REPORT BY THE

Comptroller General

OF THE UNITED STATES

U.S. Grain Transportation Network Needs System Perspective To Meet Future World Needs

Grain transportation in the United States is a complex, interrelated activity that is essential to the farmer's ability to produce and export grain. The major components of the grain transportation system are railroads, waterways, roads, and ports. These elements tend to be viewed separately rather than as an integrated system in which developments in one area affect all others.

Transportation is the lifeblood of commerce, but a number of problems threaten the ability of the grain transportation system to meet future demand. Bottlenecks that impede movement of $16 billion in grain exports and increase costs now can create even greater constraints in the future, hinder farm productivity growth, and threaten our balance of payments.

GAO has reviewed problems in grain transportation and is recommending that the Department of Agriculture bring together Government, industry, and labor representatives to develop solutions to these transportation problems.

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COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-199148

The Honorable Max Baucus
United States Senate

Dear Senator Baucus:

This report, at your request as chairman of the Subcommittee on Limitations of Contracted and Delegated Authority, Senate Judiciary Committee, examines the grain transportation system. It identifies actual and potential bottlenecks, explains their significance, and explores the status of activities addressing them. It recommends that the Secretary of Agriculture expand monitoring of the grain transportation system and bring together industry, labor, and Government representatives to explore the best way to alleviate present bottlenecks and forestall future ones.

At your request, we obtained oral comments from the Department of Agriculture and did not obtain comments from any other agency. The Department of Agriculture's comments are summarized in the report.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of the report. At that time we will send copies to the Secretaries of Agriculture and Transportation; the Commander, Corps of Engineers; and the Director, Office of Management and Budget. We will also make copies available to other interested parties.

Sincerely yours,

Milton J. Socolar

Acting Comptroller General
of the United States

REPORT BY THE
COMPTROLLER GENERAL
OF THE UNITED STATES

U.S. GRAIN TRANSPORTATION NETWORK NEEDS A SYSTEM PERSPECTIVE TO MEET FUTURE WORLD NEEDS

D I G E S T

The grain transportation system in the United States is complex and interrelated, involving railroads, waterways, roads, and ports. Changes and events in one area affect all others, straining their ability to perform efficiently. For example:

--Poor rail service and railcar shortages are major reasons for the tremendous increase in grain movement by truck. This increase can contribute to deterioration and increased maintenance costs for rural roads and bridges. (See p. 13.)

--The opening of the port at Lewiston, Idaho, has led to substantial increases in grain truck traffic from Montana to barge lines in Lewiston. The advent of this truck/barge shipping combination has taken business from railroads, increased highway deterioration, and is adding to the heavy traffic through the Bonneville Lock on the Columbia River. (See p. 13.)

--The Corps of Engineers estimates the Bonneville Lock will reach capacity by 1990 but believes that chances of completing construction of a new lock by then are extremely slim. Grain shippers will be forced to use other transportation such as rail, but rail grain movements already face considerable port congestion.

--Constraints at Locks and Dam 26 on the Mississippi River may result in more grain being exported via the Great Lakes, but increased grain exports from there could strain the capacity of the Welland Canal, an important part of the St. Lawrence Seaway system. (See p. 14.)

--When export elevators' handling capacity and the arrival of transportation subsystems, such as barges, trucks, or trains, are not synchronized with ocean freighters, traffic congestion is generated, which impairs the efficiency of the entire transportation system. (See p. 14.)

GRAIN TRANSPORTATION HAS TO BE VIEWED AS A WHOLE

Transportation is the lifeblood of commerce. In agriculture it is vital because farms are spread throughout the country and agricultural exports have become essential to the Nation's balance of international payments. Grain exports, specifically corn, wheat, and soybeans, are the top three U.S. agricultural exports in both value and volume. Their value comprises about half the total value of U.S. agricultural exports. Wheat, corn, and soybean exports have increased from $3 billion to nearly $16 billion during the 1970s and are expected to increase even more in the 1980s. The grain transportation system will be called upon to handle this movement. The amount of corn, wheat, and soybean exports increased an estimated 288 percent in the 1970-79 period, from 1.6 million bushels to 4.6 million bushels. (See p. 5.)

Efforts to improve grain transportation tend to concentrate on individual transportation modes rather than on the transportation network as a whole. An integrated analysis that considers interrelationships between the various components of the grain transportation system has yet to be conducted.

Without such an analysis, GAO believes that implementing wise policies is difficult. Although GAO believes that the ongoing studies addressing specific problem areas are to be commended, the real need is for an analysis of overall system constraints, interactions, and solutions to prepare for the expanding export industry.

VARIOUS PROBLEMS AFFECT GRAIN TRANSPORTATION

Several problems threaten the ability of the grain transportation system to meet future demand.

--The widely held notion of railcar shortages is symptomatic of a more serious problem--inefficient use of railcars.

--The proportion of grain moved by truck has increased. Although road and bridge conditions have not seriously impeded the movement of agricultural commodities, today's reasonably adequate system may be in jeopardy with increased truck use.

--Waterborne shipments continue to exceed forecasts, and there is widespread concern that the growth of grain exports could be limited by lock and dam constraints. Key locks and dams are either at capacity or will be reaching capacity in the foreseeable future. Although the U.S. Army Corps of Engineers is currently addressing these bottlenecks, a timely response is unlikely.

--Each major grain exporting port (Houston, Lower Mississippi, Duluth/Superior, and Lower Columbia River) GAO visited was hampered by problems of congestion and inefficiency. These problems reduce the use of scarce transportation resources and delay movement of grain to export elevators, impairing the efficiency of the entire transportation network. (See p. 18.)

THE GOVERNMENT AND GRAIN TRANSPORTATION

Although a number of Federal agencies affect grain transportation, the U.S. Department of Agriculture's (USDA's) Office of Transportation is the focal point for all USDA transportation matters. It publishes a grain transportation situation report that describes specific grain transportation and related activities, problems, and events. However, in fiscal year 1980 the Office of Transportation lacked the resources to address potential impediments or the effect of developments in one transportation mode on another. USDA's fiscal year 1981 appropriation included $2 million for the Office of Transportation but it will not allow for analyzing and projecting agriculture's future essential transportation needs. (See p. 8.)

GAO believes USDA should pay more attention to potential bottlenecks in the grain transportation system so that they can be addressed. GAO further believes that a catalyst is needed to bring the public and private sectors together to solve grain transportation problems, a role that could be fulfilled by USDA.

RECOMMENDATIONS TO THE SECRETARY OF AGRICULTURE

GAO recommends that the Secretary of Agriculture

--expand the monitoring of the grain transportation system to identify potential bottlenecks and analyze their impact on the total grain transportation system and

--bring together industry, labor, and Government to explore the best way to alleviate present bottlenecks and forestall future ones. (See p. 18.)

GAO identified several specific areas that should be explored and recommends that the Secretary review the level of resources available for monitoring grain transportation needs to determine what adjustments are warranted. (See p. 20.)

AGENCY COMMENTS

At the direction of the requester, GAO obtained oral comments only from USDA. It said that the report accurately describes the grain transportation system and potential constraints to it. USDA concurs in the GAO recommendations. It notes that its review of the recommendations was made in consideration with current budget constraints and that its Office of Transportation currently has a program that, within resource constraints, tries to take the systems approach recommended by GAO.

Contents

ABBREVIATIONS

DOT	Department of Transportation
GAO	General Accounting Office
OT	Office of Transportation
USDA	Department of Agriculture

CHAPTER 1

INTRODUCTION

Transportation is the lifeblood of commerce. According to the January 1980 report to the Congress by the Rural Transportation Advisory Task Force, 1/ it is vital to agriculture, both because of the geographic dispersion of farming and because exporting agricultural products has become essential to the Nation's balance of international payments. In establishing the Task Force, the Congress declared that

> "an adequate transportation system, made up of various modes of transportation, is essential to the overall success of the Nation's agriculture programs, to a sound program of rural development, and to the economic stability of the United States * * *."

This report concerns grain transportation. The term grain includes a number of agricultural commodities including wheat, corn, sorghum, oats, barley, rice, and rye. The two major grains, and the ones discussed in this report, are wheat and corn. Soybeans, which are an oilseed rather than a grain, are also discussed. These three commodities are the major U.S. field crops and represent the bulk of agricultural exports. Although the soybean is not a grain, the term grain transportation as used throughout this report will refer to the transportation of wheat, corn, and soybeans.

The United States is one of the world's most important grain and soybean producers and exporters. Corn, soybeans, and wheat were the top three U.S. agricultural exports in 1978 and 1979, as illustrated in table 1-1. Rice and grain sorghum are also in the top ten but generate considerably less export sales. Table 1-2 provides data on the growing value of corn, soybeans, and wheat exports during the 1970s and their proportion of total agricultural exports on a dollar basis. These exports are expected to grow substantially in the 1980s, and this growth will have to be accommodated by the grain transportation system.

1/Public Law 95-580 directed the administration to establish a Rural Transportation Advisory Task Force to assess the entire rural transportation network. Its final report was sent to the Congress in January 1980.

Table 1-1

U.S. Agricultural Exports

U.S. agricultural exports--top ten commodities by value, FY 1978 and 1979

Commodity	1978	1979
	(billion dollars)	
Corn	5.069	6.059
Soybeans	4.749	5.444
Wheat wheat flour	4.072	4.775
Cotton, including linters	1.707	1.910
Soybean meal	1.121	1.365
Tobacco	1.132	1.292
Hides and skins	0.604	0.970
Rice	0.834	0.865
Soybean oil	0.541	0.706
Grain sorghum	0.520	0.551

U.S. agricultural exports--top ten commodities by volume, FY 1978 and 1979

Commodity	1978	1979
	(million metric tons)	
Corn	49.108	53.885
Wheat wheat flour	32.834	32.217
Soybeans	19.686	20.194
Soybean meal	5.516	5.996
Grain sorghum	5.357	5.217
Rice	2.276	2.397
Cotton	1.378	1.395
Soybean oil	0.933	1.059
Tobacco	0.272	0.287
	(mil. pieces)	
Hides and skins	27.828	29.533

Source: USDA

Table 1-2

Fiscal Years 1970-79
Wheat, Corn, and Soybean Exports

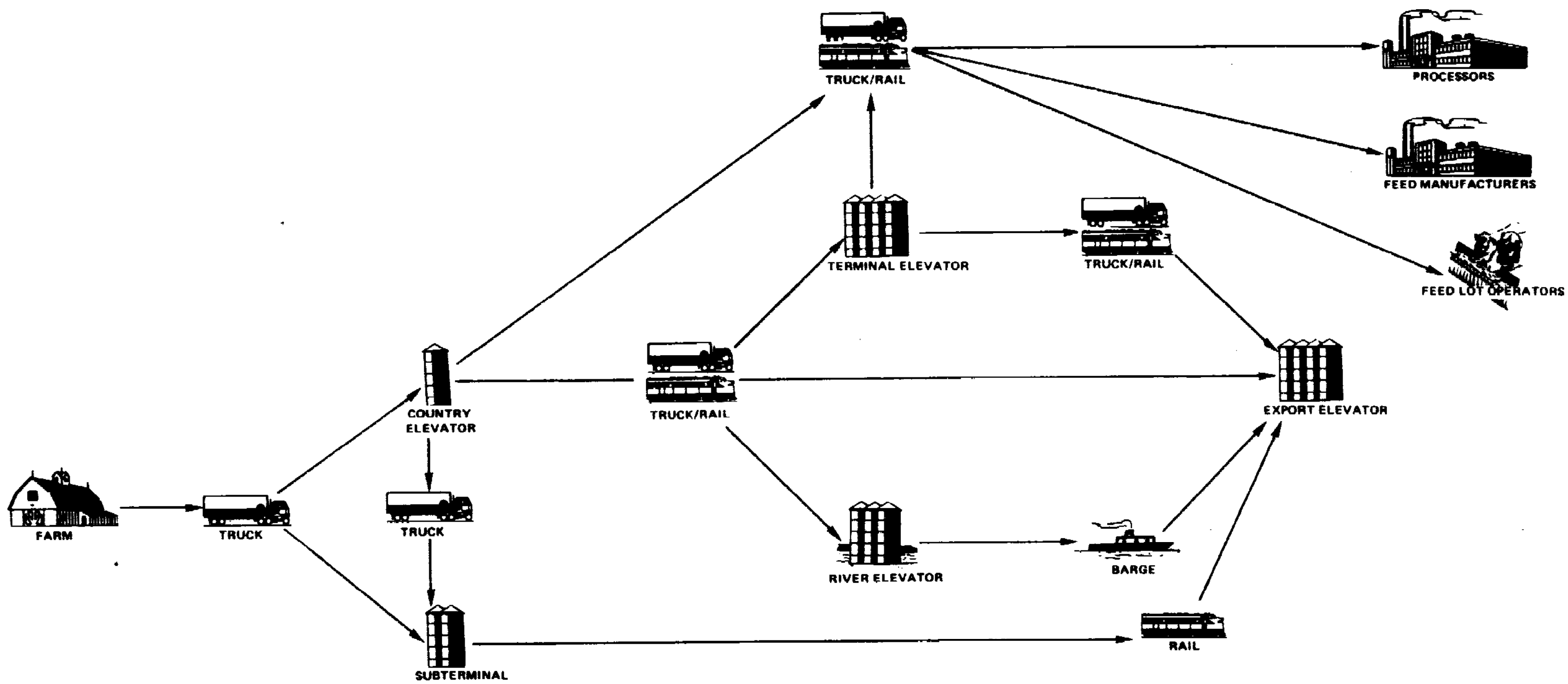
Fiscal year	Wheat	Corn	Soybeans	Total	Total agriculture exports	Wheat, corn, and soybeans as a percent of total agriculture exports
	(million dollars)					
1970	$ 895	$ 822	$1,198	$ 2,915	$ 6,958	42
1971	1,123	770	1,337	3,230	7,955	41
1972	1,044	1,066	1,317	3,427	8,242	42
1973	3,134	2,394	2,311	7,839	14,984	52
1974	4,474	3,539	3,492	11,505	21,608	53
1975	5,090	4,049	2,989	12,128	21,854	55
1976	4,578	5,199	3,038	12,815	22,760	56
1977	2,825	4,500	4,307	11,632	23,974	49
1978	3,876	5,069	4,749	13,694	27,306	50
1979	4,577	6,059	5,444	16,080	31,983	50

HOW GRAIN MOVES

Railcars, barges, and trucks transport grain in the United States. Each mode has its own characteristics of speed, cost, service, and capacity, which are major factors in mode selection. Characteristics which determine mode choices, according to a grain industry official, vary depending on grain demand and equipment availability.

Grain transportation begins at a farmer's field or storage facility. The initial movement is usually to the country elevator. Because of the small volume and short distance, the movement is by truck. From the country elevator, grain is moved by rail or truck to a variety of outlets including major terminals, processors, and feedlot operators. Transportation from these facilities is by rail, barge, or truck, depending on cost and service. Figure 1-1, which we developed from a variety of sources, indicates selected grain flows.

FIGURE 1-1. SELECTED GRAIN FLOWS*



* THIS FIGURE ILLUSTRATES SOME OF THE MAJOR GRAIN FLOWS BUT SHOULD NOT BE VIEWED AS INCLUSIVE.

The price the farmer receives for grain is influenced by transportation charges. The country elevator operator's primary goal is to pay the farmer the lowest price at which that elevator will still remain competitive with other area elevators, while receiving the highest possible price for the grain. The price offered the farmer is based on what the operator perceives as the resale opportunities. Taking the prices at which the elevator operator can sell grain, certain costs, including transportation and handling, are netted out to determine what price can be offered to farmers. For example, if an elevator can sell number 2 yellow corn in Chicago at $3.43 per bushel and would incur handling and transport charges for moving the corn to Chicago totaling approximately 60 cents a bushel, the price offered to the farmer would be no more than $2.83.

The U.S. grain transportation system has handled increasingly greater volumes of grain over the years. Between 1970 and 1979 wheat production rose from 1.4 million to 2.1 million bushels, corn from 4.2 million to 7.8 million bushels, and soybeans from 1.1 million to 2.3 million bushels. In the same period, wheat exports rose from 0.7 million to 1.4 million bushels, corn from 0.5 million to 2.4 million bushels, and soybeans from 0.4 million to 0.8 million bushels.

HEAVY FUTURE DEMAND LIKELY

On May 1, 1980, the Secretary of Agriculture testified before the House Committee on Agriculture that the favorable long-term outlook for the American farmer was due to the fast-growing foreign markets for more grains, oilseeds, and fibers and expanding domestic demand for U.S. agricultural products. He testified that foreign demand should expand at no less than 4 to 6 percent annually over the next several years.

On November 1, 1978, the Director of Economics, Policy Analysis and Budget of the U.S. Department of Agriculture (USDA) spoke before the 14th Asia-Pacific Food Production Conference, stating that by 1987-88 the world could be demanding 25 percent more grain than was produced and consumed in 1977-78. He stated that a number of the world's regions appear to be moving toward greater dependence on foreign production to meet their food needs. If present trends in production and exports continue, he said that North America will be required to supply 85 percent of the exporters' trade to meet the production shortfall in the deficit regions. The United States accounts for the bulk of North American grain production; Canada the balance. He noted that, in the short term, the major restraints to our ability to substantially increase food exports may be our ability to rapidly expand our transportation systems and port capacities.

Concern has been expressed about grain transportation capacity

Several other officials have expressed concern about the capacity of the grain transportation system. The Deputy Administrator of the former Economics, Statistics and Cooperative Service, USDA, now the Economics and Statistics Service, has stated that our handling system--storage, transportation, and port facilities--may be severely taxed at times in view of the global agricultural setting in the decade ahead. USDA, in a September 1979 statement prepared for the Senate Budget Committee, noted that record 1978-79 and 1979-80 export levels could put a severe strain on the U.S. internal transportation system and port facilities. The Assistant Secretary of Agriculture for International Affairs and Commodity Programs and his former deputy told us in October 1979 that the U.S. grain transportation sytem was approaching its physical capacity.

The Federal Government and grain transportation

Thirty congressional committees and 64 Federal agencies oversee and administer approximately 1,000 transportation policies and programs. Several other Federal agencies affect grain transportation through their broader responsibilities involving transportation. Since the grain transportation system is part of the total national transportation system, these agencies have a substantial effect on grain movements. Figure 1-2 lists various grain transportation modes and the agencies that have responsibilities affecting them.

Figure 1-2

Transportation Modes, Relevant Federal Agencies, and Their Function

Mode	Agency	Function
Rail	Interstate Commerce Commission	Regulates rail rates and services.
	Federal Railroad Administration, Department of Transportation (DOT)	Consolidates Government support of rail transportation activities, including providing for a national rail transportation policy and administering financial assistance programs.
Roads and bridges	Federal Highway Administration, DOT	Administers the Federal-aid highway program of financial assistance to the States for highway construction.
Inland Waterways/ports	U.S. Army Corps of Engineers	Constructs, maintains, and/or operates shipping channels and navigational structures such as locks and dams.
		Approves construction of piers, docks, mooring buoys, and other facilities along navigable waterways.
	U.S. Coast Guard, DOT	Monitors safety and seaworthiness of ships and barges. Establishes and enforces navigation safety rules for rivers and harbors.
		Establishes and enforces safety regulations for barge fleeting along Lower Mississippi River.
		Designates river and harbor areas acceptable for ship anchorage.
	Federal Grain Inspection Service, USDA	Inspects ships before loading for cleanliness and certifies them acceptable for grain loading.
		Inspects, with some exception, all export grain for compliance with Federal grade standards.

