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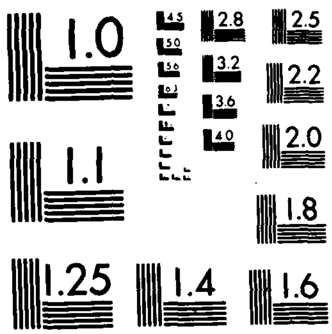

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US Army Corps of Engineers
St Paul District

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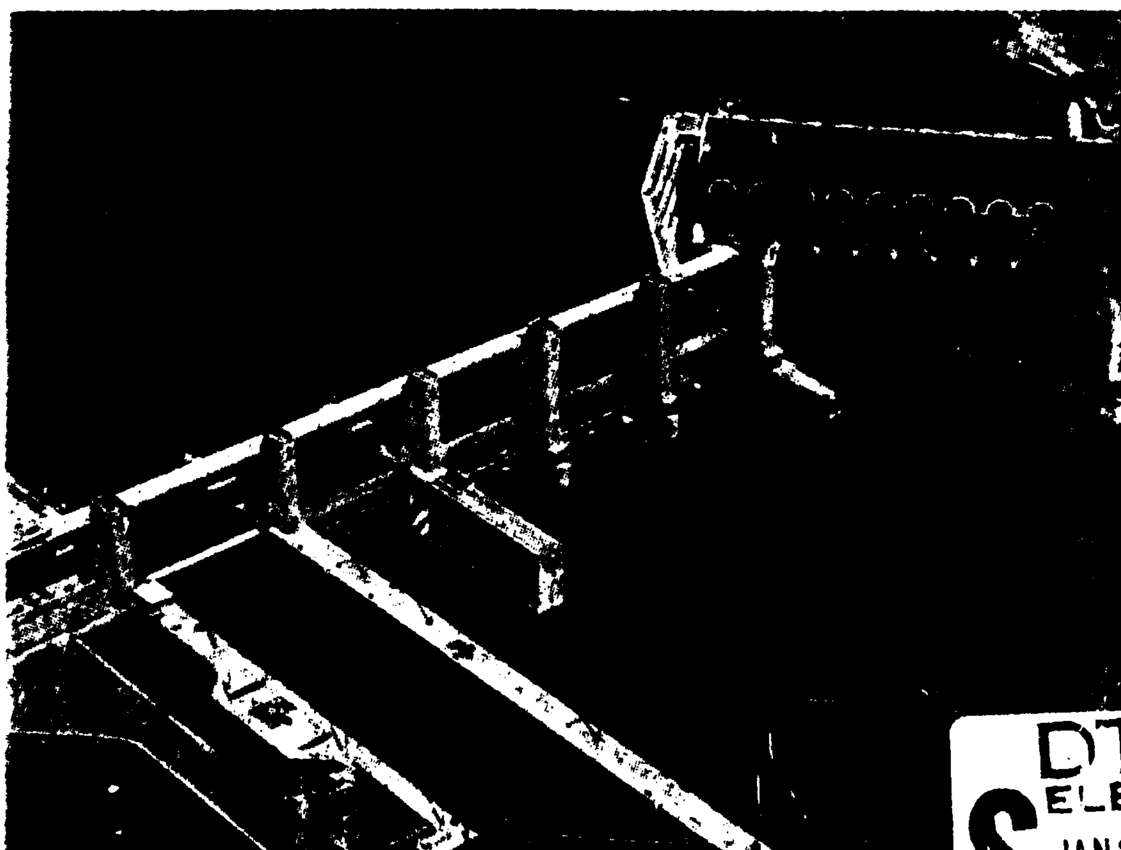
MISSISSIPPI RIVER LOCKS AND DAMS

# HISTORICAL RESOURCES EVALUATION



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HISTORY

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)


The Mississippi River has been of extreme importance to the Upper Middle West as a source of power and a transportational artery. By the 1920's, the Middle West was confronted with a transportational crisis due to rising railroad rates and the inadequacy of the 6-foot navigational channel on the Mississippi River. Political pressure eventually resulted in a nine-foot channel and a series of locks and dams along the Upper Mississippi River.

The locks and dams are good historical examples of the need the Upper Middle


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West felt for waterway improvement in the early twentieth century. Their rapid completion reflects the public works associated with the New Deal and Keynesian economics of Franklin D. Roosevelt. The historical and architectural import of the lock and dam system has led to the recommendation that a thematic nomination to the National Register of Historic Sites should be made for Lock and Dam Nos. 3-10. The Lower Hydro Station of St. Anthony Falls is also historical and technologically significant.

# HISTORICAL RESOURCES EVALUATION
# ST. PAUL DISTRICT LOCKS AND DAMS ON THE MISSISSIPPI RIVER AND TWO STRUCTURES AT ST. ANTHONY FALLS

Locks and Dams in Minnesota, Wisconsin, and Northern Iowa

Jon Gjerde
for the St. Paul District, Corps of Engineers

Contract Number NCSPD-ER-R-45

September 15, 1983

## 1. ABSTRACT

The Mississippi River has been of extreme importance to the upper Middle West throughout its history. Both as a source of power and as a transportational artery, the river has played a central role in determining human settlement in the region. Although the railroad came to predominate in the later nineteenth century, the river remained important. It allowed a transportational outlet for such goods as timber and, more importantly, it provided a rationale for the Interstate Commerce Commission to set rates on a lower basis than if no river commerce had existed. Despite the railroad's triumph, however, it began to face difficulty providing the needed transfer of goods by the early twentieth century. Moreover, transportational improvements such as the Panama Canal benefitted the coasts so that while rates declined in other areas, railroad rates became higher in the landlocked Middle West. By the 1920s, major metropolitan areas such as Minneapolis had lost their favored rate structure as the city was converted to a "dry-land" basis.

Clearly, the Middle West was facing a transportational crisis and politicians were adamant in their beliefs that waterway improvement should be increased. The six-foot channel project clearly was not making satisfactory progress in improving the Mississippi River or in encouraging private concerns to initiate carrier service on the river. The political pressure eventually resulted in a nine-foot channel project which included a series of locks and dams along the course of the upper Mississippi River. This project reflected the attitudes of the Progressive movement in that each lock and dam complex would be built on a standard framework with uniform lock sizes and a combination of standard Tainter and roller gates in the movable gate section. Moreover, hydraulic studies were made of the entire river to create the best possible design for each lock and dam in relation to other uses of the river. Through its comprehensiveness, the project was to be less expensive than earlier projects such as the Ohio River system while being more efficient at the same time. Moreover, the argument was consistently made that such a comprehensive system would benefit the entire nation. By improving the transportational infrastructure, commerce would be improved thereby benefitting all constituent parts.

The locks and dams on the upper Mississippi thus are good historical examples of the need the upper Middle West felt for waterway improvement in the early twentieth century, and the systematic notions of the Progressive impulse. Moreover, their rapid completion reflects the public works associated with the New Deal and Keynesian economics of Franklin D. Roosevelt. The lock and dam structures reflect these concerns as well. Each is an unique configuration of Tainter and roller gates which were designed for the peculiar characteristics of the upper Mississippi River. Thus, although each structure is unique, the component parts are similar. The historical and architectural import of the lock and dam system has led this study to recommend that a thematic nomination to the National Register of Historic Sites should be made for Lock and Dam Nos.



tation of the timber down the Mississippi river. In spite of its det il, however, this work is not as helpful as Fries' book

3 through 10.

The Lower Hydro Station of St. Anthony Falls is also historically and technologically significant. Built by the Pillsbury-Washburn Flour Milling Company beginning in 1895, the structure resulted in further utilization of the Falls and historic litigation concerning their use. Moreover, the engineering of the system which included transmitting the power to the Twin Cities Rapid Transit Company was significant since the power was transferred underground at a very high pressure.

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## 2. INTRODUCTION

This project has been sponsored by the St. Paul district of the United States Army Corps of Engineers as a planning tool to facilitate its obligations to preserve and project the cultural heritage. More specifically, thirteen locks and dams have been investigated in order to determine their historical value. Since seven of these lock and dam complexes are currently under evaluation for hydropower conversion, historic preservation officers of Minnesota, Wisconsin and Iowa have expressed their interest in seeing the thirteen lock and dam structures be considered for a thematic group format submission to the National Register of Historic Places. Moreover, the contract was modified to include study of the Lower Dam Hydro Station and Wasteway No. 2, both of which are located in St. Anthony Falls Historic district and may be utilized for hydropower development. The location of this study area is a large one covering a stretch of approximately 239 river miles along the upper Mississippi upon which the locks and dams are located. The specific specifications of tbe contracts are contained in the scope of work found in the Appendix.

The contractor has been Jon Gjerde, who worked approximately fifty-nine person-days on the project. Work began on October 1, 1982, with records search and field work. The composition of the report began on December 8, and was continued while further research was carried on. On December 30, 1982, the contract was amended to include the St. Anthony structures so records search and field work began anew. The report was completed on February 25, 1983, and was submitted to the St. Paul district on March 1, 1983. The records are currently in the hands of the contractor.

## 3. THEORETICAL AND METHODOLOGICAL OVERVIEW

This study, which has been undertaken for the St. Paul district of the Army Corps of Engineers, attempts to determine the historic and architectural uniqueness of the major structures built to improve the waterways of the upper Middle West. Many studies in the history of technology unduly emphasize the machines or the structures themselves rather than the social and economic background to such improvement. The authors of such studies, called "internalists," feel the machine is the thing rather than the background which led to its development. This contract, fortunately, has been stated so that the history of water improvement, in addition to the improvements themselves, should be analyzed. Such analysis provides a broader view of the importance of the locks and dams of the upper Mississippi River. As the report will argue, the structures were unique architectural and engineering achievements, but they were only approved and constructed due to an intricate historical development of waterway improvement needs and a comprehensive plan for river development. This report will closely analyze these lines of development which ended in the lock and dam system of the 1930s. The same can be said about the lower falls hydrostation and spillway No. 2. While they were heralded as one of a kind developments, the historical background for that development is stressed--some might say overstressed--in the text.

