

CTS
HE
199
.M6
C356
1995

Minnesota Freight Flows - 1990

Technical Report Documentation Page

1. Report No. MN/RC - 95/14	2.	3. Recipient's Accession No.	
4. Title and Subtitle MINNESOTA FREIGHT FLOWS - 1990		5. Report Date February 1995	
		6.	
7. Author(s) Candace Campbell Dr. David Braslau Catherine Petersen Jeff Levine		8. Performing Organization Report No.	
9. Performing Organization Name and Address Hubert H. Humphrey Institute of Public Affairs 301 Nineteenth Avenue South Minneapolis, MN 55455		10. Project/Task/Work Unit No.	
		11. Contract or Grant(G) No. Mn/DOT 71724 TOC 131	
12. Sponsoring Organization Name and Address Minnesota Department of Transportation 395 John Ireland Boulevard St. Paul, MN 55155		13. Type of Report and Period Covered Final Report	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract (Limit: 200 words) <p>Extensive transportation systems, which include highways, rivers, Great Lakes ports, railroads, airports, and pipelines, link Minnesota to markets throughout the North American Continent. This study provides a comprehensive source of freight flow information in Minnesota and shows the ways in which the transportation systems support business and commerce. It draws upon data and analysis developed over the past five years with contributions from the University of Minnesota's Center for Transportation Studies and the Minnesota Department of Transportation.</p> <p>The report summarizes the freight flows in, out, through, and within Minnesota in 1990 by model and in some cases by major commodity and major origin or destination.</p>			
17. Document Analysis/Descriptors Origin Data Destination Data Weight & Value Shipped Commodity Flows Freight Movements Freight Transportation Modes		18. Availability Statement No restrictions. This document is available through the National Technical Information Services, Springfield, Va. 22161	
19. Security Class (this report) Unclassified	20. Security Class (this page) Unclassified	21. No. of Pages 175	22. Price

MINNESOTA FREIGHT FLOWS - 1990

A Compilation and Synthesis of Data by Mode and Commodity

Prepared for the

Minnesota Department of Transportation

by the

Hubert H. Humphrey Institute of Public Affairs

University of Minnesota

Candace Campbell, Fellow
Dr. David Braslau, Adjunct Associate
Catherine Petersen, CJ Petersen and Associates
Jeff Levine, Research Assistant

February 1995

The Humphrey Institute of the University of Minnesota is hospitable to a diversity of opinions and aspirations. The Institute does not itself take positions on issues of public policy.

ACKNOWLEDGEMENTS

This report is funded by a grant from the Minnesota Department of Transportation to the Hubert H. Humphrey Institute of Public Affairs through the Center for Transportation Studies (CTS) at the University of Minnesota. The principal investigator on this project was Candace Campbell, Institute Fellow. Dr. David Braslau, Adjunct Associate, was responsible for the compilation and synthesis of the data and report preparation. Catherine Petersen, Consultant, served as the liaison with private transportation firms and prepared the chapter on transportation trends. Information on commodity movements by rail through the State of Minnesota were provided by Dr. Jerry Fruin and Daniel Halback, Department of Agricultural and Applied Economics. Dr. Wilbur Maki and Anwar Hossain, also of the Department of Agricultural and Applied Economics, provided information on the transportation sector and regional employment.

The research team appreciates the assistance provided by Perry Plank, Mn/DOT, who served as Technical Liaison for the study. Members of the Technical Advisory Panel for the project included Chuck Sanft, and Steve Alderson of Mn/DOT, and Scheffer Lang and Bill Smith of the Center for Transportation Studies Council on Transportation and the Economy. Laurie McGinnis of the Center for Transportation Studies and Ron Cassellius and Bill Bunde, Office of Research Administration, Mn/DOT, also provided project support. The research team would also like to acknowledge assistance provided by Dr. Fred Beier of the Carlson School of Management, University of Minnesota, and to representatives of the private transportation sector who provided extensive information and input into the Transportation Trends section of this report and who provided selected data for validation of publically available data sources.

TABLE OF CONTENTS

	Page
1.0 INTRODUCTION	
1.1 Study Purpose	1
1.2 Structure of this Report.....	1
1.3 Data Sources Used	1
1.4 Geographic Regions.....	2
1.5 Overview of Data Sources	7
2.0 BUSINESS TRENDS IN THE TRANSPORTATION INDUSTRY	
2.1 Industry Determinants of the Changing Demand for Transportation.....	9
2.2 Trends in the Motor Carrier Industry	11
2.3 Trends in Intermodal Transportation.....	15
2.4 Trends in Rail Transportation.....	18
2.5 Trends in Air Cargo Transportation	20
2.6 Trends in Waterways Transportation	23
3.0 FREIGHT FLOW DATA TOTALS FOR 1990	
3.1 Modal Descriptions and Definitions.....	25
3.2 Total Tonnage by Mode.....	28
3.3 Total Value	32
3.4 Modal Flows by Distance	33
4.0 FREIGHT FLOWS BY MODE	
4.1 Commodity Descriptions and Definitions	49
4.2 Modal Distribution of Commodity Flows	50
4.3 Commodity Flows by Rail.....	59
4.4 Commodity Flows by Truck.....	59
4.5 Commodity Flows by Air	59
4.6 Commodity Flows by Water	59
5.0 COMMODITY FLOWS BY ORIGIN AND DESTINATION	
5.1 Internal BEA Flows	75
5.2 Internal Minnesota Flows (BEA to BEA)	76
5.3 Upper Midwest Flows.....	81
5.4 U.S. Flows.....	93
5.5 International Flows	122
5.6 Through Flows.....	131

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1	Minnesota Reliance on Freight Transportation	137
6.2	Reliability of the Data.....	137
6.3	Recommendations for Data Collection and Analysis.....	137

APPENDIX A Glossary

APPENDIX B Related Studies of the CTS Project on Transportation and the Economy

APPENDIX C Data Sources and Documentation

APPENDIX D Data Tables

LIST OF TABLES

1.1	Minnesota Counties Included in BEA 96	6
1.2	Structure of Reebie Data Base	7
1.3	Structure of MISER Data Base.....	8
2.1	Traditional Transportation Providers and Services	10
2.2	Summary of Intermodal Movements to and from Minnesota	16
2.3	Changes in the Nation's Freight Bill for Rail Transport	18
2.4	Comparisons Between Railroads in Minnesota and the Nation, 1992	19
3.1	Total Freight Flows Into/Out of Minnesota (tons)	29
3.2	Total Freight Flows Into/Out of Minnesota (value)	32
4.1	2-Digit Commodity Classification.....	49
4.2	Commodity Flows by Mode Into/Out of Minnesota (tons).....	51
4.3	Commodity Flows by Mode Into/Out of Minnesota (value).....	52
5.1	BEA 96 County-Level Population and Employment	75
5.2	Commodity Flows between Minnesota BEA Regions	76
5.3	Commodity Flows between BEA 96 and Upper Midwest BEA Regions	82
5.4	Rail Through Shipments by Origin State	132
5.5	Rail Through Shipments by Termination State	133

LIST OF CHARTS

1.1	State Population by BEA Region (1990).....	4
3.1	Minnesota BEA Share of Outbound Shipments by Mode (based on tonnage)	30
3.2	Minnesota BEA Share of Inbound Shipments by Mode (based on tonnage).....	31
3.3	Distance Distribution of BEA 96 Outbound Flows by Tons and Mode.....	35
3.4	Distance Distribution of BEA 96 Inbound Flows by Tons and Mode	36
3.5	Distance Distribution of BEA 96 Outbound Flows by Value and Mode	37
3.6	Distance Distribution of BEA 96 Inbound Flows by Value and Mode.....	38
3.7	Distance Distribution of BEA 96 Flows by Tons and Rail	40
3.8	Distance Distribution of BEA 96 Flows by Value and Rail.....	41
3.9	Distance Distribution of BEA 96 Flows by Tons and Truck.....	42

3.10	Distance Distribution of BEA 96 Flows by Value and Truck.....	43
3.11	Distance Distribution of BEA 96 Flows by Tons and Air.....	44
3.12	Distance Distribution of BEA 96 Flows by Value and Air.....	45
3.13	Distance Distribution of BEA 96 Flows by Tons and Water.....	46
3.14	Distance Distribution of BEA 96 Flows by Value and Water.....	47
4.1	Minnesota Outbound Flows by Mode Ranked by Commodity Tonnage.....	54
4.2	Minnesota Inbound Flows by Mode Ranked by Commodity Tonnage.....	55
4.3	Minnesota Outbound Flows by Mode Ranked by Commodity Value.....	57
4.4	Minnesota Inbound Flows by Mode Ranked by Commodity Value.....	58
4.5	Rail Carload Shipments from BEA 96 (tonnage).....	60
4.6	Rail Carload Shipments into BEA 96 (tonnage).....	61
4.7	Intermodal Shipments from BEA 96 (tonnage).....	62
4.8	Intermodal Shipments into BEA 96 (tonnage).....	63
4.9	Truckload Shipments from BEA 96 (tonnage).....	64
4.10	Truckload Shipments into BEA 96 (tonnage).....	65
4.11	LTL Shipments from BEA 96 (tonnage).....	66
4.12	LTL Shipments into BEA 96 (tonnage).....	67
4.13	Private Truck Shipments from BEA 96 (tonnage).....	68
4.14	Private Truck Shipments into BEA 96 (tonnage).....	69
4.15	Air Shipments from BEA 96 (tonnage).....	70
4.16	Air Shipments into BEA 96 (tonnage).....	71
4.17	Water Shipments from BEA 96 (tonnage).....	72
4.18	Water Shipments into BEA 96 (tonnage).....	73
5.1	Minnesota Imports from Canada by Province.....	127
5.2	Minnesota Exports to Canada by Province.....	128
5.3	Minnesota Imports from Canada by Commodity.....	129
5.4	Minnesota Exports to Canada by Commodity.....	130

LIST OF MAPS

1.1	BEA Regions of the United States.....	3
1.2	Counties within BEA 96 (Minneapolis-St. Paul).....	5
3.1	Rail System in Minnesota.....	26
3.2	Highway System for 5-axle Trucks.....	27
3.3	Distance Categories from Minneapolis-St. Paul.....	34
5.1	BEA 96 Flows to Other Minnesota BEA Regions.....	77
5.2	BEA 96 Flows from Other Minnesota BEA Regions.....	78
5.3	BEA 95 Flows to Other Minnesota BEA Regions.....	79
5.4	BEA 95 Flows from Other Minnesota BEA Regions.....	80
5.5	BEA Regions within Upper Midwest.....	84
5.6	BEA 96 Flows to Other Upper Midwest BEA Regions by Weight.....	85
5.7	Upper Midwest Flows into BEA 96 by Weight.....	86
5.8	BEA 96 Rail Flows to Other Upper Midwest BEA Regions by Weight.....	87
5.9	Upper Midwest Rail Flows into BEA 96 by Weight.....	88
5.10	BEA 96 Rail Flows to Other Upper Midwest BEA Regions by Value.....	89

5.11	BEA 96 Truck Flows to Other Upper Midwest BEA Regions by Weight.....	90
5.12	Upper Midwest Truck Flows into BEA 96 by Weight.....	91
5.13	BEA 96 Truck Flows to Other Upper Midwest BEA Regions by Value	92
5.14	Outbound Flows from BEA 96 by Weight (four categories)	94
5.15	Inbound Flows to BEA 96 by Weight (four categories).....	95
5.16	Outbound Flows from BEA 96 by Value (four categories).....	96
5.17	Inbound Flows from BEA 96 by Value (four categories)	97
5.18	Top 10 Origins of Shipments to BEA 96 (all modes/all commodities/by weight)	98
5.19	Top 10 Origins of Shipments to BEA 96 (all modes/all commodities/by value).....	99
5.20	Top 10 Destinations of Shipments from BEA 96 (all modes/all commodities/by weight).....	100
5.21	Top 10 Destinations of Shipments from BEA 96 (all modes/all commodities/by value).....	101
5.22	Top 10 Destinations of Farm Products (all modes/by weight).....	102
5.23	Top 10 Destinations of Food Products (all modes/by weight).....	103
5.24	Top 10 Destinations of Manufactured Products (SIC 20-39) (all modes/by weight)	104
5.25	Top 10 Destinations of Machinery (SIC 35) (all modes/by weight).....	105
5.26	Top 10 Origins of Rail Shipments (by weight)	106
5.27	Top 10 Origins of Rail Shipments (by value).....	107
5.28	Top 10 Destinations of Rail Shipments (by weight)	108
5.29	Top 10 Destinations of Rail Shipments (by value).....	109
5.30	Top 10 Origins of Truck Shipments (by weight)	110
5.31	Top 10 Origins of Truck Shipments (by value).....	111
5.32	Top 10 Destinations of Truck Shipments (by weight)	112
5.33	Top 10 Destinations of Truck Shipments (by value).....	113
5.34	Top 10 Origins of Air Shipments (by weight).....	114
5.35	Top 10 Origins of Air Shipments (by value).....	115
5.36	Top 10 Destinations of Air Shipments (by weight).....	116
5.37	Top 10 Destinations of Air Shipments (by value).....	117
5.38	Top 10 Origins of Water Shipments (by weight)	118
5.39	Top 10 Origins of Water Shipments (by value)	119
5.40	Top 10 Destinations of Water Shipments (by weight)	120
5.41	Top 10 Destinations of Water Shipments (by value)	121
5.42	Top 20 Destinations of Commodity Exports by Value	123
5.43	Top 20 Destinations of Commodity Exports by Air and Value	124
5.44	Top 20 Destinations of Farm Exports by Value	125
5.45	Top 20 Destinations of Food Products by Value.....	126
5.46	Origin Regions of Rail Movements Through Minnesota	134
5.47	Termination Regions of Rail Movements Through Minnesota.....	135

EXECUTIVE SUMMARY

This study provides a compilation and synthesis of freight flow data within, through, into and out of Minnesota for the year 1990 and discusses business trends affecting freight transportation in Minnesota and the U.S. The purpose of the study is to provide Mn/DOT, public officials and others with a understanding of commodity movement by mode, weight and value that can assist in the development of a statewide transportation plan, the Intermodal Management System and other planning efforts of Mn/DOT.

Data Sources (Chapter 1)

The primary data sources for this report are a series of Transearch files from Reebie Associates. These are specified for Bureau of Economic Analysis (BEA) economic regions which are multi-county regions grouped around a metropolitan area. Seven BEA regions cover Minnesota and parts of surrounding states (see MAP 5.5, p.84). The largest BEA region in the state is named after the Minneapolis-St. Paul region (BEA 96) and covers 47 counties within Central Minnesota (see MAP 1.2, p.5). Detailed origin and destination data on inbound and outbound flows from and to other BEA regions in the United States were obtained only for BEA 96. Only total inbound and outbound freight flow data were obtained for the remaining six BEA regions (Minnesota portion) and used to evaluate total freight flows within, into and out of Minnesota. The Transearch files were supplemented with information from Mn/DOT, other public agencies, and the private sector.

Business Trends in the Transportation Industry (Chapter 2)

A review of general business trends in the private transportation sectors (truck, rail, air and water) demonstrates that the data presented in this report should be viewed as a snapshot in time and may not necessarily be representative of current conditions. Continuous changes have been taking place before and since 1990 which affect how commodities are moved within and into and out of the state. Most industries have changed their production and distribution methods in the following ways: 1) integrating internal corporate functions, 2) consolidating producers' physical plants, 3) reducing the number of carriers used, 4) increasing integration of relationships between shippers and carriers, and 5) increasing use of transportation services to manage inventory. Corporations are being restructured in response to these changes with manufacturers striving to be as close to the customer as possible, yet remain as flexible as possible.

Overview of Freight Flows (Chapter 3)

The volume of freight shipped within BEA 96 (Minneapolis-St. Paul including Central Minnesota) totalled 23 million tons in 1990. This compares with the following outbound shipments from BEA 96:

- To the rest of the state 5 million tons
- To the rest of the Upper Midwest (including northern Illinois) 20 million tons
(see MAP 5.5, p.84)
- To other destinations in the US 22 million tons

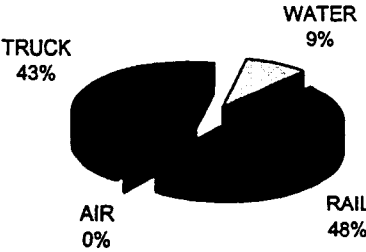
Inbound shipments to BEA 96 include:

- From the rest of the state 6 million tons
- From the rest of the Upper Midwest (including northern Illinois) 16 million tons
- From the rest of the US 33 million tons

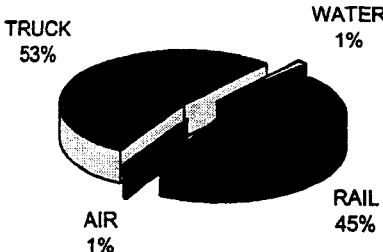
The charts on the following pages compare the modal shares of inbound and outbound shipments by weight and value.

The two pie charts below show the modal share of inbound shipments into the state of Minnesota. The chart on the left shows the modal share by weight while the chart on the right shows the modal share by value. It can be seen that the truck share by value is somewhat higher than the truck share by weight while the opposite is true for rail. The water mode share drops substantially when going from weight to value.

MINNESOTA INBOUND BY WEIGHT

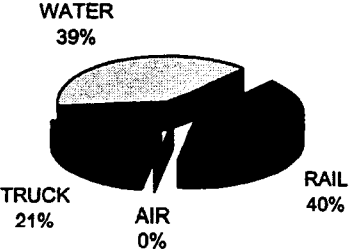


MINNESOTA INBOUND BY VALUE

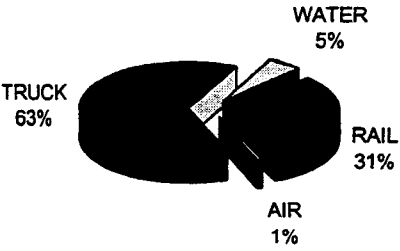


The two pie charts below show the modal share of outbound shipments from the state of Minnesota. The chart on the left shows the modal share by weight while the chart on the right shows the modal share by value. It can be seen for outbound shipments that the truck share by value is substantially greater than the truck share by weight while the water share by value is substantially less than the water share by weight. This clearly reflects the higher value of product shipped outbound by truck and relatively lower value product (grain and raw materials) shipped out by water. The rail share decreases from 40% by weight to 31% by value.

MINNESOTA OUTBOUND BY WEIGHT

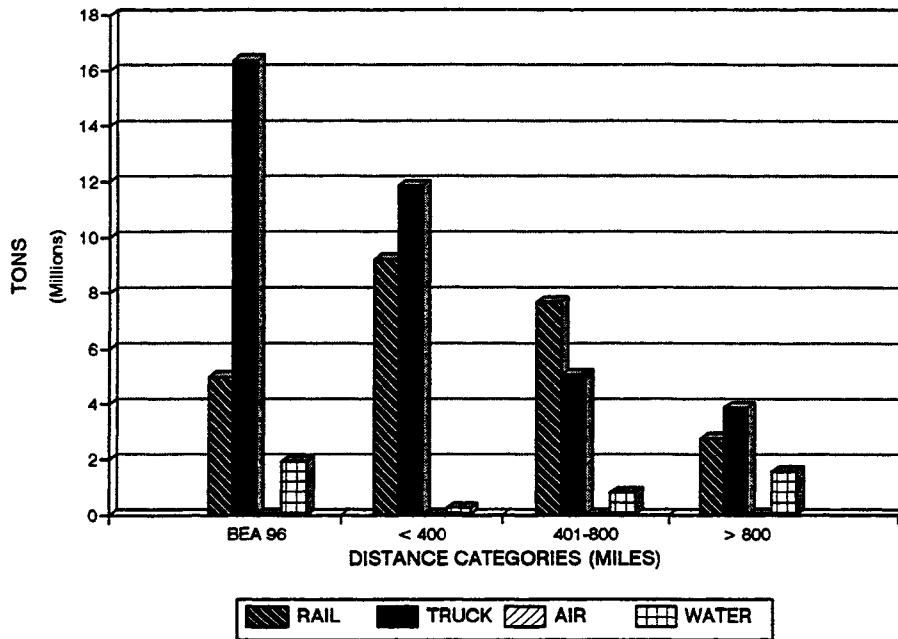


MINNESOTA OUTBOUND BY VALUE

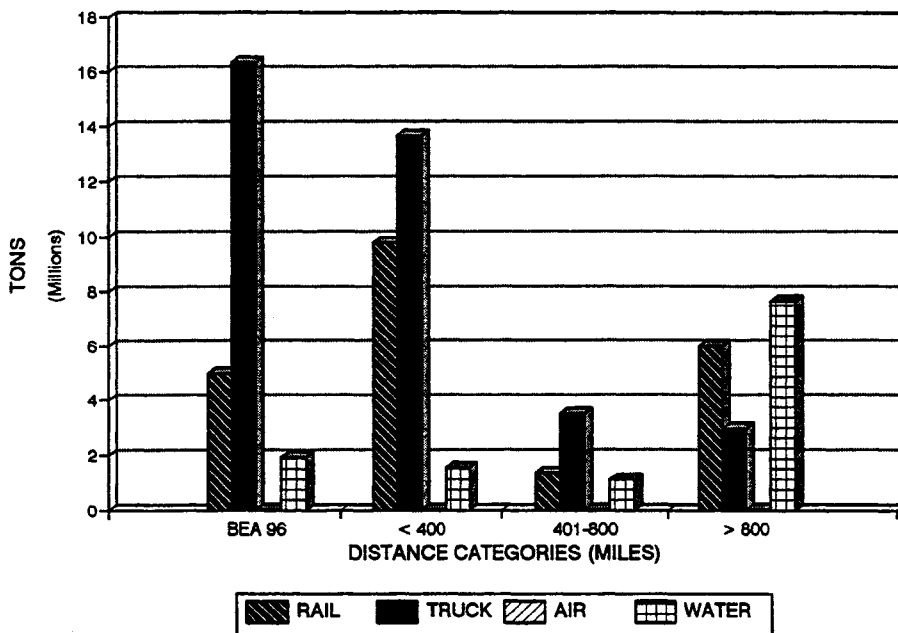


The charts below show the distribution by distance and mode of inbound and outbound tonnages to and from BEA 96 which covers much of Central. Especially prominent are shipments within BEA 96 and within 400 miles of Minneapolis-St. Paul (excluding BEA 96). Trucks carry the most tonnage within these two regions. Railroad shipments are also important within these two regions, with tonnage increasing with distance. Minnesota *Note that the vertical scales on charts throughout this report are not always identical.*

BEA 96 SHIPMENTS BY DISTANCE
INBOUND TONNAGE - 1990

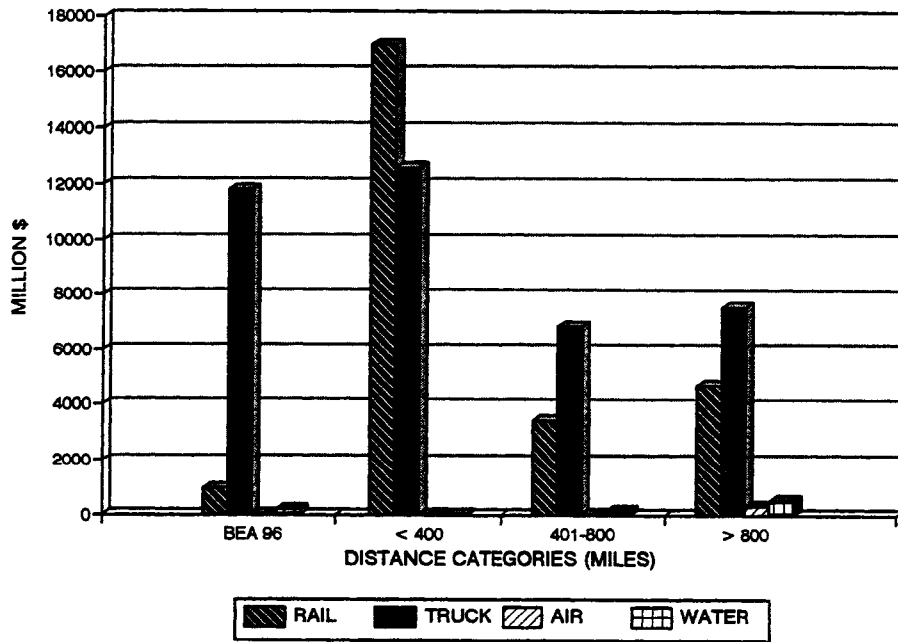


BEA 96 SHIPMENTS BY DISTANCE
OUTBOUND TONNAGE - 1990

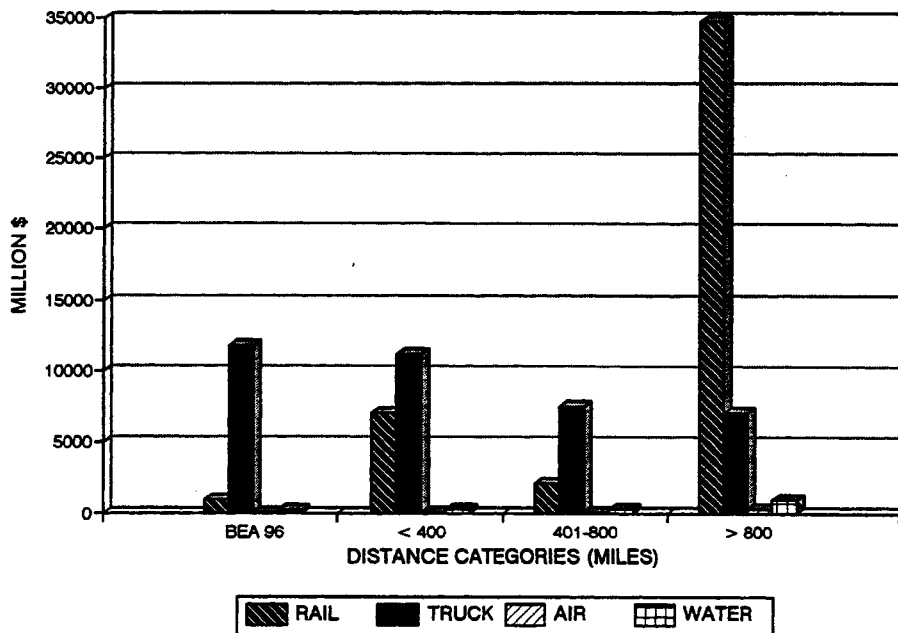


As can be seen in the charts below which show the distribution by distance and mode of inbound and outbound shipments by value to and from BEA 96, the dominance of these two nearby zones diminishes, especially for outbound shipments, when they are measured by value (dollars) rather than by weight (tons). This indicates the large amount of relatively low-value, bulk freight (e.g. coal, farm products, chemicals, etc.) carried within these two regions.

BEA 96 SHIPMENTS BY DISTANCE
INBOUND VALUE - 1990



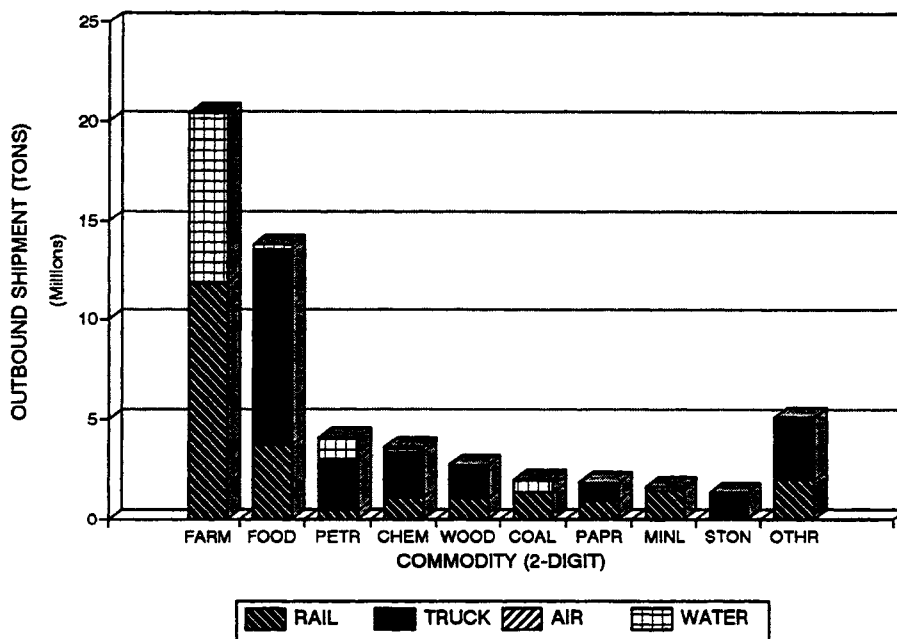
BEA 96 SHIPMENTS BY DISTANCE
OUTBOUND VALUE - 1990



Freight Flows by Mode and Commodity (Chapter 4)

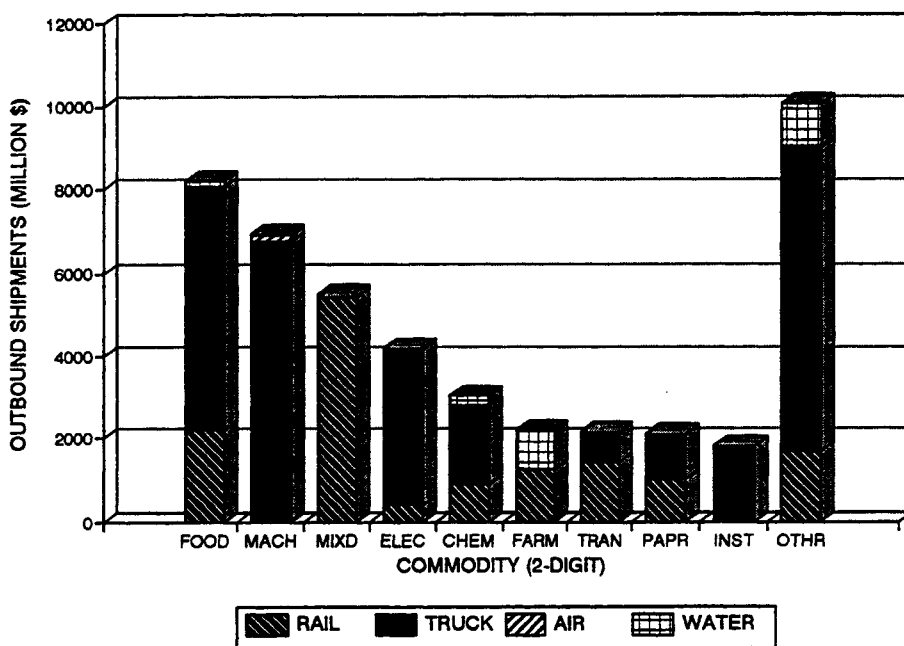
The distribution of outbound shipments by weight are shown in the chart below. Iron ore shipments or taconite (STCC 10), which are the largest outbound commodity by weight (49 million tons), are not included in the chart to permit emphasis of the smaller commodity shipments. These are followed by Farm Products (STCC 1). Because both Iron Ore and Farm Products are typically lower value and bulk commodities, they are shipped primarily by rail and water. The third largest commodity shipped out of Minnesota is Food Products (STCC 20) which moves primarily by truck and rail. Truck is the major mode for most of the other top ranked commodities including Petroleum (STCC 29), Chemicals (STCC 28), Lumber and Wood (STCC 24), Pulp and Paper (STCC 26), Clay Concrete, Glass and Stone (STCC 32) and all other commodities. Coal (STCC 11), while among the top commodities shipped out of Minnesota, is handled primarily by rail and water.

MN OUTBOUND SHIPMENTS (excl. IRON ORE)
MODE - RANKED BY TONNAGE 1990



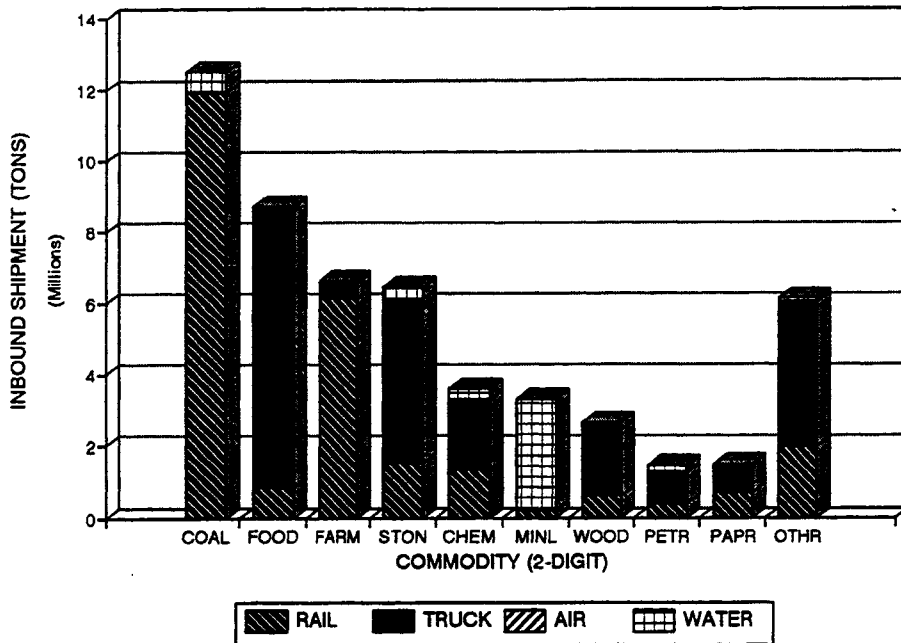
When outbound shipments are ranked by value of shipment rather than weight (see chart below), it can be seen that the truck mode handles the majority outbound shipments of Food (STCC 20), Machinery (STCC 35), Electrical Equipment (STCC 36), Chemicals (STCC 28), Pulp and Paper (STCC 26), Instruments (STCC 38) and all other commodities. Truck also carries a portion of outbound shipments of Transportation Equipment (STCC 37). Rail carries Mixed Shipments (STCC 46), and the majority of shipments of Farm Products (STCC 1) and Transportation Equipment (STCC 37).

MN OUTBOUND SHIPMENTS (excl. MAIL)
MODE - RANKED BY VALUE 1990



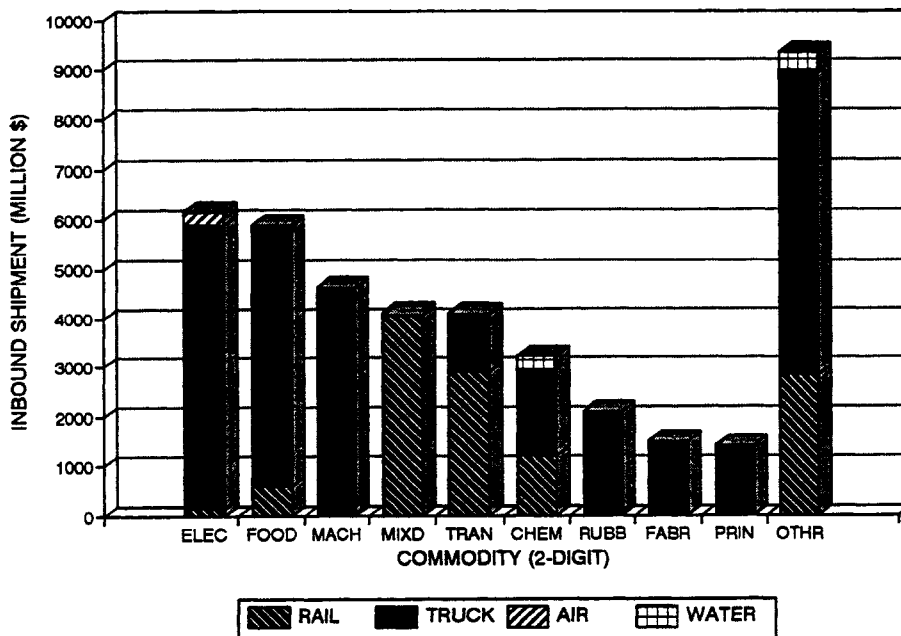
Inbound shipments into Minnesota by weight are shown in the chart below. It can be seen that Coal (STCC 11) is the major commodity by weight shipped into Minnesota which is handled almost exclusively by rail. Truck handles most of the second largest commodity, Food Products (STCC 20). Rail also handles most of the third largest inbound commodity, Farm Products (STCC 1), almost half of the Pulp and Paper Products (STCC 26) and a smaller share of all other inbound commodities. Waterways handle the majority of inbound non-metallic minerals (such as clays and potash) (STCC 14), some coal (STCC 11), Clay, Concrete, Glass and Stone (STCC 32), Chemicals (STCC 28) and Petroleum Products (STCC 29). Truck handles the majority of Clay, Concrete, Glass and Stone (STCC 32), Chemicals (STCC 28), Lumber and Wood Products (STCC 24), Petroleum Products (STCC 29), Pulp and Paper (STCC 26) and all other commodities.

MN INBOUND SHIPMENTS
MODE - RANKED BY TONNAGE 1990



Inbound shipments ranked by value rather than weight are shown in the chart below. It can be seen that the top three inbound commodities ranked by dollar value are Electrical Equipment (STCC 36), Food Products (STCC 20) and Machinery (STCC 35) which are shipped primarily by truck. The third and fourth highest value commodity groups, Mixed Shipments (STCC 46), and Transportation Equipment (STCC 37) are shipped primarily by rail. Chemicals (STCC 28) are shipped in by truck, rail and water. Truck handles all of the inbound shipments of Rubber and Plastic Products (STCC 30), Fabricated Metals (STCC 34) and Printed Matter (STCC 27).

MN INBOUND SHIPMENTS (excl. MAIL)
MODE - RANKED BY VALUE 1990



Freight Flows by Origin and Destination (Chapter 5)

Shipments within Minnesota

The largest single destination of tonnage shipped by BEA within the state is the BEA region itself. For example, 35 million tons moved within BEA 95 (Duluth-Superior) while only 2 million tons were shipped to other BEA regions within Minnesota. Most of this was accounted for by rail transfer of iron ore (taconite) to Lake Superior ports for shipment to other Great Lakes destinations. Twenty-two million tons moved within BEA 96 (Minneapolis-St. Paul) while only 6 million tons were shipped to other BEA regions within Minnesota.

Shipments within the Upper Midwest

Within the Upper Midwest (including northern Illinois), Chicago is the largest destination of Minnesota shipments by both tonnage and value. While Chicago is also a source of inbound shipments, the farm areas to the west and pulp and paper areas to the north dominate inbound shipments into BEA 96.

Shipments between BEA 96 and the United States

Outbound flows to the rest of the United States when ranked by tonnage are dominated by shipments (of grain) to the ports of New Orleans and Seattle/Tacoma. When ranked by value, shipments of commodities for foreign export and small packages to New Orleans, Los Angeles, Seattle, Memphis, and New Jersey are most important. Inbound flows from the United States when ranked by tonnage are dominated by coal shipments from Montana and imported commodities from coastal ports. When ranked by value, automobiles from Detroit, imports from coastal ports, and chemical products from the Gulf Coast are most important.

Shipments between Minnesota and Foreign Countries

Minnesota exports the greatest value of commodities to Canada and the second largest value to Japan. Several countries within the European Community are the next largest recipients of Minnesota exports followed by Mexico. Japan is the largest recipient of exports by air from Minnesota although several European countries are not far behind. South Korea is second to Canada as a destination of Food Product exports from Minnesota.

From Canada, the largest imported commodity is crude petroleum via pipelines from Alberta. [Pipelines have not been included in this study since they are privately owned and are not part of the public transportation infrastructure.] Imports from Ontario consist primarily of pulp and paper as well as some industrial products. Most of Minnesota's exports to Canada are destined for Ontario. These exports include Transportation Equipment and Non-Electrical Machinery (computers). Manitoba receives the next greatest amount followed by Alberta, Quebec and British Columbia.

Rail Shipments through Minnesota

Information on rail shipments through Minnesota was based on the 1990 ICC Waybill Sample which provides estimates of the number of rail revenue carloads passing through Minnesota. The sample expansion indicated that 765,658 revenue carloads had both origins and destination in other states but travelled through Minnesota. The states of Illinois and Montana dominate as origins of through rail shipments while Wisconsin, Washington, and Illinois dominate as destinations of through rail shipments. The Montana to Wisconsin shipment of coal is one of the major components of these flows.

Need for Additional Data Collection and Analysis (Chapter 6)

Data Issues

In order to improve on the completeness and reliability of freight data, some data-related issues that require additional study include (1) the identification of the contents of intermodal mixed shipments by specific commodity; (2) the identification of commodities shipped by TOFC (Trailer-on-a-Flat-Car) and COFC (Container-on-a-Flat-Car); (3) the identification of containers shipped to domestic and foreign destinations; (4) the identification of “domestic” shipments which are destined for foreign export; (5) the validation of origin of shipments referenced to a BEA region; (6) establishment of reliable factors for converting between tonnages and value of shipments by commodity; (7) confirmation of public data through the use of selected private data; (8) better identification of private fleet ownership and movement; and (9) confirmation of published data with results from the 1993 Census of Transportation.

Policy Issues

To assist in the development of transportation policy, some issues that require further study could include (1) development and analysis of a freight flow highway network model for Minnesota and the surrounding regions; (2) development of a methodology for updating and maintaining a freight flow data base; (3) expansion of freight forecasting capabilities of regional economic models; (4) freight flow forecasts based upon economic activity; (5) use of freight flow projections in conjunction with economic activity to identify transportation investment priorities; and (6) consider freight flows in the development of overall transportation policy.

1.0 INTRODUCTION

1.1 Study Purpose

Transportation is a key element in the state's economy, moving agricultural products from the farm to market, raw materials and workers to factories, and finished goods to stores and homes. Minnesota's location is central to the North American continent -- roughly 1200 miles from both the ports of New York and New Orleans, 1800 miles from Seattle and 2000 miles from Los Angeles. It is linked to these and other markets by an extensive transportation system including highways, rivers, Great Lakes ports, railroads, airports and pipelines. Approximately 53% of freight shipments by weight from Minnesota is destined for the Upper Midwest region (see MAP 5.5, p. 84) with 47% destined to other regions of the United States.

The Minnesota Department of Transportation commissioned this study of Freight Flows as of 1990 to provide a comprehensive source of freight flow information and to show how the transportation system supports business and commerce. This report draws upon data and analysis developed over the past 5 years with support from the University of Minnesota's Center for Transportation studies and the Minnesota Department of Transportation to better understand the linkage of transportation to the economy in the Upper Midwest. A list of reports and presentations from that study is included in Appendix B of this report. The authors acknowledge their support and that of private shippers and carriers in providing data and insight on the analysis of the data on transportation reported here.

1.2 Structure of this Report

This report summarizes the freight flows in, out, through and within Minnesota in 1990 by mode and in some cases by major commodity and major origin or destination. The report is organized into six chapters. Chapter 1 introduces the basic concepts and definitions used in the report and discusses data sources. Chapter 2 discusses general trends in freight flows from a private sector perspective. Chapter 3 presents an overview of freight flows by mode within, into and out of Minnesota for 1990. Chapter 4 introduces commodity detail and evaluates the flows of commodities by each of the modes. Chapter 5 examines the origins and destinations of commodities and modes. Chapter 6 presents study conclusions and makes recommendations for further study.

Candace Campbell was responsible for the overall narrative and editing of the report. Cathy Petersen prepared Chapter 2 on general trends in freight flows. David Braslau was responsible for Chapter 3 through Chapter 5 presenting detailed freight flow data as well as the overall structure of the report. Chapter 1 and 6 were completed jointly by the authors. Jeffrey Levine, Research Assistant of the Humphrey Institute of Public Affairs, was responsible for producing the freight flow maps contained in the report. In addition to the listed authors, data on through-movements of freight by rail was provided by Dr. Jerry Fruin, Professor, and Dan Halback, Research Associate, Department of Agricultural and Applied Economics. Supporting data from the Minnesota IMPLAN model was provided by Dr. Wilbur Maki, Professor, and Anwar Hossain, Research Assistant, of the Department of Agricultural and Applied Economics.

1.3 Data Sources Used

To understand this report it is useful to understand how the data used here are collected and used. Public access to data on transportation of goods is very limited. The U.S. Department of Commerce, Bureau of the Census conducts a transportation survey every seven years, which later becomes available to researchers, government agencies and the general public (the 1993 survey data will begin to be made available in 1995). In some cases, state Departments of Transportation have access to and use data generated by the railroad waybills

filed with the Interstate Commerce Commission to track the volume and mode of goods shipped. However, the railroad waybill data on the origin and destination as well as the commodity type may not always be uniform or consistent.

Various federal and state regulatory agencies treat freight flow data in different ways which makes the establishment of a comprehensive data base of freight flows for a region very difficult. Therefore, most public and private organizations use a data set available from a private research service., Transearch, a service of Reebie Associates of Greenwich, Connecticut. Reebie Associates produces data reports on tonnages of freight shipped from region to region by mode. Estimates of value of shipped commodity are also provided. These data are reported by BEA (Bureau of Economic Analysis) region. There are 183 of these regions in the U. S. The system of BEA regions within the contiguous United States are shown in MAP 1.1 along with selected major Metropolitan areas (see p.C-5 for a list of BEA regions).

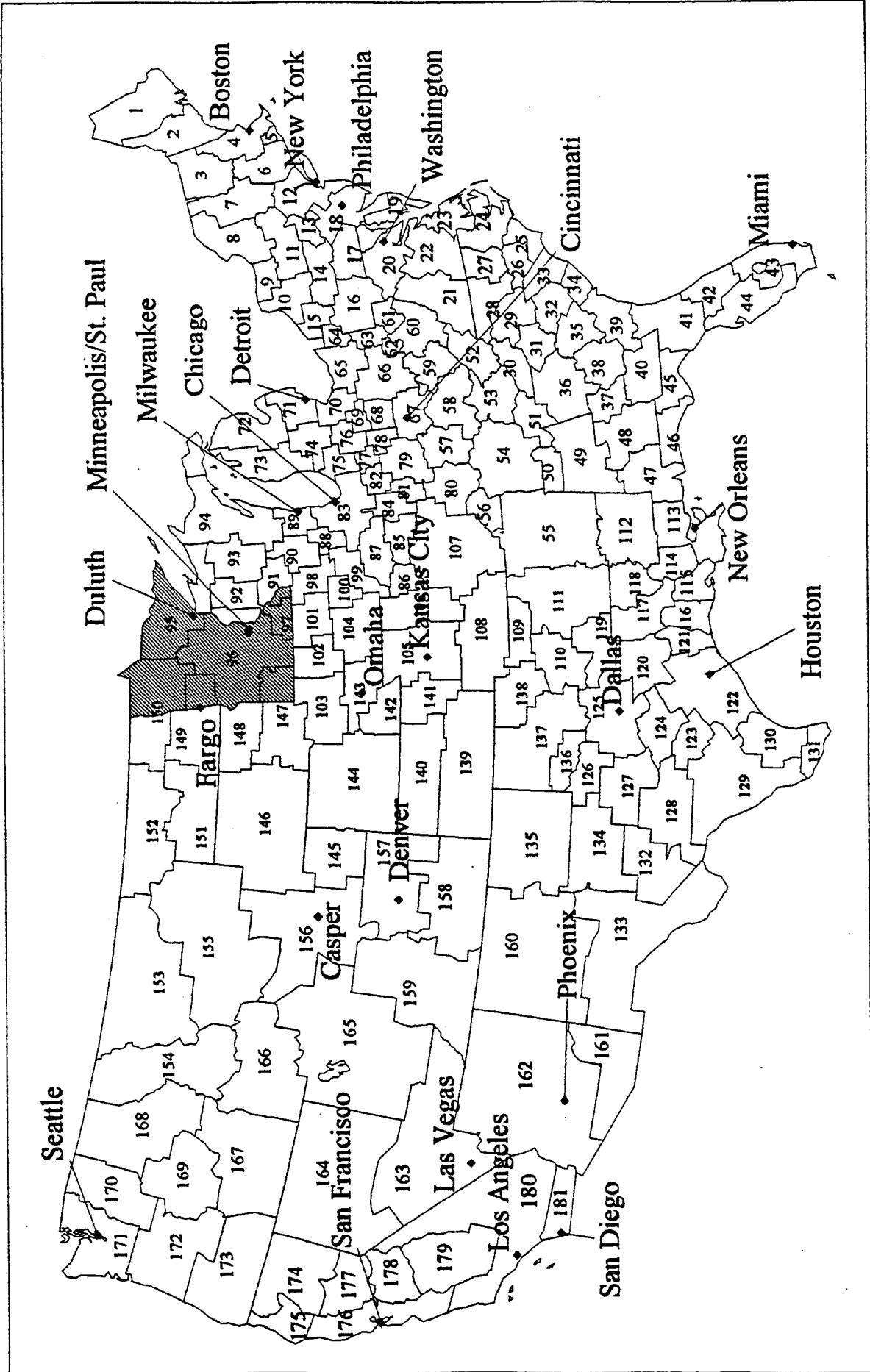
These regional boundaries were set up by the U.S. Department of Commerce, Bureau of Economic Analysis in 1969 (see Box). The boundaries are based on the criteria established to describe an economic region at that time.

Basis for the BEA Region "Each economic area consists of an economic node -- a metropolitan statistical area (MSA) or similar area that serves as a center of economic activity -- and the surrounding counties that are economically related to the center. Commuting patterns are a major factor used in determining the economic relationships among counties, and, to the extent possible, each economic area includes the place of work and place of residence of its labor force. BEA economic areas were first defined in 1969, using data from the early 1960's. These economic areas were redefined in 1977 to recognize (1) changes in the regional distribution of economic activity, (2) newly developed centers, (3) declining centers -- particularly those in agricultural areas -- that had been absorbed into other economic areas, and (4) the effects of the opening of major portions of the Interstate Highway System." from Appendix A, U.S. Department of Commerce, BEA Projections to 2040. October 1990, p. M-5.

These regional boundaries were updated in 1977 and will be reevaluated in the near future according to the 1990 travel to work data of the U.S. Census. Reebie Associates is the best source of freight transportation data available to most public and private agencies. The only alternative for better data is to wait for the reporting of the Census of Transportation or to conduct exhaustive and costly surveys of shippers and carriers. These were not viable alternatives for this report.

1.4 Geographic Regions

A range of geographic regions for which freight flow data are available is used to demonstrate the characteristics of the modes and the commodities which they carry. These include BEA regions, the State of Minnesota, the Upper Midwest (including the Rockford and Chicago, Illinois, BEA regions), the continental U.S. and the world. The smallest geographic region considered in this report is the BEA (Bureau of Economic Analysis) region. Seven of these BEA regions either lie within Minnesota or cover part of Minnesota and an adjoining state. The largest of these BEA regions is BEA 96 which is centered around the Minneapolis-St. Paul Metropolitan Area and the St. Cloud Metropolitan Area and includes just under 60% of Minnesota's counties (MAP 1.2).



MAP 1.1 BEA Regions of the United States

Within Minnesota almost three-quarters of the economic activity and therefore most of the freight transportation takes place in BEA 96. BEA 96 includes 47 of the 87 counties in Minnesota (plus four western Wisconsin counties). It contains 75 percent of the state's population (see CHART 1.1). The 47 counties within Minnesota that are included in BEA 96 are listed in TABLE 1.1 and shown in MAP 1.2 (population and employment for each county are presented in TABLE 5.1). The second largest BEA region in Minnesota is BEA 95 which includes Duluth; the Minnesota portion of BEA 95 contains 7 percent of the state's population. BEA 97 includes Rochester and includes 6 percent of the state's population. The remaining BEA regions in Minnesota include portions of regions of surrounding states and are focussed around metropolitan areas in adjacent states. These include Fargo/Moorhead (ND/MN), Grand Forks (ND), Sioux Falls (SD), and La Crosse (WI). As shown in CHART 1.1, the Minnesota portion of each of these other BEA regions each account for 4 percent or less of the state's population.

State Population by BEA Region (1990)
(Minnesota Portion Only)

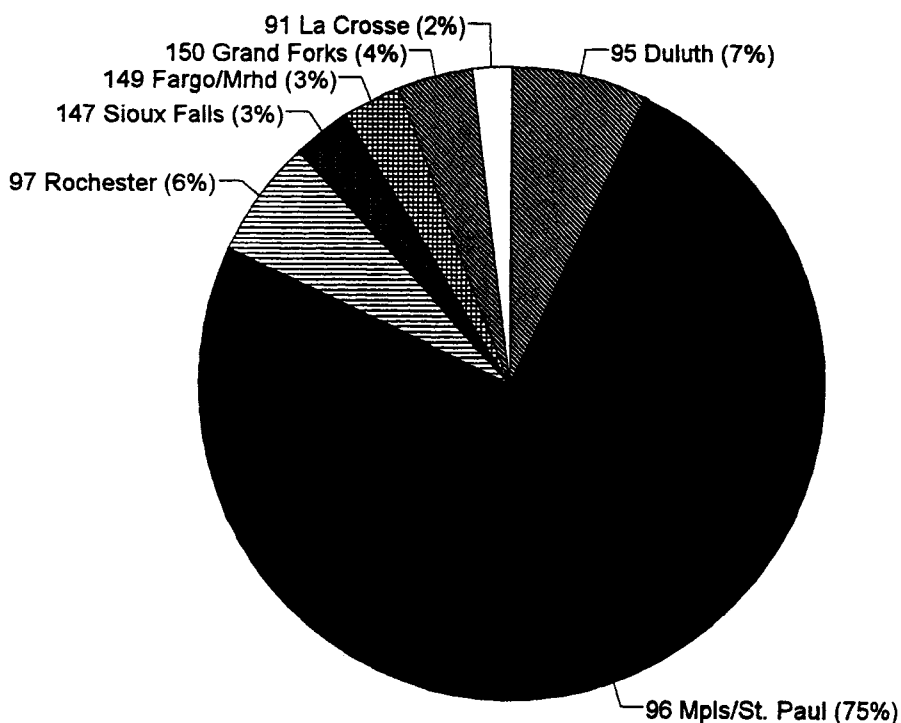
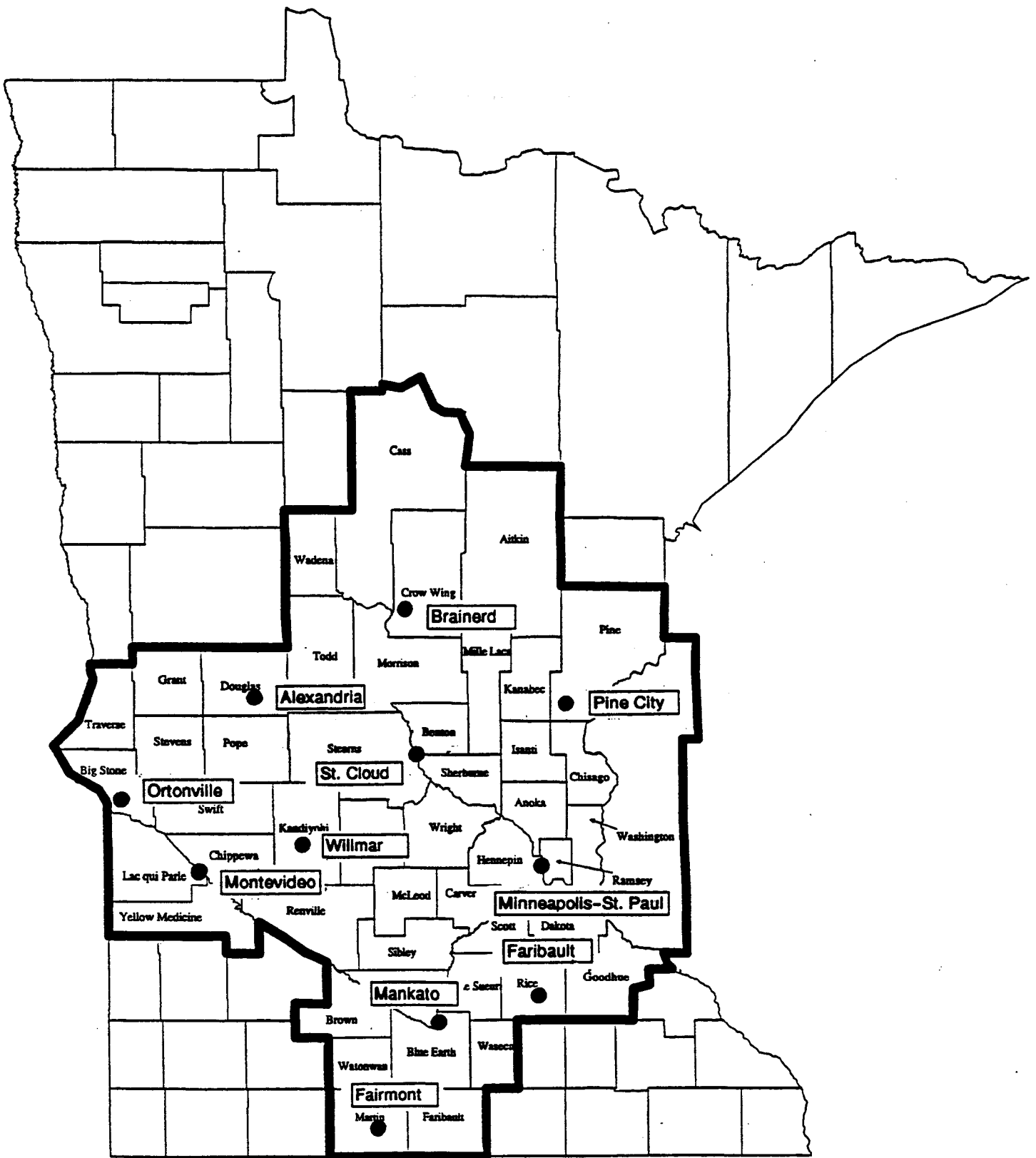


CHART 1.1 State Population by BEA Region (1990)



MAP 1.2 Counties within BEA 96 (Minneapolis-St. Paul)

TABLE 1.1

MINNESOTA COUNTIES WITHIN BEA 96

1	Anoka	25	Kanabec
2	Carver	26	Kandiyohi
3	Chisago	27	Lac Qui Parle
4	Dakota	28	Le Sueur
5	Hennepin	29	McLeod
6	Isanti	30	Martin
7	Ramsey	31	Meeker
8	Scott	32	Mille Lacs
9	Washington	33	Morrison
10	Wright	34	Nicollet
11	Benton	35	Pine
12	Sherburne	36	Pope
13	Stearns	37	Renville
14	Aitkin	38	Rice
15	Big Stone	39	Sibley
16	Blue Earth	40	Stevens
17	Brown	41	Swift
18	Cass	42	Todd
19	Chippewa	43	Traverse
20	Crow Wing	44	Wadena
21	Douglas	45	Waseca
22	Faribault	46	Watonwan
23	Goodhue	47	Yellow Medicine
24	Grant		

Readers should keep in mind that, where geographical origins and destinations are involved, the data in this report refer only to the BEA 96 portion of Minnesota's freight transportation. While it is possible to identify freight flows origins and destinations for the entire state, funds were not available to purchase the entire data set for this study. The reader should also bear in mind that, for this study, only data for those portions of the BEA regions which lie within the State of Minnesota are reported.

Data reported for the entire State of Minnesota are the sum of the flows to and from the BEA regions or portions thereof which lie within the State of Minnesota. The large volume of flows between BEA 96 and the five-state region plus northern Illinois show the importance of freight transportation between Minnesota and its immediately adjacent neighbors. Flows between BEA 96 and the other BEA regions within the United States provide a picture of the important origins and destinations of freight flows including ocean or waterway ports through which these goods are transhipped to foreign countries. Exports of commodities from Minnesota to foreign countries demonstrate the essential linkages between Minnesota and the rest of the world. Import data of this type are not readily available by individual country or by state.

1.5 Overview of Data Sources

The primary data source upon which this report is built is the 2-digit STCC commodity report obtained from Transearch, a service of Reebie Associates of Greenwich, Connecticut. The data were obtained for BEA 96 which is the Bureau of Economic Analysis Region 96 centered around Minneapolis-St. Paul and containing 47 counties within central Minnesota and four counties in Wisconsin. The freight flows by STCC commodity and mode are provided to all other BEA regions within the contiguous United States. The format of the information obtained from Transearch is shown in TABLE 1.2

TABLE 1.2

STRUCTURE OF REEBIE DATA BASE

Geographic Area:	ORIGIN BEA DESTINATION BEA
Type of Freight:	STCC - Standard Transportation Commodity Code
Mode:	RAIL CARLOAD RAIL TOFC - Trailer on Flat Car TRUCKLOAD LESS-THAN-TRUCKLOAD PRIVATE TRUCK AIR WATER

The Reebie data are developed from a range of sources as described in a letter to David Braslau contained in APPENDIX C. The number of trucking firms with direct data exchange with Reebie Associates is increasing, thus improving the reliability of the data with each year.

A second major data source is the MISER (Massachusetts Institute of Social and Economic Research) data on Minnesota foreign exports by 2-digit commodity and country of destination. These data are originally obtained from the U.S. Department of Commerce and processed to correct for certain allocation problems not addressed in the original data. The structure of the MISER data base is shown in TABLE 1.3. *No information on railroad or truck flows are included in the MISER data base.*

TABLE 1.3

STRUCTURE OF MISER DATA BASE

Type of Freight:	SIC (2-DIGIT) CODE
Geographic Destination:	COUNTRY CODE
Mode: (Note that no surface transportation modes are included in this data base)	AIR VALUE AIR WEIGHT (KG) VESSEL VALUE VESSEL WEIGHT (LTONS) CONTAINER VALUE CONTAINER WEIGHT (LTONS)

Data sources provided by the Seaway Port Authority of Duluth/Superior and the Minnesota Department of Transportation have also been used to examine waterborne flows from the Port of Duluth-Superior and the three other ports in Lake Superior (which ship primarily iron ore).

The public waybill file for rail shipments of commodities within the United States has been processed to identify flows of commodities through the State of Minnesota.

Statistics Canada data have been used to identify flows of commodities between Minnesota and individual provinces in Canada although modal information is not available for these flows.

A number of private carriers have provided data on flows within Minnesota as well as flows between Minnesota and other states and origins/destinations in the contiguous United States. These data have been used primarily to confirm public data sources.

2.0 BUSINESS TRENDS IN THE TRANSPORTATION INDUSTRY

This section integrates information about business trends, their potential impact on transportation by mode, and it compares the changes occurring on a national level with some of those occurring in Minnesota. Perspectives were provided by industry analysts, business people who are involved in transportation decision making each day, and from a number of publications about each of the modes -- rail, intermodal, truck, air, and water.

2.1 Industry Determinants of the Changing Demand for Transportation

During the past twenty years, large and small producers, across most industries have changed their production and distribution methods. These changes have placed new demands on transportation providers and the infrastructures they use. Driving forces behind these changes and evolving demands include:

- “the growing importance of international trade and the emergence of large multinational trading blocs,
- changes in the nature of production and assembly operations in manufacturing,
- efforts by manufacturers to reduce the number of suppliers they deal with and to emphasize long-term relationships with the remaining supplier base,
- continuing emphasis by manufacturers on reducing overall logistics costs and improving service quality,
- increasing pressure on manufacturers to take responsibility for recycling their products after use as a part of worldwide environmental consciousness and efforts to reduce solid waste disposal problems,
- increasing levels of highway congestion in and around the urban areas of the United States,
- changing perceptions and policies of the federal government concerning transportation systems in the United States,
- rapid increases in the scope and capacity of data networks for moving and organizing information, serves to support the trends noted above.” [1]

Traditionally, freight transportation has been defined as moving inventory (supplies and products). But it is now a part of an entire chain of steps to reduce costs. Logistics, the term which has been used to describe this chain, is driven by the desire to improve customer service, reduce costs by minimizing inventory and increase competitive edge. Companies are responding to the pressures of global competition and customer requirements by rethinking or reengineering the way they deliver products and services. Many agricultural, manufacturing or retail, firms no longer separate transportation and delivery functions from the production side of their business. Firms are asking questions such as: Where should manufacturing be located? How many distribution centers are needed and who should operate them? What is the best method to transport the goods? How do we reduce expenses related to the supply and delivery of our product?

A move toward greater integration and consolidation appears in five major changes in today's business operations: 1) integrating internal corporate functions, 2) consolidating producers' physical plants, 3) reducing the number of carriers used, 4) increasing integration of relationships between shippers and carriers, and 5) increasing use of transportation services to manage inventory. Corporations are being restructured in response to these changes with manufacturers striving to be as close to the customer as possible, yet remain as flexible as possible.

These changes are challenging transportation providers, no matter the mode, to respond to their customers. Carriers consider customers' needs in their capital purchases, their technological advances, and their

service design. This means that modes which formerly operated as separate, self-contained service providers are developing strategic partnerships to meet shipper expectations and needs. [2]

Three main types of transportation service providers are meeting the needs of Minnesota shippers. The table below depicts them by type and profiles their traditional services. The lines distinguishing these providers from each other are blurring. Companies are providing a range of transportation services to their customers which traditionally were divided into three categories: Carrier, Logistical, and Warehouse/Distribution.

