)

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Federal–Hoffman Anoka, MN (612) 323–2300	4		5		5		1	2	2 Graders 1 Payloader 25 – 55 Gallon Drums of Sawdust 1 Pettibone 3 Dump Trucks 1 Chem. Spill Trailer
Fridley Fire Dept. Fridley, MN (612) 571–3450	4	200' absorbent 200' containment	5+		2	1		6	1 Haz Mat Response Panel Truck (for small spills or leaks)
Hennepin Cty Emerg Mgt Hopkins, MN (612) 930–2613	4	* at Sherrif's Department – Mound, MN ** at Public Works Department – Hopkins, MN			20	10*	2**	25	5+ hay cases/bales 5+ graders 5+ bulldozers sand
Minneapolis Fire Dept. Minneapolis, MN (612) 673–2536	4					4		13	
Murphy Warehouse Co. Brooklyn Center, MN (612) 623–1225	4		5+		1			2	
Naval Systems Division of FMC Fridley, MN (612) 572–6938	4	100' absorbent 150' containment	3		3			1	1 payloader 1 truck with plow 2 yards of sand

LOCATION AND TYPE OF SPILL RESPONSE EQUIPMENT
ON THE UPPER MISSISSIPPI RIVER
(Continued)

Facility Name Location Telephone Number	Region	Boom	Absorbent Pillows/Pads	Skimming Devices	Pumps	Boats	Vacuum Trucks	Generators	Other Equipment
Soo Line Railroad Minneapolis, MN (612) 347–8000	4								2 Blue Boxes (located in N. Mpls. & St. Paul containing booms, pads and dispoable gear)
Super America Twin Cities, MN (606) 329–3333	4								6 plug and patch kits
United Power Assn. Elk River, MN (612) 441–3121	4	100' absorbent 100' containment	4						1 Front–End Loader
Williams Pipeline Co. Minneaplis, MN (612) 633–1555 Equipment located in Rosemount & Roseville, MN	4	600' absorbent 1000' containment	10 bales		5	1	1	2	3 Emerg. Response Trailers (located in Roseville, Rosemount & Superior
Lakehead Pipeline Co. Superior, WI (715) 394–1400 Equipment located in Thief River Falls, MN also have equipment in Bemidji, MN and Superior, WI		50' absorbent 650' containment	17 bales–pads (50 per bale)	3	2	2	1	2	1 – 1800 Gal. Portable Storage Tank
Lakehead Pipeline Co. Superior, WI (715) 394–1400 Equipment located in Superior, WI also have equipment in Bemidji & Thief River Falls, MN and Superior, WI		400' absorbent 1100' containment	15 bales–pads (50 per bale)	4	2	2	1	3	1 – 1800 Gal. Portable Storage Tank
Minnesota Power Duluth, MN (218) –		400' sorbent 300' containment	12 Cases	1 (with a manual pump)		1 (with 9.9 motor)			300 Ft Sorbent Roll

APPENDIX D
MISS-OTA-CROIX MEMBERSHIP LIST
SEPTEMBER 1991

AMOCO Oil Company 2288 West County Road C St. Paul, MN 55113	Mark Strauch 636-1780
AMOCO Pipeline Company 9400 Winnetka Ave. N. Brooklyn Park, MN 55448	Ken Andreen 425-4201
Ashland Petroleum 100 3 Avenue St. Paul Park, MN 55071	Jim Scaleucci 459-9771
Erickson Petroleum Corporation (Holiday) 4567 West 80th Street Minneapolis, MN 55437	Jim Carlson 830-8885
Koch Material Company 2209 Childs Road St. Paul, MN 55102	Fred Lawless 774-9763
Koch Fuels 778 Otto Avenue St. Paul, MN 55102	Mike Savage 228-4620
Koch Refinery P. O. Box 64596 St. Paul, MN 55164 Refinery 24 Hours	Tom Segar 437-0701 437-0700
Minnesota Pipeline Company P. O. Box 67 Cottage Grove, MN 55016	Jay Reinhardt 459-2424
Mobil Oil Corporation P. O. Box 16318 St. Paul, MN 55116	Harry Thompson 227-0731

River Fleets, Inc. dba Minnesota Harbor Service 415 West Water Street P. O. Box 7037 St. Paul, MN 55107	Jim Hartman 224-9648
Upper River Services, Inc. 40 State Street St. Paul, MN 55107	Lee Nelson 292-9293
Uno-Ven 747 Shepard Road St. Paul, MN 55102	Jim Sundberg 224-5779
Westway Trading Corporation 2175 Childs Road St. Paul, MN 55102	Gordon Meyer 774-6600
Williams Pipeline Company 2500 39th Avenue N. E. Minneapolis, MN 55421	Chuck Danchertsen 633-1555