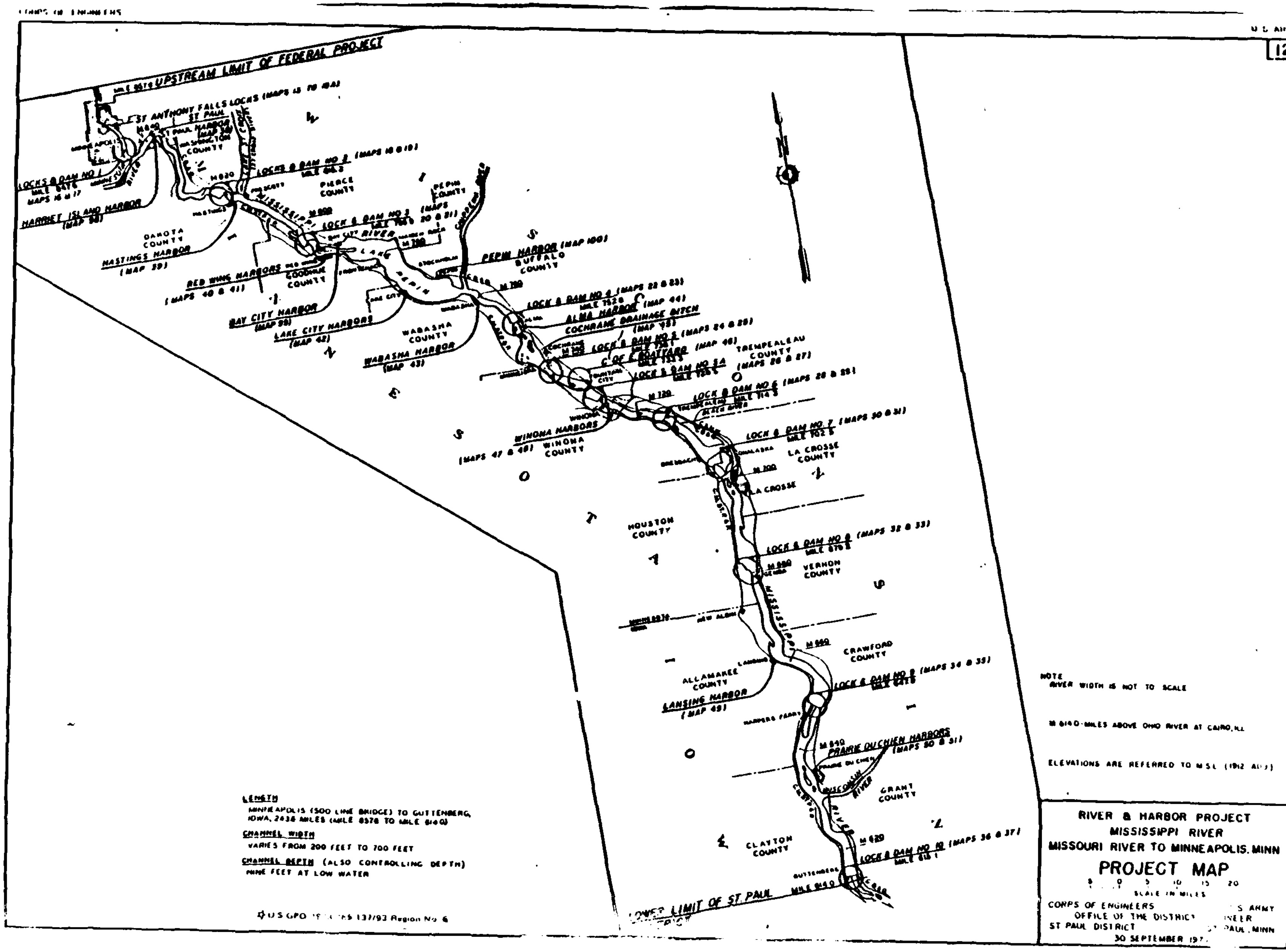
## 4. RESEARCH METHODS

Research has therefore been based in both historical agencies as well as in field work. Study at historical societies, major libraries, and archives at places such as the St. Paul district of the Army Corps of Engineers has attempted to utilize unpublished papers, government reports, river improvement congress proceedings, as well as secondary and primary literature. This study has thus ended in a report which emphasizes the historical development. Since the report did not merit it, quantitative research has not been undertaken. Interdisciplinary study using economics and the study of history of technology as well as traditional historical research, however, has been emphasized. Moreover, prominent economic historians and historians of technology have been consulted. It is felt that this has resulted in the best possible utilization of time constraints by the researcher.

## 5. RECORDS AND SOURCES REVIEW

When studying waterway improvement, we must not only examine the improvement itself but the economic, political and social background behind it. Obviously, no improvement of the upper Mississippi River would have occurred had the political and civic leaders not perceived its need and pressured the government to undertake it. The many decisions beginning over half a century that culminated in the nine-foot channel and the lock and dam system on the upper Mississippi provides a good example of political pressure. Accordingly, this study examines the process of river improvement that progressively involved greater federal input and expenses <u>and</u> the social and economic reasons for that improvement and the political pressure applied by groups that a vested interest in the improvement. Moreover, the sources that are examined not only view the changing engineering, the different methods of waterway improvement, and varied inputs of the United States Army Corps of Engineers, but the other side to upper Mississippi River improvement--the political decisions and arguments behind it.

Primary source material, which was rich both in terms of the engineering and political decisions, can be divided into six groups. First, government reports, which included the Army Corps annual reports as well as legislative reports and documents, provided a strong basis to understand the government decisions in regard to waterway improvement. The document that explored the feasibility of the nine-foot channel, for example, detailed the lock and dam system as it was proposed including an indication of the systems' structure as well as the economic and political reasons for the development. Second, groups such as the National River and Harbor Congress published their convention proceedings while the railroad interests, usually


CORPS OF ENGINEERS
U.S. ARMY
12
UPSTREAM LIMIT OF FEDERAL PROJECT
ST ANTHONY FALLS LOCKS (MAPS 13 TO 18A)
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LOWER LIMIT OF ST PAUL
M I N N E S O T A
W I S C O N S I N
I O W A
NOTE
RIVER WIDTH IS NOT TO SCALE
M 614.0-MILES ABOVE OHIO RIVER AT CAIRO, ILL
ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ)
LENGTH
MINNEAPOLIS (500 LINE BRIDGE) TO GUTTENBERG, IOWA, 243.6 MILES (MILE 857.6 TO MILE 614.0)
CHANNEL WIDTH
VARIES FROM 200 FEET TO 700 FEET
CHANNEL DEPTH (ALSO CONTROLLING DEPTH)
NINE FEET AT LOW WATER
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN
PROJECT MAP
SCALE IN MILES
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT
ST PAUL DISTRICT
30 SEPTEMBER

opposed to waterway improvement, countered with their's. This primary source provides good contemporary accounts of the arguments for or against waterway improvement from the turn of the twentieth century onward. Likewise, improvement advocates from state and local government and civic organizations published broadsides and journals which set down their rationale for the need of waterway improvement in their area. Since the Twin Cities were the largest metropolitan area on the upper Mississippi by the twentieth century, in addition to being situated between the most difficult stretch of the river, they were more than quite vocal proponents for waterway improvement. Fifth, civic journals such as The Commercial West or The Upper Mississippi River Bulletin provide an interesting indicator to the concerns of business in the upper Middle West and, more particularly, the Twin Cities. Moreover, memorials sent by state legislatures, most often by the State of Minnesota, constitute the state counterpart to civic advocates. Finally, contemporary journals give a more balanced treatment to the debates over waterway improvement. These essays, which often deal with the social and economic impact of waterway improvement, were found in such diverse magazines as Fortune and World's Work. Moreover, these journals included engineering publications such as Engineering and Contracting or the Minnesota Engineer, which highlight waterway improvement in technical articles on various projects.

Secondary source material is rich in some areas, but neraly nonexistent in others. Many works detail the history of development of the upper Middle West either in state or local histories. Likewise, the transportation networks that developed in the upper Middle West are chronicled, but interest is heavily weighted toward the earlier periods when the railroad was developing and the river steamboats were king. Some work has been done on upper Mississippi River improvement, much of it commissioned by the Army Corps of Engineers, but syncretic works analyzing the developments over the long term are clearly deficient.

The literature on the subject of upper Mississippi River improvement focusing on the approval of the nine-foot channel, therefore, is very uneven. While there exists a wealth of primary sources on the twentieth-century waterway improvement and its advocates, secondary works are rare. Likewise, the resarch on the river that has been undertaken is heavily weighted toward the early, more romantic days of steamboating. Clearly, however, this should not be the case. Certainly the steamboat was important in the early development of the upper Middle West, but its role was quickly overtaken by the railroads. While the large tows and barges of the later era do not inspire the romance of the steamboat, they are more important to the economic development of the Middle West.

Two issues which are analyzed in this report, however, should prick the interest of the historical community, and not only are they important, but very little research has been conducted on them. First, waterway improvement, as it was advocated by many civic and political leaders in the early twentieth century, is a good illustration of the Progressive impulse. The waterways were to be utilized as resources already extant that had been neglected due to unfair competition. By improving the waterways, so the argument went, the transportational infrastructure would be improved for the benefit of not just a particular region, but for the entire country. Moreover, the improvement, which culminated in the lock and dam system, was to be a comprehensive plan, not a group of stop-gap measures that degenerated into pork-barrel public works. The lines of development of such an ideology were seen early in the Whig interpretation of public works and in Republican notions expressed in political careers such as that of William Windom, who led the first large-scale examination of the waterways. But it only came to full fruition during the Progressive Era and afterwards when the need for upper Middle West waterway improvements became more acute.

Second, although the Progressive argument stated that the improved transportational infrastructure would benefit the whole nation, clearly certain regions were to gain more. The Middle West was the primary beneficiary of the improved Mississippi River and, according to political leaders from the region, it came none too soon. The Middle West, as the argument went, was suffering from a disadvantageous trade situation due to its geographical situation, but also from government neglect. Only through waterway improvement could the railroad monopoly be broken, rates be lowered, and the Middle West maintain its commercial position in the nation. This regionalism was long lasting. It was evident in sources in this study as early as 1843, but it became more pervasive as the Panama Canal aided the coasts and the railroad rates further set the interior apart from the east and the west. Moreover, it is only through an understanding of this situation that one can understand the increasing pressure that led the government to improve the Mississippi River through a slackwater navigational system that many engineers at the time considered economically unfeasible.

Possibly because the Lower Dam Hydrostation and Wasteway No. 2 at St. Anthony Falls in Minneapolis are much narrower subjects, the quality and quantity of the primary and secondary source material was reversed from that of the waterway improvement of the upper Middle West. On the one hand, a definitive study has been undertaken on water power development in and around St. Anthony Falls. Lucille Kane's The Waterfall That Built a City. The Falls of St. Anthony in Minneapolis (St. Paul, 1966) is a comprehensive work on the vicinity around the Falls analyzing the use of the Falls from Indian settlement through the development of water power upon which the city was built. Few studies could approach the subject with such thoroughness and incisiveness. On the other hand, the power station at the lower falls of St. Anthony was a private development. No government reports are therefore available studying its feasibility or need. Moreover, since it was built by private interests, the organizations that were so prevalent promoting water improvement did not exist and neither did their proceedings. The primary source material, therefore, primarily consists of newspaper accounts and what material could be found in technical journals on the construction of the dam, power station and sluiceway. While these primary materials are adequate to chronicle the development that took place near St. Anthony, that development has been ably treated by Kane.