TABLE 2.1
TRADITIONAL TRANSPORTATION PROVIDERS AND SERVICES

Carriers	Logistics Services	Warehouse/Distribution Companies
Transportation⇒ Motor Carriage, Rail, Barge, Vessel, Pipeline and Air Cargo	Transportation Arrangements, Inventory Management, Customer Service, Distribution, Product Assembly	⇐Storage, Inventory Management, Packaging, Distribution

Companies are implementing new measures to reduce their order-cycle times, i.e. the number of days from raw material to customer delivery. This allows them to effectively reduce inventories. It is estimated that in 1992, inventory investment nationwide was \$200 billion below what it was in 1981, a recession period. Typical order-cycle times have declined from 5 days in 1988 to 4.5 days in 1991, and are forecast to decline to 2.9 days in 1995.[3] This cycle time is an average, individual industries have varying lengths of optimal cycle times.

Strategies being implemented as a result of customer influence, and regional and global competition, include:

- **Manufacturers instructing their suppliers to ship directly from their warehouses to the customer;**
- **Firms redesigning their warehouse and distribution systems to streamline operations;**
- **Reliance on electronic communications through "Efficient Consumer Response" in the consumer market or at the assembly point in the manufacturing facility to determine when and which products are to be shipped Just-in-Time (JIT) for replenishment to improve inventory velocity and meet customer requirements;**
- **Logistics providers and "3rd Party" distribution companies manage inventory and in some cases perform final assembly and packaging for manufacturers, or a move from Asset-Intensive to Information-Intensive Logistics Systems;**
- **Worldwide sourcing and distribution is considered essential to competitive responsiveness.[4]**

Competition has caused Minnesota firms to adopt practices such as international sourcing, Materials Requirement Planning (MRP), and increasing inventory velocity to reduce carrying costs. Costs have been trimmed from manufacturing overhead, the remaining cost center where it is believed cost cuts can be made is in transportation and logistics. This has led firms to use customer oriented criteria for site location of distribution centers, assembly plants and manufacturing facilities. Questions being asked include: Where are our customers located? How much time do we have to get our product to our customers? What will the customers needs be in the future? Where are the strategic sites where we should be located to get the product to the customer's facility?

Transportation is now more than moving the product from Point A to Point B, rather it is a part of the strategic thinking that will lead to development of a competitive edge in the market place of tomorrow. Today customers, whether across the street or in another nation, are offered menus of choices in manufacturing and services. Companies are developing strategic alliances with their vendors to help them exceed their customer expectations. In fact, manufacturers are developing systems which will allow them to manufacture their products [1]:

- At any level of production
- Anywhere in the world
- Anytime
- According to customized specifications
- Utilizing subcontractors or partners

Or stated differently, manufacturing is undergoing great changes, among them:

- A shift from large, complex manufacturing plants toward smaller factories capable of responding quickly to local market demands,
- Increased adoption of flexible production methods capable of making a wide variety of customized products, each in low volumes.
- Shorter and shorter life cycles for products, which will also put pressure on manufacturing facilities to be more flexible and easily adaptable to production of new products.

These changes provide a new view of the transportation system and its operations. Three new goals for transportation include coordination, responsiveness and resource utilization. They point to total quality management for the transportation system that encompasses an emphasis on managing the performance of the whole system with constant attention to the customer. [1]

2.2 Trends in the Motor Carrier Industry

The total size of the national motor carrier industry is estimated by Standard & Poor's at \$280 billion in annual revenues [5]. The American Trucking Association (ATA) [6] describes the state of the industry as follows: "Truckload and Less Than Truckload motor carriers haul more than 41% of all freight by tonnage and 81% of all freight by revenue nationwide."

In Minnesota more than 50% of all freight moved is shipped by motor carrier. Even when the primary carrier is other than truck, the motor carrier has a role to play. Transport by truck is considered the best option to move the product between the shipper and the railroad, barge or ship, the airline or mixture of modes, except in those cases where direct access is possible.

The national for-hire segment encompasses more than 50,000 carriers operating within two broad categories: truckload (TL) and less-than-truckload (LTL). "While van trailers can haul freight weighing 40,000 pounds or more, the generally accepted definition of a truckload is 10,000 pounds or more. Within the estimated

\$45-billion for-hire truckload segment, some \$30 billion (or two-thirds) is identified as "general freight", i.e., packaged merchandise. The balance is bulk commodities, refrigerated goods, household goods, automobiles, and cargo typically hauled on flatbed or specialized trailers." [5]

Carriers must understand the regulations of each state where they wish to operate as intrastate carriers. Regulations implemented include economic (through tariff filing, and entry restrictions), safety regulation, and size and weight regulations. Federal legislation passed in August 1994 will affect the economic regulation of motor carriers, it relaxes the regulations on January 1, 1995. Carriers will no longer be required to provide proof of need for service nor file tariffs with Mn/DOT's Office of Motor Carrier Services. However, carriers will continue to provide proof of insurance and registration of vehicles.

At the national level, motor carriers were significantly deregulated for interstate movements in 1980. In 1980, there were some 17,000 motor carriers with nationwide operating authority. As of 1994, there are more than 50,000 motor carriers with interstate operating authority.[5] Of those carriers operating nationally under interstate authority, many have registered to do business in the state of Minnesota. The registering body, the Office of Motor Carrier Services, has registered more than 20,500 motor carriers as interstate "for-hire" carriers. This does not mean they have a presence in Minnesota, but it does mean that a carriers' fleet of trucks can operate in the state. One impact of the more liberal interstate operating authority on motor carriers has been the ability to move from state to state without significant delays. Thus carriers are able to offer a cross-country transit service between two and four days.

The increased competition triggered by fewer federal regulations opened the doors to innovation in trucking. Besides owning terminals, containers, trailers, chassis and power to pull the units, motor carriers are forming alliances with other businesses to create new services for the changing marketplace. Previously, motor carriers created regional interline agreements to partner with other truckers. Now, Less than Truckload (LTL) motor carriers have developed international partnerships with:

- International Freight Forwarders,
- Non-Vessel-Operating Ocean Common Carriers (NVOCCs),
- International Custom House Brokers, and
- Ocean Carriers.

The larger LTL motor carriers are working hard to expand their international operations because they face what is considered "slow growth" in the domestic sector. They offer highly regular service and door-to-door reliability through their existing LTL network. Shipments are routed to a central collection point and combined into ocean containers for overseas moves. As a legal matter this makes them a non-vessel operating common carrier. Trucking companies have formed their own NVOCCs, or partnered with existing NVOCCs to comply with laws enforced by the Federal Maritime Commission. They call this "redefining long-haul LTL shipping." Long-haul LTL deliveries are made to customers 600 miles to a few thousand miles from the origin point, the "redefined long-haul" is 5,000 or 10,000 miles. [7]

This is one example of innovations LTL motor carriers are examining to remain strong and healthy. Innovation is driven by the high costs this segment of the transportation industry faces in labor costs, terminal costs, and equipment investment. The market place is changing for LTL motor carriers as a result of competition from truckload, air freight, and small package services. Shippers are managing the flow of cargo between distribution centers, from vendors and to customers in ways that reduce cost, handling and transit time. For example, rather than send the small shipments across the country with a LTL carrier, firms are stocking regional distribution centers with mixed loads of product, or if it is urgent, overnight services are used to move the product quickly and directly to the customer.

According to the ATA [8], trends which will have an impact on the way motor carriers do business and the infrastructure they use include:

- Carriers “are not going to be LTL, or truckload, or tank or flatcar--they're going to be transportation companies” that are interested in identifying the needs of the customer.
- Carriers will “get into cluster arrangements where people are subcontracting businesses closer and closer to the main source of manufacturing.”
- Tonnage will increase by 28.5 percent, mileage will increase by 26.5 percent for motor carriers, and use of smaller trucks for shorter distances will also increase .[8]

The number of nationwide LTL carriers has declined since the passage of the Motor Carrier Act of 1980. It is unlikely that this industry segment will grow to previous levels, because barriers to entry are high. Nationwide LTL carriers must develop a network of nearly 500 terminals, plus personnel and technology to support the system. The new focus is on regional markets with shorter distance deliveries to respond to a manufacturer's use of Just-in-Time inventory management. [5]

Truckload motor carriers are setting a trend by partnering with other companies or developing divisions to offer non-asset based logistics services to shippers. Logistics management firms and motor carriers are partnering or motor carriers are developing their own logistics service division. They are offering shippers such services as [9]:

- inventory management to reduce cycle time or order time,
- asset utilization,
- optimum loading of equipment,
- modal choice, and
- information software.

In corridors where there are heavy flows of cargo, such as between Chicago and west coast port cities, motor carriers are choosing to move freight intermodally. Intermodal is the transfer of freight from one mode of transportation to another (i.e. truck-rail-truck). Motor carriers contract with railroads to move their trailers or containers on a double stack train, linking with motor carriage of freight. “According to Alex Brown & Sons, a Baltimore, Maryland-based brokerage firm, some 72% of national TL moves are under 500 miles, 18% of hauls fall between 500 and 1,500 miles, while only 10% of truckload movements exceed 1,500 miles.” [5] Chart 3.3 of this report (p.30), reflecting 1990 outbound tonnage, suggests that the same is true for Minnesota. Factors which have driven carriers to choose regional or shorter hauls rather than the long haul market include:

- cheaper long-haul rail intermodal service has won wide acceptance by shippers nationally, and is generally accepted by shippers in Minnesota [10];
- a driver shortage is making it difficult to attract workers to make long runs; and
- changes in distribution patterns with shippers going from single national distribution centers to multiple regional facilities is creating more short-haul traffic.

According to Industry Surveys' analysis:

The number of truckload carriers nationally is predicted to drop from nearly 50,000 in 1993 to perhaps 20,000 or less. The current tendency of shippers to limit their business to a small group of "core carriers" will contribute to the winnowing process. Shippers are seeking transportation partners that become an extension of the manufacturing/distribution process - and not simply a hired gun. [5]

Transportation companies in Minnesota do not believe an extensive reduction is likely to occur nationally or locally. Major truck load carriers operate economically and efficiently by contracting with owner-operators. A major carrier may contract with as many as 5,000 independents across the nation to service its customers. To obtain interstate operating authority, each independent is registered as an inter- and possibly as an intrastate carrier, which explains the large number of carriers nationally. It is projected that the motor carriers will maintain a stable number of independent motor carriers as contractors. Therefore, a 60% cut in carriers nationally is considered too high in the near term. It is believed it will be closer to a 20% (or 10,000 carriers) reduction nationally during a five to ten year period. This smaller reduction is more consistent with federal policies to encourage small business. It might be assumed that this estimate would coincide with the changes firms are making in their distribution and transportation systems.

Industry Survey's review also found:

Motor carriers are buying rail piggyback services and joining railroads as partners, marketing intermodal as a premium service priced at a discount. Most of the industry's 20 largest truckload lines have either formed partnerships or were holding discussions with the railroads in 1994 to develop an intermodal contract. [5]

Motor carriers, specifically truckload haulers, have long been involved in intermodal. However, it was not until the late 1980s that this alternative was used on a regular basis. It began with piggyback services moving trailers cross-country. In early 1990, rail-truckload intermodal alliances were developed. In addition, truck load carriers are restructuring their operational systems by establishing regional networks to keep drivers closer to home. Intermodal is viewed as a way of avoiding long runs for its drivers. This results in economic advantages for shippers and carriers alike. Fuel, labor, and equipment expenses are much lower for intermodal shipments, and usually shippers pay lower rates for intermodal shipments than for over-the-road moves. This is due to the economies generated when using rail equipment which allows double-stacking of containers and unit trains. The equipment eliminates the need for long-haul drivers and separate terminals. The highest cost component for motor carriers is labor, including compensation and fringe benefits. For some LTL carriers, labor costs approach 70 percent of total operating expenses. For higher-cost Truckload carriers, the figure reaches 45 percent. [13] Motor carriers ability to trace, track and deliver shipments as they would for an over-the-road move assists in selling intermodal.[5] Even LTL and small package carriers are utilizing intermodal services between cities where carriers have limited driver availability. Rules in various labor contracts determine when carriers may use intermodal for the long haul between origin and destination points according to experts within the motor carrier industry.[12]

Intermodal services offered by motor carriers enhance their competitive position economically and operationally, while effectively serving their customers. Carriers have taken different approaches to expand their intermodal capabilities by:

- Signing contracts with railroads for intermodal service and rates, and then to offer the service as a part of the motor carrier's day-to-day package to the customer.
- A buy-out of an intermodal marketing firm that will bring customers, contracts and know-how to the motor carrier.
- Forming a "RoadRailer" Cooperative. In Minnesota a group of large national truckload carriers have formed "The cooperative to potentially develop roadrailer service networks, negotiate contracts with railroads and cartage operators, lease roadrailer equipment, and provide terminal services." [11]

Shippers who own a fleet of trucks are "private motor carriers". The private carrier share of the total motor carrier industry market is estimated at 65 percent of all small-to-medium truck terminal locations, 57-to-60 percent of local and 38 percent of all interstate truckload traffic. Private fleets dominate in loads traveling under 250 miles and in a wide range of industries, including grocery and retail. It is known that there are more than 22,000 private fleets operating in the US today.[15] However, industry experts believe the number of private fleets is declining, while existing fleets are growing in size. [14] Since private fleets are not required to register neither nationally nor in Minnesota, the actual number of private fleets operating and their exact size is difficult to determine. Some private fleets are using their existing logistics and operating systems to ship product on behalf of their vendors or customers to reduce operating costs and improve asset management. They may be in need of transportation and / or logistics services to manage the flow of product both into and out of their facilities.

Carriers are developing systems to optimize equipment utilization, increase communications with drivers, and improve customer service. The systems that are being used now include [5,16]:

- two-way communications systems
- computer assisted dispatch
- on-board computer systems.
- satellite tracking systems
- hand-held scanners
- Electronic Data Interchange

2.3 Trends in Intermodal Transportation

The 1991 Intermodal Surface Transportation Efficiency Act (ISTEA) conveys a public commitment to intermodal transportation. Complementing public efforts are private efforts of the Intermodal Marketing Association (IMA) and the Intermodal Association of North America (IANA). The definition of intermodal and intermodal terminal by users of the system is more limited than the definition used in ISTEA. From the users perspective, intermodal is a concept generally defined as a "seamless" delivery of freight by more than one mode from point of origin to point of destination. The delivery is accomplished under one bill of lading, but may include truck/rail/truck, truck/air/truck, or truck/rail/vessel. The product is switched at terminals by the company issuing the original bill of lading. The concept was made a reality by the international container carriers who desired a method of efficiently moving containers long distances on a set schedule economically. The evolution of piggyback to container transportation through an intermodal shipment has created efficiencies in transportation.

Factors contributing to the development of intermodal systems by ocean carriers included:

- inefficient rail service between the Midwest, U.S. West and East Coasts, and Gulf Ports,
- high costs associated with idle equipment and personnel to track equipment as it moves to and from shippers around the U.S. or to and from the ports,
- shipper demands for reliable, scheduled service from any point in the U.S. to international destinations.

Enablers in developing intermodal as a viable service include:

- Computer technology and carrier agreements to standardize forms used within the industry and speed accurate communication between modes and carriers,
- Corporations sourcing and manufacturing globally and locally, supplying customers and their facilities across borders on a scheduled basis, and

- Double Stack Train cars owned and scheduled by the ocean carrier, but transported on rail trackage and under power by railroad owned engines, which facilitated the thru-put process.

Transportation providers, no matter the mode, are utilizing the intermodal concept to create a system of delivery that enables them to better serve firms in Minnesota. During the past two years motor carriers, railroads, third party consolidators, and air carriers have developed internal systems and external partnerships to create intermodal delivery systems. These alliances and partnerships have fostered new innovations for the domestic market.

Railroads complement their sales efforts by contracting with non-asset based companies known as "third parties" or consolidators. Why would shippers contract with these third parties? First, railroads have established minimum volume commitment for shippers to meet in order for them to contract with the railroad. Secondly, each of the 12 Major or Class I railroads have fixed delivery corridors and are unable to offer service to all destinations. Firms, both large and small, hire specialists, such as "third party" brokers, to manage their shipments, obtain economic rates, and provide information about the location of their product. These consolidators design contracts with the railroads for rates, equipment availability, and space on rail cars for any type of product to be moved. They have multiple contracts for service and rates with all 12 major railroads. The third parties ensure the timely delivery of product and reduce the amount of time a shipper must invest in delivering the product to their customers. Nationally, in 1991 6.5 billion tons of goods moved between domestic points. Of that volume, 1.3% shipped under an intermodal arrangement. It is projected by the ATA that by the year 2000, the volume being shipped under an intermodal bill of lading will reach 1.6% of the total tonnage moved. [6] The percentage of product shipped intermodally to and from Minnesota has a similar trend line to the nation's. (See Table 2.2)

TABLE 2.2

SUMMARY OF INTERMODAL MOVEMENTS TO AND FROM MINNESOTA
1990

Product Shipped by Tonnage	Product Shipped by Value	Destination
1.1 %	12.6 %	Points in the US
2.7 %	11.3 %	Minnesota

Source: Reebie Associates

To Minnesota from the US, 2.7% of all tonnage moved as intermodal freight, however these commodities represented 11.3% of the total value of goods shipped. From Minnesota to US points, 1.1% of all tonnage moved as intermodal freight, however these commodities represented 12.6% of the total value of all goods shipped. Today, intermodal provides regularly scheduled service, 2-3 day transit times from Minnesota to major cities, and it is an economic alternative to over-the-road deliveries. These features complement shipper demands for just-in-time deliveries at a lower price.

The benefits of intermodalism are reduced by barriers in rural markets. Shippers who are more than 100 miles from an intermodal rail terminal are unlikely to use intermodal services. At approximately 100 miles, the cost of intermodal exceeds the price of shipping the product direct by truck from the point of origin to destination and the delivery is delayed.

There are currently five rail / truck terminals in Minnesota and one in North Dakota serving Minnesota firms. [10] Each is capable of handling containers or trailers on rail equipment:

- Two in the Twin Cities (one operated by the Soo/CP Rail System, the other by the Burlington Northern RR)
- Dilworth
- Thief River Falls
- International Falls-owned and operated by a paper company
- Grand Forks, ND-is on the border and operates as a satellite to the Dilworth terminal.

There are two terminals serviced by scheduled double stack trains in Minnesota, they are located in Minneapolis and St. Paul. Double stack train services are limited by the scheduling established to meet customer requirements and optimize the investments they made in equipment to handle containers at these terminals. Double stack trains originating in Minnesota and delivering in Seattle, or Tacoma, WA., Newark, N.J., Los Angeles or San Francisco consistently deliver the cargo to their customers within three days of departure on schedule.

Another barrier to intermodalism is external to Minnesota. Chicago is a primary transfer point for shipments originating in the Upper Midwest and Minnesota. It is a transfer hub for shipments between railroads destined to the East Coast, the Southeast, the Gulf and Southwest. However, the Chicago system has limitations. Currently, railroads must transfer containers and trailers between terminals across town from each other. Carriers and shippers are limited to two options for moving their containers or trailers across town. The first is by motor carrier, the second is by a short line rail connection. Carriers performing cross-town deliveries during operating hours of manufacturers and carriers can encounter significant delays due to urban congestion. Given operational characteristics of firms and terminals, "carriers estimate that the only day time hours which are easy to move around in Chicago are between 9:00 a.m. to 11:00 a.m. and 2:00 to 3:00 p.m." [17]

Intermodal cross-town deliveries for shippers of heavier and/or lower value products often ship at the maximum gross vehicle weight (GVW) allowed in Minnesota and most other states of 80,000 lbs.. The types of commodities usually shipped at the maximum weight include timber, grain, and canned goods. These shipments will be legal in Minnesota, but probably not when transported over the road in Chicago. The city follows the Illinois State GVW limitation of 73,280 lbs. per truck. Both motor carriers and shippers are subject to fines issued by the Chicago Department of Transportation. Carriers avoid penalties by:

- using lighter trucks or slider chassis,
- routing the shipment on the cross town rail, a slower alternative adding two days or more to the transit time,
- hiring a carrier to provide special equipment, or
- obtain special permits to move an "overweight load" across town. [18]

The future of intermodalism depends on the ability of the terminal operators to speed the flow of product through their facilities. The intermodal terminals in Minnesota are converted boxcar yards that prove to be less than ideal for handling doublestack trains. Operations are constrained by facilities whose perimeters were staked out decades earlier. This then becomes an issue affecting firms in Minnesota in delivering product to the national and global market because of the limited capacity at the rail yards to handle the expanding volume of containers and trailers moving through the rail yards. This may mean capital investment to upgrade and update the terminals to ensure their ability to handle the projected increases in intermodal freight. [19]

One problem facing each of the modes in the region is the land use restrictions in locations where intermodal facilities are now located. This should not be underestimated as a restriction. Growth at intermodal terminals has been boxed in by environmental, political (neighborhood groups), and physical limitations. Space

is limited for the expected volume of traffic and equipment which is expected at the rail terminals. This includes truck traffic, trailer, chassis and container storage at the terminal, and the rail equipment to move the shipments within the terminal. The central city remains the optimal place in the eyes of many transportation providers. Just three reasons are cited here: the infrastructure is developed, warehouses are established, it is central to shippers and receivers of goods.

Intermodal shippers and carriers rely on state-of-the-art information systems. An intermodal shipment may have three delivering motor carriers and two rail carriers involved in one shipment. Each carrier has their own tracking and tracing system and these systems are available 24 hours a day to shippers or intermodal marketing firms. However, the time and place when the tracing and tracking generally breaks down is at a transferring rail terminal. The terminal transfer is the point when the greatest possibility for error occurs and it seems as though the carriers are unable to communicate with each other smoothly. It is one which railroads identify as a barrier to optimal utilization of both rail equipment and intermodal equipment. On the other hand, the shipping community believes that the motor carriers and third parties have the asset management tools to deliver equipment and product on a scheduled basis to their customers.

2.4 Trends in Rail Transportation

One of the primary catalysts for settlement in Minnesota and points west was construction of the railroad system. The small cities and towns that dot the map in rural Minnesota were in many cases stopover points for the steam locomotives. As technology and transportation evolved during the past century, motor carriage for passenger and freight increased. The changing structure of the market place, the highway infrastructure, and the advent of modern truck created a new environment for passenger and freight transportation. Because of intense regulation, the railroads were unable to respond to these changes. Industry analysts and insiders point to the Staggers Act of 1980 as offering greater flexibility to the railroads in their operations and service delivery. The deregulation of the industry gave them an opportunity to adjust their operations, management, and equipment to respond to some of the changes in the market place. These changes may have slowed the rate of decline, but have not stopped it. The earliest statistics on market share by mode of inter-city freight were recorded in 1960 by the Eno Transportation Foundation, Inc. in "Transportation in America". [20]

TABLE 2.3

CHANGES IN THE NATION'S FREIGHT BILL FOR RAIL TRANSPORT (Millions of Dollars)

Year	Total Freight Bill	Railroad Freight Bill	
		Amount	Percentage
1960	\$ 47,767	\$ 9,028	19
1970	83,978	11,869	14
1980	213,736	27,858	13
1990	351,915	30,403	9

Source: Eno Transportation Foundation, Inc., *Transportation in America* [20]

Transportation providers are not the engine of the economy. Producers, manufacturers, and consumers drive the economy. Railroads did not have a reliable, scheduled service to offer companies who were seeking not only carriers, but partners. Shippers are selecting carriers who offer not only a least cost delivery method, but a

reliable, on-time delivery method. Shippers continue to apply methods of reducing their costs which include just-in-time inventory, reduced cycle or lead times and an emphasis on responsive customer service through logistics management. The railroad industry has responded to shippers pressures by examining their management systems. The changes they are making include: tighter equipment management systems, reduced investment in corridors with low revenues and/or volumes, rail abandonment, investments in communications and rail technology, cost reductions, and alliances with other modes.

However, analysts and planners believe a system of rationalizing railroads has provided an economical operating system on a minimum amount of track to support their customers and operational system. The following statistics show Minnesota's standing in relationship to the nation.

TABLE 2.4

COMPARISON BETWEEN RAILROADS IN MINNESOTA AND THE NATION (1992)

Size	Number of Railroads		Number of Miles Operated	
	Entire USA	Minnesota	Entire USA	Minnesota
Major	12	4	126,237	3,539
Regional	33	6	20,697	872
Local	464	10	22,730	372

Source: Association of American Railroads, *Railroad Facts*, 1993

The railroad system operates a transportation service between modes, ports, raw materials and manufacturers, domestic and international markets. Major railroads have revenue in excess of \$251 million per year. In Minnesota, the major railroads with a significant presence are the Burlington Northern Railroad, the Canadian Pacific/Soo Line Railroad, the Chicago North Western Rail Co. (Partially owned by the Union Pacific), and the Minnesota and Manitoba Railway Co. (Canadian National).

Regional and local railroads are a vital link in Minnesota's transportation network for Minnesota's commerce. Regional railroads are defined by the revenue they generate, it must be between \$200 and \$250 million and they must operate at least 350 miles of track. The next ranking is the local or short line railroad whose revenue is less than \$20 million, and they operate less than 100 miles of track.

"In 1993, the nation's railroads hauled an estimated 1.41 billion tons of freight, or about 8% less than the record of 1.53 billion tons handled in 1973." [21] For another point of reference, it should be noted that this is the same period in time when railroads abandoned rail track and reduced the number of employees. However, railroad observers and insiders are cautiously optimistic about the future of rail transportation. Why? It is due to the railroads modest, steady, annual growth in rail revenues between 1-2 % per year between 1973 and 1993. "The industry's share of the total transportation freight dollar is little more than 8% nationally. In 1992, the rail industry earned \$21.28 per ton handled. This is in sharp contrast with the \$269 earned per ton of less-than-truckload freight handled by major motor carriers and the \$70 to \$90 per ton generated by truckload carriers. In 1992, coal was the largest traffic source, representing 39.6% of tonnage and 22.6% of revenues. The second largest commodity was farm products, largely grains, which generated 149.4 million tons, or 10.7% of Class I railroads' volume and \$2.5 billion in revenues (8.2%). Shipments of chemicals accounted for 9.4% of total rail volume in 1992, but a 14% of revenues because of the higher value of the product. Motor vehicles, which account for just 1.7% of volume, generate 9.0% of total rail revenues. Intermodal traffic, although not significant if measured in tonnage, is estimated to be 19% of total rail revenues." [21]

Railroads are hauling product longer distances, losing most of the short-haul freight to the motor carrier industry. In 1992, the typical rail shipment moved some 760 miles, compared with just 425 miles some 30 years earlier. [21] This mode excels at high volume, long distance shipments. Primary examples of this include low-value bulk commodities, autos and intermodal.

The smooth hand-off of product as freight from one carrier and mode to another is and will be a critical element of a railroad's success in meeting the expectations of their customers. Their customers include manufacturers, intermodal marketing companies, producers, motor carriers, and international container lines. An analysis of the Interstate Commerce Commission (ICC) 1990 Waybill Sample indicates as much as 20 percent of rail traffic through and to Minnesota is intermodal.

Intermodal shipments are a small portion of the actual tonnage hauled by the railroad, yet those moves produce a significant share of revenue. Railroads are paying close attention to these intermodal customers and their needs for customer service, timeliness, and scheduling. Their alliances with motor carriers and intermodal marketing firms (third-parties) are having an effect on railroad decision-making. Within Minnesota, two major railroads are examining terminal operations, capacity and systems for transferring intermodal trailers and containers. Yard size, access, and technological systems may be inhibiting factors to the growth in intermodal volume for the Burlington Northern and Canadian Pacific / Soo Line Railroads within five to ten years. This is a critical element of Minnesota's transportation connection to the global market place as well. In a recent unpublished Association of American Railroad study surveying the Major Railroads, it was found that nearly 40% of their intermodal revenue was generated by shipments originating with international container ship lines.

The Burlington Northern Railroad, the Chicago North Western, and the Canadian Pacific / Soo Line are managing their fleet to optimize equipment usage by shippers. Optimizing equipment involves: reducing the number of days equipment sits idle at a shipper's facility, improving turn time for maintenance and cleaning, and developing safe methods to clean rail cars to ensure use for multiple commodities. Coordination between railroads, increased customer communication about equipment needs, and a continuing investment in software, hardware, and personnel to manage the process will all be needed. [22] It may also mean additional investments in structures on railroad property and partnerships, seeking out management firms who are specialists in logistics and customer delivery systems to improve the turn-around of equipment for shippers.

Railroads operate best when they can handle high volumes of cars moving in a high volume corridor. A recent study by the American Trucking Association (ATA) found that interline agreements between railroads work best when they involve trainload movements on established schedules. However, railroads do handle smaller shipments or individual carloads. Shippers want to know where an individual rail car is located whether it is when rail cars are at a premium during the last two quarters of the year, or when they must schedule labor and product movement. Railroads have developed scheduling and car reservation programs, tracing and tracking systems, as well as equipment maintenance to ensure scheduled delivery. However, shippers and third-parties often must make a phone call or use each railroad's computer dial-up data processing package to determine the location and estimated arrival of the unit to their facility or that of their customer. This process can be circumvented by subscribing to a private information network that has electronic data interchanges with every railroad.

2.5 Trends in Air Cargo Transportation

When discussing air transport, it is important to understand there are four principal types of firms in the air cargo industry [23]:

- (1) Combination carriers (airlines carrying passengers and freight),
- (2) All-cargo airlines,
- (3) Air freight forwarders/brokers, and
- (4) Motor carriers hauling expedited air freight.

Within this section, the focus will be on combination and all-cargo airlines.

The passenger carrier who handles freight as well as moves people is a combination carrier. There is currently one major combination carrier in the US passenger market that operates all-cargo planes, or has a partnership with a carrier that has combi-planes. A "major carrier" is defined by the US Department of Transportation (DOT) as an airline with more than \$1 billion in annual revenues. Secondly, "there are all-cargo carriers, a group that includes specialists in the express air delivery of small packages and documents." [24] These are the carriers who have designed their operations around freight handling, dispatch and the logistics of product movement that comes in all sizes and shapes.

Combination Carriers

Combination (Passenger-Freight) Carriers have developed a niche in the international air freight market. Their international network of service and operations are a boon to exporters and importers alike. The domestic cargo is generally handled by the all-cargo carriers.

"The major carriers reported their third consecutive year of huge losses in 1992. By early 1993, the airline industry was desperately struggling to emerge from the worst financial crisis in its more than 60-year history." [24] Causes cited by industry analysts and Minnesota carriers include the Persian Gulf War, the US recession, and slow growth in the economy. In fact, during 1991 and 1992, a total of six national (A "national carrier" is a carrier with annual revenues between \$100 million and \$1 billion.) and major carriers filed for protection under Chapter 11 of the Bankruptcy Code. [24] This picture is brightening as carriers begin to post gains to their revenue during early 1994. Passenger revenue is expected to have support through growth in the air cargo market. These markets are America/Asia, Europe/Asia, and North America/Latin America. [24] Statistics compiled by the Air Transportation Association in their 1994 annual report show that just over 50 percent of all Cargo Traffic Revenue Ton Miles is generated by freight shipped internationally. When taken as a percentage of Total Passenger and Cargo Revenue Ton Miles, it generates less than 10 percent of the total.

The limited capacity for freight on international flights inhibits these carriers in their efforts to handle large volumes of freight. It is the passenger market that has the carriers seeking "cross border alliances" to develop global operations. "However, considerable controversy has arisen over the process. In 1989, KLM acquired a 49% equity interest (25% voting) in Northwest. In 1992, the US DOT approved the KLM/Northwest arrangement under the policy of "Open Skies." Open skies agreements permit the airlines of the countries adopting them to have free access to each other's markets. The first of these was signed between the US and the Netherlands, opening the way to the KLM/Northwest deal." The largest US flag carriers are bitterly opposed to open skies arrangements because they believe the proposal would benefit foreign carriers more in the US than US flag carriers in foreign markets. [24] This perspective may change as the European Union acts to deregulate the airline industry in Europe. The potential merger of the operations of KLM, SAS, Swissair, and Austrian Airlines was an example cited. In April 1993, US Congress established a National Commission to Ensure a Strong Competitive Airline Industry to consider investment by foreign carriers in US airlines.

It might be assumed that most shipments with an international destination depart on direct flights from the St. Paul-Minneapolis Airport. One-third of all cargo shipped departs on direct flight according to a 1994 Metropolitan Airport Commission analysis of data from carriers, forwarders, and shippers. Two-thirds of foreign destined cargo is trucked from a consolidation point near or at the St. Paul-Minneapolis airport to facilities in Chicago. Cargo is rehandled and stowed into air containers for direct flights around the world. Consolidations ship daily to destinations in the Far East, Europe, the Middle East, Africa and South America.

Shippers select carriers who route their cargo to Chicago where it will be rehandled for two primary reasons. First, there are limited direct flights between Minnesota and international points. Second, passenger carriers have restrictions on weight and size that inhibit the movements of larger packages. The amount of space for freight carriage (or lift) is limited, so it is often faster and cheaper than inter-lining the shipment between airlines in Minneapolis and Chicago.

All-Cargo Carriers

“Growth in the air cargo market during the 1980s was mainly due to the rise of air express carriers. During the period from 1982 to 1990, the number of shipments in the domestic air express market grew at an average annual rate of about 19%.” [24] According to the Metropolitan Airport Commission, the Minneapolis-St. Paul Airport was serviced by 13 All-cargo carriers in 1992. They handled 130,000 tons of freight that year, or an increase of 11% over 1991.

It is believed shippers will continue to expand their use of air freight. Nationally, revenues and volumes have increased by 10 to 13 percent between 1992 to 1993--domestically and internationally. This growth is probably related to all-cargo carriers ability to offer integrated services through an agreement with a motor carrier or their own fleet. With one phone call a shipper has the cargo picked-up, documentation, air shipment and delivery accomplished. This type of service is not available directly from a passenger carrier, and it competes with forwarders who can make similar arrangements. Forwarders offer services, but do not have the capital assets of a carrier. [25]

“A number of factors contributed to the growth of air express of documents. These included the growing need for the rapid delivery of documents and small packages in an information- and service-based economy; the development of centralized distribution systems; the adoption of just-in-time inventory and production systems; and the willingness of shippers to pay premium rates for such services. These companies used a central hub system through which all freight is shipped, sorted, and rerouted which made large-scale overnight delivery possible for the first time. Although the hub system is likely to remain as the foundation of most air express operations, growth has necessitated some variations. The primary change is that some major operators have established regional hubs to serve specific areas of the country.” [24]

Rapid delivery of documents and small packages brought about the revolution in air freight delivery systems. Ongoing technological advances, such as Electronic Data Interchange (EDI) and facsimile machines, are pushing air freight carriers to refine their services now. Air carriers are shifting their attention to “value added” services by focusing on shippers who must move finished goods or parts rapidly to their customers. They are expanding their role by offering firms logistics management, distribution services, data processing, communications networks offering tracing, tracking, and automated billing or accounting services. [26] Carriers are seeking international markets by developing international operations systems in Asia and Europe, or by relying on working agreements with local organizations in other countries to position themselves in international express markets.

Generally, overcapacity in the air freight market has been a benefit to the shipper and a problem for the carrier. Air carriers were unable to raise their rates due to the competition, in spite of the fact that the rates did not always cover operating costs. During the next few years, the air cargo industry is expected to replace existing aircraft with smaller equipment, thus reducing cargo capacity. This may lend impetus to smaller freight shipment sizes and encourage increased use of just-in-time inventory and manufacturing. Yet service should remain strong as regional carriers pick up routes that larger carriers drop.

2.6 Trends in Waterways Transportation

The waterway system connecting Minnesota to the nation and the world is a major navigational channel for commercial and recreational users alike. However, in this brief trend analysis the emphasis will be on river transportation not the Great Lakes. The network of locks, dams, terminals, and ports complement the rail and truck transportation of high volume, low value, seasonal products and commodities. At the same time, the Mississippi River and its tributaries serve the region as a recreational and natural resource, some commercial fishing, as a source of drinking water and hydroelectric power.

The system itself is made up of a series of locks and dams owned by the Federal Government and operated by the U. S. Army Corps of Engineers. There is a series of 29 locks and dams constructed and maintained since the 1930s by the U. S. Army Corps of Engineers along the Mississippi River between Minneapolis, MN and St. Louis, MO. "As of January 1994, 48 percent of all lock chambers in the entire inland waterway system have exceeded their 50-year design life ..." [27] Along the Upper Mississippi Riverway, 78 percent of all lock chambers are over 50 years old. [28] This has been highlighted in discussions by industry sources as an issue that must be addressed to maintain the viability of our connection to world markets through the Gulf Ports of Houston and New Orleans, while balancing environmental and recreational demands and uses. The use of the waterway is directly related to the ability of barge carriers to remain competitive with railroads in hauling and transporting bulk products. From a systems perspective, all systems are needed to handle the volumes of product that will ship in a timely fashion. Products transported to and from Minnesota by water include agricultural commodities, fertilizers, salt, steel, gravel, sand, rock, chemicals, cement, and petroleum products. [29]

Private barge operators hauling products commercially, or shipper-owned barge operators utilize the river system and see the system as autonomous. The system is used by professionals who acknowledge both the importance and competitive forces of railroads and motor carriers. The intermodal linkage between rail, truck and water transport providers is the terminal operator. The terminal operator is a third party provider of services and coordinates and prioritizes the handling of shipments. This is similar to the services that third parties provide to motor carriers and the railroads. However, railroads and motor carriers have also developed on-line communication systems with each other to create both intermodal and multi-modal networks which enhance each others services. This is not the case in the barge industry. River transport firms have daily contact with their fleet and what is going "on the river". Cellular phones and on-board computers aid in communications between shore staff and river crews. This assists them in predicting arrival and departure times of equipment.

The literature reviewed does not track the cycle times of barges, but industry sources indicate that the travel time for a barge traveling between Minneapolis, MN and St. Louis, MO ranges between 25 and 50 days. Barge owners/operators state that the 25 day round trip is desirable to ensure higher return on investment. Barge operators rely on the spring and fall seasons to generate the majority of their revenue in any given year. That revenue is still determined by the size of the grain harvest and the potential export market generating cargo for delivery to USA gulf ports.

Due to favorable tax laws between 1975 and 1983, there were many investors who were attracted to the industry. It grew to approximately 1,800 barge and towing companies during the early 1980's. The barge industry leveraged its capital and invested in equipment. The surge in barge companies was complemented by a surge in barges being built. In 1981, 15 percent of the total current capacity was built (about 2,500 hopper barges).[30] In 1993, the size of the fleet remained high at 10,538 covered hopper barges, and 8,135 open hopper barges. However, the number of barge operators in 1993 had dropped to a total of 600 operators nationally. [27] The changes are considerable when it is understood that nearly 2,000 waterway transportation companies operated on the Mississippi River and its tributaries in 1983. [31]

“Market conditions reduced the profitability of the smallest waterway transportation companies, and they had difficulty competing with the larger multi-service firms on the rivers. By 1993, the top nine operators controlled more than 45 percent of total industry capacity.”[31] Although the inland waterway transportation industry operates with a smaller fleet than it did ten years ago, the vessels handle more tonnage and complete more trips annually. [32] Current projections are that shipping will increase at a rate of about 2.0% per year for the next twenty years. [33]

Changes in the marketplace, operating systems, and technology have provided the impetus to integration within the industry. Major trading companies own and operate their own fleets. On the other hand there are cross modal mergers occurring in the general freight industry, the only example of horizontal integration in the river transport business occurred when the CSX Railroad (owner of the containerized vessel operator Sealand Service, Inc.),and ACBL Barge Company merged.[27] Integration, whether through a trading company or a multi-modal operator, provides the barge industry with the financial support to sustain itself, rather than rely totally on the vagaries of the market place. It may also offer a larger scale of operations, which support the barge operator.

The river supports the transportation of products that are competitive if they can continue to ship them at a low cost. Barge operators fear additional taxes and costs for maintaining and operating their fleets on the river. Margins are low and measured in terms of fractions of a dollar per ton. The volume of product hauled on the river is related to variables in the market place, including environmental controls, operating fees, the price of fuel, the price of grain to name a few. The aging system and environmental impact issues are two additional factors that will have an impact on the volumes that may be transported on the river in the future.

A statement made in 1987 is still true today. “River transportation fulfills a need for low-cost, accessible service to move large quantities of low-value bulk commodities, that are either produced or consumed in the Upper Midwest region, to and from the South, and overseas markets. Barge service for each commodity group faces competitive pressures from land-based transportation modes for similar movements or alternative movements via different origins or destinations.” [32]

3.0 FREIGHT FLOW DATA TOTALS FOR 1990

3.1 Modal Descriptions and Definitions

Railroad Movements of Commodities

A rail system map for the State of Minnesota is shown in MAP 3.1. This map shows Class I (major), Class I (regional), and Class III (short line and private) railroad lines within the state.

Rail Carload

This includes rail carload shipments of bulk and non-bulk commodities, whether carried in dedicated cars (to a specific commodity) or box cars. This also includes rail shipments within a BEA region such as shipments by the DM&IR Railroad from iron ore mines to ports on Lake Superior.

Rail Intermodal

This includes Trailer-on-flat-car (TOFC) and Container-on-flat-car (COFC) movements which have either domestic or foreign destinations. The Reebie Data do not distinguish between a Container destined to a domestic BEA (San Francisco/Oakland) and a Container destined to a foreign country shipped through the port of Oakland. Rail intermodal shipments are specified only for those BEA regions in which an intermodal transfer facility is located.

Highway Movements of Commodities

A map of those roads with the highest volumes of heavy commercial traffic is included here as MAP 3.2. This clearly shows those highway links responsible for carrying the major part of commodity shipments by truck in Minnesota.

Truckload (TL)

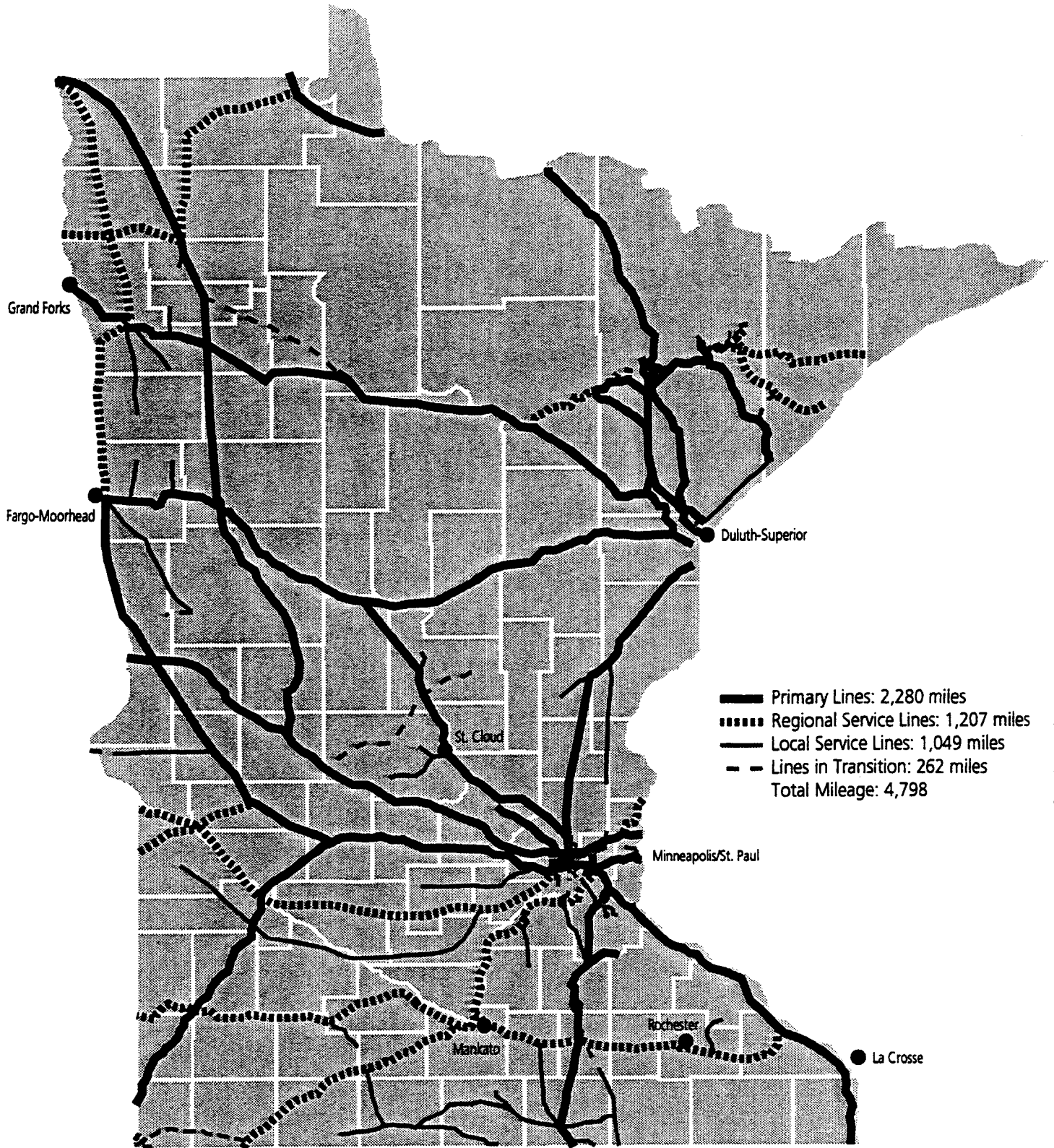
This includes truckload shipments of bulk and non-bulk commodities, whether carried in dedicated trailers (to a specific commodity) or in other configurations, that are contracted to motor carriers. Trailers destined to an intermodal terminal within a BEA may be included in this definition since those are considered truck movements within the region itself.

Less-than-Truckload (LTL)

This includes less-than-truckload shipments by contract motor carriers.

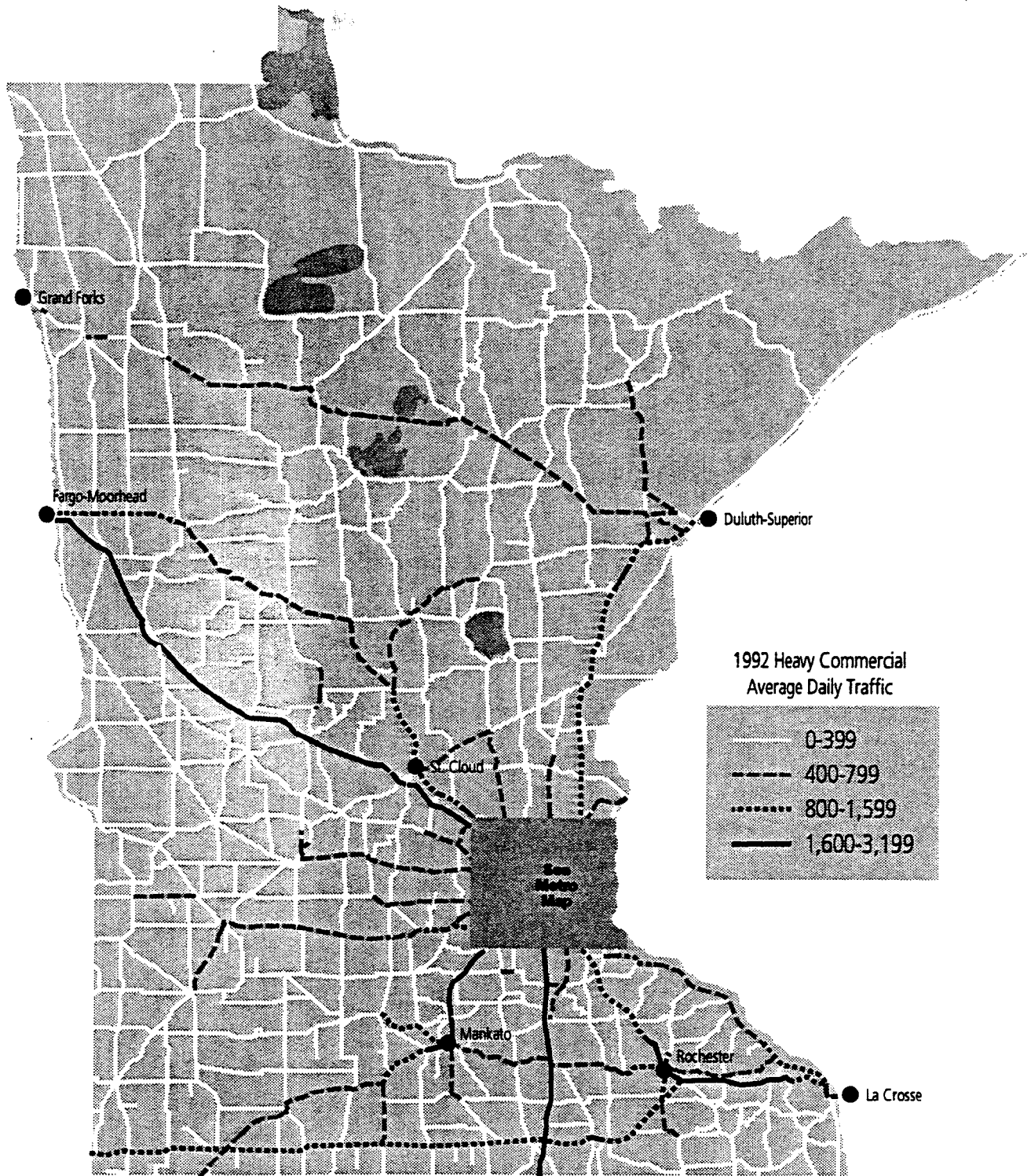
Private Truck

This includes all shipments of commodities that are carried out without use of contract motor carriers. Included in this category are wholly-owned over-the-road fleets, special equipment associated with bulk commodity producers and company-owned distribution fleets.



Source: Mn/DOT State Rail Plan

MAP 3.1 Rail System in Minnesota



Source: Mn/DOT Traffic Volume Map

MAP 3.2 Highway System for 5-axle Trucks

Air Transport

Air transport shipments of freight include small packages, belly cargo and cargo carried in large or small dedicated cargo aircraft. US mail is not included for aircraft in the Reebie data base. A comprehensive system of airports has been developed for the State of Minnesota which provides every city in the State with relatively quick access to air transportation.

Water Transport

Commodity movements by water occur along the inland waterway system in Minnesota (primarily the Minnesota and Mississippi Rivers) and to and from ports on Lake Superior. There are 183.8 miles of commercially navigable channel on the Mississippi River, 24.5 miles on the St. Croix and 21.8 miles on the Minnesota River. There are 48 Mississippi River terminals in four port areas. There are six operating terminals on the Minnesota River. Movements on the St. Croix are between Stillwater and the confluence of the St. Croix with the Mississippi at Prescott, Wisconsin. Great Lakes ports on Lake Superior include Duluth-Superior, Two Harbors, Silver Bay, and Taconite Harbor. While shipments from Duluth only are specified in the Reebie data base, it is not always possible to separate shipments into those for Duluth and Superior.

3.2 Total Tonnage by Mode

The data indicate that 89% of truck shipment tonnage is accounted for by trips of less than 400 miles. With the trends toward less warehousing and more just-in-time delivery, it is not surprising to see more freight in constant motion on highways, railroads, rivers and at airports throughout the state. The volume of freight moving within the BEA 96 region is significant - totalling 23 million tons in 1990. This compares to 5 million tons shipped out of the region to the rest of the state, 20 million tons shipped to the Upper Midwest and 22 million tons shipped to other destinations in the U.S.

TABLE 3.1 shows the total tonnage of commodities shipped (domestically) into and out of Minnesota.

CHART 3.1 shows the share (based on tonnage) by mode of Minnesota BEA shipments out of Minnesota.

CHART 3.2 shows the share (based on tonnage) by mode of inbound shipments to Minnesota BEA regions. These charts show that BEA 96 generally dominates both outbound and inbound shipments over all modes except for BEA 95 (Duluth-Superior) where rail carload and water shipments (consisting of coal and iron ore) are greater.

TABLE 3.1

TOTAL FREIGHT FLOWS INTO AND OUT OF MINNESOTA
1990 COMMODITY TRAFFIC IN 1000 TONS

STCC	COMMODITY	INBOUND (000 TONS)	OUTBOUND (000 TONS)
01	Farm products	6682.33	20508.36
09	Fresh fish/marine products	31.28	0.01
10	Metallic ores	12.81	49731.60
11	Coal	12544.91	2101.90
13	Crude petrol/natural gas	0.12	0.00
14	Nonmetallic minerals	3385.37	1753.72
20	Food/kindred products	8784.86	13833.77
21	Tobacco/products	1.25	0.01
22	Textile mill products	89.67	7.00
23	Apparel/related products	62.51	30.38
24	Lumber/wood products	2664.40	2752.21
25	Furniture/fixtures	153.86	131.70
26	Pulp, paper, allied products	1517.24	1890.98
27	Printed matter	247.61	259.80
28	Chemicals/allied products	3646.99	3684.91
29	Petrol/coal products	1530.65	4168.45
30	Rubber/plastics	647.73	427.05
31	Leather/leather products	27.86	3.57
32	Clay/concrete/glass/stone	6487.88	1361.20
33	Primary metal products	1409.70	746.68
34	Fabricated metal products	630.04	584.86
35	Machinery	532.67	545.13
36	Electrical equipment	387.07	300.91
37	Transportation equipment	886.73	447.39
38	Instruments/photo/optical	46.81	75.67
39	Misc manufacturing	67.66	77.89
40	Waste/scrap materials	113.07	526.58
41	Misc freight shipments	1.60	0.29
42	Shipping containers	99.38	38.30
43	Mail/contract traffic	37.61	87.92
45	Shipper association traffic	2.91	0.00
46	Misc mixed shipments	680.59	904.54
	Totals	53415.17	106982.78

OUTBOUND SHIPMENTS BY MINNESOTA BEA AS PERCENT OF TOTAL FOR EACH MODE

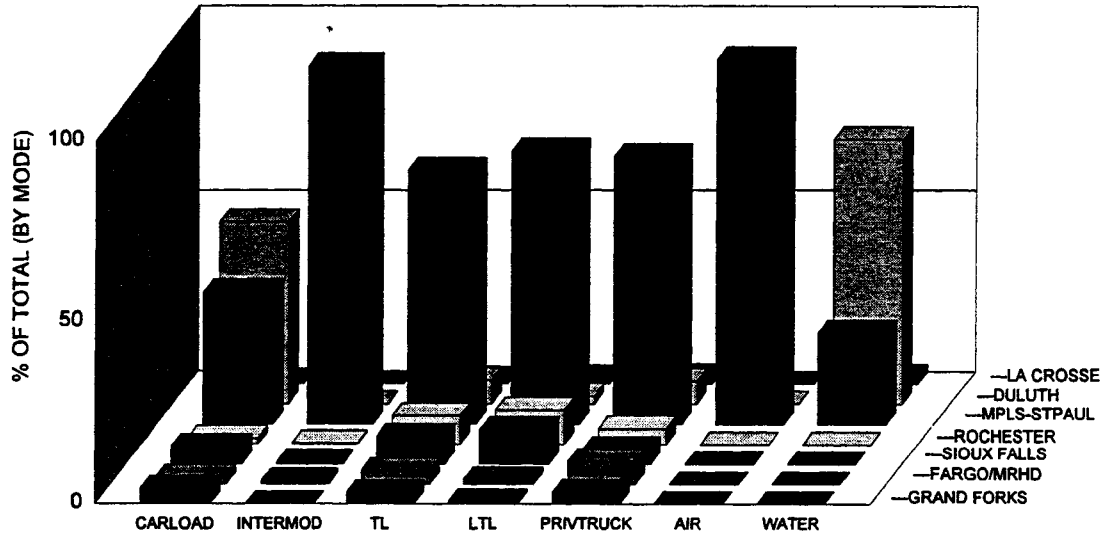


CHART 3.1 Minnesota BEA Share of Outbound Shipments by Mode (based on tonnage)

The large bars across the chart represent the high percentage across all modes that is accounted for by the Minneapolis-St. Paul BEA (which includes the St. Cloud Metropolitan Area). However, the large share accounted for by the Duluth-Superior BEA reflects the large coal movement from Minnesota to the coal transfer facility in Superior and the large tonnage of iron ore that is shipped from Duluth and the other three Minnesota Lake Superior ports.

**INBOUND SHIPMENTS BY MINNESOTA BEA
AS PERCENT OF TOTAL FOR EACH MODE**

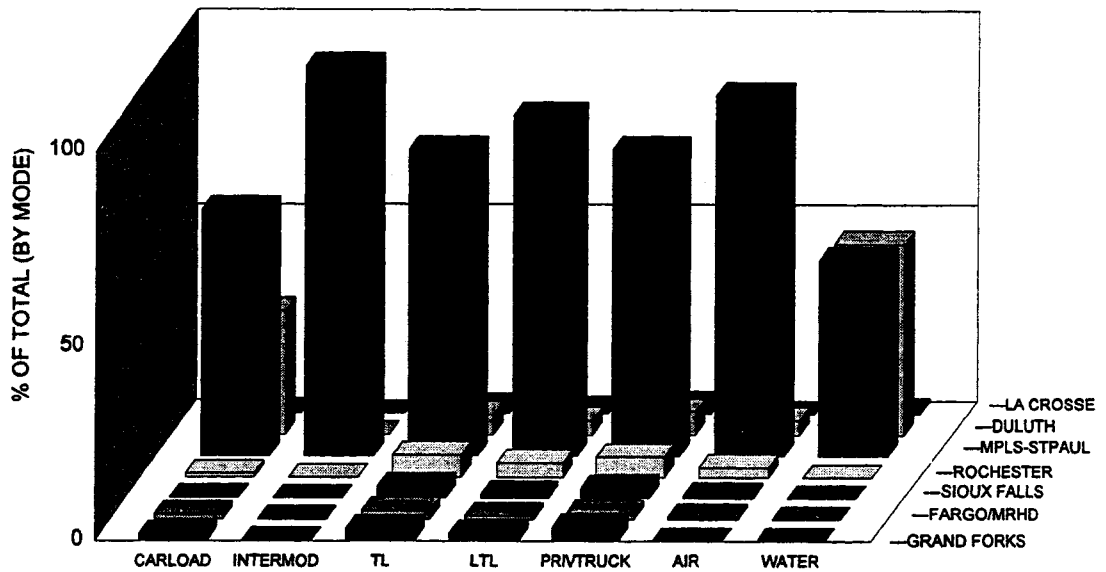


CHART 3.2 Minnesota BEA Share of Inbound Shipments by Mode (based on tonnage)

The picture for inbound shipments is similar to that for outbound shipments with Minneapolis-St. Paul again dominating these shipments and with Duluth-Superior showing significant shares in Rail Carload and Water, although somewhat smaller than for outbound shipments.

3.3 Total Value

TABLE 3.2 shows the total value of commodities shipped (domestically) into and out of Minnesota.

TABLE 3.2
TOTAL FREIGHT FLOWS INTO AND OUT OF MINNESOTA
1990 COMMODITY TRAFFIC IN MILLION \$

STCC	COMMODITY	INBOUND (Million \$)	OUTBOUND (Million \$)
1	Farm products	775.15	2255.92
9	Fresh fish/marine products	176.27	0.06
10	Metallic ores	0.33	1293.02
11	Coal	351.26	58.85
14	Nonmetallic minerals	47.40	38.58
20	Food/kindred products	5921.00	8244.93
21	Tobacco/products	34.43	0.41
22	Textile mill products	301.29	20.20
23	Apparel/related products	659.34	299.22
24	Lumber/wood products	660.77	1100.88
25	Furniture/fixtures	620.66	504.13
26	Pulp, paper, allied products	1411.03	2133.03
27	Printed matter	1413.84	1493.33
28	Chemicals/allied products	3245.82	3073.21
29	Petrol/coal products	211.23	558.57
30	Rubber/plastics	2114.20	1395.59
31	Leather/leather products	337.26	42.19
32	Clay/concrete/glass/stone	726.64	117.06
33	Primary metal products	1358.95	934.85
34	Fabricated metal products	1507.06	1303.07
35	Machinery	4664.08	6963.49
36	Electrical equipment	6183.10	4245.22
37	Transportation equipment	4119.77	2185.06
38	Instruments/photo/optical	945.92	1829.07
39	Misc manufacturing	437.37	477.47
40	Waste/scrap materials	54.95	359.12
41	Misc freight shipments	2.65	0.49
42	Shipping containers	246.07	95.05
43	Mail/contract traffic	13743.92	32129.44
46	Misc mixed shipments	4133.89	5499.60
	Totals	56405.65	78651.11

3.4 Modal Flows by Distance

MAP 3.3 shows concentric circles at 400 mile intervals from the Minneapolis-St. Paul Metropolitan Area, representing the market center for BEA 96. These have been used to determine the distribution by distance of inbound and outbound freight flows between BEA 96 and the rest of the United States. This information provides a clearer understanding how distance and modal shipments are interrelated.

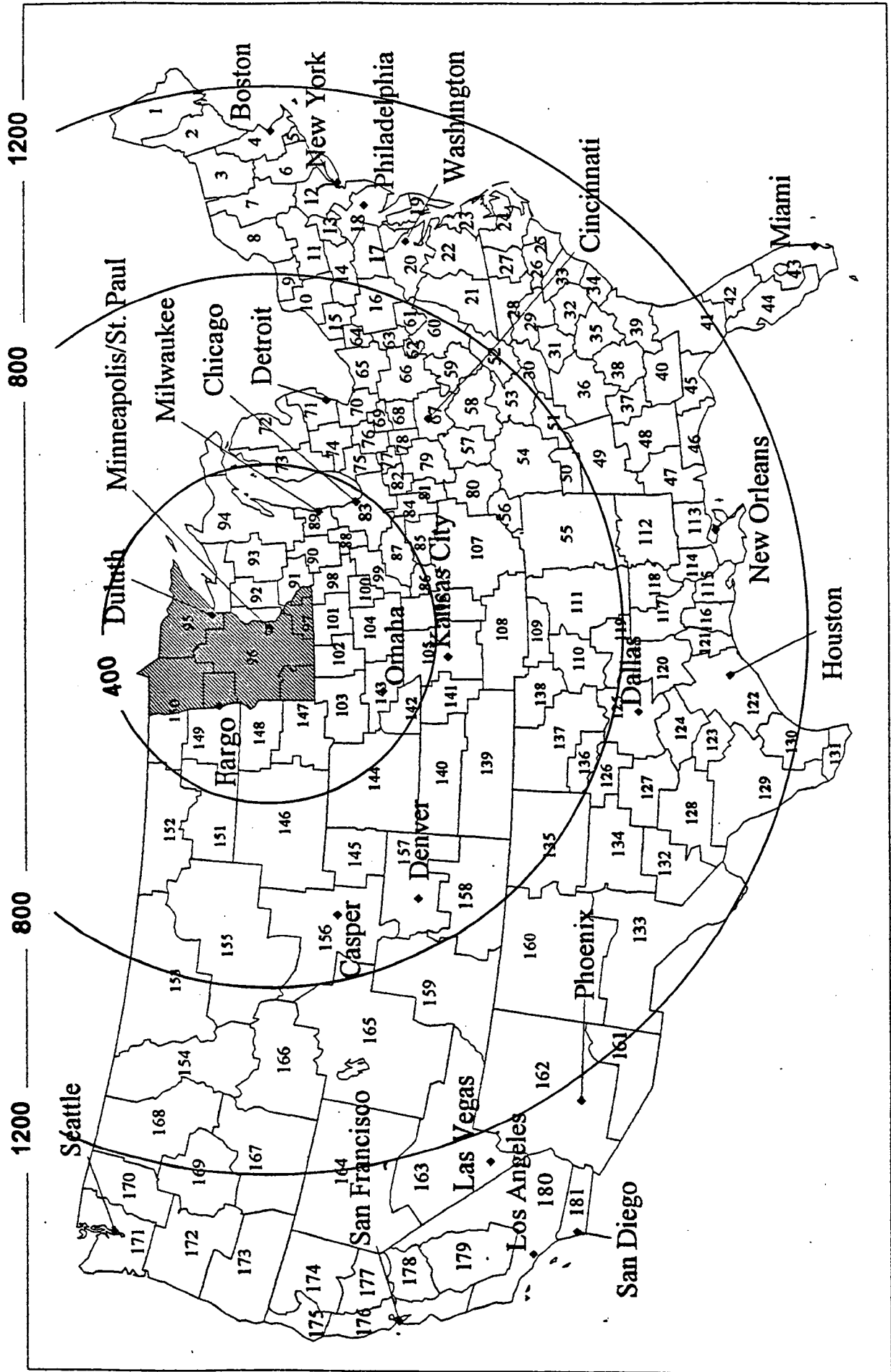
In the charts that follow, flows to and from these 400 mile intervals are presented. "BEA 96" refers to flows within BEA 96 only. "<400" refers to distances within the 400-mile circle but excludes flows within BEA 96.

CHART 3.3 shows the general distribution of outbound flows (tonnage) by mode and by distance category within the contiguous United States. It is important to note, however, that some of the flows to those distance categories which include major ports are likely related to foreign exports. However, no data are currently available for determining the foreign content of these shipments. As mentioned earlier, truck is the dominant mode of shipments in each distance category, except those greater than 800 miles. For long distance hauls (>800 miles), rail and water dominate. This chart does not show air shipments due to the small weights shipped.