USDA's Office of Transportation focuses on agricultural transportation

Except for the activities of its Federal Grain Inspection Service, USDA plays an indirect role in grain transportation. On December 12, 1978, the Secretary of Agriculture established the Office of Transportation (OT) to consolidate USDA's transportation activities. The duties assigned OT include, among others:

--serving as a focal point for all USDA transportation matters;

--developing USDA agricultural and rural development transportation policies and strategies;

--advising the Secretary and other policy-level USDA officials on transportation policies and programs;

--reviewing and evaluating USDA transportation programs and progress; and

--representing USDA at conferences, meetings, and other contacts where transportation matters are discussed, including liaison with other Government agencies and departments.

The Office of the Director, OT, further delineated OT's responsibilities to include identifying impediments to a transport system adequate to meet the needs of agriculture and rural areas. The Chief of the Transportation Services Division, OT, expressed the belief, however, that the office didn't have sufficient staff to assess future needs. The office had an estimated budget of $1.7 million and a staff of 36 in fiscal year 1980. Eight percent of OT's professional resources were allocated to identify current and projected essential transportation needs of agriculture in fiscal year 1980. The USDA appropriation included $2 million for OT in fiscal year 1981 compared with a budget request of $2.2 million. Most of the increase is to be spent on establishing joint field stations with DOT. OT officials said that no funding existed to build up economic analysis, although the OT budget included $50,000 of unspecified funds. They contend that the funding will make it possible to establish and maintain an information system that could help monitor the day-to-day transportation situation through the field offices but will not allow for analyzing and projecting future essential transportation needs of agriculture to avoid further problems. USDA has approved a fiscal year 1982 budget request of $2.9 million for OT in its internal budget process.

OT, principally through the work of one staff member, publishes a weekly document entitled "Grain Transportation Situation," which contains one page of text describing specific grain transportation and related activities, problems, and events as well as information on grain harvest and exports. This page is followed by a variety of tables on specific activities such as railcar loadings, barge loadings, inspections for export, cash grain prices, and major export sales. Data is provided by week in the current year and the comparable week a year earlier. Grain prices and export sales are provided for wheat, corn, and soybeans.

The Economics and Statistics Service has a transportation research group in the National Economics Division. It conducts long-term research on agricultural transportation, a large part of which relates to grain and oilseeds. This group had four professionals as of September 2, 1980, with two professional positions vacant.

OBJECTIVES, SCOPE AND METHODOLOGY

The chairman, Senate Subcommittee on Limitations of Contracted and Delegated Authority, Committee on the Judiciary, asked us to make a comprehensive review of grain transportation problems. Our objectives were to understand how the grain transportation system works, identify actual and potential bottlenecks, explain their significance, determine their impact, and explore the status of activity addressing them.

We examined the three major transportation segments by which grain moves--rail, road, and inland waterway. We also examined ports because of the importance of grain exports and their expected growth in the 1980s. For rail and road, we conducted our review in four important grain-producing States--Iowa, Kansas, Montana, and North Dakota; we also reviewed reports that examined these subjects on a national scale. Iowa is one of the top corn- and soybean-producing States. Kansas and North Dakota are the two largest wheat producers. Montana is one of the 10 largest wheat producers and along with North Dakota, has less transportation competition than other States. It reportedly has significant grain transportation problems.

In assessing the role of rail transportation in grain marketing we sought to (1) determine the extent and cause of the railcar shortages and their impact on grain transportation and other transportation modes, (2) document railroad branchline abandonments and their present and potential impact on alternative grain transportation modes, and (3) determine to what extent railroad rate policies affect grain movements and the overall grain transportation system.

To accomplish these objectives, we interviewed State officials in Montana, North Dakota, Iowa, and Kansas; university officials in Montana, North Dakota, and Iowa; and grain marketing organizations in Montana and North Dakota. We discussed rail transportation issues with corporate and/or local officials of four railroads serving the four States visited. In addition, we obtained available statistics, reports, and studies pertinent to railroad transportation of grain from Federal and State government agencies and from various private organizations.

In assessing the role of truck transportation in grain marketing, we sought to document past, present, and future trends in truck use along with their cause; determine the adequacy of rural roads and bridges to handle both current and projected traffic loads; and assess the ability of State and local governments to maintain rural roads and bridges. To accomplish these objectives, we interviewed State highway department officials in Iowa, Kansas, Montana, and North Dakota. We visited local/county highway officials in two Iowa, two Kansas, three North Dakota, and five Montana counties. We also obtained available statistics, reports, and studies relative to road and bridge conditions at Federal, State, and local levels of government. We drove over many rural roads and bridges and observed existing conditions in the areas we visited.

Counties were selected on the basis of grain production, railroad abandonments, and/or referrals from State highway officials.

In reviewing the inland waterways, we sought to understand their role in grain transportation, document actual constraints and identify potential ones, and determine the status of efforts to address them. Key locks and dams on the inland waterway system have already been the subject of considerable study. Consequently, we relied mainly on reports and interviews in compiling information. We drew heavily from the final report of the Rural Transportation Task Force dated January 1980, the national waterway study review draft dated April 1980, the "Analysis and Assessment of Historical and Projected Traffic and Delay at Existing

Locks and Dam No. 26, Mississippi River," which was prepared by Peat, Marwick, Mitchell and Company for the American Waterways Operators, Inc.; "Locks and Dam No. 26 Supplemental Economic Data," dated January 1977, which was prepared by the U.S. Army Corps of Engineers; and the "Bonneville Lock, Columbia River, Oregon-Washington Feasibility Report," dated January 1977, which was also prepared by the Corps. We conducted interviews with OT representatives; Corps of Engineer personnel in Washington, D.C., St. Louis, Missouri, and Portland, Oregon; the study manager for the National Waterways study; barge operators in St. Louis and Portland, Oregon; and various grain companies and trade associations. We did not perform any detailed constraint analyses of the inland waterways.

In reviewing the port areas, our objectives were to (1) gain an understanding of how export elevators receive grain from the interior and subsequently load it on to ocean-going vessels, (2) explore the importance of coordinating ship arrivals with interior grain receipts, and (3) identify current and potential grain transportation problems.

Our work focused on four separate grain export areas, which account for almost two-thirds of U.S. grain exports--the Lower Mississippi River area because it accounted in 1979 for approximately 38 percent of all U.S. grain export and because information obtained previously indicated that barge traffic congestion was a problem, the Port of Houston because it accounted in 1979 for approximately 10 percent of total U.S. grain exports and because information obtained previously indicated the area experienced extensive rail problems, and the Lower Columbia River area and Duluth/Superior because they accounted in 1979 for approximately 8 and 7 percent, respectively, of total U.S. grain exports.

We interviewed officials of export elevators, railroads, railroad research projects, barge companies, local port authorities, local labor unions, shipping firms, Federal agencies, several grain transportation consultants, and various other companies and organizations involved in port area grain transportation. We also interviewed truck drivers delivering grain to the Duluth/Superior port area since more than half its grain receipts arrive by truck. In addition, we obtained available statistics, reports, and studies pertaining to port operations from many of the organizations visited. Most of the information presented in chapter 6 was obtained from these individuals and from documentation they provided. Our conclusions regarding port area problems are applicable only to the areas visited and should not be interpreted as representative of conditions existing in other port areas.

One audit approach we considered using for all these transportation elements but rejected was developing quantitative data to judge the grain transportation system's capacity to meet future demand. Quantitative data on future grain transportation capacity would have to be based on current capacity, planned capital improvements, and forecasts of grain demand. This report views the grain transportation network over a long enough time period to permit new capital improvements, in most instances, to meet any growth in demand. Any judgments based on data available today would have questionable value since capacity would be expanded to meet production and export growth. Consequently, our review qualitatively addresses potential constraints likely to affect grain transportation. Where appropriate, we quote expert judgment on when actual bottlenecks are likely to occur in transportation elements, principally waterways, where the time needed for capital construction exceeds the time at which the bottleneck is likely to develop.

CHAPTER 2

COMPLEX AND INTERRELATED GRAIN TRANSPORTATION SYSTEM HAS PROBLEMS WHICH WILL GROW IF NOT DEALT WITH

America's grain transportation system is extremely complex; it requires the services of railroads, motor carriers, barges, grain elevators, ports, and ocean freighters. The natural tendency is to view these components in isolation rather than as integral parts of an overall grain transportation system. It is important to realize that changes or constraints in one component have a direct impact on the others and on how the system functions as a whole. An efficient transportation system that takes advantage of the unique contributions of each component is essential to our ability to meet future export demand and vital to the continued prosperity of American agriculture. As USDA's Director, Economic, Policy Analysis, and Budget noted, our ability to supply a substantial increase in world food imports may be limited by our ability to rapidly expand our transportation systems and port capacities.

The problems and potential constraints in each grain transportation system segment--railroads, roads and bridges, inland waterways, and ports--are discussed in the remaining chapters of this report. This chapter provides the reader with an overview of the problems and complexities and the interrelationships between the various transportation modes. It also contains conclusions and recommendations dealing with the system's problems.

GRAIN TRANSPORTATION: A COMPLEX, INTERRELATED SYSTEM

The grain transportation system includes the railroad system for train movements, the inland waterway system for barge movements, and the road and bridge system for truck movements. For grain export movements, which have become increasingly important to U.S. agriculture, the ports are another system element into which grain movements by each mode ultimately funnel.

Changes and events in one element of the grain transportation system affect other elements, putting pressure on their ability to perform most efficiently. Following are examples of this interrelationship.

--Poor rail service and shortages in available railcars are major reasons for the tremendous increase of grain movement by truck. For example, from 1976 to 1979, truck movement of grain has increased 221 and 145 percent in North Dakota and Montana, respectively, and now represents about 40 percent of all grain movements in these States. Increases in shipments of grain and other goods by truck, centralization of grain elevators and storage facilities (partly in response to more direct farm marketing as well as large farm equipment), and difficulties in enforcing vehicle size and weight restrictions have all contributed to deterioration and increased maintenance costs of rural roads and bridges.

--Between 1963 and 1978 truck traffic to the port of Duluth/Superior increased approximately 381 percent. The result has been added highway stress and increased congestion at ports not geared to handle the influx. The port problem is one of inadequate unloading capacity and truck parking space at the elevators. Significant truck congestion occurs in the spring when the port opens and during the fall harvest when trucks often wait up to 3 days to unload, seriously jeopardizing truckers' profitability.

--The opening of the port at Lewiston, Idaho, has altered regional grain marketing patterns. Since its opening in 1975, substantial increases have occurred in grain truck traffic from Montana to barge lines in Lewiston. The advent of this truck/barge shipping combination has taken business from the railroads, increased highway deterioration, and added to the heavy traffic through the Bonneville Lock, which is part of the Snake/Columbia River system moving export grain to Lower Columbia River ports.

--The Corps of Engineers estimates that the Bonneville Lock will reach capacity by 1990, increasing delay times from a little over 3 hours in July 1980 to projections exceeding 13 hours by 1990. The Corps believes the chances of completing construction of a new lock before 1990 are extremely slim. It concluded that the increased delay times to grain shippers will force them to use other transportation modes such as rail. However, rail grain movements to Portland already face considerable port congestion.

--Locks and Dam No. 26 has become a major constraint on Mississippi River barge movement, with completion of a new lock and dam not estimated until 1989. We were told that the constraint imposed by Locks and Dam No. 26 is pushing more U.S. grain out through the Great Lakes. Great Lakes shipments move through the St. Lawrence Seaway System, a key component of which is the wholly Canadian-owned Welland Canal. The canal is the major bottleneck in the present seaway system. Several Canadian grain company officials told us that the Welland could be at capacity by 1985. Increased U.S. grain shipments through the Great Lakes resulting from Locks and Dam No. 26 capacity constraints could add further strain on the Welland Canal.

--Railroad rate-setting policies are governed by many factors, probably the most important being competition. Innovations to make railroads more competitive may compound problems at ports that are forced to accommodate such a change. For example, 4 days after multicar rates went into effect for Pacific Northwest destinations from Iowa and Nebraska, more than 1,400 grain cars were on hand and five more unit trains were enroute to one terminal elevator. A lack of coordination between incoming grain by rail and ship arrivals resulted in the elevator being embargoed. 1/ Such operational changes can cause shipping delays, increased costs, inefficient use of equipment, and may do little to enhance overall system performance. Grain companies at Pacific Northwest ports have subsequently revised their grain ordering procedures, which has resulted in more orderly grain shipments and reduced turnaround times.

--When export elevator handling capacity and the arrival rate of the transportation subsystems are not synchronized, traffic congestion is rapidly generated, which impairs the efficiency of the entire transportation system. For example, one Lower Mississippi River elevator was expecting a ship to arrive on the afternoon of May 30, 1980, for a load of soybeans and was unloading soybeans from barges into the elevator in preparation for ship loading.

1/An embargo is a method of controlling traffic movement when, in the judgment of the serving railroad, car accumulations threaten temporary congestion or other interferences with operations.

About mid-morning on May 30, the elevator was notified that the ship would not arrive before June 1 and that another ship for a load of corn would arrive 4 to 5 days ahead of schedule. Unexpected delays are not uncommon. In this case, the elevator stopped taking on soybeans and prepared to receive corn. Soybeans not unloaded would be stored in barges tied up in fleeting areas until after the corn ship was loaded. Scheduling and coordination problems such as these can increase shipping costs and cause congestion in the fleeting areas, although elevator managers may do well in coping with the situation. Similar congestion problems have occurred involving other transportation modes--especially rail.

THE GRAIN TRANSPORTATION SYSTEM NEEDS TO BE VIEWED AS A WHOLE

Efforts to improve grain transportation tend to concentrate on individual transportation modes rather than to view the system as a whole and recognize that all system components are interrelated. A variety of government and private entities have tried to analyze and resolve transportation problems. Individual States have developed rail plans in an attempt to anticipate railroad industry changes, minimize the impact of branch line abandonments, and guarantee continued rail service. Research groups have been formed in Portland and Houston to study rail problems in these terminal areas. Studies are underway to identify the extent of capital improvements needed at the Port of Houston. The Corps of Engineers, through its national waterways study, has assessed current capability and future needs of our waterway system.

These studies emphasize the particular transportation mode of interest. An integrated analysis that considers interrelationships between the various components of the grain marketing system has yet to be conducted, although a study of grain flows now being completed by a 41-State consortium holds promise for producing vital data about how much of each grain each State produces and moves by what mode, to what destination. This study, the North, Central and Southern Regional Research Committee's Grain Flow Study, chaired by the University of Illinois, had 41 States and 3,500 grain firms participating. It will result in separate reports about flows of each grain type. The corn, soybean, and wheat reports are expected to be issued in the summer of 1981.

We believe implementing wise policies affecting a multifaceted system is difficult if impacts on and interrelationships of all component systems are unknown or unquantified. Although the ongoing studies will address specific problem areas and are to be commended, the real need is for an analysis of overall system constraints, interactions, and solutions to prepare for the growing needs of an expanding export industry.

OT, which serves as a focal point for all USDA transportation matters, has as one of its stated goals "* * * to provide for the continuous identification of impediments to a transport system adequate to meet the needs of agriculture * * *." However, OT officials told us that they may not have sufficient resources to assess future needs. OT does monitor grain transportation, publishing a weekly report entitled "Grain Transportation Situation." This report describes the current situation and compares it with the situation a year ago but does not address possible future constraints and the impact of developments in one mode on other modes. We believe OT's attention to grain transportation should be expanded to include potential bottlenecks and interrelationships.

TRANSPORTATION VITAL TO GRAIN BUT PLAGUED WITH A VARIETY OF PROBLEMS

Transportation is vital to agriculture both because of the geographic dispersion of farming and because agricultural exports have become essential to the Nation's balance of international payments. Grain exports have increased substantially during the 1970s and are expected to increase even more in the 1980s. The grain transportation system will be called upon to handle this movement.

A variety of problems affect grain transportation. Some of these problems and the status of activity related to them follow.

--The widely held notion of railcar shortages is symptomatic of a more serious problem--the inefficient use of existing resources. Many people believe that improved use is the key to solving railcar shortages. We concluded in a earlier report ("There Is No Shortage Of Freight Cars-Railroads Must Make Better Use of What They Have," CED-81-2, Nov. 11, 1980) that railroads cannot satisfy the demand for freight cars because they do not use the existing car fleet efficiently. Turnaround times, a major factor in railcar use, have increased recently for grain movements by rail. Most of the time required for grain cars to move from origin to destination is spent in terminals and railyards, not in actual movement.

--The only alternative to rail transportation in many areas is truck. Limited railcar availability, poor rail service, branch line abandonments, alternative markets, favorable rates, and faster payment have contributed to an increase in the percentage of grain moved by truck. While road and bridge conditions have not seriously impeded the movement of agricultural commodities, today's reasonably adequate system may be in jeopardy. Roads are deteriorating and maintenance expenses are escalating while funds for maintenance and construction are decreasing, or at least not increasing fast enough to keep up with inflation. Since little recorded data exists concerning the extent of these problems, even at the local level, where funding is woefully inadequate, no large-scale effort to monitor and correct these problems is evident.

--Waterborne shipments continue to exceed forecasts, and there is widespread concern that the growth of grain exports could be limited by lock and dam constraints. It is anticipated that the capacity of planned replacement facilities will be exceeded by the time construction is complete.

--Key locks and dams on river systems important to grain movement either are already causing congestion and significant traffic delays, or will be reaching capacity in the foreseeable future. Although the Corps of Engineers has efforts underway addressing these bottlenecks, chances of a timely response to these conditions are not great, because the process of conceiving, authorizing, and constructing navigation projects takes more than 25 years to complete.

--Since more U.S. than Canadian grain moves through Canada's Welland Canal--the major bottleneck on the St. Lawrence Seaway System--capacity constraints pose greater problems for U.S. shippers. While Canadian grain company officials believe the canal may be at capacity by 1985, the Canadian Seaway Authority believes a phased improvement program will keep the canal's capacity ahead of cargo demand.

--Each major grain exporting port we visited is hampered by problems of congestion and inefficiency. Improvements will be needed in the ability of port elevators to coordinate the arrival of grain from the interior with the arrival of ships on which the grain is to be loaded. Study groups have been formed at two ports to research and resolve port/rail problems; however, capital improvements in elevator, rail, and barge facilities to handle increased volumes will also be required.

CONCLUSIONS AND RECOMMENDATIONS TO THE SECRETARY OF AGRICULTURE

Every constraint that jeopardizes the efficient movement of grain ultimately hinders our ability to meet export demands and reduces farm profitability. We believe USDA should focus on the overall transportation system, including potential bottlenecks and interrelationships as well as addressing the present transportation situation. The need clearly exists for Government and industry to jointly study and resolve common problems. A catalyst to bring the various parties, industry and Government, together is needed. We believe this role can be filled by USDA.

We recommend that the Secretary of Agriculture

--expand the monitoring of the grain transportation system to identify potential bottlenecks and analyze their impact on the total grain transportation system and

--bring together industry, labor, and Government to explore the best way to alleviate present bottlenecks and forestall future ones.