## General Works: Upper Middle West

Blegen, Theodore C. Minnesota: A History of the State. Minneapolis: University of Minnesota Press, 1963.

The best comprehensive history of Minnesota. Covering the breadth of the history of Minnesota, Blegen considers activities on the Mississippi River including exploration, steamboat traffic, and tourism. The impetus to create a nine-foot channel on the upper Mississippi is briefly sketched.

Federal Writers' Project. Iowa, A Guide to the Hawkeye State. New York: The Viking Press, 1938.

A history of Iowa written under the auspices of the Federal Writers' Project during the Great Depression. The volume provides an overview of development of Iowa with brief consideration of the Mississippi River as an important transportation artery.

Havighurst, Walter. Upper Mississippi, A Wilderness Saga. New York: Farrar and Rinehart, 1937.

Port the Rivers of America series, this volume examines the settlement around the upper Mississippi River including its farms and timber camps. Very little emphasis, however, is placed on the river itself and even less still on river transportation and improvement. Curiously, there is a heavy stress placed on the Scandinavian settlements in the region.

Hosmer, James K. A Short History of the Mississippi Valley. Boston: Houghton, Mifflin and Company, 1901.

An old-fashioned history of the Mississippi Valley unusually weighted in emphasis to prehistoric, pre-Indian/European contact, and pre-European settlement. The Civil War, of course, is stressed as is the coming of the railroad.

Nesbit, obert C. Wisconsin: A History. Madison: University of Wisconsin Press, 1973.

A general survey of Wisconsin's history. Nesbit is very comprehensive in covering Wisconsin's past and does touch on the importance of the river trade for transportation of lead, timber and grain. While he notes the presence of a railroad-waterway competition, Nesbit does not extensively examine it.

Works Project Administration. Wisconsin, A Guide to the Badger State. New York: Duell, Sloan and Pearce, 1941.

One of the series of state histories undertaken by the Works Projects Administration during the Great Depression.

Although this volume is not one of the better histories in the series, it does contain brief references to Mississippi River traffic and its possible revival due to the nine-foot channel.

## Economic Factors in the Development of the Upper Middle West

Belthuis, Tyde C. "The Lumber Industry in Eastern Iowa." The Iowa Journal of History and Politics, 46.2 (April 1948): 115-155.

An overview of Iowa's lumber industry spanning the period of initial settlement when it was realized that wood was needed up to the present. This comprehensive description, then, covers the rise and fall of the timber interests. It devotes major sections not only to Iowa-cut timber, but that floated down the Mississippi River from Wisconsin and Minnesota.

Blakeley, Russell. "History of the Discovery of the Mississippi River and the Advent of Commerce in Minnesota." Collections of the Minnesota Historical Society (St. Paul: Minnesota Historical Society, 1898), 8: 303-418.

A long description of the early exploration of the Mississippi River by Europeans leading up to the steamboat era. At that point, Blakeley gives a year-by-year account of steamboating heavily weighted toward particular steamboats and their journeys. Not particularly useful except in this particularlistic context.

Clark, John G. The Grain Trade in the Old Northwest. Urbana: University of Illinois Press, 1966.

A general history of the grain trade in Wisconsin, Illinois, Ohio, Indiana, and Michigan up to the Civl War. Clark emphasizes the river trade and coming of the railroad which altered the grain movement, but since he is concerned mainly with the Old Northwest, grain shipments on the Ohio, Illinois and lower Mississippi Rivers are stressed while upper Mississippi traffic is not analyzed at length.

Ernst, Dorothy J. "Wheat Speculation in the Civil War Era: Daniel Wells and the Grain Trade." Wisconsin Magazine of History, 42.2 (Winter 1963-64): 125-135.

Concentrates largely on the fortunes of one Daniel Wells who attempted to exploit the wheat crops between 1860 and 1862. Ernst touches, however, on the methods of marketing wheat and the transportation routes utilized by Minnesota famers before a railroad reached the state in 1862, the Mississippi traffic in particular.

Fries, Robert F. "The founding of the Lumber Industry in Wisconsin." Wisconsin Magazine of History, 26.1 (September 1942): 23-35.

Fries focuses on the beginnings of lumbering in Wisconsin, stressing both abundant wood supplies and the river systems which provided transportation and power for milling. Since only earliest stages of the lumber industry is considered, however, the essay does not examine the marketing or transportation of lumber at length.

Fries, Robert F. Empire in Pine. The Story of Lumbering in Wisconsin 1830-1900. Madison: The State Historical Society of Wisconsin, 1951.

A very good account of the lumbering industry in Wisconsin during the nineteenth century. Fries examines the development of the lumber industry, the conflict between local lumbermen and out-of-state interests, problems in soil conservation, and the like. Most important for this study, however, he considers the transportation questions with unusual clarity --the steamboat-lumber trade conflicts, the competition between the railroads and waterways for the lumber trade, and general technical explorations of rafts, sloughs and the like.

Gilman, Rhoda R. "Last Days of the Upper Mississippi Fur Trade." Minnesota History, 42.4 (Winter 1970): 122-140.

Examines the fur trade industry primarily in Minnesota and argues that the fur trade did not necessarily die between 1836 and 1870, but its character changed. Whereas early fur trappers were Indians dealing with white traders, the later stages saw pioneer farmers as the primary trappers. Gilman emphasizes famous personages in the trade that provided an important Mississippi River cargo without considering the steamboat traffic per se.

Gilman, Rhoda R. "The Fur Trade in the Upper Mississippi Valley, 1630-1850." Wisconsin Magazine of History, 58.1 (Autumn 1974): 2-18.

A very descriptive account of the fur trade in the upper Mississippi Valley beginning with initial European-Indian trade contact. Although Gilman examines the nineteenth century fur trade, the transportation of furs on the Mississippi is not considered. The article, therefore, provides a description of a resource that was transported on the Mississippi more than an analysis of Mississippi travel itself.

Haefner, Marie. "Rivalry Among the River Towns." The Palinopseat, 18.5 (May 1937): 160-174.

Considers the rivalry that developed on the Mississippi River towns of Keokuk, Burlington, Davenport, Muscatine, and Dubuque. Giving many examples of town boosting, Haefner examines the periods of industrial development, river traffic and the coming of the railroad focusing on the era before the panic of 1857. After that time, she argues the town rivalry was passing as the interests of the state took precedence over local claims.

Hartman, George B. "The Iowa Sawmill Industry." The Iowa Journal of History and Politics, 40.1 (January 1942): 52-93.

Another overview of Iowa's timber industry from its beginning to the present. The log rafting down the Mississippi is considered as well as the political and legal conflict between Wisconsin timber interests and those who wanted to ship timber down the river to sawmills. More quantitative than Belthuis' article, this piece provides a better overall description of Iowa and its sawmills.

Hartsough, Mildred. "Transportation as a Factor in the Development of the Twin Cities." Minnesota History, 7.3 (September 1926): 218-232.

A concise examination of the important transportational factors that facilitated or hindered urban development in Minnesota. Focusing on the Twin Cities, Hartsough describes the role of transportation beginning with the establishment of Fort Snelling through the Interstate Commerce Commission decisions in the early twentieth century that affected the trade routes of the state. In-between, she considers the Mississippi River and the eventual rise of the railroad.

Jarchow, Merrill E. "'King Wheat.'" Minnesota History, 29.1 (March 1948): 1-28.

A good synopsis of one of the most significant cargoes of the Mississippi River in the late nineteenth century. While Jarchow concentrates on the rise and fall of wheat as a primary grain, he touches on the shipping via steamboats and the competition supplied by the developing railroad networks.

Kane, Lucille M. The Waterfall That Built a City. The Falls of St. Anthony in Minneapolis. St. Paul: Minnesota Historical Society, 1966.

A very good treatment of a rather narrow, albeit important, subject. Using the Falls of St. Anthony as the focus, Kane exmines the growth of Minneapolis that was tied to the Falls. Beginning with European-Indian contact in relation to the Falls, the book follows the development of milling and hydroelectricity. Important for this project is the description of the planning and construction of the local locks and dams--the Meeker Island project, the High Dam (Lock and Dam No. 1), and the St. Anthony Falls lock and dam projects.

Kleven, Bernhardt J. "The Mississippi River Logging Company." Minnesota History, 27.3 (September 1946): 190-202.

Describes the Mississippi River Logging Company placing particular emphasis on the Beef Slough, where a boom was operated from 1870 until 1904. Considers the rivalries between downriver sawmills and businessmen nearer the source of the logs who wished to mill the lumber.

Larson, Agnes . History of the White Pine Industry in Minnesota. Minneapolis: University of Minnesota Press, 1949.

A very detailed history of the lumber industry in Minnesota. Three chapters alone consider in length the transpor-

tation of the timber down the Mississippi river. In spite of its detail, however, this work is not as helpful as Fries' book on Wisconsin lumbering, for example. Larson describes colorful personalities and interesting events, but important issues such as the steamboat-lumber raft conflicts, the changing methods of floating the logs down the river, and the legal constraints on the use of the waterways by timbermen are given short shrift.

Loehr, Rodney. "Caleb D. Dorr and the Early Minnesota Lumber Industry." Minnesota History, 24.2 (June 1943): 125-141.

Describes the career of Caleb D. Dorr in relation to lumbering and milling on the upper Mississippi. After moving to Minnesota in 1847, and building a dam and a boom near St. Anthony Falls, he served a superintendent of booms from 1866 to 1882 and from 1885 to 1888 for the Mississippi and Rum River Boom Company. The article is narrowly defined, but does mention Dorr's interets in steamboating above St. Anthony Falls.

Meyer, Marie E. "River Towns." The Palimpseat, 7.12 (December 1926): 381-389.

A short essay on the river towns of Iowa, distinct places in Iowa history that Meyer argues have been overlooked. Having grown up in an Iowa river town, Meyer explains life on the Mississippi and in the river towns, and notes that the river towns now are often sleepy villages when before they were bustling towns due to the great river traffic.

Petersen, William J. "Population Advance to the Upper Mississippi Valley, 1830-1860." The Iowa Journal of History and Politics, 32.4 (October 1934): 312-353.

A survey of population growth of the upper Mississippi Valley emphasizing the speed in which the area was settled between 1830 and 1860. Petersen views transportation routes, transportation means, and the nativity of American- and foreign-born immigrants in his long narrative in addition to available census materials.

Raney, William F. "Pine Lumbering in Wisconsin." Wisconsin Magazine of History, 19.1 (September 1935): 71-90.

Describes the Wisconsin pine industry by examining the different river systems upon which the industry was based. The stream systems flowing into the Mississippi discussed include the Wisconsin, Chippewa, Black and St. Croix Rivers. Raney also examines the methods of cutting and marketing the pine and considers transportation on Wisconsin's river systems to the mills.

Sanford, Albert H. "The Beginning of a Great Industry at LaCrosse." Wisconsin Magazine of History, 18.4 (June 1935): 375-388.