CHART 3.4 shows the distribution of inbound flows (tonnage) by mode and distance category. Truck is the predominant mode here as well, with 75% of inbound shipments originating within 400 miles of the Twin Cities. The large rail shipments inbound from distance of 401-800 miles are primarily coal shipped in from Wyoming.

CHART 3.5 shows the distribution of outbound flows (value) by mode and distance category. When the value of the freight shipped is considered, rail and truck carry virtually all of the shipments out of the Twin Cities.

CHART 3.6 shows the distribution of inbound flows (value) by mode and distance category. Truck and rail also share the vast majority of in-bound shipments by value, with rail carrying the greatest total value of shipments in the less than 400 mile range.



MAP 3.3 Distance Categories from Minneapolis-St. Paul

BEA 96 SHIPMENTS BY DISTANCE OUTBOUND TONNAGE - 1990

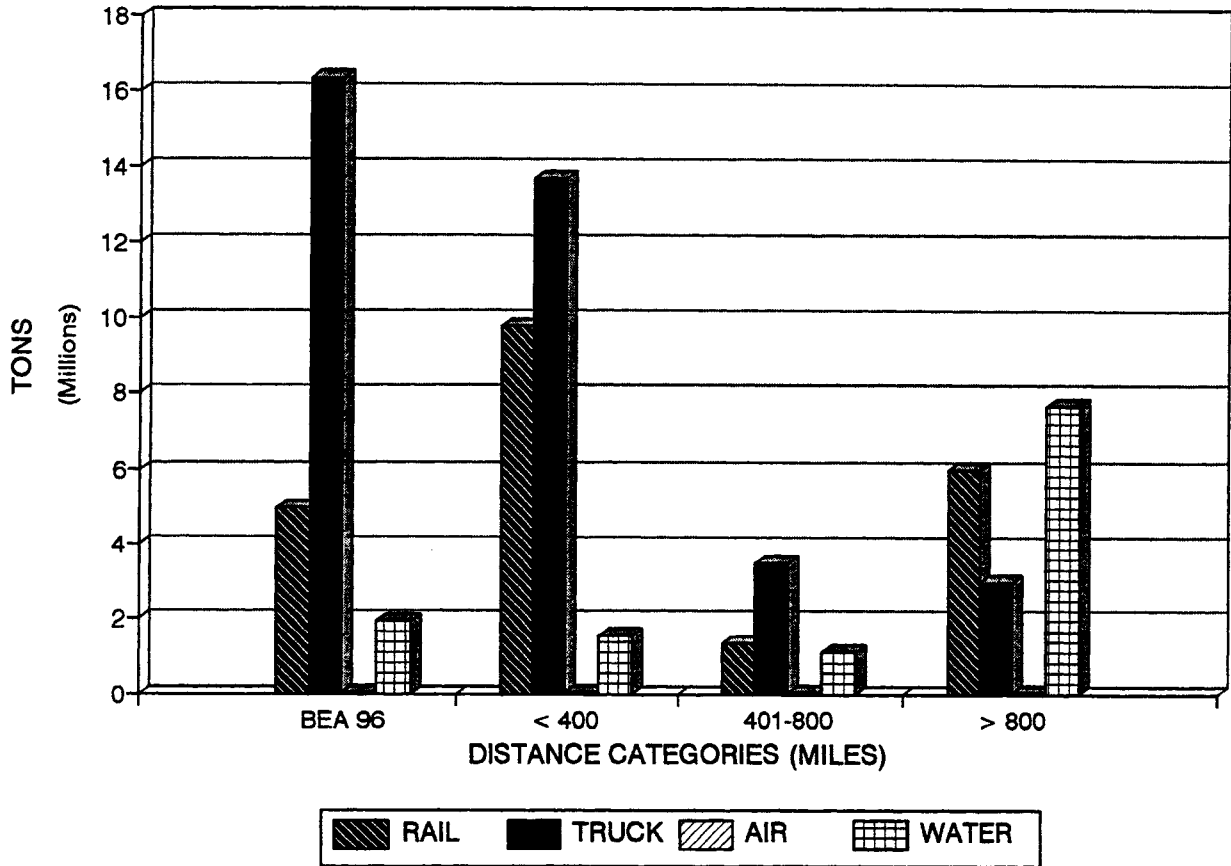


CHART 3.3 Distance Distribution of BEA 96 Outbound Flows by Tons and Mode

This chart shows the strong role played by trucking within BEA 96 and in the region which is less than 400 miles from Minneapolis-St. Paul. Rail shipments are also strong in this distance zone, reflecting a large volume of shipments to Chicago, which lies just within the 400 mile circle. Water shipments are strongest for the longest distance category reflecting primarily shipments of grain to New Orleans. Overall, air shipments represent only a small fraction of freight movement by weight.

BEA 96 SHIPMENTS BY DISTANCE INBOUND TONNAGE - 1990

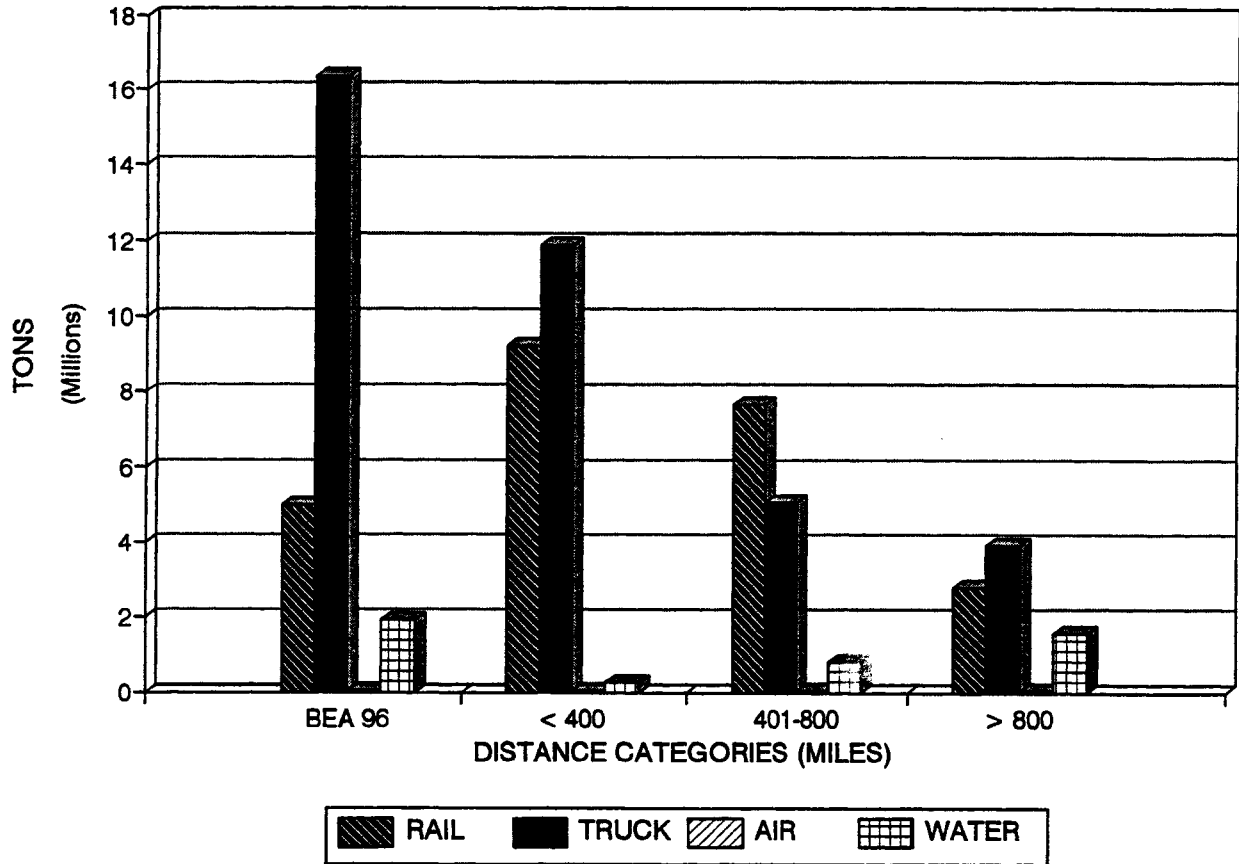


CHART 3.4 Distance Distribution of BEA 96 Inbound Flows by Tons and Mode

Inbound shipments by truck dominate for the less than 400 mile and greater than 800 mile categories. Chicago dominates as a source of inbound rail shipments in the less than 400 mile category. Water shipments into BEA 96 play a smaller role than do water shipments out of BEA 96.

BEA 96 SHIPMENTS BY DISTANCE OUTBOUND VALUE - 1990

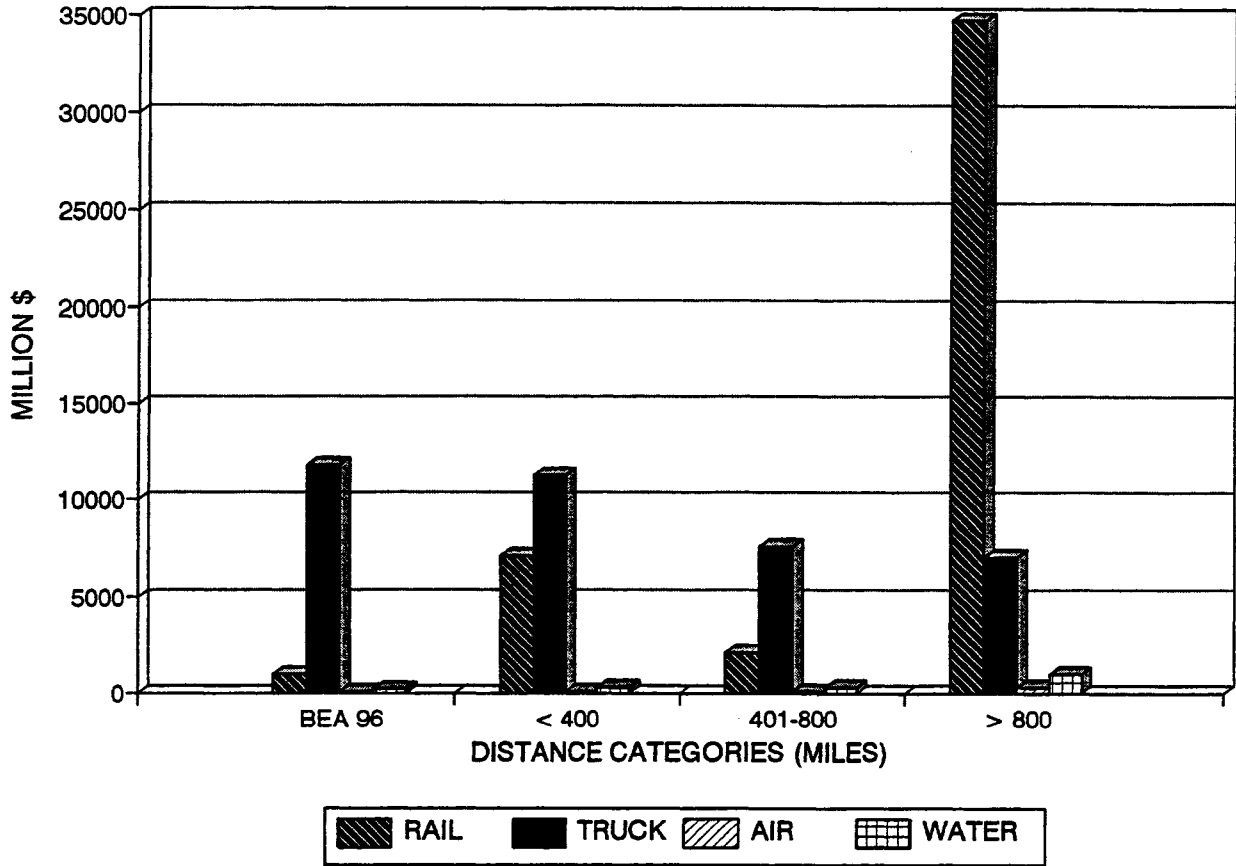


CHART 3.5 Distance Distribution of BEA 96 Outbound Flows by Value and Mode

When shipments by value are considered, trucking tends to dominate across all distance categories. The large bar for rail in the greater than 800 mile category reveals a distortion in the data where mail and small package shipments assigned to rail are valued much higher than any other commodity. Otherwise, rail shipments by value would be highest in the less than 400 mile zone, again reflecting the importance of Chicago.

BEA 96 SHIPMENTS BY DISTANCE INBOUND VALUE - 1990

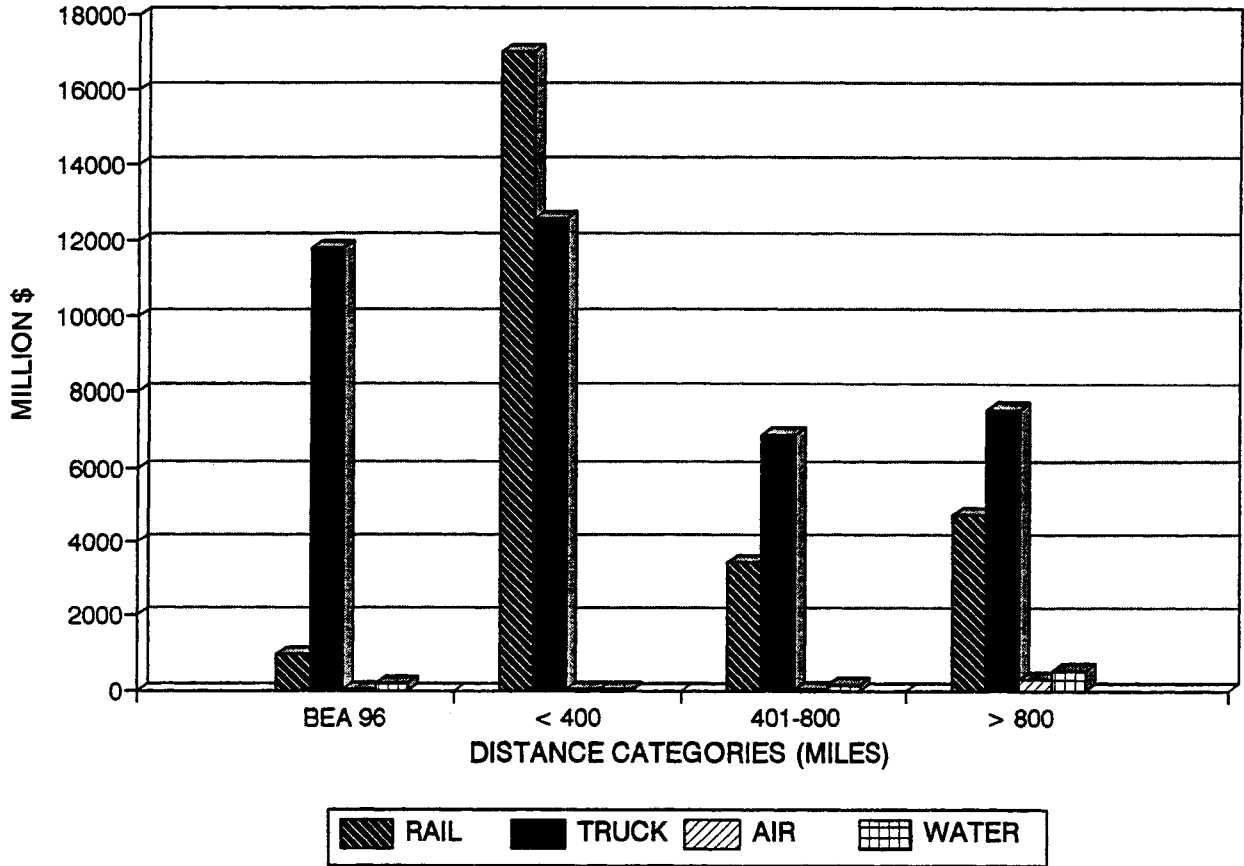


CHART 3.6 Distance Distribution of BEA 96 Inbound Flows by Value and Mode

This chart demonstrates the importance of trucking across all distance zones although rail still dominates in the less than 400 mile category (which includes Chicago). Water shipments by value are relatively small. For the greater than 800 mile zone, air transportation shipments by value begins to show up, being more than half that of water.

Rail Shipments

CHART 3.7 shows the distribution of rail shipment *tonnage* by distance for both inbound and outbound shipments. This chart demonstrates the importance of rail for moving goods in within 400 miles and out within 800 miles of the Twin Cities. CHART 3.8 shows the distribution of rail shipment *value* by distance for both inbound and outbound shipments. This again illustrates the importance of rail for Minnesota's import of goods from within 400 miles and the state's export of goods to destinations greater than 800 miles.

Truck Shipments

CHART 3.9 shows the distribution of truck shipment *tonnage* by distance for both inbound and outbound shipments. This shows that outbound truck shipments (70%) are far greater within 400 miles than longer distances, however, inbound truck shipments from greater than 400 miles are 42% of the total truck tonnage shipped. CHART 3.10 shows the distribution of truck shipment *value* by distance for both inbound and outbound shipments. The value of inbound shipments exceeds outbound shipments by 9.5%, with significant shares coming from as far away as 1200 miles.

Air Shipments

CHART 3.11 shows the distribution of air shipment *tonnage* by distance for both inbound and outbound shipments. CHART 3.12 shows the distribution of air shipment *value* by distance for both inbound and outbound shipments. Air shipments by both weight and value are predominantly from distances of 800 - 1200 miles which includes the majority of the continental U.S.

Water Shipments

CHART 3.13 shows the distribution of water shipment *tonnage* by distance for both inbound and outbound shipments. CHART 3.14 shows the distribution of water shipment *value* by distance for both inbound and outbound shipments. These suggest that while a great deal of tonnage is shipped within BEA 96 the majority of the waterways' tonnage and value is shipped to and from ports 800-1200 miles (New Orleans).

<p>For those readers making comparisons between modes using this series of charts, the reader should be aware that different vertical scales (i.e., tonnage or value) are used for each of the modes both outbound and inbound.</p>

BEA 96 RAIL SHIPMENTS BY DISTANCE TONNAGE - 1990

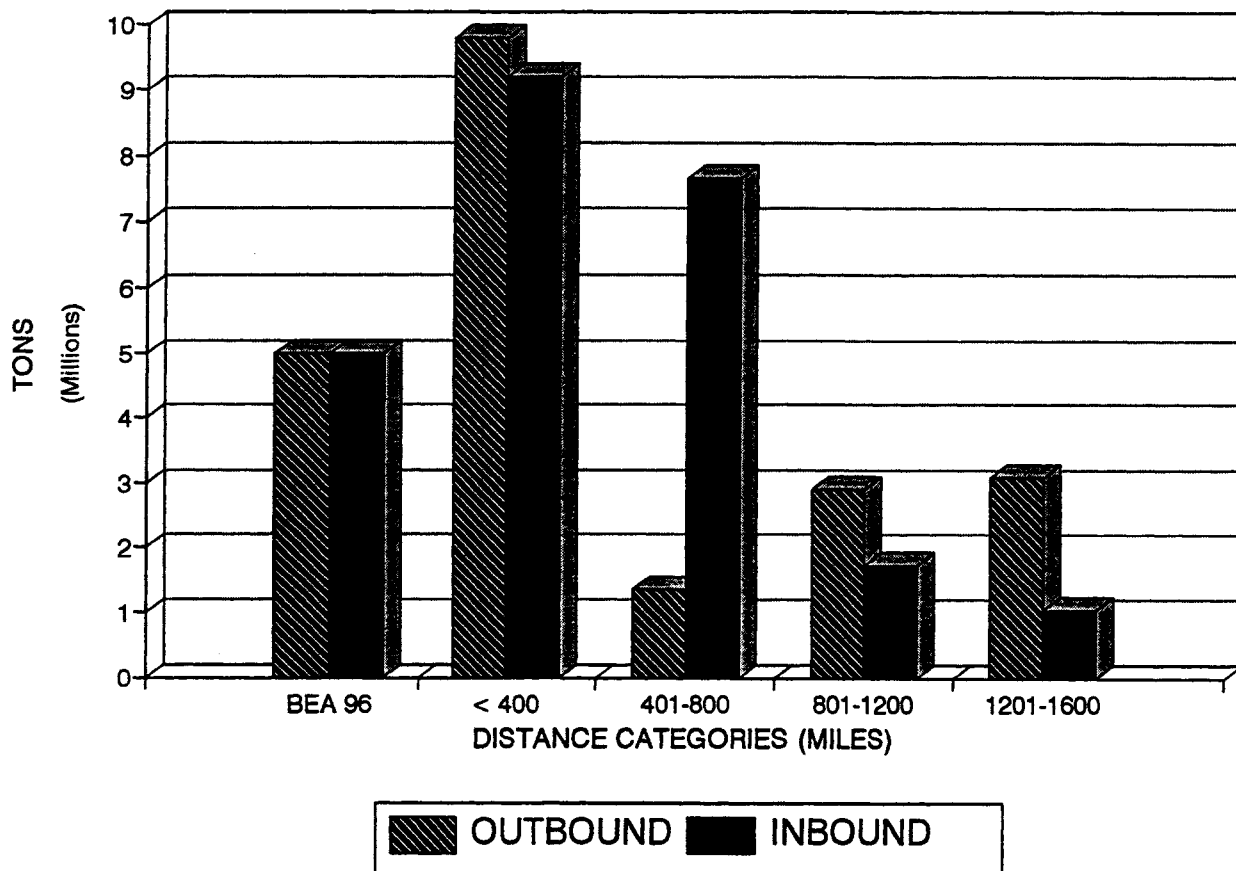


CHART 3.7 Distance Distribution of BEA 96 Flows by Tons and Rail

This chart shows both outbound and inbound flows by rail tonnage only. The BEA 96 bars are the same height reflecting simply that shipments to and from locations within the region are equal. Rail shipments within the 400 mile zone are nearly identical, while for the 401-800 mile zone, inbound rail movements dominate. This likely reflects shipments of motor vehicles from Detroit and other Great Lakes manufacturing centers. Outbound shipments dominate for the longer distance categories reflecting primarily grain movement to ocean ports.

BEA 96 RAIL SHIPMENTS BY DISTANCE \$ VALUE - 1990

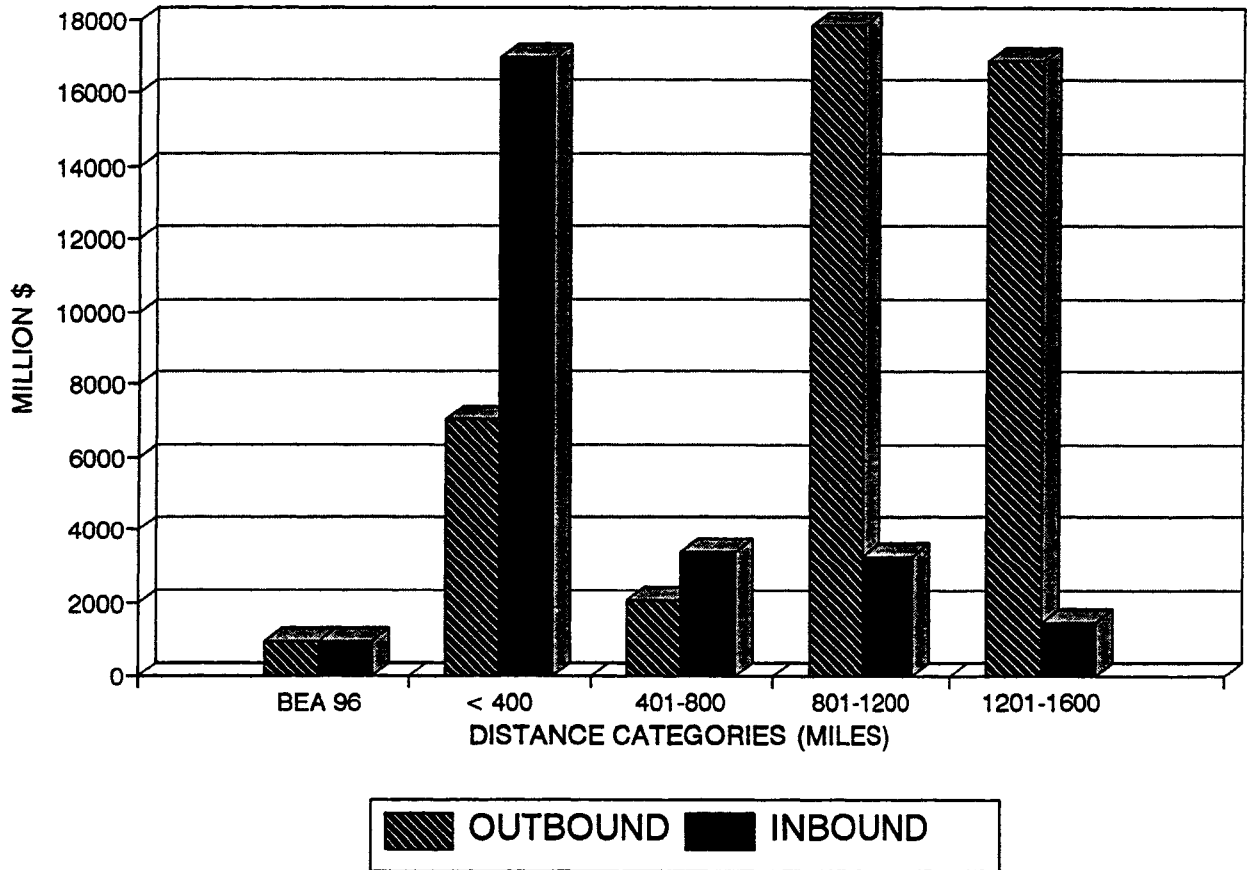


CHART 3.8 Distance Distribution of BEA 96 Flows by Value and Rail

When rail shipments by value are considered, the internal BEA 96 flows become only a small part of the total. Rail shipments from the less than 400 mile zone, primarily Chicago, dominate inbound flows with outbound flows for the greater distances dominating. This again reflects to some extent the distortion in rail data created by the artificially high value of mail and small package shipments.

BEA 96 TRUCK SHIPMENTS BY DISTANCE TONNAGE - 1990

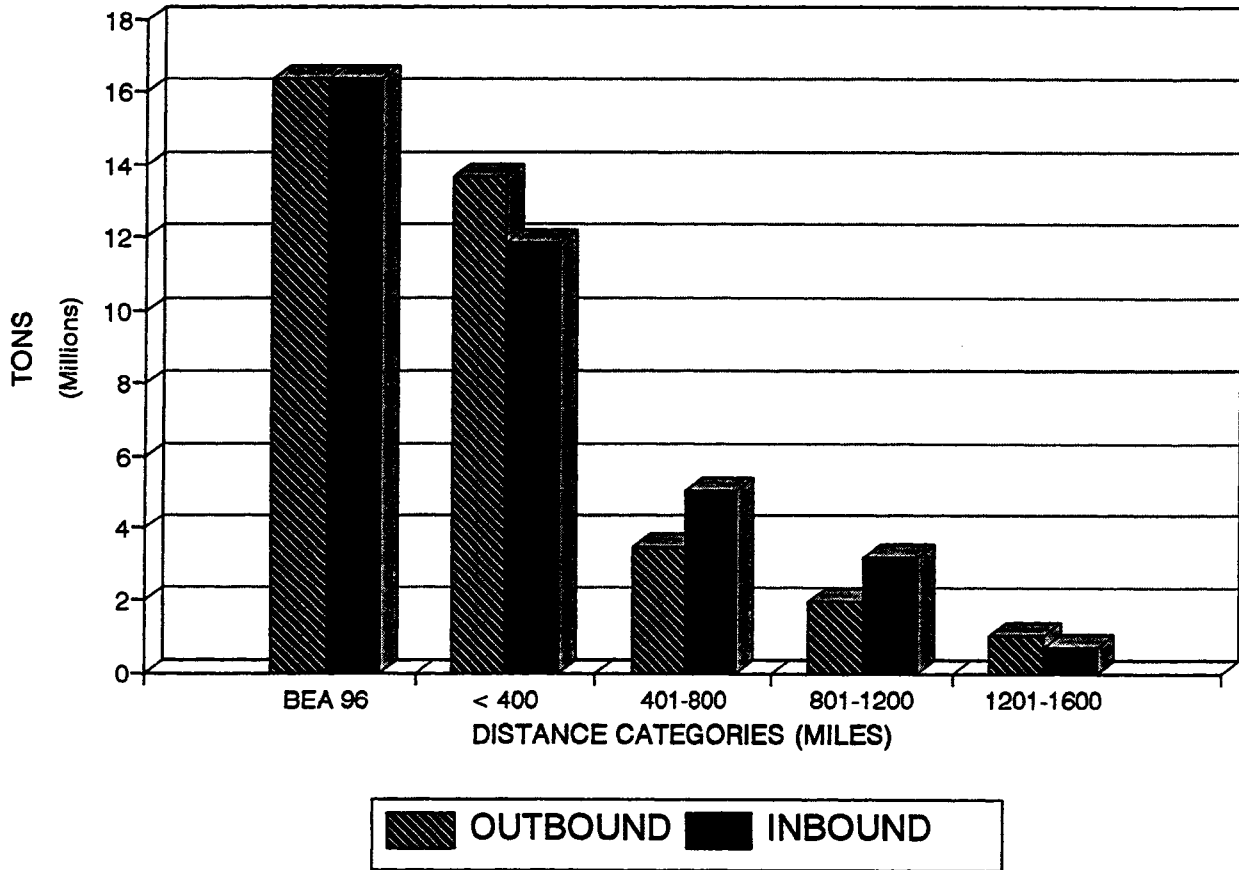


CHART 3.9 Distance Distribution of BEA 96 Flows by Tons and Truck

Truck shipments by tonnage within BEA 96 are significant reflecting the important distributional role of trucks within the region. However, both outbound and inbound shipments by weight drop off rapidly beyond 400 miles, with trucks playing only a minor role in tonnage in the over 1200 mile zone.

BEA 96 TRUCK SHIPMENTS BY DISTANCE \$ VALUE - 1990

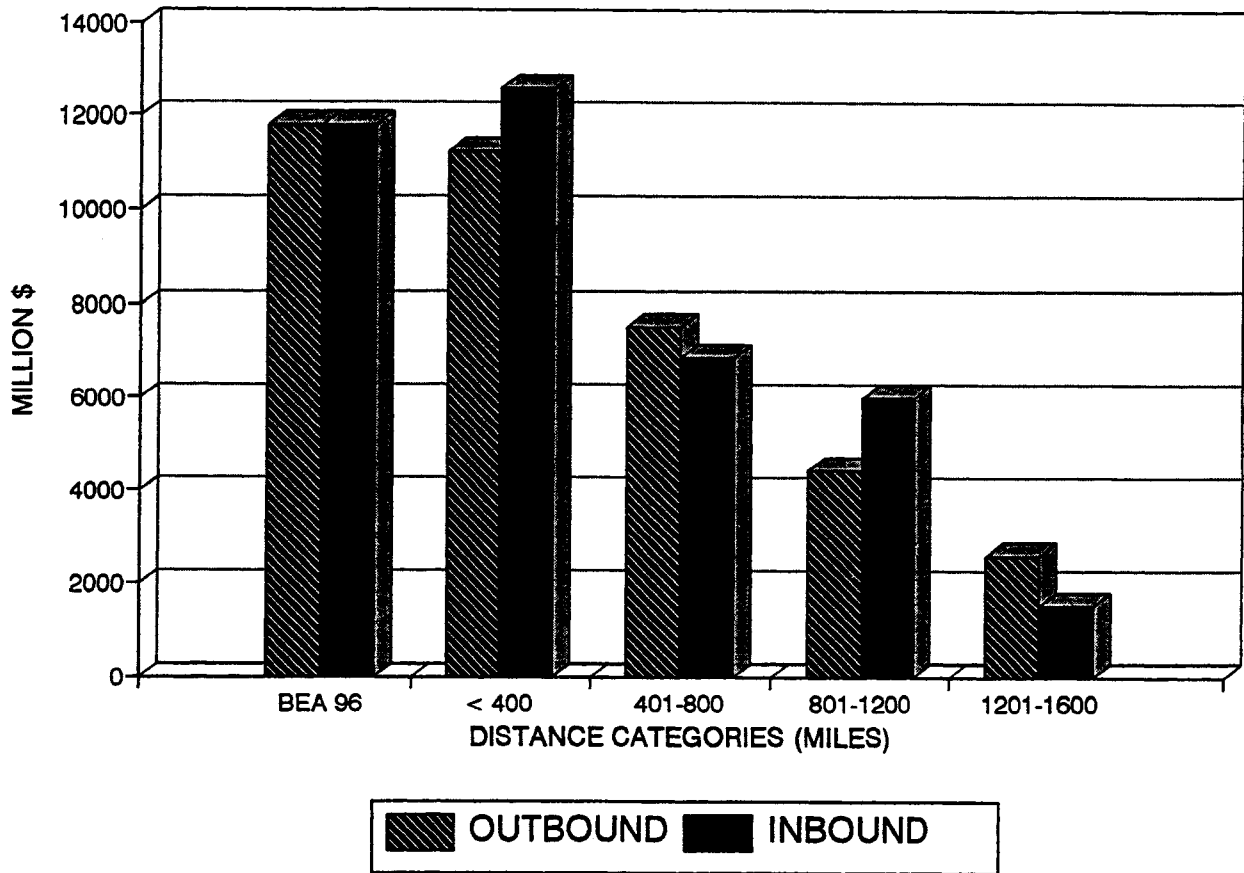


CHART 3.10 Distance Distribution of BEA 96 Flows by Value and Truck

The picture does not change significantly when truck shipments by value are considered. Trucks do play a larger role, however, for longer distance shipments when value is taken into account.

BEA 96 AIR SHIPMENTS BY DISTANCE TONNAGE - 1990

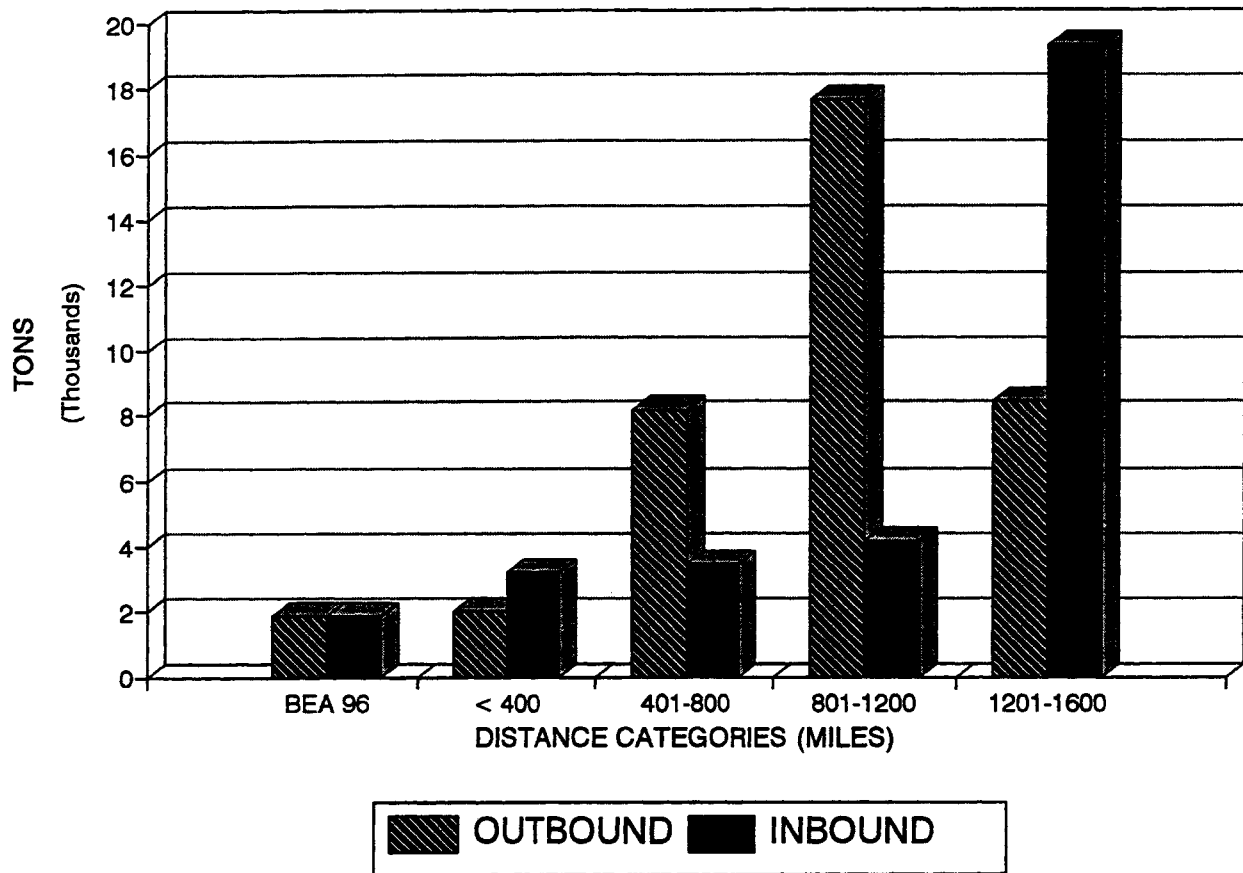


CHART 3.11 Distance Distribution of BEA 96 Flows by Tons and Air

The role of air transportation as a long-distance hauler of freight is clearly seen in this chart. While some outbound tonnage occurs less than 800 miles, major shipments are for distances greater than 800 miles. Outbound dominates between 801 and 1200 miles while inbound dominates between 1201 and 1600 miles. The 801 - 1200 mile zone includes most of the Atlantic and Gulf states which represent major manufacturing areas within the United States.

BEA 96 AIR SHIPMENTS BY DISTANCE
\$ VALUE - 1990

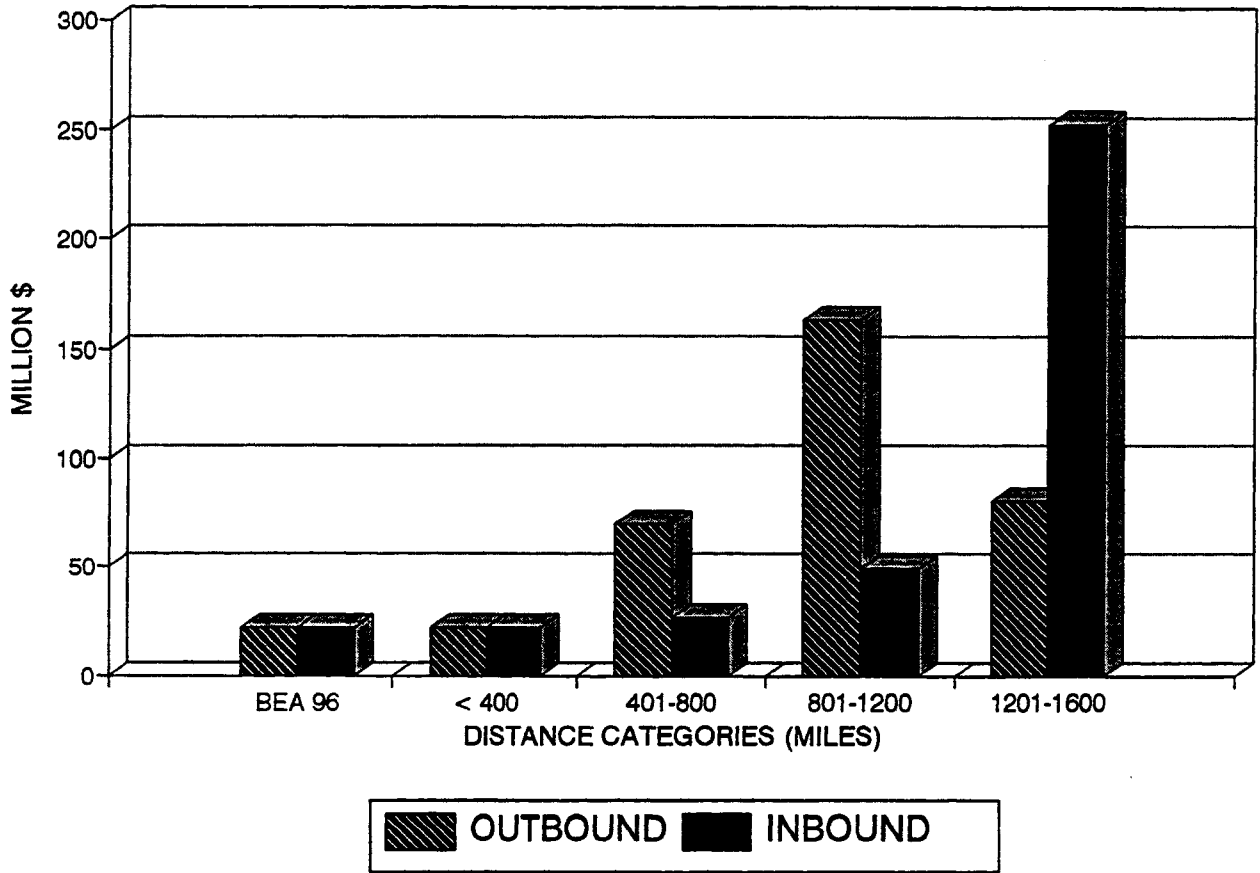


CHART 3.12 Distance Distribution of BEA 96 Flows by Value and Air

As with trucking, the picture does not change significantly when shipments by value are considered. The importance of the regions greater than 800 miles for air shipments can still be clearly seen.

BEA 96 WATER SHIPMENTS BY DISTANCE TONNAGE - 1990

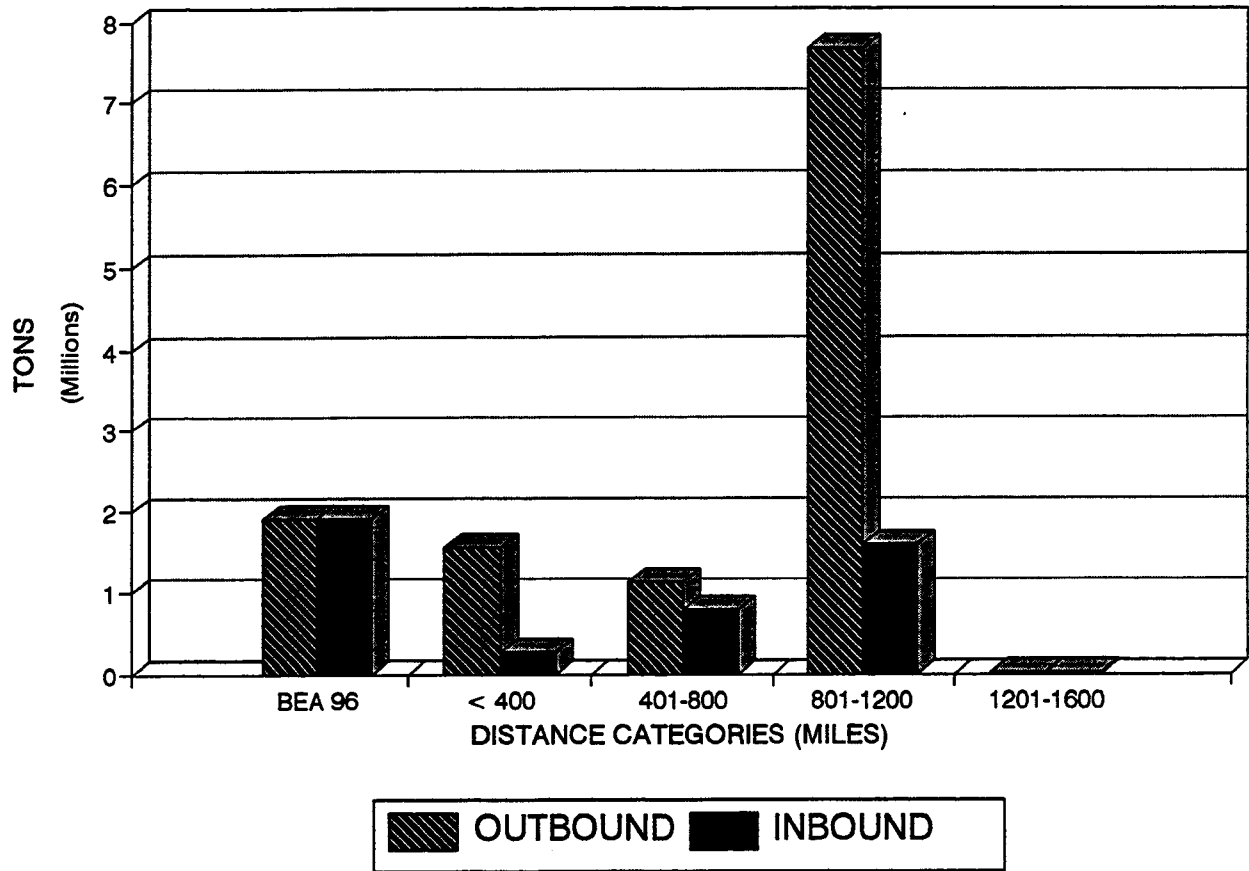


CHART 3.13 Distance Distribution of BEA 96 Flows by Tons and Water

BEA 96 shipments represent the movement of coal and sand and gravel within the region. Some shipments of bulk commodities to other locations on the inland waterway system account for some outbound volume for distances less than 800 miles. The dominant movement is outbound and greater than 800 miles reflecting the major grain movement to New Orleans.

BEA 96 WATER SHIPMENTS BY DISTANCE \$ VALUE - 1990

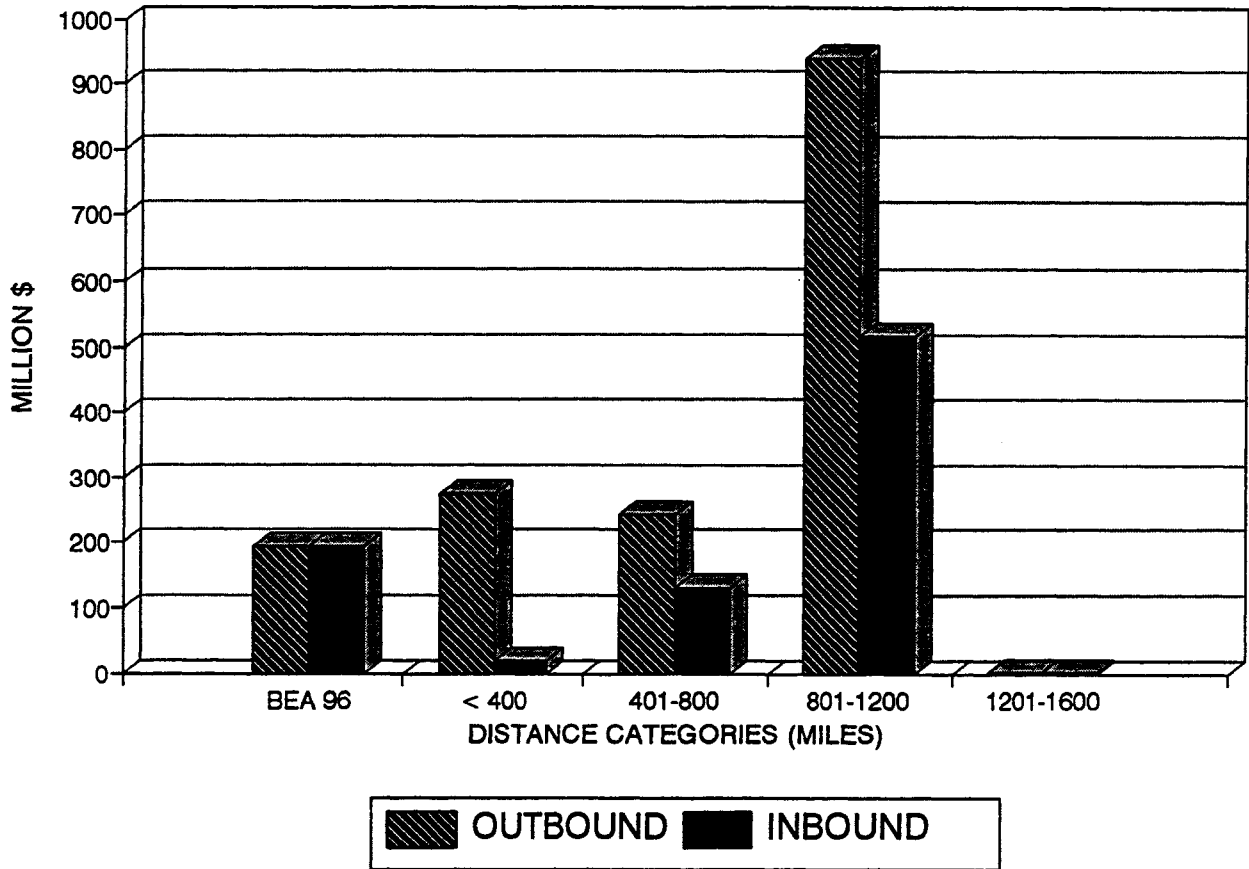


CHART 3.14 Distance Distribution of BEA 96 Flows by Value and Water

When value is considered, inbound shipments in 801 to 1200 mile zone are more important than when only weight is considered. This likely reflects inbound chemicals and fertilizers from the Gulf Region.

4.0 FREIGHT FLOWS BY MODE

4.1 Commodity Descriptions and Definitions

In this report 2-digit classification codes are used. The STCC (Standard Transportation Commodity Classification) is used primarily by the railroad industry and is the classification used in the Reebie data base. However, at the 2-digit level, this classification is virtually identical to the 2-digit SIC (Standard Industry Classification) of commodities and industries which is used in the reporting of foreign exports and in regional economic analysis. The 2-digit classification used in this report is presented in TABLE 4.1.

TABLE 4.1

2-DIGIT COMMODITY CLASSIFICATION

STCC/SIC	COMMODITY CLASSIFICATION
01	Farm products
09	Fresh fish/marine products
10	Metallic ores
11	Coal
13	Crude petrol/natural gas
14	Nonmetallic minerals
20	Food/kindred products
21	Tobacco/products
22	Textile mill products
23	Apparel/related products
24	Lumber/wood products
25	Furniture/fixtures
26	Pulp, paper, allied products
27	Printed matter
28	Chemicals/allied products
29	Petrol/coal products
30	Rubber/plastics
31	Leather/leather products
32	Clay/concrete/glass/stone
33	Primary metal products
34	Fabricated metal products
35	Non-Electrical Machinery (incl. computers)
36	Electrical equipment
37	Transportation equipment
38	Instruments/photo/optical
39	Misc manufacturing
STCC	NON-SIC CLASSIFICATIONS
40	Waste/scrap materials
41	Misc freight shipments
42	Shipping containers
43	Mail/contract traffic
45	Shipper association traffic
46	Misc mixed shipments

4.2 Modal Distribution of Commodity Flows

TABLE 4.2 shows commodity flows by mode into and out of Minnesota by tonnage (1000 tons). The railroad and truck modes are aggregated into "Rail" (carload plus intermodal) and "Truck" (TL plus LTL plus Private Truck). TABLE 4.3 shows commodity flows by mode into and out of Minnesota by value (million \$). The tons to value conversion was based upon 4-digit value per pound data for 1990 also provided by Reebie Associates. Values for the 2-digit classification were developed using 4-digit data for BEA 96 from the year 1988 that was obtained earlier by Mn/DOT. Therefore, some error in the tons to value conversion can be expected although the 4-digit data cannot be confirmed. However, the shipments by value are important since they reveal different shipping patterns that would be observed if tonnage alone is used.

The four classifications shown in the TABLE 4.2 and TABLE 4.3 are Rail (carload plus intermodal), Truck (TL plus LTL plus Private Truck), Air and Water.

TABLE 4.2

COMMODITY FLOWS BY MODE INTO AND OUT OF MINNESOTA
1990 COMMODITY TRAFFIC IN 1000 TONS

STCC	COMMODITY	INBOUND BY TONNAGE 000				OUTBOUND BY TONNAGE 000				TOTAL
		RAIL	TRUCK	AIR	WATER	RAIL	TRUCK	AIR	WATER	
01	Farm products	6103.52	521.56	0.00	57.25	6682.33	11754.82	131.37	8622.17	20508.36
09	Fresh fish/marine products	0.00	0.00	0.00	31.28	31.28	0.00	0.00	0.01	0.01
10	Metallic ores	0.61	0.00	0.00	12.20	12.81	19472.44	0.00	30259.16	49731.60
11	Coal	11948.48	15.00	0.00	581.43	12544.91	1445.28	0.00	656.61	2101.90
13	Crude petrol/natural gas	0.00	0.00	0.00	0.12	0.12	0.00	0.00	0.00	0.00
14	Nonmetallic minerals	252.16	0.00	0.00	3133.20	3385.37	1560.89	0.00	192.84	1753.72
20	Food/kindred products	866.96	7864.07	3.35	50.49	8784.86	3707.71	9827.04	298.97	13833.77
21	Tobacco/products	0.00	1.25	0.00	0.00	1.25	0.00	0.01	0.00	0.01
22	Textile mill products	1.24	87.52	0.09	0.82	89.67	0.00	7.00	0.00	7.00
23	Apparel/related products	0.00	61.97	0.54	0.00	62.51	0.00	30.32	0.00	30.38
24	Lumber/wood products	629.92	2027.82	0.06	6.60	2664.40	990.73	1761.35	0.12	2752.21
25	Furniture/fixtures	15.25	138.36	0.25	0.00	153.86	0.00	131.70	0.00	131.70
26	Pulp, paper, allied products	720.51	796.10	0.09	0.53	1517.24	888.23	1002.27	0.00	1890.98
27	Printed matter	0.00	246.04	1.56	0.00	247.61	0.00	248.94	0.00	259.80
28	Chemicals/allied products	1340.29	1978.26	0.94	327.50	3646.99	1066.07	2314.14	304.46	3684.91
29	Petrol/coal products	378.29	945.06	0.00	207.31	1530.65	383.86	2669.79	1114.80	4168.45
30	Rubber/plastics	16.27	631.13	0.34	0.00	647.73	1.50	424.75	0.00	427.05
31	Leather/leather products	0.00	27.86	0.00	0.00	27.86	0.00	3.57	0.00	3.57
32	Clay/concrete/glass/stone	1516.73	4602.80	0.48	367.87	6487.88	2.84	1317.26	41.08	1361.20
33	Primary metal products	364.48	976.15	0.16	68.91	1409.70	172.55	573.99	0.14	746.68
34	Fabricated metal products	0.21	628.17	1.66	0.00	630.04	2.59	578.63	3.64	584.86
35	Machinery	4.49	522.93	5.26	0.00	532.67	2.62	526.48	16.03	545.13
36	Electrical equipment	8.93	360.46	17.68	0.00	387.07	29.23	268.17	3.52	300.91
37	Transportation equipment	623.90	260.04	2.79	0.00	886.73	289.15	157.11	0.00	447.39
38	Instruments/photo/optical	0.00	45.27	1.54	0.00	46.81	0.00	75.35	0.32	75.67
39	Misc manufacturing	0.00	67.54	0.12	0.00	67.66	0.00	77.51	0.38	77.89
40	Waste/scrap materials	105.93	0.00	0.00	7.14	113.07	454.93	0.00	71.64	526.58
41	Misc freight shipments	1.60	0.00	0.00	0.00	1.60	0.00	0.00	0.00	0.29
42	Shipping containers	99.38	0.00	0.00	0.00	99.38	38.30	0.00	0.00	38.30
43	Mail/contract traffic	37.61	0.00	0.00	0.00	37.61	87.92	0.00	0.00	87.92
45	Shipper association traffic	2.91	0.00	0.00	0.00	2.91	0.00	0.00	0.00	0.00
46	Misc mixed shipments	680.59	0.00	0.00	0.00	680.59	904.54	0.00	0.00	904.54
	Totals	25720.26	22805.36	36.91	4852.65	53415.17	43256.20	22126.75	36.53	41563.28
										106982.78

TABLE 4.3
 COMMODITY FLOWS BY MODE INTO AND OUT OF MINNESOTA
 1990 COMMODITY TRAFFIC IN MILLION \$

STCC	COMMODITY	INBOUND BY VALUE (MILLION \$)				OUTBOUND BY VALUE (MILLION \$)				TOTAL	
		RAIL	TRUCK	AIR	WATER	TOTAL	RAIL	TRUCK	AIR		WATER
1	Farm products	708.01	60.50	0.00	6.64	775.15	1293.03	14.45	0.00	948.44	2255.92
9	Fresh fish/marine products	0.00	0.00	0.00	176.27	176.27	0.00	0.00	0.00	0.06	0.06
10	Metallic ores	0.02	0.00	0.00	0.32	0.33	506.28	0.00	0.00	786.74	1293.02
11	Coal	334.56	0.42	0.00	16.28	351.26	40.47	0.00	0.00	18.39	58.85
14	Nonmetallic minerals	3.53	0.00	0.00	43.86	47.40	34.34	0.00	0.00	4.24	38.58
20	Food/kindred products	584.33	5300.38	2.26	34.03	5921.00	2209.79	5856.92	0.03	178.19	8244.93
21	Tobacco/products	0.00	34.43	0.00	0.00	34.43	0.00	0.41	0.00	0.00	0.41
22	Textile mill products	4.18	294.08	0.29	2.74	301.29	0.00	20.20	0.00	0.00	20.20
23	Apparel/related products	0.00	653.68	5.66	0.00	659.34	0.00	298.62	0.60	0.00	299.22
24	Lumber/wood products	156.22	502.90	0.02	1.64	660.77	396.29	704.54	0.00	0.05	1100.88
25	Furniture/fixtures	61.51	558.14	1.02	0.00	620.66	0.00	504.13	0.00	0.00	504.13
26	Pulp, paper, allied products	670.08	740.38	0.09	0.49	1411.03	1001.92	1130.56	0.55	0.00	2133.03
27	Printed matter	0.00	1404.91	8.93	0.00	1413.84	0.00	1430.92	62.41	0.00	1493.33
28	Chemicals/allied products	1192.86	1760.65	0.83	291.47	3245.82	889.10	1929.99	0.20	253.92	3073.21
29	Petrol/coal products	52.20	130.42	0.00	28.61	211.23	51.44	357.75	0.00	149.38	558.57
30	Rubber/plastics	53.09	2060.01	1.10	0.00	2114.20	4.92	1388.09	2.58	0.00	1395.59
31	Leather/leather products	0.00	337.24	0.02	0.00	337.26	0.00	42.19	0.00	0.00	42.19
32	Clay/concrete/glass/stone	169.87	515.51	0.05	41.20	726.64	0.24	113.28	0.00	3.53	117.06
33	Primary metal products	351.36	941.01	0.16	66.43	1358.95	216.04	718.64	0.17	0.00	934.85
34	Fabricated metal products	0.51	1502.58	3.98	0.00	1507.06	5.77	1289.19	8.11	0.00	1303.07
35	Machinery	39.30	4578.75	46.04	0.00	4664.08	33.47	6725.27	204.75	0.00	6963.49
36	Electrical equipment	142.63	5757.97	282.50	0.00	6183.10	412.35	3783.27	49.60	0.00	4245.22
37	Transportation equipment	2898.64	1208.14	12.99	0.00	4119.77	1412.20	767.34	0.00	5.52	2185.06
38	Instruments/photo/optical	0.00	914.74	31.18	0.00	945.92	0.00	1821.31	7.76	0.00	1829.07
39	Misc manufacturing	0.00	436.58	0.79	0.00	437.37	0.00	475.12	2.35	0.00	477.47
40	Waste/scrap materials	51.48	0.00	0.00	3.47	54.95	310.26	0.00	0.00	48.86	359.12
41	Misc freight shipments	2.65	0.00	0.00	0.00	2.65	0.00	0.00	0.00	0.49	0.49
42	Shipping containers	246.07	0.00	0.00	0.00	246.07	95.05	0.00	0.00	0.00	95.05
43	Mail/contract traffic	13743.92	0.00	0.00	0.00	13743.92	32129.44	0.00	0.00	0.00	32129.44
46	Misc mixed shipments	4133.89	0.00	0.00	0.00	4133.89	5499.60	0.00	0.00	0.00	5499.60
	Totals	25600.91	29693.42	397.91	713.45	56405.65	46542.00	29372.19	339.11	2397.81	78651.11

These data are ranked by weight and value to show the major commodity groups shipped into and out of Minnesota (BEA 96). CHART 4.1 shows that the largest outbound shipments by weight are Farm Products (1). Because these are typically low value, bulk commodities they are shipped primarily by rail and water. The second largest commodity group shipped out of Minnesota is Food Products (20) which goes by truck and rail. Truck is the major mode for most of the other top ranked commodities including Petrol (29), Chemicals (28), Lumber and wood (24), Pulp and Paper (26), Clay Concrete, Glass and Stone (32) and all other commodities (99). Coal, while among the top commodities shipped out of Minnesota, is shipped primarily by rail and water.

All other commodities (99) is a 2-digit classification used in this report only and does not refer to any other Department of Commerce classification.

CHART 4.2 shows that Coal is the major commodity shipped into Minnesota, almost exclusively by rail. Rail also handles most of the third largest commodity shipped in, Farm Products (1), almost half of the Pulp and Paper Products (26) and a smaller share of all the other commodities shipped in. Waterways handle the majority of the non-metallic minerals (such as clays and potash) (14), and some of the coal (11), Clay, Concrete, Glass and Stone (32), Chemicals (28) and Petrol Products (29) shipped in. Truck handles the majority of the other major commodities shipped in -- Food Products (20), Clay, Concrete, Glass and Stone (32), Chemicals (28), Lumber and Wood Products (24), Petrol Products (29), Pulp and Paper (26) and all other commodities (99).

**MN OUTBOUND SHIPMENTS (excl. IRON ORE)
MODE - RANKED BY TONNAGE 1990**

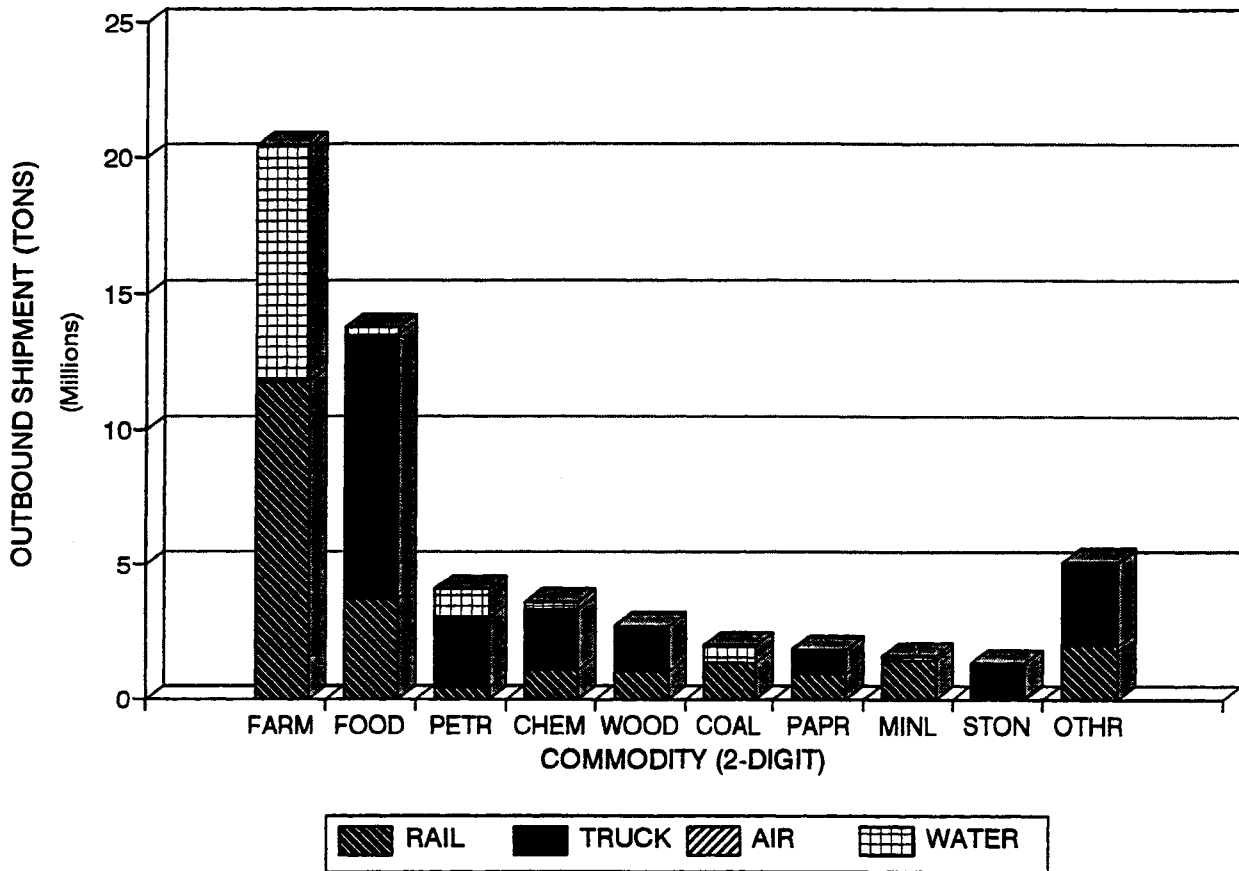


CHART 4.1 Minnesota Outbound Flows by Mode Ranked by Commodity Tonnage

This chart shows the top nine plus all other commodities by tonnage outbound from Minnesota.. Shipments of iron ore are excluded since that tonnage is more than twice that of farm shipments (50 million tons). Those shipments are all by water from Lake Superior ports and would mask other commodity detail if included on the chart. The commodities shown on the chart with their STCC classification are Farm Products (1), Food Products (20), Petroleum Products (29), Chemicals (28), Wood Products (24), Coal (11), Paper (26), Non-industrial Minerals (14), Clay/Stone (32) and Other (99). This chart shows Farm Products as the largest outbound commodity by weight when iron ore shipments from the state are excluded. Because of their relatively low value, rail and water are the dominant modes. Food Products comprise the second largest outbound shipments from the state with truck carrying the largest percentage. Petroleum Refining products, Chemicals and Wood make up the next most important categories being carried to a large extent by truck. Coal and non-industrial mineral shipments are carried primarily by rail and water.

