CHANGING DEMANDS ON NORTH DAKOTA'S ROAD AND BRIDGE NETWORK

by

Daniel L. Zink

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BY

DANIEL L. ZINK

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UPPER GREAT PLAINS TRANSPORTATION INSTITUTE
NORTH DAKOTA STATE UNIVERSITY
P. O. BOX 5074
FARGO, NORTH DAKOTA 58105

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PREFACE

This report was prepared as part of the Transportation Needs Assessment Study (HCR 3069) in cooperation with the Planning Division, North Dakota State Highway Department. The dynamic nature of North Dakota's economy has led to some forces which are having increasing impacts on our road system. These forces and the impacts they are having on the state's road network are identified in this report.

For further information regarding this report contact:

Daniel L. Zink
Transportation Economist
Upper Great Plains Transportation Institute
North Dakota State University
Fargo, North Dakota 58105

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INTRODUCTION

Management and utilization of North Dakota's transportation network is extremely dynamic in nature. This has always been the case, but particularly so in the past five to ten years. Several factors have accelerated the changes in demands on the transportation system and its management. Some of these factors include agricultural marketing patterns, shifting demographics, concentration of tourist and recreational activities, city subdivision/fringe area development, industrial and commercial plant siting, and increasing maximum allowable vehicle weights.

AGRICULTURAL PRODUCTION AND MARKETING PATTERNS

One of the most pronounced changes in North Dakota which is affecting the state's road and bridge network is the dynamic agricultural production and marketing system. The North Dakota economy is based largely on agriculture. This industry is one of the primary users of the road system in the state, particularly at the local level on the secondary road or county/township system. Several network patterns in the agricultural industry are changing rapidly and are having substantial impacts on the road network. The two general areas where change is occurring include the level of production of agricultural commodities, and the changing agricultural marketing patterns.

Agricultural Production

Production of agricultural commodities in North Dakota generally has been expanding since the development of farming in the state. Several factors have contributed to this expansion. Technological advances have been a major contributor in the areas of plant hybridization, machinery manufacturing, financial and marketing management, and others. Demand for North Dakota's grains is provided by worldwide and domestic markets. Due to the low population relative to food produced, a high proportion of production is exported from North Dakota (Table 1).

TABLE 1. PRODUCTION AND MARKETINGS OF HARD RED SPRING AND DURUM WHEAT, NORTH DAKOTA.

Year[a]	Wheat Production	Wheat Marketings
	----------million bushels----------	
1981(82)	325,290	230,050
1982(83)	320,075	257,932
1983(84)	189,325	248,246
1984(85)	262,190	263,779
1985(86)	307,505	268,433

[a]Production is based on calendar years, marketings are based on the crop marketing year (July through June).

SOURCE: North Dakota Crop and Livestock Reporting Service, (1986), and Ogg, Dennis C. (1987).

A period of rapidly expanding production can certainly be of concern to managers of public transportation facilities. In North Dakota, increased production most likely means more shipments of those agricultural commodities by farm truck, semi-truck and railroad. The level of each type of shipment has implications for North Dakota's rural and state road system, as well as for the rail network.

Agricultural Marketing Patterns

The agricultural marketing system includes movement of products starting at the "farm gate" and extends to the actual end-user. A significant portion of this marketing chain takes place on North Dakota's road and bridge network, and is therefore of substantial concern to providers of highway services. The portions of this marketing system of concern to North Dakotans relative to their road network include farm truck transport, semi-truck shipments, country elevator marketing, development of subterminal elevators and "satellite" stations, and changes in federal/state legislation affecting rail line abandonment. Each of these sectors is discussed below relative to recent changes and their impacts on the state's road and bridge network.

Farm Trucks

The first transportation vehicle used in marketing of agricultural products is the farm truck. It is utilized for hauling grains both from field to farm storage and from farm

storage to the local country elevator. Although not comparable in size and capacity to the over-the-road semi-truck, farm truck shipments do have an impact on local roads due to their own maximum vehicle weights and axle configurations.

Several changes in farm truck transportation of agricultural commodities are notable because of their potential effects on North Dakota's road system. The average payload of farm trucks has increased over the past decade from 248 bushels to 310 bushels (Table 2). Also, the distance traveled by farm truck has increased. The average one-way distance traveled to country elevators increased from 9.6 to 12 miles, while the total vehicle miles increased from 2,510 to 5,162 miles per year over the same time period. Although no data were available for 1973, in 1980 sixteen percent of all farm trucks in North Dakota were tandem-axle trucks. A higher proportion of tandem-axle trucks are found in eastern North Dakota than in the central or western regions.

TABLE 2. SELECTED FARM TRUCK TRANSPORTATION STATISTICS, NORTH DAKOTA, 1973 AND 1980.

Characteristic	1973	1980
Average payload/trip (bu.)	248	310
Average mileage/trip (one-way)	9.6	12
Total annual truck mileage	2,510	5,162
Single axle/tandem axle ratio	N.A.	80/16

SOURCE: Griffin, Gene C. et. al. (1975), and Griffin, Gene C., et. al. (1984).

Semi-Trucking

Since the development of effective truck transportation in the early 1900s, the transportation of agricultural products and inputs in North Dakota has been characterized by some combination of rail and truck shipment, each vying for a greater share of the total traffic and revenues. The effectiveness of either in dominating or capturing traffic has been a function of many variables including government policies and regulation, technology, production patterns, and a host of other marketing factors. In the recent past, railroads have been able to capture the larger share of the raw agricultural product shipments from North Dakota; however, trucks did haul 41 percent of all grains and oilseeds shipped from the state in the 1978-79 crop year (Table 3).