As part of this effort, we recommend that the Secretary

--examine the impact of a changing railroad role in grain movement on alternative modes of transportation and export facilities. Factors which should be considered include: (1) whether the rural road and bridge network can accommodate current or increased levels of grain movements without impairing grain movement efficiency and thus affect farm income and (2) whether port facilities can accommodate increased grain shipments via unit trains (many railcars carrying only grain) without creating additional congestion problems, thus potentially offsetting railroad innovations to increase efficiency (See pp. 26, 27, and 28);

--explore the relationship of grain shipments via the Mississippi River and the Great Lakes and the capability of the Welland Canal to accommodate projected Great Lakes grain shipments and suggest actions that could be taken to improve grain movement through the canal; and

--determine the impact of port congestion and inefficiencies on the entire grain transportation system and help involved parties find solutions to improve overall system effectiveness.

We further recommend that the Secretary review the level of resources available for this purpose to determine what adjustments are warranted.

AGENCY COMMENTS

USDA said that the report accurately describes the grain transportation system and potential constraints to it. It concurs in the recommendations. It notes that its review of the recommendations was made in consideration with current budget constraints and that OT currently has a program that, within resource constraints, tries to take the system approach we recommended.

CHAPTER 3

CHANGING RAILROAD OPERATIONS SIGNIFICANTLY

AFFECT GRAIN MARKETING PATTERNS

Rail transportation has been the preferred mode for transporting grain for years; however, grain shippers are dissatisfied with rail service and high costs. In recent years, rail equipment used to ship grain has not been available when and where needed due to increased grain export demand, retirements of old, 40-foot boxcars, and inefficient equipment use. The railroads are also trying to reduce an extensive and often redundant rail network by abandoning unprofitable branch lines. Many grain elevator operators see this trend as a threat to their business. Competition has caused railroads to establish multicar freight rates in major grain-producing areas to retain their market share. These rates also provide definite advantages to many shippers in the form of lower costs. However, overall transportation system efficiency may be affected adversely when other components of the system cannot easily adapt to the change.

RAILCAR SHORTAGES: TOO FEW CARS OR MISUSE?

Historically, demand for railcars to ship grain has been greatest during harvest season, but in recent years demand for railcars has been more related to the price of grain. Although a railroad official told us that during the spring of 1980 railcar supply nearly equaled demand, railcars had been in tight supply for more than 2 years until April 1980.

Two factors are generally thought to have contributed to railcar unavailability: retirement of numerous, 40-foot, narrow-door boxcars, which for years have been the mainstay of grain-hauling rail equipment, and increasing turnaround times from point of origin to destination and return. However, railroads have been purchasing significant numbers of covered hopper cars to replace old boxcars and together with large increases in private covered hoppers have increased the total railcar supply. But shippers on light-density branch lines that cannot accommodate the new larger railcars may not benefit from these developments. Furthermore, the railroads have not made any concerted effort to reduce railcar turnaround times.

Railcar numbers are not the problem

Historically, grain-hauling railcars were unavailable primarily during harvest periods when all farmers in a geographic area needed to ship their grain. According to the Association of American Railroads, however, many farmers have invested in storage facilities, which allows them to be more selective as to when they sell their grain. As a result, the sale of grain and the resulting demand for railcars have become more related to the grain price than to harvest periods. This has resulted in periods of railcar unavailability. For example, the railroads experienced car overages in the summer of 1977, but in early 1978 export demand surged, and by April 1978 the U.S. experienced the most severe grain car shortage in history. This situation continued for more than 2 years. In April 1980 the supply of cars nearly equaled demand due to substantial railcar purchases in the last 2 years and the January 4, 1980, Russian grain embargo, which gave the railroads relief from the excessive car demand of late 1979 and allowed them to catch up.

For many years, the 40-foot, narrow-door boxcar was the mainstay of the railroads' grain-hauling equipment. Many boxcars are old and unserviceable, therefore, the railroads embarked on a large scale retirement program. Boxcars were replaced by larger, covered hopper cars capable of carrying about 1.7 times as much grain as the boxcar. But many branch lines serving grain elevators cannot accommodate the larger, heavier, covered hopper cars because of the type of track used and poor track and railroad bridge conditions. With the number of the smaller boxcars that can use these rail lines declining, fewer railcars were available to the smaller shippers on these branch lines.

Railroad purchases of covered hoppers have not been enough to offset the loss of carrying capacity caused by boxcar retirements between 1978 and 1980. However, significant increases in the private, covered hopper fleet added substantial numbers of railcars and carrying capacity to the total grain-hauling railcar fleet, as shown in table 2-1.

Table 2-1

Grain-hauling Capacity, 1978 and 1980 (note a)

	1978		1980	
	Number of railcars	Bushel capacity	Number of railcars	Bushel capacity
		(thousands)		(thousands)
Railroad railcars:				
40' Narrow-Door boxcars	86,081	172,162	55,100	110,200
Covered hoppers	94,621	325,111	107,200	364,480
Total	180,702	497,273	162,300	474,680
Private railcars:				
Covered hoppers	54,075	183,855	80,900	275,060
Total	234,777	681,128	243,200	749,740

a/According to OT officials, about half of the covered hoppers are used for hauling grain. They had no estimate of what proportion of the 40' narrow-door boxcars are used for hauling grain.

Railcar use may be the problem

Total grain-carrying capacity is determined by the number of railcars and their capacity and frequency of use. Because the number and capacity of railcars used for grain transportation is increasing, the problem is primarily railcar use.

Most people agree that the railroads could not, and should not, maintain a railcar fleet capable of meeting peak demands. Many railroad officials believe that improved use is the key to solving railcar shortages. Research done by the Rural Transportation Advisory Task Force in 1979 for its January 1980 report revealed that absolute car numbers were not the problem, but rather car use. In our report, "There Is No Shortage of Freight Cars--Railroads Must Make Better Use of What They Have" (CED-81-2, Nov. 11, 1980), we concluded that railroads cannot satisfy the demand for freight cars because they do not use the existing car fleet efficiently.

A major factor in railcar use is turnaround time from origin to destination and return. Information supplied by Dr. Phillip Baumel of Iowa State University, an authority on grain transportation, to the Senate Committee on Agriculture, Nutrition, and Forestry indicates that turnaround times are increasing; times from central Iowa to Gulf export ports for all types of shipments (single and multiple car) increased across-the-board from 1977 to April 1978. USDA, in commenting on our freight car shortage report, pointed out that the use of covered hopper cars declined from 17.6 trips per year in 1972 to 13.5 trips per year as of June 1980.

Turnaround time appears to be most affected by the time railcars spend in origin, intermediate, and destination terminals and railyards. A July 1977 study by the Texas Transportation Institute showed that time spent in origin, destination, and intermediate terminals and railyards accounted for 15.8 days out of the total turnaround time of 25.5 days.

Although railroad officials expressed concern about railcar turnaround times, they placed the major share of the blame on ports rather than on their own operations. Burlington Northern, a major western railroad, analyzed turnaround times to various ports from different origins. The Burlington Northern's 1978 railcar utilization study's purpose was to determine how much time was being lost at the ports. Although the study showed that railcars spent about 4.5 days unloading at Pacific Northwest ports and about 3.6 days loading, it also showed that an average of 15.3 out of 23.4 days (65.5 percent) required to complete a turnaround were spent in transit (both empty and loaded) from origin to destination and back. However, the study did not identify how much of this time was spent in line-haul operations versus intermediate terminals and yards. 1/ These delays in terminals and intermediate yards caused by congestion, complexity of the terminal, and operation constraints increase turnaround times and effectively reduce car supply.

1/Line-haul railroads, as used in this report, are major class I railroads hauling grain and other freight from one part of the country to another.

Impact of railcar unavailability

The inability of railroads to supply railcars when and where needed has encouraged grain shippers to make more of their grain shipments by truck rather than rail. For example, from 1976 to 1979, truck movement of grain in North Dakota and Montana increased 221 and 145 percent, respectively, and now represents about 40 percent of all grain movements in these States. This shift from rail to truck has caused at least one railroad to propose more competitive wheat rates to the Pacific Northwest ports from several States, including Montana and North Dakota, in an attempt to regain some of this grain traffic.

Conclusions

Railcar unavailability seems to be primarily caused by inefficient railcar use. Although the number of railcars operated by the rairoads has declined, this has been offset by the significant increase in privately owned or leased railcars. Net carrying capacity has increased substantially, primarily due to private, covered hoppers. The Burlington Northern's 1978 railcar utilization study and the July 1977 Texas Transportation Institute's study indicate that improvements in railroad operations in origin, destination, and intermediate terminals and yards could yield significant reductions in railcar turnaround time. Without such improvements, rail service to grain shippers could continue to be a major factor in the diversion of grain transportation to trucks. Chapter 4 discusses the impact increased grain hauling by truck has on rural roads and bridges.

RAIL LINE ABANDONMENTS: AN EMOTIONAL ISSUE WITH THE POTENTIAL TO AFFECT GRAIN MARKETING PATTERNS

Railroads appear to be taking a more aggressive stand toward eliminating unprofitable branch lines from an extensive and often redundant rail network. This trend could result in increased trucking of grain, grain elevator closures or changed elevator function, and the advent of subterminals. To date, however, rail line abandonments have not been a significant factor in recently changing grain transportation patterns; that is, the shift from rail to truck movement of grain.

Abandonments are increasing

Much of the rail network in the United States was built in the late 1800s when every town wanted a railroad. Communities offered financial support to the railroads to bring rail service to them. As a result, thousands of miles of light-density rail lines extend across agricultural areas today. Some of these lines were uneconomical when built and many others have become uneconomical since the advent of the internal combustion engine and all-weather roads.

Railroads are more aggressively abandoning unprofitable branch lines to reduce their extensive and often redundant rail network. Traffic volume on many branch lines is very low; in fact, many class B lines 1/ constitute 22 percent of all rail line mileage but produce only 3 percent of railroad revenues. As traffic volume declines, unit costs of providing service increases; the cost of transporting a gross ton-mile over a low-volume branch line can be 700 percent higher than over a high-volume main line. The higher unit costs resulting from low traffic densities in relation to operating and financial requirements of major class I railroads 2/ are causing increasing railroad demands to further curtail service and abandon what rail companies regard as marginal and submarginal line operations.

Rail abandonment policy, set by the Interstate Commerce Commission, was often slow and cumbersome in the past. However, it changed in the 1970s. The Railroad Revitalization and Regulatory Reform Act of 1976 significantly altered abandonment policy, requiring the Commission to act within strict time constraints once an application is filed. As is shown in table 2-2, railroad line mileage declined by about 60,000 miles between 1929 and 1978. However, average decreases per year for selected periods indicate that railroads abandoned more rail lines in recent years, as illustrated in table 2-3.

1/A class B branch line handles less than one million gross tons per mile annually. These lines constitute about 44,000 miles (27.5 percent) of the national rail line mileage.

2/A class I railroad has annual revenue of $50 million or more.

Table 2-2

Miles of Rail Line for Selected Years

Year	Nationwide miles of track
1929	249,433
1955	220,670
1970	206,265
1975	199,126
1978	190,555

Table 2-3

Average Miles of Rail Line Abandoned During Selected Years

Period	Miles abandoned	Average abandonments per year
1929-55	28,763	1,106
1955-70	14,405	960
1970-75	7,139	1,428
1975-78	8,571	2,857

Not included in these statistics are several thousand miles of track being abandoned by the Milwaukee Road and Rock Island Line. Both the Milwaukee Road and the Rock Island Line are bankrupt. As a result, the Milwaukee Road has been sharply curtailed, having abandoned all mileage west of Miles City, Montana. The Rock Island Line no longer exists. These railroads operated primarily in grain-producing areas and were heavily involved in grain transportation. Some segments of this track are currently being operated and may be purchased by other railroads; therefore, it is difficult to determine how much track ultimately will be abandoned and the resulting impact on grain marketing and transportation.

Abandonments raise concerns that may be unfounded

The Rural Transportation Advisory Task Force discovered during its hearings that rail line abandonment is an emotional issue for farmers and grain shippers. Some of them stated that abandonment would cause a major increase in their costs and would perhaps drive them out of business. Additionally, rail users were concerned about deterioration of rural roads and bridges that would have to handle the diversion of remaining traffic from the abandoned lines. (This subject is discussed in ch. 4.)

To date, however, no clear evidence exists that grain elevators have closed or dramatically increased their costs as a result of rail line abandonments, although the number of relevant instances is small. For example, a rail line abandonment in Iowa resulted in a new subterminal being built by a farmer-owned cooperative elevator firm on a main line 10 miles away. The original cooperative elevator was relegated to a storage function, subordinate to the subterminal. The new subterminal requires some additional trucking of grain by the farmer and some additional costs of transferring grain from the original elevator to the subterminal. But it has also resulted in higher grain prices paid to the farmer caused primarily by multiple car freight rates. Although cooperative members wanted to continue to fight for preservation of the branch line to the original elevator, members now agree that they must accept changes in grain transportation just as they have in grain production.

Conclusions

While rail line abandonment is an emotional issue for farmers and elevator operators who fear increased transportation costs or elevator closure, we found no evidence among the limited number of available examples to demonstrate that these fears are based on actual occurrences. An experience in Iowa indicates that if elevators and farmers are willing to adapt to changing transportation patterns, a very successful operation can result. We could detect no significant diversion toward grain hauling by truck on rail lines pending abandonment. Our sample size was rather small, however, and should large-scale abandonments occur (as is possibly the case with the bankruptcy of the Milwaukee Road and the Rock Island Line) significant diversion to trucking and grain elevator closures could result.

REDUCING RAIL RATES: A BENEFIT FOR SOME, A POTENTIAL PROBLEM FOR OTHERS

Competition has caused railroads to establish multiple car and unit train freight rates in major grain-producing areas. These rates provide definite advantages to shippers in the form of lower transportation costs and to railroads in terms of lower costs and increased revenues. While beneficial at present, these rates can adversely affect overall transportation system efficiency when other system components cannot easily adapt to changes.

Grain is shipped via railroad under single- and multiple-car rates. Single-car rates apply to any carload shipment of grain and are available in all grain-producing areas. Multiple-car rates usually apply to shipments from one location of five or more railcars containing the same commodity and bound for the same destination. Single-commodity ship-shipments of 25 or more railcars are often called unit trains.

Single-car rates are generally the only rates available to most wheat and barley shippers. Wheat- and barley-producing areas are characterized by numerous, small elevators capable of loading only a few railcars in a 24-hour period. These areas also produce more diversified crops, which makes unit trains less practical. Additionally, alternative transportation modes and even competing railroads have been the exception rather than the rule, especially in the Upper Great Plains States. For example, the lack of competition has perpetuated high, single-car rail rates in Montana and North Dakota, and railroad officials agree that their wheat and barley rates are very profitable in these States. For these reasons, multiple-car rates historically have not been instituted in these areas, usually resulting in higher transportation costs under the single-car rates.

Multiple-car rates offer shippers and railroads significant advantages. Shippers receive considerable transportation cost savings because these rates are lower than single-car rates. Multiple-car and unit-train shipments also result in lower railroad costs since local railcar switching is reduced. Additionally, railroad revenues are increased because railcar turnaround times are generally reduced, thus more trips can be made in a given time, which raises railroad revenues.

The primary reason railroads have instituted multiple-car and unit-train rates appears to be competition from other modes (truck and truck/barge) and in some cases intramodal competition. Multiple-car rates were instituted on corn moving from producing areas to the South to meet barge and independent truck competition. Recently, multiple-car rates on corn and sorghum were instituted by two major western railroads from Iowa and Nebraska to the Pacific Northwest ports as a result of the competition between these railroads for such shipments. Lower single- and multiple-car rates have also been proposed in Montana and North Dakota, which should result in considerable savings for grain shippers and increased prices for farmers. One major western railroad said that it instituted multiple-car rates on wheat effective December 1, 1980, from Montana, North Dakota, and South Dakota to Pacific Northwest ports.

The change in rate structure in Iowa and Nebraska, effective August 2, 1980, while definitely a benefit to shippers, created a problem at the ports. The arrival of ships and the increased incoming shipments of grain were not well coordinated. Consequently, the export elevator had more than 1,400 railcars of corn waiting to unload and five more unit trains (270 railcars) from Iowa embargoed since it could not accept any more grain. (The difficulties in accepting unit trains at several port facilities is discussed in ch. 5.) According to one railroad official, grain companies subsequently revised their grain ordering procedures, which has resulted in more orderly grain shipments and reduced turnaround time.

Because transportation costs are a very important factor considered by farmers in deciding when to sell their grain and by elevator operators in deciding where to ship their grain, it has a direct relationship to how much grain goes to particular destinations. Reducing transportation rates may have an adverse impact on the receivers of the grain if they are not prepared to accommodate increased shipments. Therefore, although reduced multiple-car rates may encourage farmers and elevators to sell and ship more grain, they may also result in many railcars being tied up at embargoed export elevators, making railcars less available for the increased shipments.

Conclusions

As evidenced by the foregoing discussion, railroad operations and changes to them have significant impacts on other components of the overall transportation system. Railcar availability and rail line abandonments may affect how grain is shipped to market; freight rates charged not only affect how grain is shipped but when and where it is shipped. Railroads are making significant changes to their operations, which can be expected to create benefits for some system components and potential problems for others.

CHAPTER 4

TRUCK TRANSPORTATION AND THE

ADEQUACY OF RURAL ROADS AND BRIDGES

The farmer-owned and often operated motor vehicle initiates the movement of grain. Not only do trucks provide the initial movement of grain from farms to country elevators, they also transport significant amounts of grain to terminal markets and transfer points for transhipment by rail or barge.

Concern is growing over the adequacy of rural roads and bridges to meet present and future transportation needs. Many roads and bridges are in poor condition; funds are inadequate to make desired improvements; inflation is straining State and local road budgets; and the number of heavy vehicles traveling on rural roads is increasing. Despite these problems, highway officials noted that commodities will flow to market regardless of road and bridge conditions. Even so, adequate rural roads are critical to efficient commodity movement. Among the possible effects of road deficiencies are the inability to carry frequent heavy loads without further deteriorating road surfaces and increasing maintenance and transportation costs. Reduced efficiency and increased transportation costs can ultimately affect the price farmers receive for their goods and threaten farm profitability.

CURRENT TRENDS LIKELY TO ADD STRESS TO RURAL ROADS AND BRIDGES

The rural road network includes all roads outside populated areas of more than 5,000 and is composed of the interstate and other arterial highways, collectors, and local roads. Rural roads can also be distinguished by whether they are under Federal, State, or local administrative jurisdiction. Approximately 70 percent of all rural mileage is under local control. Some rural roads are eligible for Federal funds and are thus considered to be on the Federal-aid system. Roads not eligible for Federal funds are referred to as off-system roads.

Although the design and maintenance of rural roads have remained basically the same for decades, changing conditions have significantly affected these roads. Increases in shipments of grain and other goods by truck, centralization of grain elevators and storage facilities, an increase in the size and weight of trucks and farm machinery, and difficulties in enforcing vehicle size and weight restrictions have all contributed to deterioration and increased maintenance costs of rural roads and bridges.

Although grain movements by truck have increased, State and local officials stated that grain is just one of many commodities moving by truck and should not be considered in isolation. The volume of heavy truck traffic also has increased considerably for such commodities as oil, lumber, milk, and potatoes. State and local officials are aware of these trends and their potential to increase maintenance costs and accelerate deterioration of the rural road network. However, planning to deal with these trends is limited.