APPENDIX E

MISS-OTA-CROIX TOOL AND EQUIPMENT INVENTORY

20 - Hard hats
24 - Rubber gloves (pairs)
5 - Safety glasses
5 - Goggles
20 - Respirators
10 - Rubber boots
1 - Knee high hip wader
2 - Chest wader
10 - Rain suits
25 - Coveralls
4 - Life vests
1 - 24 Unit first aid kit
35 - Bails sorbent pads
3 - Bails matasorb M-75
3 - Bails 3M 280 sorbent boom
1 - Bail 3M 270 sorbent boom
1 - Bag of oil snare
8 - Tow bridles
1 - 200 ft. ACME boom 8" - 12"
5 - 100 ft. ACME boom 8" - 12"
8 - 50 ft. ACME boom 6" - 6"-3/8
1 - 50 ft. ACME boom 4" - 4"
1 - 10 ft. ACME boom 2" - 2"
21 - Bags floor dry
15 - Bags grit-o-cob
1 - Mop head 20 oz.
Assortment of sample bottles and tags
2 - 55 Gallon drums
2 - 30 Gallon drums
4 - 5 Gallon pails
1 - Boat with oars
3 - Rakes
1 - Push broom
2 - Squeegees
2 - Fan rakes
2 - 8# Sledge hammers
1 - Square shovel
3 - Shovels
2 - Aluminum scoop shovels
1 - Fence post driver
1 - Ax

APPENDIX E
MISS-OTA-CROIX

TOOL AND EQUIPMENT INVENTORY (CONT.)

Rope, 1/2" by 100' and assortment
4 - Extension cord (1-100', 12-2; 3-50', 16-2)
1 - Aluminum step ladder 6'
1 - Roll chicken wire
12 - Fence posts
1 - 2" Sandpiper pump air operated
1 - 2" 3HP centrifugal pump
1 - 2" 3HP diaphragm pump
1 - 2" monarch hand operated diaphragm pump
1 - Mant ray skimmer
1 - Box of 1/4" chain approx 100'
1 - Generator
2 - 5 Gallon gas cans
1 - Portable chemical toilet
2 - Flashlights for hazardous location
2 - Flashlights
1 - Lantern 6 volt
1 - Duradead light/flasher 6 volt
3 - Rolls duct tape
4 - Spare "D" batteries
4 - Spare 6 volt lantern batteries
12 - Flood light bulbs
1 - Portable clamp lamp
2 - Funnels
Assortment of rags
1 - 24" bolt cutter
1 - Tool box
1 - 52 pc. cobra socket set 1/4"-3/8"-1/2"
1 - Set combination wrench
1 - Set 3/8" sockets
1 - Role friction tape
2 - pairs of pliers
1 - Channel locks
1 - Plumb claw hammer
1 - 12" ridged pipe wrench
4 - Adjustable wrenches 12", 10", 8", 6"
1 - 4" C-clamp
1 - Set screw drivers
1 - Roll mechanics wire
1 - Ice chisel
2 - 18" Pipe wrenches

PLEASE NOTE: You recently received a copy of a report entitled "Water Supply and Spill Response Management for the Mississippi River Upstream of the Twin Cities". The following errata sheet replaces parts of p. 57.

EXISTING NOTIFICATION AND RESPONSE SYSTEM

SPILL RESPONSE NOTIFICATION

Hazardous materials spill reporting requirements have been established by the State of Minnesota, the federal government, and by certain local governments. As a result of these requirements, the party responsible for a hazardous materials spill must report it to the Minnesota Duty Officer; and, in most cases, to the National Response Center (see later discussion). Depending upon the nature of the spill, and/or the local jurisdiction involved, a notification of local government may also be required.

The exact sequence of spill notification calls sometimes depends on which governmental agency receives the initial call. If a local 911 dispatcher receives a notification from either the responsible party or a citizen, it may relay that notification to the Minnesota Duty Officer. In addition, the Minnesota Duty Officer will notify the affected local government of all significant spills/releases of which it has been notified. These are courtesy notifications that do not relieve the party responsible for the spill from the notification requirements described above.

Minnesota Duty Officer

In 1992 the State of Minnesota established a single point of contact for reporting serious accidents/incidents, and any type of hazardous materials spill or release. This 24-hour operation is known as the Minnesota Duty Officer, and it is operated by the Minnesota Department of Public Safety, Division of Emergency Management (DEM). The Duty Officer telephone numbers are: 612/649-5451, TDD 612/297-5353 for the Minneapolis-St. Paul Metropolitan Area and outside of the State of Minnesota; 1-800/422-0798, TDD 1-800/627-3529 for Greater Minnesota.

In the event of a spill affecting the Mississippi River, the Minnesota Duty Officer will notify all appropriate state government agencies. These notifications will always include the Minnesota Pollution Control Agency (MPCA). Depending upon the nature of the incident, they may also include the Department of Agriculture (MDA), the Department of Transportation (Mn/DOT), the Department of Natural Resources (DNR), the Department of Health (MDH), and others.

At the federal level, the Duty Officer will notify the Coast Guard of all Mississippi River (and Minnesota and St. Croix) River spills. In addition, the U.S. Fish and Wildlife Service will be notified of a spill that has/may result in a major impact/kill of fish or wildlife.

Lastly, if a spill occurs in a body of water that borders more than one state, the Duty Officer will notify the other affected state(s).