The proportions of North Dakota commodities shipped by rail and truck have significant implications for management and funding of the state's public transportation facilities, particularly the state and county road systems. Truck shipments of grain and oilseeds constitute a significant share of the vehicle miles and weight. Diverting those shipments to railroads, although not necessarily desirable from a competitive standpoint, relieves pressure on the existing road network. Although the truck share of total shipments has declined since 1978-79, the absolute volume carried by trucks has remained relatively constant due to the increasing volume produced and marketed from North Dakota (Table 4).

TABLE 3. MODAL SHARE OF GRAIN AND OILSEED SHIPMENTS FROM NORTH DAKOTA, CROP YEARS 1975-76 TO 1985-86.[a]

Crop Year	Total Grain and Oilseed Shipments	Rail Share	Truck Share
	thousand bushels	----------percent----------	
1975-76	320,285	74	26
1976-77	305,912	67	33
1977-78	358,604	66	34
1978-79	456,233	59	41
1979-80	476,065	62	38
1980-81	401,085	63	37
1981-82	461,862	69	31
1982-83	491,671	69	31
1983-84	538,818	73	27
1984-85	511,856	73	27
1985-86	478,391	74	26

[a]Grain marketing statistics are reporting for the crop marketing year, July through June.

SOURCE: Ogg, Ibid.

TABLE 4. VOLUME OF GRAIN AND OILSEED SHIPMENTS FROM NORTH DAKOTA, BY MODE, 1975-76 TO 1985-86.

Year	Rail Shipments	Truck Shipments
	thousand bushels	
1975-76	236,491	83,793
1976-77	205,129	100,783
1977-78	235,178	123,426
1978-79	271,069	185,165
1979-80	294,342	181,724
1980-81	251,938	149,147
1981-82	317,304	144,558
1982-83	340,461	151,210
1983-84	393,110	145,709
1984-85	375,009	136,847
1985-86	355,387	123,004

SOURCE: Ogg, Ibid.

Changes in the vehicles themselves and methods of truck shipment as well as the absolute volume of North Dakota agricultural commodities shipped by truck to out-of-state destinations have affected North Dakota's road system. Size of over-the-road trucks have generally increased since their introduction in the early 1900s and have been limited in their growth by federal and state regulations. It has been purported that the growth in size of trucks has out-stripped the road system's capability to accommodate the larger vehicles. This has

been caused at least in part by increased pressures toward cost efficiencies in the trucking industry and discontinuity in road construction and upgrading. Reducing costs is a goal strived for through increasing the maximum allowable weight of a truck due to natural competitive forces in the transport of agricultural products. This weight increase does not necessarily coincide with a concurrent upgrading of roads sufficient to accommodate the heavier loads. A history of the maximum allowable truck weights and lengths in North Dakota is presented in a later section of this report.

Country Elevator Marketing

Country grain elevators have long served in their primary role of consolidating smaller grain shipments from farmers and merchandising them in larger consignments at major terminal markets. This role involves basically three steps. First, grain is purchased and received from farmers who deliver grain in their single- or tandem-axle trucks. The second step involves intermediate conditioning of grain at the country elevator. This process normally involves blending of grain to desired qualities, drying to acceptable moisture levels, cleaning to remove foreign materials, and storage. The final step involves sale and shipment of grain to buyers at terminal markets such as Minneapolis. Shipment is made in either over-the-road trucks or by hopper-bottom rail car.

The number of grain elevators in North Dakota has been decreasing since approximately the turn of the century when over 2,000 elevators were in operation. Due to pressures toward increased throughput and other reasons, the number is currently down to 577 (Table 5).

TABLE 5. NUMBER OF LICENSED COUNTRY GRAIN ELEVATORS, AVERAGE STORAGE CAPACITY AND AVERAGE VOLUME HANDLED, NORTH DAKOTA.

Year	Licensed Elevators	Average Storage Capacity	Average Volume Handled
	--number-	----------bushels----------	
1915	2,031	30,000	--
1922	1,832	30,000	--
1952	936	68,000	--
1964	789	159,000	--
1969	663	188,000	460,000
1971	650	197,000	460,000
1973	636	207,000	647,000
1975	617	204,000	519,000
1977	600	229,000	598,000
1979	589	248,000	808,000
1980	592	263,000	678,000
1981	589	265,655	784,000
1982	578	287,531	851,000
1983	582	304,900	985,000
1984	563	316,148	909,000
1985	577	308,478	829,000

SOURCE: North Dakota Grain Dealers Association, (1985); North Dakota Board of Railroad Commissioners, (1916); and Ogg, Ibid.

A reduction in elevator numbers has significant implications for North Dakota's transportation system, particularly for local roads. The area from which farmers haul grain to a particular grain elevator is called that elevator's "trade area." Most

producers are fortunate in that they have more than one elevator market available to them, thereby providing competition for available grain. However, as fewer elevators compete for patrons, producers may find themselves having to haul farther to market as elevator trade areas grow in size. As deliveries from a larger trade area to an elevator are funneled to fewer roads approaching the elevator, more dramatic road deterioration may be experienced.