Increased movement of grain by truck

The only alternative to rail transportation for most grain shippers is truck. Limited railcar availability, poor rail service, branch line abandonments, alternative markets, favorable truck rates, and faster payment for grain moved by truck than rail have contributed to an increase in the percentage of grain moved by trucks. For example, in North Dakota during the 1974-75 harvest year, 19 percent of the grain was shipped by truck. This percentage has increased each succeeding year and in 1978-79, 41 percent of the grain was moved by truck. Montana grain shipments show similar trends; in 1976, trucks moved 23 percent of the grain and by 1979 truck movements had increased to 38 percent. Comparable data was not available for Kansas and Iowa; however, indications are that the trend toward increased trucking is common throughout the Midwest.

Numerous State and local officials, while acknowledging that railroads were the more energy-efficient means to move grain, cited poor service and railcar shortages as primary causes for the increase in grain truck traffic. One elevator operator stated that he would go broke waiting for railcars if he depended on the railroads.

The Upper Great Plains Transportation Institute, a North Dakota State transportation research organization, in a study entitled "The Cost and Operations of Exempt Motor Carriers in North Dakota," noted that rail rates set an upper limit on truck rates. The study found that 81 percent of elevator operators would ship by rail if truck rates exceeded rail rates. Typically, truck rates are somewhat lower than rail rates. Other than rate considerations, the study reported that the major factors influencing elevator operators to ship by truck were

--a desire to keep truckers available,

--faster speed of delivery, and

--lack of railroad service.

Another factor not mentioned in the study, but brought to our attention by elevator operators in Montana, was that payments are received much sooner when shipments are made by truck. It takes at least 30 days to get paid if grain is shipped by rail compared with about 10 days when trucks are used.

Abandonment of branch lines was also mentioned as a cause for increased trucking. However, to date, in the States visited, abandonments did not appear to contribute significantly to this trend. Kansas Department of Transportation officials observed that although rail line abandonments increase the burden on rural roads and bridges, the effect to date has been minimal because relatively little Kansas branch line mileage has been abandoned in recent years. In Iowa, rail density is high on existing lines and the traffic volumes on abandoned lines were usually very low, therefore, truck traffic generated as a result of abandoned lines is not significant. The impact of abandonments in Montana and North Dakota has also been minimal.

The potential for future increases in trucking attributable to abandonments, however, cannot be ignored. Listed below are the miles of track subject to future abandonment as listed in each State's rail plan:

	Miles	Percent of total trackage
Iowa	1,519	21
Kansas	258	3
Montana	1,784	37
North Dakota	340	7

Although the lack of data makes it difficult to document the significant impacts of branch line abandonments, such impacts should be considered. For example, 34 elevators are on rail lines potentially subject to abandonment in Montana. These elevators shipped a reported 6,344,992 bushels of wheat and barley by rail in 1979. Had these shipments been diverted to truck, an estimated 7,049 truck trips would have been generated.

In addition, the demise of the Milwaukee Road in Montana and the bankruptcy of the Rock Island Railroad in March 1980 have tremendous potential to alter grain-marketing patterns in States served by these companies. For example, in Colorado an estimated 13.4 million bushels of wheat were awaiting shipment along Rock Island lines. As of March 1980 there were not enough trucks available, but if trucking becomes the only option, approximately 18,000 tractor trailer loads will be required to move this grain.

The opening and expansion of terminal facilities at Lewiston, Idaho, has also created large movements of grain by truck in Montana. For example, in January 1980, 51,000 tons of wheat moved through Lewiston compared with 24,000 tons during January 1978. There has been a noticeable increase in road deterioration on U.S. routes 2 and 200, which are primary truck routes from Montana to Lewiston, according to a Montana Highway Department official.

Increases in the size and weight of truck and farm machinery

Rapid technological change has had a major effect on the type of agriculture in the United States. Large mechanical equipment, pesticides, fertilizer, and improvements in crop and livestock breeding have greatly improved farm productivity. Advanced agricultural technology creates pressures for larger farms, and over the years farm size has increased substantially.

Increased farm size and productivity have led to the use of larger, more efficient machinery. Present day disks and cultivators are up to 54 feet wide. Large combines and other equipment have difficulty crossing narrow bridges and it is not uncommon for farmers to cut railings down in order to get through. Feed, fertilizer, petroleum, grain, and bulk milk trucks have all become larger. For example, the typical farm truck used to carry 100-300 bushels. Today, the average truck hauls 250-500 bushels, larger trucks haul between 600 and 800 bushels, and semi-trucks can carry as many as 1,500 bushels. Single-axle trucks weigh about 30,000 pounds fully loaded and double-axle trucks weigh up to 50,000 pounds. The larger grain trucks can weigh from 54,000-70,000 pounds when loaded.

Less wheat is going to country elevators from farms each year, as farmers can save on unloading by shipping direct via semi-trucks. Some farmers have begun contracting with trucks to move grain from the farm to terminal markets, In the past, they used their own smaller vehicles to carry grain from the field to country elevators. Direct marketing from farm to ultimate destination through custom grain haulers has given further encouragement to the use of larger vehicles to haul grain longer distances.

North Dakota highway statistics illustrate the trend toward more and larger trucks. Annual vehicle miles traveled by dual-axle and larger trucks increased 15 percent from 1976 to 1978. In addition, the number of registered trucks with gross vehicle weights of 24,000 pounds or more increased about 14 percent during the same period.

Our prior report, "Excessive Truck Weight: An Expensive Burden We Can No Longer Support," CED-79-94A, July 16, 1979, summarizing responses from State officials noted:

> "States also felt that truck traffic has increased over the past 10 years in total number, percent of traffic, and average truck weight."

The report also stated:

> "The American Association of State Highway and Transportation officials reported that concentrating large amounts of weight on a single-axle multiplies the impact of the weight exponentially. Although a five-axle tractor trailer loaded to the current 80,000 pound Federal weight limit weighs about the same as 20 automobiles, the impact of the tractor trailer is dramatically higher. Based on Association data, and confirmed by its officials, such a tractor trailer has the same impact on an interstate highway as at least 9,600 automobiles."

Commenting on the use of heavy vehicles to haul grain, a North Dakota County Commissioner stated that it is difficult to see how the road system will stand up to increased heavy truck traffic. The commissioner told us that you can actually see the road lift after trucks pass and these roads were not designed to withstand this kind of pressure.

<u>Overloaded vehicles--A common occurrence</u>

Discussions with officials at both the State and local level indicated that overweight vehicles are a matter of concern. Listed below are some of the comments received.

--Most farm grain trucks are single-axle and frequently overloaded.

--Overloading is a serious problem, especially on single-axle, farm-to-market vehicles that on an average weigh 26,000-30,000 pounds.

--Enforcement of weight limits is a problem.

--A problem for the county is that there is a State weigh station outside of town. As a result, many overloaded vehicles by-pass the station and travel on county roads.

--Overloading is a serious problem, and in this era of high energy costs it is not likely to improve.

Many of the same problems were noted in the previously cited GAO report:

--State agencies enforce weight laws on only 40 percent of the Nation's highways.

--Most fines for overweight violations are too low to be effective deterrents.

--Most permanent scales are ineffective because they are easily avoided.

Planning to address trend to more trucking lacking

Planning to address the impact of increased trucking on rural roads and bridges caused by poor rail service, branch line abandonment, and centralization of elevators has been nonexistent for all practical purposes. Montana and North Dakota State and county highway officials we interviewed were well aware of the trends toward increased use of trucks for transporting grain and other commodities. They were also aware that these developments are likely to increase maintenance costs and accelerate road deterioration. As one official stated, impacts on road systems should be, but are not, addressed when development of subterminals or railroad abandonment is considered. Many officials at both the State and local levels emphasized a need for improved planning, while agreeing that, to date, nobody has taken a look at how increased grain trucking, railroad abandonments, the growth of subterminals, and related developments affect highways.

We believe implementing wise policies is difficult if the impacts on all transportation systems are unknown or unquantified. Railroad abandonment is a good example.

State rail plans 1/ are supposed to address impacts on highways, but for the most part, the analysis in the four State plans we examined was superficial. For example, one rail plan contained the following statement:

> "In view of the fact that rail is responsible for transporting 81 percent of agricultural commodities marketed by grain elevators along this line, abandonment and forced reliance upon truck transportation would substantially alter fuel consumption."

This statement was the only impact cited in the plan of what effect abandonment of a branch line would have on other transportation systems. Attempts in these rail plans to correlate rail abandonment with the adequacy, inadequacy, or capacity of the attendant road network were few.

It may be less costly to maintain rail service than to build and maintain highways to handle resulting increases in truck traffic, according to one State official. He stated that before an abandonment is approved States should determine

--specifically how much and what commodities will move by truck,

--which routes will be followed,

--what road conditions are along these routes, and

--how much it will cost to upgrade and maintain road capacity.

Data of this nature is not readily available and State officials say that resources for such work are limited. This may partially explain why integrated analysis that considers interrelationships between rural roads and other modes of transportation is yet to be conducted.

1/The Railroad Revitalization and Regulatory Reform Act of 1976 required that a State establish an adequate plan for rail service as part of an overall planning process for all transportation services to be eligible for rail service assistance.

ADEQUACY OF RURAL ROADS AND BRIDGES QUESTIONABLE

The rural road network in the United States is vast and conditions vary from region to region. The consensus among officials in the States visited is that although road and bridge conditions have not seriously impeded the movement of agricultural commodities, today's reasonably adequate system may be in jeopardy. Some elements of the system of particular concern are the bridges and secondary roads under local jurisdiction.

The rural road network

The United States, with 3.9 million miles of roads and streets in 1978, has the most extensive road network of any country in the world. The rural sytem, including all roads outside populated areas of more than 5,000 people, consisted of 3.3 million miles in 1978. Some 2.3 million (about 70 percent) of this rural mileage was under local control; State roads accounted for 0.7 million miles; those under Federal control, 0.2 million.

The rural system is composed of the interstate and other arterial highways, collectors, and local roads. Arterial highways provide the network for intrastate and interstate travel, and they generally accommodate high-volume traffic on long trips. Collectors primarily service intracounty and other local travel, including travel between shipping and receiving points and from farms to county seats. Local roads are by far the most extensive network in rural areas, and they provide for the short distance travel to access lands.

In addition to the functional classification described above, roads are also distinguished by whether or not they are on the Federal-aid system. Roads on the Federal-aid system, referred to as on-system roads, are eligible for construction, reconstruction, rehabilitation, restoration, and resurfacing funds from the Highway Trust Fund. Approximately 72 percent of the Nation's rural mileage is not on the Federal-aid system. Rural and urban off-system roads and bridges, that is, those not on the Federal-aid system, are eligible for only very limited amounts of Federal funding. Roads are also classified administratively depending upon whether they are under Federal, State, or local jurisdiction. Practically all of the roads and streets in the U.S. are under the jurisdiction of State and local governments. All highways on the Federal-aid system are designated as such by State and local governments, subject to the approval of the Federal Highway Administration.

Rural road deficiencies

Among the possible effects of road deficiencies are the inability to carry frequent heavy loads without further deteriorating road surfaces and prohibitively increasing maintenance and transportation costs. State highway officials generally believed that commodities will flow regardless of road and bridge conditions, even though many heavily traveled roads are old, of substandard construction for today's environment, and in a deteriorated condition. These conditions may cause delays and thus increased costs, which in turn can affect the prices farmers will receive.

DOT asked the States to identify road deficiencies in 1970 based on minimum tolerable conditions, using guidelines considerably below those used for new construction. The standards included such items as traffic capacity, width, pavement type, and drainage. Under the guidelines used, more than three-fifths of all arterial and collector roads were identified by the States as deficient. Of the approximately 2 million miles of local roads, about half were considered deficient.

While this study has not been updated, available statistics indicate that deficiencies still exist. The Montana Department of Highways estimated in April 1979 that 38 percent of Montana's primary roads and 48 percent of the secondary roads were deficient. North Dakota did not have current data summarizing miles of deficient roads under State jurisdiction; however, it was estimated that to bring county Federal-aid secondary roads to current standards would require improvements on 50 percent of gravel-surfaced roads and 33 percent of paved roads. Although figures were not available specifying the number of rural miles needing upgrading in Iowa, approximately 35 percent of the State's highway mileage is currently inadequate for today's travel.

State officials indicated that off-system roads under local jurisdiction are likely to be the most affected by increased trucking. The width, bases, grades, surface design, and capacities of many rural roads are based upon the traffic needs of the 1930s and 1940s. Heavy rutting is noticeable on many road segments and pavement is depressed where truck tires pass. A need exists to monitor conditions on local rural roads, yet knowledge about local road conditions is almost nonexistent. State agencies did not have such data as local roads are not under their jurisdiction. Local officials are very knowledgeable about road conditions, but this knowledge is based on personal experience and is seldom quantified and summarized in written documents.

The North Dakota Highway Department held a series of local public roads workshops in late 1979. The workshops were initiated to identify local road problems. The results provide insight into local rural road conditions and are consistent with comments obtained in our discussions with local officials in North Dakota and other States. Comments relative to problems with the adequacy and conditions of local rural roads included

--overweight vehicles breaking up road surfaces,

--lack of hard surface road (dust and rideability),

--design of roads built in the past not adequate to meet today's needs,

--advanced state of deterioration of local roadways, and

--too many roads to maintain.

On the one hand it is believed that goods will move regardless of road conditions. Yet, on the other hand, many are concerned about overweight vehicles, under-designed roads, poor conditions, and the current and future adequacy of the rural road system. In any event, we need to know more and have better data about local rural conditions and the capability of those roads to meet future transportation requirements.

Bridges: a special problem

The number of deficient bridges on rural roads poses a serious restriction to the continuing flow of traffic along these routes. About three-fourths of all bridges were constructed before 1935 and most have a life expectancy of 50 years or less. Although the Federal Highway Administration's annual report to the Congress on the Highway Bridge Replacement and Rehabilitation Program issued in February 1980 did not include a rural classification, it did show that there are 56,709 structurally deficient and/or functionally obsolete bridges on the Federal-aid system, 22 percent of the total. A structurally deficient bridge is one that has been restricted to light vehicles only, closed, or requires immediate rehabilitation to keep open. A functionally obsolete bridge is identified as one whose deck geometry, load-carrying capacity, clearance, or approach roadway alignment can no longer safely service the system of which it is an integral part.

States are in the process of inventorying off-system bridges and were expected to be finished by December 31, 1980. Of the 170,488 bridges inventoried as of February 1980, 42,317 (23 percent) were found to be structurally deficient and another 40,614 (24 percent) were found to be functionally obsolete.

State and local officials expressed more concern about the adequacy of bridges than any other aspects of the highway system. This concern was especially true at the county level where bridges on county roads were considered the weak link in the transportation network. Comments we obtained from county commissioners vividly illustrate this situation.

--One county has 94 bridges; all but 15 are load-posted. Fully loaded school buses unload children before crossing some of these bridges. Many bridges are 60-70 years old and are literally going to pieces. More than 25 are in need of immediate replacement. Most are too narrow and farmers frequently cut railings to get equipment across.

--Another county has 200 bridges, 120 of which need work because they are too narrow, have limited load capacity, or are in a poor state of repair. About 90 percent of them are not fit to handle fully loaded grain trucks. Many bridges are designed to handle 10-ton loads, but are being used by 25- and 30-ton vehicles. People will take risks rather than use alternate routes. Eight bridges collapsed in 1979 and just when the county is in a position to make a few gains another will go down.

--Another county's bridges are aging and, coupled with increasing numbers of heavy vehicles, this situation has accelerated bridge losses. Many 5-ton bridges are carrying 15-20 ton loads. Several are condemned and many have collapsed in recent years. Some farmers are forced to detour 5-10 miles. The bridge problem is spiraling out of control. If current trends continue, the county will be in serious trouble in less than 5 years. The county has 514 bridges, 367 of which are substandard.

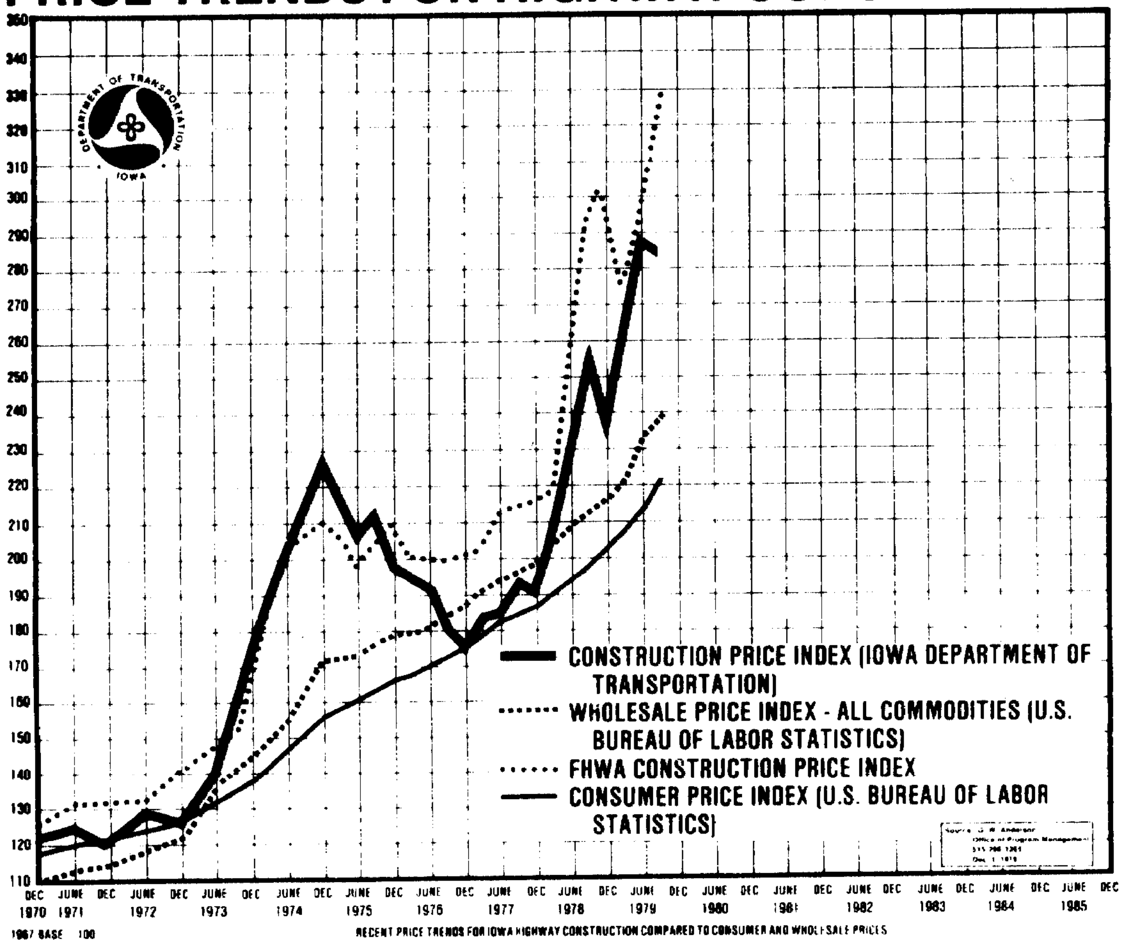
ABILITY OF STATE AND LOCAL GOVERNMENTS TO MAINTAIN AND IMPROVE RURAL ROADS AND BRIDGES IS UNSURE

There is a lack of funds to reconstruct and maintain the present system of roads and bridges to accommodate changing transportation requirements. The cost of desired improvements strains State and local resources because of inflation and the inability of traditional revenue sources to keep pace. Numerous solutions have been proposed to the rural road and bridge problem. It is clear that there is no one answer to such a complex issue. Final solutions will likely include a combination of many alternatives.