MN INBOUND SHIPMENTS MODE - RANKED BY TONNAGE 1990

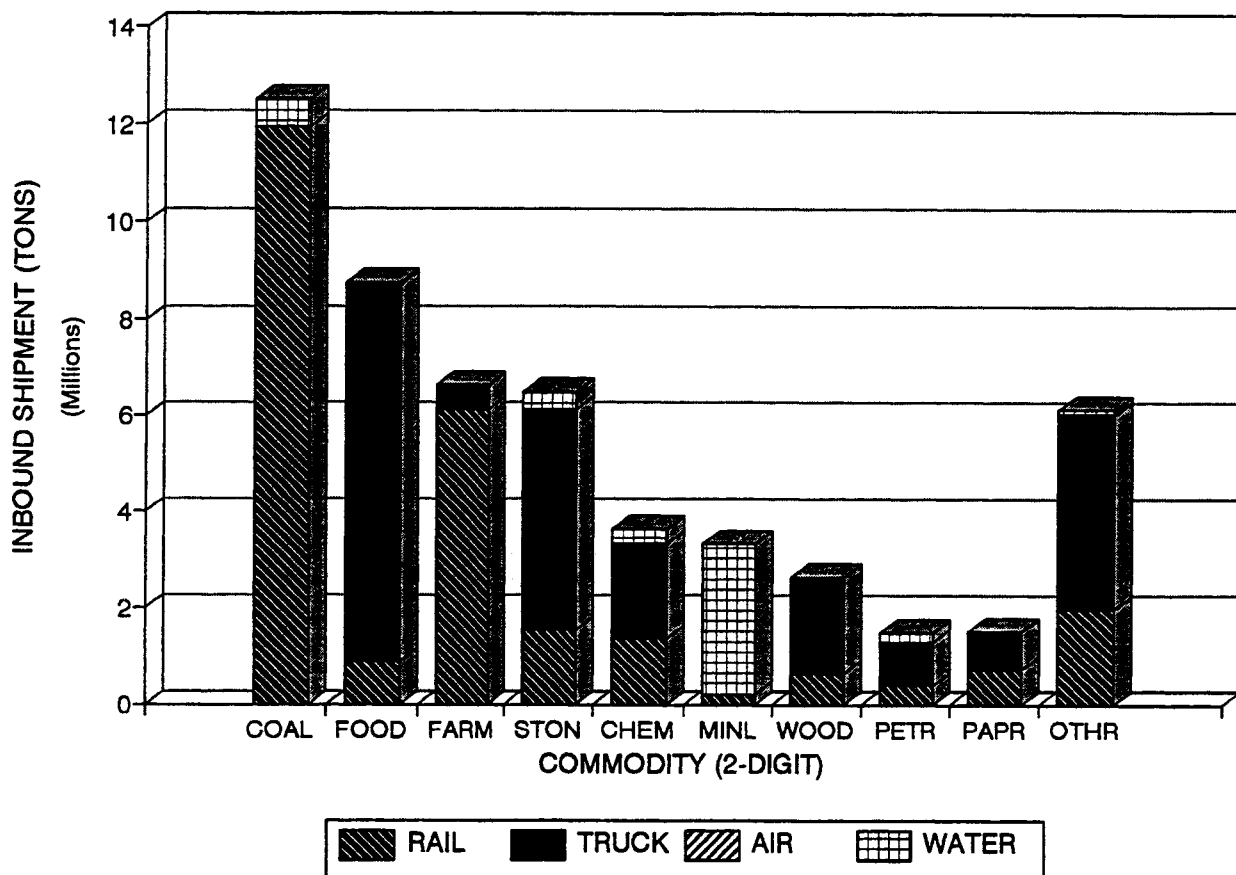


CHART 4.2 Minnesota Inbound Flows by Mode Ranked by Commodity Tonnage

This chart shows the top nine plus all other commodities by tonnage inbound into Minnesota. Shipments of iron ore are not excluded since inbound tonnage is insignificant. The commodities shown on the chart with their STCC classification are Coal (11), Food Products (20), Farm Products (1), Stone/Clay (32), Chemicals (28), Non-industrial Minerals (14), Wood Products (24), Petroleum Products (29), Paper (26) and Other (99). This chart shows the predominant movement of coal into the state, although approximately half of this is reshipped to Superior. Rail also accounts for much of the Farm Products that are shipped into the state. The dominance of trucks for bringing finished Food Products into the state can be clearly seen. The dominance of water for non-industrial minerals such as clay and potash can also be seen. Trucks bring a wide variety of other products into the state which accounts for the large "Other" bar at the right side of the chart.

CHART 4.3 illustrates the modal split of major outbound commodities by their dollar value. Truck handles the majority of Food (20), Machinery (35), Electrical Equipment (36), Chemicals (28), Pulp and Paper (26), Instruments (38) and All other commodities (99) and a portion of Transportation Equipment (37). Rail has the majority of Mixed Shipments (46), Farm Products (1) and Transportation Equipment (37).

CHART 4.4 shows the major commodities shipped into BEA 96 ranked by dollar value. The top three commodities, Electrical Equipment (36), Food Products (20) and Machinery (35) are shipped in primarily by truck. The third and fourth highest value commodity groups, Mixed Shipments (46), and Transportation Equipment (37) are shipped primarily by rail. Chemicals (28) are shipped in by truck, rail and water. Truck ships in all of the Rubber and Plastic Products (30), Fabricated Metals (34) and Printed Matter (27). The remaining value of shipments into BEA 96 are shipped by truck and rail with some by water and air.

MN OUTBOUND SHIPMENTS (excl. MAIL)
MODE - RANKED BY VALUE 1990

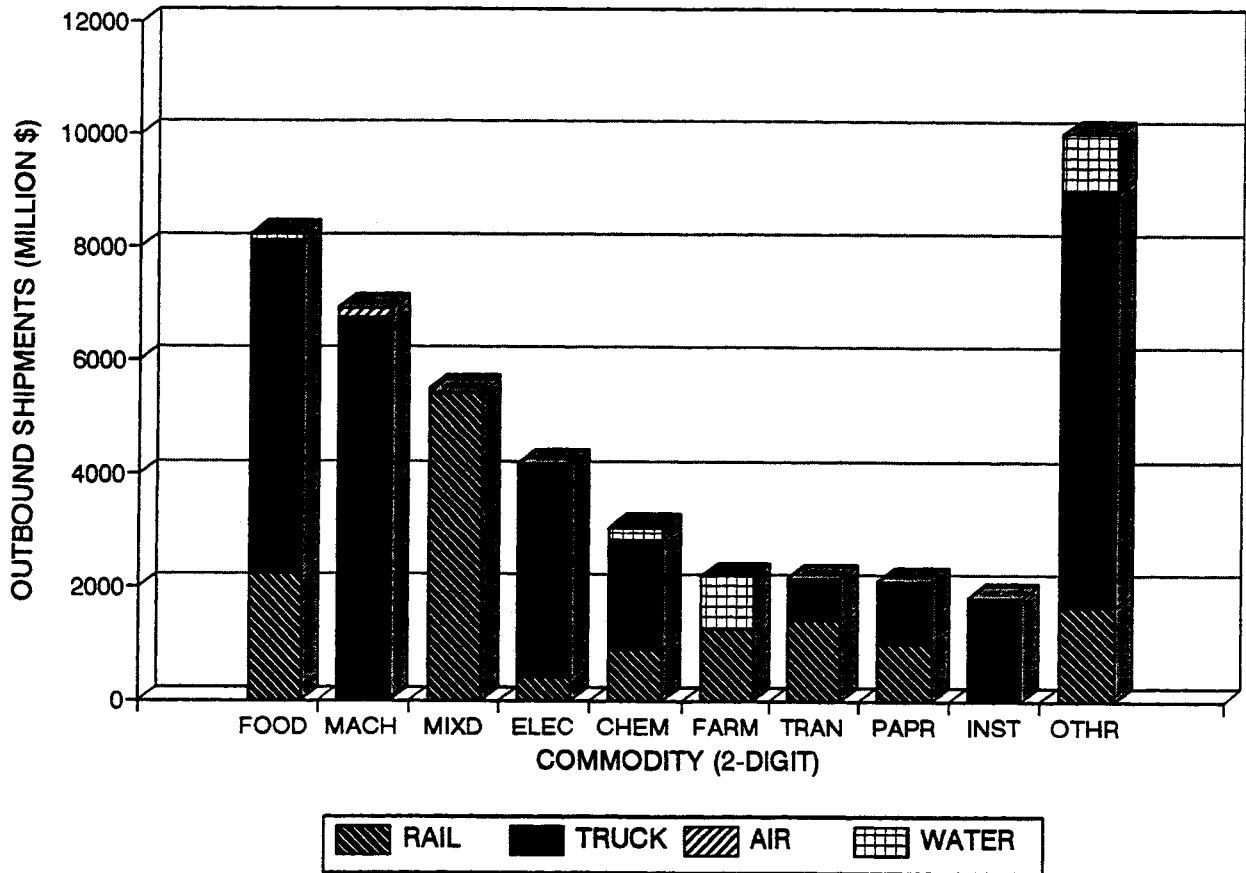


CHART 4.3 Minnesota Outbound Flows by Mode Ranked by Commodity Value

This chart shows the top nine plus all other commodities by value outbound from Minnesota. Shipments of mail by rail are excluded since that high value distorts the overall picture. The commodities shown on the chart with their STCC classification are Food Products (20), Non-electrical Machinery/computers (35), Mixed Shipments/intermodal (46), Electrical Equipment (36), Chemicals (28), Farm Products (1), Transportation Equipment (37), Paper Products (26), Instruments (38), and Other (99). When shipments by value are considered, the role of truck becomes more important. Except for Mixed Shipments (intermodal), Farm Products, Transportation Equipment and Paper, Trucking dominates outbound shipments by value.

**MN INBOUND SHIPMENTS (excl. MAIL)
MODE - RANKED BY VALUE 1990**

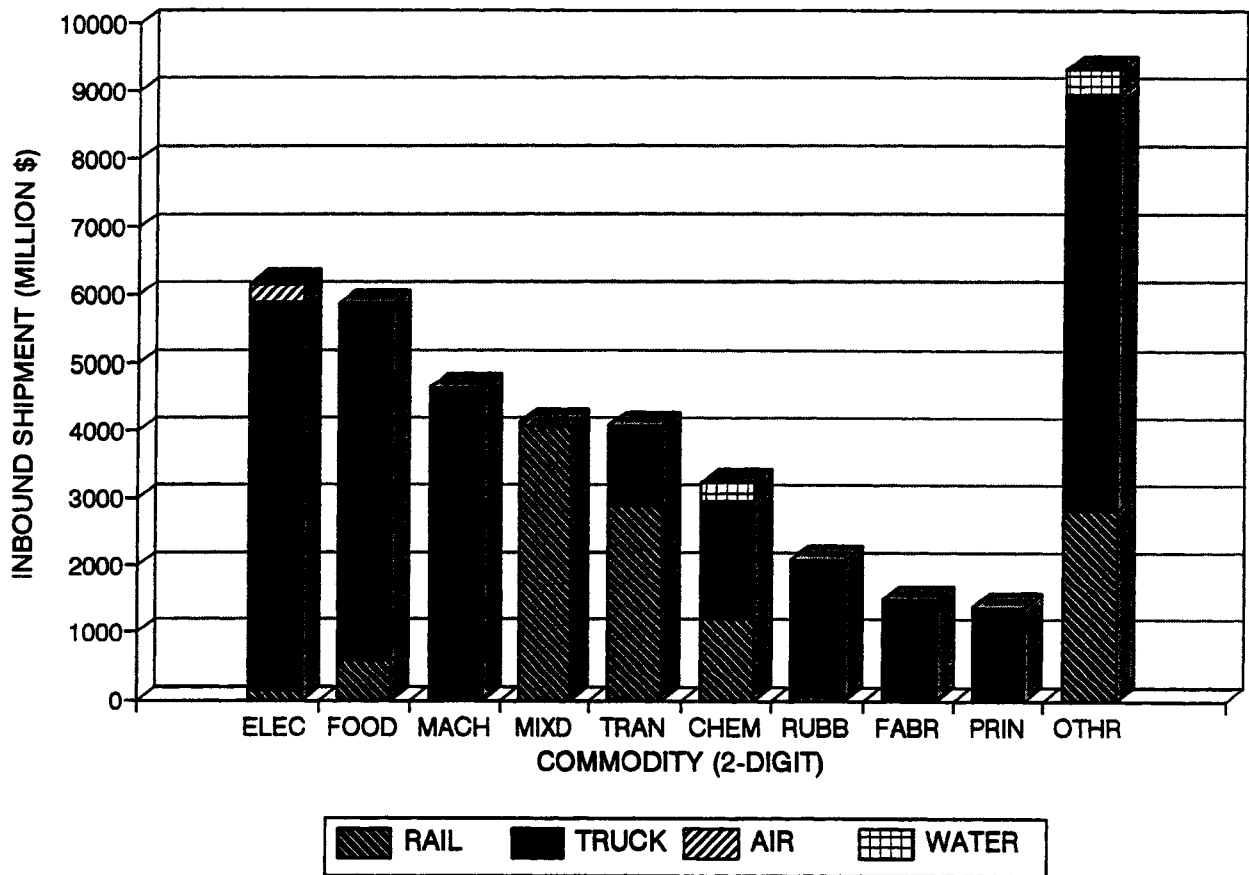


CHART 4.4 Minnesota Inbound Flows by Mode Ranked by Commodity Value

This chart shows the top nine plus all other commodities by value inbound into Minnesota. The commodities shown on the chart with their STCC classification are Electrical Equipment (36), Food Products (20), Non-electrical Machinery (35), Mixed Shipment (46), Transportation Equipment (37), Chemicals (28), Rubber/Plastics (30), Fabricated Metal (34), Printing/Publishing (27), and Other (99). The three largest inbound commodity groups (Electrical Equipment, Food Products, and Machinery (including computers) are completely dominated by truck. The next two high value commodities, Mixed Shipments (trailers on flat cars and containers) and Transportation Equipment are dominated by rail. Trucking also accounts for most of the Other Category (99).

4.3 Commodity Flows by Rail

CHART 4.5 and CHART 4.6 show the top 10 commodities by tonnage shipped by rail carload from and to BEA 96. CHART 4.7 and CHART 4.8 show the top 10 commodities by tonnage shipped by rail intermodal from and to BEA 96. These and the following charts show the relative importance of commodities carried by each of the modes out of and into BEA 96. It can generally be seen that in many cases only one to five commodities dominate shipments within each mode. These charts are intended to provide an overview of modal movements of commodities by tonnage. More specific data can be found in TABLE 4.2.

4.4 Commodity Flows by Truck

CHART 4.9 and CHART 4.10 show the top 10 commodities by tonnage shipped by truckload from and to BEA 96. CHART 4.11 and CHART 4.12 show the top 10 commodities by tonnage shipped by LTL from and to BEA 96. CHART 4.13 and CHART 4.14 show the top 10 commodities by tonnage shipped by Private Truck from and to BEA 96.

4.5 Commodity Flows by Air

CHART 4.15 and CHART 4.16 show the top 10 commodities by tonnage shipped by air from and to BEA 96.

4.6 Commodity Flows by Water

CHART 4.17 and CHART 4.18 show the top 10 commodities by tonnage shipped by water from and to BEA 96.

CARLOAD SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

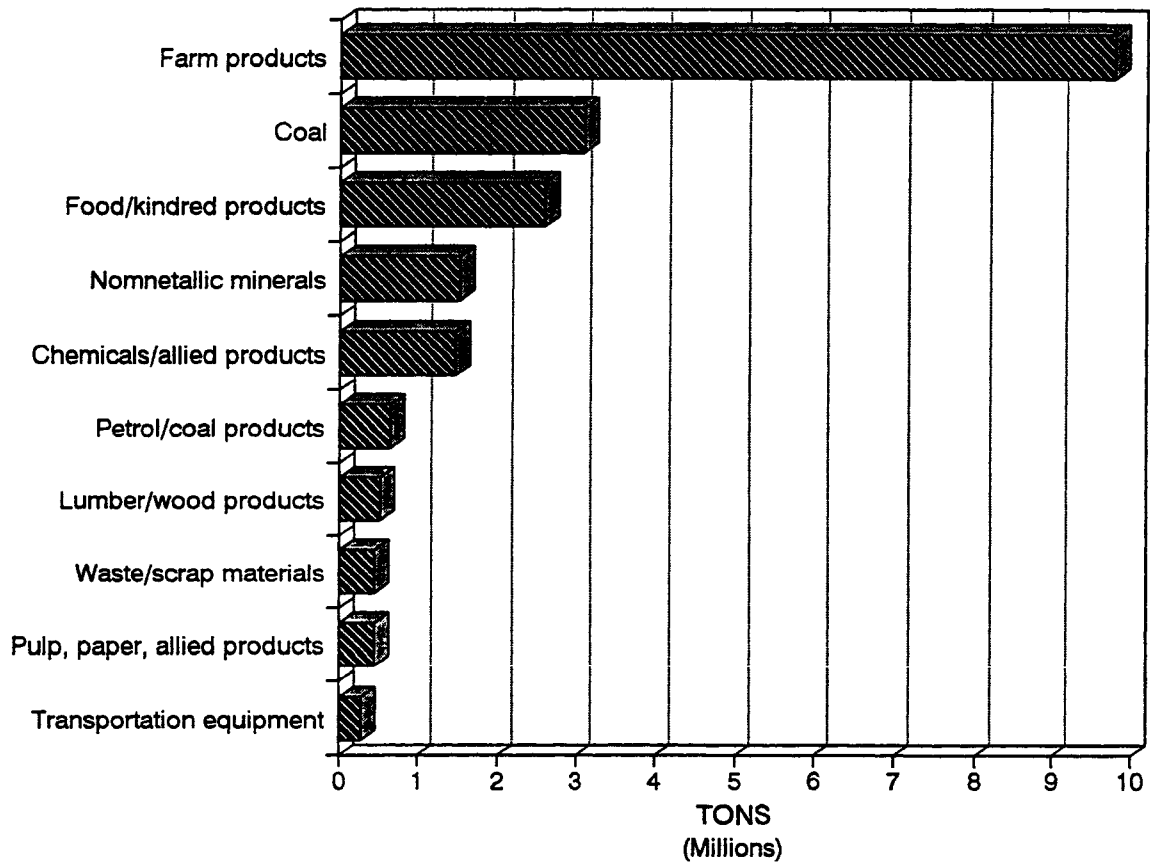


CHART 4.5 Rail Carload Shipments from BEA 96

Rail carload shipments of Farm Products clearly dominate outbound shipments by tonnage. Only four other commodities show significant volumes (coal, food products, nonmetallic minerals, and chemicals).

CARLOAD SHIPMENTS INTO BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

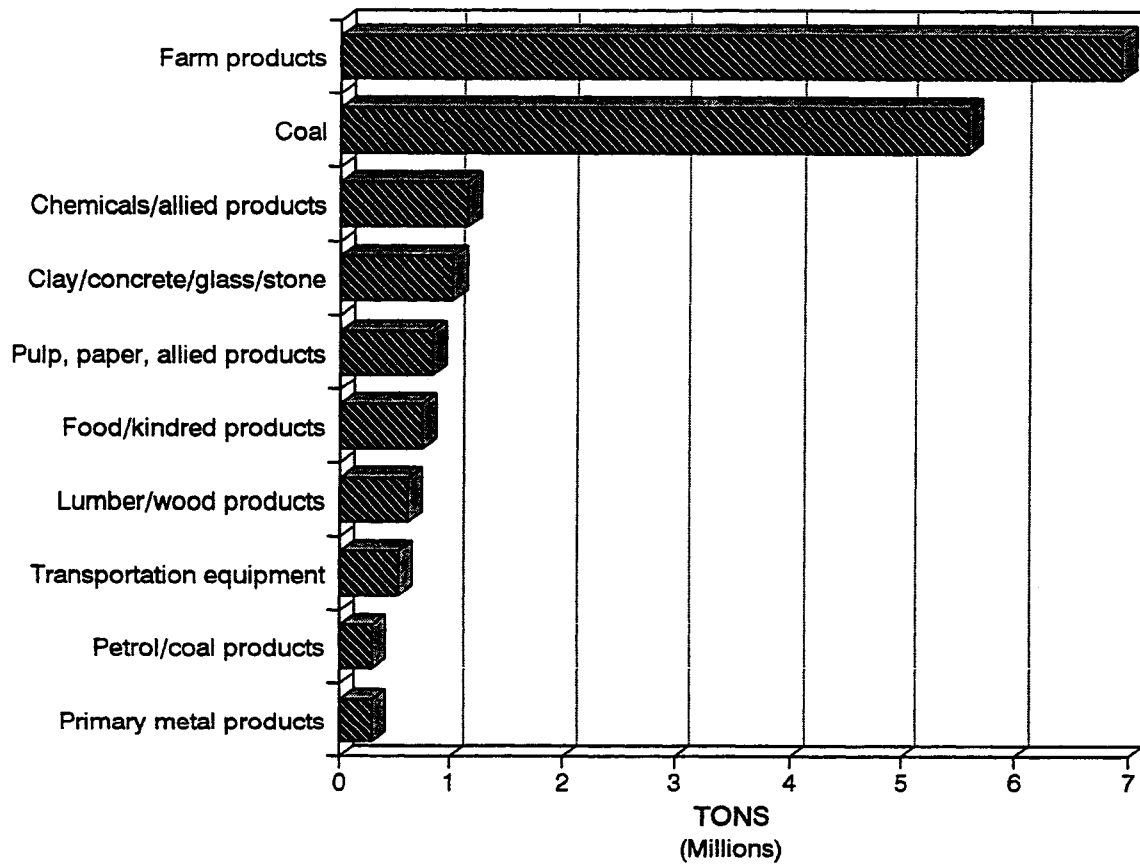


CHART 4.6 Rail Carload Shipments into BEA 96

Farm Products and coal dominate this movement. A large amount of the coal is reshipped to the coal transfer facility in Superior, Wisconsin.

INTERMODAL SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

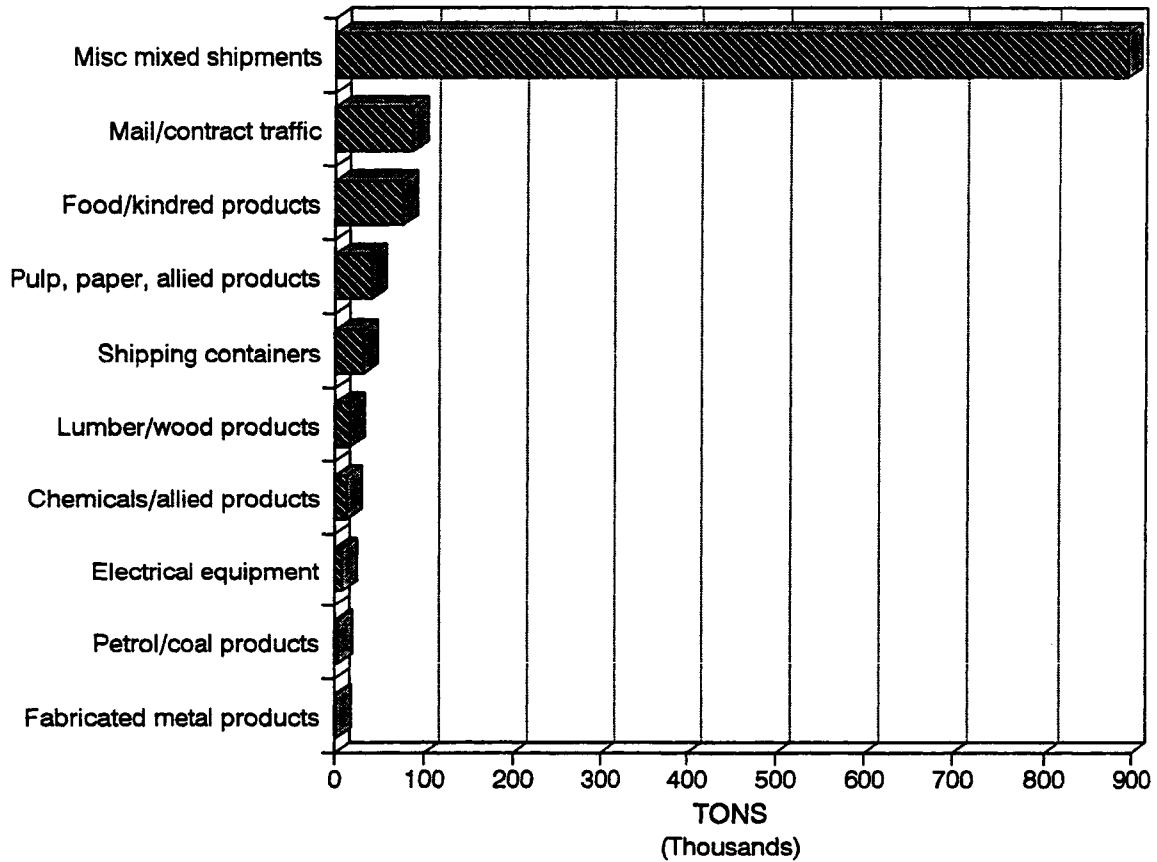


CHART 4.7 Intermodal Shipments from BEA 96

Most intermodal shipments are classified as Freight-All-Kinds (FAK) or Mixed Shipments. Information on specific commodities included is not readily available since the trailer or container contents do not have to be specified if their destination is domestic. These shipments clearly dominate intermodal activity from BEA 96.

INTERMODAL SHIPMENTS INTO BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

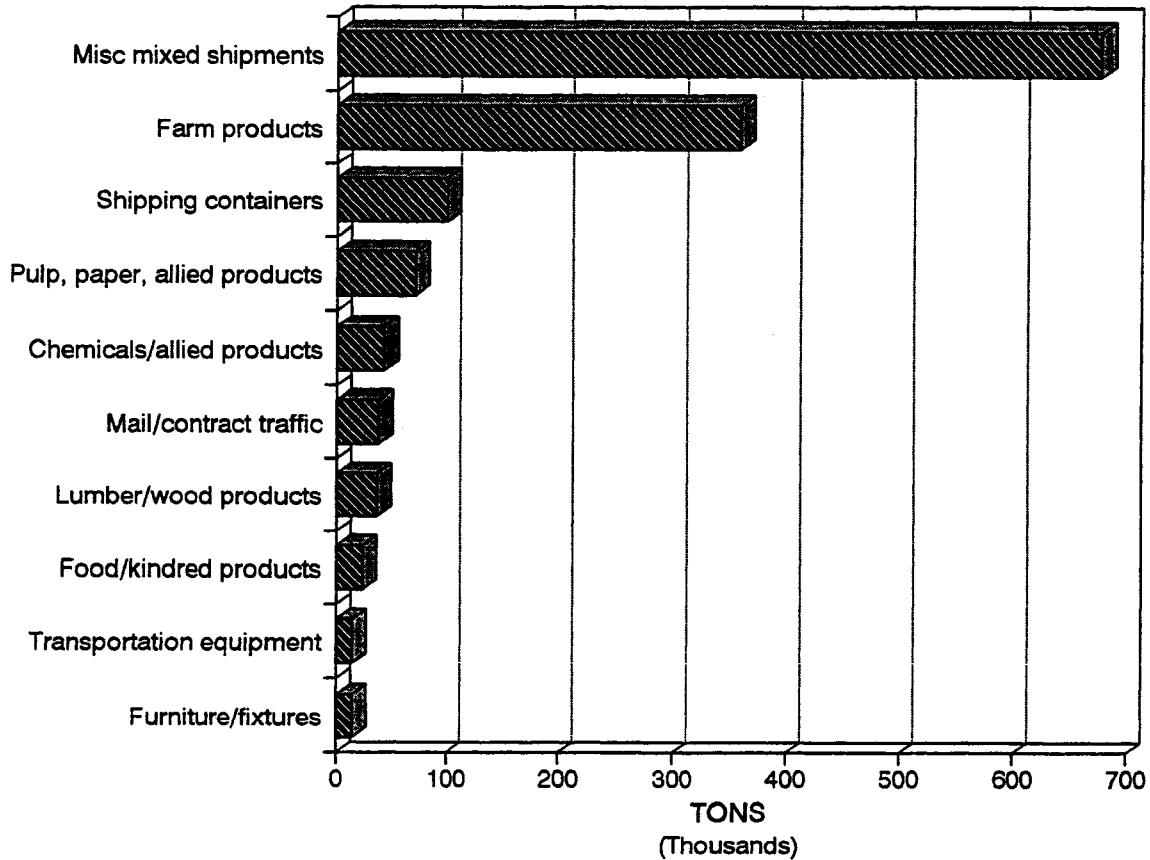


CHART 4.8 Intermodal Shipments into BEA 96

Miscellaneous Mixed Shipments also dominate inbound intermodal shipments. However, Farm Products make up a substantial portion of intermodal inbound shipments. Empty containers make up the third largest tonnage of inbound intermodal shipments.

TRUCKLOAD SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

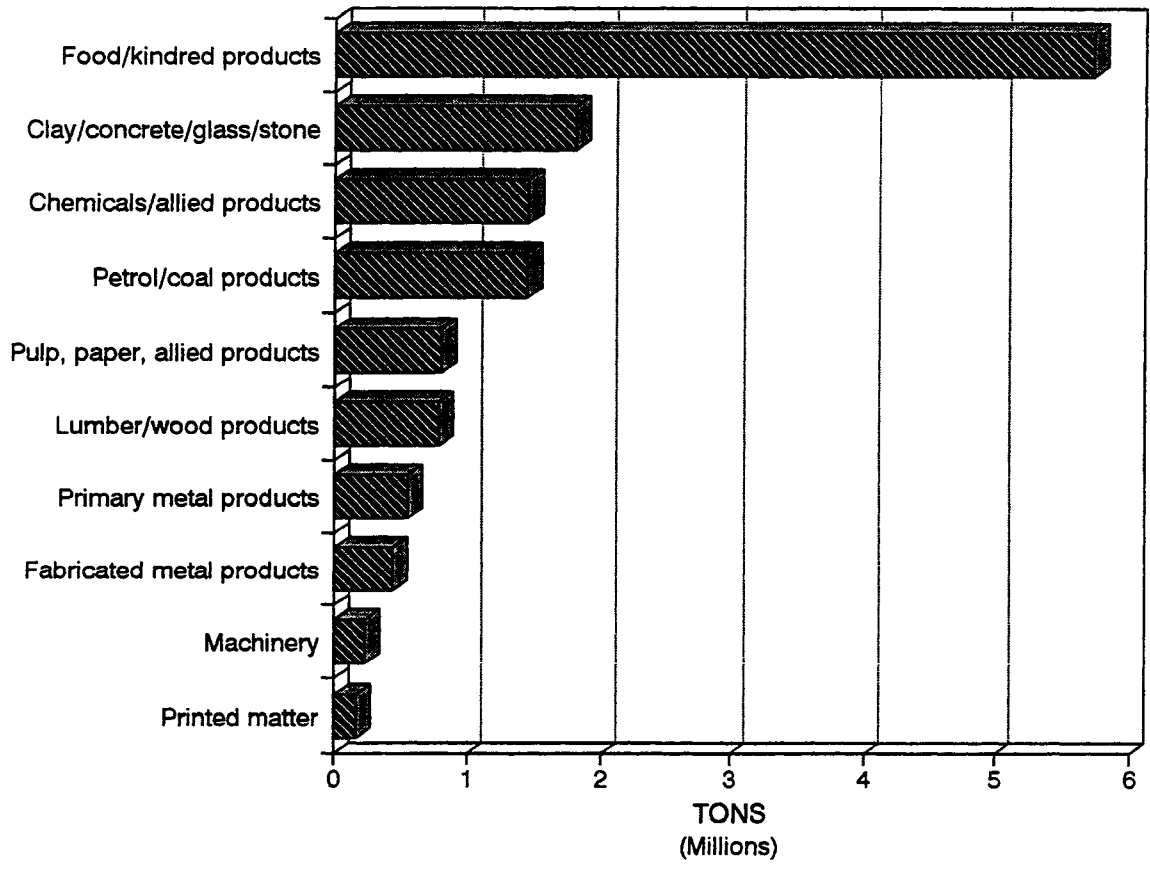


CHART 4.9 Truckload Shipments from BEA 96

Food Products clearly dominates truck shipments from BEA 96 showing the importance both of food products to the Minnesota economy and of trucks in moving these products out of the state. It can be seen that the other top truckload shipments by tonnage are accounted for by bulk commodities, paper and wood products.

TRUCKLOAD SHIPMENTS INTO BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

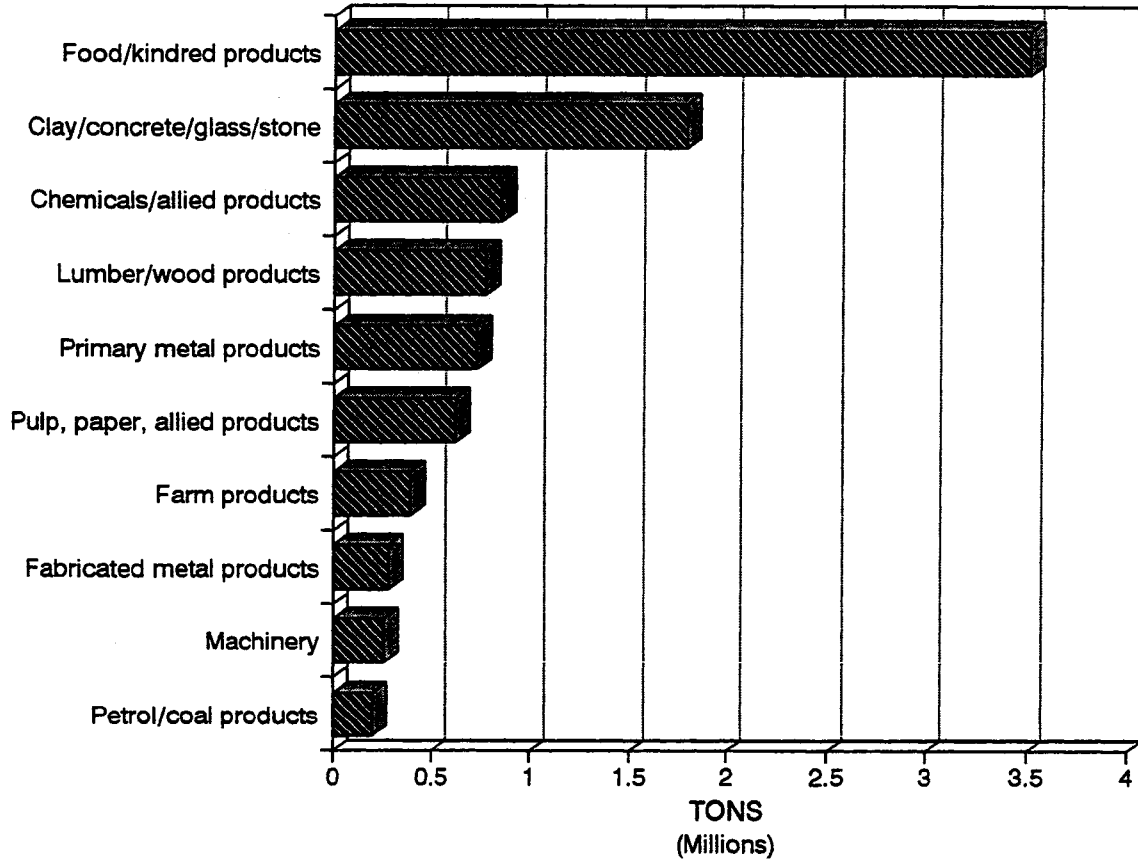


CHART 4.10 Truckload Shipments into BEA 96

The top 10 inbound commodities shipped by truck are quite similar to the top 10 outbound commodities which are shipped by truck..

LTL SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

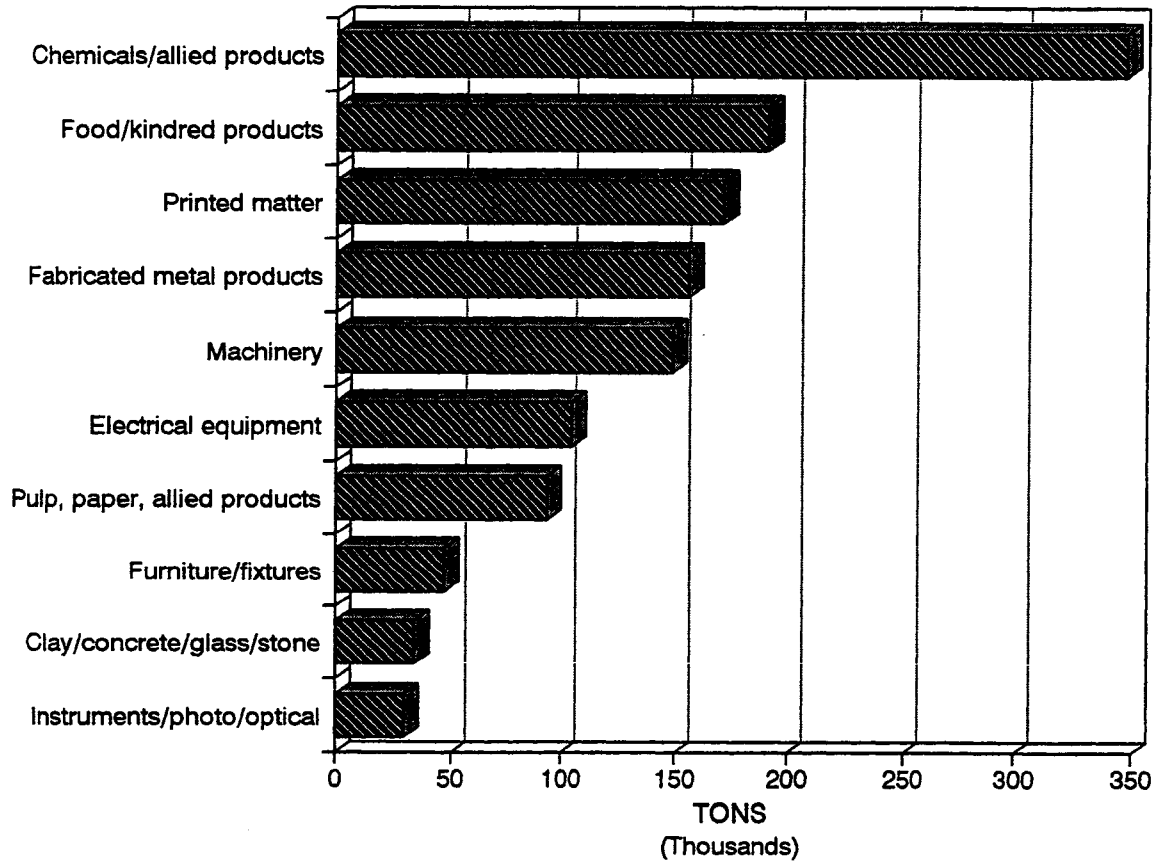


CHART 4.11 LTL Shipments from BEA 96

LTL shipments are dominated by chemicals and allied products, although the remaining top 10 commodities make up a significant portion of LTL shipments. Some of the higher value commodities such as Printed Matter, Fabricated Metal Products, Non-Electrical Machinery and Electrical Equipment are carried by LTL carriers.

LTL SHIPMENTS INTO BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

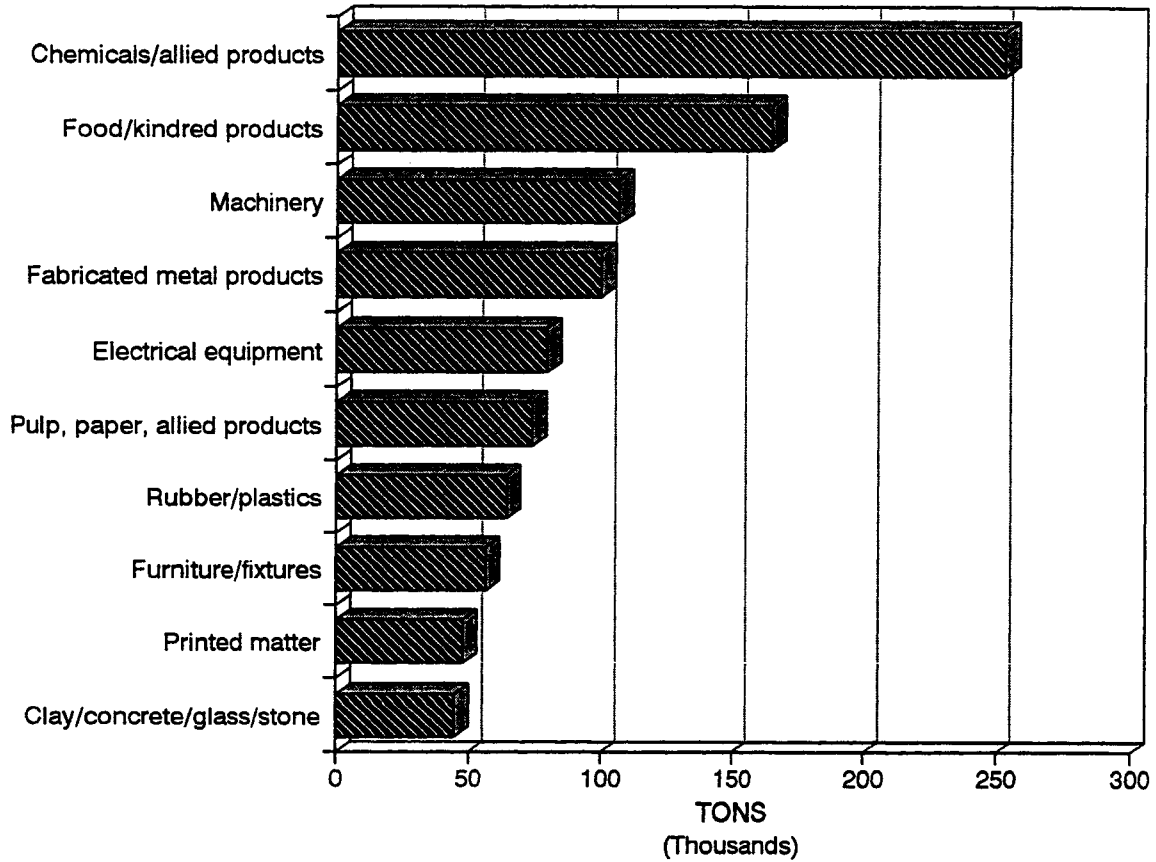


CHART 4.12 LTL Shipments into BEA 96

As with truckload shipments from and to BEA 96, LTL shipments from and to the region are similar with respect to the commodities moved.

PRIVATE TRUCK SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

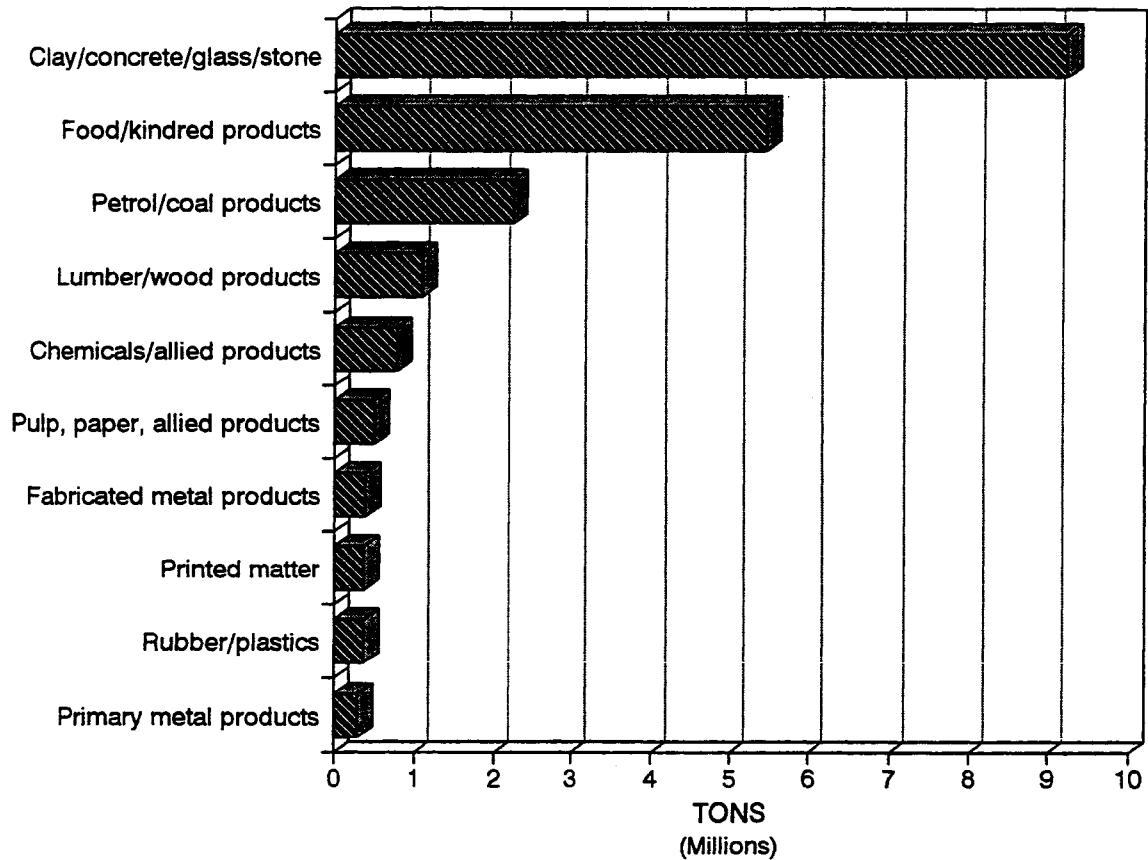


CHART 4.13 Private Truck Shipments from BEA 96

Private Truck shipments by tonnage are dominated by Clay/Concrete/Glass/Stone since most sand and gravel operations as well as quarries and concrete production facilities own and operate their own trucks. However, a large amount of food products is also carried on private fleets.

**PRIVATE TRUCK SHIPMENTS INTO BEA 96
TOP 10 COMMODITIES (BY TONNAGE)**

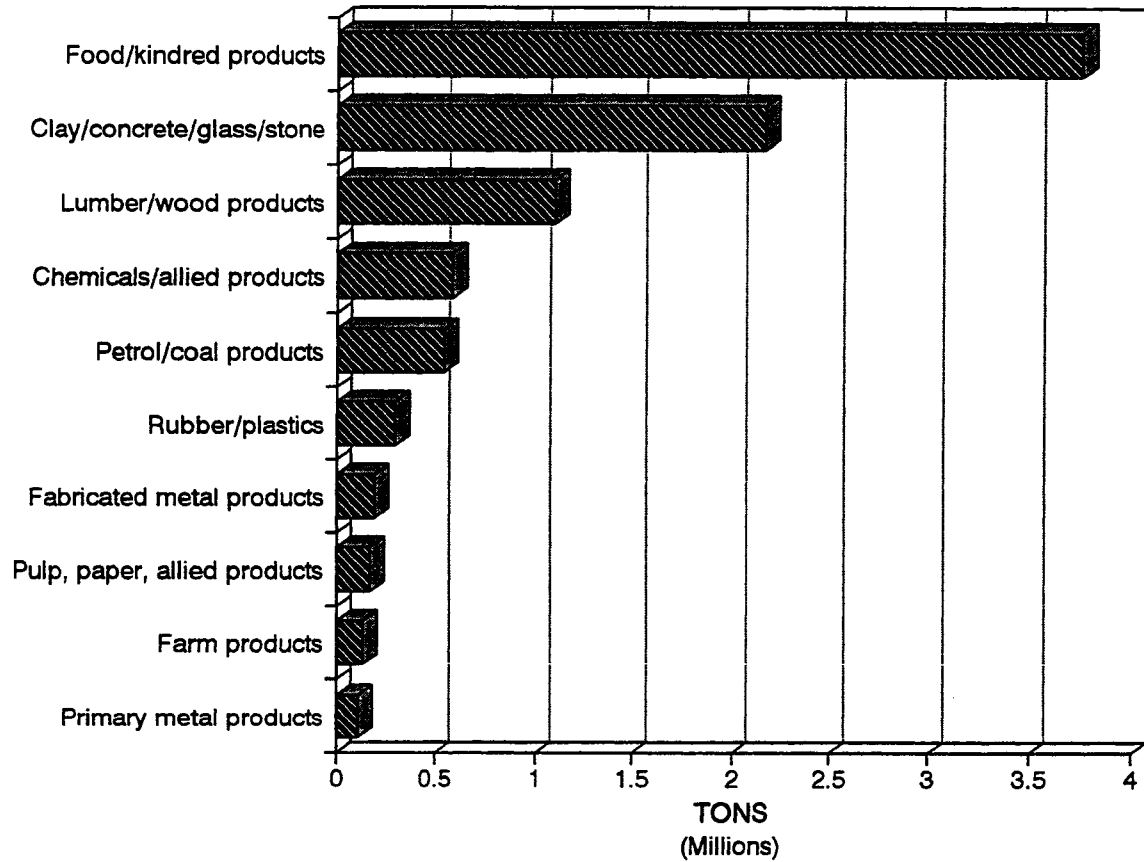


CHART 4.14 Private Truck Shipments into BEA 96

For inbound Private Truck movements, the two top commodities are reversed from the outbound flows. Food Products make up the dominate inbound commodity while Clay/Concrete/Glass/Stone shipments are about one half of that weight.

AIR SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

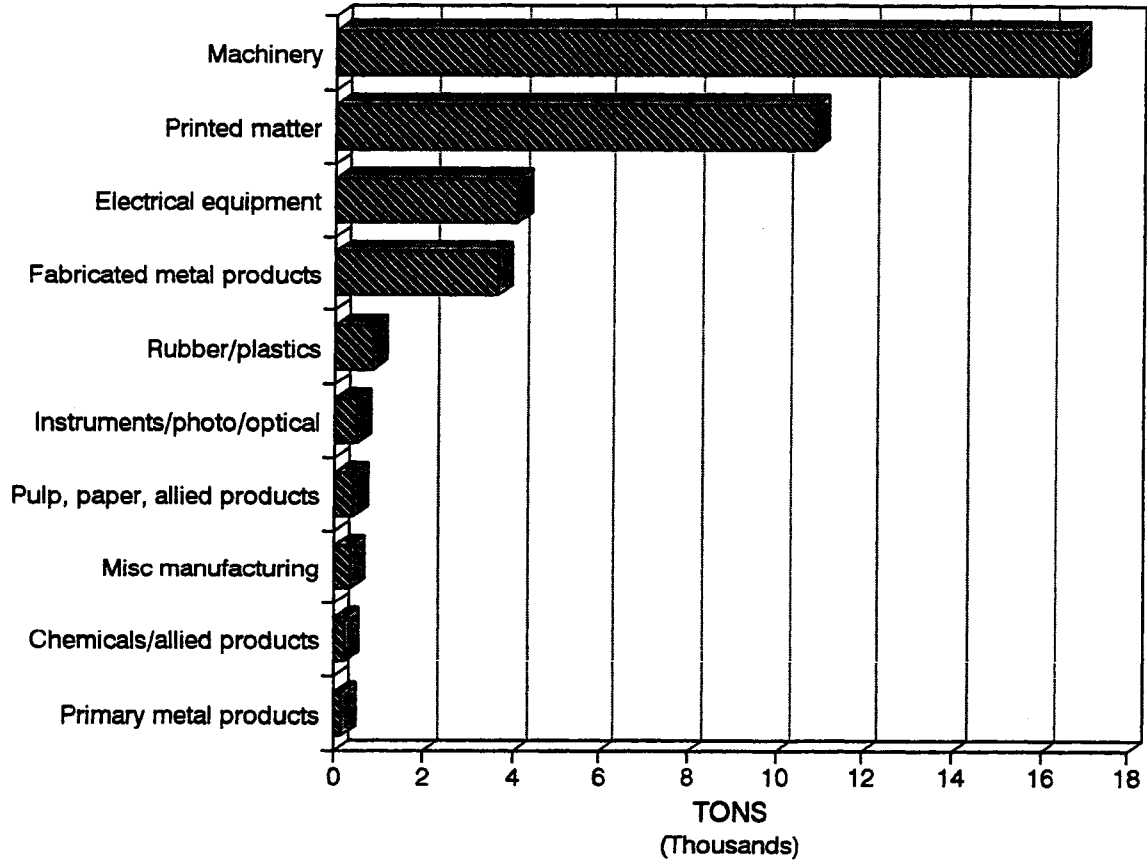


CHART 4.15 Air Shipments from BEA 96

Air shipments are dominated by and generally limited to high value commodities such as Non-Electrical Machinery (which includes computers). Printed Matter makes up the second largest commodity by weight.

AIR SHIPMENTS INTO BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

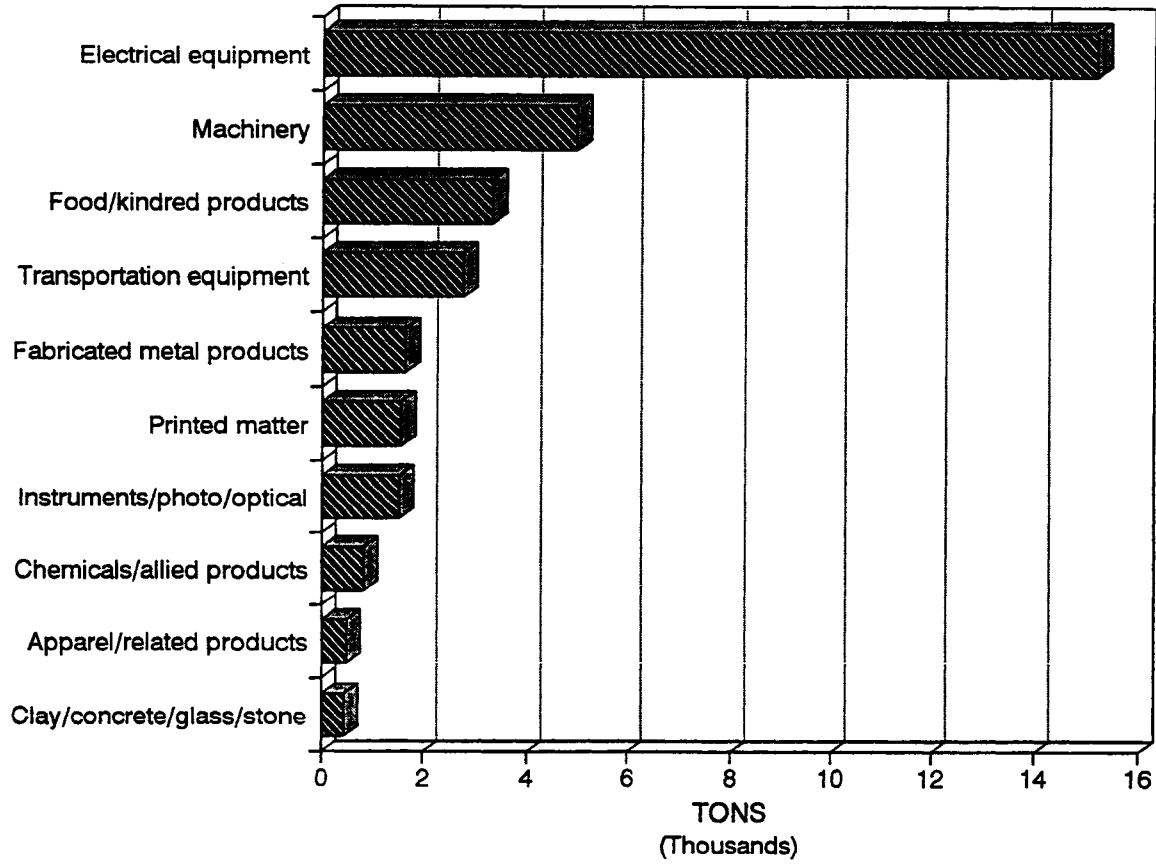


CHART 4.16 Air Shipments into BEA 96

Inbound shipments by air are similar to outbound shipments except that a wider variety of commodities is carried by this mode into BEA 96.

WATER SHIPMENTS FROM BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

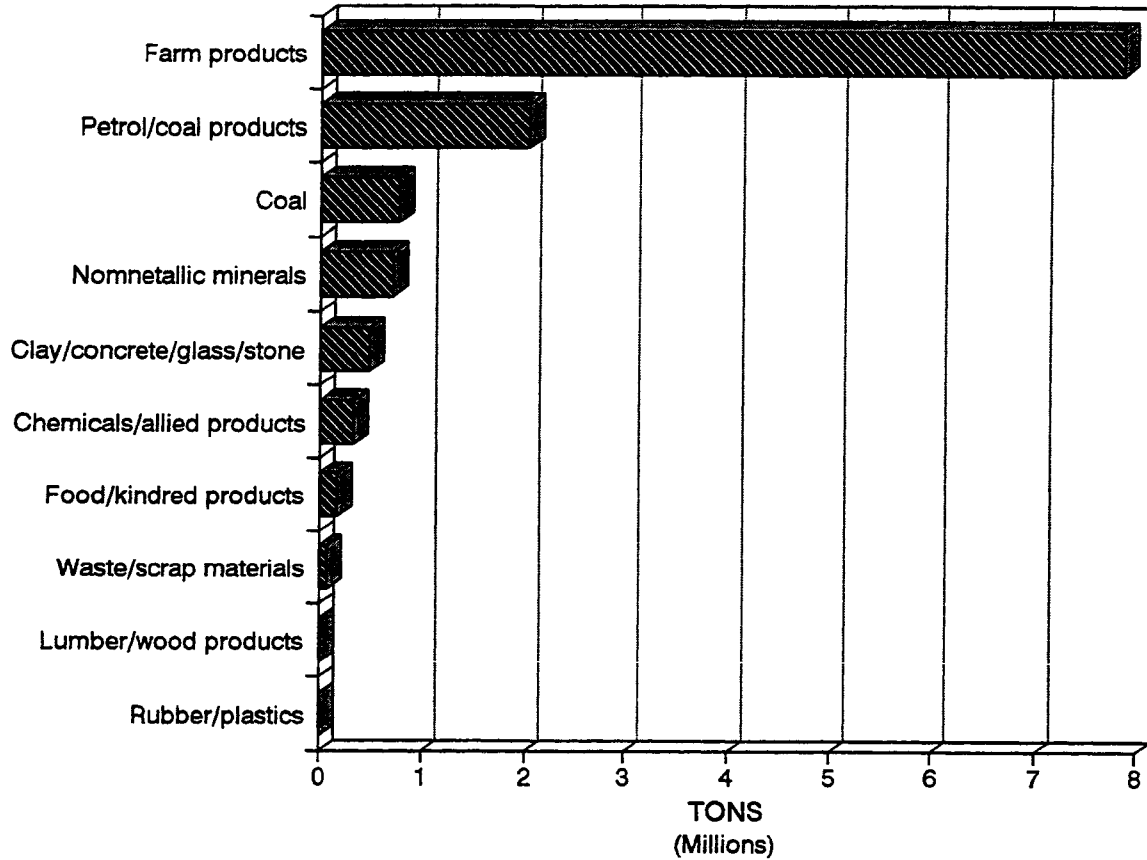


CHART 4.17 Water Shipments from BEA 96

Water shipments are dominated by grain shipments to the lower Mississippi River. Several other bulk commodities are represented on the chart.

WATER SHIPMENTS INTO BEA 96 TOP 10 COMMODITIES (BY TONNAGE)

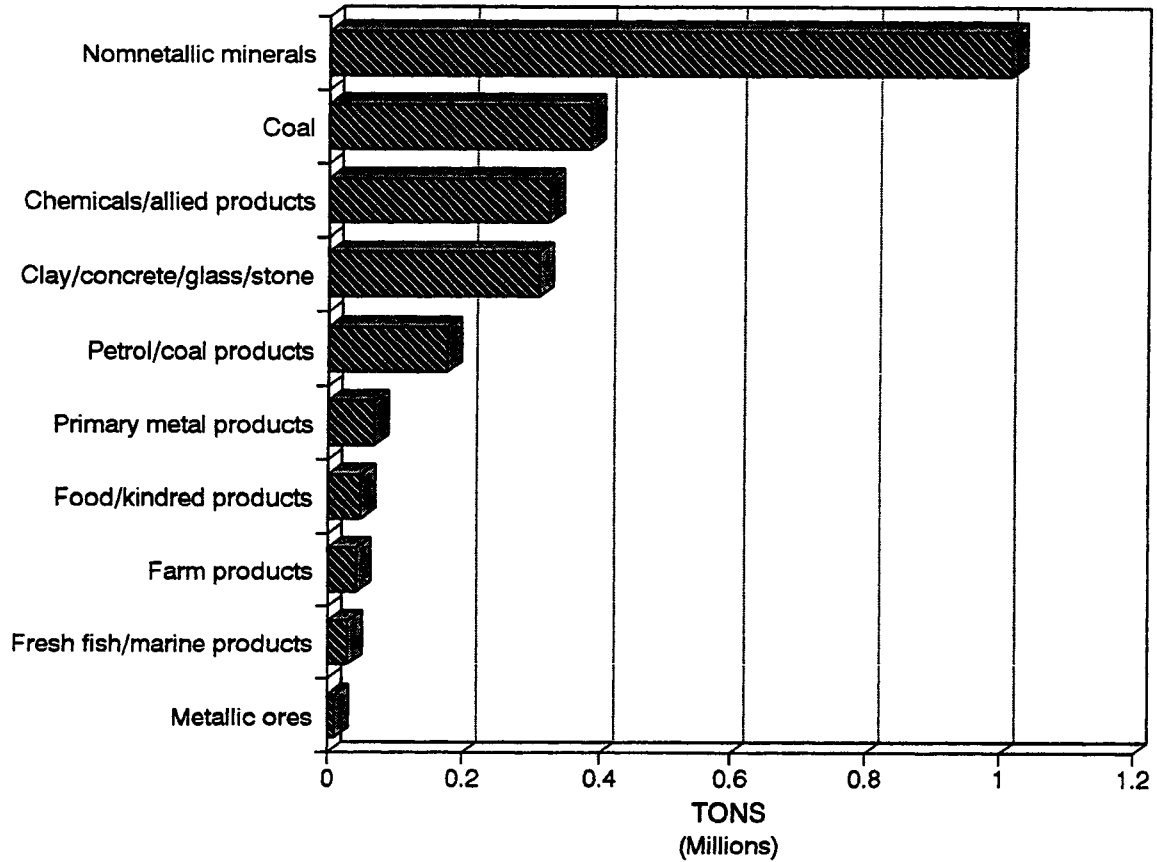


CHART 4.18 Water Shipments into BEA 96

Inbound shipments by water (barge) are dominated by Nonmetallic minerals such as clay and potash. Coal, Chemicals, and Clay/Concrete/Glass/Stone make up much of the remaining weight of shipments into BEA 96.

5.0 COMMODITY FLOWS BY ORIGIN AND DESTINATION

5.1 Internal BEA Flows

No data are available on flows between counties within each BEA region. However, through the use of the IMPLAN economic model, it is possible to derive estimates of the population and employment within each industry that can be used to examine the relative potential for shipments into and out of counties. These are shown in TABLE 5.1. The relative share of population and employment in the seven-county Twin Cities Metropolitan Area suggests that most of the flows within each BEA are between the central market core (Metropolitan Area) and the other counties which make up the market area within each BEA.