While elevator numbers overall have been decreasing, a shift in the concentration of grain moving through the remaining stations has occurred. A larger share of the total grain handled is done through a smaller number of firms. For example, the five largest grain elevators in 1977-78 handled about 5 percent of all grains marketed from North Dakota. In 1985-86, the largest five firms handled almost 10 percent of all grains (Table 6).

TABLE 6. VOLUME OF GRAIN HANDLED BY THE LARGEST COUNTRY ELEVATOR FIRMS IN NORTH DAKOTA.

Year	Largest 5 Firms	Largest 10 Firms	Largest 20 Firms	Largest 50 Firms	Total Volume of Grain Handled
	----------percent----------				bushels
1977-78	5.0	8.9	15.1	28.3	358,604,000
1978-79	5.3	9.0	15.0	28.5	456,234,000
1979-80	5.3	9.2	15.5	29.4	476,064,000
1980-81	6.2	10.7	17.9	31.5	401,085,000
1981-82	6.6	11.3	18.5	32.0	461,862,000
1982-83	9.7	15.0	23.2	38.5	491,671,000
1983-84	9.9	15.2	22.9	39.2	538,818,000
1984-85	9.3	14.1	21.5	37.4	511,855,000
1985-86	9.3	15.2	24.2	40.8	478,390,000

SOURCE: Rodriguez, Julene M. (1985).

This concentration of grain shipments may also cause increased rural road deterioration due to the larger number of truck shipments bringing grain into these higher volume elevators.

In the 1980s, North Dakota has witnessed significant changes in the traditional country grain gathering system. These changes have been precipitated largely by the introduction of "multi-car" or "unit train" railroad rates. Under these new rate structures, rate reductions are offered to ship grain in greater than single car lots. Some of the more common "multiple-car" lots are 3 car, 26 car, and 52 car. An example of the rate savings or incentives offered for these shipments is presented in Table 7. Railroads offer these rate savings as part of their marketing and pricing programs to reduce their costs of operation and increase their volume of grain shipped from the state.

TABLE 7. RAIL WHEAT RATES FROM CARRINGTON, NORTH DAKOTA TO MINNEAPOLIS, ST. PAUL, MINNESOTA TRANSFER, DULUTH, MINNESOTA, AND SUPERIOR, WISCONSIN, OCTOBER 1985.

Consignment Size	Rail Rate in Cents per Hundredweight
Single Car	96
3 Car	93
26 Car	83
52 Car	77

SOURCE: Burlington Northern Railroad.

Subterminal Elevators

Changes brought about by the introduction of multi-car railroad rates have been numerous and far-reaching. The country elevator industry has been undergoing significant structural changes in an effort to adjust to and take advantage of the new rates. One major result has been the emergence of what has been termed the "subterminal" grain elevator. Subterminal elevators are simply those that have the physical capabilities to load grain onto 26 or 52 car trains and access the associated rate savings. Local country elevators normally must add rail trackage, add storage capacity, or upgrade internal machinery in order to accommodate the fast-loading requirements of multiple car shipments. Virtually all of the subterminal elevators existing today were constructed or upgraded to subterminal capacity since the introduction of multiple car rates in December of 1980. Today, 147 grain elevators in North Dakota have capabilities to load 26 or 52 car trains (Table 8).

TABLE 8. NUMBER OF SUBTERMINAL ELEVATORS SHIPPING 24-27 OR 50-54 CAR TRAINS, NORTH DAKOTA, 1980-1985.

Year	Number of Subterminal Elevators
1980	0
1981	52
1982	63
1983	71
1984	124
1985	147

SOURCE: Upper Great Plains Transportation Institute, unpublished data.

Although the 147 subterminals represent only 30 percent of all elevators operating in North Dakota, they account for a significantly higher percentage of all grains and oilseeds shipped from the state. In the 1984-85 crop year, the 147 subterminals shipped 339 million bushels or 59 percent of all grain and oilseeds shipped from North Dakota. The effects of this concentration of grain shipments through fewer elevators may be felt on North Dakota's state and rural road network. As fewer elevators handle more grain, the average length of haul by farmers to country markets will become longer. This means that more vehicle miles will be put on local roads with farm and other trucks.