Inflation strains State and local resources

Roads are deteriorating and maintenance expenses are escalating with inflation while funds for maintenance are decreasing or at least not increasing fast enough to keep pace with inflation. Costs to maintain or construct highways have tripled since 1969. Construction cost per mile, based upon construction price trends for Federal-aid highways, rose from $60,000 in 1965 to $70,000 in 1970, doubling in 1975 to $140,000 and jumping to an estimated $160,000 in 1980. Although most of the roads we examined were off-system local roads, the increase in costs on non-Federal-aid roads is not appreciably different from those on Federal-aid highways. Futhermore, highway costs have risen faster than general rates on inflation, as illustrated in the following chart.

PRICE TRENDS FOR HIGHWAY CONSTRUCTION



SOURCE: IOWA DEPARTMENT OF TRANSPORTATION

Traditional sources of highway funding, that is, gas taxes, vehicle and operator licenses, and property taxes have not produced sufficient increases in revenue to keep pace with inflation. As one official stated, energy conservation has kept gas sales tax revenues down, the mill levy is fixed by law with no possibility for increase, and costs are soaring. One of a series of papers examining the growing crises in rural transportation contained in a November 1973 report of the Senate Committee on Agriculture and Forestry stated that a county solely dependent upon an agrarian economy simply cannot raise enough county taxes to maintain and improve its road system. Were it to try, according to this paper, its farms would be taxed out of existence.

States are also feeling the pressure. A Montana highway department official observed that inflation has hurt the State's ability to maintain, construct, and rehabilitate its roads. Funding has remained at relatively constant levels, causing them to steadily fall behind. According to the Iowa Department of Transportation, the rapidly decreasing buying power of the construction dollar is pushing the system toward the breakdown level. Inflation is expected to reduce the buying power of future revenues by approximately 35 percent between 1978 and 1997. Approximately 50 percent of the total road system needs can be expected to be unmet during the 1978-97 period as a result of inflation and lack of actual revenue dollars.

Desired improvements beyond financial ability of State and local governments

Needs are so great compared with the funds available that the problem of continued road deterioration appears unsolvable, according to one Montana highway consultant who is president of a planning engineering design firm. As a North Dakota official stated, efforts to define highway needs result in a dollar amount that is so high that it becomes unreasonable to seriously consider sums of this magnitude. Rather than define future needs, the State tries to operate on a day-to-day basis, keeping the system in the best possible condition with available resources. In Montana, Federal-aid highway system needs for both new construction and deficient highways were estimated to cost more than $1.7 billion. Present funding levels provide only enough money to handle the amount of mileage becoming deficient during each fiscal year but not enough to repair existing deficient mileage that will remain constant without an increase in funding. In Iowa, needed improvements will take 175 years at the present pace.

The situation, in our opinion, is even more severe at the local level in two of the States we visited--North Dakota and Montana. For example, one county responsible for more than 400 miles of road has an annual construction budget of $130,000. Costs to build 1 mile of oiled road are between $80,000 and $120,000, and major upgrading can run as high as $65,000 per mile. As a result, the county has sold its road construction equipment and commissioners are seriously considering converting some of their oiled roads to gravel.

Voters in another county approved a 10-year, farm-to-market road program in September 1971. Improvements were to be made on approximately 200 miles, and work was to be completed by 1981. To date, approximately 40 miles have been completed and the county engineer estimated that it will take an additional 30-50 years to finish the project because of increased costs and a lack of funds.

Another county estimated that it would cost $4 million to do needed bridge work, compared with a fiscal year 1980 budget of $142,000. A Montana commissioner best summarized local conditions by saying that the way finances are, it is hard to imagine doing more than maintenance. Certainly there is not money available for significant system improvements.

Federal funds cannot meet needs

State officials said that the Federal Bridge Replacement Program and the Safer-Off-System Roads Program provided some funds, but that funding authorizations would not meet estimated needs. For example, since 1973 approximately $10 million in Federal funds have been allocated for bridge replacement in North Dakota. This amount compares with needs of $238 million as estimated by the North Dakota State Highway Department. Federal funds are stretched very thin at the county level. One county eligible for Federal-aid had 75 substandard bridges and has thus far replaced one under the program. More importantly, even when Federal funds are available, States and counties often cannot meet requirements for local shares because of budget constraints.

While increased financial commitments at all levels of government may be needed, consideration should also be given to other possibly less costly alternatives. Possibilities that have been suggested by Montana and North Dakota State and local highway officials and others concerned with rural transportation include:

--Abandoning unnecessary roads and bridges.

--Improving enforcement of truck size and weight restrictions.

--Placing additional local mileage under State jurisdiction or on the Federal-aid system.

--Replacing inadequate bridges with culverts or "Texas crossings."

--Improving rail service.

--Improving planning and priority setting.

--Regionalizing local road operations and/or sharing specialized equipment.

No easy answer exists to the rural road and bridge problem. The likely solution will include a combination of these and other alternatives. However, if current trends continue unabated, rural transportation services will suffer further deterioration in the years to come.

CHAPTER 5

SEVERAL CONSTRAINTS MAY IMPEDE FUTURE

INLAND WATERWAY GRAIN FLOWS

The inland waterway system is a major grain transportation mode that is especially important for the export trade. The bulk of waterborne grain movement is concentrated on the Illinois, Mississippi, Ohio, and Columbia/Snake Rivers. A system of locks and dams makes navigation possible on these waterways.

Key constraints on the inland waterway system have already caused delays and could impede future grain movement. Locks and Dam No. 26, located just below the confluence of the Illinois and Mississippi Rivers, is already experiencing significant traffic delays and could face serious congestion problems even after a new lock is completed in 1989. The Bonneville Lock on the Columbia River will probably reach capacity before a replacement lock can be built. As delay times increase, shippers will face additional costs.

The Corps of Engineers is responsible for constructing and maintaining navigation aids on the inland waterways such as locks and dams. Conceiving, authorizing, and constructing navigation projects, which requires congressional authorization, takes at least 25 years, making it difficult to identify potential bottlenecks and renovate or replace them before they become waterway constraints.

As of 1979 the Welland Canal, although a Canadian rather than a U.S. facility, handled more U.S. than Canadian grain. The canal, the major bottleneck on the St. Lawrence Seaway, could be at capacity by 1985, according to Canadian grain industry officials.

CAPACITY AT KEY LOCKS AND DAMS MAY BE INADEQUATE TO HANDLE PROJECTED FUTURE DEMAND

Two locks pose key constraints to waterborne grain movements. Locks and Dam No. 26, located just below the Illinois and Mississippi Rivers, must serve the traffic for both. While construction is underway for one new replacement lock, there are already major delays in transiting the current locks and there seems to be general agreement that the new lock will be at capacity near the time of its estimated completion. Several studies have recommended that a second lock be built to prevent this future congestion.

The Bonneville Lock is the most downstream lock on the Columbia River, so virtually all Columbia/Snake River grain going to export terminals must pass through it. Built before standard Columbia River lock sizes were established, it is smaller than the other locks. The Corps of Engineers estimates that the lock's capacity will be reached by 1990, but given the conception, authorization, and contractual process for a lock such as Bonneville, it is unlikely that a new lock will be completed by 1990.

Barge traffic, concentrated on a few rivers, moves in units called tows

Inland waterway transportation has become highly significant to agriculture, particularly in export trade. Measured in ton miles, agricultural freight is the second largest commodity group moved on inland rivers and canals. In 1960 only 14 million tons of grains and oilseeds were shipped by barge. In 1978 barges hauled about 50 million tons, about 40 percent of the total exports of these commodities.

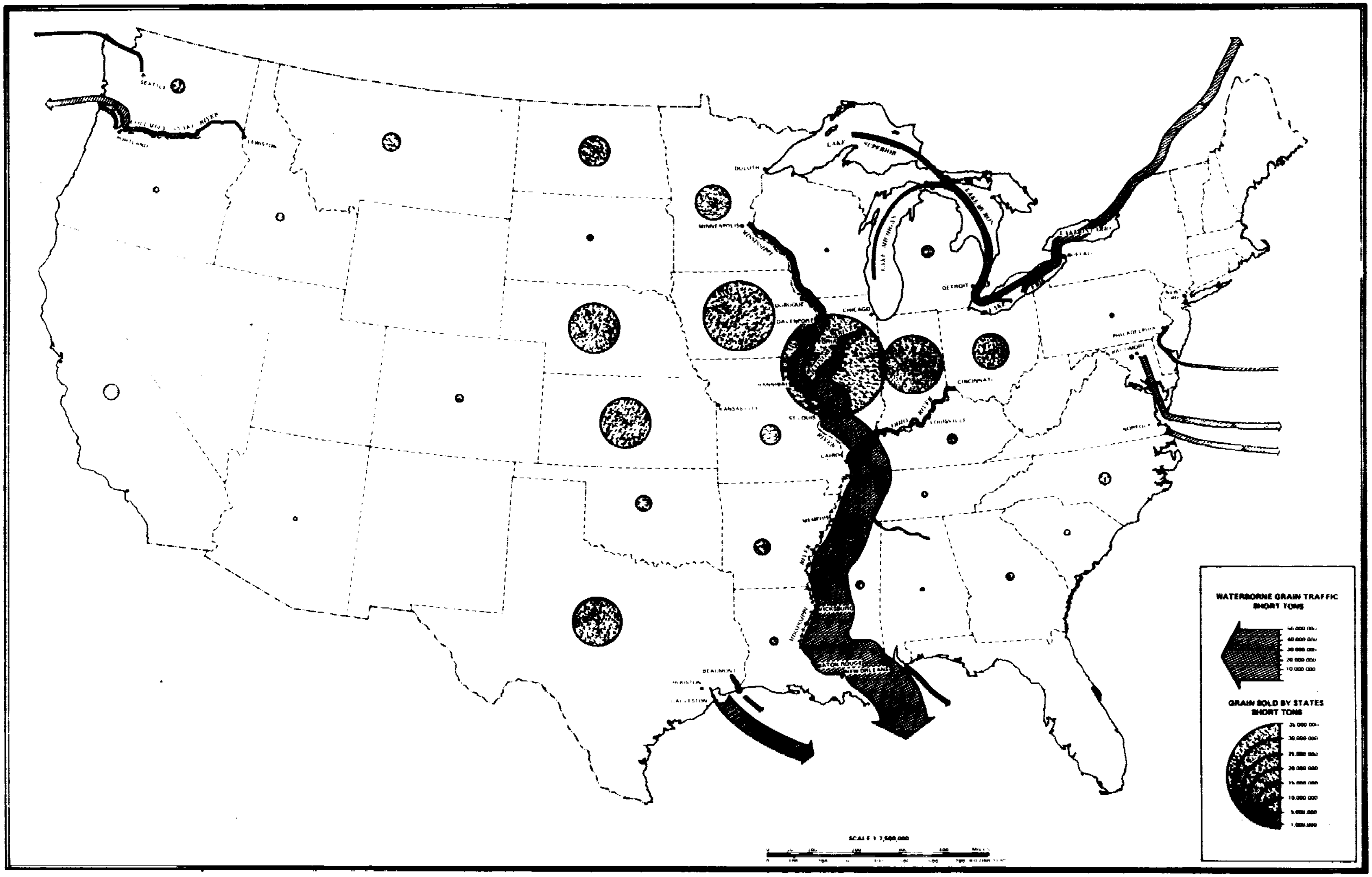
Barge grain traffic, as shown in figure 4-1, is highly concentrated on several rivers--the Illinois, Mississippi, Ohio, and Columbia/Snake. In 1977, 84 percent of total barge grain tonnage traveled on these rivers. Almost all Columbia/Snake wheat is shipped to the Portland, Oregon, area, and 88 percent of all corn, wheat, and soybeans loaded on the Mississippi River System in 1977 was bound for the New Orleans area.

Barges move in groupings called tows. These tows are pushed by towboats. The most powerful towboats are capable of pushing tows with 40,000-50,000 ton cargo capacities, which is about 30 barges, each 195 feet long.

The size of tows is restricted by water depth and the dimension of waterway locks and dams. In their natural state, rivers usually can be navigable near their outfall to the sea, where the water has sufficient depth, negligible slope, and minimal velocity. Inland reaches of rivers are often characterized by narrower, winding courses; progressively steeper water surface slopes; and higher velocities. To ensure that navigation is possible in large rivers, dams are built to create pools to obtain sufficient water depths, sustain flatter water slopes, and check flow velocities. Locks are chambers permitting the vessels to pass through the dam location while maintaining the upstream and downstream water elevations almost unchanged. A uniform depth of at least 9 feet must be maintained to allow several barges to move together as one unit.

FIGURE 4.1

WATERBORNE GRAIN TRAFFIC 1976



SOURCE: U.S. Army Corps of Engineers.

On major rivers such as the Mississippi, most locks are 110 feet wide and 600 feet long. These dimensions allow single-time locking of tows of six 195-foot barges with a cargo capacity of 9,000 tons. Larger tows are disassembled before and rejoined after locking, but this requires additional time and can be expensive. As grain tows proceed downstream, more barges are usually added. For instance, south of St. Louis, the Mississippi is an open river free of locks and dams, and tows of 30 grain barges each 195 feet in length are common. Each such tow can transport more cargo than four, 100-car railroad unit trains with 100 net tons per car.

Inadequate lock capacity is the most important concern of inland waterway users. The size of the lock chamber determines the vessel and/or tow size that can be accommodated during each locking event. If the lock chamber can handle only 9 barges at a time, as is the case of many locks on the Mississippi and Illinois Rivers, two lockages are required to process a 15-barge tow.

Locks and Dam No. 26 major Mississippi River constraint

Locks and Dam No. 26 is located on the Mississippi River, adjacent to Alton, Illinois, approximately 20 miles north of St. Louis, Missouri. This structure lies between the mouths of two major tributaries--the Illinois River, 15 miles upstream, and the Missouri River about 8 miles downstream. All inland navigation traffic between the Illinois and Upper Mississippi Rivers and the gulf ports must pass through No. 26. Because of this crucial location, Locks No. 26 must serve traffic for both the Mississippi and Illinois Rivers.

Only two locks--Nos. 26 and 27--are necessary for navigation between the confluence of the Illinois and Upper Mississippi River and the gulf ports. Locks No. 27, south of Locks No. 26, is a relatively new facility with greater lock capacity, consisting of two lock chambers (1,200 feet by 110 feet, and 600 feet by 110 feet). On the other hand, No. 26 is an obsolete facility that was opened to navigation in 1938 and has relatively less lock capacity, consisting of two lock chambers (600 feet by 110 feet and 360 feet by 110 feet).

Since Locks No. 26 was opened to traffic in 1938, the tonnage traversing the facility has increased from 1.4 million tons to as much as 62.5 million tons per year. Table 4-1 illustrates the increases in tonnage since 1966.

Table 4-1

Annual tonnage through Locks No. 26, 1966-79

Year	Annual tonnage (thousands)	Percent change
1966	36,796	+ 7.6
1967	39,715	+ 7.9
1968	40,910	+ 3.0
1969	44,223	+ 8.1
1970	48,674	+10.1
1971	46,499	- 4.5
1972	54,040	+16.2
1973	51,336	- 5.0
1974	52,893	+ 3.0
1975	54,568	+ 3.2
1976	57,875	+ 6.0
1977	58,369	+ 0.1
1978	62,531	+ 7.1
1979	60,900 (approx.)	- 2.6

Grain tonnage through Locks and Dam No. 26 in 1979 was about 33.3 million tons, which represents 55 percent of the total tonnage.

Forecasts of the most likely waterborne commerce through Locks No. 26, prepared by the Corps of Engineers in its January 1977 "Supplemental Economic Data for Locks and Dam No. 26 Replacement," have already been surpassed. The 1980 level was projected at 61.2 million tons, which was exceeded by the 1978 actual level of 62.5 million tons. The 1979 level was down slightly to approximately 60.9 million tons because of severe winter weather. The Corps further predicted that total tonnage at Locks No. 26 will be 76.2 million tons by 1985 and 88.9 million tons by 1990.

Public Law 95-502, enacted October 21, 1978, authorized a new dam and single, 110 foot- by 1,200-foot lock about 2 miles downstream from the present dam at an estimated cost of $421 million. The legislation also required the Upper Mississippi River Commission to study the need for a second chamber. Construction on the new dam and lock commenced in November 1979. Present estimates call for the lock to be partially functional by 1987 and complete by 1989. The estimated cost of the three-phase construction is now up to $540 million.

Major delays encountered at Locks No. 26 place a significant economic burden on the carriers, which has to be passed on to shippers and farmers. Average delays experienced by tows waiting to pass through Locks No. 26 during the April 1979-80 shipping season were 25 hours, which, according to Corps of Engineers estimates, cost carriers $38 million. The average delay time as of July 1980 was 48 hours, which could cost shippers $69 million a year if the delay remains the same throughout the year. A Corps official told us that delay cost could reach $210 million annually before the completion of the new lock.

The Rural Transportation Advisory Task Force, in its January 1980 final report, was concerned that the constraint of Locks and Dam No. 26 could limit the growth of grain exports in the next several years. It recommended that the Corps of Engineers be directed to accelerate its construction schedule and that the Congress appropriate the necessary funds to facilitate implementing an accelerated schedule.

There seems to be general agreement that the new replacement lock will be at capacity near the time of its currently planned completion date. The Corps of Engineers, in considering alternatives for replacement of Locks and Dam No. 26, pointed out that one 1,200-foot lock would only increase capacity 18 percent, to 86 million tons. It projected this capacity would be reached by 1989.

The task force's final report recommended that a second lock of 600 feet be built to provide the capacity needed on the basis of grain export and other commodity projections and as an important alternative in case of an emergency closing of the principal lock. The task force was convinced that by the time the currently authorized facility is completed its capacity will be exceeded.

A September 1979 Peat, Marwick, Mitchell, and Company report prepared for the American Waterway Operators, Inc. had similar findings. The report concluded that:

--A second chamber of at least 600 feet by 110 feet at Replacement Locks No. 26 is required to serve the major increases in traffic demands at the facility that are forecast for the 1990s. Without a second chamber, congestion delays and queues of tows will occur at Replacement Locks No. 26 soon after the facility is opened to traffic and existing Locks No. 26 is modified so as not to impede navigation.

--Provisions for two chambers at Replacement Locks No. 26 (a main, 1,200-foot by 110-foot chamber and an auxiliary 600-foot by 110 foot chamber) are identical to the capacity of Locks No. 27 immediately downstream and the last navigation structure between Locks No. 26 and open river south of St. Louis.

--A second chamber at Replacement Locks No. 26 is highly desirable for operational reasons. It can be used by light boats and recreational vessels so that these traffic demands do not diminish the productive capacity of the main chamber. Furthermore, it provides an alternative chamber when maintenance is being performed on the main chamber and during emergencies.

A Corps official told us that there was a potential savings of $50 million to the Government if a second lock, 600 feet by 110 feet was built in conjunction with the one currently under construction. The savings could be realized because the expense of getting construction crews back into place could be avoided. Of course such action would require congressional authorization, as discussed below.