TABLE 5.1

BEA 96 COUNTY-LEVEL POPULATION AND EMPLOYMENT

Source: IMPLAN 1990

MINNEAPOLIS - ST. PAUL MSA COUNTIES		
COUNTY	POPULATION (thousand)	EMPLOYMENT (thousand)
Anoka	243.6	94.4
Carver	47.9	23.4
Chisago	30.5	12.8
Dakota	275.2	122.3
Hennepin	1032.4	882.4
Isanti	25.9	9.8
Ramsey	485.8	346.6
Scott	57.8	24.9
Washington	145	54.2
Wright	68.7	26.9
METRO TOTALS	2412.8	1597.7

NON-METROPOLITAN AREA COUNTIES		
COUNTY	POPULATION (thousand)	EMPLOYMENT (thousand)
Aitkin	12.4	4.6
Benton	30.2	12.0
Big Stone	6.3	3.4
Blue Earth	54.8	34.2
Brown	27.0	17.3
Cass	21.8	9.0
Chippewa	13.2	7.3
Crow Wing	44.2	23.5
Douglas	28.7	16.8
Faribault	16.9	9.0
Goodhue	40.7	23.1
Grant	6.2	3.4
Kanabec	12.8	5.4
Kandiyohi	38.8	22.5
Lac Qui Parle	8.9	4.4
Le Sueur	23.2	10.6
Martin	22.9	14.0
McLeod	3.2	22.0
Meeker	20.8	9.7
Mille Lacs	18.7	10.6
Morrison	29.6	12.4
Nicollet	28.1	14.2
Pine	21.3	8.1
Pope	10.7	5.1
Renville	17.7	9.9
Rice	49.2	27.3
Sherburne	41.9	13.7
Sibley	14.4	6.0
Stearns	118.8	74.5
Stevens	10.8	4.4
Swift	10.7	5.5
Todd	23.4	9.7
Traverse	4.5	2.8
Wadena	13.2	6.7
Waseca	18.1	11.1
Watonwan	11.7	6.9
Yellow Medicine	11.7	6.8
NON-METRO TOTALS	887.5	488.0

BEA 96 TOTALS	3300.3	2085.7
METRO SHARE (%)	73.1	76.6

5.2 Internal Minnesota Flows (BEA to BEA)

TABLE 5.2 shows the total flows of commodities between the BEA regions (Minnesota portion) within Minnesota. Origin BEA regions are shown on the left hand side of the table while destination BEA regions are shown across the top. For example, BEA 91 (LaCrosse) shipped 108,300 tons to itself (internal shipments are represented along the diagonals), 3,800 tons to Duluth-Superior, 92,140 tons to Minneapolis-St.Paul, 430,560 tons to Rochester, 1,190 tons to Sioux Falls, 1,450 tons to Fargo-Moorhead, and 1,210 tons to Grand Forks.

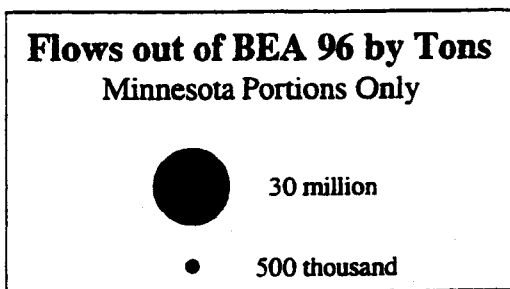
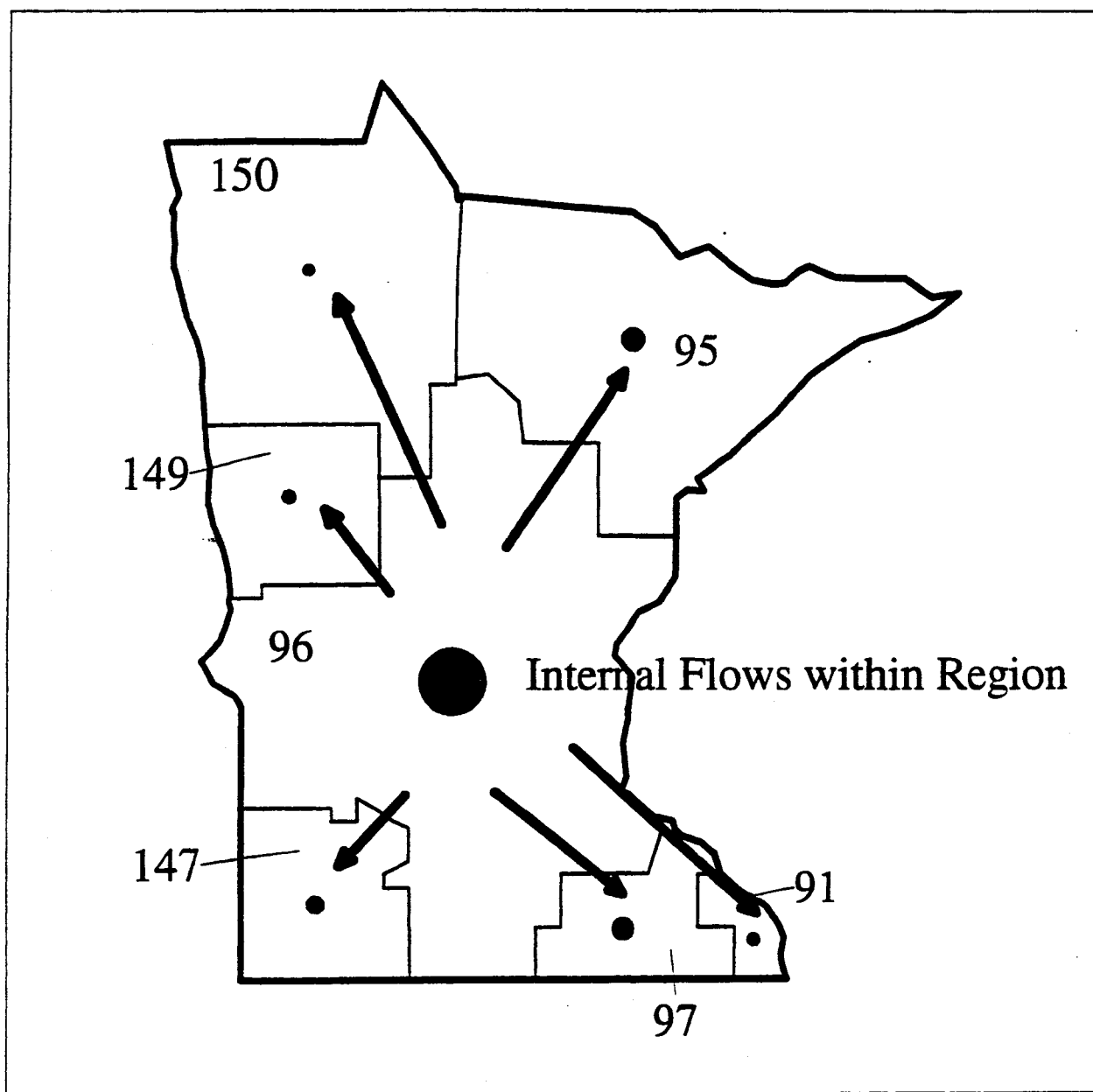
TABLE 5.2
COMMODITY FLOWS BETWEEN MINNESOTA BEA REGIONS
1990 COMMODITY TRAFFIC IN 1000 TONS

		DESTINATIONS						
		91	95	96	97	147	149	150
		LaCrosse	Duluth-Superior	Mpls-St.Paul	Rochester	Sioux Falls	Fargo-Moorhead	Grand Forks
O	91	108.03	3.80	92.14	430.56	1.19	1.45	1.21
R	95	9.76	34954.42	1580.39	38.44	10.40	25.73	270.73
I	96	557.38	1634.56	22706.58	1491.87	752.66	631.09	506.39
G	97	543.66	23.90	783.57	1368.62	35.86	4.85	5.18
I	147	4.81	36.01	1684.91	90.05	904.70	62.65	9.60
N	149	6.11	108.01	693.48	50.32	33.16	658.37	40.60
S	150	25.27	278.56	879.66	43.64	8.96	65.56	722.64
Totals		1255.02	37039.26	28420.73	3513.50	1746.93	1449.70	1556.35

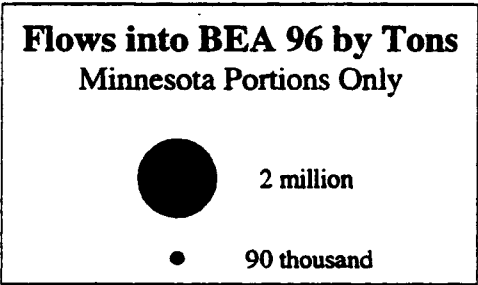
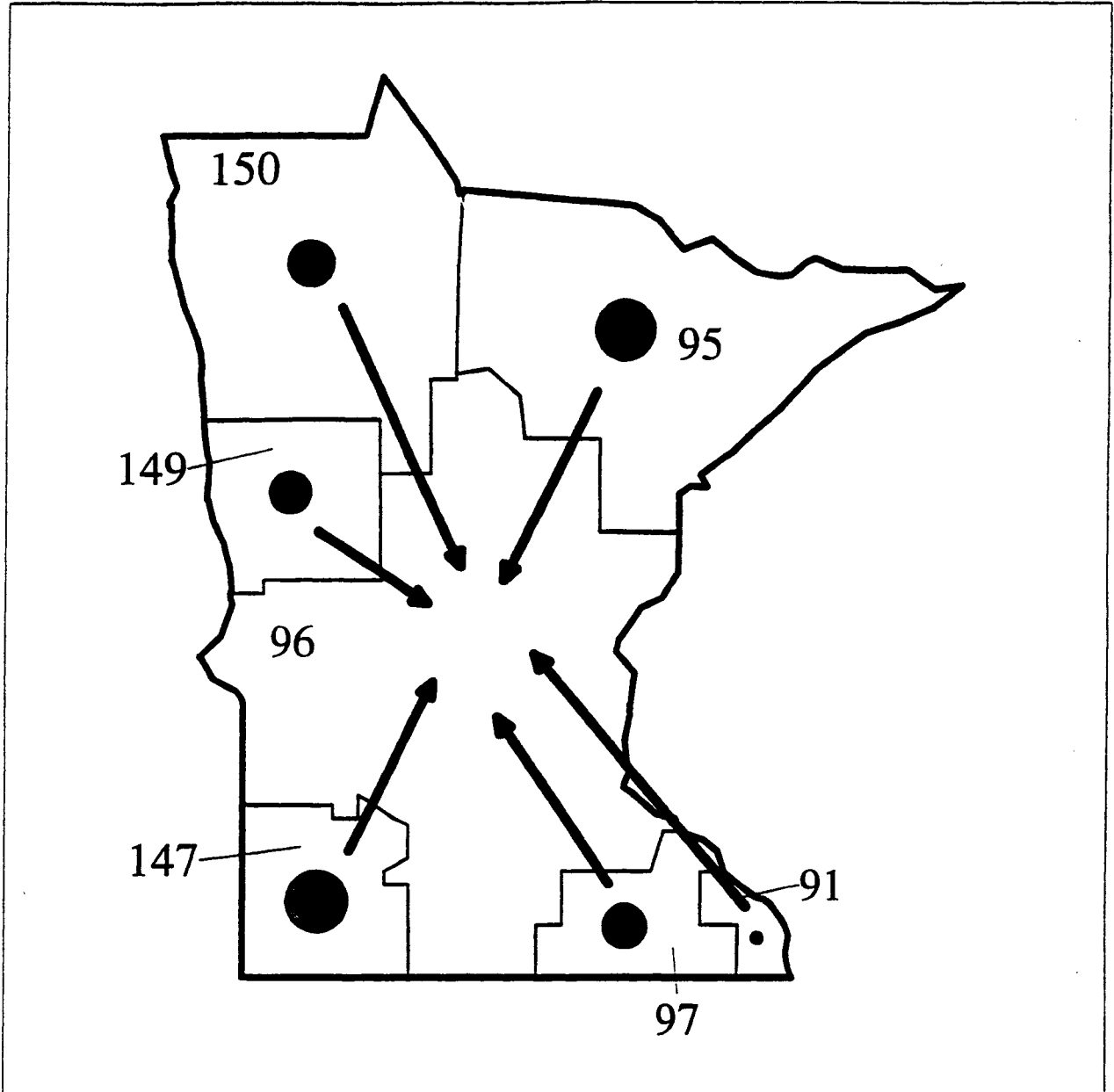
MAP 5.1 shows the relative magnitude of flows from BEA 96 to the other BEAs within Minnesota. MAP 5.2 shows the relative magnitude of flows from the other BEAs within Minnesota to BEA 96. MAP 5.3 shows flows from BEA 95 to the other BEAs within Minnesota. MAP 5.4 shows flows from the other BEAs within Minnesota to BEA 95.

Note that the flows into BEA 96 (MAP 5.2) are approximately 1/10 as large as flows out of BEA 96 (MAP 5.1). Flows into BEA 95 (MAP 5.4) are approximately 1/20 of flows out of BEA 95 (MAP 5.3).

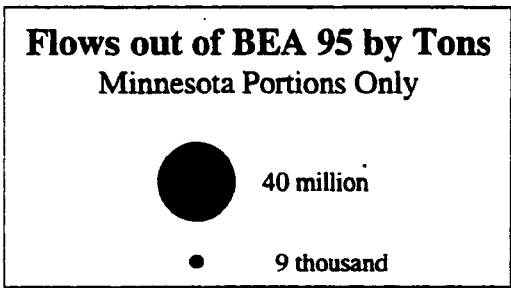
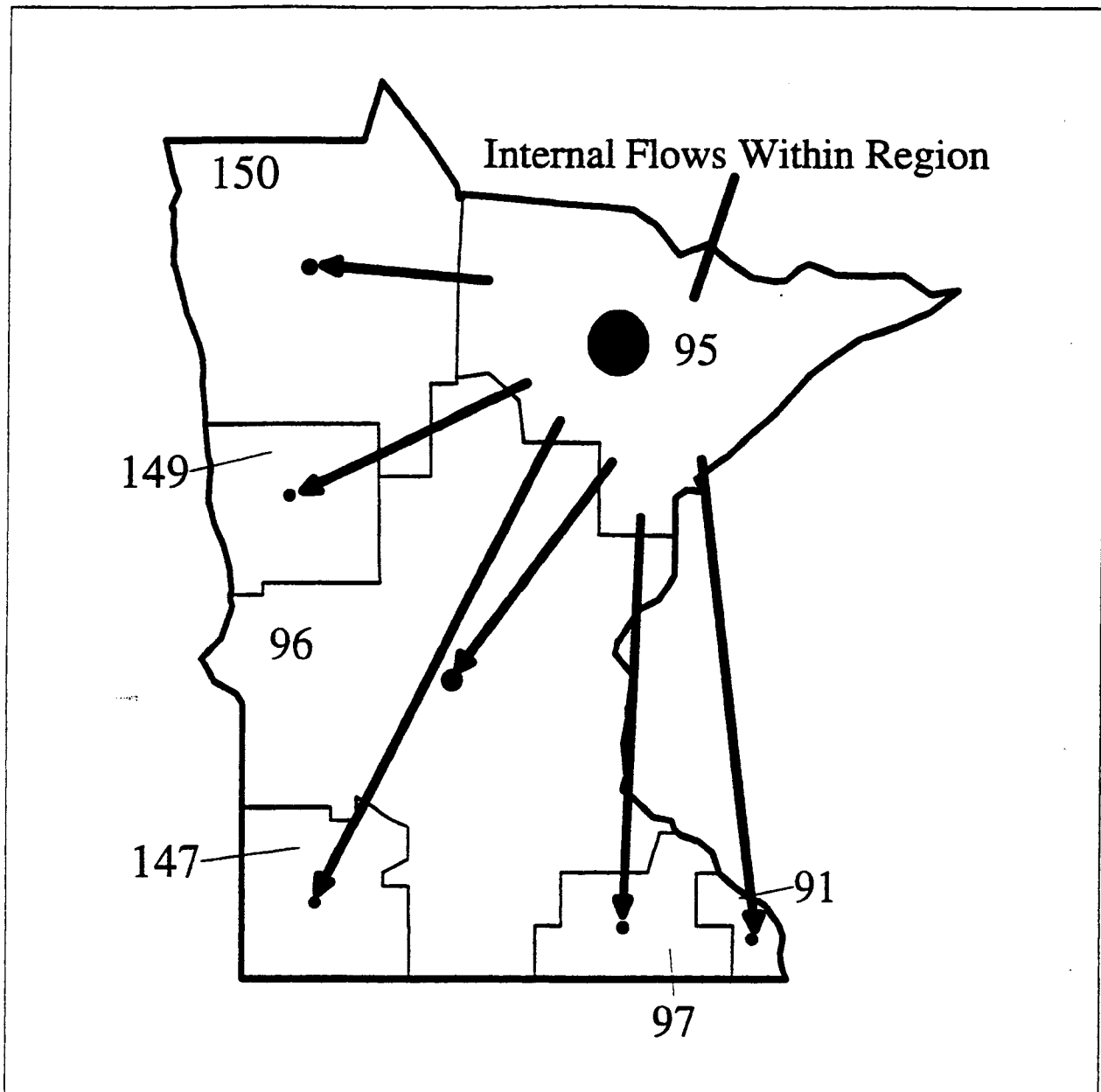
Detailed modal and commodity flows between Minnesota BEA regions are contained in APPENDIX D.



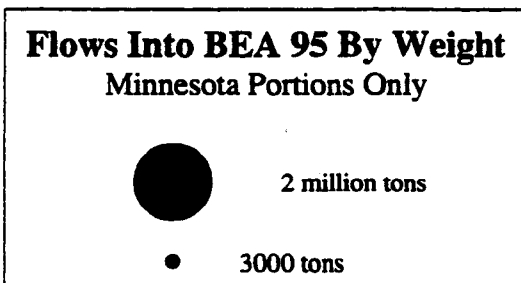
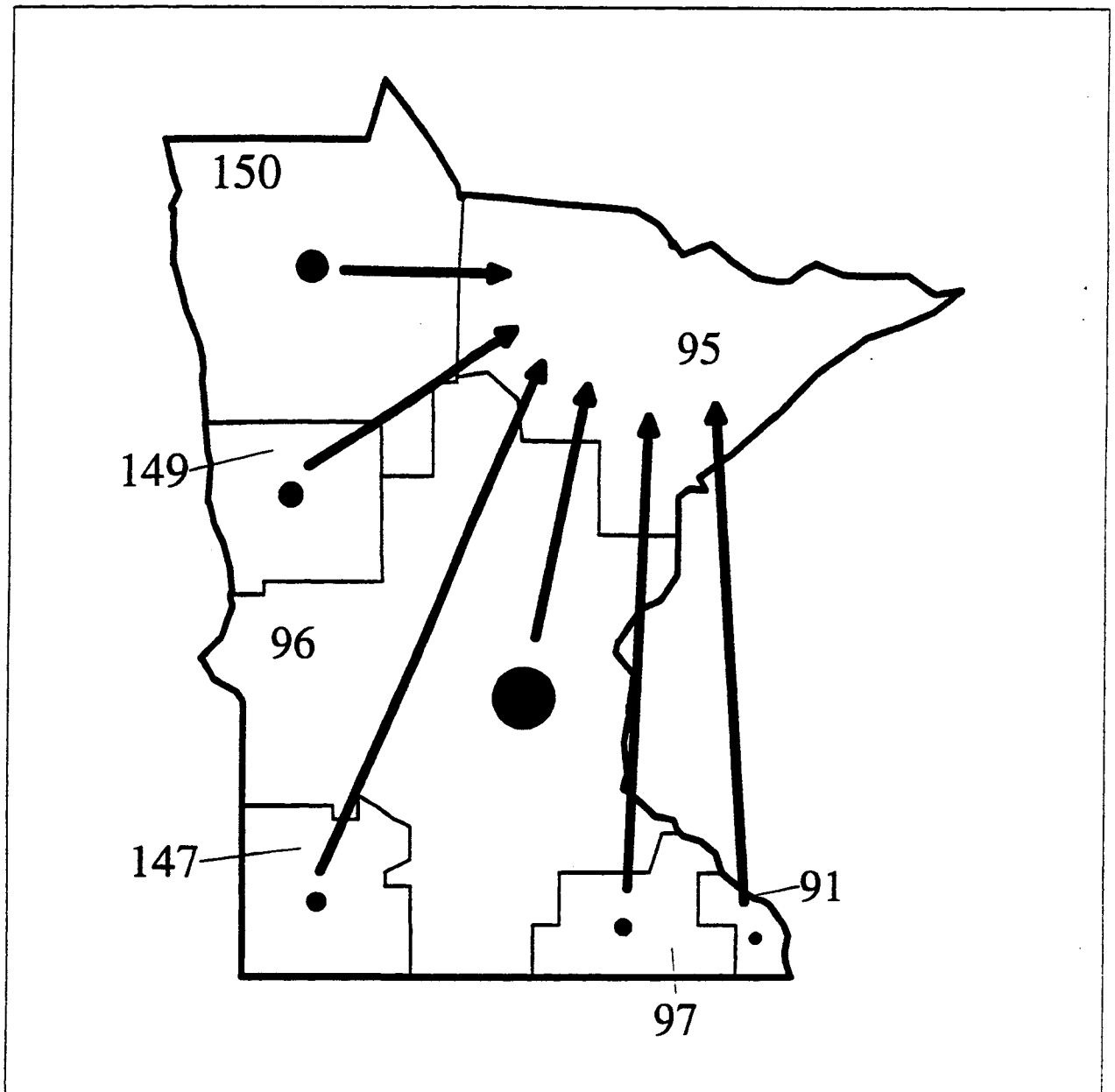
MAP 5.1 BEA 96 Flows to Other Minnesota BEA Regions



MAP 5.2 BEA 96 Flows from Other Minnesota BEA Regions



MAP 5.3 BEA 95 Flows to Other Minnesota BEA Regions



MAP 5.4 BEA 95 Flows from Other Minnesota BEA Regions

5.3 Upper Midwest Flows

TABLE 5.3 shows the total flows of commodities between BEA 96 and the other BEA regions which make up the immediate Upper Midwest market area served by BEA 96. For this report, this area is assumed to include the Rockford and Chicago BEA regions in northern Illinois.

The left side of the table shows imports or flows into BEA 96 from other BEA regions. The right side shows exports or flows from BEA 96 to other BEA regions. The data demonstrates the dominance of rail in the movement of Farm Products and the importance of trucking for most manufactured goods. As can be expected, water shipments within the Upper Midwest region are relatively small and air shipments are only a small fraction of the total.

The total weight inbound from the Upper Midwest (45.3 million tons) and outbound to the Upper Midwest (47.8 million tons) are similar, emphasizing the close interdependence of BEA 96 with the rest of the region. This balance extends over all of the modes.

MAP 5.5 identifies the BEA regions which make up the Upper Midwest market area as used in this report. The metropolitan area within each BEA has been identified. BEA 83 (Chicago) and BEA 88 (Rockford) are included along with the BEA regions in the four adjoining states of North and South Dakota, Iowa and Wisconsin.

MAP 5.6 shows the total commodity flows by weight on all modes from BEA 96 to other BEAs within the region. The concentration of flows to the east and southeast demonstrates the strong economic connection between Minnesota and these regions.

MAP 5.7 shows the total commodity flows by weight on all modes from other BEAs within the Upper Midwest to BEA 96. This reflects the importance of agricultural flows from the regions to the west as well as to the east and south of BEA 96.

MAP 5.8 shows BEA 96 outbound flows by weight and by rail to the Upper Midwest. This shows the relative importance of rail in moving heavy commodities within the region.

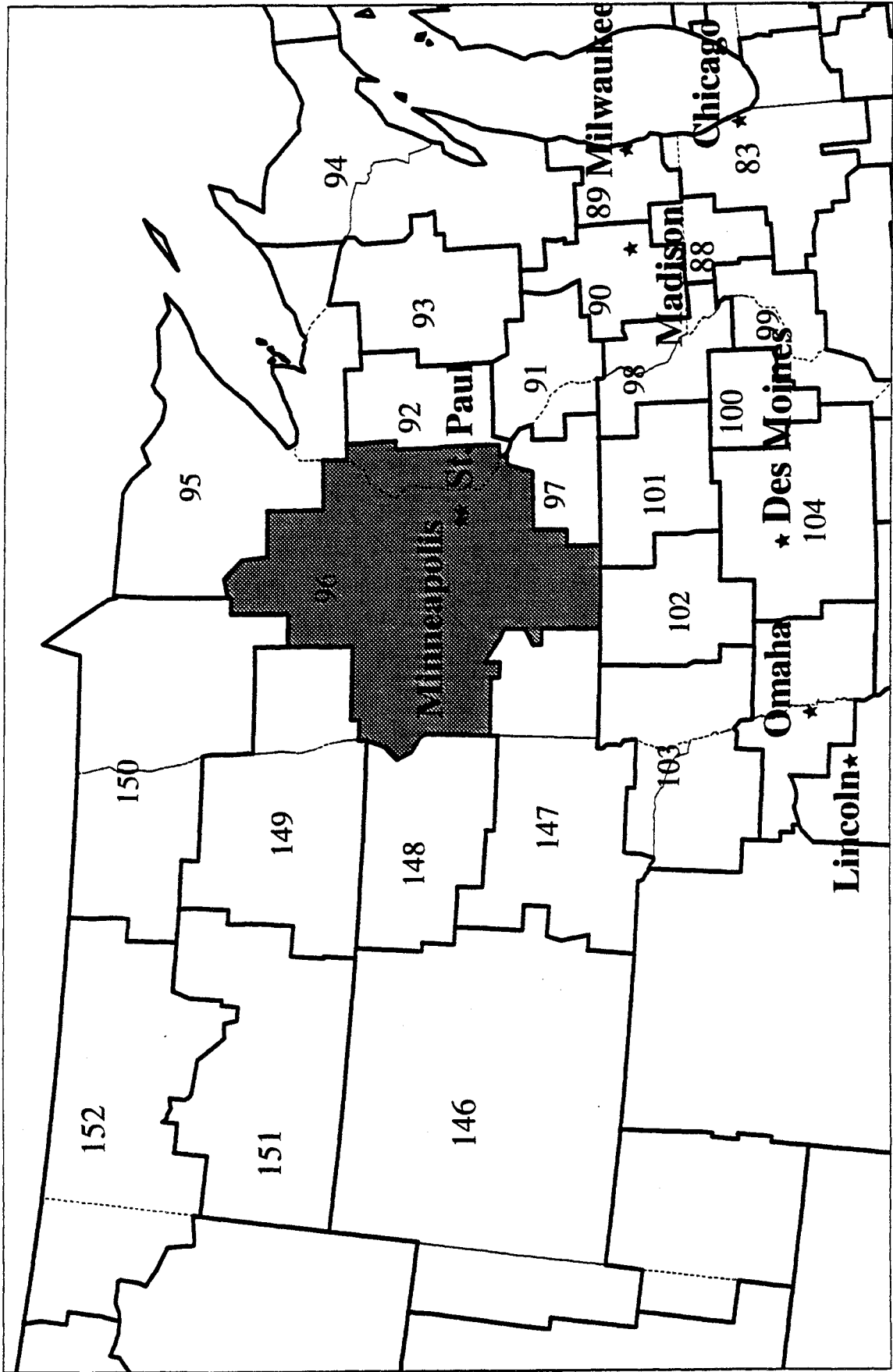
MAP 5.9 shows flows by weight and by rail from the Upper Midwest to BEA 96. This again demonstrates the importance of rail in moving agricultural commodities into the central core of the Upper Midwest region.

MAP 5.10 shows outbound flows by value and by rail. The importance of Chicago as a destination for these shipments reflects the higher value of intermodal shipments. The final destination of these shipments could be examined with the use of waybill statistics although no analysis of those data are currently available..

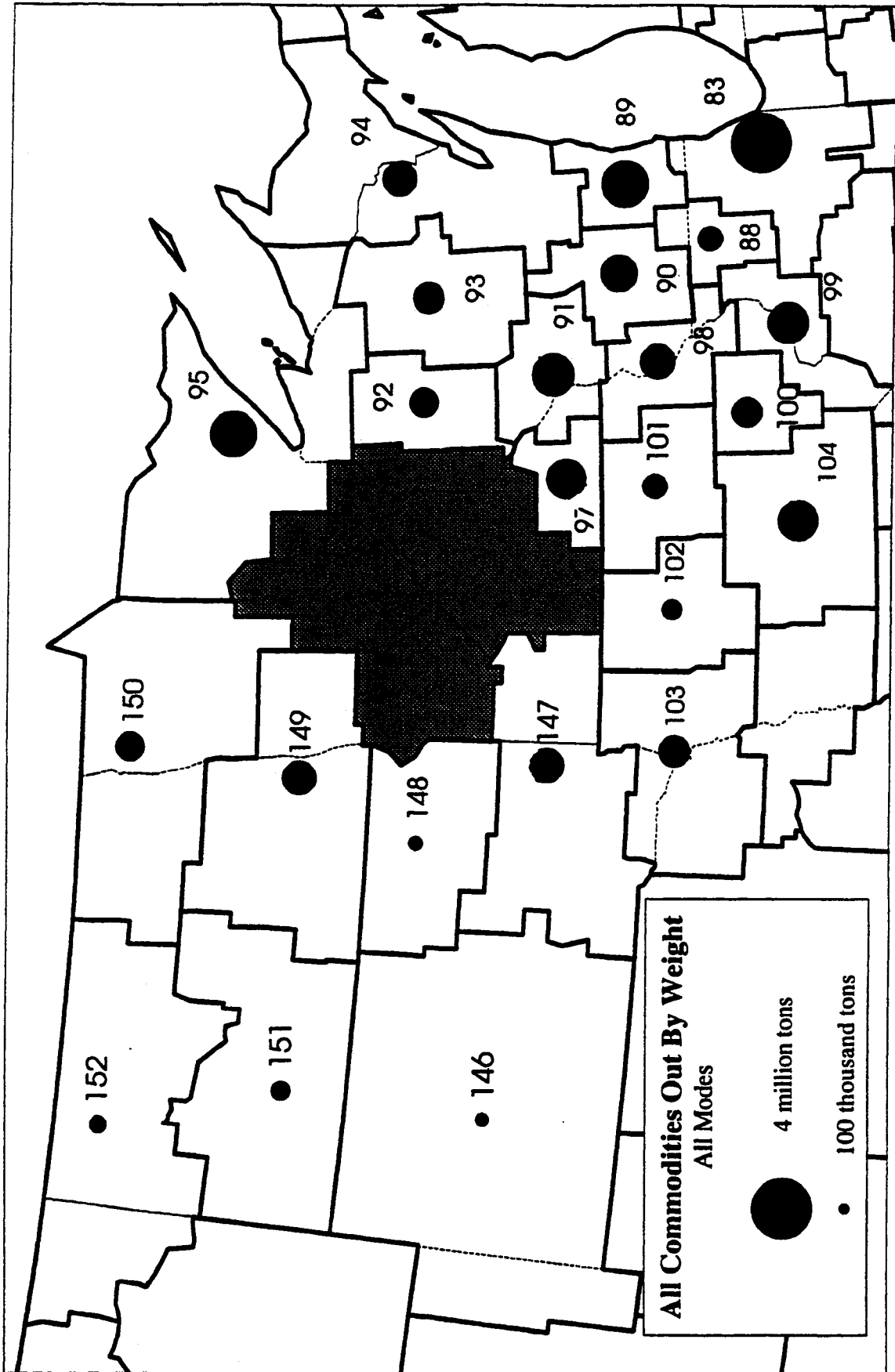
MAP 5.11 shows outbound flows by weight and by truck to the Upper Midwest. Again most of the flows are to the east and southeast although a distribution more uniform than rail can be seen.

MAP 5.12 shows inbound flows by weight and by truck to BEA 96. It can be seen that the inbound shipments with this mode are similar to outbound shipments, demonstrating the efficient use of the highway system in bringing goods both into and out of the region.

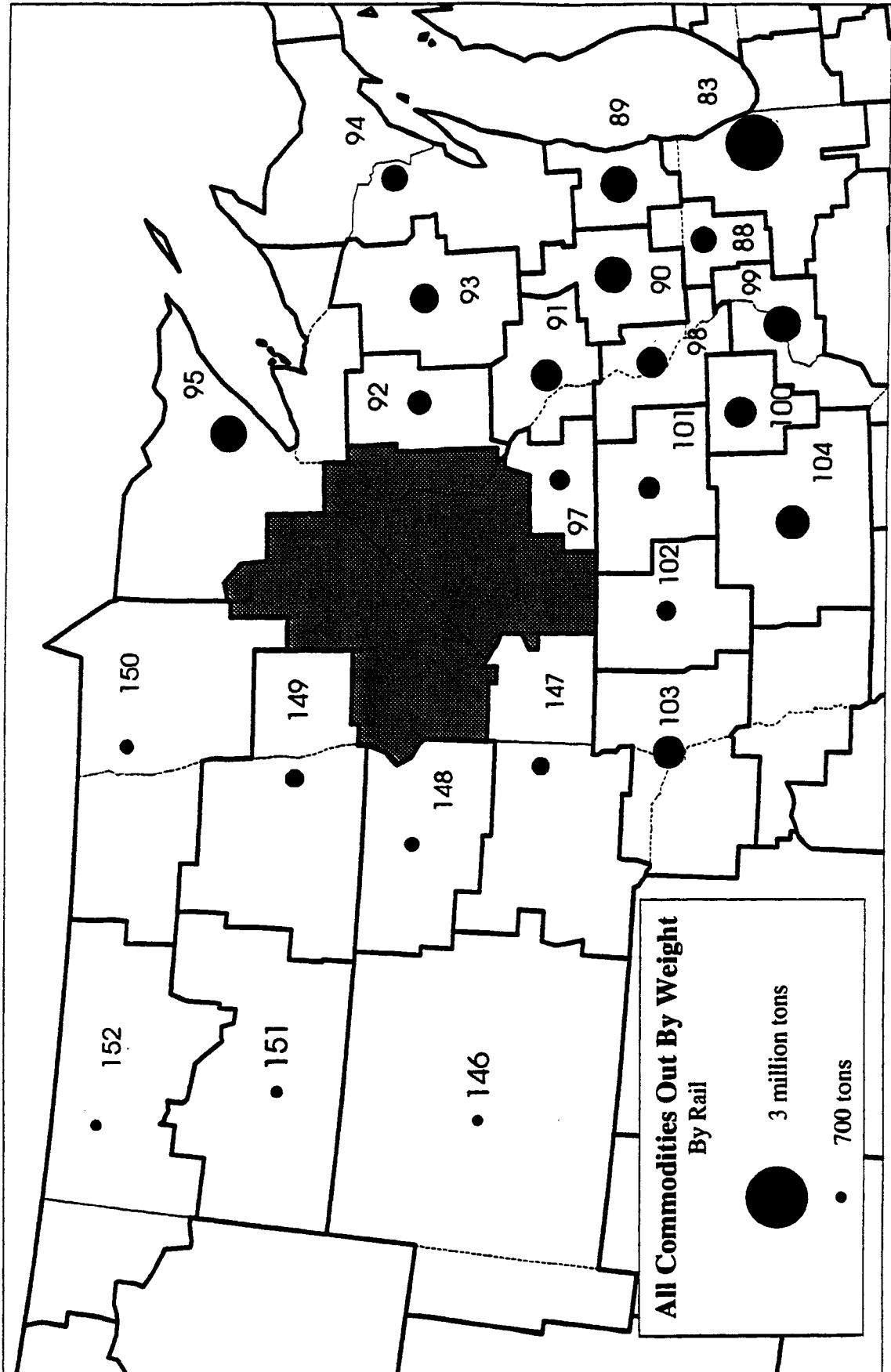
MAP 5.13 shows outbound flow by value and by truck to the Upper Midwest. A slightly higher concentration of higher value shipments to major metropolitan areas can be seen.



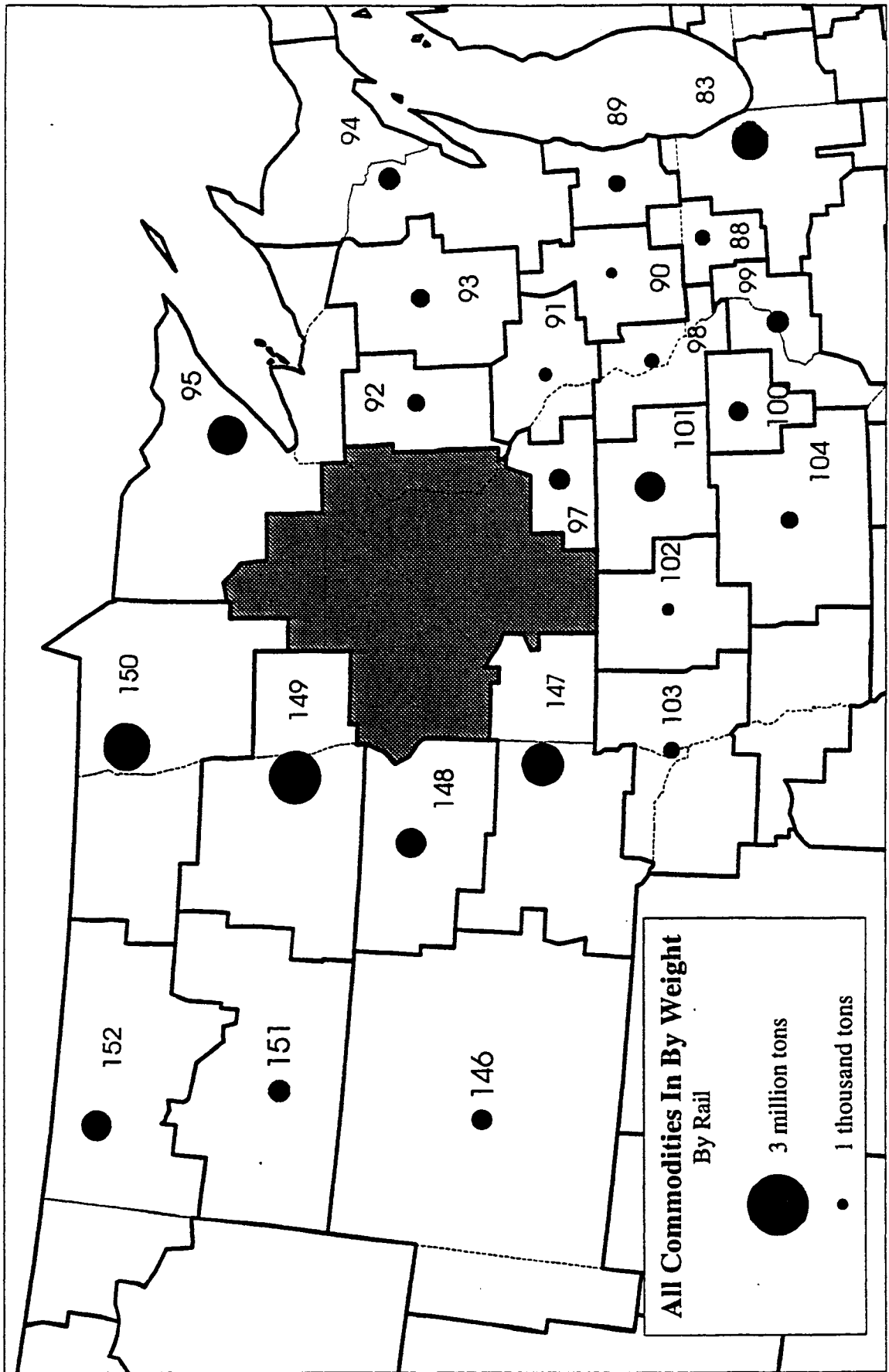
MAP 5.5 BEA Regions within Upper Midwest



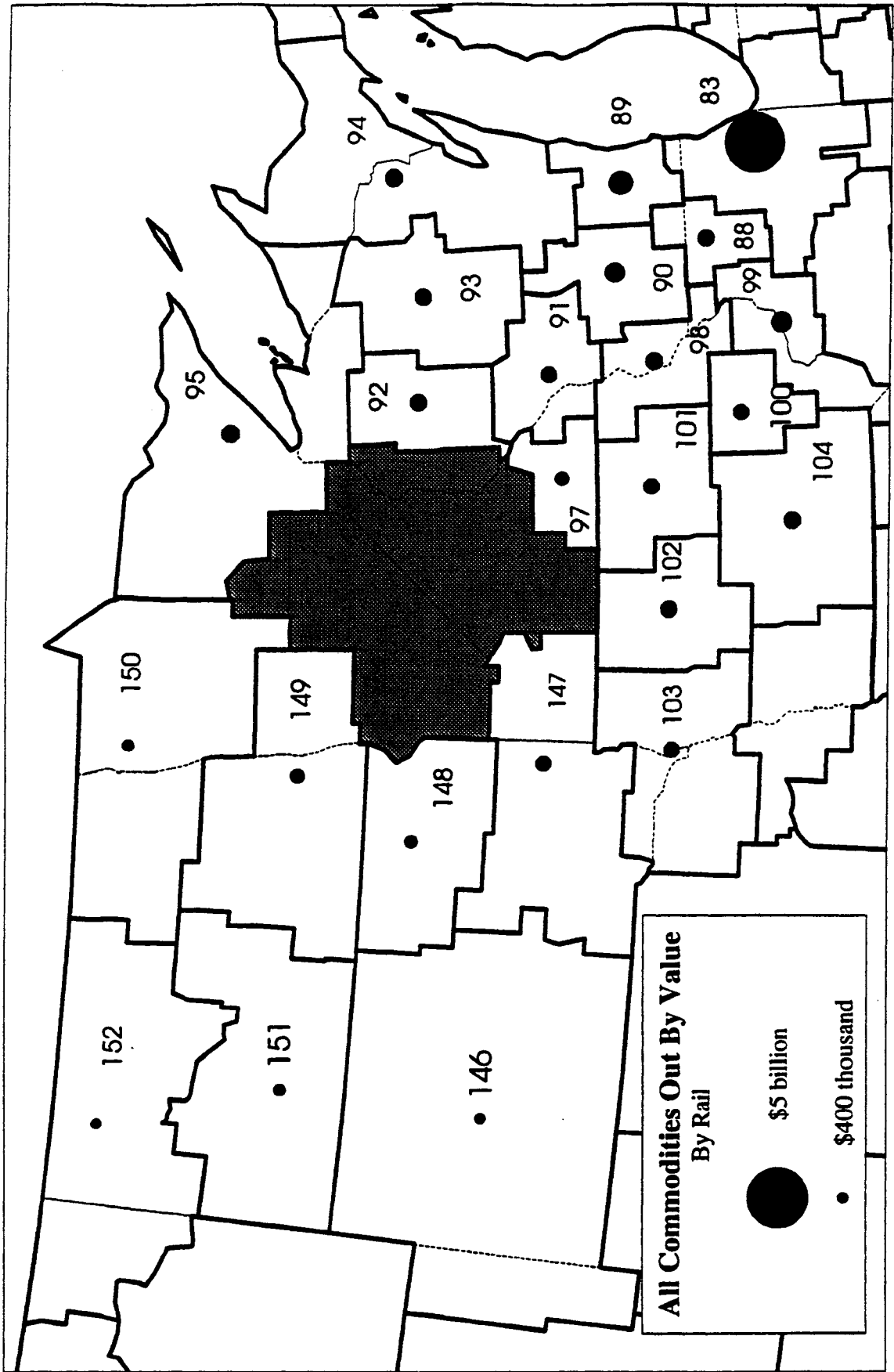
MAP 5.6 BEA 96 Flows to Other Upper Midwest BEA Regions by Weight



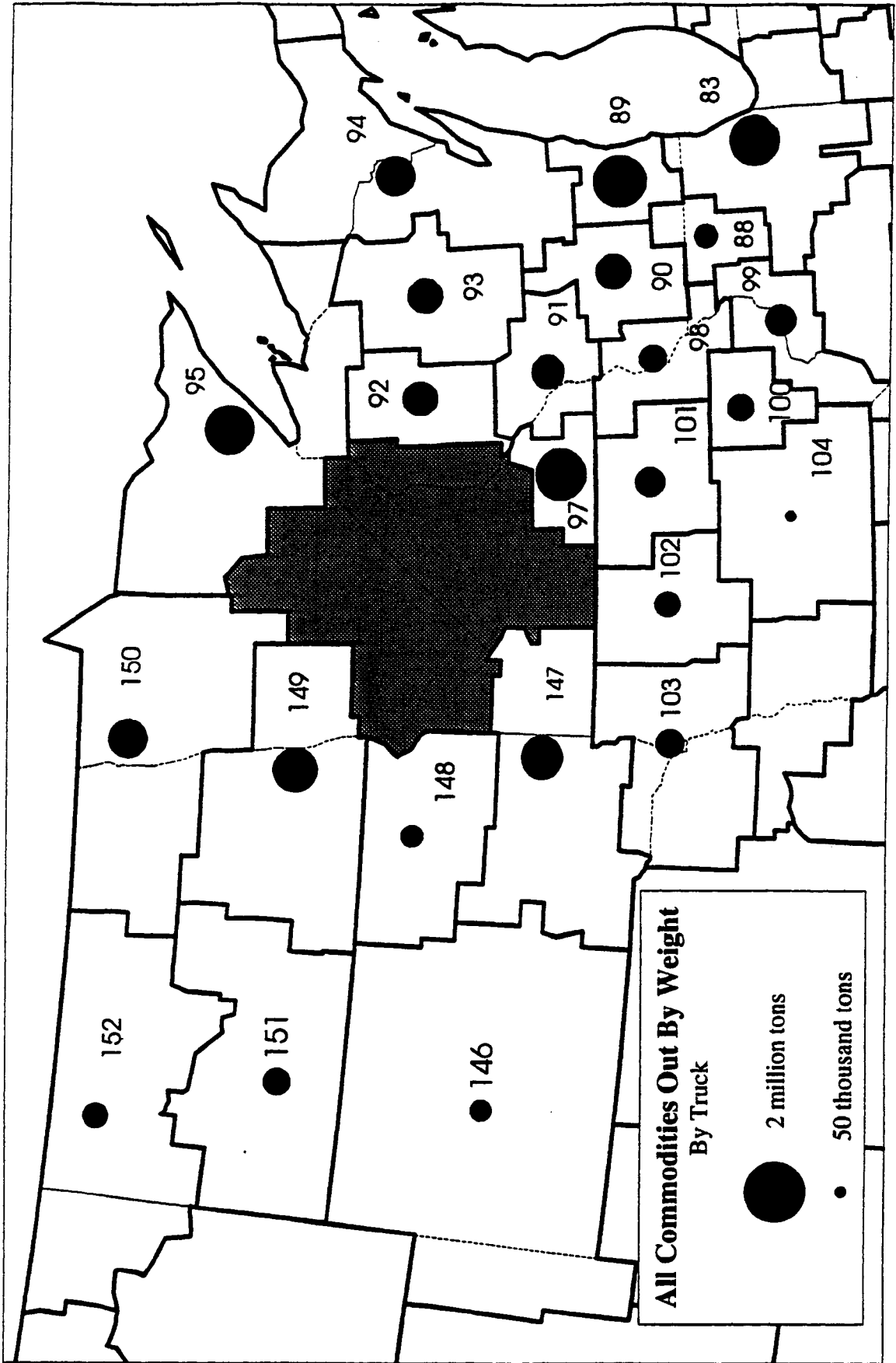
MAP 5.8 BEA 96 Rail Flows to Other Upper Midwest BEA Regions by Weight



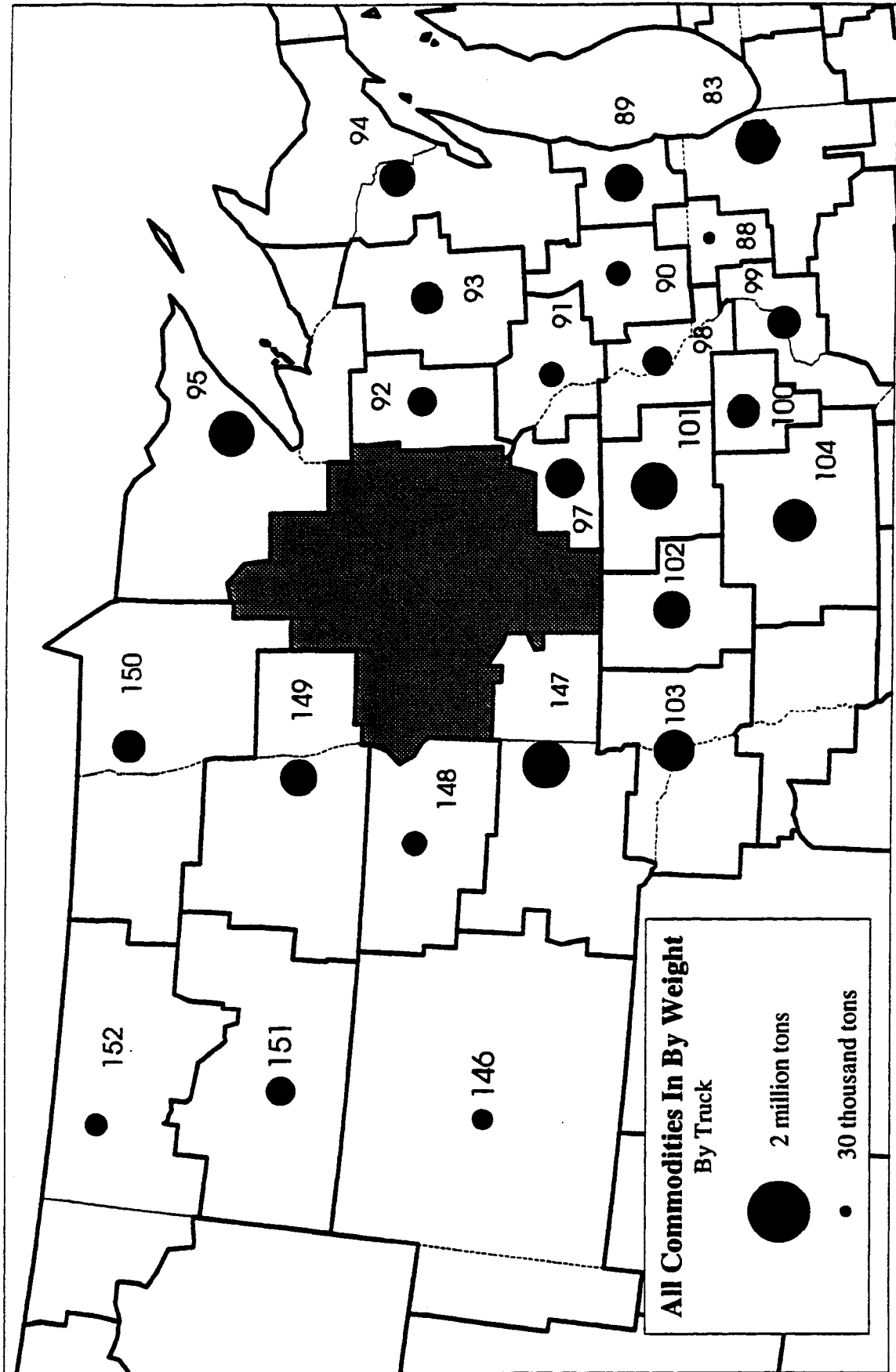
MAP 5.9 Upper Midwest Rail Flows into BEA 96 by Weight



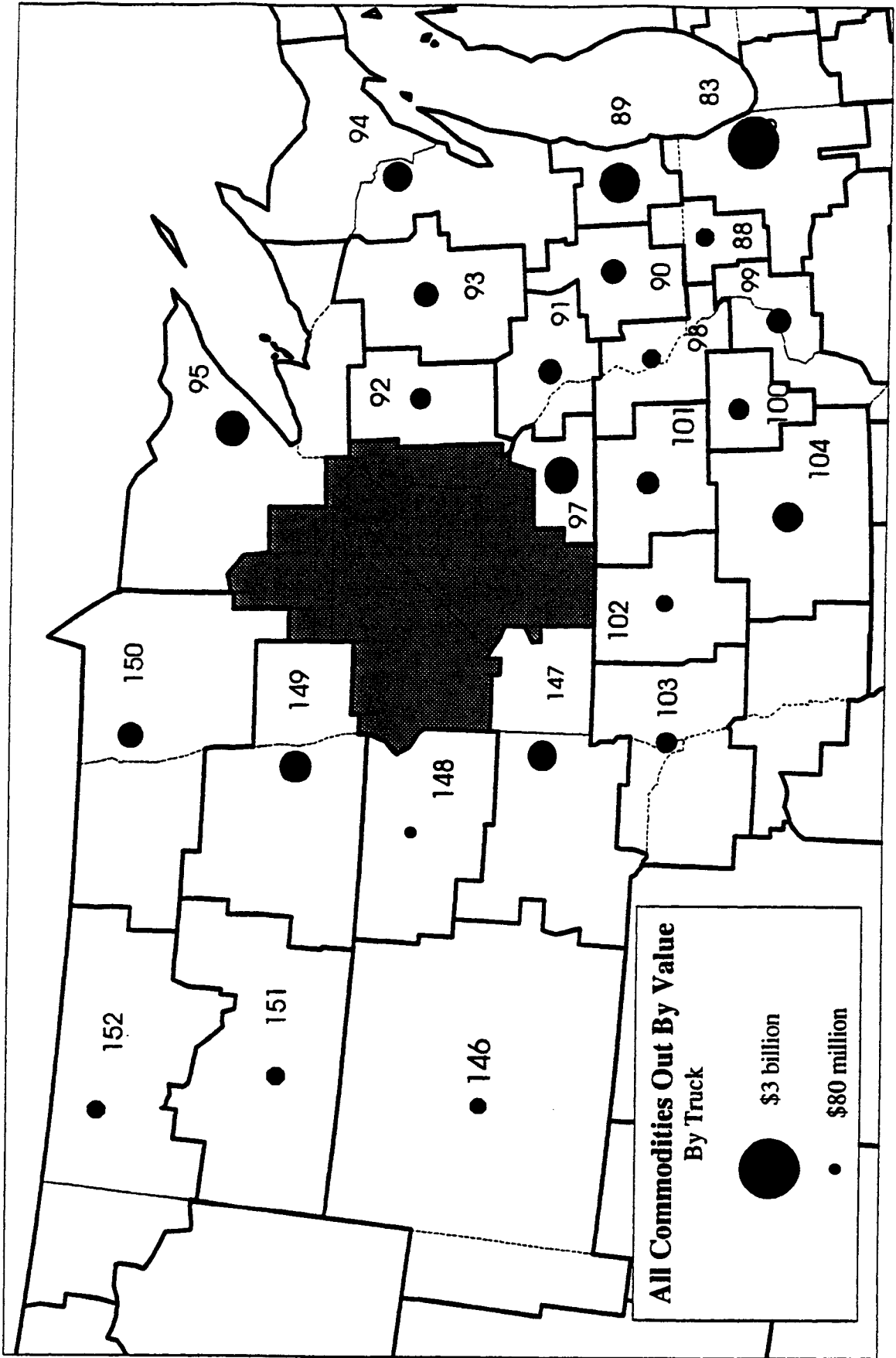
5.10 BEA 96 Rail Flows to Other Upper Midwest BEA Regions by Value



MAP 5.11 BEA 96 Truck Flows to Other Upper Midwest BEA Regions by Weight



5.12 Upper Midwest Truck Flows into BEA 96 by Weight



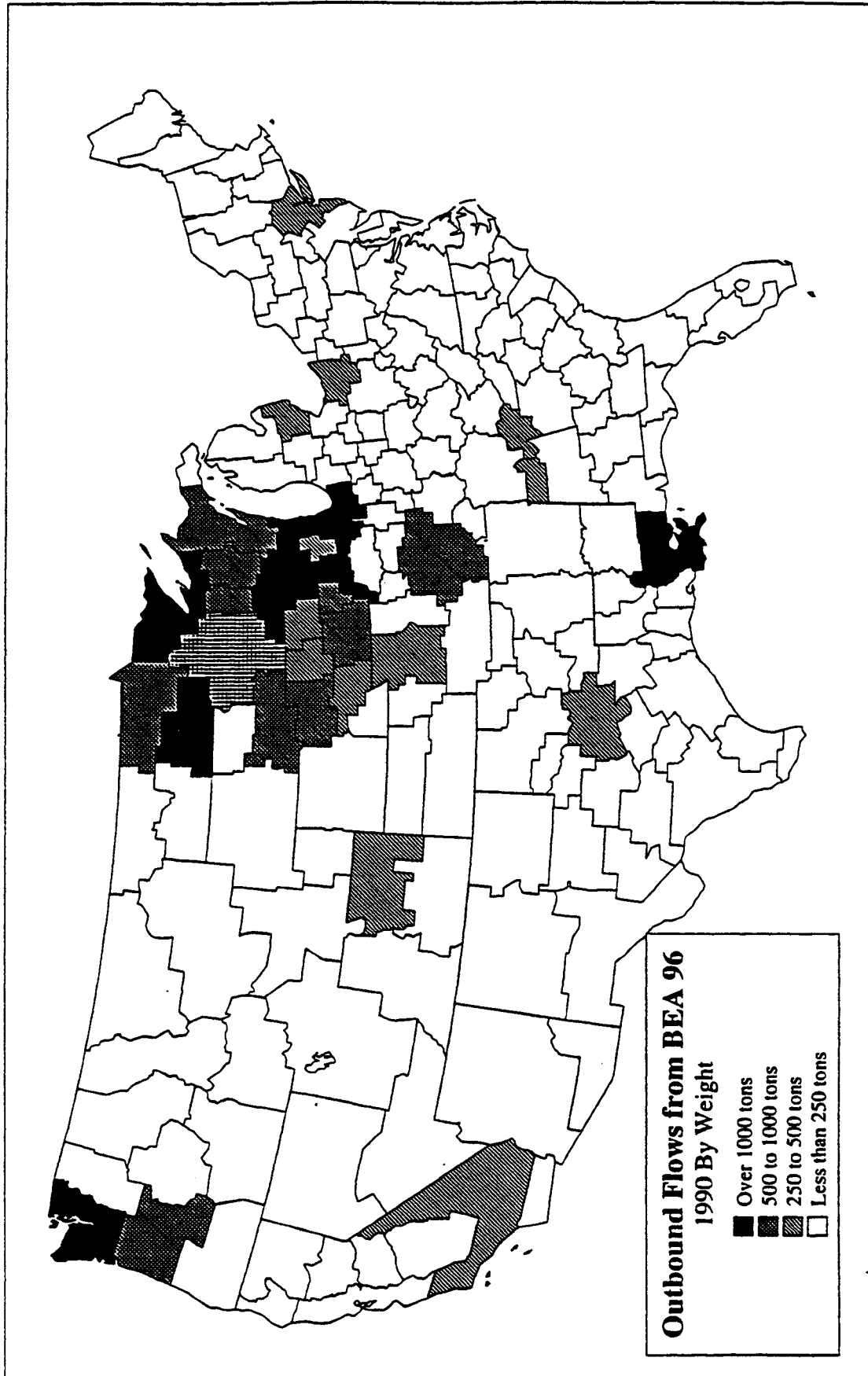
MAP 5.13 BEA 96 Truck Flows to Other Upper Midwest BEA Regions by Value

5.4 U.S. Flows

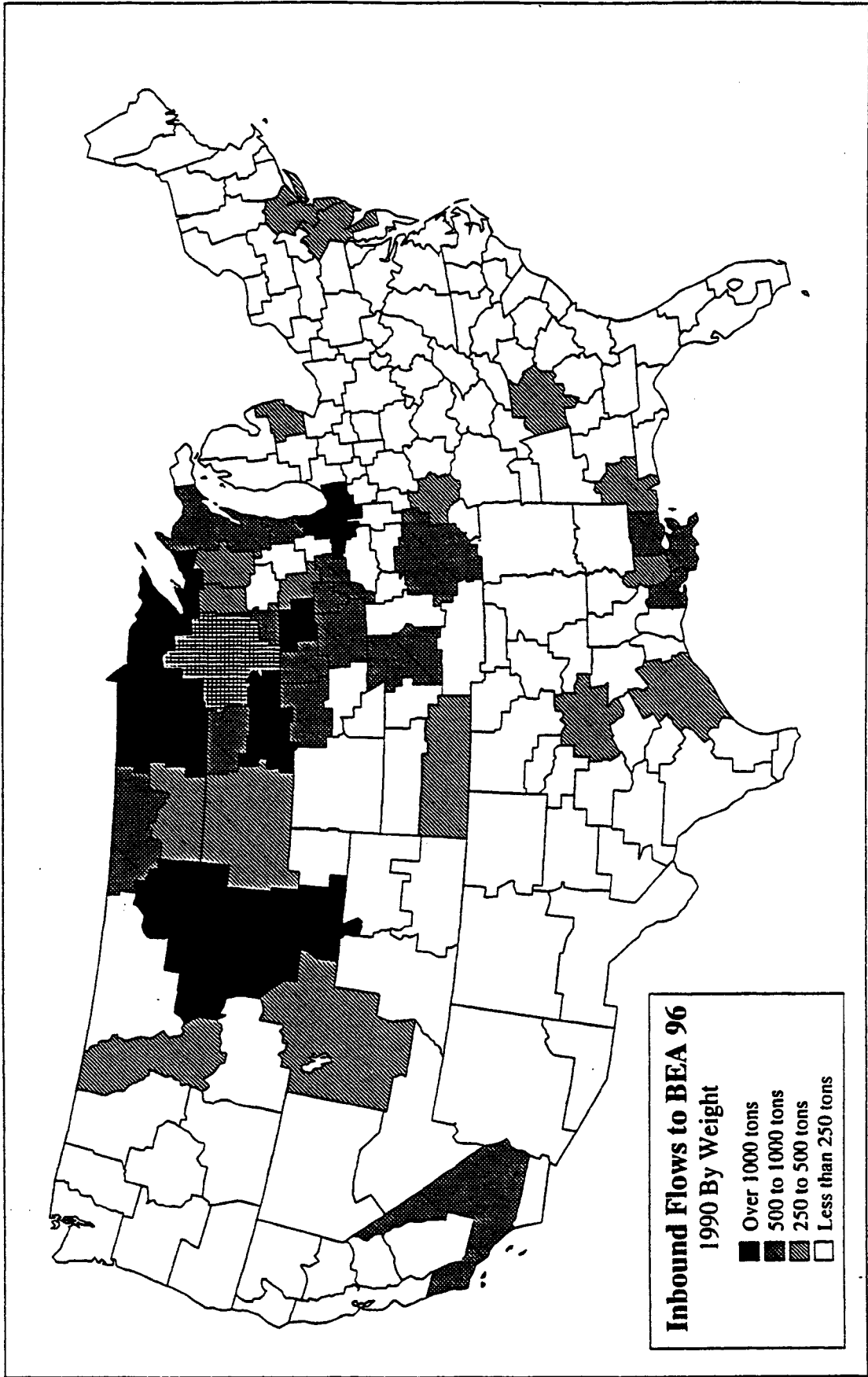
BEA 96 outbound and inbound flows to and from other BEAs within the contiguous United States are presented in this section. The following maps represent a wide range of freight flows between BEA 96 and other BEA regions in the United States. The first four (MAP 5.14 through MAP 5.17) show total shipments in and out by weight and value and are divided into four categories or ranges for purposes of presentation. The remaining maps represent the top ten origins and destinations for a variety of modes and commodities.