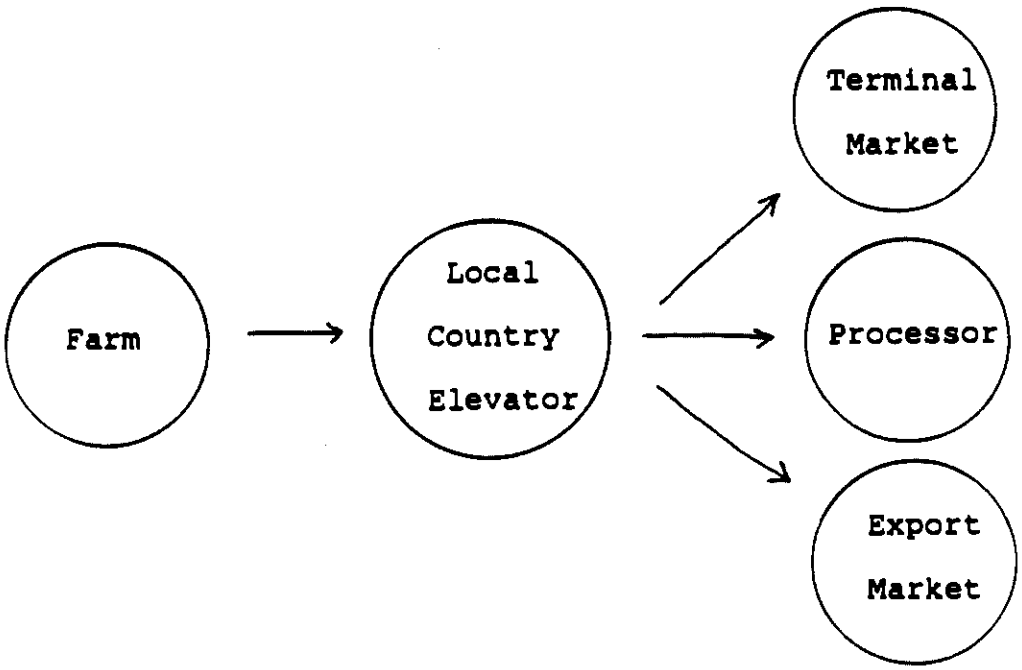
These subterminals rely heavily on rail shipment of grain due to the rate savings available from multi-car or trainload shipment. While the statewide modal split in the 1984-85 crop year was 68 percent rail and 32 percent truck, the modal split for these 147 subterminals was 76 percent rail and 24 percent truck. This higher proportion of rail shipments also has implications for North Dakota's road system. As the proportion of rail shipments increases, the truck modal share decreases, potentially removing truck shipments from the roadways. However, before reaching conclusions regarding truck modal share and truck vehicle-miles, an investigation of the total bushels shipped from the state must be made. As shown earlier in Tables 2 and 3, truck modal share has decreased since the 1978-79 crop year, but bushels shipped has remained relatively constant. If trucks had

maintained their share over this time period, their absolute volume would have increased from 185 million bushels in 1978-79 to 235 million bushels in 1983-84.

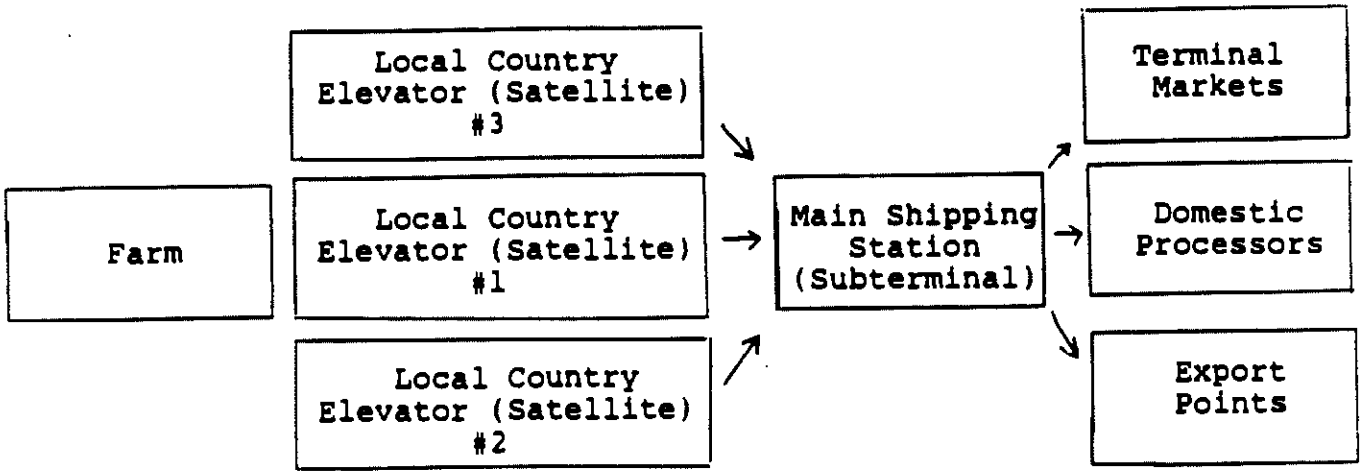
Subterminal/Satellite Elevator Firms

The advent of the subterminal elevator in North Dakota has had other consequences relative to North Dakota's road and bridge network. Very likely the most significant has been the development of the "subterminal/satellite" cooperative elevator companies. This type of cooperative is formed by the merger or consolidation of several local elevators for the purpose of consolidating grain shipments through a single, central shipping point (Figure 1). The central shipping point is generally a newly constructed subterminal or an existing station upgraded to subterminal capabilities. Operational activity generally consists of the following activities:

1. Grain is delivered to local country elevators ("satellites" or "substations") by producers in single or tandem-axle farm trucks.
2. Grain is stored, blended or conditioned at the local substation.
3. Grain is trucked (usually with larger semi-trucks) from the substation to the central shipping point (subterminal).
4. Grain is blended or stored at the subterminal and subsequently loaded onto 26 or 52 car trains for reshipment to terminal markets.



Traditional Model of Country Grain Marketing.



Model of Country Grain Marketing Under the Subterminal/Satellite Elevator Organization.

Figure 1. Comparison of Traditional Model of Country Grain Marketing to Marketing Under the Subterminal/ Satellite Elevator Organization.

Inspection of this process will reveal that a new activity has been added to the traditional country grain marketing system. Consolidation of shipments from substations and semi-truck movement to the subterminal has led to a significant increase in local truck traffic in some areas of the state. Although the primary method of marketing is still the farm to country elevator to terminal market, a significant number of bushels are trucked from one elevator to another for reshipment. In the crop years 1983-84 and 1984-85, an average of over 31 million bushels per year was shipped from one North Dakota elevator to another, presumably for reshipment by rail (Table 9).