A clumbsily written account of Charles Lane Colman and his shingle factory in LaCrosse, which eventually became Colman Lumber Company. Detailing only the years 1854-1858, Sanford does not examine the river trade, but he does provide an example of business based on the lumber industry and capability of transporting lumber on the river to LaCrosse.

Twining, Charles E. Downriver: Orrin H. Ingram and the Empire Lumber Company. Madison: The State Historical Society of Wisconsin, 1975.

A narrow account of Orrin H. Ingram and his Empire Lumber Company of Eau Claire, Wisconsin. Ingram, one of the earliest of Eau Claire's lumbermen, was a leader in the initial attempts by Wisconsin lumbermen to prohibit non-resident owners such as Frederick Weyerhaeuser from entering the Wisconsin trade. The Mississippi River transportation of lumber is, of course, part of Twining's story. Some wonderful photographs of lumber transportation on the Mississippi accompany the text.

Vinette, Bruno. "Early Lumbering on the Chippewa." Wisconsin Magazine of History, 9.4 (1926): 442-447.

Actually written by William W. Bartlett, who interviewed Vinette and wrote the reminiscences as if Vinette had himself written them. Vinette, an early logger, discusses his arrival in Wisconsin and his work in the logging camps.

Wilgus, James A. "The Century Old Lead Region in Early Wisconsin History." Wisconsin Magazine of History, 10.4 (1927): 401-416.

A short descriptive history of the lead mining region in southwestern Wisconsin beginning with initial European discovery of the lead deposits through the 1840s. While examining the region, little attention is paid to the transportation routes used to market the lead.

## Transportation in the Upper Middle West

### Primary Sources:

Blair, Walter A. A Raft Pilot's Log. A History of the Great Rafting Industry on the Upper Mississippi, 1840-1915. Cleveland: The Arthur H. Clark Co., 1930.

A helpful history of the rafting industry on the upper Mississippi by a former raft pilot. Typical of this genre, the volume is extremely descriptive and anecdotal; all river boats and raft pilots are listed. But Blair does provide his views on river improvement such as wing dams and he does attempt to determine the amount and value of the lumber taken down the river.

Merrick, George Byron. Old Times on the Upper Mississippi. The Recollections of a Steamboat Pilot From 1854 to 1863. Cleveland: The Arthur H. Clark Co., 1909.

Part autobiography, part history, Merrick's work provides a background of steamboating on the upper Mississippi. Although the book is full of anecdotes, Merrick does provide an interesting argument against river improvement stating that the steamboat on the river cannot compete successfully against the railroad with or without government work.

Russell, Charles Edward. A-Rafting on the Mississippi. New York: The Century Co., 1928.
Another descriptive history of rafting on the Mississippi. Stories are told of the logging and the marketing of timber or of rafts in a storm and others treating bridges. The book is quite anecdotal with lively reading as its intent, but it is not very useful for the study of river improvement or of understanding the transportation of lumber down the river for that matter.

Sargent, Fred W. "Railroad Versus Waterways Transportation." Commercial West (June 12, 1926): 20-21.
Written by the president of the Northwestern and Omaha Railways, this article argues that railways remain more efficient than waterways in transportation. Sargent takes the three most common arguments for waterway improvement--that railroads are overburdened, that waterways will regulate rail rates, and that water transportation is cheaper--and attempts to show that they are fallacious.

Sumner, John D. "An Anlysis of Mississippi river Traffic: 1918-1930." The Journal of Land and Public Utility Economies, (November 1931): 355-366.
An examination of the volume and nature of the Mississippi River freight traffic between 1918 and 1930. Major findings show a phenomenonal growth between 1918 and 1928 with a diminished growth in 1929 and 1930, and, contrary to general supposition, a river traffic not confined to low-value, bulky raw materials. First of two parts.

Sumner, John D. "II. An Analysis of Mississippi River Traffic: 1918-1930." The Journal of Land and Public Utility Economies, (February 1932): 11-23.
Second part of an analysis of Mississippi River traffic which concentrates on the lower Mississippi River and freight carried by the Federal Barge Line. Contrary to most assumptions, Sumner finds that the type of cargo and its value carried on the Mississippi is of equal or greater value to that carried by freight trains.

Turner, Captain J. M. "Rafting on the Mississippi." Wisconsin Magazine of History, 23.2 (December 1939): 163-176; 23.3 (March 1940): 313-327; 23.4 (June 1940): 430-438; and 24.1 (September 1940): 56-65.
A four-part account by Turner of his fifty years on the Mississippi in various jobs. According to the editors, Turner's memory is not clear, but he does provide illustrations of his colorful Mississippi River life.

Secondary Sources:

Appleton, John B. "The Declining Significance of the Mississippi as a Commercial Highway in the Middle of the

Nineteenth Century." Geographical Society of Philadelphia Bulletin, 28 (January-October 1930): 267-274.
Argues that the Mississippi River route in the mid-nineteenth century offered many disadvantages such as a short shipping season due to freezing, uncertain shipping conditions due to low water, capital loss due to spoilage in the South, and a less enviable port in New Orleans than New York and Boston. When the east-west route became available, it was utilized because of the lack of disadvantages it offered and the directness of the flow of goods.

Blegen, Theodore C. "The 'Fashionable Tour' on the Upper Mississippi." Minnesota History, 20.4 (December 1939): 377-396.
Provides a vivid description of the beginning of Minnesota tourism through the Fashionable Tour, steamboat trips that terminated in what became the Twin Cities. Tracing the tour from its beginnings with Beltrami and Catlin, Blegen explains its popularity with a series of descriptive quotations. While he ably considers the height of the travel, however, Blegen gives short shrift to its decline.

Flanagan, John T. "Mark Twain on the Upper Mississippi." Minnesota History, 17.4 (December 1936): 369-384.
A romantic account of Mark Twain's three visits to Minnesota, the Twin Cities, and the upper Mississippi River. Describing his assertion of the Mississippi in 1882 (which resulted in Life on the Mississippi), his descent in 1886, and visit in 1895 as a platform entertainer, the article stresses the scenery without considering other basic issues such as steamboating.

Fries, Robert F. "The Mississippi River Logging Company and the Struggle for the Free Navigation of Logs, 1865-1900." Mississippi Valley Historical Review, 35.3 (December 1948): 429-448.
Describes the many cases of litigation involving the rafting of lumber down the Mississippi River from Wisconsin. The prolonged conflict, in essence, was between operators who drove logs down the river to mills in Illinois, Iowa and Missouri, and the lumbermen who had established mills near the wood source on the Chippewa River. According to Fries, the conflict attained great importance because it involved the Mississippi River Logging Company, a large logging firm.

Haefner, Marie. "Argonauts of the Mississippi." The Palimpseat, 13.12 (December 1932): 473-486.
Describes one advantage of a declining steamboat industry and river traffic: the development of the button-making industry from Mississippi River clamshells.

Hirschheimer, H. J. "LaCrosse River History and the Davidsons." Wisconsin Magazine of History, 28.3 (March 1945): 263-276.
Describes the rise of the Davidson brothers in LaCrosse

attempting to "somewhat soften the harsh portrait" of William F. Davidson found in other works especially in regard to his price wars on the upper Mississippi.

Meyer, Marie E. "Rafting on the Mississippi." The Palimpseat, 8.4 (April 1927): 121-131.

Describes the rise and decline of log rafting on the upper Mississippi. Meyer notes the beginning of the log raft, the transition to the raftboat period, and the importance of timber to the Iowa river town economies. In addition to outlining the log rafting developments, she attempts to flesh out the lives of the men on the rafts.

Petersen, William J. "Captains and Cargoes of Early Upper Mississippi Steamboats." Wisconsin Magazine of History, 13.3 (March 1930): 224-240.

Views the great captains--Daniel Smith Harris, William F. Davidson, Diamond Jo Reynolds and so on--and the periods of steamboating according to cargo. Although Petersen mentions four periods--the lead period, the immigration period, the grain period and the period of decline--he only examines the first two.

Petersen, William J. "Indians and the Steamboats on the Upper Mississippi." The Iowa Journal of History and Politics, 30.2 (April 1932): 155-181.

A somewhat dull account of the relationship between Indians and the steamboat. Petersen describes the transportation of Indians on upper Mississippi steamboats, their fear of the steamboat after first contact with it, and other functions of steamboat traffic in Indian-white relations such as treaties and annuity.

Petersen, William J. "Steamboating in the Upper Mississippi Fur Trade." Minnesota History, 13.3 (September 1932): 221-242.

Considers the relationship between early steamboating and the fur trade. Petersen begins with the first fur trade related trip to Fort Snelling in 1825 and although he admits that the Mississippi traffic in furs was small compared to the lead trade or the government ships to the military and Indian frontiers, he argues that it was important since it offered a supplemental cargo.

Petersen, William J. "The Rock Island Railroad Excursion of 1854." Minnesota History, 15.4 (December 1934): 405-420.

Describes the joint railroad and steamboat excursion in 1854 to commemorate the completion of the first railroad to unite the Atlantic and the Mississippi River. With participants as prominent as Millard Fillmore, this event was probably the most important singular event popularizing the Fashionable Tour according to Petersen. While the author recounts at length the stops along the Mississippi and the revelry aboard the ships, he fails to note the irony of the coming of the railroad and the inevitable decline of the steamboat traffic because of it.

Petersen, William J. "A Century of River Traffic." The Palimpseat, 27.10 (October 1946): 289-300.
Examines one hundred years of river traffic on the Mississippi, Missouri and internal Iowa Rivers. Emphasizing the Mississippi in the article, Petersen outlines six stages of development in the century ending with the towboat period which began in 1937 with the inauguration of the Federal Barge Line Company on the upper Mississippi and proceeded as modern terminals ewre built and a nine-foot channel was secured. He stresses the renaissance of the river in the final period which actually resulted in much larger tonnages than during the steamboat era's heyday.

Petersen, William J. "Transportation by Land." The Palimpseat, 27.10 (October 1946): 301-316.
Departing from his usual theme of river traffic, Petersen examines transportation by land beginning with dirt roads, through the introduction and increasing use of the railroad and ending with motor traffic. The water traffic that competed against and complemented land transportation is not considered.

Petersen, William J. "The Mississippi River Through Many Eyes." The Iowa Journal of History and Politics, 46.4 (October 1948): 339-377.
Interesting documentation of different perceptions of the Mississippi River ranging from Indian beliefs to the prose of Mark Twain. Beginning with the writings and stories of the Indians and explorers, Petersen also describes the impressions by those on steamboats. The essay concludes with an imaginary trip up the Mississippi and the varying assertions about the cities on the Mississippi including New Orleans, Natchez, Vicksburg, Memphis and St. Louis. Unfortunately, the trip does not continue far into the upper Mississippi ending in the Iowa river towns.