Bonneville Lock and Dam likely to be Columbia River constraint

The Columbia River is navigable for barge traffic between the export elevators in the lower Columbia region to the Tri-Cities (Richland, Kennewick, and Pasco, Washington) on the Columbia River and to Lewiston, Idaho, on the Snake River. Eight lock transits are required between the Lower Columbia River and Lewiston. Grain elevators and loading facilities are located at river ports all along this system.

The Bonneville Lock is the most downstream lock in the system. Therefore, virtually all grain on the waterway going to export terminals must pass through it. All dams on the waterway, except Bonneville, have locks that are 86 feet wide by 675 feet long. Because Bonneville was built in 1938, before the Corps of Engineers established a standard lock size on the Columbia/Snake River system, the lock is only 76 feet wide by 500 feet long. Barge tows are frequently made up to the dimension of the upstream locks (86 feet by 675 feet) and must be broken into smaller units to pass through Bonneville Lock. The result is a significant increase in lockage times at Bonneville and a higher incidence of queuing.

The Corps of Engineers, in its January 1977 "Feasibility Study For Modifying the Bonneville," estimated that the Bonneville Lock's capacity would be reached by 1990. The study's 1985 projection of 7,132,100 tons was already exceeded in 1979, when 7,527,918 tons passed through the Bonneville Lock.

The 1979 grain traffic level of 4,467,420 is approaching the Corps' 1990 projection of 4,784,000 tons. The average time it takes a barge tow to go through Bonneville Lock including delay time could go from the July 1980 time of a little over 3 hours to estimates that exceed 13 hours by 1990. The Corps of Engineers concluded that the cost of these increased delay times to grain shippers will force them to use other modes of transportation such as rail. As indicated in chapter 6 on ports, rail grain movements to Portland already face considerable port congestion.

Barge companies indicated to us that the Bonneville Lock is the number one constraint on the Columbia/Snake Waterway. Specifically, the companies indicated that the lock itself creates a bottleneck situation because of its narrow size. They also considered the upstream and downstream lock approaches hazardous. One barge operator told us that he averaged 10 to 12 hours to get a tow through Bonneville Lock. In June 1980 another operator told us that when there is traffic, he experiences delays of 18 hours.

The Rural Transportation Advisory Task Force's final report recognized that the Bonneville Lock is a potential bottleneck on the Columbia/Snake River System. It also noted that the Bonneville Lock currently limits movements at times of heavy traffic flow. It stated that expanding the Bonneville Lock would

--improve competitive forces in the transportation of agricultural products from the Upper Midwest and Northwest, thus reducing transportation costs;

--reduce the potential for future problems related to uncertainties in the long-term economic efficiency of using the Panama Canal; and

--reduce energy use by improving conditions for movements from the west coast to the Far East, a distance approximately half as great as that from New Orleans to the Far East via the Panama Canal.

The Corps of Engineers believes the chances of completing construction of a new lock before 1990 are extremely slim. Constructing a new lock will take 6 years. The Chief of Planning for North Pacific Division, Corps of Engineers, doesn't believe that the steps necessary to start construction can be completed in 4 years, therefore, a new lock probably can not be completed by 1990.

Other locks and dams could become future constraints

If future constraints are not identified early and necessary improvements are not made on a timely basis, traffic demand may reach the point where there is simply not enough traffic lockage time during the navigation season to handle all of the traffic. This will cause higher costs to shippers--costs which will ultimately be passed on to the farmer and place an additional strain on the other modes of transportation, especially railroads.

The Congress authorized the national waterways study in Section 158 of the Water Resources Development Act of 1976 (Public Law 94-587). The Secretary of the Army, acting though the Chief of Engineers, was authorized and directed to make a comprehensive study and report on the system of waterway improvements under his jurisdiction. More specifically, the objectives were

--to define the Nation's needs for waterway systems,

--to assess the capability of the existing waterway systems to meet both current and projected national needs,

--to describe the relationship between use of waterways for transportation and use for other beneficial purposes,

--to formulate alternative plans for waterway system improvements required to meet national needs and to assess the effects of alternative plans, and

--to recommend to the Congress alternative waterway systems required to meet projected national needs.

An April 1980 review draft prepared by the national waterways study group identified the following locks as actual or potential constraints to waterway use.

Waterway region	Lock
Upper Mississippi (Minneapolis, Minn., to the mouth of the Illinois River)	No. 22
Lower Upper Mississippi (Illinois River to Cairo, Ill.)	Nos. 26, 27
Lower Mississippi (Cairo, Ill., to Baton Rouge, La.)	Old River (Part of the Gulf Intracoastal Waterway)
Gulf Coast West (New Orleans, La., to Brownsville, Tex.)	Algiers Vermillion
Gulf Coast East (New Orleans, La., to Key West, Fla.)	Industrial Canal
Illinois River (Chicago, Ill., [Guard Lock] to mouth of Illinois River)	Chicago Harbor Lockport Brandon Road Marseilles Starved Rock
Columbia/Snake Waterway (Lewiston, Idaho, to mouth)	Bonneville
Ohio River (Head of navigation to Mississippi)	Emsworth Dashields Montgomery Gallipolis Nos. 50, 51, 52, 53 Winfield (Kanawha) Nos. 7, 8 (Monongahela)
Tennessee River (Head of navigation to mouth)	Kentucky
Tombigbee-Alabama-Coosa Black Warrior River (Heads of navigation to mouth, including Tennessee-Tombigbee Waterway)	No. 17 (Warrior)

As bottlenecks occur, farmers will ultimately pay the higher costs associated with necessary changes in grain distribution. Farmers may have to accept lower export bids for their grain because of higher transportation costs. In some areas farmers may decide to simply use their grain as feed for their livestock.

NAVIGATION PROJECT PROCESS TAKES MORE THAN A QUARTER OF A CENTURY

More than 25 years are required to conceive, authorize, and construct a new lock and dam. Major delays can occur because of the authorization and appropriation process, which is beyond the Corps' control. The time needed to conduct and review a feasibility study also contributes significantly to the overall time required for the process.

Corps of Engineers responsible for inland waterways

The Corps of Engineers has the responsibility for constructing, maintaining, and operating U.S. inland waterways for commercial navigation. This responsibility includes engineering feasibility studies, economic analysis, and developing overall jurisdiction data as a basis for congressional action to authorize and finance river improvements.

Conceiving, authorizing, and constructing most navigation projects, such as locks and dams, requires specific congressional authorization. The process is divided into four phases: (1) study authorization, (2) accomplishment of study, (3) study review and project authorization, and (4) advanced planning, design, and construction. Even though Corps officials estimate this process takes more than 25 years, they told us that there is no meaningful average time.

Study authorization needed

Most studies are initiated by local citizens who have requested assistance from their congressional representatives to solve navigation problems. Local interests may also request advice from representatives of the Corps of Engineers on the appropriate procedures. The congressional representative usually requests the Senate Committee on Environment and Public Works or the House Committee on Public Works and Transportation to direct the Corps to conduct a survey of previous reports. The committees may request Corps advice on the desirability of authorizing a study. If the committee is convinced that a need exists for a study, it will include authorization in a bill for consideration by the Congress.

Once a study is authorized, it must be funded through the budget process. There is generally a lag of 1 or more years between study authorization and study funding. The study itself usually takes several years. For example, the Bonneville Lock study authorization was contained in a Senate Resolution dated April 11, 1967. Funding was not received until 1970; the study was started in October 1970 and completed in January 1977.

Study must be reviewed and project authorized

When the study is completed, it is reviewed at various Corps and Army levels, by other Government entities, and by other interested parties. The survey report is then presented to the Congress and referred to the House Committee on Public Works and Transportation and the Senate Committee on Environmental and Pubic Works, who may conduct hearings to consider the projects the Corps has recommended for authorization. Thirty-three months after the feasibility report on the Bonneville Lock started the review phase, it was still being reviewed by the Chief of Engineers.

Advanced planning, design, and construction are the final steps

Authorized projects are in competition with each other for funding. Therefore, if local cooperation cannot be reaffirmed, the project is shelved. All project funding requests are made through the Office of Management and Budget before they are submitted to the Congress. The Congress approves, disapproves, or revises these requests. Those projects approved are sent to the President for signature. Generally, after initial funding, further appropriations are required in succeeding years until the project is completed.

After funds are approved, advanced planning and detailed design is performed by the district engineer with assistance, review, and approval from the division engineer and the Chief of Engineers. Essentially, this process begins with reviewing and updating the basic authorized plan and proceeds through progressively more detailed design to produce construction plans, specifications, and detailed cost estimates. After completing these detailed construction plans and specifications for a project or a portion of it, qualified contractors are invited to submit construction bids. After contract award, the contractor works under the technical direction of the Corps.

Previous GAO report identified similar problems

In our September 22, 1978, report, "Corps of Engineers Flood Control Projects Could Be Completed Faster Through

Legislative and Managerial Changes", (CED-78-179), we examined a process that is essentially the same as the one used for navigation projects. The report found that an average of 26 years is spent on planning and design activities before construction is begun. Only about half of the time, however, was used for the actual study and project design work. Of the remaining time, about 10 years were used waiting for authorization or appropriation of funds and about 3 years were used to review study reports. The report found that most delays occur because of the authorization and appropriation process, which is largely beyond Corps control. The Corps offered different authorization and appropriation approaches to eliminate unproductive time and suggested ways to strengthen its project management.

Work on Locks and Dam No. 26 started in 1956

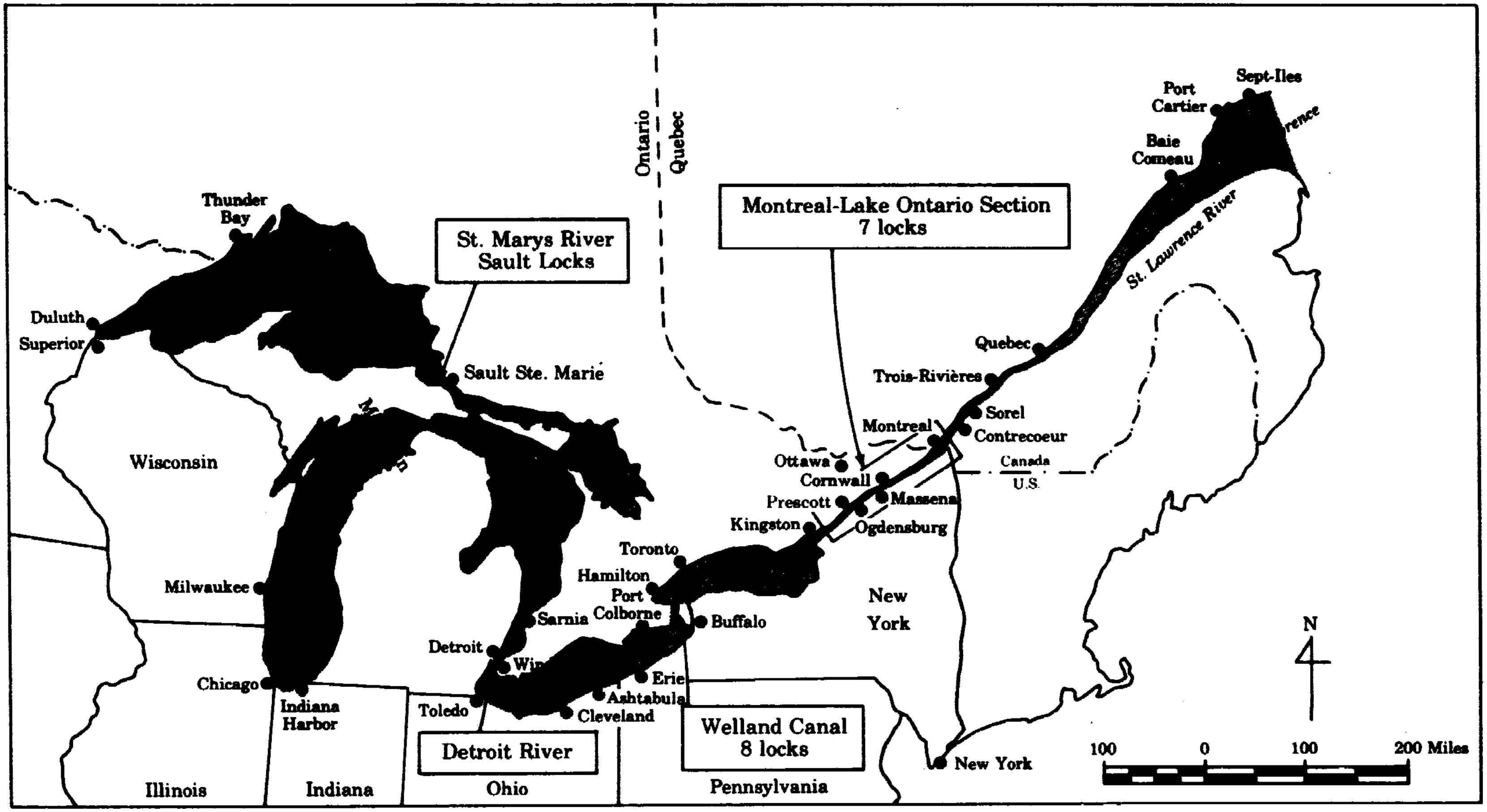
Improvements to Locks and Dam No. 26 help illustrate the length of the process. As early as 1956 the Corps was looking into problems associated with Locks and Dam No. 26. The Corps, believing that it didn't need specific congressional authorization to construct a new locks and dam, completed all necessary study and design phases and would have been ready to ask for construction bids on August 8, 1974. However, on August 7, 1974 the project was placed under an injunction because of a lawsuit challenging whether the Corps could build a new locks and dam without specific congressional authorization. The lawsuit also challenged the adequacy of the environmental impact statement and the economic data. The Secretary of the Army agreed in March 1975 that congressional action was needed and the conception, authorization and, construction process was begun. Since the Corps had already completed most of the needed studies and design work, the process went extremely fast. However, the environmental impact statement and the economic data were redone because the Corps realized that it still faced challenges. On October 21, 1978, Public Law 95-502 authorized replacing Locks and Dam No. 26. Construction was started in November 1979 and present estimates call for the lock to be partially functional by 1987 and completed by 1989.

THE WELLAND CANAL IS A CANADIAN WATERWAY BUT A POTENTIAL U.S. CONSTRAINT

The Welland Canal, a Canadian facility that is important to U.S. Great Lakes grain transportation, is the major bottleneck in the St. Lawrence Seaway system. While the Canadian Seaway Authority believes a phased improvement program will keep the Canal's capacity limit ahead of cargo demand, thus avoiding major reconstruction or cargo diversion, several Canadian grain company officials told us in May 1980 that the Welland could be at capacity by 1985. More U.S. than Canadian grain moves through the Canal, and since the Canadians see the bulk of their export growth through the west coast, Welland Canal capacity is more a U.S. than Canadian concern.

The Welland Canal bypasses Niagara Falls and is part of the Great Lakes--St. Lawrence Waterway. U.S. grain exports from the port of Duluth/Superior, as well as Canadian grain exports from Thunder Bay, Ontario, must pass through the Welland, as can be seen in figure 4-2. In 1979 U.S. grain accounted for 56.5 percent of the grain moving via the Welland Canal.

FIGURE 4.2 GREAT LAKES - ST. LAWRENCE WATERWAY AND PORTS



SOURCE: THE ST. LAWRENCE SEAWAY: HISTORY AND ANALYSIS OF A JOINT WATER HIGHWAY

Welland Canal: the Major Seaway Bottleneck

The Welland Canal is the major bottleneck in the present seaway system, according to the 1979 seaway report of the Canadian St. Lawrence Seaway Authority. As early as 1964 the Welland experienced severe congestion, which was alleviated by 1967 with improvements in existing facilities and operating procedures. These improvements included the development of what has now become a detailed computer simulation that makes possible a highly sophisticated assessment of the Welland's physical capacity limitations.

It has been calculated that the practical maximum demand that the Welland Canal can be expected to handle in a season is about 6,400 lockages. This capacity limit has remained relatively unchanged since the mid-1960s major improvement program. The trend toward larger vessels, however, has resulted in a substantial increase in total tonnage that can be moved with fewer lockages. This trend is likely to continue. Comparing Welland cargo projections with the annual cargo capacity limit, Welland cargo demand is expected to exceed the estimated capacity limit soon after the year 1986, as cargo demand passes 74 million tons. Several Canadian grain company officials and a representative of a Canadian Government/grain trade group told us in May 1980 that the Welland could be at capacity by 1985.

The Welland Canal set a traffic record of 66.2 million tons in 1979, well below the 74 million ton capacity previously mentioned. Transits totaled 6,547, which was 147 above the 6,400 lockage capacity calculation. This increase indicates that the Welland can handle more lockages than previously estimated but that concern still exists over its ability to handle future tonnages.

The Canadian Seaway Authority believes it should be possible to gain at least a 40-percent increase over the canal's 1986 cargo capacity limit. Physical improvements alone might give about a 10-percent increase, but most importantly, will provide the time required for the fleet to further augment its average cargo per transit. It is hoped that a phased improvement program will keep the capacity limit ahead of cargo demand, thus avoiding major reconstruction or cargo diversion for many years to come. In 1979 various projects were carried out.

Grain is the largest component of Welland Canal traffic, accounting for 40.7 percent of the cargo moving via the canal. The bulk of the grain movement consists of U.S. and Canadian exports that originate at the Upper Great Lakes terminals. In 1979 about 26 million tons of grain moved through the canal, of which about 15 million tons originated in the United States and about 11 million tons originated in Canada.

Developments affecting the U.S. grain transportation system could have a significant impact on U.S. Great Lakes shipment levels. A Canadian Wheat Board Commissioner told us that he believed the Locks and Dam No. 26 situation is pushing more U.S. grain out through the Great Lakes. This, in our opinion, underlines how interrelated the grain transportation system is.

CHAPTER 6

CONGESTION AND INEFFICIENCIES AT PORTS

INFLUENCE PERFORMANCE OF THE DOMESTIC

GRAIN TRANSPORTATION SYSTEM

Every port area visited experienced some problems that affect the efficiency and effectiveness of the entire domestic grain transportation system. These problems reduce the use of scarce transportation resources and delay movement of grain to export elevators. They affect

--the export elevator's ability to coordinate the arrival of grain from the interior of the country with the arrival of ships on which to load grain and

--the ability of the three primary modes of domestic grain transportation--rail, barge, and truck--to physically move the volume of grain needed within the desired time frames.

Each domestic transportation mode has or may soon have problems that limit its ability to move the volume of grain to elevators in the time frames necessary to meet ship arrival schedules. These problems relate primarily to rail facilities because rail facilities generally have not kept pace with the demand for rail service. Because of such problems as insufficient yard space, trackage layout, and inefficient operating practices, elevator operators frequently do not know when or what volume of grain will arrive, making coordination difficult. However, railroads are taking the initial steps to solve their problems at the two ports most affected. If the ports are to meet projected demands, improvements to the transportation system will be necessary.

EXPORT ELEVATORS MUST COORDINATE ARRIVAL OF DOMESTIC GRAIN SHIPMENTS WITH SHIP ARRIVALS TO REDUCE PORT AREA CONGESTION

The export elevator is the vital link between the maritime or ship transportation system and the domestic transportation system of railroads, barges, and trucks. Because of the large volume of grain exported and the limited storage capacity of the export elevators, the elevator operators must orchestrate each system to achieve maximum efficiency. When the export elevator's handling capacity and the arrival rate of the transportation subsystems are not coordinated, traffic rapidly becomes congested, impairing the efficiency of the entire transportation network and reducing use of transportation equipment. Problems with any of the rail, barge, truck, and ship subsystems adversely impact efficient movement through the ports.