The potential impacts of these inter-elevator shipments on North Dakota's rural road system becomes more apparent when the volumes are expressed in numbers of truckloads required to ship this quantity of grain. In 1983-84, almost 40,000 truckloads were shipped between elevators, while 38,000 truckloads were shipped in 1984-85. It is important to note that these shipments are in addition to the 145 and 139 million bushels shipped by truck from North Dakota in the same crop years. The most critical consequence of this phenomenon is that a large proportion of these intra-state shipments take place on the rural road system. While inter-state truck shipments are generally routed to the nearest major arterial such as an Interstate highway, the intra-state shipments are made primarily over state or county roads.

TABLE 9. VOLUME OF GRAIN SHIPPED INTER-ELEVATOR, NORTH DAKOTA, CROP YEARS 1983-84 AND 1984-85.

Crop Marketing Year	Inter-Elevator Shipments	Truckload Equivalents[a]
1983-84	31,929,339	39,912
1984-85	30,713,125	38,391

[a]Based on 800 bushels per truckload.

Many of these subterminal/satellite operations exist in North Dakota, and are highly variable in size and scope. A number of local farmer cooperatives have merged or consolidated into a larger cooperative, some have simply bought nearby stations, while others have not changed their organizational structure, but simply purchase grain from surrounding stations and merchandise it through their own facilities.

In-State Processing of Agricultural Commodities

A significant addition to North Dakota's agricultural marketing system was made in the 1970s and 1980s in the processing of agricultural commodities. Prior to the 1970s, agricultural processing was mostly limited to mixing and grinding at feed plants for local livestock consumption. The only exceptions to this were the state-owned North Dakota Mill and Elevator at Grand Forks and the sugar beet processing plants in the Red River Valley. Since then several plants of varying sizes have been constructed. These include three sunflower crushing

plants, two barley malting plants (one in Moorhead, Minnesota), a pasta manufacturing plant, and two alcohol fuels plants.

The volume of commodity shipments into agricultural processing can be substantial. In the 1984-85 crop marketing year total shipments of grain and oilseeds to in-state processors amounted to approximately 70 million bushels of which over 50 million was shipped by truck.

RAIL LINE ABANDONMENT

Passage of transportation legislation at the federal level can and has influenced North Dakota's agricultural transportation network. Significant changes have occurred in the past decade regarding federal regulation of the nation's railroads.

Rail transportation regulation at the federal level has been substantially relaxed in the past ten years. The 4R Act of 1976 and the Staggers Rail Act of 1980 relaxed Interstate Commerce Commission regulation of railroad rate making, as well as addressing other issues such as abandonment of service, mergers, and exemption of commodities from regulation.

Possibly one of the most significant results of recent federal legislative action was the treatment of rail line abandonment in the Staggers Rail Act of 1980. In general, the Staggers Act expedited ICC procedures for filing and approving (or denying) rail line abandonment. This is not to say that the Staggers Act was the cause of or promoted abandonment. However, it allowed the "machinery" to work more quickly.

The position of the State of North Dakota regarding rail line abandonment has been that where the public interest will be potentially damaged, and if shipper/community support is evident, the State will aid in an official protest of an abandonment application. On the other hand, where no public or local impact is perceived, no protest will be filed. Several of each instance have occurred recently. Mixed results have occurred in the cases where the State has filed a protest. A historical record of rail lines abandoned in North Dakota is presented in Table 10.

The extent of rail line abandonment in North Dakota is important from a public transportation facilities perspective in that traffic may be diverted from railroads onto the local road system. Several factors will affect the extent to which road impacts are felt. If country grain elevators and other shippers relied heavily on rail transport prior to abandonment, a significant amount of traffic could be diverted to trucks traveling over local roads. However, if shippers were not utilizing rail shipments extensively, abandonment may have little or no impact on the remaining transportation system. The organizational structure of firms after abandonment also will affect the road network. Some firms will attempt to merge or consolidate facilities to retain access to rail shipment. Road impacts will be felt if this reorganization involves substantial truck shipments to nearby rail loading points.

TABLE 10. HISTORICAL RECORD OF RAIL LINE ABANDONMENT IN ND.