Petersen, William J. "Rafting on the Mississippi: Prologue to Prosperity." Iowa Journal of History, 58.4 (October 1960): 289-320.
Describes the rating of lumber from the northern pineries to the Iowa sawmills. Emphasizes the importance of the timber traffic both in terms of the volume on the Mississippi River and on Iowa towns. While the article contains many stories of the raft period, it also attempts at times to quantitatively outline the importance of the trade.

Petersen, William J. Steamboating on the Upper Mississippi. Iowa City: State Historical Society of Iowa, 1968.
An overly long descriptive history of steamboats, steamboatmen and steamboating on the upper Mississippi. Beginning with an analysis of the origin of the name Lake Itasca, Petersen follows the history of the river through the steam-

boat era to around 1870. By emphasizing episodes and personalities, important issues such as the influence of the railroad or the developing transportation networks are neglected.

Petersen, William J. "Upper Mississippi Towboating." The Palimpseat, 53.9 (September 1972): 385-432.
A widespread group of articles highlighting both the rise of the upper Mississippi River traffic in the twentieth century and Petersen's own work on Mississippi River history. Most useful for the purposes of this study are the articles on the Federal Barge Line Company and its initiation of upper Mississippi River traffic in 1927 and an explication of the various goods--grain, coal, and molasses--shipped on the river today. Since this is a contemporary report on recent developments, it is valuable in the sense that it emphasizes the renewal of traffic on the Mississippi and its increasing volume greater than that of the steamboat era's heyday.

Peterson, Harold F. "Early Minnesota Railroads and the Quest for Settlers." Minnesota History, 13.1 (March 1932): 25-44.
Examines the steamboat's major competitor for passengers--the railroad--and their attempts in the 1860s and 1870s to encourage immigrtion through advertising and immigrant agents.

Quick, Herbert, and Edward Quick. Mississippi Steamboatin'. A History of Steamboating on the Mississippi and Its Tributaries. New York: Henry Holt and Co., 1926.
A broad history of the emergence and decline of the steamboat on the Mississippi River. The Quicks begin in the 1770s long before steamboats were in use and end with the demise of the boats in the face of railroad competition. Novel topics, such as a full chapter on river bandits, are considered as well as a separate chapter focusing on travel and trade on the upper Mississippi River.

Raney, William F. "The Building of Wisconsin Railroads." Wisconsin Magazine of History, 19.4 (June 1936): 387-403.
Provides a description of the rivers' major transportation rival--the railroads. Little time is spent on the river, however, as the major railroad companies and lines are examined.

Reynolds, A. R. "Rafting Down the Chippewa and the Mississippi: Daniel Shaw Lumber Company, A Type of Study." Wisconsin Magazine of History, 19.4 (December 1948): 143-152.
A short, concise, well-written aticle on the rafting of lumber down the Chippewa and Mississippi Rivers. Using the Shaw Lumber Company as a case study, Reynolds illustrates the stages of transportation down the rivers, the rise and fall of lumber rafting, and the costs of running lumber down the Mississippi.

Rice, Herbert W. "Early Rivalry Among Wisconsin Cities for

Railroads." Wisconsin Magazine of History, 35.1 (Autumn 1951): 10-15.

A short analysis of the rivalry among towns for railroads concentrating on the period before 1858 when railroads reached the Mississippi River. Rice examines at some length the attempts by Mississippi River towns such as Prairie du Chien, LaCrosse and Potosi, to attract the railroad and thus become a transfer point between the river and the rail.

Shippee, Lester. "Steamboating on the Upper Mississippi After the Civil War: A Mississippi Magnate." Mississippi Valley Historical Review, 6.4 (March 1920: 470-502.

In the Beardian tradition, Shippee castigates the steamboat owners, William F. Davidson in particular, for their ruthless business activities. He focuses on the anti-monopoly conventions in the Twin Cities in the 1860s organized to work against Davidson's control of the upper Mississippi traffic. Finally, he examines the coming of the railroad which put the steamboat trade out of business and concludes that the steamboat men erred in working with the railroads that would ultimately destory them.

Toole, Robert C. "Steamboat Pioneer. The Early Career of William F. Davidson." Minnesota History, 36.7 (September 1959): 250-258.

A descriptive account of William F. Davidson and his entrance into and success in upper Mississippi steamboat operations. Although the article at times sets Davidson in the expanding steamboat travel, it remains largely biographical focusing mainly on the 1850s.

## Waterway Improvement in the Upper Middle West

### Primary Sources:

Association of American Railroads. Report on Water Transportation on the Mississippi River System. : Association of American Railroads, 1945.

As can be guessed, this report argues that government improvement of river systems do not result so much in savings as in a transfer of costs from the water carriers to the taxpayers. Railroads, on the other hand, do not cause the public to bear such "hidden costs" and are at a disadvantage because of it. The report provides a short, not very helpful, synopsis of river improvement.

Beckjord, Walter C., Ralph M. Davie, and Lester H. Gadsby. "A Study of Proposed Water Power Development at U.S. Lock and Dam No. 1, Mississippi River Between St. Paul and Minneapolis." Ph.D. dissertation, University of Minnesota, 1909.

A technical report of a proposed lock and dam construction where Lock and Dam No. 1 now is built. The dissertation argues that one lock and dam is better than the project then underway to build two locks and dams between Minneapolis and St. Paul. Gives a good background of rivalry between Minneapolis and St. Pau which resulted in the two lock and dam project to begin with; proposed dam, spillway, powerhouse, water-wheel and steam auxiliary types, and provides photographs of the river south of Lake Street.

"Inland Waterways Threaten Already Dwindling Revenue of the Railways." *Commercial West* (January 26, 1929): 19.
Short article on the problems faced by railway companies. As the automobile captures a share of the railroad's passenger train clientele, the Inland Waterways Corporation is forcing railroads to lower their rates and lessen their revenues and profits. Based on a speech by Charles Donnelly, president of the Northern Pacific Railway Company, the articles notes that the I.W.C. barges are government-owned and operated yet are competing with private enterprise concerns.

"Thorpe Tells *Commercial West* Readers of New River Transportation Savings." *Commercial West* (August 27, 1927): 12-13.
An article which hails the arrival of the *S.S. Thorpe*, the first towboat operated by the Inland Waterways Corporation to travel to the Twin Cities after the reinauguration of river travel in 1927. Included a summary of savings to be secured by the cheaper water rates and an interview with S. S. Thorpe, head of the Minneapolis realty firm of Thorpe Bros., who was in charge of a commitee that encouraged river traffic to Minneapolis.

Committee on River Development of the Minneapolis Civic and Commerce Association. *River Navigation: Can the Mississippi River Be Made Useful to Minneapolis Shippers?* Minneapolis: Minneapolis Civic and Commerce Association, 1915.
This report, a group of short articles, outlines the benefit to be levied from water transportation improvement. Among other things, it argues that improvement will benefit Minneapolis and other cities, that it will mainly facilitate bulk freight trade, and that Minneapolis must develop an adequate terminal facility. An interesting "artist's conception" of the future terminal site near Minneapolis' Washington Avenue is included.

"Mississippi River Traffic into Minneapolis." *Construction Craftsman* (August 1963): 11-14.
A good description of the construction of the upper lock at St. Anthony Falls. This publication of the AFL-CIO concentrates on the work needed to complete the project and is profusely illustrated.

Cooley, L. E. "Remarks on the Improvement of the Upper Mississippi River." *Proceedings of the Upper Mississippi River Convention, Held at Quincy, Illinois, November 12-13, 1902.*

Quincy, Ill.: Volk, Jones and McMein Co., Printers, 1902.

Like most other river conventions in the early twentieth century, this is a speech of rier improvement boosterism. Cooley outlines his system of trunk waterways from the Gulf of St. Lawrence to the Great Lakes, the Illinois and Mississippi Rivers and discusses the advantages of the Keokuk dam. The speech is somewhat important, however, because while Cooley advocates the continuation of the six-foot channel plan, he argues for a slackwater navigation using locks and dams that would not only create a nine- to twelve-foot channel to Minneapolis but would also link Lake Superior with the Mississippi.

Decker, W. F. "River Navigation: A War Measure That Is Likely to Prove of Permanent Value." The American Review of Reviews, 57.2 (February 1918): 174-176.

Written during World War I, this article examines the recent use of the Mississippi River at the government's behest due to wartime emergencies. Since railways could not handle all freight shipment with adequate speed, goods were moved on the river. this utilization leads Decker to argue that the river remains a cheap and reliable transportation source especially given an adequate channel and terminals and that its utilization should continue, most preferably in conjunction with rail traffic.

Dimock, Marshall E. Developing America's Waterways: Administration of the Inland Waterway Corporation. Chicago: The University of Chicago Press, 1935.

Mainly examining the past and potential of the Inland Waterways Corporation, this book also considers channel improvement that will permit a fuller utilization of the waterways. The book, although written as a neutral study of I.W.C., was commissioned by the I.W.C. and aggressively advocates incresing the purview of the Corporation arguing that waterways are cheap methods of transportation that will help build up the Middle West.

Donaldson, Scott. "Upper Harbor Project Faces New Test." Minneapolis Star, June 5, 1957, p. 10D.

A very useful article that notes a new test faced by the Minneapolis Upper Harbor project in Congress. Local public works projects were facing scrutiny, the Upper Harbor among them, and arguments for and against the completion of the Upper Harbor were given. Most helpful are those arguments which give the pros and cons of the project by the interest groups.

Dunn, Samuel O. "The Proposed Development of Inland Waterways." Scribner's Magazine. 47.6 (June 1910): 750-758.

A concise argument against the proposed fourteen-foot channel in the Mississippi. Dunn notes that the three proposed benefits of an enlarged channel would be cheaper transportation, a regulated railroad rate, and additional transpor-

tational facilities. Yet he shows that the proposed $500 million public expenditure to create the deep channel would not provide for cheaper transportation if government costs were included. Moreover, he argues that railway rates are already so low that it would be difficult for rivermen to compete even with the new channel. Finally, since railroad freight is so cheap, Dunn believes that if additional transportational facilities are needed through government expenditures, it should be railroads, not river improvement, that receives the funding.

Durham, Charles W. "Reclamation and Conservation of the Alluvial Lands in the Upper Mississippi Valley, Now and Formerly Subject of Overflow." Engineering and Contracting, 37.1 (January 3, 1912): 21-24.

Written by the principal assistant U.S. Engineer for Upper Mississippi River Improvement, this essay examines in depth areas on the upper Mississippi subject to floods and describes levees built on the river to control overflow.

"Unique Construction Methods and Devices Employed at Lock and Dam No. 1, Mississippi River Improvement." Engineering and Contr!cting, 39.12 (March 19, 1913): 315-318.