- 5.14 Outbound Flows from BEA 96 by Weight (four categories)
- 5.15 Inbound Flows to BEA 96 by Weight (four categories)
- 5.16 Outbound Flows from BEA 96 by Value (four categories)
- 5.17 Inbound Flows from BEA 96 by Value (four categories)
- 5.18 Top 10 Origins of Shipments to BEA 96 (all modes/all commodities/by weight)
- 5.19 Top 10 Origins of Shipments to BEA 96 (all modes/all commodities/by value)
- 5.20 Top 10 Destinations of Shipments from BEA 96 (all modes/all commodities/by weight)
- 5.21 Top 10 Destinations of Shipments from BEA 96 (all modes/all commodities/by value)
- 5.22 Top 10 Destinations of Farm Products (all modes/by weight)
- 5.23 Top 10 Destinations of Food Products (all modes/by weight)
- 5.24 Top 10 Destinations of Manufactured Products (SIC 20-39) (all modes/by weight)
- 5.25 Top 10 Destinations of Machinery (SIC 35) (all modes/by weight)
- 5.26 Top 10 Origins of Rail Shipments (by weight)
- 5.27 Top 10 Origins of Rail Shipments (by value)
- 5.28 Top 10 Destinations of Rail Shipments (by weight)
- 5.29 Top 10 Destinations of Rail Shipments (by value)
- 5.30 Top 10 Origins of Truck Shipments (by weight)
- 5.31 Top 10 Origins of Truck Shipments (by value)
- 5.32 Top 10 Destinations of Truck Shipments (by weight)
- 5.33 Top 10 Destinations of Truck Shipments (by value)
- 5.34 Top 10 Origins of Air Shipments (by weight)
- 5.35 Top 10 Origins of Air Shipments (by value)
- 5.36 Top 10 Destinations of Air Shipments (by weight)
- 5.37 Top 10 Destinations of Air Shipments (by value)
- 5.38 Top 10 Origins of Water Shipments (by weight)
- 5.39 Top 10 Origins of Water Shipments (by value)
- 5.40 Top 10 Destinations of Water Shipments (by weight)
- 5.41 Top 10 Destinations of Water Shipments (by value)

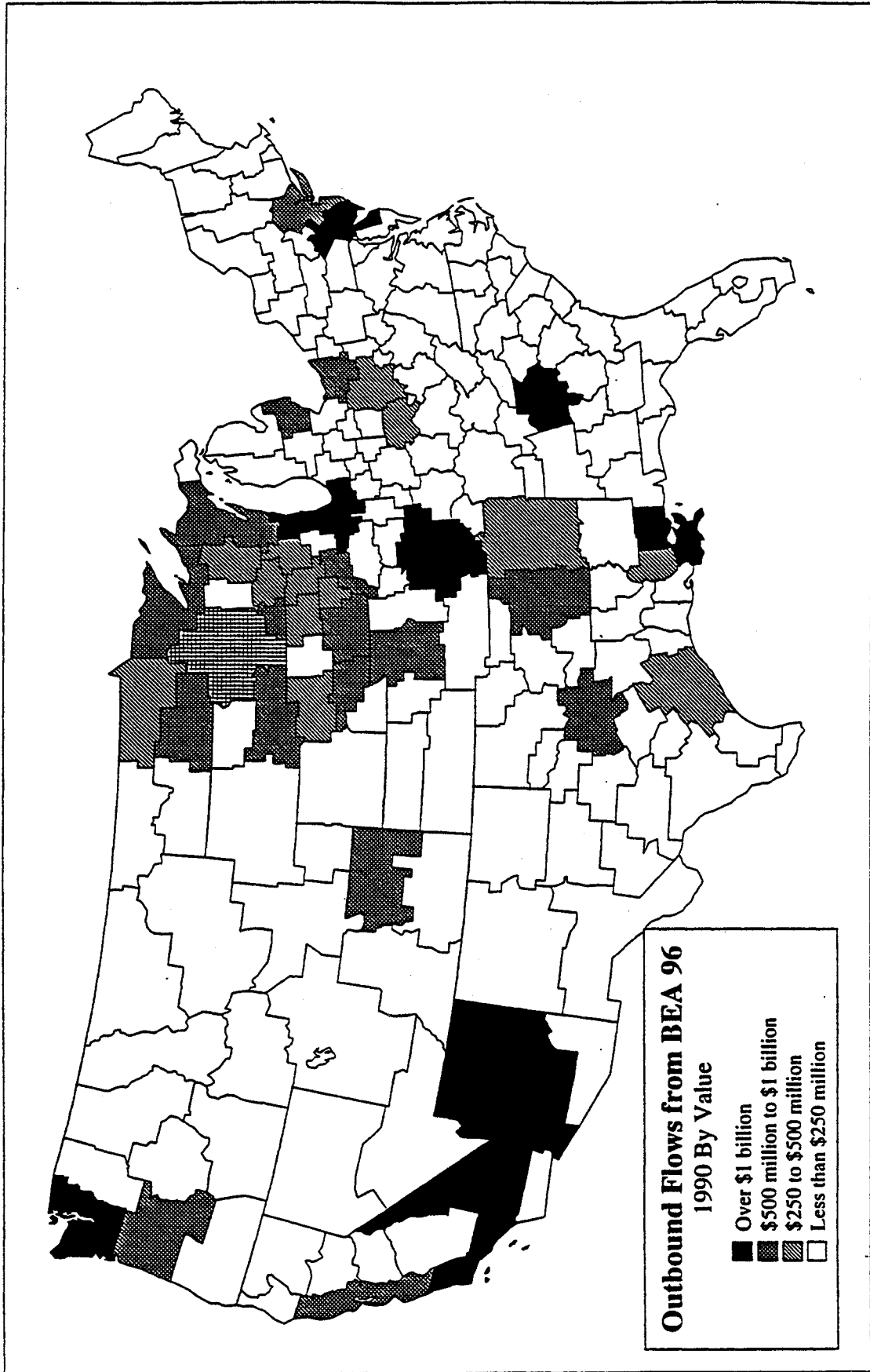
The top ten origins and destinations by weight or value are shown at the bottom of each of the maps. Interpretation of the data is left to the reader since a detailed evaluation of these data is beyond the scope of this data compilation and synthesis.



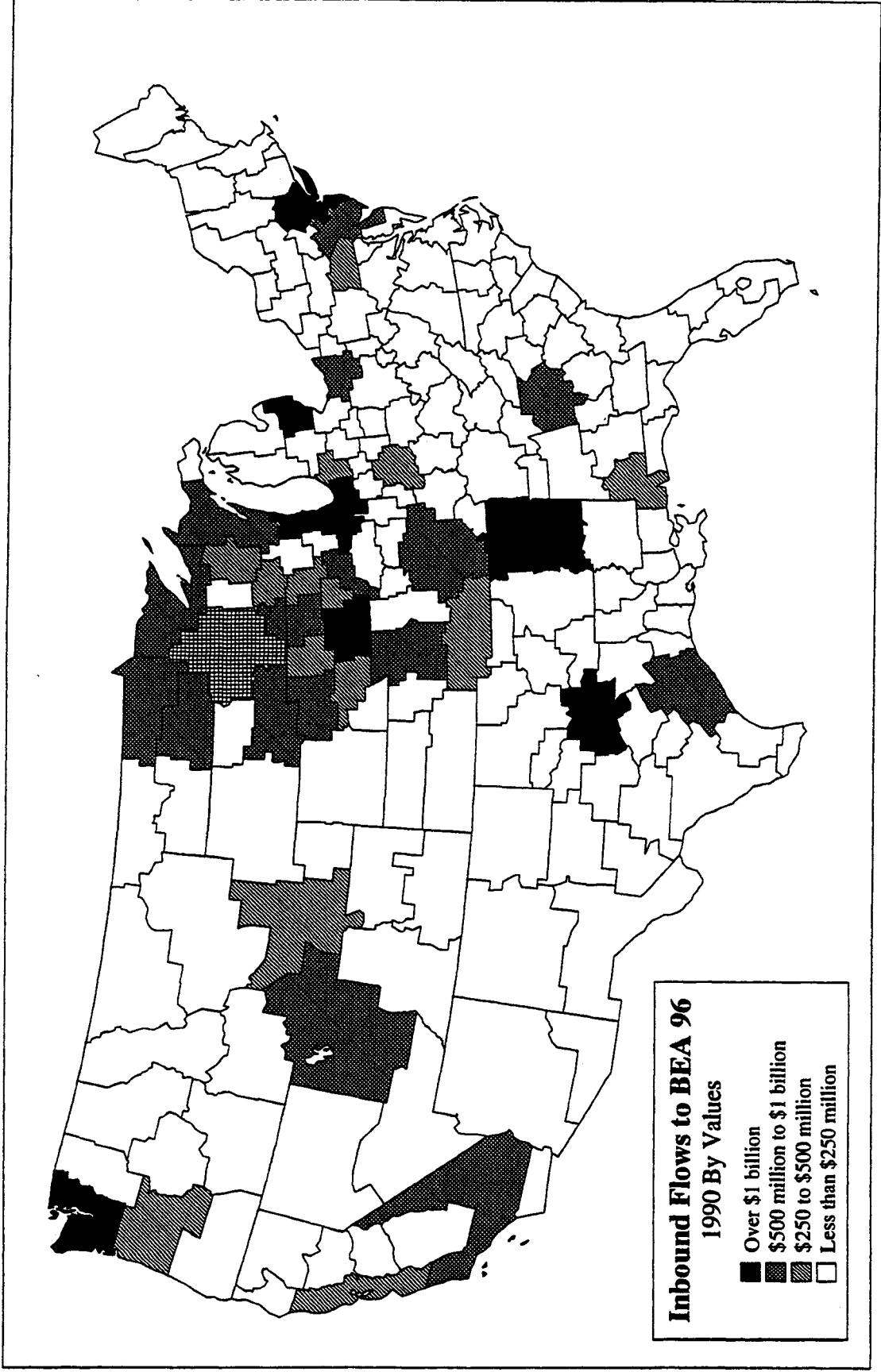
MAP 5.14 Outbound Flows from BEA 96 by Weight (four categories)



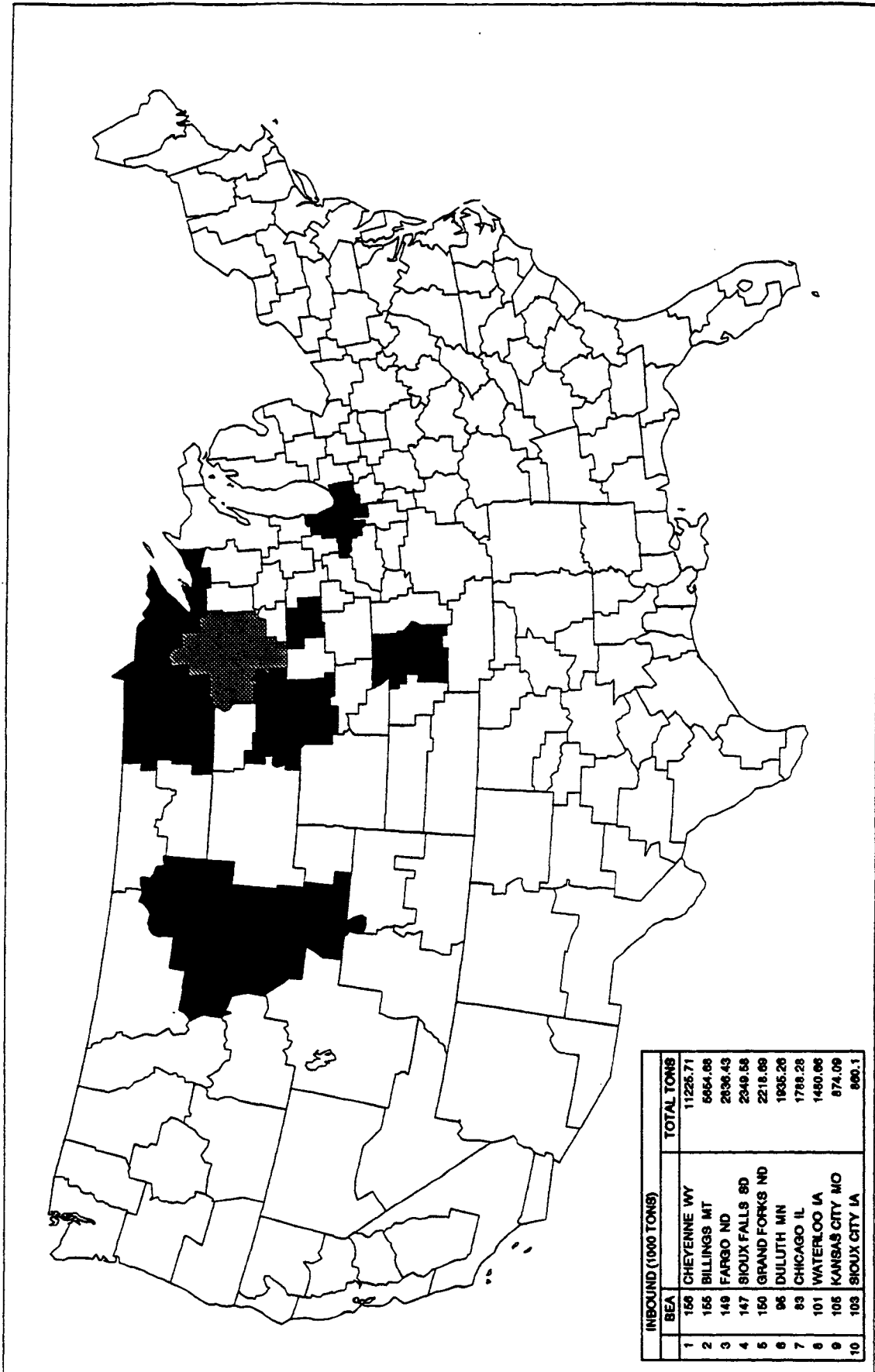
MAP 5.15 Inbound Flows to BEA 96 by Weight (four categories)



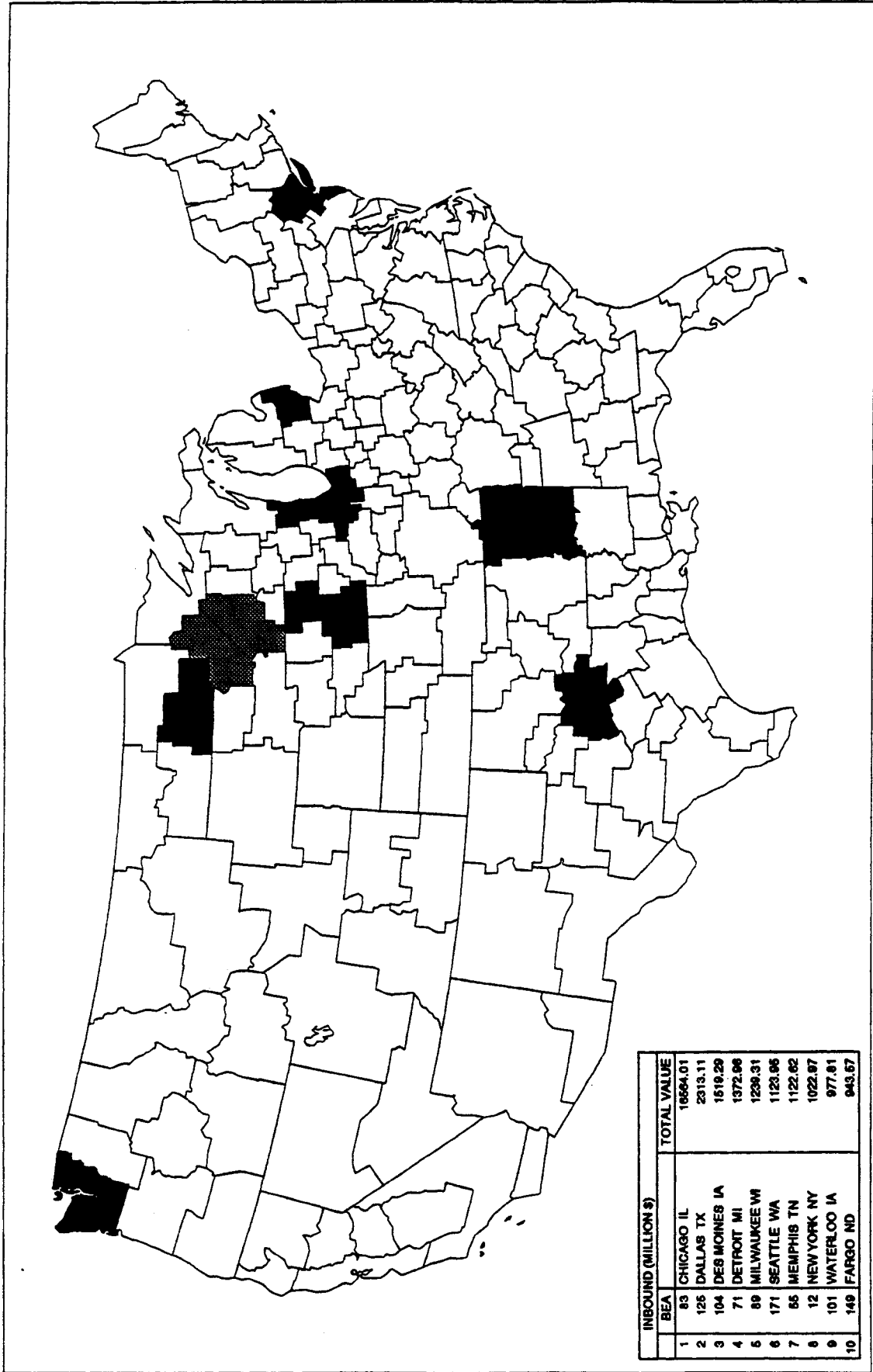
MAP 5.16 Outbound Flows from BEA 96 by Value (four categories)



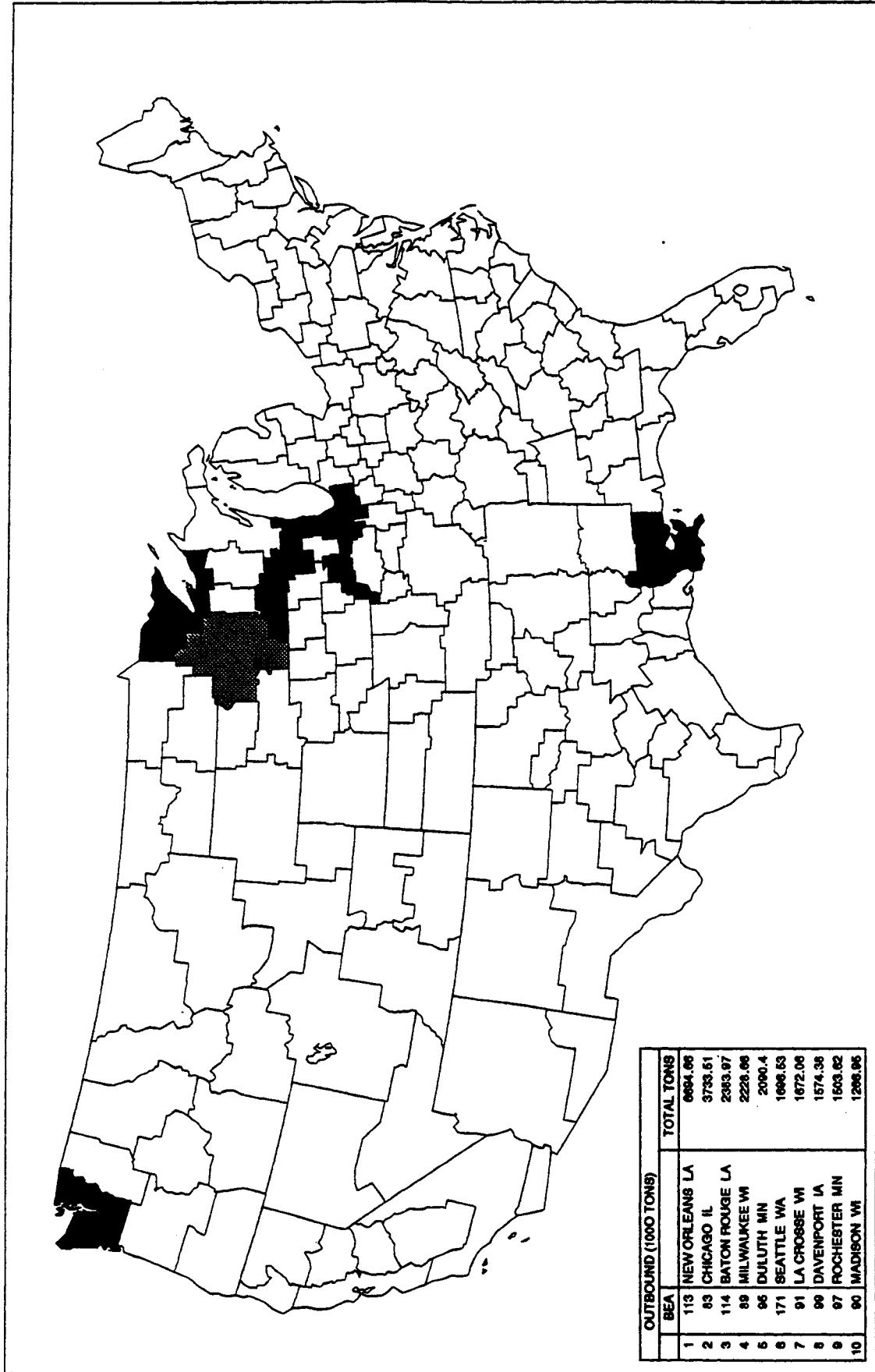
MAP 5.17 Inbound Flows from BEA 96 by Value (four categories)



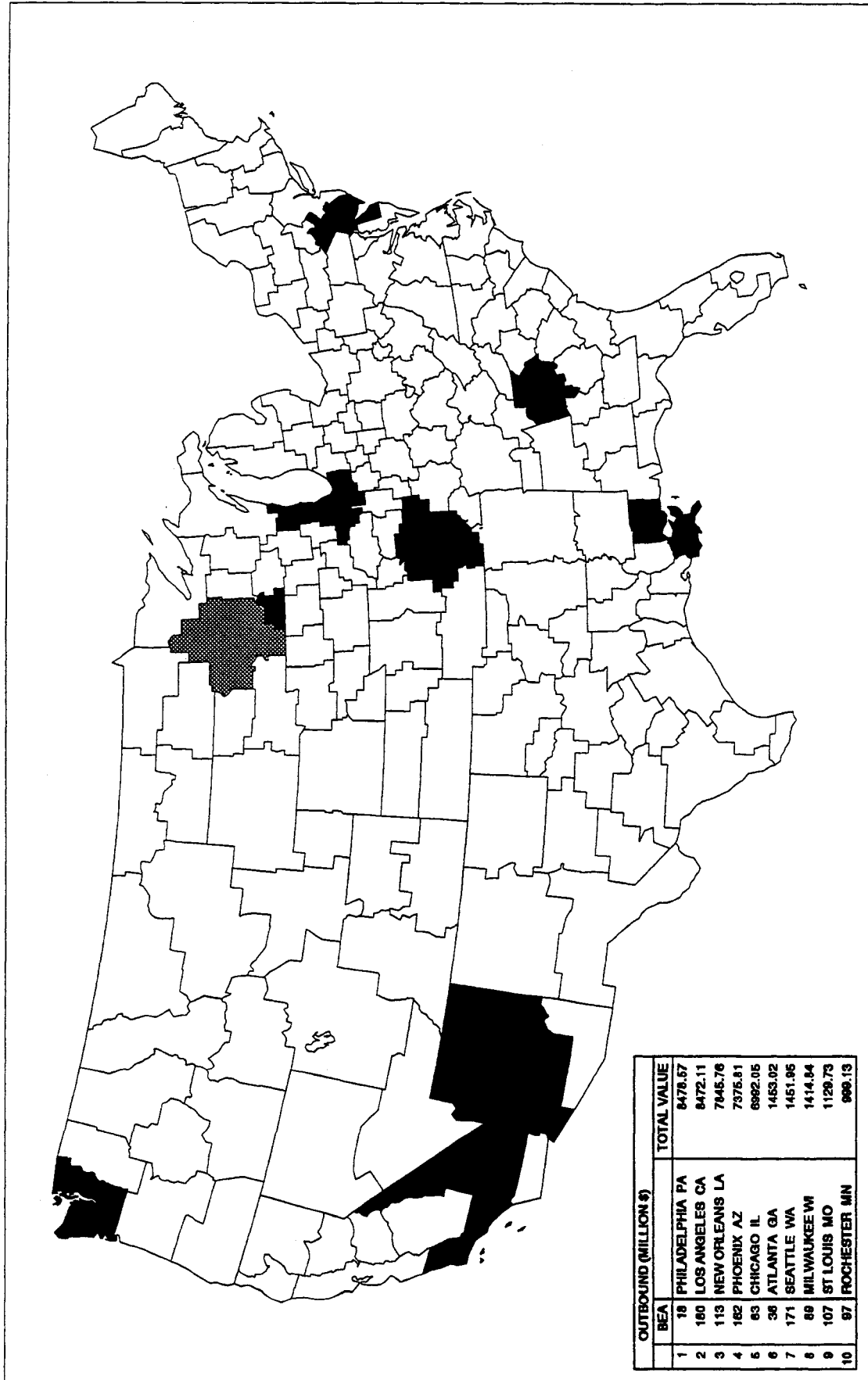
MAP 5.18 Top 10 Origins of Shipments to BEA 96 (all modes/all commodities/by weight)



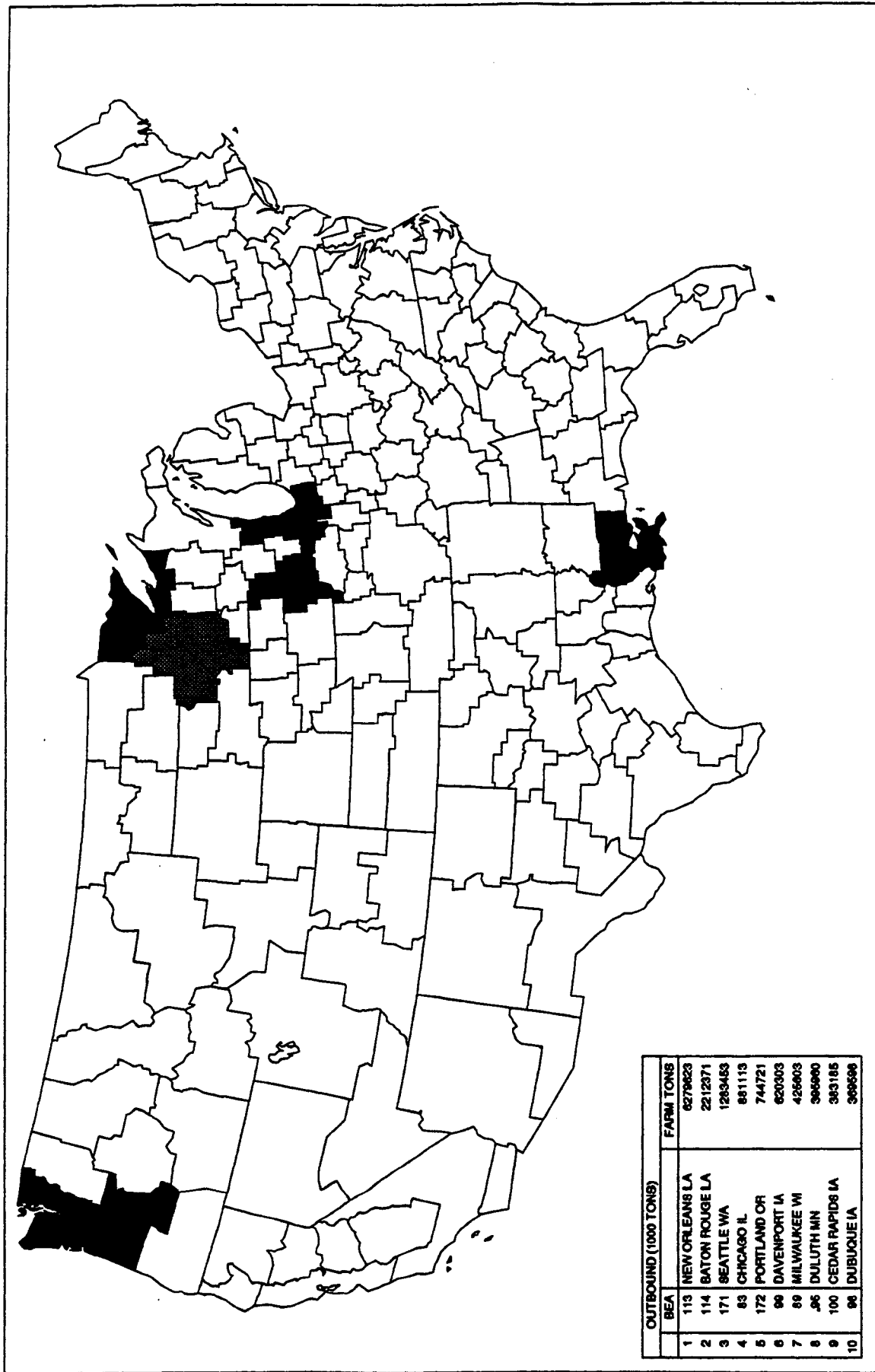
MAP 5.19 Top 10 Origins of Shipments to BEA 96 (all modes/all commodities/by value)



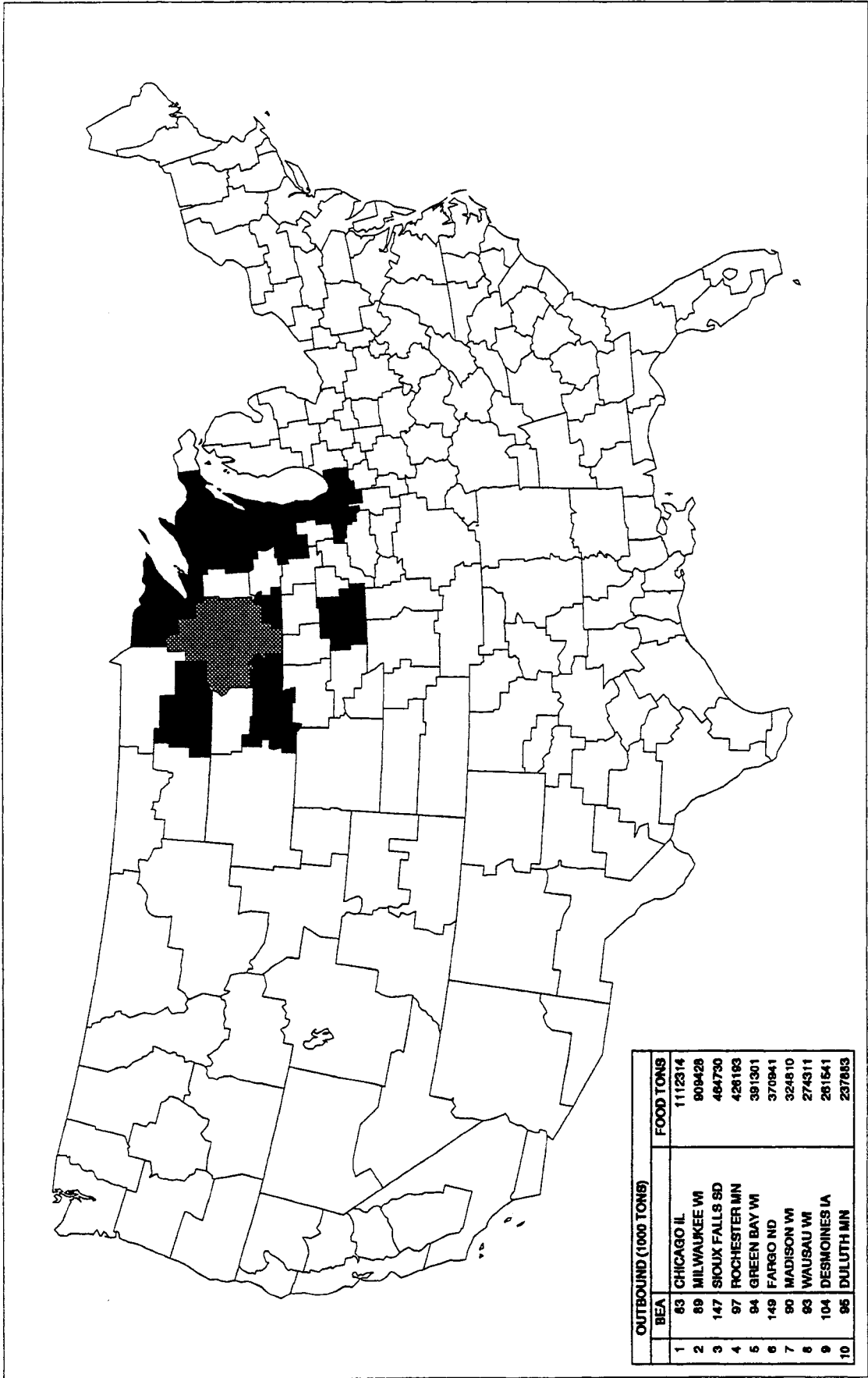
MAP 5.20 Top 10 Destinations of Shipments from BEA 96 (all modes/all commodities/by weight)



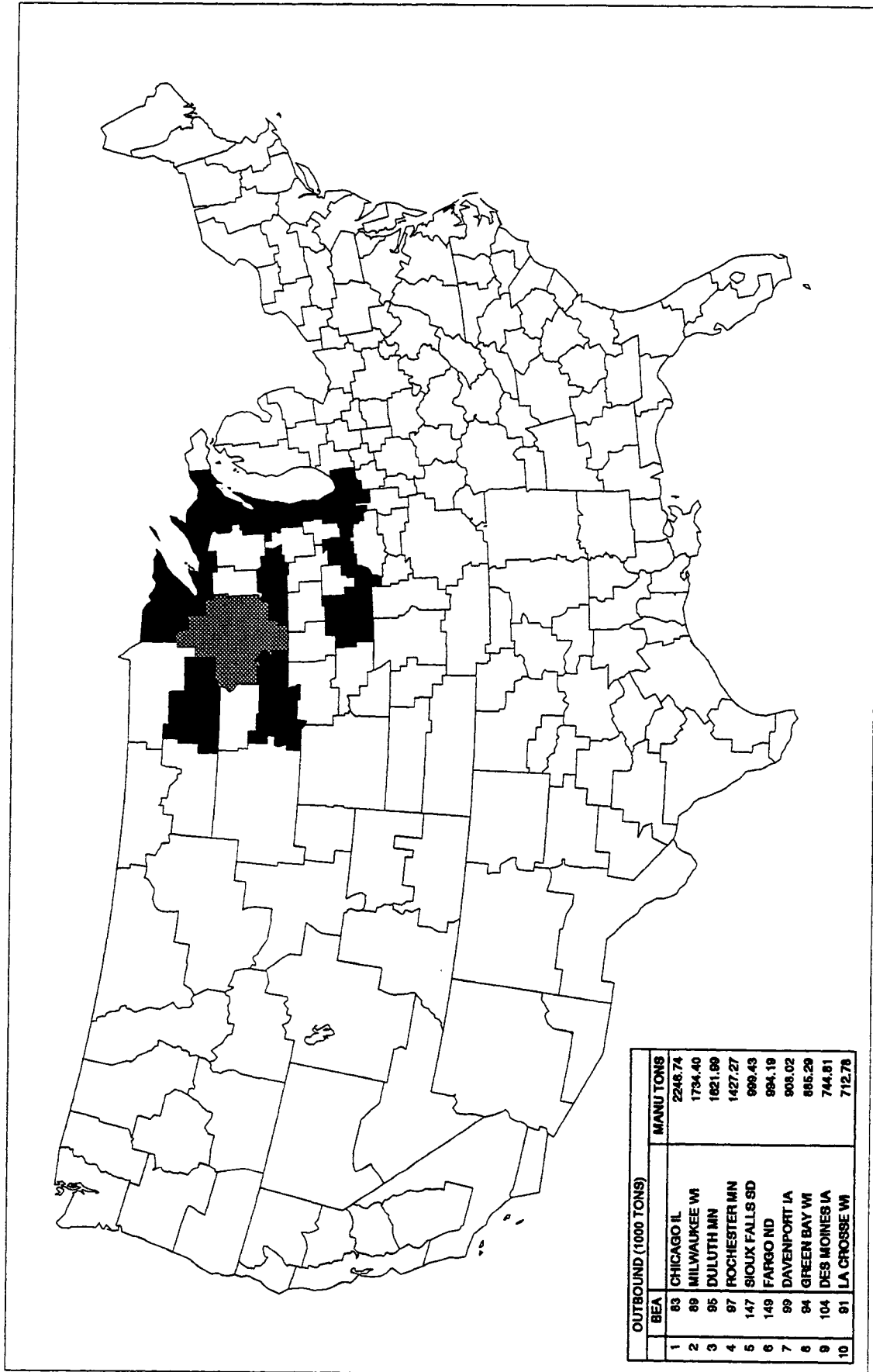
MAP 5.21 Top 10 Destinations of Shipments from BEA 96 (all modes/all commodities/by value)



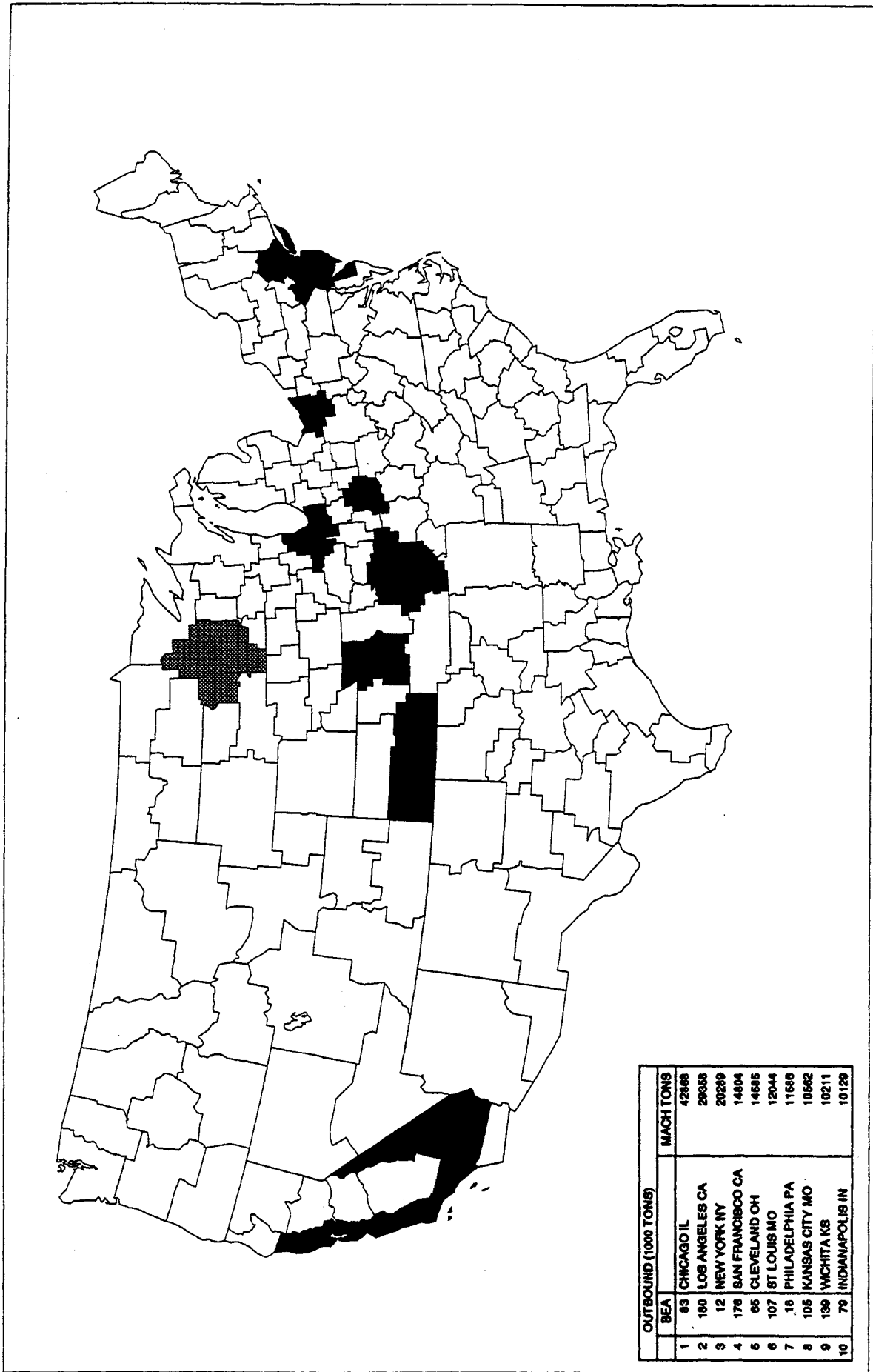
MAP 5.22 Top 10 Destinations of Farm Products (all modes/by weight)



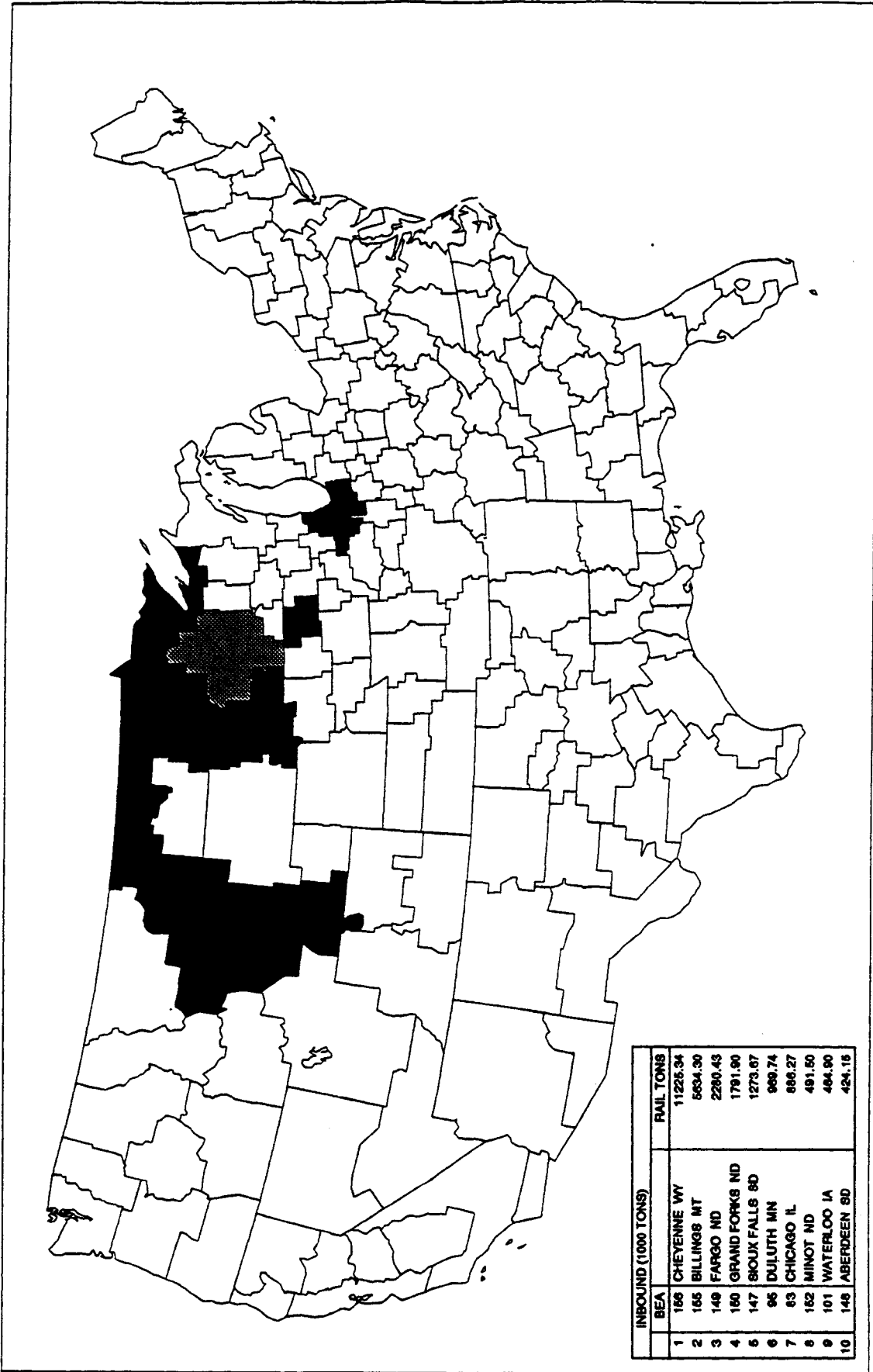
MAP 5.23 Top 10 Destinations of Food Products (all modes/by weight)



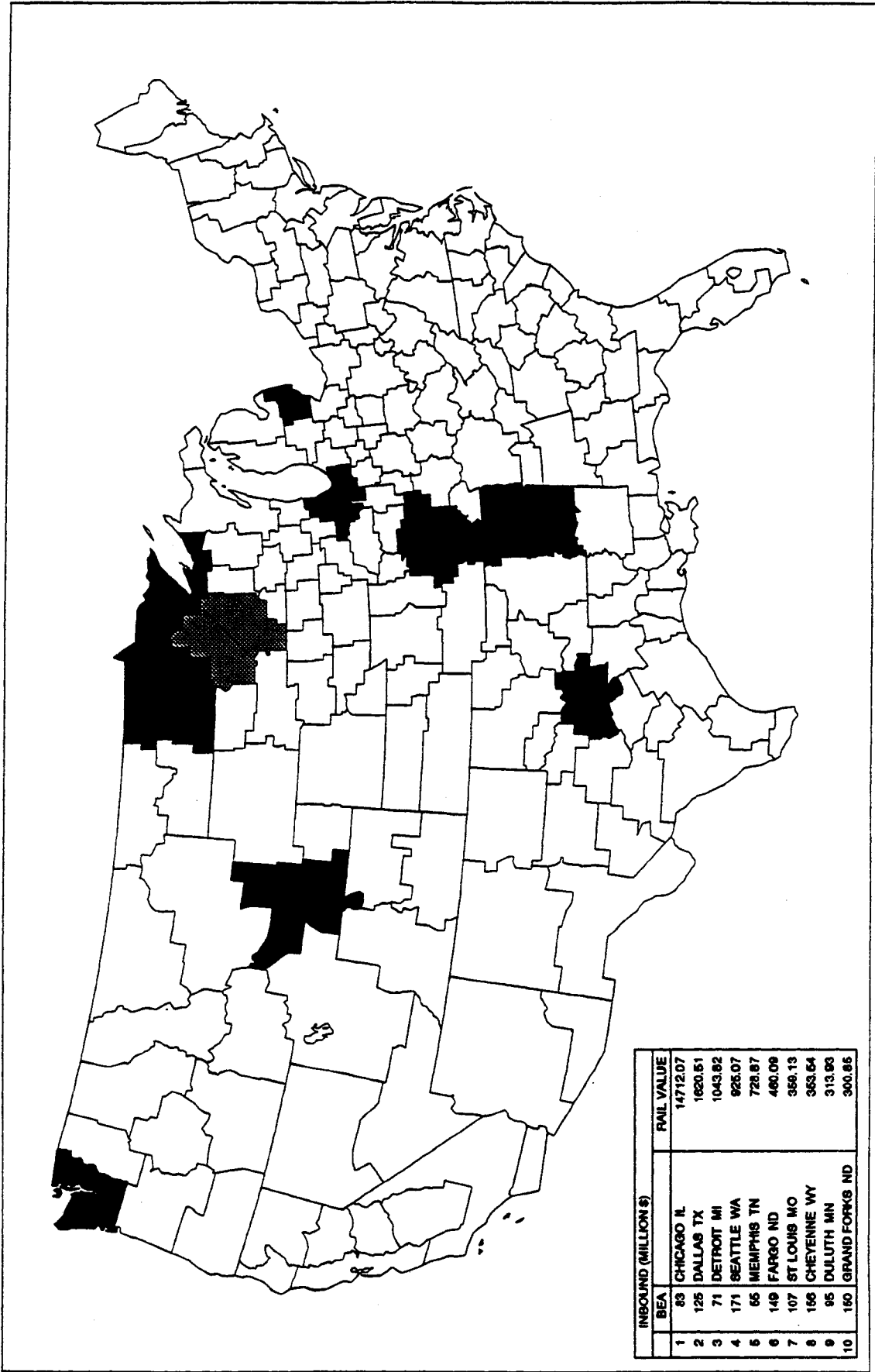
MAP 5.24 Top 10 Destinations of Manufactured Products (SIC 20-39) (all modes/by weight)



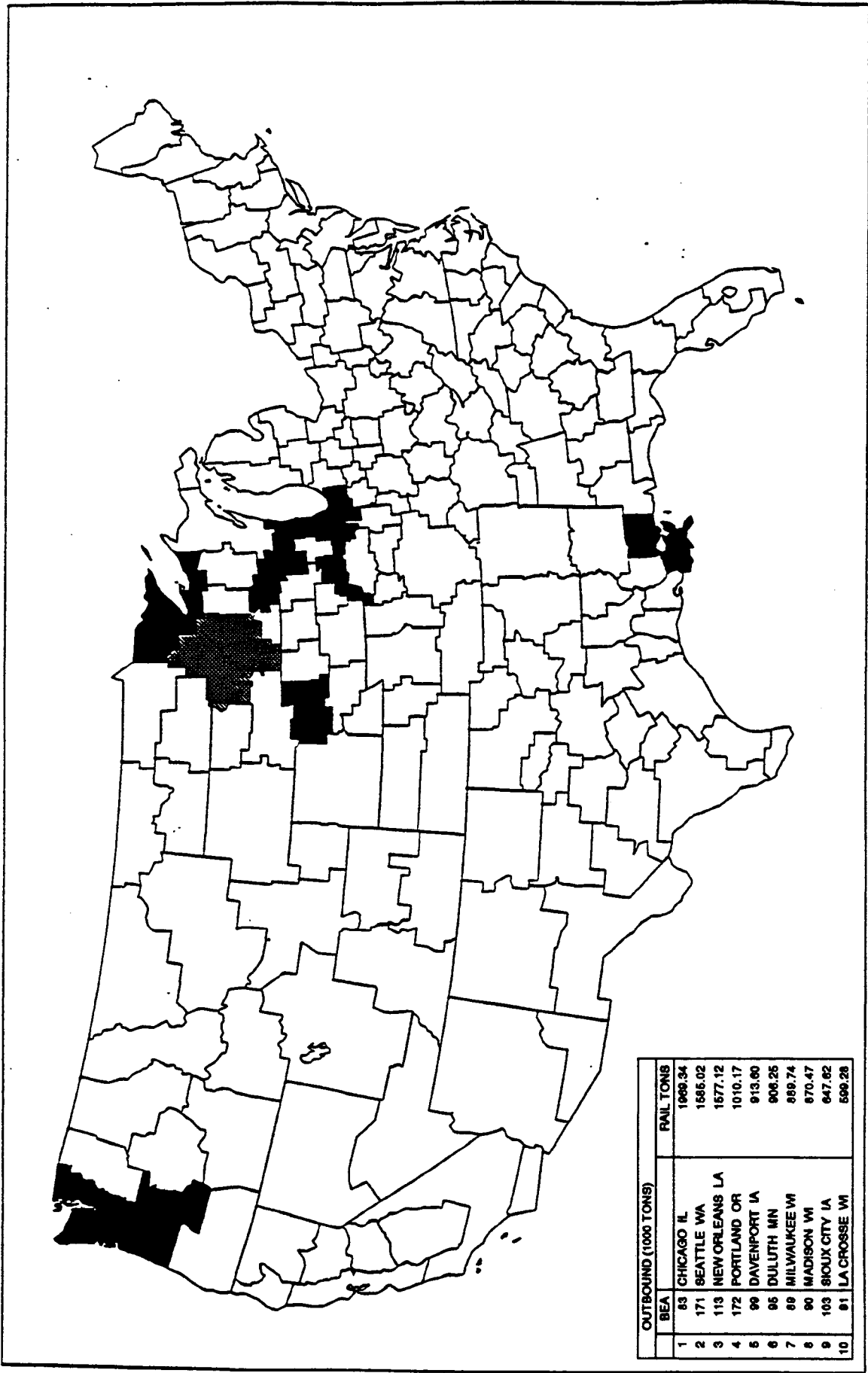
MAP 5.25 Top 10 Destinations of Machinery (SIC 35) (all modes/by weight)



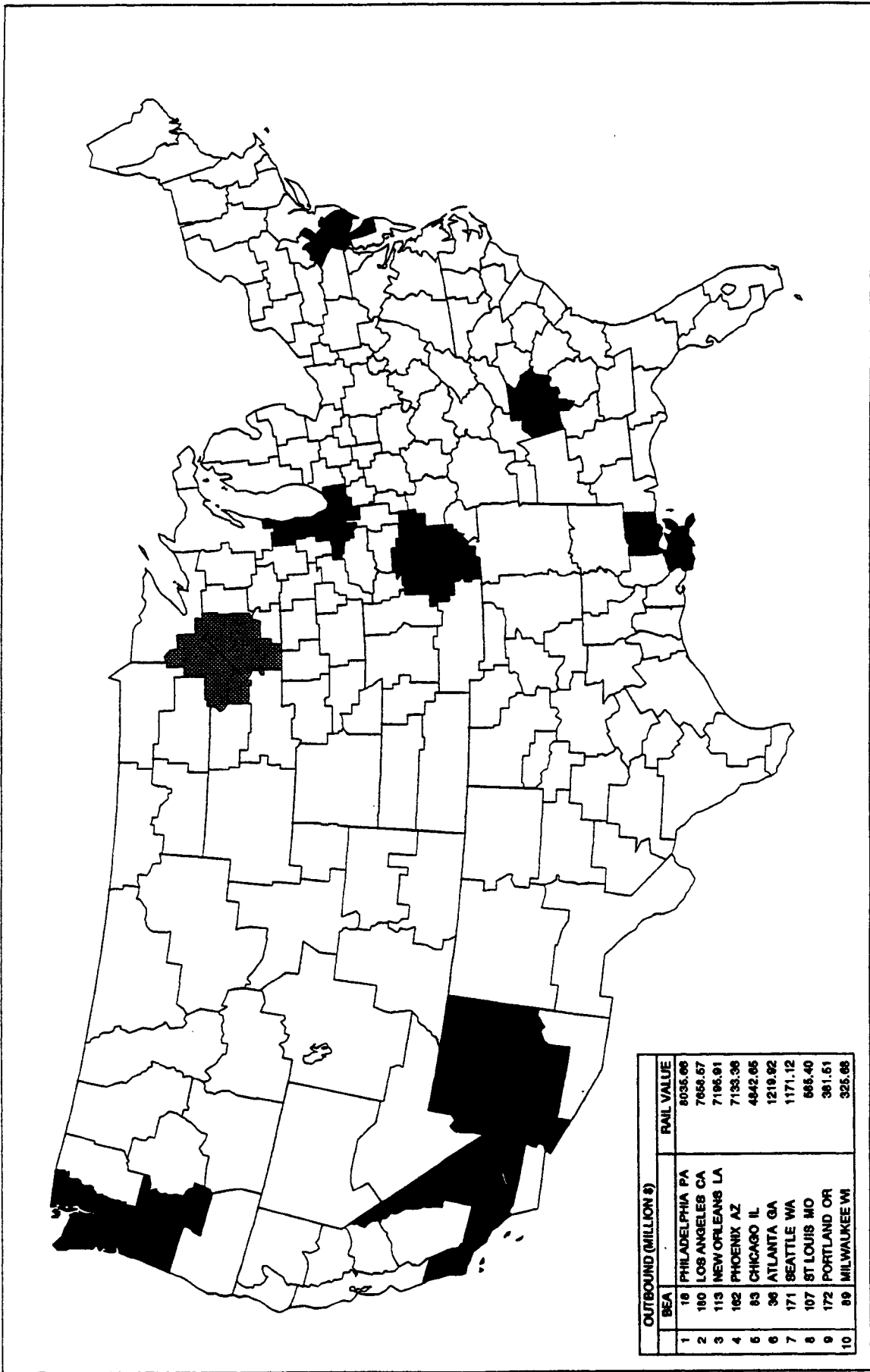
MAP 5.26 Top 10 Origins of Rail Shipments (by weight)



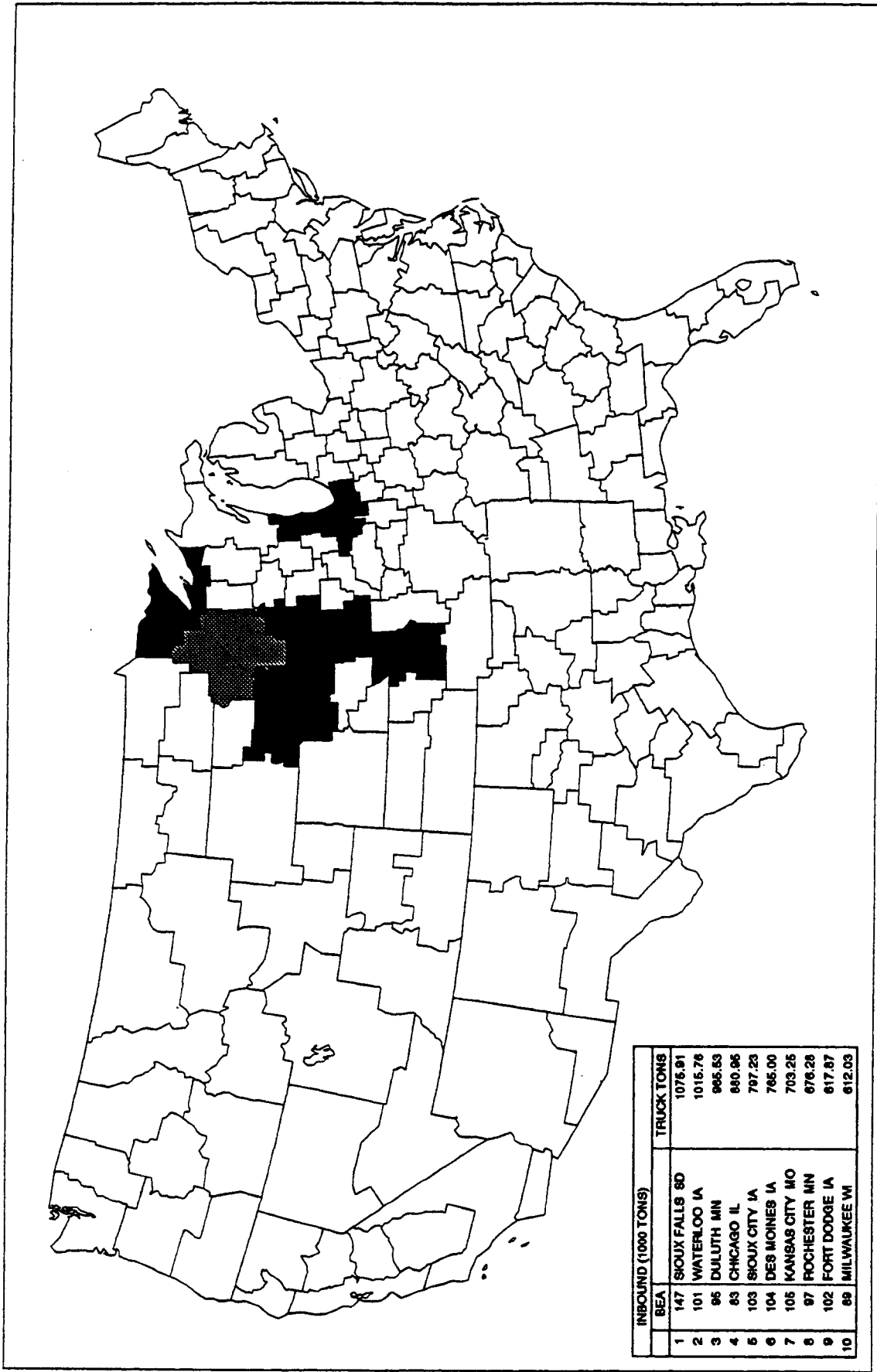
MAP 5.27 Top 10 Origins of Rail Shipments (by value)



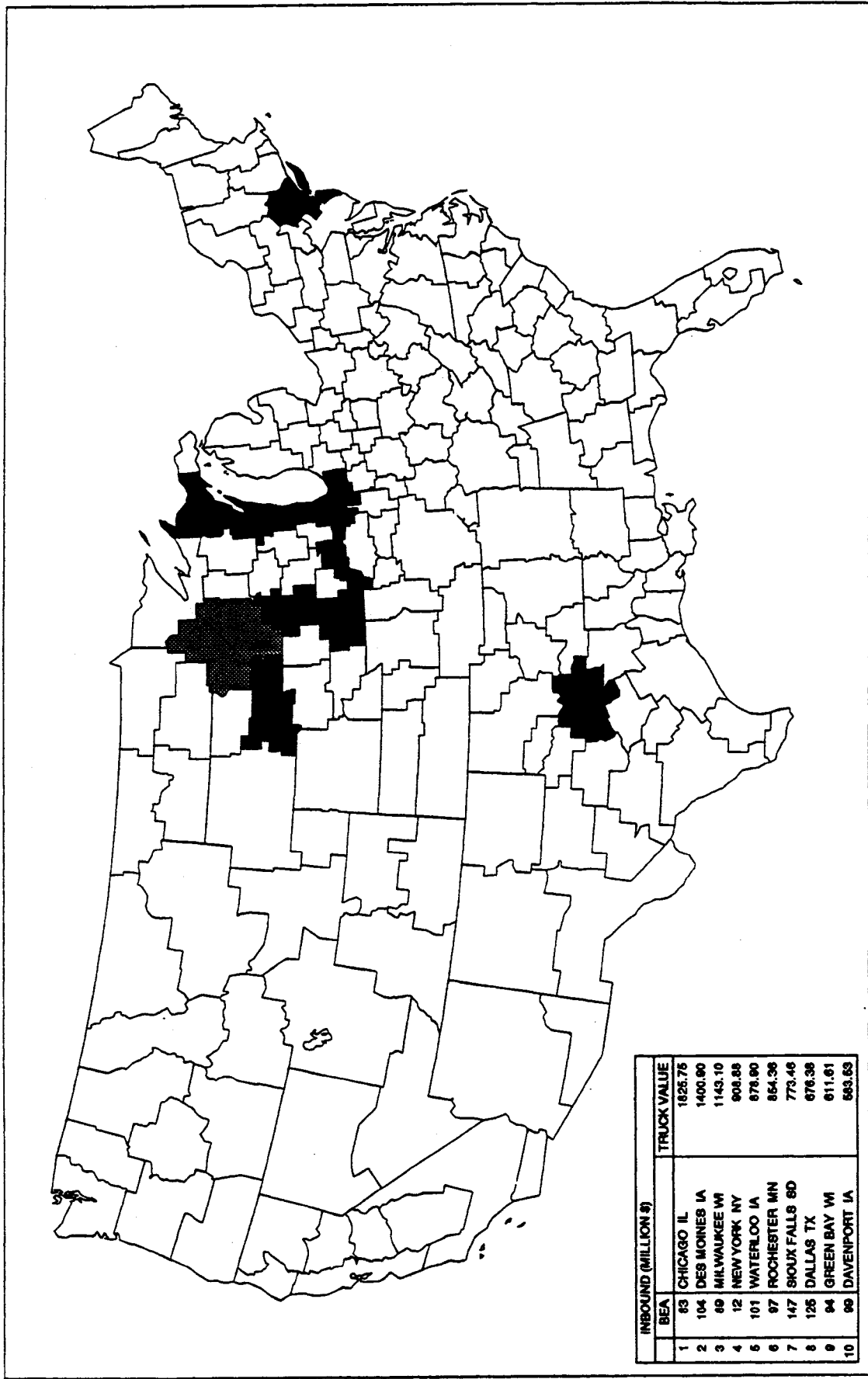
MAP 5.28 Top 10 Destinations of Rail Shipments (by weight)



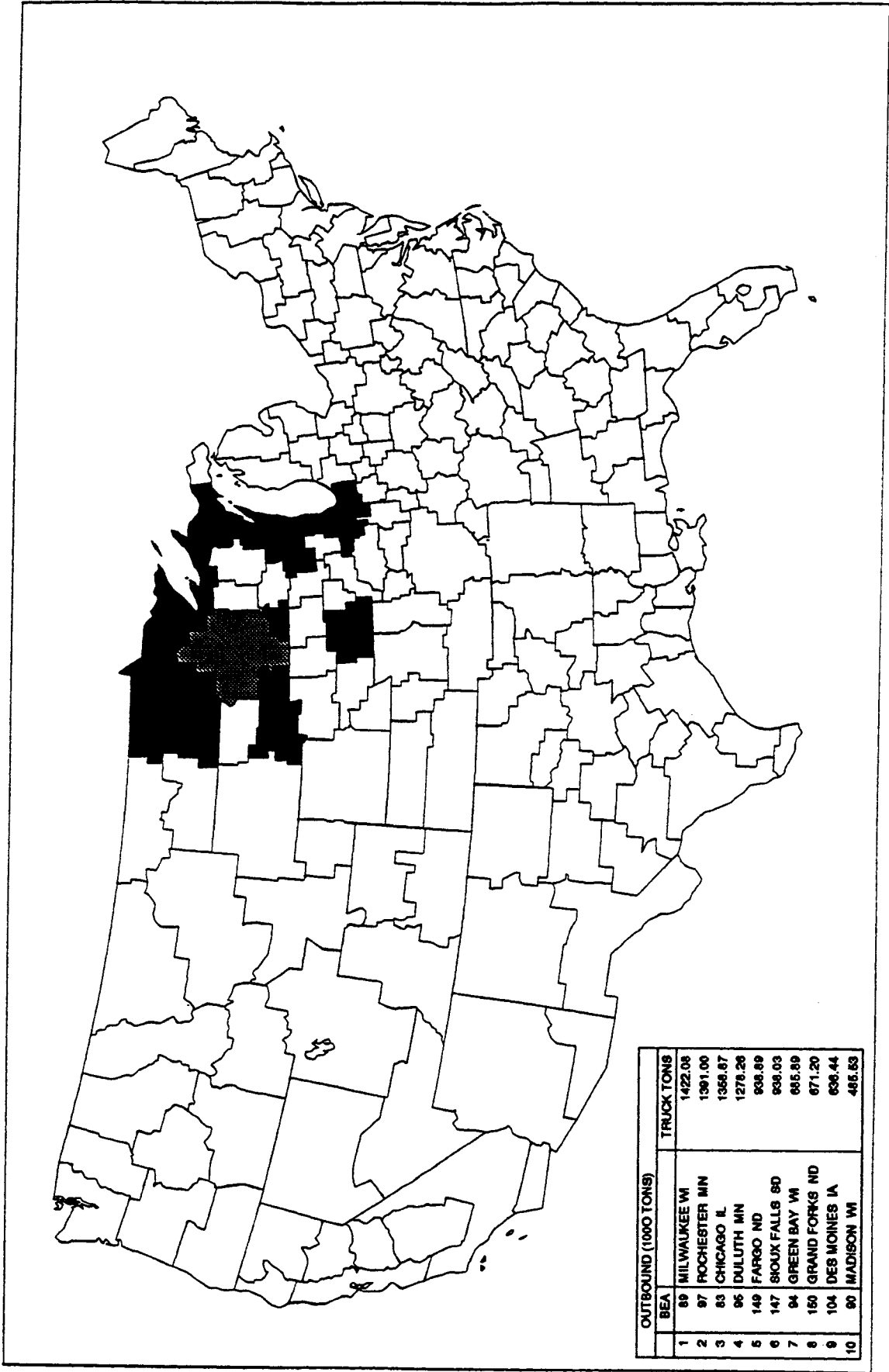
MAP 5.29 Top 10 Destinations of Rail Shipments (by value)