Company	Rail Line Segment	Length	Date[a]
Milw.	Brampton to Cogswell	7.5	1936
GN	Walhalla to CN Border	5.3	1936
GN	St. John to CN Border	3.6	1936
GN	Clifford to Portland	10.0	1962
Mid-Cont	Clementsville to Edgeley	48.5	1970
BN	Maxbass to Dunning	4.7	1972
BN	Rutland to Ludden	30.2	1974
BN	Neche to Canadian Border	1.0	1976
BN	Blanchard to Mayville	10.1	1976
BN	Minnewauken to Brinsmade	7.5	1976
BN	Brinsmade to Leeds	9.9	1977
BN	Jamestown to Klose	5.9	1979
Milw.	Fargo to SD Border	70.4	1980P
Milw.	Edgeley to SD Border	31.5	1980P
Milw.	Brampton to SD Border	4.5	1980P
BN	Ellendale to Forbes	13.5	1980P
BN	Devils Lake to Warwick	21.1	1980C
BN	Joliette to Pembina	12.2	1980P
BN	Fairview Jct. to Great Bend	8.8	1981P
BN	Binford to McHenry	11.7	1981C
BN	Newburg to Dunning	5.6	1981N
Milw.	New England to SD Border	123.8	1982P
BN	Golva to MT Border	7.4	1981N
BN	Wolford to Dunseith	23.4	1982P
BN	Casselton to Amenia	6.1	1982C
BN	Rolla to St. John	7.2	1982N
Soo	Wimbledon to Clementsville	9.3	1982N
BN	Grand Forks to Honeyford	16.6	1983C
BN	Edgeley to Streeter	39.4	1983P
BN	Ludden Jct. to Ellendale	20.1	1984P
BN	Beach to Golva	12.9	1984N
BN	Truax to Truax Jct.	6.7	1984N
BN	Regan to Wilton	11.5	1984N
BN	Loraine to Sherwood	7.6	1984N
BN	Zeeland to SD Border	6.0	1984P
Soo	Egeland to Armourdale	19.6	1984N
BN	Westhope to Antler	13.0	1985N
BN	Hunter to Blanchard	10.5	1985N
BN	Zap to Killdeer	40.9	1984P
CNW	Oakes to SD Border	14.2	Withdrawn

[a]P = Protest filed with Interstate Commerce Commission (ICC), C = Comments filed with ICC, N = No protest or comments filed with ICC.

SOURCE: North Dakota Public Service Commission, unpublished data.

DEMOGRAPHIC PATTERNS

North Dakota's rural road network is extensive by any measure. The state has a total of over 104,000 miles of all roads and streets. On a per capita basis this is higher than any other state in the country. The need for an extensive road network like North Dakota's was very likely at its greatest several decades ago when the rural and agricultural population was a more dominant factor in the state. More recently, however, significant shifts have occurred in the demographic structure in North Dakota.

The number of farms in North Dakota has been declining steadily for several decades. In 1950, over 65,000 farms were operating in the state. That number has since declined to 34,000, about half of the 1950 level (Table 11). The rural population base has also diminished along with the changes in number of farms. In 1940, 327,000 people or over half the total state population lived on farms (Table 12). An additional 83,000 people lived in rural non-farm communities. The urban population made up less than 35 percent of the total state population base. The rural/urban make-up of the state has since shifted toward the urban areas, with approximately 52 percent of the state's population living in cities with over 2,500 people. The rural farm portion of the population has decreased by over 68 percent in this time period. Rural non-farm population and urban population increased by 178 percent and 44 percent respectively.

TABLE 11. NUMBER OF FARMS, AVERAGE SIZE FARM, AND ALL LAND IN FARMS, NORTH DAKOTA.

Year	Number of Farms	Average Size of Farms	All Land in Farms
		acres	thousand acres
1950	65,400	630	41,200
1954	61,900	676	41,900
1959	54,900	755	41,500
1965	49,500	848	42,000
1966	48,000	857	42,000
1967	48,000	873	41,900
1968	47,000	891	41,900
1969	46,000	911	41,900
1970	45,500	921	41,900
1971	45,000	929	41,800
1972	44,000	950	41,800
1973	43,500	961	41,800
1974	43,000	970	41,700
1975	42,000	1,007	42,300
1976	41,500	1,012	42,000
1977	41,000	1,020	41,800
1978	41,000	1,017	41,700
1979	40,500	1,030	41,700
1980	40,000	1,043	41,700
1981	38,500	1,073	41,300
1982	37,000	1,108	41,000
1983	36,500	1,123	41,000
1984	35,500	1,155	41,000
1985	34,000	1,203	40,900

SOURCE: North Dakota Crop and Livestock Reporting Service (1986).

TABLE 12. NORTH DAKOTA RURAL FARM, NON-FARM AND URBAN POPULATION, 1940-1980.

Year	State Population[a]	Urban[b]	Rural Non-Farm[c]	Rural Farm
1980	612,717	318,310	231,502	102,905
1970	617,792	273,442	192,058	152,261
1960	632,446	222,708	205,340	204,398
1950	619,636	164,817	200,974	253,845
1940	641,935	221,694	83,254	327,498

[a]Urban, rural non-farm and rural farm may not total to state population due to slight overlap among categories.
[b]Cities greater than 2500 population.
[c]Non-farm residents of cities less than 2500 population.

SOURCE: U.S. Department of Commerce (1981).

The distribution of North Dakota cities among city size groupings also reflects the shift in population from rural to urban areas. In 1930, only 12 North Dakota cities had populations over 2500, compared to 20 in 1980 (Table 13). In that same time period, number of cities under 1000 grew from 285 to 301. The number of cities with population 1000-2500 grew from 29 to 46. Growth in the number of cities in these larger two categories further substantiates the rural to urban shift.

TABLE 13. NUMBER OF NORTH DAKOTA CITIES, BY SIZE CATEGORY.

Year	Less than 1000	1000-2500	Over 2500
1930	285	29	12
1940	285	36	12
1950	286	47	13
1960	294	49	15
1970	298	44	18
1980	301	46	20

SOURCE: U.S. Department of Commerce, Ibid.

These data give insight into the changing rural population in North Dakota. This demographic shift has implications for performance of the local road system serving the public. Several decades ago when many farms occupied a smaller geographic area, many more users depended on local roads for personal and commercial transport. Today, fewer farm units and rural residents depend on basically the same size road network. However, the demand for local road miles does not decrease in proportion to the number of local residents or users. The essential skeleton network of roadways is still required to move agricultural commodities from the land. Also, the stable or diminishing tax base in rural areas is creating a finance problem for local jurisdictions. Fewer users exist to pay for the local road system, yet the network is essential to support the economic and social structure of the entire region.