Factors involved in coordination effort

Export elevators must consider many factors in their coordination effort, such as

--anticipated ship arrival dates,

--ship inspections for seaworthiness and cleanliness,

--type and amount of grain on hand and enroute,

--estimated grain arrival dates,

--available elevator storage capacity,

--inclement weather--particularly rain, which can halt ship loading, and

--labor availability for loading ships and moving them through port.

Export elevators continually try to adjust the amount of grain flowing toward the elevators and solve problems occurring with the above factors. An inability to do so creates port area congestion and reduces transportation resource use, as the following examples illustrate:

--One Lower Mississippi River area elevator was expecting a ship to arrive on the afternoon of May 30, 1980, for a load of soybeans and was unloading soybeans from barges into the elevator in preparation for ship loading. About mid-morning on May 30 the elevator was notified that the ship would not arrive before June 1 because it was undergoing repair. That morning the elevator also received notice that another ship would arrive at the elevator for a load of corn on the afternoon of May 31--4 to 5 days ahead of schedule. Having little corn in the elevator, the manager searched his inbound grain pipeline for corn that could be obtained in time to load the ship without delay. He located a sufficient supply, so the elevator stopped taking on soybeans and prepared to receive corn. Soybeans not unloaded were stored in barges tied up in fleeting areas (waiting areas along the river) until after the corn barges were received and unloaded and the corn ship loaded. Unloading delays such as these can increase shipping costs and cause congestion in the fleeting areas, although the elevator manager may have done a good job orchestrating the response to this individual situation.

--An export elevator in the Lower Columbia River purchased a train load of wheat that was to leave Denver, Colorado, on June 24, 1980, and arrive in Portland, Oregon, on June 27 for loading on a ship scheduled to arrive on June 28 or 29. The train had not arrived by July 1 when we visited the elevator and its time of arrival and reason for delay were unknown. To avoid paying costly ship waiting charges, the elevator operators purchased grain locally at a higher cost and began loading the ship on or about July 1. The elevator operators hoped the train would not arrive until after July 6 because the next ship was expected to arrive then and the elevator did not have storage space. If the train arrived before then, it would have to sit in a rail yard, adding to congestion until the next ship arrived.

Control over the inbound flow of grain is important to efficient grain exporting. Some elevators apparently have more control over this flow than others and so experience fewer congestion and delay problems. For example, the manager for one Houston area elevator told us that his company has fewer coordination problems than neighboring elevators because it can control the flow in its inbound grain pipeline. Other than grain received by truck, the elevator receives grain from only two terminal elevators, both of which are owned by the same company that owns the export elevator. In addition, the company has leased a fleet of railcars to haul grain only between the two terminals and export elevator. Under this system, the company can control the time of loading and amount of grain loaded and does not have to worry about railcar shortages.

In contrast, one elevator in the Houston area that has less control over the input into its pipeline experienced more coordination problems. An official of that elevator stated that the elevator had little control over grain arrivals at the elevator because the elevator contracted for a grain shipment in a particular month, but with no specific date identified. Shipment could start anytime during that month at the shipper's discretion. About the only aspect of shipment the elevator controlled was the port destination of the grain. This situation is also a problem at the elevators we visited in Duluth/Superior.

The extent of an elevator's coordination problems depends largely upon the transportation mode used and increases with the number of modes used. Problems with each domestic mode are discussed in the following section.

PORT AREAS GENERALLY EXPERIENCE MORE PROBLEMS WITH RAIL SHIPMENTS THAN WITH BARGE OR TRUCK SHIPMENTS

The ability of the domestic transportation modes--rail, barge, and truck--to move the volume of grain needed within specific time frames is a constant concern of exporters at each port area we visited because of the necessary coordination tasks discussed in the preceding section. Each port area experiences or anticipates some problems with at least one transportation mode. However, the extent of the difficulties apparently depends upon the mode of transportation. For example, rail transportation accounts for more congestion and delay problems than any other mode in the Port of Houston and Lower Columbia River areas. Barges currently present relatively few port area problems but could face future difficulties due to dwindling waiting areas along the Lower Mississippi River. Considerable truck congestion affects Duluth/Superior during the spring and at harvest time and the Port of Houston during the grain sorghum harvest period of July and August, when large numbers of trucks are waiting to unload. Table 5-1 shows the extent to which port areas depend upon each transportation mode.

Table 5-1

Use of Transportation Modes, 1979-80

Port area	Estimated percentage of grain received by transportation mode: Rail	Barge	Truck	Total
Port of Houston	85	a/	15	100
Lower Mississippi River	15	85	a/	100
Lower Columbia River	50	50	a/	100
Duluth/Superior	48	--	52	100

a/Usually less than 1 percent of the grain is received by these modes.

Note: We based these estimates on data provided by grain company and port authority officials and transportation consultants.

Rail problems

Inadequate rail facilities and inefficient operating practices in the Port of Houston and Lower Columbia River and Duluth/Superior port areas create congestion and delays which (1) reduce railcar use and (2) create uncertainties in grain arrival schedules. Rail facilities in these areas have generally not kept pace with expanding traffic demands. Some operating practices are outdated, inefficient, and create a haphazard flow of grain to export elevators. These facilities and operating problems also frustrate effective use of the unit train 1/ concept.

1/A unit train, as used in this report, is a train used to haul nothing but grain. In theory, empty cars are assembled into a unit train and moved to an origin elevator and loaded without being disassembled by the elevator. The loaded unit train is then moved intact to an export elevator where it is unloaded again without being disassembled. The empty train, which maintains its integrity, is returned to the grain-producing region for reloading. The rates and tariff under which the train operates are predicated upon assured repetitive volumes and lower handling costs per car. Use of this concept significantly reduces handling costs, increases car utilization, and increases the carrying capacity of the grain car fleet.

The time required for loaded grain cars to move through port terminals, unload, and leave the terminals varies with (1) the volume of grain traffic, (2) the elevator destination, (3) the railroad hauling grain to the terminal, and (4) the method of shipment; that is, whether the grain is shipped in single cars or in unit trains. Railroad officials gave us various estimates of time frames required to move railcars through the port areas visited. These estimates are summarized in table 5-2.

Table 5-2

Estimated Time Required to Move Railcars Through Selected Port Areas, June 1980

Port area	Estimated time requirements: Time frame	Optimum time frame
Port of Houston:		
Unit trains	2-13-1/2 days	1-3-1/2 days
Single cars	2-20 days	2-7 days
Lower Columbia River:		
Unit trains	a/12-19 days	1-2 days
Single cars	12-19 days	1-2 days
Lower Mississippi River:		
Unit trains	b/ 1-2 days	b/1-2 days
Duluth/Superior:		
Single cars	c/ 3-11 days	3-5 days

a/Unit trains and single cars are handled in the same way because of insufficient trackage at elevators. Also, most cars have to be temporarily stored outside of town. If this were not necessary, time through the terminal would be only 3 to 4 days.

b/Single estimates were not obtained since most grain moves by unit trains that are delivered intact.

c/Average times include a combination of optimum and worst case estimates for single-car movements. Unit train estimates were not obtained since most grain moves in single carloads.

Inadequate facilities

Rail yards at the Port of Houston and Lower Columbia River port areas generally have insufficient track space to accommodate the current volume of grain and nongrain traffic without causing congestion and delivery delays. Additionally, export elevators at these locations and most elevators at Duluth/Superior have insufficient trackage to (1) accommodate the volume of grain cars arriving in peak periods or (2) accept and keep unit trains intact. In the Port of Houston the empty train cars are frequently sent piecemeal back to upcountry locations for reassembly and redistribution, substantially reducing railcar use. In the Lower Columbia River area ports, the recent introduction of unit-train rates on wheat and corn shipments may exacerbate problems in moving these trains through the ports.

When elevators cannot accept the volume of cars the railroads have for delivery, railroads constructively place 1/ cars in a yard or on a siding where space is available. This significantly lengthens the delivery time, especially at the Lower Columbia River terminal area. In this port area, constructive placement is usually made as far as 100 to 185 miles from the terminal, thereby lengthening the time necessary for car delivery when elevators can accept them.

Operating practices

Some existing operating practices do as much to restrict and delay grain car movements as do the facilities problems previously mentioned. These practices stem from (1) the manner in which rail service developed through the years, (2) historical provisions of negotiated labor contracts, (3) management decisions, and (4) Federal regulation.

Grain cars can pass through several different yards and interchange with other railroads before final delivery at an elevator. The exact number of railroads and yards involved in delivery depend upon the originating railroad and the elevator for which the grain is destined. The constructive

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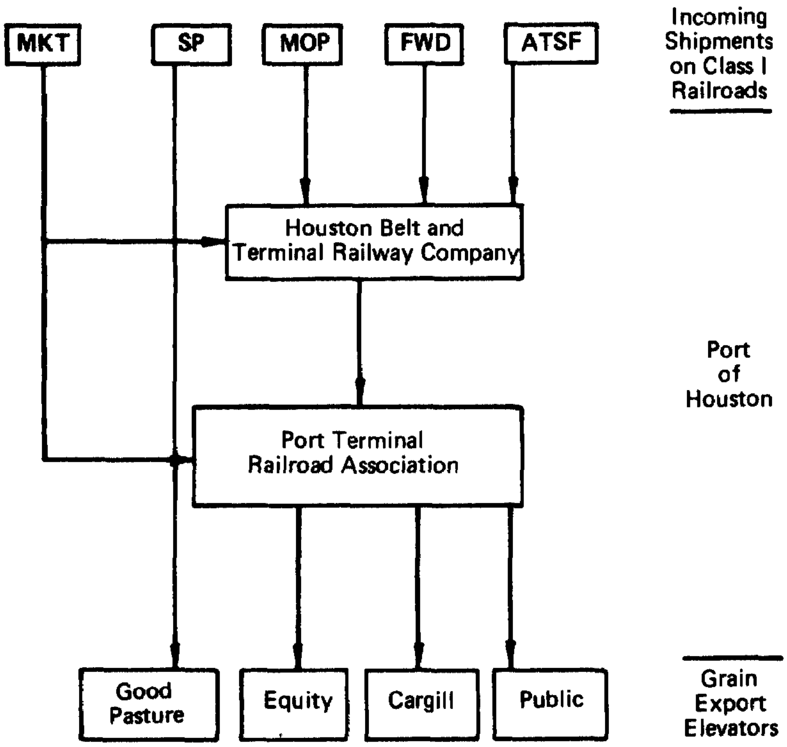
1/Constructive placement is the temporary storage of cars at an alternate site until the elevator can accept delivery of them.

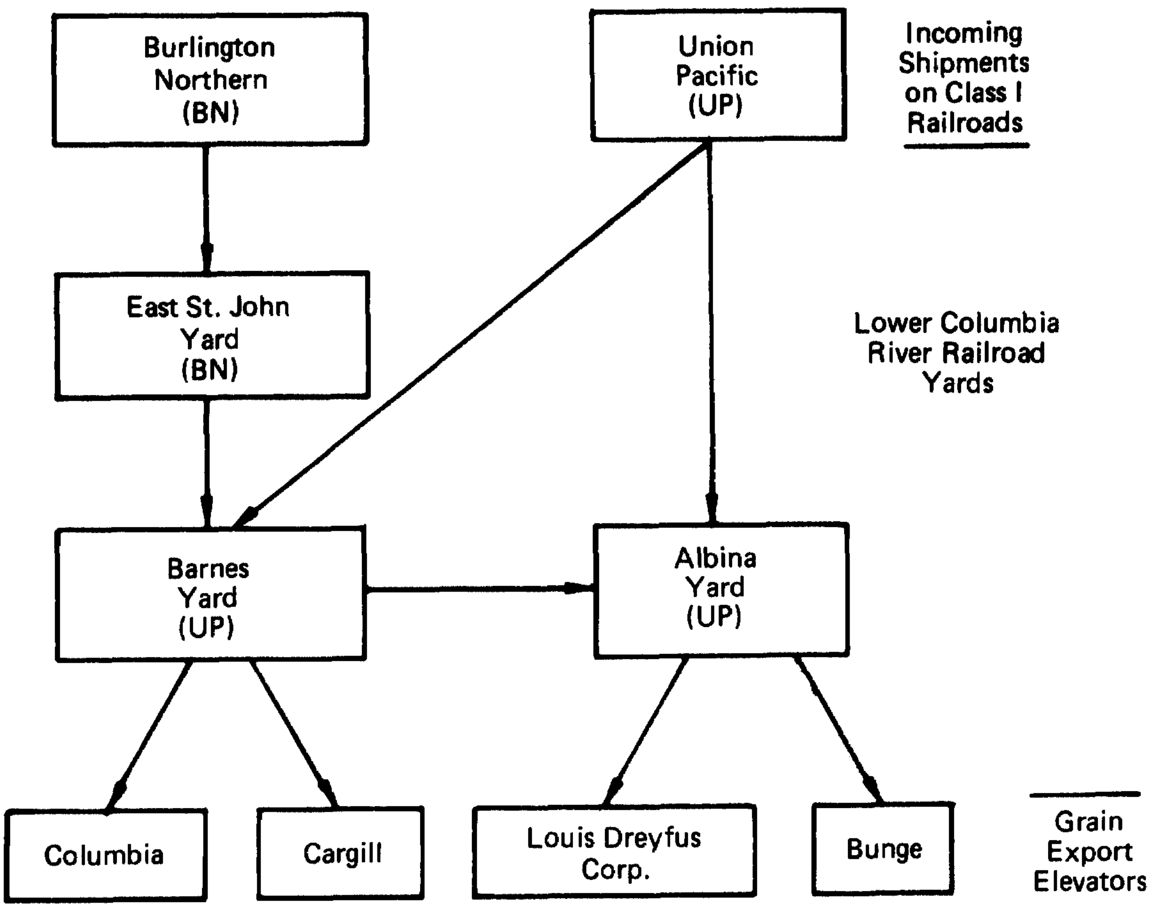
placement practice mentioned above can increase the number of yards involved. Cars are delayed at each yard and interchange location. In the Port of Houston area, grain cars can pass through as many as four different yards and be handled by three different railroads before final delivery. Empties follow the same route. One official estimated the delay at 12 to 24 hours for each switching yard entered. In the Lower Columbia River terminal area, cars can be stopped at as many as three yards and can be handled by two railroads. Figure 5-1 illustrates grain movement through the Port of Houston; figure 5-2 through the Portland, Oregon terminal area.

FIGURE 5-1. RAIL SERVICE TO THE GRAIN ELEVATORS AT THE PORT OF HOUSTON



MKT: Missouri-Kansas-Texas
SP: Southern Pacific
MOP: Missouri Pacific
FWD: Fort Worth and Denver
ATSF: Atchison, Topeka, and Santa Fe

FIGURE 5-2. RAIL SERVICE TO PORTLAND, OREGON, ELEVATORS



NOTE: **Less than 1 percent of export grain into Portland is handled by Southern Pacific Railroad. The Longview Switching Company services the Continental Grain Company elevator at Longview, Washington, which is not shown here.**

This complicated rail movement is an outgrowth of historical rail development. Basic rail facilities, which predate export elevators in the ports we visited, were built by many competing railroads. Elevators had to be constructed within the framework of these existing facilities, whose layout is much the same today as it was when the railroads were built. Railroads hauling grain from the interior often do not have track going to the export elevators and so must use other railroads' track. Railroads cannot operate over tracks owned by another railroad unless the owner grants trackage rights. All railroads in the terminal areas do not have trackage rights with the railroads actually servicing export elevators. Therefore, grain cars have to be interchanged with the railroad owning the tracks, creating a complex situation.

When a trainload of grain arrives on a railroad that does not have tracks to the export elevator, it must be handled by other railroads. In Houston, as shown in figure 5-1, only one line-haul railroad, the Southern Pacific, has tracks going to an export elevator, and those tracks go to only one elevator. The others must deliver their loaded grain cars and pick up their empties from the two Houston switching railroads.

These switching railroads are local railroads, established and owned by the line-haul railroads, providing railcar delivery service from the line-haul railroads to local rail customers inside a specific area. However, only one of these switching railroads can actually move grain cars to and from export elevators. The other switching railroad can only move the grain cars from the line-haul railroad to the switching railroad, which then actually moves the cars to and from the elevator. Each time the grain cars must be handled by a different railroad a delay occurs and costs increase.

In the Lower Columbia River area, which includes the Portland terminals, three line-haul railroads and one switching railroad are involved in grain traffic, as shown in figure 5-2. Only two of the line-haul railroads and the switching railroad actually directly serve the export elevators. Other railroads in the terminal only shuttle cars among themselves and between those servicing the elevator.

Other delaying practices are as follows.

--Interchange points--Railroads must designate certain rail yards or sidings at which they will transfer and receive traffic from each other and notify labor unions of these so their hours of service and "callout" times can be negotiated. Some current interchange points are at the most congested rail yards in the port area, and time taken to switch grain traffic through the yards can be extensive. Changing such problem interchange points can reduce delays considerably.

--Labor sources, work locations, and starting times--Railroads must negotiate with labor unions for a labor supply to operate the train, the locations where specific crews will report for work, the specific times of day a crew can be called to work at the agreed-to location, and the specific work to be done by the crew. Unions must agree before the operations can be changed, perhaps to speed up car movement. In Houston, particularly, union agreement has not always been forthcoming, especially when the number of jobs would be reduced.

--Selective car ordering--In the Lower Columbia River port area, export elevators control which cars are actually delivered. Because elevators do not have sufficient space to accept all cars that railroads can deliver, the railroads notify the export elevators, by railcar number, which cars have arrived in the terminal area or have been constructively placed for delivery. The elevators then order specific cars to meet their needs. They can select cars that have been waiting the longest for unloading--those costing the most in demurrage 1/ charges--or those containing specific types and grades of grain. We were told by a railroad official that elevator operators have in the past allowed unit trains to wait in yards close to the elevators while they ordered cars in from a distant constructive placement yard.

--Individual car inspection and grading--Lower Columbia River export elevators require that the grain in each railcar be inspected, graded, and weighed by either the Federal Grain Inspection Service or Washington Department of Agriculture before unloading. This procedure establishes the type, grade, and protein content of the grain; its storage location within the elevator; and serves as the basis for paying the shipper. However, it lengthens the time railcars

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1/Demurrage is a charge assessed by railroads for detaining cars beyond free time stipulated for unloading.

spend in yards before delivery. This procedure is optional at Duluth/Superior, but where used, apparently does not significantly affect the time railcars spend in rail yards, raising a question of why it does so in the Lower Columbia River. We were told gulf coast elevators do not use this procedure because they do not export as wide a variety of grain types and protein contents.

--Hours of service--The Hours of Service Act (Railroads), Public Law 91-169, dated December 1969, limits the number of hours train operating crews may be on duty to 12 hours in any 24-hour period. Consequently, cars can be stopped short of interchange points waiting for new crews to be called out to move the grain across town to the prescribed interchange points.

Railroads and most export elevators in these port areas have little, if any, room on which to expand existing rail facilities. To improve grain customer service they must construct entirely new yard and track facilities and/or revise current operating practices to expedite car movement through existing facilities.