Describes technically the unique construction methods used to modify Lock and Dam No. 1. since this lock and dam was partially complete when the plans were changed from a two lock and dam system to a single lock and dam system between Minneapolis and St. Paul, the structure had to be altered. Among the more unique features were the removal of a heavy concrete lock floor without disturbing its walls; the raising of concrete walls by filling between concrete slabs permanent forms; the use of concrete molds for casting concrete slabs; the combination of separately cast and molded in place concrete dam construction; and special mechanical devices for handling and placing concrete slabs and beams.

"New Mississippi Port for Minneapolis." Engineering News-Record, 147.11 (September 13, 1951): 37-39.

A brief, but very good acount of the rationale for the Upper Harbor and engineering of the St. Anthony Locks to create it. Good diagrams sketch the various cofferdam activities and the proposed structures. This article concentrates on the lower lock and dam.

"Solving a Tricky Dewatering Problem." Engineering News-Record, 147.15 (October 11, 1951): 39-43.

This article focuses on the difficult of unwatering cofferdam No. 1 in the lower lock and dam project at St. Anthony Falls. Because of porous sandstone underneath the base of the cofferdam, water continued to fill in the cofferdam. The driving of a steel sheet pile cut-off wall is described which corrected the problem.

"The Mississippi River Lock and Dam No. 1." Engineering Record, 65.3 (January 20, 1912): 60-61.

A technical article which explains the construction of the Mississippi River Lock and Dam No. 1 focusing on the changes that had to be made after the project specifications were altered. Without Lock and Dam No. 2 in the plan, the lock walls had to be made higher and the lock floor lowered. Moreover, another novel feature is the hollow dam with the decks made up of narrow reinforced concrete slabs.

Fishback, W. M., et al. Improvement of the Mississippi River. St. Louis: R. P. Studley and Co., 1893.

Speeches by W. M. Fishback, Governor of Arkansas, W. C. Stone, Governor of Missouri, and H. C. Haarstick, president of the St. Louis and Mississippi Valley Transportation Company before the Commercial Club of St. Louis. All three advocate water improvement and note that, in the long run, it would be cheaper than railroads, but little attention is given to the specifics of that improvement.

Flather, J. J. "The Mississippi River High Dam Project." The Minnesota Engineer, 21.1 (November 1912): 1-21.

A technical article which argues that since the federal government has modified its plans for improvement of the Mississippi south of Minneapolis to include a high dam suitable for power production, an investigation of the costs and benefits of that production should be made. By examining average flow, types of generator units available, auxiliary steam plant methods, and probable power demand, Flather argues that either the hydraulic plant must be increased in capacity and the steam plant operated over a longer period, or that the steam plant must be increased, or that some of the load must be cut off.

"Deeper Rivers: The Mid-West is Getting Them." Fortune, 4.10 (October 1931): 39-45, 133-144.

An excellent, contemporary account of the recent decisions to extend the Mississippi waterway system. Divided into four parts--pros and cons, the engineers, a telescoped history of waterway politics, and boats and barges from Fulton to the diesel--the article attempts to show the conflict between the waterway interets and the railroad. The political clout of the Mississippi Valley and sympathetic presidents, however, tipped the balance of power to those who advocated river improvement. Aimed at reporting the developments, the article is obviously written from a perspective that opposes channelization of the Mississippi.

Fossen, George, and M. R. Swedberg. "The Effect of the High Dam Upon the Sewers of Minneapolis and St. Paul" Ph.D. dissertation, University of Minnesota, 1911.

A technical study to determine if the High Dam south of Minneapolis will cause pollution of the Mississippi River to such an extent as to create a public nuisance. The damming of the river will create a pool behind the dam extending some six miles up the river. The problems that will be created will be mitigated by an improved outlet system which will secure greater

rapidity of sewage diffusion. Each outlet above the dam is discussed in turn.

Fullteron, Aubrey. "The Completing of the Mississippi." World Today, (May 1906): 494-498.

A short article which examines improvements on the upper Mississippi that "completes" the river. The reservoir system near the source is considered as are the two locks and dams being built between St. Paul and Minneapolis. Fullerton reiterates the argument that river improvement acts as a regulator of rail rates.

"Minneapolis Nearer Ocean Front." Greater Minneapolis, 4.4 January 1953): 23.

Short article describing the Upper Harbor project, its benefits, and its costs. Notes that the Upper Harbor is ideal because of its wide shoreline that is ideal for warehousing, docking facilities and railroad line.

"The Minneapolis Harbor." Greater Minneapolis, 12.8 (May 1961): 15-17ff.

A brief, but very detailed examination of the locks being built at St. Anthony Falls. Provides a description of the design and construction of each lock and is a valuable source. Good illustrations accompany the text.

Hess, Ralph H. "The Waterways and Commercial Evolution." The Annals of the American Academy of Political and Social Science, 49 (May 1915): 259-282.

An even-handed analysis of the costs and benefits of railroad versus waterway transportation and improvement while Hess notes that waterways lost out to the railroad due to obsolescence, inadequacy, and unfair railroad competition, he argues that a public expenditure to improve the waterways would be wise. Railroads have reached their summit of efficiency so that unit costs have been increasing since 1906. Moreover, trade is increasing putting more demands on railroad lines. If a well-conceived waterway improvement policy was conceived, the integration of railroad and waterway transportation would work to public good.

Hill, James J. "Highways of Progress." The Future of Our Waterways." World's Work, 19 (April 1910): 12779-12791.

Another appeal for waterway improvement by James J. Hill, the railroad magnate. His argument is based on two reasons: 1) railroad expansion has been checked by legislation that represses legitimate enterprise; and 2) an enormous pressure of traffic on railroad trunk lines can only be relieved by river transportation. Instead of seeing the railroad and waterways as incompatible, Hill argues that they are actually complementary and that waterways can carry the bulky, heavy goods cheaply. This development, however, can only occur if the waterways are revived by a comprehensive plan of waterway improvement that would deepen the Mississippi river to at best fourteen feet.

Hoover, Herbert. "The Improvement of Our Mid-West Waterways." Annals of the American Academy of Political and Social Science, 135 (January 1928): 15-24.

Obstensibly speaking on Mississippi River flood control, Hoover decries the tragedy of the recent flood but dwells mainly on plans to improve Middle Western waterways to decrease trade disadvantages incurred as railroad rates increased and the Panama Canal affected coastal commerce. He underlines the changing situation, the remedy and the plan which is to channelize the Mississippi, Missouri and Ohio Rivers and create waterways on the St. Lawrence and Illinois Rivers.

"A Western Demand for Internal Improvements. Editorial reprint from The Miners' Express (Dubuque), November 3, 1843." Iowa Journal of History and Politics, 14.2 (April 1916): 265-267.

An interesting reprint from a mid-nineteenth century Iowa paper that argues strongly for internal improvements in the upper Mississippi Valley. In spite of paying taxes, the West is not getting its fair share of government monies. The editors argue for "improvement of Western waters" by a "practical pioneer," not some "Wasp-waisted dandies imported" from the East.

Jevne, George W., and William D. Timperley. "Study of Proposed Water Power Development at U.S. Lock and Dam No. 1, Mississippi River Between St. Paul and Minneapolis." Ph.D. dissertation, University of Minnesota, 1910.

A technical study which examines the potential for water-power development at the proposed high dam at Lock and Dam No. 1. In addition to a historical background, the study covers Mississippi River flowage, backwater computations, preliminary studies of the dam, spillway and powerhouse, and an investigation into the best formula for economic development through use of the power generated.

Lidicker, William Z. "Mississippi River Lock and Dam No. 3." Old Man River, 4.9 (September 1937): 12-15.

This article focuses on the construction of the dam abutments at site No. 3 using a new type of steel sheet piling walls.

Mathews, John L. "The Future of Our Navigable Waters." The Atlantic Monthly, 100.6 (December 1907): 721-728.

Mathews describes the decline of the river traffic focusing on the Mississippi River valley. He argues that although the railroads have conquered the river, they cannot haul all the freight now while the river remains unutilized. People look at the lack of use of the river in disbelief, he continues, and are beginning to work for change. Still, the federal government needs a comprehensive broad view of river development that the single river improvements do no4 provide. It needs a Department of Public Works rather than the small department of engineers in the Department of War. Ultimately, Mathews argues that the river must be improved, and it must be improved using a comprehensive plan.

Mathews, John L. Remaking the Mississippi. Boston: Houghton, Mifflin Co., 1909.

Argues that a comprehensive plan must be developed to complement the improvements already made on the Mississippi River so that the middle of the U.S. will have adequate transportational facilities. Mathews describes the decline of the river, but he considers it inevitable that the Mississippi will return as a major route especially with the establishment of the Inland Waterway Commission in 1907. The book considers the entire river, but separate chapters describe sections of it including one on the upper Mississippi.

McGee, W. J. "Our Great River: What It Is and May Be for Commerce, Agriculture, and Sanitation--The Largest Inland Project of Our Time." World's Work, 13 (February 1907): 8576-8584.

A melodramatic essay examining the need for Mississippi river improvement and the organizations formed to lobby for changes in the river channel "which is as lawless as a monster of the jungle." Argues that the primary reason for the decline of the river was the lack of river improvements and fails to consider extensively the role played by railroads.

Meyer, Adolph F., and Lewis H. Brittin. Saint Paul's Plan for Development and Utilization of Power at Government Dam No. 1. St. Paul: McGill-Warner Company, 1921.

An interesting plan of St. Paul's proposed development around the hydroelectric power at the High Dam. Potential industry and labor is examined and St. Paul argues that it deserves the power created at Dam No. 1. This document was presented before the Federal Power Commission in 1921.

"New Phase of Upper Harbor Plan Begun." Minneapolis Star and Tribune, September 28, 1956, p. 1.

Describes the completion of the lower lock at St. Anthony Falls and the plans for work on the upper lock to begin in 1959. A useful source since it examines the problems of construction of the lower lock.

"Completing Our Harbor." Minneapolis Tribune, February 19, 1949, p. 12.

Short article which reports the clearing of legal difficulties which have hampered the St. Anthony locks project. A compromise over altering private bridges and public utilities was reached so the project can proceed as a postwar public construction program.

"Upper Harbor Work Can Start Sept. 1; Engineers Announce Plans Set; Wait Councils' Transfer of City Funds July 30." Minneapolis Tribune, July 21, 1948, p. 1.

Announces that work on the Upper Harbor in Minneapolis can begin as soon as the city of Minneapolis transfers funds to the city's upper harbor fund. Moreover, this article provides a synopsis of construction plans for the upcoming years according to Colonel W. K. Wilson, Jr., district engineer at St. Paul.

The Mississippi Valley Committee. Report of the Mississippi Valley Committee of the Public Works Administration. Washington, D.C.: U.S. Government Printing Office, 1934.

Describes generally the work of the federal Pubic Works Administrtion in the Mississippi Valley, the problems it faces, and the solutions it proposes. Among other things, the navigational improvements of the upper Mississippi is discussed.