UTILIZATION OF RECREATIONAL AREA ACCESS ROADS[1]

Tourism is one industry in North Dakota whose growth has put increased demands on the state's road network. Utilization of recreational facilities in North Dakota has increased in recent history, as evidenced by indicators such as hunting and fishing license sales. For example, resident fishing license sales increased over 60 percent between 1968 and 1983. During this same time period nonresident fishing license sales increased 149 percent. Similar trends are noted in hunting license sales.

Many recreational activities also occur in the state where shifts in utilization cannot be documented by license sales. However, estimates have been made by surveys and other means to elicit utilization of facilities in the state. North Dakota state park visitation has increased over the years and peaked in 1978 (Table 14). Park visitation has stabilized at approximately one million visitors per year since then. Increased participation in outdoor activities is also evident from studies of participation in activities by outdoor enthusiasts. According to these studies, recreational activities which require utilization of roadways or access roads have grown in popularity. Between 1973 and 1985, the number of activity-days fishing increased by 46 percent, powerboat/waterskiing increased by 26 percent, big game and upland game increased by 48 and 28 percent,

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[1]Most of the information included in this section is a synopsis of a report entitled, "An Assessment of Access Roads to Recreation Areas," prepared by the North Dakota Parks and Recreation Department, Bismarck, 1986.

TABLE 14. NORTH DAKOTA STATE PARKS VISITATION, 1971-1985.

Year	Number of Visitors
1971	394,309
1972	347,855
1974	773,749
1975	808,144
1976	973,953
1977	950,317
1978	1,094,960
1979	884,131
1980	919,176
1981	948,210
1982	975,416
1983	1,029,070
1984	908,857
1985	806,317

respectively, and camping increased 14 percent. These figures give an indication of the growing demand for outdoor leisure activities and therefore the increasing pressure on roads serving these outdoor activity sites.

In order to gain insight into the extent of need for improvements in recreational road condition in North Dakota, a survey was conducted whereby individual road segments were

categorized as to condition and usage. Surveys were sent to county road officials, district game wardens, and state park managers. The questionnaire was designed to obtain information on access road mileage, surface type, surface condition, utilization, and priority of the road segment. Segments were then prioritized based on these criteria, as well as on the perceived utilization if access roads were upgraded. Some sites were considered to have a high potential for utilization if access roads are upgraded.

Priorities for inclusion in a recreational roads upgrading program were based on the three following utilization/condition combined criteria:

1. High utilization and major repair/reconstruction needed.
2. High potential utilization and major repair/ reconstruction needed.
3. Average utilization, major repair/reconstruction needed and maintenance higher than normal.

Using these criteria, 32 access road segments were identified as high priorities in a recreational road improvement program. These segments included 44 paved miles, 163 gravel miles and 10 unimproved miles. Also, a list of secondary priorities was developed and included 47 access road segments. These segments included 17 paved miles, 206 gravel miles and 5 unimproved miles.

The number of road segments and extent of mileage in these two categories is indicative of the impact that higher utilization of recreational facilities has had on access road

condition. In order to fully utilize and gain maximum utility from our state's outdoor activities, serious consideration must be given to upgrading access roads. Also, from an economic development standpoint, good quality recreational access roads are desirable in that out-of-state tourists may be more likely to utilize North Dakota facilities in their travel plans.

CITY SUBDIVISION DEVELOPMENT

One isolated yet very real problem for some counties and cities is the issue of larger city subdivision development. For example, the rapid expansion of the city of Lincoln, ND (four miles southeast of Bismarck) has created problems for Burleigh County road officials due to the high density of commuter traffic between Lincoln and Bismarck. Rapid expansion of these types of subdivisions combined with the fact that long-term road system planning cannot predict such development can lead to many problems. Some of these problems include:

1. traffic volumes on formerly low density roads increase dramatically leading to accelerated surface deterioration,
2. increased demand for maintenance such as snow removal,
3. questions regarding jurisdictional responsibility for roads between subdivisions and nearby larger cities,
4. traffic congestion on routes not designed for higher traffic volumes.

Often these problems fall on county road officials because roads between subdivisions and larger cities are often the responsibility of the county. Although the problem of rapid subdivision development is isolated to only a few areas of the entire state, those few incidents cause a very real problem for officials in those jurisdictions.

VEHICLE SIZE AND WEIGHTS[2]

Very likely one of the most important issues affecting North Dakota's road and bridge network is the historical trend toward increasing the maximum allowable weights on the various jurisdictions' road systems. Pressure to increase the maximum allowable weights on the highways primarily comes from the motor carrier and shipping communities. Allowing higher weights for a vehicle contributes to the operating efficiencies of the firm and may provide lower transportation rates to the shipping public.