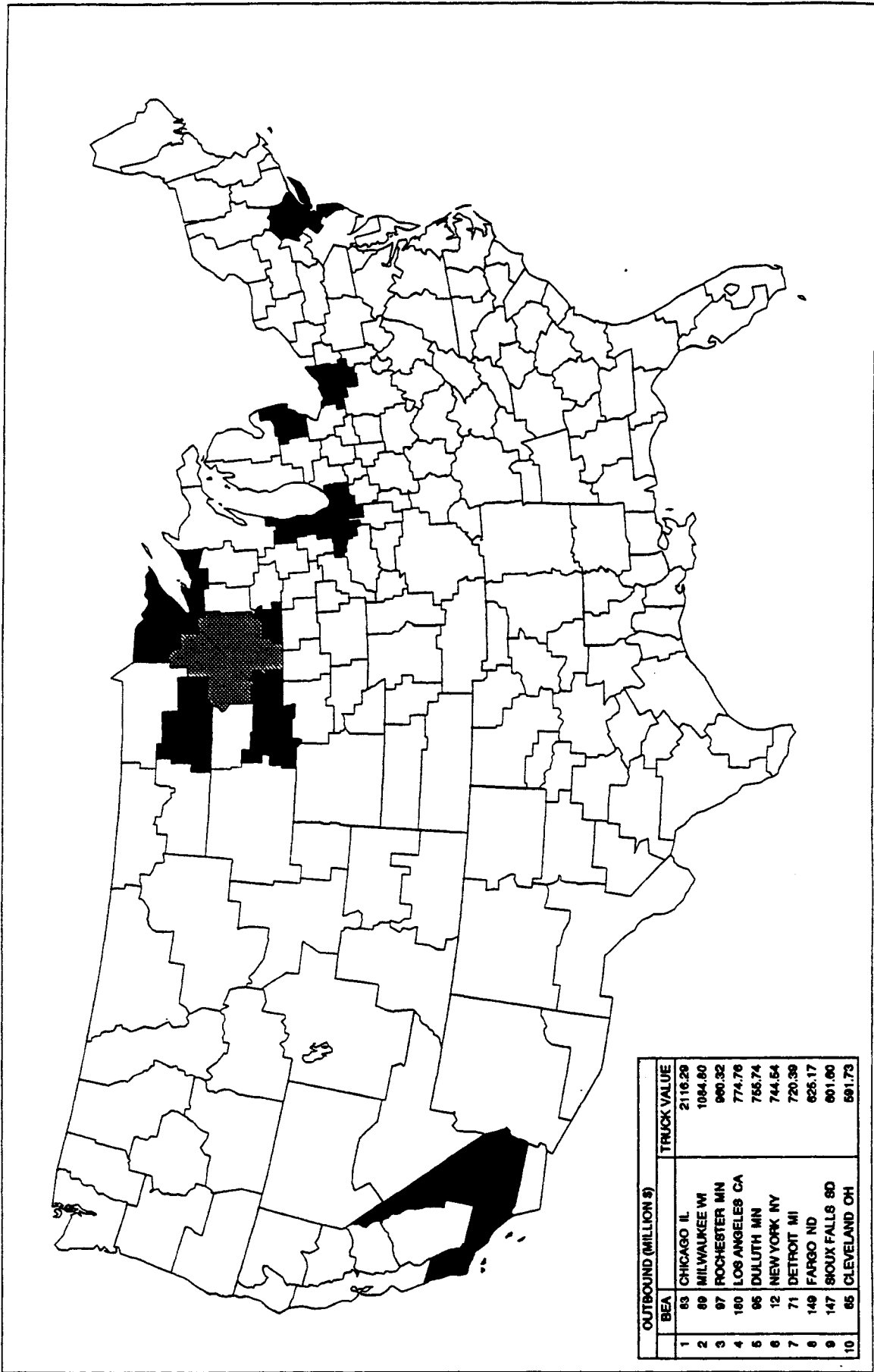
MAP 5.30 Top 10 Origins of Truck Shipments (by weight)



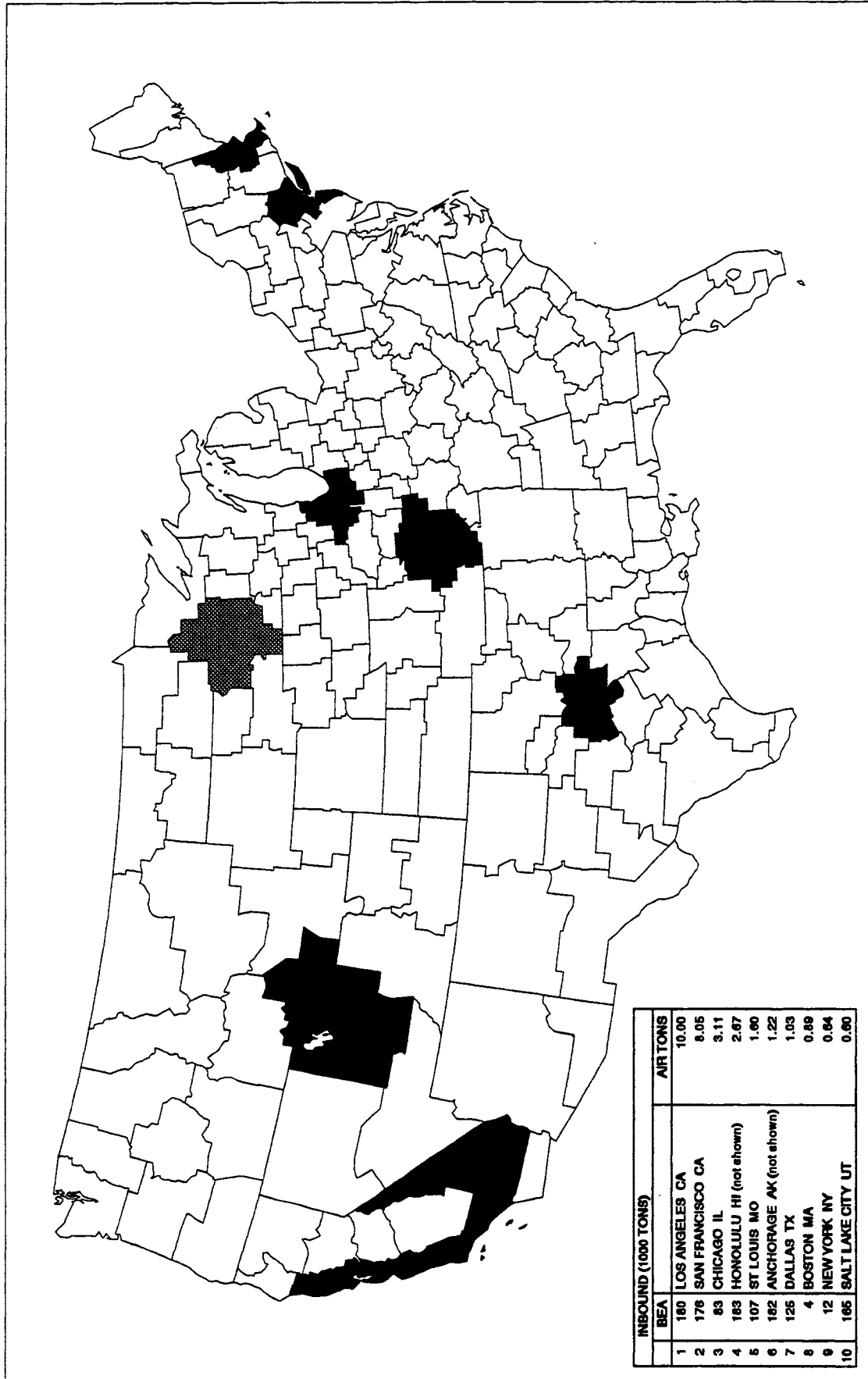
MAP 5.31 Top 10 Origins of Truck Shipments (by value)



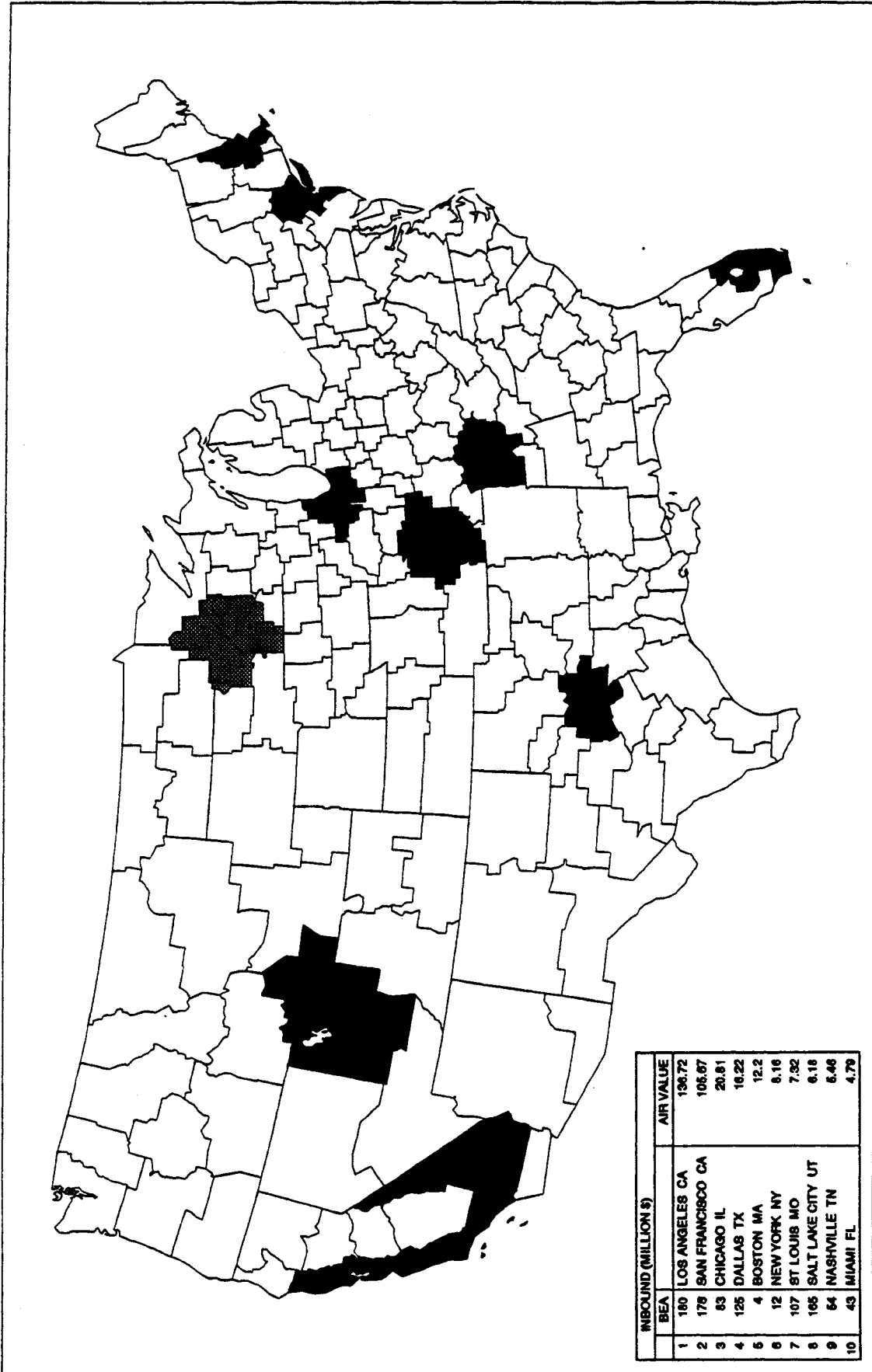
MAP 5.32 Top 10 Destinations of Truck Shipments (by weight)



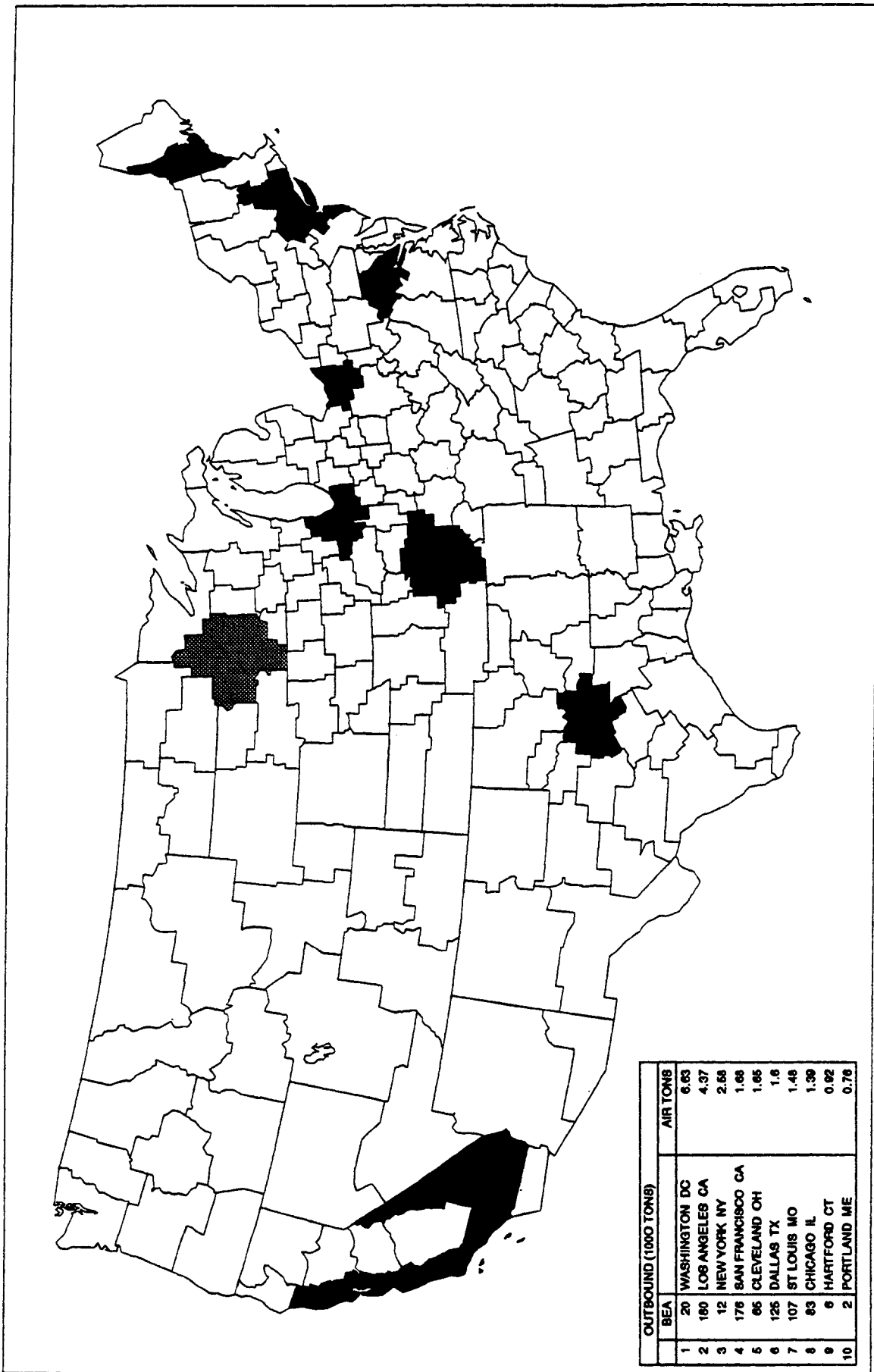
MAP 5.33 Top 10 Destinations of Truck Shipments (by value)



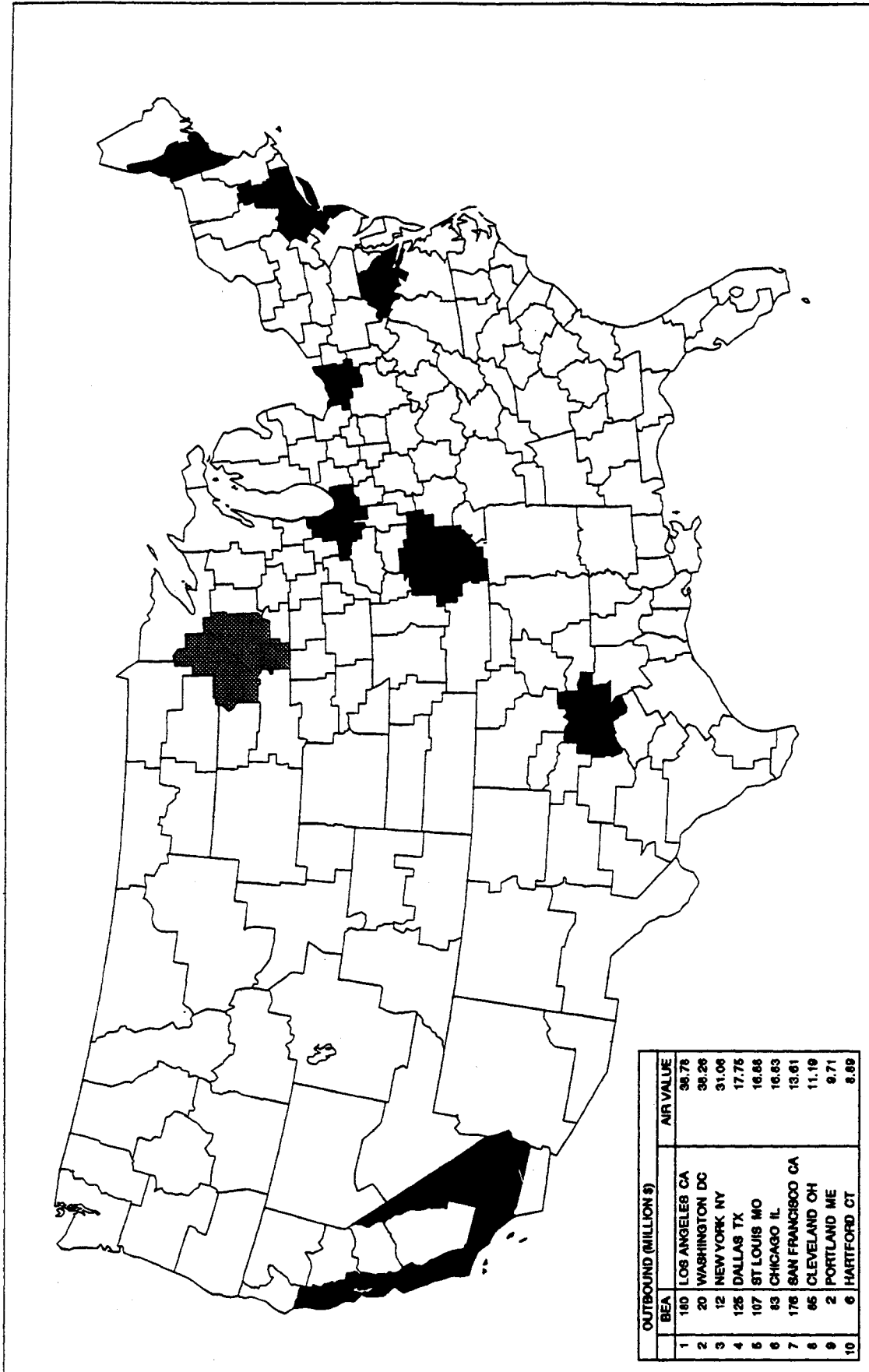
MAP 5.34 Top 10 Origins of Air Shipments (by weight)



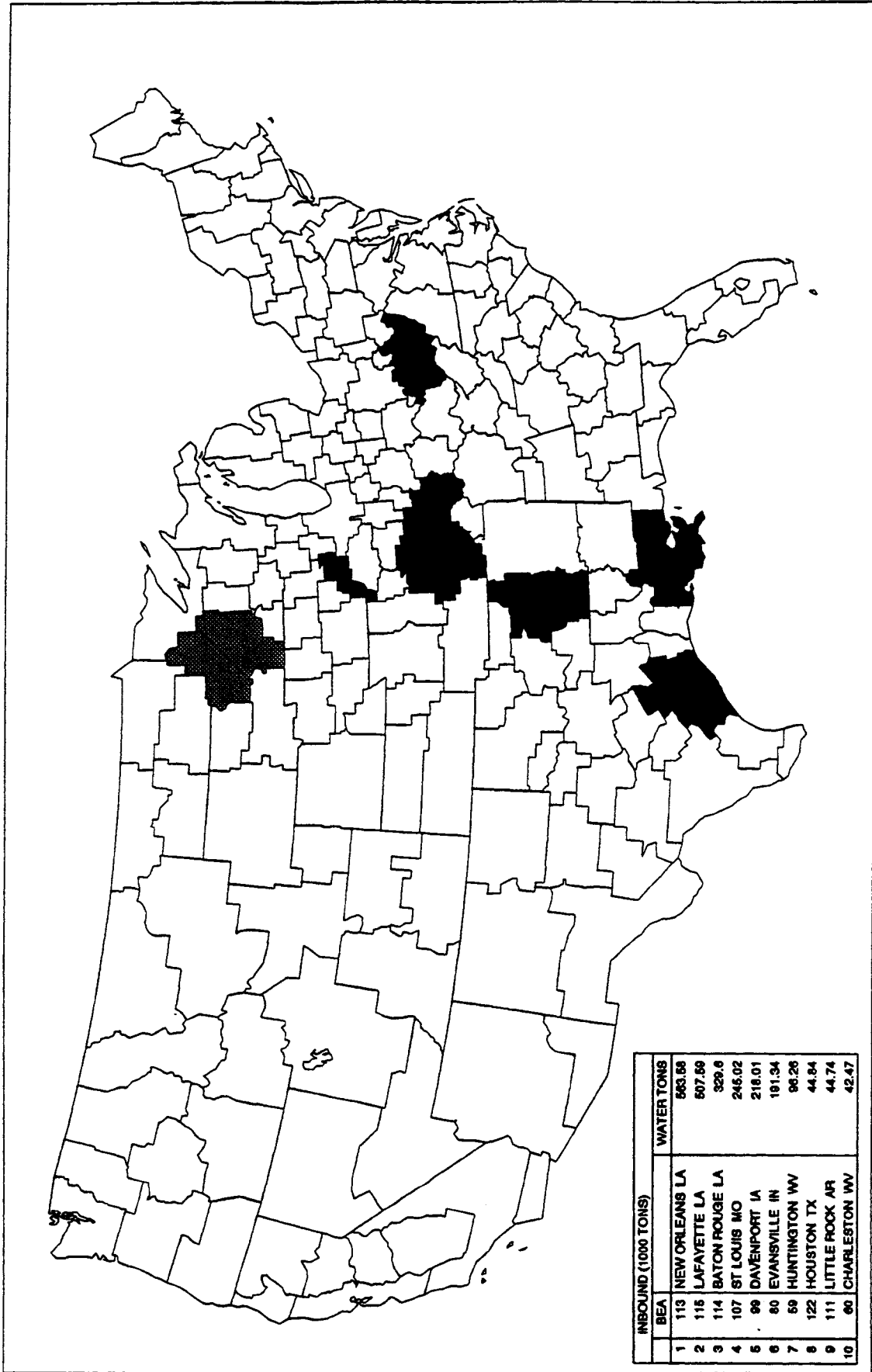
MAP 5.35 Top 10 Origins of Air Shipments (by value)



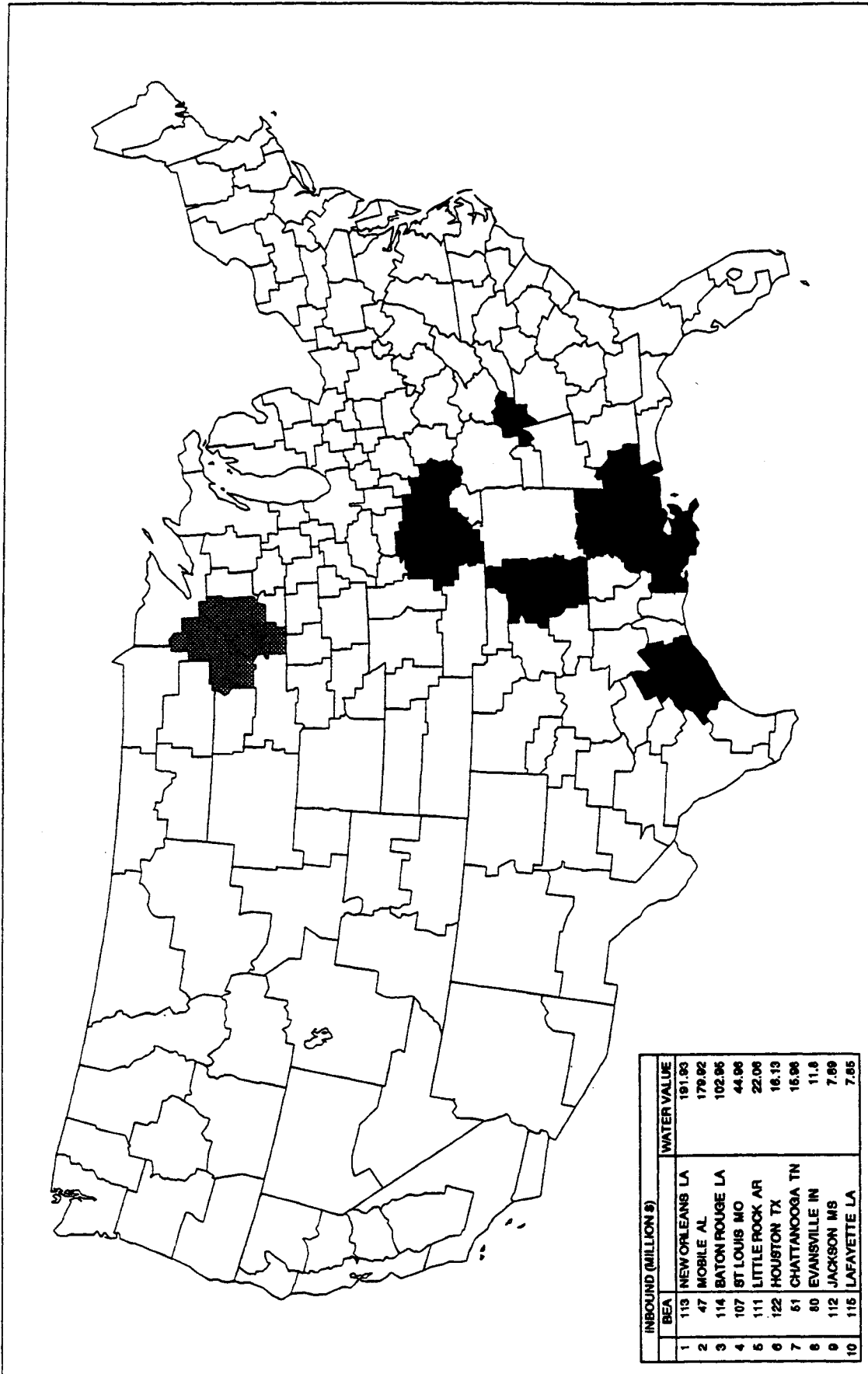
MAP 5.36 Top 10 Destinations of Air Shipments (by weight)



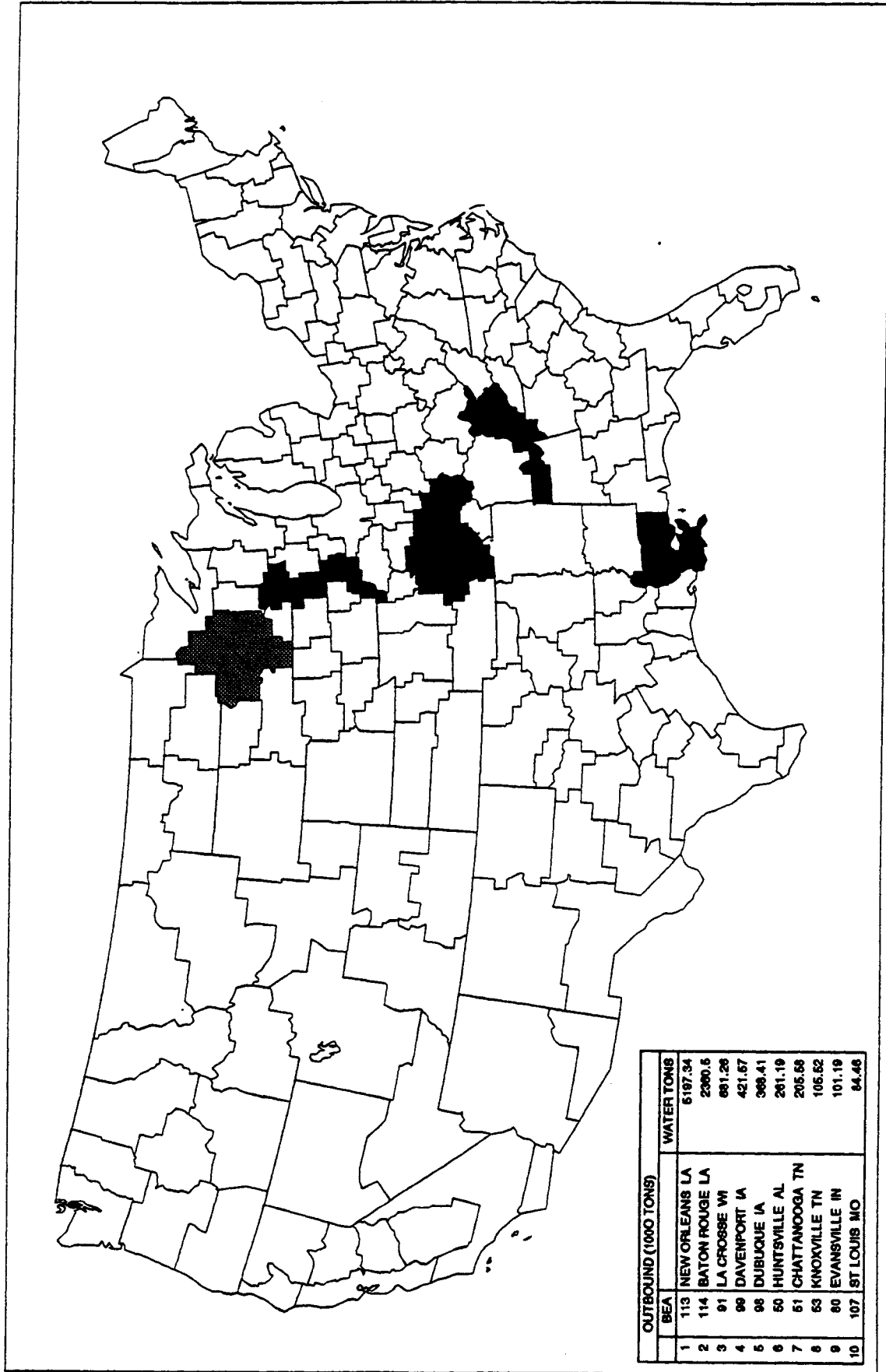
MAP 5.37 Top 10 Destinations of Air Shipments (by value)



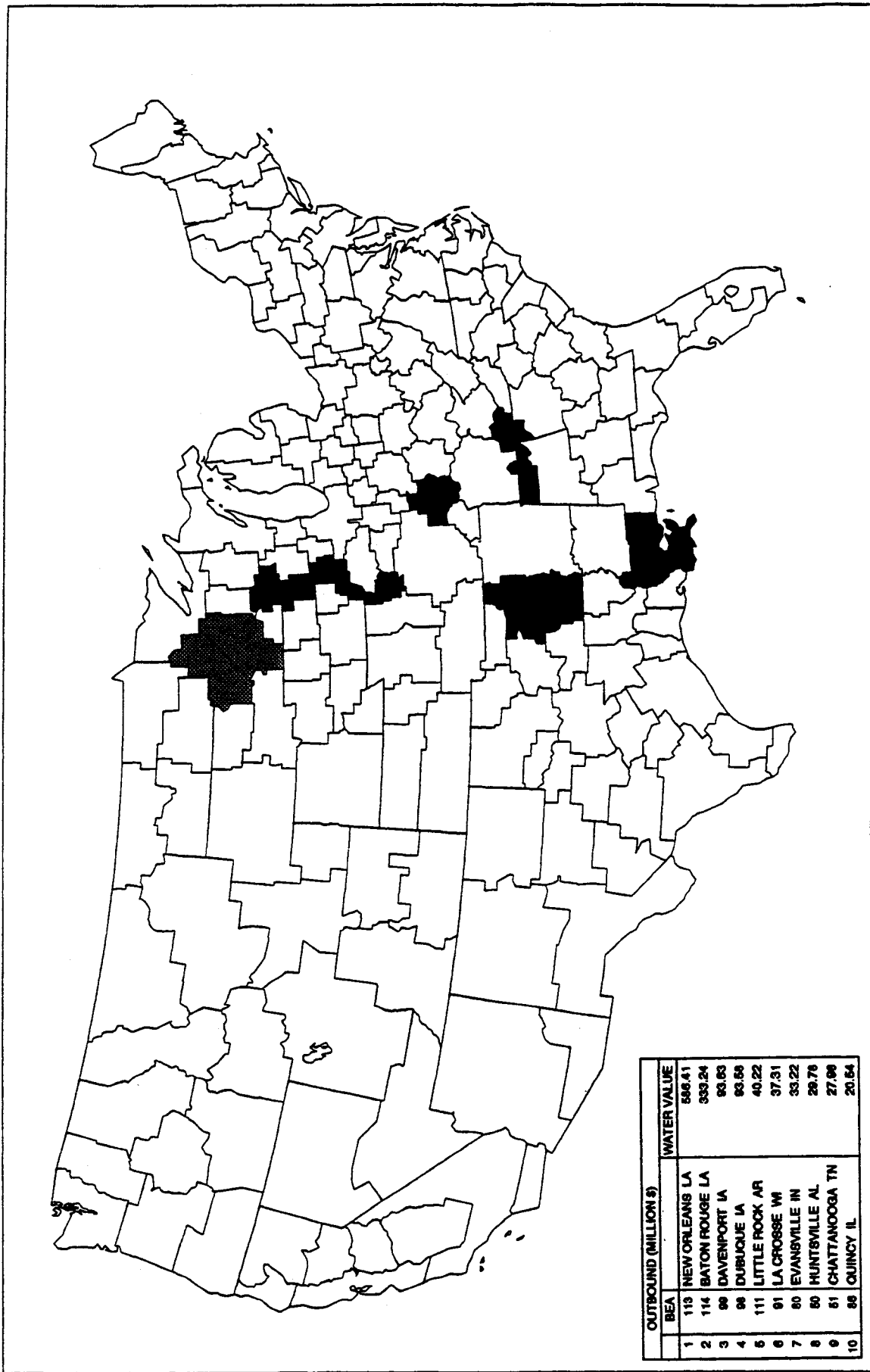
MAP 5.38 Top 10 Origins of Water Shipments (by weight)



MAP 5.39 Top 10 Origins of Water Shipments (by value)



MAP 5.40 Top 10 Destinations of Water Shipments (by weight)



MAP 5.41 Top 10 Destinations of Water Shipments (by value)

5.5 International Flows

Foreign exports from Minnesota to countries around the world are shown by value only. Data on surface shipments by weight and value to Canada and Mexico are not available although these data are available for air and vessel shipments to all countries.

MAP 5.42 shows the top twenty destinations of Minnesota exports for all modes by value in 1990. Canada receives the largest amount followed by Japan. The European Community is the next largest recipient of Minnesota exports followed by Mexico.

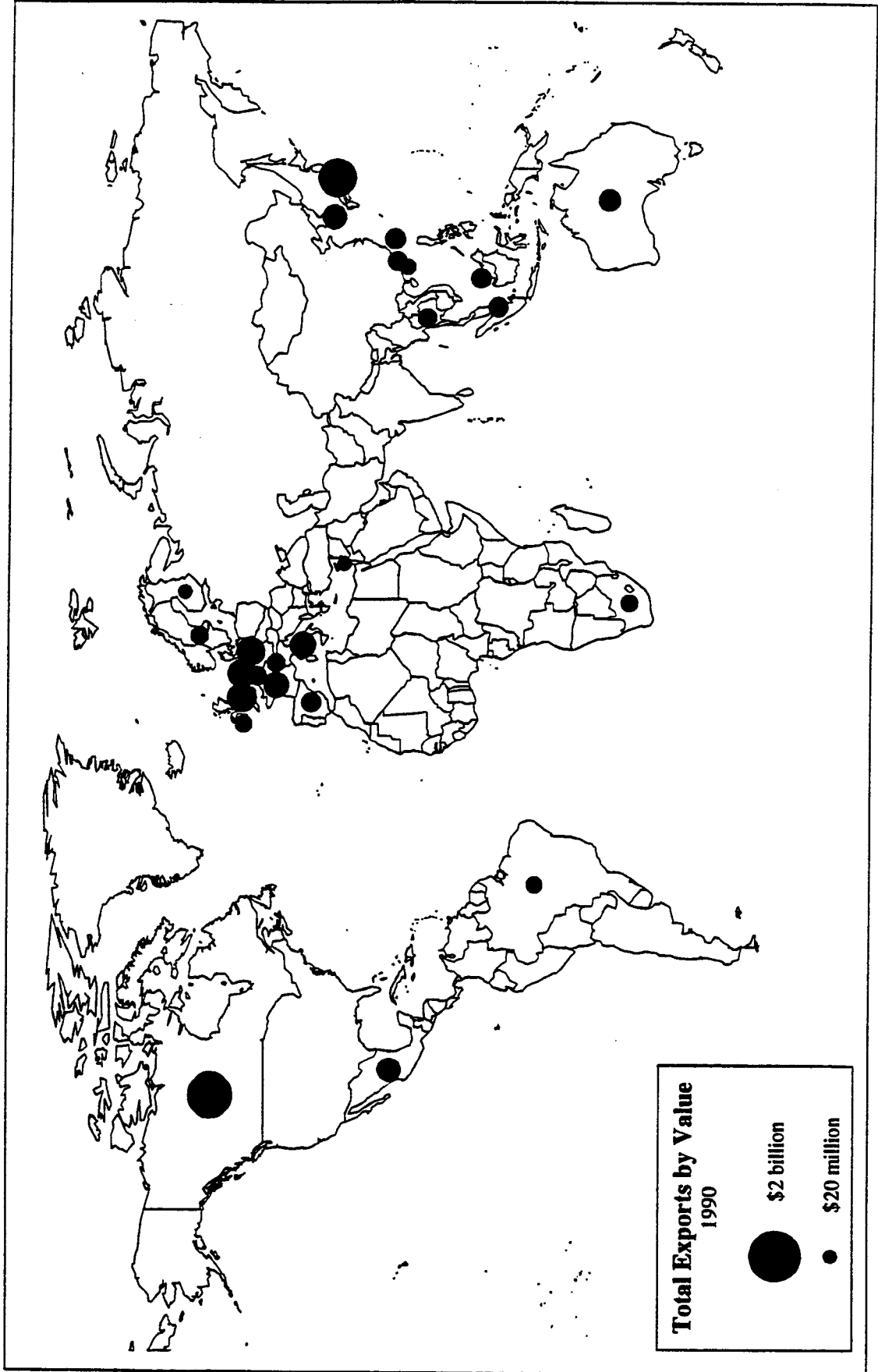
MAP 5.43 shows the top twenty destinations of Minnesota exports for air by value in 1990. Japan ranks first with several European countries close behind. Exports to Canada and Mexico are carried primarily by rail and truck.

MAP 5.44 shows the top twenty destinations of Farm Products from Minnesota. Again Japan ranks number one with Canada close behind. Italy is also a large recipient of Minnesota Farm Products.

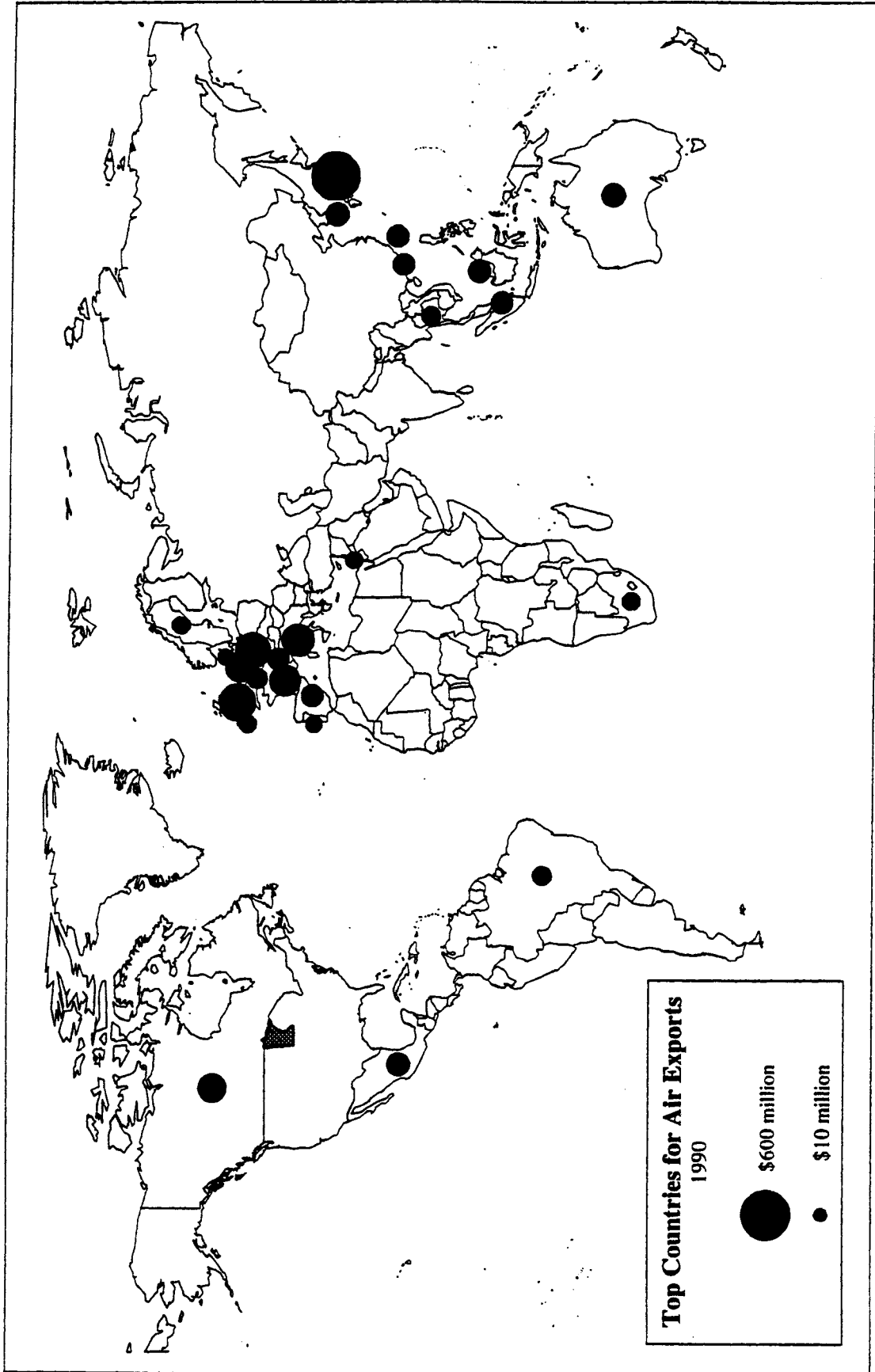
MAP 5.45 shows the top twenty destinations of Food Products from Minnesota. Canada ranks number one with South Korea number two. Japan also receives significant exports of Food Products from Minnesota.

Since Canada is Minnesota's largest trading partner, several charts are included which describe the pattern of trade with Canada. CHART 5.1 shows Minnesota imports from Canada by province. CHART 5.2 shows Minnesota exports to Canada by province. CHART 5.3 shows Minnesota imports from Canada by commodity. CHART 5.4 shows Minnesota exports to Canada by commodity.

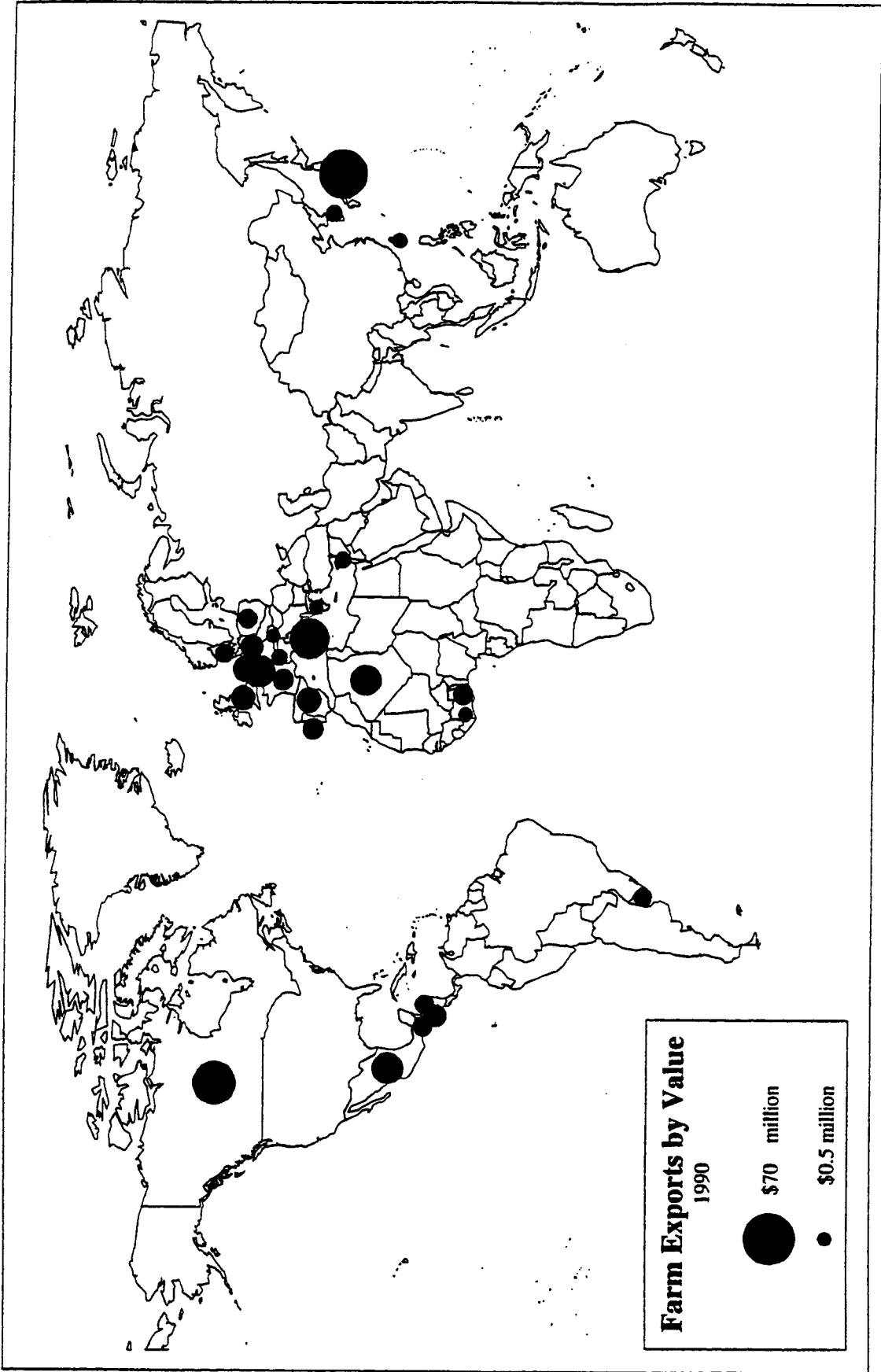
Supporting data tables for the maps are contained on pages D-4 through D-7 of APPENDIX D. Supporting data tables for the charts are contained on pages D-8 and D-9 of APPENDIX D.



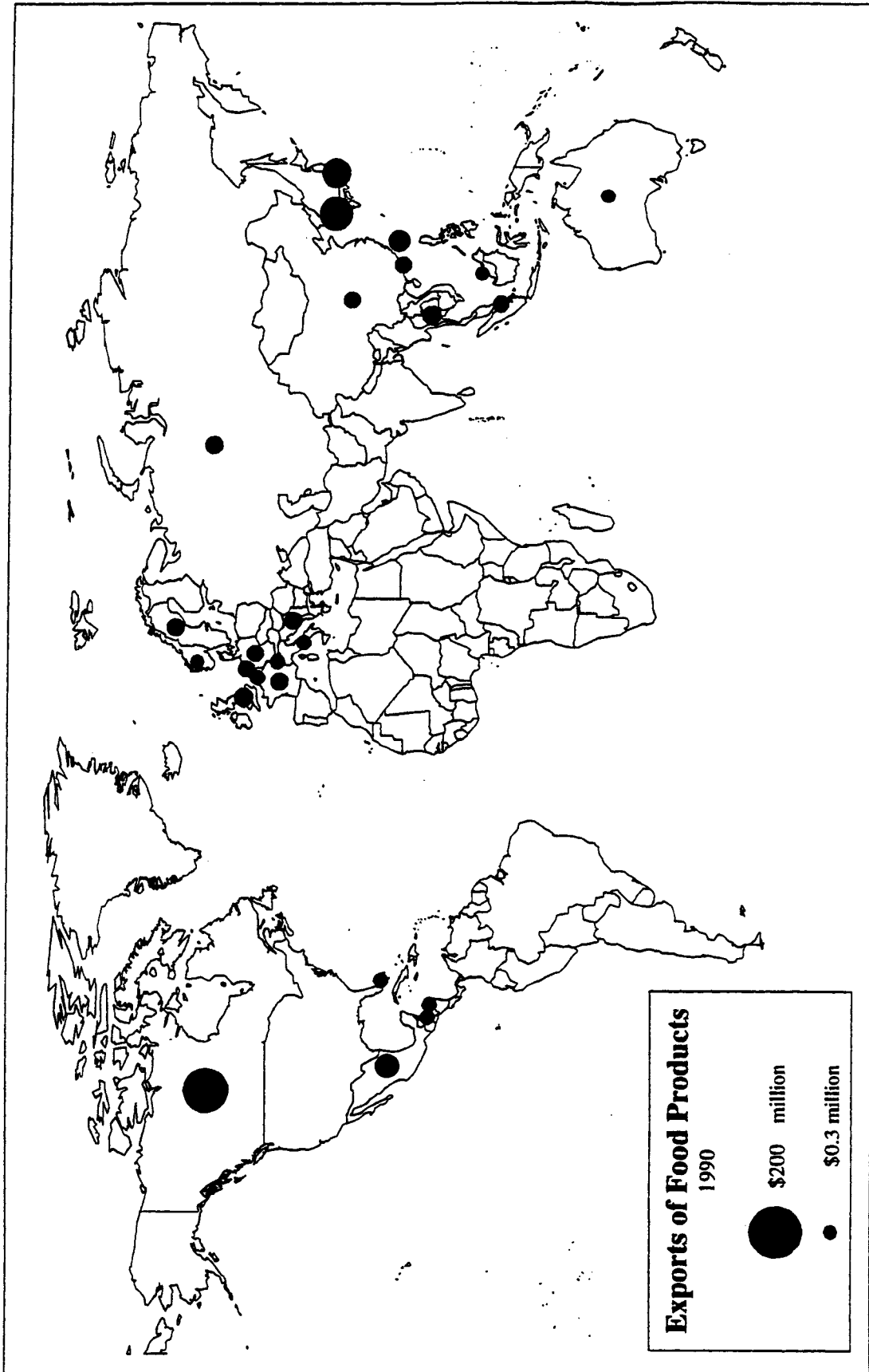
MAP 5.42 Top 20 Destinations of Commodity Exports by Value



MAP 5.43 Top 20 Destinations of Commodity Exports by Air and Value



MAP 5.44 Top 20 Destinations of Farm Exports by Value



MAP 5.45 Top 20 Destinations of Food Products by Value

MINNESOTA IMPORTS FROM CANADA BY PROVINCE 1990

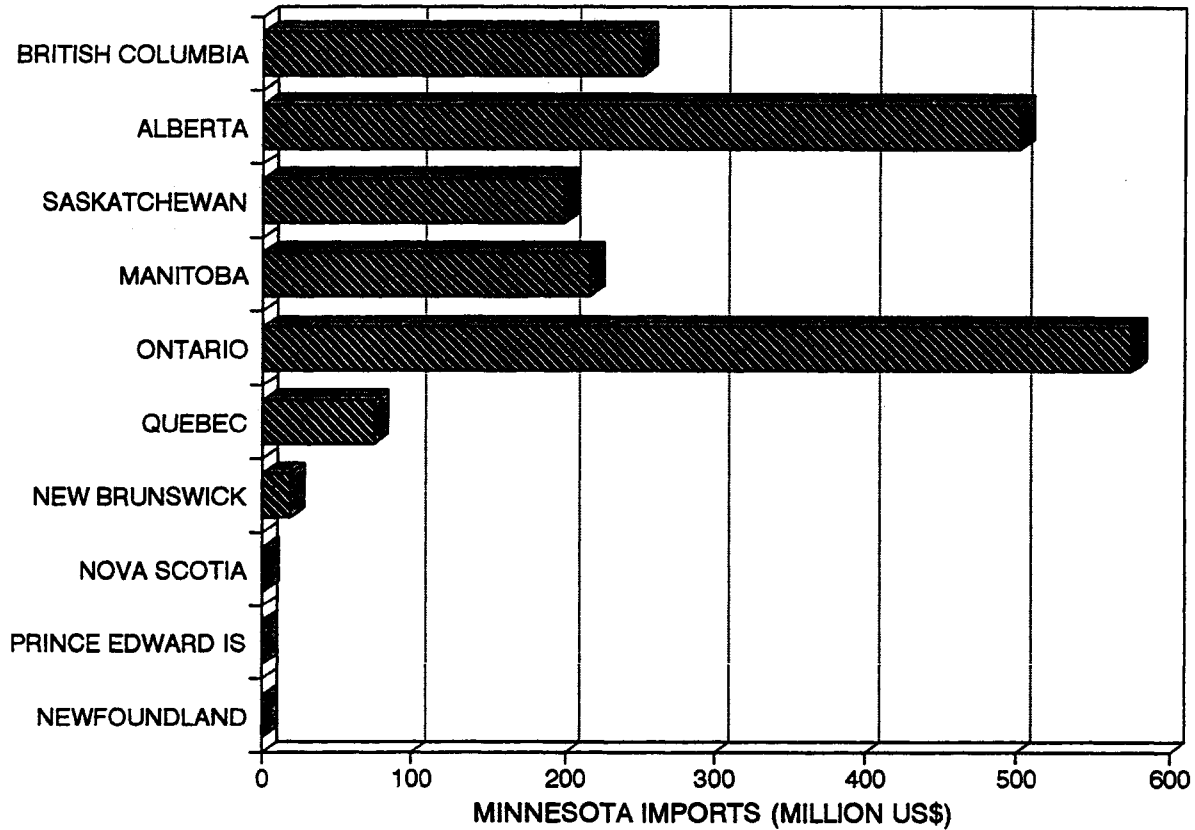


CHART 5.1 Minnesota Imports from Canada by Province

International trade data are normally specified in terms of value rather than tons. While tonnages are provided for air and water shipments, none are provided for rail and truck exports (to Canada and Mexico). Thus, foreign export and import data are presented in terms of value only. This chart shows the importance of Alberta and Ontario as a source of Minnesota imports from Canada. The major import from Alberta is crude petroleum in pipelines. Pipelines have not been included in this study since they are privately owned and are not part of the public transportation infrastructure. Ontario imports are primarily pulp and paper as well as some industrial products.

MINNESOTA EXPORTS TO CANADA BY PROVINCE 1990

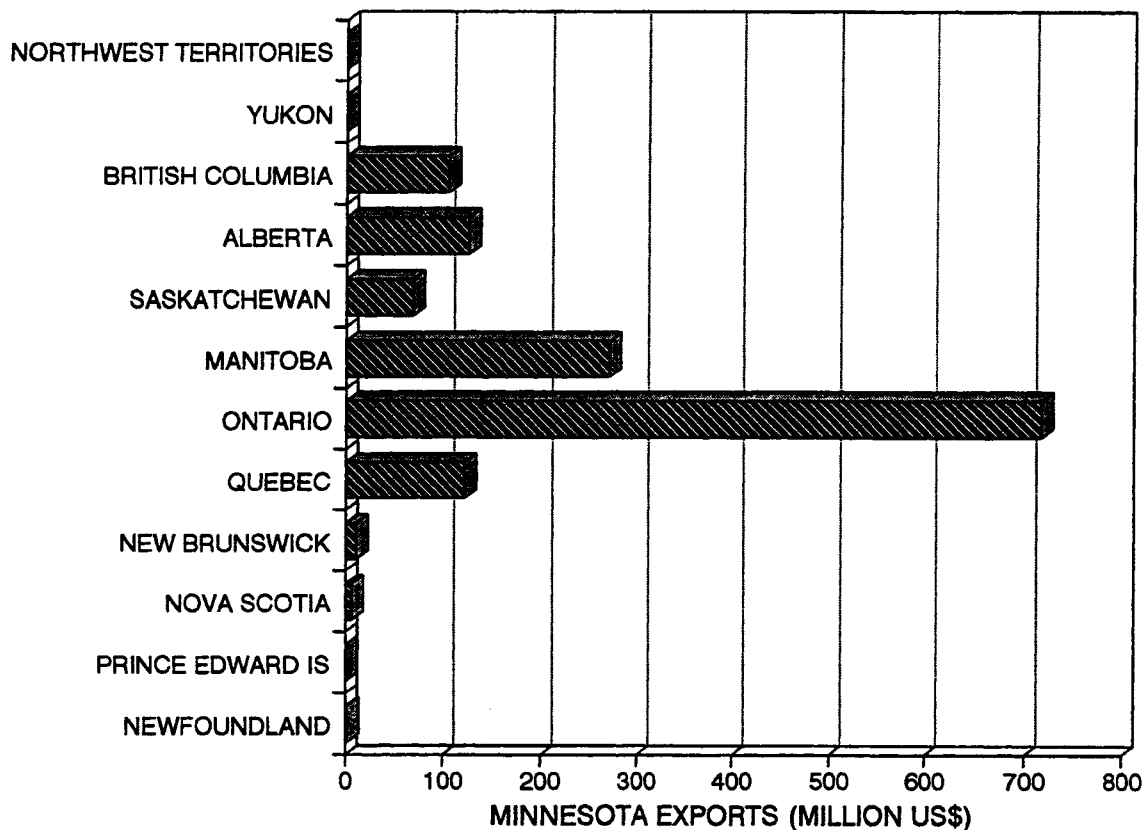


CHART 5.2 Minnesota Exports to Canada by Province

Most of Minnesota's exports to Canada are destined for Ontario, the most populous province. Manitoba receives the next greatest amount with Alberta, Quebec and British Columbia ranking third.

MINNESOTA IMPORTS FROM CANADA BY COMMODITY 1990

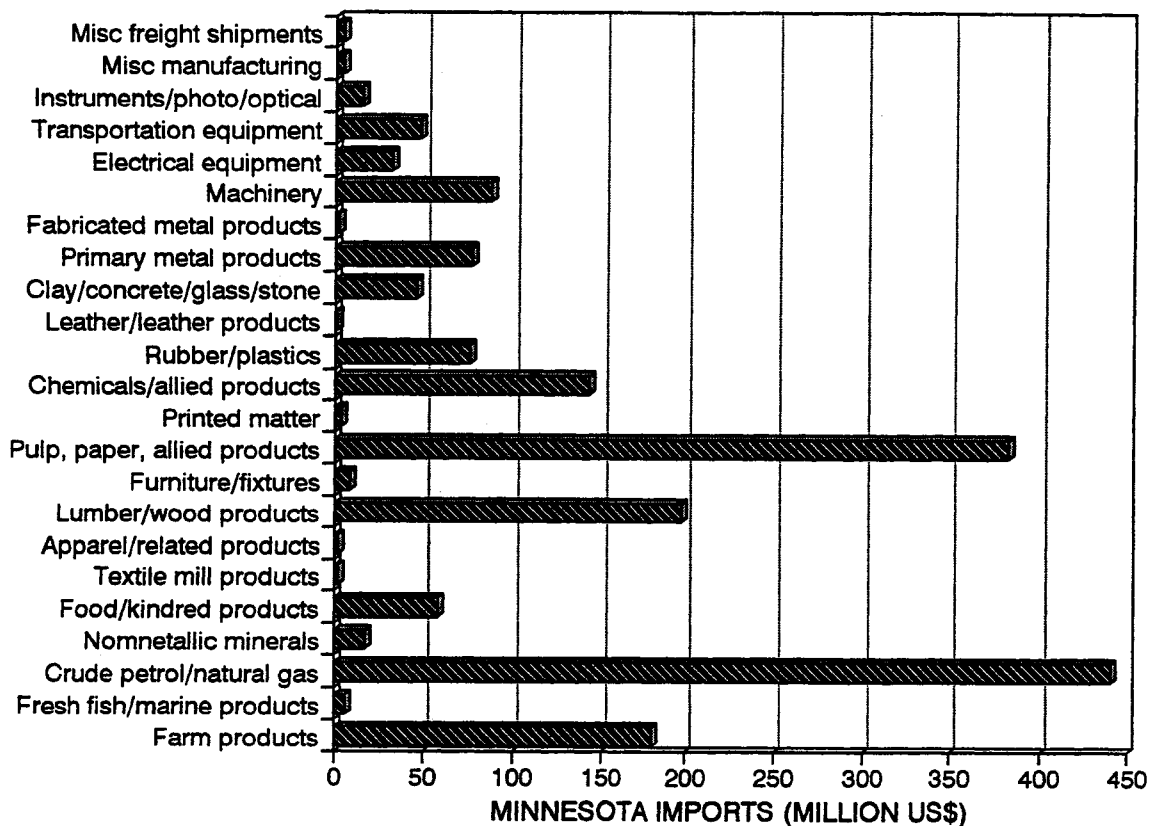


CHART 5.3 Minnesota Imports from Canada by Commodity

The dominance of crude petroleum imports from Canada can be clearly seen on this chart. The second most important import from Canada is Pulp, Paper, and Allied Products with Wood Products ranking third. Imports of Farm Products and Chemicals are also significant.

MINNESOTA EXPORTS TO CANADA BY COMMODITY 1990

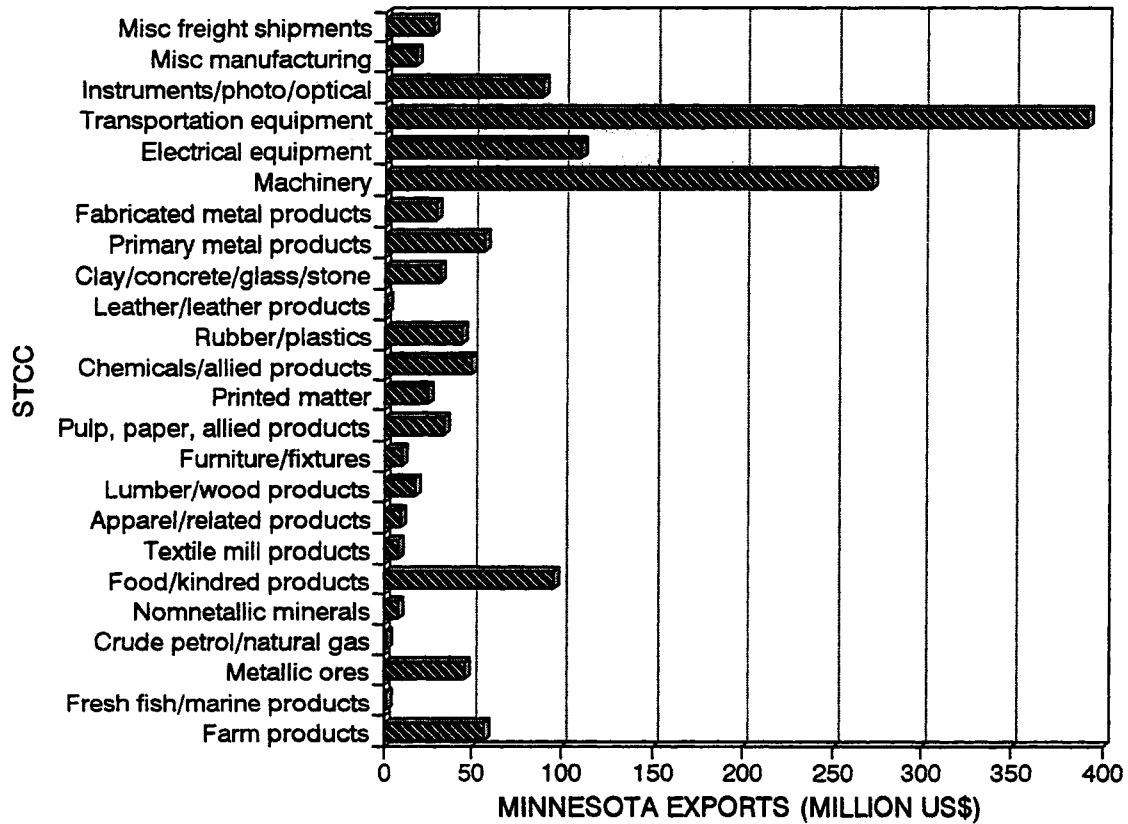


CHART 5.4 Minnesota Exports to Canada by Commodity

Minnesota exports to Canada are dominated by transportation equipment much of which probably originates in St. Paul. Non-Electrical Machinery (including Computers) is the second largest export with Electrical Equipment and Instruments ranking third and fourth. Some Food Products and Farm Products are also exported to Canada.