Morgan, Arthur E. "A Policy for the Mississippi." Annals of the American Academy of Political and Social Scien#e, 135 (January 1928): 50-56.

Argues that the Mississippi River Commission has never had a scientific policy with which to study the river. The presence instead of a "rule of thumb" method has led to miscalculations and resulted in tragedies such as the recent great flood. Morgan stresses the need for the introduction of such a scientific policy that would create better flood control. Implicit in the article is the need for scientific policies in general that might included river improvement.

Nelson, Martin E. "Hydraulic Model Experiments--Iowa City." Old Man River, 2.5 (December 1935): 25-28.

Describes the hydraulic laboratory at the University of Iowa where special problems encountered in the design of locks and dams or in deciding upon methods of channel regulation. Using river models, flowage damage is estimated or best arrangement for composition of a project is decided.

"A Visit by the President." Old Man River, 1.5 (September 1934): 1-5.

This report describes the visit of Franklin D. Roosevelt on August 8, 1934, to Lock and Dam No. 5. It provides a picture of Roosevelt's visit to the river and summarizes the report given him at the site which outlines the benefits of a nine-foot channel.

"Lock and Dam No. 10, Guttenburg, Iowa." Old Man River, 6.8 (August 1939): 11.

Short notice that welcomes Lock and Dam No. 10, which previously had been in the Rock Island district, to the St. Paul district, due to general order by the Chief of Engineers.

Paquette, Philip E. "Minneapolis--A River Port at Last." Greater Minneapolis, 11.4 (January 1960): 51-52.

Written by the chairman of the Upper Harbor Committee, this short article gives the advantages of the St. Anthony locks which will create "one of the best inland harbors in the United States." Paquette provides most of the arguments for the Upper Harbor in a rather simple fashion.

Pugh, Wilbur W. "The Construction of Lock and Dam 5A." Old Man River, 2.5 (December 1935): 8-13.

A short synopsis of the progress of construction of Lock and Dam No. 5A with more anecdote and less hard data than other construction histories.

Quick, Herbert. American Inland Waterways, Their Relation to Railway Transportation and to the National Welfare; Their Creation, Restoration and Maintenance. New York: G. P. Putnam's Sons, 1909.

Not as helpful as one might expect, this book examines all the inland waterways and advocates their improvement in view of the railroad car shortage that developed in 1906 and 1907. Quick discusses the problem of deforestation, the need for competition with railroads in order to depress freight rates and conconcludes that waterways need reliable channels and that reliability can be achieved through the use of reservoirs.

"Nine-Foot Channel Now Seems Assured." Saint Paul Association Weekly News Bulletin, 16.21 (May 23, 1930): 2.

A short notice which announces the impending approval of the nine-foot channel project by the United States Senate. The article is illuminating not only in the information it provides, but in the role played by the Saint Paul Association in advocating its approval.

"St. Anthony Falls Lock Dedicated." St. Paul Dispatch, September 21, 1963, p. 3.

Newspaper article which notes the opening of the St. Anthony upper lock leading the way for the Upper Harbor in Minneapolis. Cites politicians' statements at its opening including an assertion that this was a "marginal" project.

Thompson, W. A. "Improvement of Mississippi River From Winona to LaCrosse." Professional Memoirs, Corps of Engineers, United States Army, and Engineer Department at Large, 9.45 (May-June 1917): 300-307.

A detailed examination of improvement on this twenty-eight and one-half mile stretch of the upper Mississippi considered the second most obstructed stretch of the Mississippi River before improvements. The article is very detailed containing pictures, maps and diagrams, and it considers the history of river improvement of the river section including the periods of no river improvement before 1878, the four and one-half foot channel project and the achievement of a six-foot channel in the early twentieth century.

U.S. Engineer Department. The Upper Mississippi River Navigation Improvement. St. Louis: U.S. Division Engineer, 1938.

Probably the best short treatment of the nine-foot channel discovered in the literature. This seventeen-page publication gives a detailed explanation of the project, its history, and its engineering. Most useful is the discussion of lock and dam types including analysis of Tainter and roller gates used on the movable section of the dam. Written toward the end of the massive undertaking of constructing the locks and dams, the article also notes how important the channel will be to the upper Middle West.

"U.S. Speeds Work on Construction of Nine-Foot Channel." Upper Mississippi River Bulletin, 2.7 (1933): 1.

Taken from the Minneapolis Journal, this article outlines work that is progressing on the nine-foot channel project and notes that another $22 million might be allocted by tne Public Works Administration to speed up its completion.

"Status of the Nine-Foot Channel." Upper Mississippi River Bulletin, 3.8 (1934): 1-2.

Describes the status of construction at the locks and dams on the upper Mississippi and gives a synopsis of Franklin D. Roosevelt's 1934 trip to Minnesota to view river construction work at Lock and Dam No. 5.

"Alma Lock and Dam Complete, Ready to Aid Navigation, Control Floods." Upper Mississippi River Bulletin, 4.8 (August 1935): 1, 3-4.

Pictures and describes the Alma Lock and Dam No. 4 which was recently completed. The dimensions and use of the lock and dam are explained through use of the pictures.

Way, R. B. "Mississippi Improvements and Traffic Prospects." The Annals of the American Academy of Political and Social Science, 31.1 (January 1908): 146-63.

Way argues that in spite of the great cost of maintaining a navigable stream in the Mississippi and the even greater costs of deepening the channel, such government expenditures are worthwhile. Trade with Latin America is increasing, the Panama Canal when it opens will change transportaiton routes to the advantage of Mississippi barge traffic, and water tarnsport provides a competition for railroads that ends in lower transportation rates. Although Way considers the whole Mississippi River system, he pays especial attention to the upper Mississippi.

White, Lazarus. "Closing Cofferdam No. 2 at Dam No. 6." Old Man River, 2.4 (October 1935): 6-12.

While describing the construction of Dam No. 6, this article stresses the building and closing of a cofferdam.

Wilcox, Uthai Vincent. "Our Growing System of Inland Waterways." Economic Geography, 7.2 (April 1931): 154-165.

A general review of inland waterways in the United States and their recent development. Wilcox considers the changing rate structures and the activist Hoover administration as major causes for increased waterway use. All inland waterways are examined, the upper Mississippi among them, but the lower Mississippi and Ohio Rivers are emphasized.

Wilson, Jack. "City Harbor Bill Signed By President; Project for Upper River Is Approved After Long Fight." Minneapolis Tribune, March 3, 1945, p. 1.

Describes the signing by President Franklin D. Roosevelt of the omnibus rivers and harbors bill that authorized postwar construction of the Upper Harbor in Minneapolis. The article also discusses the legal difficulties and the circumvention of those problems in the latest bill.

Wiprud, A. C. "Importance of the Mississippi Waterway to the Twin Cities." Upper Mississippi River Bulletin (September 1932): 3-4.

An examination of the problems of transportation faced by the Twin Cities in the early 1930s and the role played by the Mississippi River in solving it. Notes that the commercial decline of certain industries such as flour and linseed oil production can be traced to transportational problems. Also reviews the early history of railroad to Mississippi River transportation. A good example of civic concern about the economic stature of the Twin Cities prior to the nine-foot channel !doption.

Wood, S. E. "Historical Sketch--Construction of Lock and Dam No. 6." Old Man River, 3.8 (October 1936): 19-22.

This sketch, while still helpful is much shorter than other construction histories. Wood describes the contract, quantities of major items used in construction, and the government organization of both Lock and Dam No. 6.

Wood, L. E. "Historical Sketch--Construction of Lock and Dam No. 5A." Old Man River, 3.9 (November 1936): 17-20.

Another short historical sketch, less helpful than other more detailed sketches by Wood. The contract, quantities of construction materials used, and government organization are briefly outlined for both lock and dam.

Wood, L. E. "9 Foot Channel--Missouri River to Minneapolis." Old Man River, 4.1 (January 1937): 14-20.

This short discussion describes briefly the progress of each lock and dam in the St. Paul district. Moreover, it gives a status of construction as of January 1, 1936, and the proposed operations for the next two calendar years.

Wood, L. E. "Lock and Dam No. 5--History of Construction." Old Man River, 4.11 (February 1937): 9-11.

Shorter than most construction histories in Old Man River, this history of Lock and Dam No. 5 describes the progress of construction in an abbreviated form.

Wood, L. E. "Historical Sketch of Lock and Dam No. 7." Old Man River, 4.4 (April 1937): 16-21.

Another detailed history of the construction of a lock and dam which includes the progress of construction of each and a photograph of the completed structure.

Wood, L. E. "Historical Sketch of Lock and Dam No. 8." Old Man River, 4.5 (May 1937): 16-21.

This history of Lock and Dam No. 8 provides a discussion of the background of the construction of both lock and dam. More detailed than most construction histories in Old Man River, it also includes a photograph of the completed structure.

Wood, L. E. "Work Accomplished During 1937 in the St. Paul District." Old Man River, 4.12 (December 1937): 17-20.

A short synopsis of the work completed, including accomplishments on the nine-foot channel project, in 1937. While this report is somewhat more detailed than the Annual Reports issued by the Army Corps of Engineers, it might be of some help. Still, it is mainly repetitive of the Annual Reports and should be used only if a very detailed account is desired.

Wood, L. E. "Historical Sketch of Construction of Lock and Dam No. 9." Old Man River, 5.2 (February 1938): 7-12.
Yet another history of the construction of a lock and dam. As with other such historical sketches, this article describes construction and provides a photograph of Lock and Dam No. 9.

Wood, L. E. "Historical Sketch--Construction of L/D No. 3." Old Man River, 5.3 (March 1938): 12-18.
A detailed history of the construction of Lock and Dam No. 3. The progress of the construction of both the lock and dam is described including discussion of the novel features of each. A photograph of the structure is included.

Wood, L. E. "A Nine-Foot Depth in the St. Paul District Below St. Anthony Falls." Old Man River, 5.5 (May 1938): 2-8.
A good background article on the nine-foot channel. Wood describes the Mississippi River stream, the improvement prior to the adoption of the nine-foot channel, the approval of the deeper channel, and the typical structure and plan of operation of the lock and dam system. More specifically, he examines the lock and dam system in the St. Paul district. The article is profusely illustrated.

## Improvement Association Proceedings

Minutes of the Deep Waterway Convention for the Organization of the Lakes-to-the-Gulf Deep Waterway Association, 1906. St. Louis: Business Mens League, 1907.
The initial meeting of the Deep Waterway Convention. Although concerned primarily with a waterway system linking Lake Michigan and the Mississippi Rivers, the convention also urged other waterway improvements included a six-foot channel for the upper Mississippi River. Concern is expressed that railroad rates are too high and that railroad trackage is increasing too slowly so that waterways, the Lakes-to-the-Gulf Waterway, in particular, are necessary.