Corrective actions

Groups have been formed in Portland, Oregon, and Houston, Texas, to research rail problems in these port terminal areas. No such group exists in Duluth/Superior. The Portland Terminal Project and Houston Terminal Project were created in April 1979 and February 1977, respectively, by the Task Force on Rail Transportation--a group of railroad and labor union presidents concerned with improving the quality of rail service around the country. Locally, these groups represent a fragile alliance of historical adversaries. Their success depends heavily upon mutual trust and cooperation as changes to existing practices must consider worker welfare as well as management needs. Both labor and management must approve all changes. The Federal Railroad Administration assisted the groups through funding contracts.

The Portland Terminal Project was slow in getting staffed and has studied grain movements but has undertaken no experiments to improve them. The Houston Terminal Project has studied grain movements extensively and has recommended several changes in facilities and operating practices to reduce delays. Several of the more significant recommendations are listed below.

--Connect all line-haul and switching railroads serving the port area to a common computer data bank that will allow each to identify grain traffic from other railroads. This change, which is already in process, will let railroads know how much yard space will be needed to accommodate incoming loads and empties and let them better plan car flow. The project anticipates that this change will improve car use equivalent to adding 2,700 new cars each year.

--Reassemble empty cars into unit trains as closely as possible to the export elevators to speed up their return to interior elevators and construct yards at certain designated locations to facilitate this.

--Move certain interchange points to less congested locations. An experiment with one such change showed delivery time to one elevator could be reduced by about 2 days.

--Create a new position at one switching railroad to monitor and control distribution of empty, privately owned cars. This position, which has been made permanent at the railroad, significantly reduced the number of empty private cars moving to improper destinations.

Another subject that may be studied in the future is the use of a permit system to control the pipeline of grain inbound for Houston. Under such a system, railroad management maintains control over the entire flow of grain cars and meters them through the system. The permit system is intended to maintain order in a complex marketing/transportation environment and to maximize car use and minimize car delays.

Barge problems

The Lower Mississippi River and the Lower Columbia River area elevators receive 85 and 60 percent of their grain, respectively, by barge. The Port of Houston receives less than 1 percent of the grain by barge. The elevator and barge officials contacted did not express concern about transit time to the port areas other than the delays associated with certain locks. These were discussed in chapter 5. However, once in the port areas, barges encounter unloading delays, especially in the Lower Mississippi River area. Here, barges remain in a barge fleet from several days to several weeks waiting to be unloaded because of a ship's late arrival or the elevator's practice of using barges for inexpensive storage space.

The elevators are generally allowed 5 days to unload the barge before they are charged demurrage.

The barge companies in the Lower Columbia River pay the elevators an incentive fee if the barges are unloaded within 2 days and the elevators must pay demurrage if barges are unloaded after the 2-day period.

Although no major problems currently exist, some industry sources in the Lower Mississippi River area are concerned with the diminishing supply of suitable space for additional barge fleeting operations. They believe that once the remaining space is put to use, additional barges needed for increased exports can be accommodated only through improved use brought about by reducing the length of time barges spend in the area. They believe this reduction could be accomplished by (1) speeding up the rate at which elevators unload barges and (2) curtailing the elevators' practice of using barges for inexpensive storage instead of constructing fixed storage space.

Truck problems

Of the elevators at ports visited, only those at Duluth/Superior receive significant amounts of grain by truck. Trucks transport about 50 percent of the grain received at Duluth/Superior, 15 percent at the Port of Houston, and less than 1 percent of the grain received at the other two ports.

Notable problems with truck deliveries exist both at Houston and Duluth/Superior, where elevator unloading capacity is inadequate during peak truck arrival periods. Truck congestion in Houston occurs primarily during the grain sorghum harvest period of July and August when nearly one-third of Houston's truck-delivered grain arrives. During this period, trucks often wait 30 hours to unload because queues of as many as 275 trucks await unloading. In 1977 the truck delay problem was compounded by ship arrival delays, causing truck queues to exceed 5 miles. Grain truck traffic to Duluth/Superior increased 381 percent from 1963 to 1978. Truck congestion occurs primarily during the spring, after the port opens, and during harvest in the fall; trucks have waited up to 3 days to unload during this period. Because there are inadequate parking facilities, trucks lined city streets waiting to unload. Elevators apparently have been unwilling to construct additional truck unloading facilities because (1) peak periods are short, (2) facilities are adequate for nonpeak periods, and (3) elevator officials believed trucking would not continue at such a high rate.

Increased exports necessitate transportation system improvements

Increases in grain exports will place additional demands upon the transportation system as well as the export elevators. To effectively accommodate the increased demands, improvements to existing facilities and methods of operations are needed. All the ports we visited needed better control over grain input to the pipeline and better coordination of ship and grain arrivals at elevators, except for Duluth/Superior, which has better notice of ship arrivals. It appears that extending the shipping season at Duluth/Superior would have the biggest impact on the port's ability to meet additional export demands. Improvements needed at individual ports are shown below.

--On the Lower Mississippi River, barge fleeting may become a problem because of scarcity of suitable land available between New Orleans and Baton Rouge, Louisiana, for barge fleeting operations. Therefore, to accommodate the increase in barge traffic, barge use needs to be improved. Presently, elevators use barges for additional storage capacity, but this practice will need to be changed to free up barge fleeting space.

--Around the Port of Houston, management improvements and capital improvements to the rail system may be needed to handle the expected 1985 traffic. Studies are underway to identify the extent to which capital improvements are needed and potential sources of funds.

--In the Lower Columbia River area, capital improvements in the rail system; additional barges; and improved rail management, labor union, and grain elevator practices will be needed.

--At the Port of Duluth/Superior, the shipping season is limited to about 9 months--April through late December--due to ice blockage on the St. Lawrence Seaway during the winter months. It has been recommended by some that the port be kept open all year for Great Lakes shipping and the seaway season be extended to 10 months for export traffic. The extended season would benefit primarily the sunflower crop, which cannot be harvested until after the first hard freeze, usually at the end of October. This leaves little time to harvest the crop and transport it to the port. A recently completed study by the Corps of Engineers concluded that the proposal to keep the port open all year and the seaway open 10 months a year would be feasible both from an economic and engineering standpoint.

GRAIN MARKETING AND TRANSPORTATION

This appendix provides a brief description of the U.S. grain marketing and transportation system. It is designed to give background information on how grain marketing and transportation operates so that readers unfamiliar with the system can better understand the significance of the grain transportation problems we have identified in the report.

GRAIN MARKETING

Grain marketing may be defined as the execution of activities that move grain to the ultimate consumer at the time and in the place and form he or she desires at a price he or she is willing to pay. It is a complex operation involving physical facilities for transporting, storing, merchandising, and processing and exchange functions for pricing grain and grain products.

The production of grain at the farm level is the first step in what can be described as a long and intricate chain of events which utlimately lead to the final consumption of grain. Once harvested, it may remain on the farm in the form of feed or seed, be processed for domestic consumption as a foodstuff or feed, or be exported in raw or processed form. Grain's final destination will determine its marketing pattern.

The country elevator is usually the first step in the grain marketing process. It functions as the prime collecting and buying point within a local community. Grain sent to the local elevator usually arrives by truck. After weighing and sampling to determine grade, it is either stored or outloaded immediately into freight cars, trucks, or barges for shipment to its next destination.

From the country elevator grain is shipped to a variety of destinations including port elevators for export, terminal elevators for eventual resale to processing facilities, feed manufacturers, interior distribution points or export facilities, or directly to these facilities, bypassing the terminal elevator as in the case of export grain.

Pricing, although usually not classified as a marketing function, is the linkage in transfer of ownership and also in the transfer conditions concerning marketing services.

Prices relate especially to transportation rates, warehouse storage charges, interest rates for financing, risk-bearing costs, and grading charges. Trading terms include grade, credit terms, delivery place, delivery date and trading prices. Grain ownership may be transferred many times, sometimes even resold to an earlier seller, depending upon the date and place delivery is required at any one time. Prices paid for grain at any one time reflect the different ways that time, form, and place considerations are being valued.

The transportation system moves grain from one destination to the next. Grain marketing determines the demands placed on transportation. The balance of this appendix provides background information on the grain transportation system.

RAIL TRANSPORTATION

Transportation is vital to agriculture, both because of the geographic dispersion of farming and because agricultural exports have become essential to the Nation's international balance of payments. Railroads are the dominant mode for transporting grain; agriculture depends on the year-round, long-haul capacity of the railroads to move grain to both domestic and export markets. Conversely, the railroads derive a significant portion of their traffic and revenue from the shipment of agricultural commodities and thus agriculture is of great importance to railroads.

Railroads transported about 44 billion bushels of grain to various markets in 1979; approximately 56 percent of these shipments went to ocean and lake ports for export. This represented the second largest year of the 1970s only slightly short of 1973 when large grain sales to the Soviet Union resulted in a big increase in agricultural tonnage hauled. In addition to affecting the amount of agricultural products hauled, export sales have also increased the distance these products are transported. The average distance these products traveled was greater in 1973 than other recorded years, primarily due to the increase in exports. It is generally conceded that other transportation modes could not replace rail for long-haul, or in many cases short-haul, transportation of agricultural products.

While railroad transportation to agricultural is vital, the converse may also be true; railroads derive substantial revenue from farm products. From 1954 to 1976, an average of 9.3 percent of all railroad carload tonnage was farm products, which provided an average of 10.4 percent of railroad revenue. These statistics are even more important for railroads located primarily in grain-producing areas. For example, grain products represented 12.3 percent of total tonnage and 14.3 percent of total revenue for one such railroad. Thus, it appears that rail transport of agricultural products, especially grains, is an extremely mutually beneficial operation for both the agricultural community and the railroads.

TRUCK TRANSPORTATION

Trucks play an important role in the grain marketing system. Not only do they provide the initial movement of grain from farms to country elevators, they also transport significant amounts of grain to terminal markets and transfer points for transhipment by rail or barge. For example, in 1979, 39,413,566 bushels, or 38 percent, of Montana's grain shipments and 185,165,000 bushels, or 41 percent, of North Dakota's grain shipments went by truck.

Typically, grain truckers may haul exempt agricultural goods, livestock, or other unregulated goods. Agricultural goods and livestock are exempted from ICC economic regulation. Generally, the exempt motor carrier industry is characterized by a relatively large number of independent owner-operators interacting in a competitive field. However, very little else is known about these truckers.

Although there is little information available on the industry, the effects that the exempt carrier has upon the performance of the grain marketing system is readily apparent. Trucks frequently provide the only competitive force on the railroads that serve grain-producing States. Trucks may be viewed as placing an upper limit on rail rates. It is generally conceded that trucks are the higher cost mode of transporting grain for relatively long distance. Based upon this contention, rail rates cannot exceed truck costs of moving grain by a substantial margin in the long run, or the trucking industry would soon eliminate or substantially reduce the railroad's market share. Thus, the upper limit on rail rates in the long run is truck costs. In turn, truck rates cannot substantially and continually exceed rail rates. Therefore, through the competitive interaction of rails and trucks, each mode constrains the other.

Truck transportation of grain provides several benefits through its services to grain producers. The first is the provision of an alternative mode for transporting grain to market. The second is the additional capacity for grain movements provided by trucks. Finally, through a combination of the first two services, the truck exerts competitive pressure on the railroads. The combination of these services together with the absolute movement of grain by truck cast the motor carrier as a vital cog in the grain transportation system.

INLAND WATERWAYS

The United States has the most extensive waterway system in the world. The inland waterway system, which consists of natural and artifical waterways, is more than 25,000 miles long. Nearly 15,700 miles, or 61 percent, are 9 feet deep or more (the standard operating depth) and about 9,900 miles are less than 9 feet deep.

Waterway transportation has become highly significant to agriculture, particularly in export trade. Measured in ton miles, agricultural freight is the second largest commodity group moved on inland rivers and canals. In 1960 only 14 million tons of grains and oilseeds were shipped by barge. In 1978 barges hauled about 50 million tons, about 40 percent of the export of these commodities.

Barge grain traffic is highly concentrated. Several rivers--the Illinois, Mississippi, Ohio, and Columbia/Snake--loaded 84 percent of total barge tonnage in 1977. Almost all Columbia/Snake wheat is shipped to the Portland, Oregon, area and 88 percent of all corn, wheat, and soybeans loaded on the Mississippi River System in 1977 was bound for the New Orleans area.

Waterway transportation is the most energy efficient mode of transportation. According to the American Waterways Operators, Inc., the inland waterways move 12 percent of the Nation's total freight at about 2 percent of the total cost. Barge cargo achieves an average 400 ton-miles per gallon of diesel fuel, as compared with 200 for rail and 70 for truck. However, barge costs are influenced more strongly by fuel price increases than rail costs because fuel costs are a larger percentage of total barge costs.

Barge capacity expanding

Covered cargo barges and open hopper barges are the two major types used for grain. Covered barges, except for their watertight covers over the cargo hold, are virtually the same as open barges. The most popular size is 195 feet in length with a 1,500 ton capacity, or about 5 times its unloaded weight.

The barge grain fleet has been expanding substantially in the past 7 years in response to this Nation's rapidly increasing grain exports. The American Waterways Operators, Inc., estimates that the grain fleet consists of some 9,000 barges of which roughly 56 percent have been added since 1972. In 1979 the industry placed some 1,200 new barges into service and another 1,200 grain barges are currently on order at shipyards for delivery in 1980.

Tow size restricted by several factors

The size of tows, which are groupings of barges lashed together, is restricted by water depths and the dimension of waterway locks and dams. A uniform depth of at least 9 feet must be maintained to allow several barges to move together as one unit. On major rivers such as the Upper Mississippi most locks are 110 feet wide and 600 feet long. These dimensions allow single-time locking of tows of six 195-foot barges with a cargo capacity of 9,000 tons. Larger tows are disassembled before and rejoined after locking but this requires additional time and can be expensive. As grain tows proceed downstream, typically more barges are added. For instance, south of St. Louis, the Mississippi is an open river free of locks and dams, and tows of 30-195 feet grain barges are common. A tow of 30 barges, 195 feet in length, can transport more cargo then four 100-car unit trains with 100 net tons per car.

The American Waterways Operators, Inc., estimates that there are roughly 270 towboats utilized to move the grain fleet. The trend has been to build more powerful and efficient towboats and tugboats in the 5,000-6,000 horsepower range. Towboats of 6,000 horsepower are capable of pushing barges with cargo capacities ranging from 40,000 to 50,000 tons.

How locks and dams operate

In their natural state, the rivers usually can be navigable near their outfall to the sea, where the water has sufficient depth, negligible slope, and minimal velocity. Inland reaches of rivers are often characterized by narrower windings courses, progressively steeper water surface slopes and higher velocities. To ensure that navigation is possible in large rivers, dams are built to create pools to obtain sufficient water depths, sustain flatter water slopes, and check flow velocities. Locks are chambers permitting the vessels to pass through the dam location while maintaining the upstream and downstream water elevations almost unchanged.

The dam maintains a more or less constant pool elevation and is equipped with a gated or ungated spillway that allows the passage of river flows. The gates are opened just enough to pass only the incoming flow, and thus maintain the upper pool elevation unchanged. During severe floods the gates are kept open in order to permit open river flow. During spring ice breakup, the gates are operated as required to alleviate detrimental ice conditions.

The lock chambers are equipped with gates and filling and emptying systems. When a downstream bound vessel is to pass from the upstream side of the dam to the lower pool, the lock is filled so that the water level inside the lock becomes equal to that of the upstream water surface. The upstream gate opens to permit the vessel to enter the lock, while the downstream gate remains closed. After the vessel enters, the upstream gate is closed and water is allowed to empty out of the lock until equilibrium is reached between lock water level and the downstream pool. Then, the downstream gate opens and the vessel exits the lock to continue its journey downstream.

Inadequate lock capacity is one of the most important concerns of inland waterway users. The size of the lock chamber determines the vessel and/or tow size that can be accommodated during each locking event. If the lock chamber can handle only nine barges at a time, as is the case of many locks on the Upper Mississippi and Illinois Rivers, then two lockages are required to process a 15-barge tow.

Service or processing time is another important component of lock capacity. Once a lock chamber has been made ready to receive a tow or vessel, the tow or vessel must approach the chamber, enter the chamber, wait until the chamber is filled and then leave the chamber. When a tow must be broken up in order to fit within the chamber, additional time is required for the breaking up and making up of the tow. The time required for chamber approach, fill, and exit is also a key determinant of lock capacity.

Additional components of lock capacity are length of season and use by recreational vessels. Length of season is limited on the Upper Mississippi, and on occasion, the Illinois and Ohio Rivers, thus reducing capacity. Recreational vessels seeking lockages also reduce capacity. This can be a problem on the Upper Mississippi, Ohio, and Illinois Rivers.

PORTS

U.S. grain is exported from four U.S. coasts--Atlantic, Great Lakes, Gulf of Mexico, and Pacific. In 1979 exports reached a record 4.564 billion bushels with Gulf of Mexico ports from Brownsville, Texas, to Mobile, Alabama, accounting for 61 percent of the total. The Pacific, Atlantic, and Great Lakes ports accounted for 15, 13, and 11 percent, respectively. We visited four port areas responsible for almost two-thirds of total exports. The general operation of the port areas visited is described below.

--The Lower Mississippi River port area, which we defined as that 280-mile portion of the Mississippi from Baton Rouge, Louisiana, to the Gulf of Mexico, accounted in 1979 for 38 percent of total U.S. grain exports. The area's 10 export elevators are dispersed along a mostly rural but industrialized 170-mile section of river in the towns of Myrtle Grove, New Orleans, Westwego, Ama, Destrehan, Reserve, Paulina and Port Allen. The elevators are all operated by grain companies but are owned by both grain companies and local port authorities. Most grain exported from the area originates in production areas convenient to the Mississippi River and its tributaries and arrives in the lower river area by barge.

--The Port of Houston, which is approximately 50 miles inland from the Gulf, accounted for about 10 percent of total U.S. grain exports. It has four export elevators located along a 15-mile section of the heavily populated and industrialized Houston Ship Channel in the cities of Houston, Galena Park, Deer Park, and Channelview. One elevator is owned and operated by the local port authority, and three are owned and operated by grain companies. Most grain exports arrive by rail from production areas, according to one study, in Texas, Oklahoma, Kansas, Nebraska, and Iowa.

--The Lower Columbia River port area, which we defined as that 100-mile portion of the river from the Portland, Oregon-Vancouver, Washington, metropolitan area to the Pacific Ocean, accounted in 1979 for approximately 8 percent of U.S. grain exports. The area contains seven export elevators--four on the Willamette River in Portland and three on the Columbia River in Vancouver, Kalama, and Longview, Washington. All elevators are operated by grain companies but are owned by grain companies, local port authorities, and a railroad company. Most of the area-exported grain originates in Washington, Oregon, Idaho, Montana, and the Dakotas, but when freight rates are favorable, it may also come from Colorado, Nebraska, and Kansas. The grain can be hauled directly to export elevators, or it can be hauled by rail or truck to elevators along the Upper Columbia and Snake Rivers and then barged to export elevators.

--The Port of Duluth-Superior, which is at the mouth of Lake Superior, accounted in 1979 for 7 percent of U.S. grain exports. It is at the head of the Great Lakes-St. Lawrence Seaway. It has 12 exports elevators, operated and owned by a combination of grain companies, railroads, and grain terminal associations. Grain is the port's principal export, accounting for a lion's share of total port tonnage each year. The grain originates in the Midwest States and Montana, arriving at the port by rail and truck.

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