5.6 1990 Rail Traffic Through Minnesota

The information presented here, which is based on the 1990 ICC Waybill Sample, provides estimates of the number of rail revenue carloads passing through Minnesota during calendar 1990. The sample expansion indicates that 765,658 revenue carloads had both origins and destinations in other states but travelled through Minnesota.

TABLE 5.4 shows the estimates of through traffic by origin state in descending order of traffic volume for states originating more than 7,000 cars of through Minnesota traffic. MAP 5.46 shows four shipment size categories of origin states shipping goods through Minnesota.

TABLE 5.5 provides estimates of through traffic in descending order by termination state. MAP 5.47 shows four shipment size categories of termination states receiving goods that passed through Minnesota.

The following observations should be noted:

- The data were not analyzed for “rebilling” so in some instances these may only be part of the move.
- The waybill sample includes many Canada to U.S. shipments but very few U.S. to Canada shipments. The sample indicates that more than 100,000 cars originating in Canada passed through Minnesota but less than 5,000 from the U.S. to Canada. This difference is probably due to waybill procedures and not solely to differences in traffic flow volume.
- Illinois to Oregon and Oregon to Illinois accounted for 5.4% of total through traffic. Most of this traffic was miscellaneous mixed and empty containers.
- Montana to Wisconsin accounted for over 16% of the total through traffic. Most of this was coal (to Superior). Wyoming to Wisconsin accounted for 2.4% of total through movements and also was dominated by coal.
- British Columbia and Alberta were major originators of traffic passing through Minnesota. British Columbia shipped primarily lumber but had destinations in 29 states. Alberta’s largest commodity was nonmetallic minerals (potash). Alberta through traffic went to 28 different states.

TABLE 5.4

RAIL SHIPMENTS THROUGH MINNESOTA
BY ORIGIN STATE AND CANADIAN PROVINCE

ORIGIN	CARLOADS
Illinois	151024
Montana	141789
Washington	99371
North Dakota	72476
British Columbia	51260
Alberta	40958
South Dakota	38548
Saskatchewan	29264
Wyoming	23343
Oregon	20976
Wisconsin	18354
Ontario	11892
Iowa	11811
Nebraska	11668
Missouri	7608
Michigan	7480
Manitoba	7440
Kentucky	4596
Ohio	2800
Idaho	2420
Indiana	1240
Texas	1160
Colorado	1000
Arkansas	880
Florida	736
Other	5564
Total	765658

TABLE 5.5

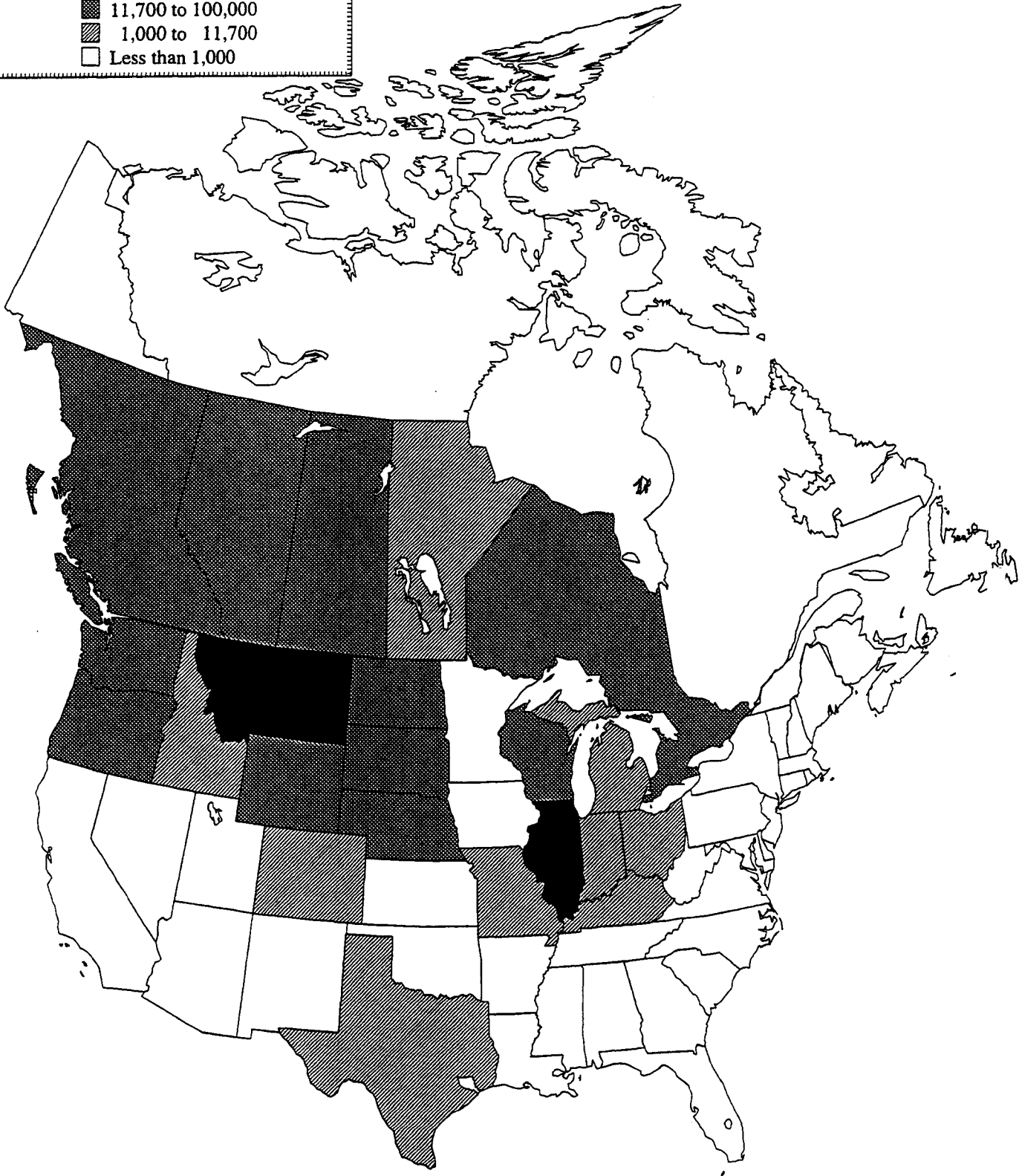
RAIL THROUGH SHIPMENTS BY TERMINATION STATE

STATE OF TERMINATION	CARLOADS
Wisconsin	190146
Washington	166092
Illinois	162035
Oregon	38616
Missouri	20137
Iowa	15543
Texas	15105
Florida	14522
Ohio	9602
North Carolina	9388
Michigan	9300
Tennessee	8964
Montana	8396
Kentucky	8152
Indiana	8071
Louisiana	7852
North Dakota	7390
Georgia	6520
Pennsylvania	5728
South Dakota	4824
Nebraska	4464
California	4340
Alabama	4200
New York	3692
New Jersey	3260
Other	24485
Total	760824

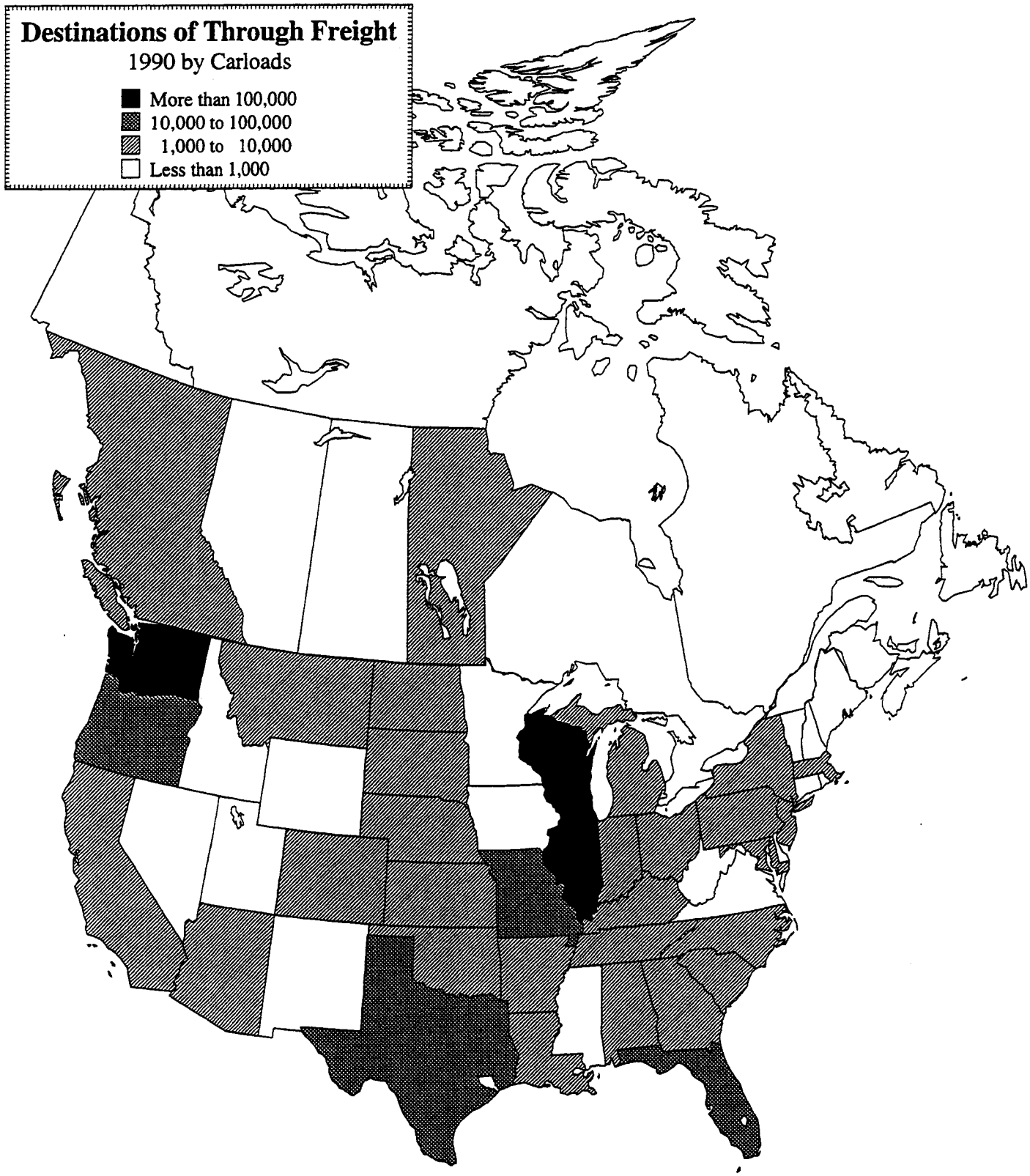
Origins of Through Freight

1990 by Carloads

- More than 100,000
- 11,700 to 100,000
- ▨ 1,000 to 11,700
- Less than 1,000



MAP 5.46 Origin Regions of Rail Movements Through Minnesota



MAP 5.47 Termination Regions of Rail Movements Through Minnesota

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Minnesota Reliance on Freight Transportation

The importance of freight transportation and the economy has been investigated in the Center for Transportation Studies project on Transportation and the Economy of the Upper Midwest and by the Humphrey Institute of Public Affairs study of Transportation and the Economy. This compilation and synthesis of freight flow data within, through, into and out of Minnesota provides a consistent set of information upon which these studies can continue to build. While no comparisons have been made between the Minnesota economy and the value of freight flows, it is clear that the state's economy could not be supported without the extensive flow of freight identified in this report. An exact assessment of Minnesota's reliance on freight transportation is beyond the scope of this study.

It must again be emphasized that the freight flows presented and discussed in this report are for the year 1990. Since that time, some significant changes have occurred not only in the domestic transportation system but in international destinations for Minnesota exports. The section on trends in transportation in Chapter 2 of this report identifies many of these changes and discusses how they might impact freight flows in the future.

6.2 Reliability of the Data

The primary source of data used for the compilation of data is the Transearch data from Reebie Associates for BEA 96 in the year 1990. These are based upon actual data obtained from selected transportation providers through electronic data transfer and adjusted using a number of other factors as discussed in APPENDIX C. The data reliability is being continuously improved by Reebie as more transportation providers are tied directly into their data system. The 1993 Census of Transportation will provide a basis for evaluating the reliability of the 1993 Reebie data but not the 1990 data. Some comparisons were made with confidential data provided to the Humphrey Institute of Public Affairs by major carriers which tended to support the Reebie data used here. For purposes of an overall snapshot of domestic freight activity, these data appear to be sufficiently reliable.

The primary source of data used for export shipments from Minnesota to foreign countries was the MISER database which is built upon U. S. Department of Commerce data. The data are adjusted by MISER to account for unspecified or unallocated shipments. For the most important foreign destinations of Minnesota exports, the data are likely quite reliable. It should be noted that no equivalent data on foreign imports are available by state since data on the distribution of imports into the United States are difficult or impossible to establish. Estimates of imports are available by commodity through the Minnesota International Trade Model developed for the Minnesota Department of Trade and Economic Development by Regional Econometrics, Inc.

6.3 Recommendations for Data Collection and Analysis

Data Needs

The following data needs have been identified during the course of this study.

- (1) Identification of the contents of intermodal mixed shipments by specific commodity

Most of the shipments by rail intermodal are classified as FAK (freight all kinds) and are mixed shipments originating from shippers or consolidators. The commodity breakdown of these

shipments is not currently possible. A method for determining or allocating commodity weights and values to these shipments would be helpful.

- (2) Identification of commodities shipped by TOFC (Trailer-on-a-Flat-Car) and COFC (Container-on-a-Flat-Car)

The current reporting methodology does not distinguish between TOFC and COFC, although the ultimate origins or destinations of these are quite different.

- (3) Identification of containers shipped to domestic and foreign destinations

Containers are primarily associated with imports and exports and information on these would help in merging the domestic and foreign export data currently available.

- (4) Identification of "domestic" shipments (to domestic ports) which are destined for foreign export

The Reebie data base shows large shipments to BEA regions in which major port facilities are located. It is generally assumed that much of these shipments are for foreign export. However, there is no current method for separating out the foreign from domestic shipments.

- (5) Validation of origin of shipments referenced to a BEA region and the identification of the origins of shipments within the state

BEA regions can include a large number of counties such as BEA 96 (Minneapolis-St. Paul) so that the precise origin or destination of shipments cannot be identified. It would be helpful if more specific data on origins (by county) could be developed.

- (6) Establishment of reliable factors for converting between tonnages and value of shipments by commodity

This is one of the most important data needs for relating transportation to regional economies. Reebie Associates provides estimates of value per pound at the 4-digit commodity level, but these are based upon the original 1977 Census of Transportation and updated. Some analysis of the conversion of weight to value was also undertaken in the Transportation and the Economy of the Upper Midwest project.

- (7) Confirmation of public data through the use of selected private data

Data from the private sector (transportation providers) can be used to confirm or validate publicly available data on freight flows. However, this presents some problems because many service providers concentrate in certain geographical areas or specialize in selected commodities. Private data do have the potential, however, of providing useful insights into freight flows and freight flow requirements for the future.

- (8) Better identification of private fleet ownership and movement

Information on private fleets, which can carry a large portion of some commodities, is not currently available. More information on this sector of the transportation industry would be helpful.

- (9) Confirmation of published data with results from the 1993 Census of Transportation

The 1993 Census of Transportation will provide data for a smaller number of regions than are currently available through the Reebie data base. While aggregates of data can be confirmed by the Census, data for smaller regions cannot be. The usefulness of the 1993 data will depend upon whether the data can successfully be allocated to smaller regions.

- (10) Development and analysis of freight flow highway network within Minnesota

An initial effort to develop a freight highway network within Minnesota was made under the Transportation and the Economy of the Upper Midwest project. This is an essential element for future transportation planning within Minnesota as well as other areas of the United States.

- (11) Development of a system for updating and maintaining freight flow data base

This report presents data only for the year 1990. A system should be established for updating and maintaining the freight flow data base to provide planners and decision-makers with comprehensive and accurate information.

- (12) Development of historical trends in freight flows

The data base used as the primary source of information for this report (Reebie Associates) has been undergoing continuous improvement over the years so that an accurate compilation of historical data for comparison purposes may be possible only for specific modes and commodities. However, a historical compilation of data similar to that presented in this report would provide an invaluable source of information for planning, forecasting and policy analysis.

Policy Issues

Some policy issues related to freight movement that could benefit from further study, improved data and a better understanding of freight flows are:

- (1) Development and analysis of a freight flow highway network model for Minnesota and surrounding regions

Such a network would permit the evaluation of freight flows in conjunction with passenger movement. An initial evaluation of the Twin Cities Metropolitan Area may be the most meaningful.

- (2) Development of a methodology for updating and maintaining a freight flow data base

While a snapshot in time of freight flows such as that presented here can be helpful in identifying the structure of flows, a continuously updated and maintained freight flow data base would identify changes and provide the most current information for planning and the development of investment strategies.

- (3) Expansion of freight forecasting capabilities of regional economic models

Economic models, especially input-output models which specify the structure of a state or regional economy, can be used to predict freight flows by commodity for a given region. These models can also be used to disaggregate or allocate freight flows to smaller regions. What these models lack is the ability to tie origins and destinations together as in a network model. However, the models can serve as a means of generating exports (productions) and imports (attractions) for a statewide or regional freight transportation network model such as that noted above. Improved relationships between weight and value of shipments will improve the forecasting capabilities of these models.

(4) Freight flow forecasts based upon economic activity

Freight flows based upon forecast changes in economic activity rather than on historical trends will provide the most reliable information.

(5) Use of freight flow projections in conjunction with economic activity to identify transportation investment priorities

Once meaningful forecasts of freight flows and their relationship with economic activity have been developed, the development of transportation investment priorities can account for freight as well as passenger movement.

(6) Consideration of freight flows in the development of overall transportation policy

Finally, the availability of reliable information on freight movement can be used along with other information to help develop an optimal overall intermodal transportation policy for the State of Minnesota.

APPENDIX A

Glossary

Shipping Terminology, A Lexicon

Business Logistics: The systematic and coordinated set of activities required to provide the physical movement and storage of goods (raw materials, parts, finished goods) from vendor/supply services through company facilities to the customer (market) and the associated activities. These include packaging, order processing, etc. - in an efficient manner necessary to enable the organization to contribute to the explicit goals of the company.

Containers: A box, usually constructed of aluminum, fiberglass or sheet steel, used for the transport of cargo. Common sizes include 20' x 8' x 8', 40' x 8' x 8', and 45' x 8' x 8'. The term container does not include conventional packing nor vehicles.

FAK/Freight All Kinds: Generally, a freight classification where the rate is pre-determined by virtue of the service agreement between the consolidator and railroad and is based on one unit. The one unit being the container or tractor/trailer carried.

Interline: The act of passing cargo from one carrier to another to continue the transit. The term is most common among motor carriers and railroads.

Intermodal: A concept generally defined as a "seamless" delivery of freight by more than one mode from point of origin to point of destination. The delivery is accomplished under one bill of lading, but may include truck/rail/truck, truck/air/truck, or truck/rail/vessel. The cargo is switched at terminals by the company issuing the original bill of lading. The concept was made a reality by the steamship industry to efficiently move containers long distances efficiently and economically.

Just-in-Time (JIT): A system that attempts to reduce inventory levels by coordinating demand and supply to the point where the item desired arrives just in time for use. The implication is that each operation is closely synchronized with the subsequent ones to make that possible.

Lead time (cycle time): The time that elapses from placement of an order until receipt of the order. This includes time for order transmittal, processing, preparation, and shipping.

Less Than Container Load: Container which is filled with consignments of cargo for more than one consignee or from more than one shipper. A container may be packed with LCL cargo at a container freight station for LCL delivery.

Less Than Truck Load: A shipment weighing less than the weight required for the application of the Truckload rate.

Multi-Modal: Moving people or freight by more than one mode, with each mode completing the transaction independent of the previous one. The carrier provides a transfer point or terminal, but only makes the cargo available to the consignee, it is the owner's responsibility to pick-up or deliver the cargo to the next mode or end delivery point.

PiggyBack: Intermodal transport is provided by conventional means, generally referred to as "piggyback", or by double-stack (DST) service.

a. Piggyback: Term derived from a tractor/trailer or container riding on an open rail flat car. These two types of movements are commonly referred to as **TOFC (trailer on flat car)** or **COFC (container on flat car)**.

b. DST/Double Stack Train: This is the nesting of one trailer or container without wheels one atop another in specially built railcars which are designed to enable high-speed transit.

c. Trailer-Rail: This conceptual system will allow railroads to handle the wider range of equipment types over shorter hauls. The full system is composed of 3 components, the trailer-rail terminal; the tractor-railer; and the trailer-railer.

In conventional service, the railroad supplies the railcar and the power (locomotive). With DST service, the railroad supplies the power only and the DST railcars are owned or operated by the DST operator. They depend only on the railroad for power and trackage. Heavily utilized rail corridors for DST service include Chicago/Los Angeles, Seattle/Chicago, Norfolk/Chicago, and Chicago/Newark. DST operators are normally third-party consolidators or steamship lines.

Third-party Consolidators:

Trailers: A vehicle without motive power designed to be drawn by another vehicle and so constructed that no part of its weight rests upon the towing vehicle.

Trailer on Flat Car: The movement of a trailer, inclusive of wheels on a railroad flatcar. A trailer may be 45', 48' or 53' long.

Sources:

Global Training Center, Inc., *Export/Import Reference Glossary*

Andersen Consulting, Cranfield School of Management for the Council of Logistics Management
"Reconfiguring European Logistics Systems."

John J. Coyle, Edward J. Bardi, C. John Langley, Jr., "The Management of Business Logistics", West Publishing.

APPENDIX B

Related Studies of the CTS Project on Transportation and the Economy

LIST OF PAPERS AND PRESENTATIONS
COMPLETED AS PART OF THE STUDY ON
TRANSPORTATION AND THE ECONOMY OF THE UPPER MIDWEST

Center for Transportation Studies Research Conference - May 1991

- Transportation Costs of Production and Sales in the Upper Midwest Region (M. Swanson, D. Braslau, C. Campbell)
- Transportation Outlook for the Upper Midwest: Three Scenarios to 2010 (W. Maki, C. Campbell, D. Olson)
- Twin Cities Air Transportation Demand: A Global Economic Framework (D. Braslau, W. Maki)

Center for Transportation Studies Research Conference - May 1992

- Interregional Trade Flows in the Upper Midwest (D. Braslau)

Mid-Continent Regional Science Association Annual Meeting - June 1992

- Interregional Trade Flows: A review of Data and Concepts (D. Braslau)

HHH Research Symposium: Transportation Infrastructure as Public Investment Strategy - October 1992

- The Changing Structure of Local Economies: Implications for Public and Private Investment in Transportation Infrastructure in the Upper Midwest (D. Braslau, C. Campbell, W. Maki)

Center for Transportation Studies Research Conference - May 1993

- Trade Flows in the Upper Midwest - An Update (D. Braslau, W. Maki, C. Campbell)
- Mid-Continent Regional Science Association Annual Meeting - June 1993
- Economic Projections and the Role of Transportation (W. Maki, D. Olson)
- Regional Commodity Movements and Economic Activity (D. Braslau, A. Hussain, B. Hanninen)
- Use of the IMPLAN Model for Transportation Planning (A. Hussain, W. Maki)
- Metropolitan Commodity Movements and Economic Activity (B. Hanninen, D. Braslau)

- The Private Sector Role in Regional Transportation (C. Petersen, C. Campbell, D. Braslau)
- Policy Issues for Transportation in the Upper Midwest (C. Campbell, C. Petersen, W. Maki, D. Braslau)

OTHER REPORTS AND SEMINARS

- Development of the Twin Cities International Trade Model, (D. Braslau), July 1992
- Transportation and the Economy: Prospective Changes in Traffic-Generating Activity in Minnesota and the Upper Midwest (W. Maki, D. Olson), prepared for CTS Seminar on 17 February 1993
- The Changing Structure of the Transportation Sector: An Input-Output Analysis; Staff Paper P93-22, September 1993, A. Hussain, W. Maki, D. Olson, D. Braslau]
- Verification of Truck Volumes on a Selected Link Predicted by the IMPLAN/Simplified State Roadway Network; October 1993, C. Campbell, D. Braslau

APPENDIX C

Data Sources and Documentation

References for Chapter 2.0

- [1] Turnquist, M. A., *Transportation and Research Record*, 1993; pp.129-134.
- [2] Braslau, D., Campbell, C., Maki, W., "The Changing Structure of Local Economies: Implications for Public and Private Investments in Transportation Infrastructure in the Upper Midwest", *Research Symposium on Transportation Infrastructure as Public Investment Strategy*, University of Minnesota, October 1992; p.48.
- [3] Cass Logistics, "Small Shippers Fare Better Than Ever," *Traffic World*, June 22, 1992; pp.33-34.
- [4] Langley, J., "Logistics Integration: The Evolving Process", *Council of Logistics Management Twin Cities Roundtable Presentation*, February 17, 1994.
- [5] *Industry Surveys*, "Trucking markets in state of flux," November 4, 1993; pp.R22-27.
- [6] American Trucking Association, 1994, *21st Century Trucking*; p.II-3.
- [7] Vail, B., "Truckers, Ship Lines get along fine", *American Shipper*, February 1994; p.16.
- [8] Donahue, T.J., American Trucking Association, "Donohue sees bright future for trucking, changes in ATA's role as industry leader", *Traffic World*, December 13, 1993, pp.12-14.
- [9] Schultz, J.D. "Truckload carriers, logistics companies seek synergies with partnerships", *Traffic World*, February 14, 1994; p.27.
- [10] Harper, D.V. and Evers, P.T., *An Analysis of Intermodal Railroad-Truck Freight Transportation Facilities and Services in Minnesota*, December 1991; pp. ix, p.45, p.64.
- [11] Craven, B., news release, July 18, 1994.
- [12] Contract National Level Paragraphs, Art. 29. Substitute Service. *Changes in the National Master Freight Agreement*, 1994.
- [13] McNamara, T.M., "Trucking", *U. S. Industrial Outlook*, 1994.
- [14] Schulz, J.D., "Private truck group finds niche in regulatory arena, fleet management", *Traffic World*, May 3, 1993; p.27.
- [15] Transportation Technical Services, *The Private Fleet Directory '94-'95*.
- [16] *Traffic World*, "Qualcomm signs Omnitracs deals with Hunt, five other carriers", April 12, 1993; p.40.
- [17] Richardson, W., "Intermodalism-1993", *Presentation to the Twin Cities Roundtable of the Council of Logistics Management*.

- [18] *Traffic World*, "Chicago Uses Portable Scales to Crack Down on Overweight Trucks on Intermodal Routes", March 14, 1994; p.50.
- [19] *Traffic World*, "Intermodal Terminals of the Future will Offer Myriad of Choices, Demand Careful Planning", April 18, 1994; p.37.
- [20] Eno Transportation Foundation, Inc., *Transportation in America*, 11th Edition, 1993, p.40.
- [21] *Industry Surveys*, "Railroads & Trucking," November 4, 1993; pp.R18-21.
- [22] Progressive Railroading, "Car utilization: How to make the most of existing fleets.", June 1994; p.70.
- [23] *American Trucking Association*, "21st Century Trucking", 1994, p.V-1.
- [24] *Industry Surveys*, "Aerospace and Air Transport," July 1, 1993; pp.A33-41.
- [25] Page, P., "Cargo carriers hope the 1993 traffic surge yields higher returns in next 12 months", *Traffic World*, January 3, 1993; pp.20-21.
- [26] Page, P. "Shippers see shifting alliances, new services in the future for competitive air cargo industry", *Traffic World*, September 27, 1993; p.41.
- [27] Hough, J.A., "Logistics of the U.S. What Industry", *The Upper Great Plains Transportation Institute Publication No. 100*, October 1994, North Dakota State University, Fargo, North Dakota.
- [28] US Army Corps of Engineers, *Upper Mississippi River Water Way System Navigation Study*, May 1994; pp.1-6.
- [29] Fruin, J., and Halbach, D., *Barge Movements on the Upper Mississippi River: Trends and Projections 1963-2002*, Department of Agriculture and Applied Economics Staff Paper Series P94-19, University of Minnesota, August 1994.
- [30] Lambert, J., *Barge Fleet Profile of Inland River Equipment for the Mississippi River System and Connecting Waterways*, March 1992; p.11.
- [31] Price Waterhouse, *The Economic Activity Associated with the Commercial Utilization and Maintenance of the Upper Mississippi River-Illinois Waterway*, April 1994; p.III-2.
- [32] Temple, Barker & Sloane, Inc., Regional Science Research Institute, Experience, Inc., *The Economic Impact of Commercial Navigation on the Twin Cities Region*, December 1987; p.I-13.
- [33] Mississippi River Coordinating Commission and National Park Service, *Final Comprehensive Management Plan, Environmental Impact Statement, Volume One*, October 1994; p.170.

Letter to David Braslau from Reebie Associates on source and reliability of the data

May 19, 1992

Mr. David Braslau
David Braslau Associates, Inc.
1313 5th Street S.E., Suite 322
Minneapolis, MN 55414

Dear David:

We are in the midst of updating our TRANSEARCH user guide, due to the significant number of changes we made this year, so I will outline the major aspects of TRANSEARCH development.

RAILROAD

We rely on the ICC Waybill Sample for rail flows. Traffic is identified at 4- or 5-digit commodity levels, and about 60% of all rail traffic is reported by BEA of origin and destination. The remaining movements were identified with a railroad rate territory as at least one of the geographic components.

Over the years we have refined a processing methodology to desegregate the rate territory information into BEAs. The rate territory information is used in cases where there are less than three shippers or consignees for a specific product in a BEA. Consequently, a rate territory movement cannot have originated in a BEA where that commodity has been revealed.

If this first step does not pinpoint a specific BEA for allocation, we then reference the previous year's waybill, and then the earlier TRANSEARCH data, and adopt an earlier pattern if present. Generally, at this stage we will have been able to assign all but a handful of flows to specific BEAs. Any remaining flows at this point are assigned to traffic lanes based on a manual review and assessment of the likelihood of the commodity being present in the remaining potential markets.

New for this year, we were able to obtain access to a summary of the ICC Full Waybill Sample, which was used as a cross-check, and to make minor refinements to the enhanced patterns. This methodology is used for all rail carload and intermodal information in the data base.

WATER FLOWS

Water traffic data is adapted from the Corps of Engineers comprehensive information. However, the fully-detailed data lags one year behind our data base. Consequently, we use more current Corp of Engineer information which provides broader-level data, such as state of origin and commodity totals, which are then used to develop update factors which are applied to the flow patterns.

AIR TRAFFIC

TRANSEARCH air traffic information begins with the FAA's airport loading reports, which contain the total tonnage of air cargo originating at all U.S. airports. We desegregate these numbers into commodity flows based on the previous year's TRANSEARCH data. The pre-existing flow data can be traced back to the '77 Census of Transportation, but each subsequent year incorporated revisions based on changing production patterns.

TRUCK COAL

Energy Information Administration (from the Department of Energy) information is used to process truck movements of coal. The EIA reports state-to-state truck movement tonnage. We then desegregate the origins to the BEA level using county mine production data, again from the EIA. Destinations at the BEA level are determined using files we have created which contain the locations and capacities of coal-powered utility plants, and additional EIA data on coal consumption at Coke plants, other industrial usage, and residential and commercial consumption.

TRUCK - MANUFACTURED GOODS

We begin the creation of these truck flows by calculating national production levels, by commodity. We utilize a variety of information published by the Department of Commerce and industrial trade organizations. Geographic detail is refined through use of a data base of manufacturing establishments created by Trinet. This is similar to D & B's or TRW's.

Consumption area detail is created using economic input- output tables developed by WEFA. Using these tables, we can calculate the consumption in a market based on the producing industries located there.

At this point we then essentially subtract the rail, water and air traffic from the production-consumption data, with the remaining volumes being further delineated into truckload, LTL and private truck volumes. The truck segregation is based on the '77 Census of Transportation, but we then make additional adjustments based on our data exchange program.

Last year we initiated a program with 14 TL carriers, representing about 15% of the long-haul market, providing us with detailed information about their traffic. This data was then used to revise the movement patterns in the data base.

Throughout all phases of our processing we implement various checks and routines to avoid creating fragmentary flows, and other "un-natural" patterns, such as large movements of wet cement across the country by truck. In total, TRANSEARCH relies on over 75 individual sources of background information, which is then processed through a series of 200 computer programs.

If there are specific areas in which you have more questions, please let me know. Additionally, as we are constantly trying to improve the data base, we would be happy to receive any information that you and your associates might have regarding supplemental or alternate sources of data.

Sincerely,
Paul R. Ciannavei
Manager

BEA REGION DESIGNATIONS

1	BANGOR ME	51	CHATTANOOGA TN	101	WATERLOO IA	151	BISMARCK ND
2	PORTLAND ME	52	JOHNSON CITY TN	102	FORT DODGE IA	152	MINOT ND
3	BURLINGTON VT	53	KNOXVILLE TN	103	SIOUX CITY IA	153	GREAT FALLS MT
4	BOSTON MA	54	NASHVILLE TN	104	DES MOINES IA	154	MISSOULA MT
5	PROVIDENCE RI	55	MEMPHIS TN	105	KANSAS CITY MO	155	BILLINGS MT
6	HARTFORD CT	56	PADUCAH KY	106	COLUMBIA MO	156	CHEYENNE WY
7	ALBANY NY	57	LOUISVILLE KY	107	ST LOUIS MO	157	DENVER CO
8	SYRACUSE NY	58	LEXINGTON KY	108	SPRINGFIELD MO	158	COLORADO SPRINGS
9	ROCHESTER NY	59	HUNTINGTON WV	109	FAYETTEVILLE AR	159	GRAND JUNCTION CO
10	BUFFALO NY	60	CHARLESTON WV	110	FORT SMITH AR	160	ALBUQUERQUE NM
11	BINGHAMTON NY	61	MORGANTOWN WV	111	LITTLE ROCK AR	161	TUCSON AZ
12	NEW YORK NY	62	PARKERSBURG WV	112	JACKSON MS	162	PHOENIX AZ
13	SCRANTON PA	63	WHEELING WV	113	NEW ORLEANS LA	163	LAS VEGAS NV
14	WILLIAMSPORT PA	64	YOUNGSTOWN OH	114	BATON ROUGE LA	164	RENO NV
15	ERIE PA	65	CLEVELAND OH	115	LAFAYETTE LA	165	SALT LAKE CITY UT
16	PITTSBURGH PA	66	COLUMBUS OH	116	LAKE CHARLES LA	166	POCATELLO ID
17	HARRISBURG PA	67	CINCINNATI OH	117	SHREVEPORT LA	167	BOISE CITY ID
18	PHILADELPHIA PA	68	DAYTON OH	118	MONROE LA	168	SPOKANE WA
19	BALTIMORE MD	69	LIMA OH	119	TEXARKANA TX	169	RICHLAND WA
20	WASHINGTON DC	70	TOLEDO OH	120	TYLER TX	170	YAKIMA WA
21	ROANOKE VA	71	DETROIT MI	121	BEAUMONT TX	171	SEATTLE WA
22	RICHMOND VA	72	SAGINAW MI	122	HOUSTON TX	172	PORTLAND OR
23	NORFOLK VA	73	GRAND RAPIDS MI	123	AUSTIN TX	173	EUGENE OR
24	ROCKY MOUNT NC	74	LANSING MI	124	WACO TX	174	REDDING CA
25	WILMINGTON NC	75	SOUTH BEND IN	125	DALLAS TX	175	EUREKA CA
26	FAYETTEVILLE NC	76	FORT WAYNE IN	126	WICHITA FALLS TX	176	SAN FRANCISCO CA
27	RALEIGH NC	77	KOKOMO IN	127	ABILENE TX	177	SACRAMENTO CA
28	GREENSBORO NC	78	ANDERSON IN	128	SAN ANGELO TX	178	STOCKTON CA
29	CHARLOTTE NC	79	INDIANAPOLIS IN	129	SAN ANTONIO TX	179	FRESNO CA
30	ASHEVILLE NC	80	EVANSVILLE IN	130	CORPUS CHRISTI TX	180	LOS ANGELES CA
31	GREENVILLE SC	81	TERRE HAUTE IN	131	BROWNSVILLE TX	181	SAN DIEGO CA
32	COLUMBIA SC	82	LAFAYETTE IN	132	ODESSA TX	182	ANCHORAGE AK
33	FLORENCE SC	83	CHICAGO IL	133	EL PASO TX	183	HONOLULU HI
34	CHARLESTON SC	84	CHAMPAIGN IL	134	LUBBOCK TX		
35	AUGUSTA GA	85	SPRINGFIELD IL	135	AMARILLO TX		
36	ATLANTA GA	86	QUINCY IL	136	LAWTON OK		
37	COLUMBUS GA	87	PEORIA IL	137	OKLAHOMA CITY OK		
38	MACON GA	88	ROCKFORD IL	138	TULSA OK		
39	SAVANNAH GA	89	MILWAUKEE WI	139	WICHITA KS		
40	ALBANY GA	90	MADISON WI	140	SALINA KS		
41	JACKSONVILLE FL	91	LA CROSSE WI	141	TOPEKA KS		
42	ORLANDO FL	92	EAU CLAIRE WI	142	LINCOLN NE		
43	MIAMI FL	93	WAUSAU WI	143	OMAHA NE		
44	TAMPA FL	94	GREEN BAY WI	144	GRAND ISLAND NE		
45	TALLAHASSEE FL	95	DULUTH MN	145	SCOTTSBLUFF NE		
46	PENSACOLA FL	96	MPLS-ST. PAUL MN	146	RAPID CITY SD		
47	MOBILE AL	97	ROCHESTER MN	147	SIOUX FALLS SD		
48	MONTGOMERY AL	98	DUBUQUE IA	148	ABERDEEN SD		
49	BIRMINGHAM AL	99	DAVENPORT IA	149	FARGO ND		
50	HUNTSVILLE AL	100	CEDAR RAPIDS IA	150	GRAND FORKS ND		

UPPER MIDWEST REGION AS DEFINED IN THIS REPORT

APPENDIX D

Data Tables

COMMODITY FLOWS BETWEEN MINNESOTA BEA REGIONS
(Supporting data for TABLE 5.2)

ORIG BEA	DEST BEA	CARLOAD	INTERMOD	TRUCKLOAD	LTTL	PRIVTRUCK	AIR	WATER	TOTAL
91	91	0.00	0.00	18.84	0.36	88.56	0.00	0.26	108.03
91	95	0.00	0.00	1.61	0.65	1.54	0.00	0.00	3.80
91	96	9.22	0.00	29.94	7.97	43.76	0.00	1.25	92.14
91	97	0.08	0.00	74.37	1.11	354.99	0.00	0.00	430.56
91	147	0.00	0.00	0.50	0.20	0.49	0.00	0.00	1.19
91	149	0.00	0.00	0.58	0.22	0.65	0.00	0.00	1.45
91	150	0.00	0.00	0.40	0.27	0.54	0.00	0.00	1.21
95	91	0.00	0.00	5.87	0.06	3.83	0.00	0.00	9.76
95	95	32538.82	0.00	313.56	6.09	446.10	0.00	1649.85	34954.42
95	96	698.55	0.00	394.64	8.11	479.07	0.00	0.00	1580.39
95	97	0.00	0.00	21.43	0.17	16.84	0.00	0.00	38.44
95	147	0.00	0.00	3.72	0.00	6.68	0.00	0.00	10.40
95	149	3.26	0.00	10.12	0.00	12.32	0.00	0.03	25.73
95	150	247.04	0.00	12.93	0.15	10.61	0.00	0.00	270.73
96	91	102.35	0.00	82.95	5.22	222.59	0.00	144.27	557.38
96	95	477.20	0.00	272.89	13.98	870.50	0.00	0.00	1634.56
96	96	4968.10	0.20	4503.20	304.76	11013.19	1.60	1915.54	22706.58
96	97	112.61	0.00	392.22	21.41	965.63	0.00	0.00	1491.87
96	147	47.16	0.00	188.23	7.67	509.60	0.00	0.00	752.66
96	149	9.28	0.00	160.69	5.28	455.84	0.00	0.00	631.09
96	150	5.63	0.00	109.91	6.20	384.65	0.00	0.00	506.39
97	91	197.97	0.00	54.77	2.17	288.75	0.00	0.00	543.66
97	95	0.00	0.00	13.00	1.13	9.77	0.00	0.00	23.90
97	96	142.71	1.33	275.33	21.77	342.44	0.00	0.00	783.57
97	97	13.40	0.00	196.85	1.96	1156.41	0.00	0.00	1368.62
97	147	0.00	0.00	14.49	0.61	20.76	0.00	0.00	35.86
97	149	0.00	0.00	1.67	0.38	2.81	0.00	0.00	4.85
97	150	0.00	0.00	1.24	0.15	3.79	0.00	0.00	5.18
147	91	0.00	0.00	1.74	0.45	2.63	0.00	0.00	4.81
147	95	19.94	0.00	5.37	0.25	10.45	0.00	0.00	36.01
147	96	1116.86	0.00	200.63	6.69	360.74	0.00	0.00	1684.91
147	97	1.21	0.00	34.63	0.63	53.59	0.00	0.00	90.05
147	147	0.00	0.00	153.82	0.52	750.37	0.00	0.00	904.70
147	149	0.00	0.00	23.25	0.27	39.13	0.00	0.00	62.65
147	150	0.00	0.00	3.24	0.08	6.28	0.00	0.00	9.60
149	91	2.81	0.00	1.09	0.22	1.99	0.00	0.00	6.11
149	95	89.44	0.00	7.42	0.19	10.97	0.00	0.00	108.01
149	96	352.80	0.00	137.68	3.98	199.03	0.00	0.00	693.48
149	97	37.22	0.00	4.24	0.14	8.72	0.00	0.00	50.32
149	147	0.00	0.00	12.51	0.12	20.53	0.00	0.00	33.16
149	149	5.26	0.00	140.12	0.25	512.74	0.00	0.00	658.37
149	150	0.00	0.00	16.62	0.38	23.61	0.00	0.00	40.60
150	91	19.62	0.00	2.91	0.00	2.74	0.00	0.00	25.27
150	95	219.57	0.00	7.43	0.00	51.56	0.00	0.00	278.56
150	96	574.48	0.00	124.13	0.38	180.67	0.00	0.00	879.66
150	97	23.95	0.00	8.02	0.00	11.67	0.00	0.00	43.64
150	147	0.00	0.00	3.25	0.00	5.71	0.00	0.00	8.96
150	149	23.77	0.00	7.50	0.00	34.28	0.00	0.00	65.56
150	150	2.17	0.00	85.09	0.56	634.83	0.00	0.00	722.64

c:\job\93027\reebie\btobtot.wk1 "mnbotob"

1990 Commodity Traffic in 1000 Tons (ALL COMMODITIES INCL. MAIL)
 (Supporting data for MAP 5.6 through MAP 5.13)

	Into Minneapolis-St Paul					From Minneapolis-St Paul				
	Rail	Truck	Air	Water	Total	Rail	Truck	Air	Water	Total
BEA 83	886.28	880.94	3.11	17.95	1788.28	2345.38	1358.87	1.39	27.87	3733.51
BEA 88	33.84	31.83	0.00	0.00	65.67	314.83	133.56	0.00	0.00	448.40
BEA 89	48.71	612.03	0.09	0.01	660.83	805.99	1422.07	0.56	0.04	2228.66
BEA 90	1.56	153.14	0	0	154.7	781.43	485.52	0	0	1266.95
BEA 91	10.66	200.02	0	1.64	212.32	508.28	482.53	0	681.26	1672.06
BEA 92	53.67	288.91	0	0	342.58	196.04	466.08	0	0	662.13
BEA 93	73.31	419.43	0	0	492.73	380.59	480.93	0	0	861.52
BEA 94	164.15	548.15	0	0.03	712.33	312.24	685.89	0	0.05	998.18
BEA 95	969.74	965.52	0	0	1935.26	812.14	1278.26	0	0	2090.4
BEA 96	4982.44	16334.99	1.6	1915.54	23234.57	4982.44	16334.99	1.6	1915.54	23234.57
BEA 97	144.03	676.28	0	0	820.31	112.61	1391	0	0	1503.62
BEA 98	26.13	294.28	0	6.82	327.23	437.23	233.31	0	368.41	1038.94
BEA 99	178.72	416.27	0	218.01	812.99	818.78	334.03	0	421.57	1574.38
BEA 100	112.99	467.51	0	0	580.5	425.21	241.32	0	0	666.52
BEA 101	464.9	1015.76	0	0	1480.66	121.22	296.39	0	0	417.6
BEA 102	6.99	617.87	0	0	624.86	102.81	183.35	0	0	286.16
BEA 103	62.88	797.23	0	0	860.1	544.62	267.61	0	0	812.23
BEA 104	65.24	764.99	0	0	59.83	636.43	0.05	0	896.31	1532.79
BEA 146	144.95	112.06	0	0	257.01	0.07	119.36	0.02	0	119.45
BEA 147	1273.67	1075.91	0	0	2349.58	61.43	938.03	0	0	999.46
BEA 148	424.15	185.01	0	0	609.15	17.83	106.46	0	0	124.28
BEA 149	2280.43	556	0	0	2836.43	91.25	938.89	0	0	1030.14
BEA 150	1791.9	426.79	0	0	2218.69	16.95	671.21	0	0	688.16
BEA 151	175.45	278.38	0	0	453.84	5.16	236.27	0	0	241.43
BEA 152	491.5	131.35	0	0	622.86	1.15	187.93	0	0	189.08
REGION	14868.289	28250.655	4.803	2160.001	44513.318	14832.115	29273.914	3.567	4311.051	48420.617
US	35802.49	37154.83	35.66	4546.78	77539.76	22095.47	36495.63	38.07	12257.22	70886.39
Reg as % US	41.53	76.03	13.47	47.51	57.41	67.13	80.21	9.37	35.17	68.31

c:\job\93027\reebie\regtot.wkl "first"

1990 Commodity Traffic in MILLION \$ (ALL COMMODITIES INCL. MAIL)
(Supporting data for MAP 5.6 through MAP 5.13)

	Into Minneapolis-St Paul					From Minneapolis-St Paul				
	Rail	Truck	Air	Water	Total	Rail	Truck	Air	Water	Total
BEA 83	14712.08	1825.75	20.81	5.37	16564.01	4895.93	2116.29	16.83	16.27	7045.33
BEA 88	157.23	56.45	0.00	0.00	213.68	79.36	152.54	0.00	0.00	231.90
BEA 89	95.44	1143.11	0.76	0	1239.31	325.68	1084.79	4.36	0	1414.84
BEA 90	1.73	156.29	0	0	158.03	154.19	327.24	0	0	481.43
BEA 91	10.55	257.15	0	0.73	268.43	63.34	316.45	0	37.31	417.09
BEA 92	27.06	144.96	0	0	172.02	105.27	227.65	0	0	332.93
BEA 93	30.84	305.18	0	0	336.02	79.23	329.15	0	0	408.38
BEA 94	118.66	611.61	0	0.03	730.3	141.18	547.09	0	0	688.27
BEA 95	313.93	523.54	0	0	837.47	127.4	755.73	0	0	883.14
BEA 96	992.35	11837.77	19.16	203.82	13053.11	960.14	11794.49	21.77	193	12969.4
BEA 97	25.4	854.36	0	0	879.76	38.81	960.32	0	0	999.13
BEA 98	23.25	257.6	0	1.49	282.34	104.66	155.3	0	93.58	353.54
BEA 99	70.24	583.54	0	5.35	659.12	200.18	316.9	0	93.63	610.71
BEA 100	82.03	362.58	0	0	444.6	64.91	203.12	0	0	268.02
BEA 101	98.9	878.91	0	0	977.81	72.7	245.43	0	0	318.12
BEA 102	1.73	274.17	0	0	275.9	78.25	133.48	0	0	211.72
BEA 103	37.58	541.79	0	0	579.37	75.31	206.34	0	0	281.65
BEA 104	118.4	1400.89	0	0	1519.29	84.62	546.2	0.73	0	631.55
BEA 146	19.07	55.19	0	0	74.26	0.04	113.77	0.22	0	114.02
BEA 147	148.63	773.46	0	0	922.08	51.16	601.6	0	0	652.76
BEA 148	50.93	126.82	0	0	177.75	14.87	83.09	0	0	97.96
BEA 149	460.09	483.48	0	0	943.57	30.41	625.16	0	0	655.58
BEA 150	300.84	200.01	0	0	500.85	11.06	378.57	0	0	389.63
BEA 151	19.83	68.22	0	0	88.06	4.27	161.78	0	0	166.05
BEA 152	104.94	39.29	0	0	144.23	0.95	147.86	0	0	148.81
REGION	18021.73416	23762.11708	40.732662	216.789386	42041.37329	7763.920712	22530.34015	43.913594	433.794768	30771.95922
US	26447.13	38806.84	374.55	870.78	66499.31	44837.05	37932.23	360.83	1652.81	84782.96
Reg as %US	68.14	61.23	10.88	24.9	63.22	17.32	59.4	12.17	26.25	36.29

c:\job\93027\reebie\regtot.wk1 "second"

TOTAL MINNESOTA EXPORTS BY VALUE (MILLION \$)			
(Top 20 countries account for 86.76% of total exports)			
(Supporting data for MAP 5.42)			
RANK	COUNTRY	TOTAL VALUE	%
1	CANADA	1606.836	25.24
2	JAPAN	915.639	14.38
3	UNITED KINGDOM	451.043	7.08
4	GERMANY	388.062	6.09
5	NETHERLANDS	377.587	5.93
6	ITALY	276.794	4.35
7	FRANCE	242.583	3.81
8	SOUTH KOREA	229.685	3.61
9	MEXICO	162.680	2.55
10	AUSTRALIA	150.022	2.36
11	TAIWAN	110.526	1.74
12	HONG KONG	94.167	1.48
13	SINGAPORE	89.558	1.41
14	BELGIUM	88.163	1.38
15	MALAYSIA	80.365	1.26
16	SPAIN	76.623	1.20
17	SWITZERLAND	65.743	1.03
18	UNIDENTIFIED COUNTRIES	65.361	1.03
19	THAILAND	59.203	0.93
20	SWEDEN	59.148	0.93
21	IRELAND	50.206	0.79
22	SOUTH AFRICA	49.297	0.77
23	BRAZIL	47.546	0.75
24	MACAO	30.850	0.48
25	ISRAEL	28.710	0.45
26	FINLAND	28.045	0.44
27	INDIA	26.854	0.42
28	CHINA	25.973	0.41
29	PORTUGAL	25.903	0.41
30	VENEZUELA	24.864	0.39
31	DENMARK	23.248	0.37
32	NEW ZEALAND	23.007	0.36
33	INDONESIA	22.991	0.36
34	ANDORRA	21.833	0.34
35	SAUDI ARABIA	20.807	0.33
36	ARGENTINA	20.561	0.32
37	YUGOSLAVIA	20.452	0.32
38	AUSTRIA	19.326	0.30
39	PHILIPPINES	18.889	0.30
40	ALL OTHERS	248.009	3.90
	TOTAL	6367.160	100.00

EXPORTS BY AIR AND VALUE (MILLION \$)			
(Top 20 countries account for 88.31% of total exports)			
(Supporting data for MAP 5.43)			
RANK	COUNTRY	AIR VALUE	%
1	JAPAN	550.561	21.93
2	UNITED KINGDOM	260.725	10.38
3	GERMANY	229.015	9.12
4	ITALY	185.607	7.39
5	FRANCE	152.410	6.07
6	NETHERLANDS	135.220	5.39
7	CANADA	109.287	4.35
8	SOUTH KOREA	60.693	2.42
9	MALAYSIA	59.384	2.37
10	AUSTRALIA	57.973	2.31
11	MEXICO	57.922	2.31
12	SINGAPORE	48.216	1.92
13	HONG KONG	47.424	1.89
14	SWITZERLAND	47.219	1.88
15	TAIWAN	45.136	1.80
16	SPAIN	43.442	1.73
17	BELGIUM	39.565	1.58
18	BRAZIL	33.566	1.34
19	THAILAND	30.347	1.21
20	SOUTH AFRICA	23.552	0.94
21	SWEDEN	23.473	0.93
22	IRELAND	21.775	0.87
23	PORTUGAL	20.120	0.80
24	ISRAEL	17.730	0.71
25	DENMARK	14.308	0.57
26	INDIA	13.454	0.54
27	CHINA	13.443	0.54
28	ARGENTINA	12.717	0.51
29	AUSTRIA	11.840	0.47
30	VENEZUELA	10.001	0.40
31	COLOMBIA	9.677	0.39
32	FINLAND	9.146	0.36
33	NEW ZEALAND	8.939	0.36
34	INDONESIA	8.444	0.34
35	USSR	8.358	0.33
36	NORWAY	7.894	0.31
37	YUGOSLAVIA	7.756	0.31
38	ANDORRA	6.732	0.27
39	PHILIPPINES	5.496	0.22
40	ALL OTHERS	62.331	2.48
	TOTAL	2510.898	100.00

MINNESOTA FARM EXPORTS BY VALUE (MILLION \$)			
(Top 20 countries account for 97.47% of total exports)			
(Supporting data for MAP 5.44)			
RANK	COUNTRY	VALUE	%
1	JAPAN	63.110	24.12
2	CANADA	48.092	18.38
3	ITALY	34.753	13.28
4	MEXICO	17.039	6.51
5	BELGIUM	16.748	6.40
6	ALGERIA	14.864	5.68
7	NETHERLANDS	8.458	3.23
8	UNITED KINGDOM	8.028	3.07
9	SPAIN	7.445	2.84
10	GERMANY	6.575	2.51
11	EL SALVADOR	5.033	1.92
12	FRANCE	4.265	1.63
13	PORTUGAL	3.888	1.49
14	GHANA	3.828	1.46
15	GUATEMALA	3.131	1.20
16	POLAND	2.972	1.14
17	HONDURAS	2.499	0.95
18	DENMARK	1.910	0.73
19	URUGUAY	1.340	0.51
20	ISRAEL	1.104	0.42
21	SOUTH KOREA	1.037	0.40
22	SWITZERLAND	0.940	0.36
23	TAIWAN	0.619	0.24
24	IVORY COAST	0.604	0.23
25	AUSTRIA	0.573	0.22
26	GREECE	0.570	0.22
27	SWEDEN	0.392	0.15
28	TUNISIA	0.260	0.10
29	HUNGARY	0.253	0.10
30	FINLAND	0.237	0.09
31	CHILE	0.177	0.07
32	ARGENTINA	0.169	0.06
33	BAHAMAS	0.133	0.05
34	SAUDI ARABIA	0.122	0.05
35	PAKISTAN	0.086	0.03
36	MOROCCO	0.079	0.03
37	TURKEY	0.061	0.02
38	ICELAND	0.058	0.02
39	INDIA	0.051	0.02
40	ALL OTHERS	0.192	0.07
	TOTAL	261.694	100

MINNESOTA PROCESSED FOOD EXPORTS BY VALUE (MILLION \$)			
(Top 20 countries account for 97.37% of total exports)			
(Supporting data for MAP 5.45)			
RANK	COUNTRY	TOTAL VALUE	%
1	CANADA	130.400	44.19
2	SOUTH KOREA	62.566	21.20
3	JAPAN	34.114	11.56
4	MEXICO	15.847	5.37
5	TAIWAN	10.920	3.70
6	UNITED KINGDOM	4.414	1.50
7	THAILAND	4.311	1.46
8	YUGOSLAVIA	3.717	1.26
9	USSR	3.476	1.18
10	FRANCE	3.265	1.11
11	SWEDEN	2.471	0.84
12	GERMANY	2.129	0.72
13	NETHERLANDS	1.544	0.52
14	SINGAPORE	1.525	0.52
15	CHINA	1.443	0.49
16	HONG KONG	1.303	0.44
17	BAHAMAS	1.126	0.38
18	SWITZERLAND	1.123	0.38
19	BELIZE	0.912	0.31
20	ITALY	0.745	0.25
21	BELGIUM	0.741	0.25
22	HONDURAS	0.640	0.22
23	MALAYSIA	0.483	0.16
24	NORWAY	0.432	0.15
25	AUSTRALIA	0.376	0.13
26	NEW ZEALAND	0.367	0.12
27	BERMUDA	0.318	0.11
28	PHILIPPINES	0.307	0.10
29	COSTA RICA	0.267	0.09
30	DENMARK	0.238	0.08
31	WESTERN SAMOA	0.237	0.08
32	PANAMA	0.217	0.07
33	SAUDI ARABIA	0.215	0.07
34	ECUADOR	0.205	0.07
35	DOMINICAN REPUBLIC	0.205	0.07
36	ISRAEL	0.183	0.06
37	JAMAICA	0.172	0.06
38	INDONESIA	0.160	0.05
39	SPAIN	0.148	0.05
40	ALL OTHERS	1.862	0.63
	TOTAL	295.117	100.00

CANADA EXPORTS TO MINNESOTA
 (Data supporting CHART 5.1 and CHART 5.3)
 (MILLION US\$)

STCC	NEWFOUNDLAND	PRINCE EDWARD IS.	NOVA SCOTIA	NEW BRUNSWICK	QUEBEC	ONTARIO	MANITOBA	SASKATCHEWAN	ALBERTA	BRITISH COLUMBIA	CANADA
1	0.01	0.35	0.07	0.33	0.38	13.89	45.34	61.54	56.43	2.30	180.65
9	0.34	0.00	0.47	1.02	0.03	1.63	2.70	0.16	0.01	0.06	6.41
13	0.00	0.04	0.00	0.05	0.19	27.00	40.84	11.53	361.10	0.04	440.78
14	0.07	0.00	0.00	0.00	0.88	2.66	1.23	0.44	12.68	0.07	18.03
20	0.03	0.02	0.00	0.25	1.41	4.65	27.26	13.87	7.35	3.39	58.26
22	0.00	0.00	0.00	0.00	0.29	0.96	1.10	0.00	0.03	0.03	2.40
23	0.00	0.00	0.07	0.00	0.79	0.66	0.26	0.00	0.01	0.01	1.81
24	0.00	0.00	0.02	16.10	2.02	8.47	13.02	2.70	17.11	138.29	197.74
25	0.00	0.00	0.00	0.00	0.18	3.28	4.34	0.00	0.82	0.27	8.89
26	0.00	0.00	0.00	0.15	13.19	251.22	2.37	8.66	13.06	94.83	383.49
27	0.00	0.00	0.01	0.00	0.04	1.19	1.72	0.59	0.05	0.08	3.68
28	0.00	0.00	0.00	0.32	14.88	24.46	4.15	80.98	17.68	0.77	143.24
30	0.00	0.00	0.08	0.00	1.69	52.05	17.04	0.06	4.83	0.73	76.47
31	0.00	0.00	0.00	0.01	0.29	0.08	0.44	0.02	0.11	0.06	1.01
32	0.00	0.00	0.00	0.04	1.66	40.37	3.81	0.13	0.01	0.04	46.05
33	0.00	0.00	0.08	0.08	5.25	44.20	10.10	13.14	1.42	3.06	77.32
34	0.00	0.00	0.00	0.00	0.16	1.35	0.14	0.00	0.30	0.20	2.14
35	0.10	0.01	0.23	0.20	7.25	58.05	10.48	4.85	4.14	3.01	88.32
36	0.00	0.00	0.00	0.21	2.04	10.72	14.30	0.46	3.79	1.05	32.57
37	0.00	0.03	0.00	0.00	20.90	11.21	12.54	0.01	0.18	3.36	48.22
38	0.00	0.00	0.01	0.03	0.35	13.54	1.11	0.04	0.16	0.06	15.29
39	0.00	0.00	0.00	0.00	1.04	2.66	0.35	0.07	0.04	0.51	4.67
41	0.00	0.00	0.00	0.04	0.33	1.05	2.23	0.29	0.29	0.02	4.26
TOTAL	0.56	0.46	1.08	18.82	75.22	575.34	216.87	199.54	501.58	252.25	1841.72

c:\job\93027\canada\xrminmtot.wk1 "canadexp"

CANADA IMPORTS FROM MINNESOTA
(Data supporting CHART 5.2 and CHART 5.4)
(MILLION US\$)

STCC	NEWFOUNDLAND	PRINCE EDWARD IS.	NOVA SCOTIA	NEW BRUNSWICK	QUEBEC	ONTARIO	MANITOBA	SASKATCHEWAN	ALBERTA	BRITISH COLUMBIA	YUKON	NORTHWEST TERRITORIES	CANADA
1	0.00	0.00	0.01	0.01	6.23	18.19	13.20	12.69	2.66	4.70	0.00	0.00	57.69
9	0.00	0.00	0.00	0.00	0.16	0.78	0.08	0.07	0.02	0.04	0.00	0.00	1.16
10	0.00	0.00	0.00	0.00	0.00	46.12	0.01	0.02	0.00	0.00	0.00	0.00	46.15
13	0.00	0.00	0.00	0.01	0.03	0.38	0.53	0.29	0.04	0.10	0.00	0.00	1.38
14	0.00	0.00	0.01	0.07	0.85	4.80	0.35	0.90	0.46	0.21	0.00	0.00	7.65
20	0.00	0.00	0.14	0.11	0.84	55.56	29.03	4.96	1.14	4.16	0.00	0.00	95.94
22	0.00	0.00	0.00	0.01	0.78	2.31	2.52	0.60	0.85	0.30	0.00	0.00	7.37
23	0.00	0.03	0.00	1.22	0.04	5.67	1.19	0.07	0.54	0.38	0.00	0.00	9.14
24	0.00	0.00	0.00	0.00	0.07	7.04	6.28	2.22	1.14	0.51	0.00	0.00	17.26
25	0.06	0.01	0.09	0.17	1.07	4.93	2.38	0.45	0.46	0.71	0.00	0.00	10.32
26	0.00	0.00	0.04	0.02	0.94	18.38	9.14	0.62	0.96	4.26	0.00	0.00	34.36
27	0.07	0.01	0.24	0.22	1.09	15.55	3.57	0.31	1.15	2.28	0.00	0.00	24.49
28	0.03	0.00	0.03	0.13	5.23	29.96	9.62	2.26	1.61	1.15	0.00	0.00	50.03
30	0.01	0.00	0.33	0.23	2.30	30.45	7.35	1.00	1.85	0.99	0.00	0.00	44.50
31	0.00	0.00	0.00	0.07	0.22	0.62	0.51	0.00	0.02	0.02	0.00	0.00	1.45
32	0.00	0.00	0.02	0.10	1.56	19.18	5.26	0.92	3.15	1.29	0.01	0.00	31.50
33	0.01	0.01	0.06	0.18	2.24	24.92	12.54	11.05	2.57	4.12	0.00	0.00	57.70
34	0.03	0.13	0.06	0.45	2.27	19.60	3.14	0.66	1.61	1.55	0.04	0.00	29.52
35	0.29	0.16	0.74	2.12	22.27	170.78	35.64	8.57	15.99	15.06	0.02	0.00	271.63
36	0.10	0.02	0.21	0.47	12.57	73.37	13.16	2.47	3.76	3.75	0.00	0.01	109.89
37	1.94	0.26	4.28	4.77	35.73	102.16	101.52	17.46	69.38	52.94	0.00	0.00	390.44
38	0.05	0.01	0.30	0.26	21.54	43.10	3.74	0.59	15.47	3.92	0.00	0.00	88.98
39	0.09	0.00	0.01	0.22	1.98	9.42	3.32	0.21	0.90	1.31	0.00	0.00	17.47
41	0.02	0.02	0.09	0.31	3.26	12.97	6.23	0.70	1.13	2.15	0.00	0.00	26.89
TOTAL	2.70	0.65	6.67	1 1.13	123.26	716.24	270.32	69.09	126.84	105.90	0.07	0.01	1432.90

c:\job\93027\canada\mminntot "canadimp"