Increasing the maximum vehicle weights, however, is not without its associated costs. In general terms, higher axle-loadings cause increased stress on the road surface, although altering axle spacings and axle configurations can mitigate at least some of these effects. The problem of higher vehicle weights would not be severe if road surfaces were constructed or upgraded to accommodate the heavier loads when the increased maximums are allowed. Several factors prevent this from

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[2]Information contained in this section is a synopsis of "North Dakota Vehicle Size and Weights, 1961-1986," prepared by the North Dakota State Highway Patrol, Col. Brian Berg, Chief.

occurring. First, highways are generally constructed with an expected life of about 20 years. Climate, intensity of use, and other factors will influence the actual road life, but design standards and expected traffic levels (including lading weights) indicate an expected life of about 20 years. A change in the regulations after construction will therefore impact that road's actual life span. Second, funds are simply not available to adjust the entire road system to a change in allowable weights. A re-construction project of this scale is unimaginable in size and scope. Government jurisdictions are therefore faced with attempting to adjust to higher weights with existing resources. By many estimates, the result has been a deterioration in road surface quality with further damage expected.

Maximum vehicle weights have increased over the past 25 years, as indicated in Table 15. The maximum weight for single axle trucks has increased from 18,000 to 20,000 pounds, while the maximum tandem axle weight has increased from 32,000 to 34,000 pounds. The largest increase, however, has been on gross vehicle weight of multi-axle vehicles and vehicle combinations. Between 1961 and 1979 the maximum gross vehicle weight has increased from 73,280 pounds to 105,500 pounds, an increase of 44 percent. In 1983, the 105,500 pound limit was extended to include the entire state highway system, except for the interstate system.

TABLE 15. NORTH DAKOTA MAXIMUM ALLOWABLE TRUCK WEIGHTS, 1961-1986.

	Maximum Weight		
Year	Single Axle	Tandem Axle	Gross Vehicle Weight
	----------pounds----------		
1961	18,000	32,000	73,280
1973	20,000	34,000	82,000
1979	20,000	34,000	105,500 (designated routes only)
1983	20,000	34,000	105,500 (entire state system, excluding interstate)

Along with increasing maximum allowable truck weights in North Dakota, size restrictions on the width and length of vehicles have increased (Table 16). Changes in vehicle width and height have been small or nonexistent. However, the allowable maximum on vehicle length has changed considerably over time. Some vehicle combinations on designated routes can now legally reach lengths of up to 110 feet.

TABLE 16. MAXIMUM ALLOWABLE VEHICLE DIMENSIONS, NORTH DAKOTA, 1961-1986.

Year	Width	Height	Length
1961	8'	13'6"	35' (2 axle) 40' (3 axle) 60' (2 vehicle combination)
1965	8'	13'6"	65' (2 vehicle combination)
1977	8'	13'6"	40' (all single units)
1979	8'	13'6"	60' (all combination vehicles) 75' (all combination vehicles-designated routes)
1982	8'6"	13'6"	no change
1983	8'6"	13'6"	50' (all single units) 75' (all combination vehicles-all (routes) 110' (combinations on designated (routes)

SUMMARY

The dynamic nature of North Dakota's economy has caused some problems for a primarily static road system in the state. A road network designed for the needs of the state 20 years ago may be inappropriate for today's requirements. This longer road life, changing traffic patterns, and scarce resources for road rebuilding have led to a road system condition which "lags" the needs and requirements of today's motoring public.

Several factors have occurred simultaneously which have accelerated the expected performance of North Dakota's road network. First, the agricultural marketing system in the state

has gone through some significant changes. Grain elevator consolidations and the proliferation of in-state agricultural processing have substantially increased the amount of local truck traffic on the state and local road systems. In some areas where high traffic densities are concentrated over a single road to a facility, road condition has been seriously affected. Also, trucks hauling agricultural commodities (farm trucks and larger semi-trucks) have become larger over the years and have heavier loads than many roads were built to handle. Rail line abandonment has also been a significant concern to road officials. Local roads will suffer due to this increase in truck shipments to the extent that abandonment diverts grain or other traffic from rail shipments to trucks.

Second, a gradual yet pronounced shift in demographics has occurred in North Dakota over the past several decades. Since 1950, the number of farms in North Dakota has decreased by 50 percent, and the rural farm population decreased by over 68 percent. This migration of the population from rural to urban centers has changed the way in which the rural road network serves the state. Fewer farm units and rural residents depend on the same size network. However, the demand for that local system has not decreased in the same proportions. A diminishing tax base in rural North Dakota is creating a finance problem for local jurisdictions, yet the network is essential to support the economic and social structure of the entire region.

Third, the expanded use of recreational facilities in North Dakota has put pressure on the roads leading to the more heavily utilized recreational areas. In order to provide adequate recreational services for North Dakota residents, adequate access roads must be provided. Additionally, consideration must be given to the overall condition of recreational facilities from an economic development perspective. These facilities are utilized by out of state tourists and their condition may affect the level of tourist interest in the state.

Finally, the trend toward increased maximum truck weights has had an impact on the state and local roads. Although the economics of truck operation make heavier weights desirable, the heavier loads can do substantial damage to a road surface that does not have the design capacity to handle the weight. The result is accelerated damage to road surfaces, shorter roadway life, and higher costs to build and maintain the road network. The key to establishing appropriate maximum vehicle weights is to reach the proper balance between providing maximum economic benefits to motor carriers and maintaining a minimum quality level of road surfaces as part of a long term highway services plan.

Each of these factors must be considered as a part of a long range road and bridge program. A roads program must be considerate of the changing demands and attempt to satisfy those demands while still utilizing resources in an efficient manner.

Also, shippers and carriers must be aware of how changes in their traffic patterns will affect the public transportation network. These will ensure a road and bridge network which will serve the public far into the future.

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