Report of the Second Annual Convention of the Lakes-to-the-Gulf Deep Waterway Association, 1907. St. Louis: The Lakes-to-the-Gulf Deep Waterway Association, 1907.
This second annual convention of the Lakes-to-the-Gulf Deep Waterway Association, like the first, is concerned primarily with a fourteen-foot channel from Lake Michigan to New Orleans. There are, however, a number of speeches that apply to the upper Mississippi such as Iowa Governor Albert B. Cummins'

address on the importance of improving the upper Mississippi River. Of additional interest is President Theodore Roosevelt's speech which argues for a comprehensive waterway plan.

Third Annual Convention of the Lakes-to-the-Gulf Deep Waterway Association Held at Chicao, Il., October 7th, 8th and 9th, 1908. St. Louis: The Lakes-to-the-Gulf Deep Waterway Association, 1908.

Another convention proceedings of the Lakes-to-the-Gulf Deep Waterway Association. This third convention had a star-studded cast including speeches by future president William Howard Taft, William Jennings Bryan, Giffard Pinchot and James J. Hill. Only a few speeches, however, considered the need of improving the upper Mississippi River.

Report of the Proceedings of the National Rivers and Harbors Congress, Held at McCoy Hall, Johns Hopkins University, Baltimore, Md., October 8th and 9th, 1901. Baltimore: Fleet, McGinley & Co., Printers, 1901.

The proceedings from the First National Rivers and Harbors Congress. apparently concerned over the recent failure of a federal rivers and harbors bill in 1901, the congress met to advocate the need for federal appropriations in rivers and harbors maintenance and to decry the common beliefs that most rivers and harbors bills were indeed pork-barrel legislation.

Proceedings of the National Rivers and Harbors Congress, Third Annual Convention, Washington, D.C., Dec. 4, 5 and 6, 1907. Cincinnati: The Ebbert and Richardson Co., 1908.

The fourth annual convention of the National Rivers and Harbors Congress which includes addresses by James J. Hill, Secretary of State Elihu Root, Minnnesota Governor John A. Johnson, and Iowa Governor Albert B. Cummins, emphasizes the failure of railroads to maintain their preeminent place in the transportation infrastructure. The waterways, which will complement the railroads, are considered a logical extension of transportation lines.

Proceedings of the National Rivers and Harbors Congress Sixth Annual Convention, Washington, D.C., Dec. 8, 9 and 10, 1909. Cincinnati: The Ebbert and Richardson Co., 1910.

The sixth annual convention of the National Rivers and Harbors Congress which includes speeches by President William Howard Taft; A. O. Eberhardt, Governor of Minnesota; and Frank Gates Allen, representing the Upper Mississippi Improvement Association. All advocate a larger and more active government role in improving and maintaining the Upper Mississippi.

Proceedings of the National Rivers and Harbors Congress Eighth Annual Convention, Washington, D.C., Dec. 6, 7 and 8, 1911. Cincinnati: The Ebbert and Richardson Co., 1912.

The eighth annual National Rivers and Harbors Congress convention saw less prestigious speakers than previously but continued calls for greater river improvement. Addressses by Secretary of War Henry L. Stimson and Representative Stephen M. Sparkman among others noted the impending completion of the Panama Canal which would have to be supplemented with improved river facilities in order to achieve full benefit of the new waterway. Speakers continued to stress that railroad and waterways were complementary, not antithetical, types of transportation and that both would benefit from each other.

Proceedings of the National Rivers and Harbors Congress Ninth Annual Convention, Washington, D.C., Dec. 4, 5 and 6, 1912. Washington, D.C.: Press of W. F. Roberts Co., 1913.

Including speeches by President William Howard Taft and Secretary of War Henry L. Stimson, the ninth annual convention of the National Rivers and Harbors Congress continued its plea for waterway development. A recent emphasis is on the need for adequate terminal facilities which many argue constrain river traffic to a greater degree than inadequate channel depth.

Proceedings of the Eighteenth Convention of the National Rivers and Harbors Congress, Washington, D.C., December 6 and 7, 1922. Washington, D.C.: Press of Ransdell Inc., 1923.

Shorter than earlier National Rivers and Harbors Congress conventions, the eighteenth convention shows a continued emphasis on railroad competition with new nuances. Once unfair competition was the predominant concern of speakers. By 1922, while many are concerned about price cutting and the like, many others stress the declining conditions of railroads that will prohibit an adequate transfer of goods.

Proceedings of the Twenty-First Convention National Rivers and Harbors Congress, Washington, D.C., December 9 and 10, 1925. Washington, D.C.: Press of Ransdell Inc., 1926.

These proceedings of National Rivers and Harbors Congress contain mainly reports from various waterway associations throughout the United States. Importantly, there is no upper Mississippi River association--only the Mississippi Valley Association. Probably the most noteworthy piece in this volume is Herbert Hoover's speech decrying the inadequate transportation facilities for Midwestern farmers. In the address, Hoover calls for a transportation system that is comprehensive including the whole Mississippi Valley, a precursor of his actions as president.

Proceedings of the Twenty-Second Convention National Rivers and Harbors Congress, Washington, D.C., December 8 and 9, 1926. Washington, D.C.: Press of Ransdell Inc., 1927.

Another proceedings of the National Rivers and Harbors Congress. Although probably less helpful than others previous to it, this volume of the Proceedings does contain a history of the Upper Mississippi Barge Line Company, with a short history of upper Mississippi River boat traffic, the genesis of concern for improved river traffic, the organization of the U.M.B.L.C., and its relationship to the Inland Waterways Corporation.

Proceedings: The Upper Mississippi River Improvement Association. Moline, Ill., 1907.

Proceedings include speeches by prominent politicians from Iowa, Illinois, Wisconsin and Minnesota as well as by experts such as Lyman E. Cooley. The introduction stresses the progress in obtaining upper Mississippi River improvement.

Proceedings of the Upper Mississippi River Improvement Association. Clinton, Ia., 1908.

Another proceedings of river improvement convention replete with boosterism for federal input in maintaining the upper Mississippi River. The highlights included speeches by politicians from Iowa, Minnesota and Wisconsin, a history of upper Mississippi River improvement by Major C. S. Riche of the Corps of Engineers, and a speech by Lyman E. Cooley.

Proceedings of the Upper Mississippi River Improvement Association. Winona, 1909.

These proceedings feature A. O. Eberhardt, Governor of Minnesota, who notes that waterway improvement is esential to his state and that rivers help railways rather than hurt them. Speakers continue to compare the United States with Europe and the ability of countries in the latter to develop their rivers while Americans do not.

Proceedings of the Convention of the Upper Mississippi River Improvement Association. St. Paul, 1910.

These proceedings note that the 1910 River and Harbors Act is best so far enacted and include speeches by Minnesota politicians such as the Minneapolis mayor urging a high dam to permit navigation to his city. Speeches emphasize the importance of the Panama Canal to navigation and trade.

Proceedings of the Upper Mississippi River Improvement Association. Alton, Ill., 1911.

Along with the usual reports on river improvement associations and federal bills and expenditures, these proceedings include speeches by prominent Illinois politicians arguing for river improvement. Again the ramifications of the Panama Canal are stressed.

## Government Documents

"History of Construction Upper Mississippi River." St. Paul District, Army Corps of Engineers Archives.

Each lock, dam and other major construction has a detailed history deposited at the archives. They are profusely illustrated, rich in detail and invaluable in researching the

construction histories of the structures of the upper Mississippi.

Annual Report of the Chief of Engineers U.S. Army. Washington, D.C.: U.S. Government Printing Office, various dates.
The Annual Reports are rich in data on proposed developments and work completed each year by the Army Corps of Engineers. They are divided such that the St. Paul district and its work can be easily discovered.

"Survey of Mississippi River." 34th Congress, 1st Session, House of Representatives Report No. 72. Washington, D.C.: Cornelius Wendell, Printers, 1856.
Contains an appeal from legislature of the Minnesota Territory to the House Committee on Commerce which recommends improvement of the Mississippi River beween the Falls of St. Anthony and the Minnesota River mouth and between the Falls and Sauk Rapids. Such improvements would facilitate trade and settlement of Minnesota. The improvement between the Falls and the Minnesota River could be completed by removing the impediments from the river.

"Improvement of Navigation of Mississippi River. Memorial of the Legislature of the State of Minnesota for the Improvement of the Mississippi River." 36th Congress, 2d Session, House of Representatives Miscellaneous Document No. 29. Washington, D.C.: Government Printing Office, 1860.
This memorial, which calls for the familiar improvements of the river between Fort Snelling and St. Anthony Falls and St. Anthony Falls and Sauk Rapids, notes that steamboats have traded at the Minneapolis and St. Anthony landings when water was adequately high. If the channel was improved so traffic could be steady, trade would be facilitated and the memorial argues would pay for improvements made.

"Memorial of the Legislature of Minnesota in Favor of a Grant of Land to Perfect the Navigation of the Mississippi River to the Falls of St. Anthony." 39th Congress, 1st Session, State Miscellaneous Document No. 54. Washington, D.C.: Government Printing Office, 1866.
Memorial requests a lock and dam system near the Falls of St. Anthony that would permit navigation to St. Anthony and Minneapolis rather than St. Paul. It notes that before 1857, steamboats regularly travelled to the Falls, but financial downturns, serious droughts and the Civil War have ended that trde. Argues that the river is a natural avenue of commerce between north and south and that it regulates fares charged by other carriers, the railroads in particular.

"Survey of Upper Mississippi River." 39th Congress, 2d Session, House of Representatives Executive Document No. 58. Washington, D.C.: Government Printing Office, 1867.
A detailed report of over one hundred pages examining

the upper Mississippi River and its tributaries--Minnesota, Fox, Wisconsin, St. Croix, Zumbro Rivers, among others--and delineating the possible improvements of each. Improvement of the upper Mississippi mainly considered to be through dredging and the construction of wing dams with the goal of creating and maintaining a four-foot channel up to the St. Croix River mouth and three-feet up to Fort Snelling. A lock and dam, however, is recommended for the Meeker Island site to enable navigation up to the villages of St. Anthony and Minneapolis.

"Memorial of the Legislature of Minnesota in Favor of the Improvement of the Mississippi River, Commencing Near the Mouth of the Minnesota River, to the Falls of St. Anthony." 40th Congress, 1st Session, Senate Miscellaneous Document No. 21. Washington, D.C.: Government Printing Office, 1868.

A memorial urging improvement of the Mississippi between the mouth of the Minnesota River and the Falls of St. Anthony through the construction of a dam that would permit slackwater navigation to the Falls during the entire season of navigation. The Minnesota legislature notes that its state has paid taxes which have gone into Atlantic coast improvements while little has been appropriated for river traffic.

"Survey of the Upper Mississippi." 40th Congress, 2d Session, House of Representatives Executive Document No. 247. Washington, D.C.: Government Printing Office, 1868.

A short report reiterating the findings of earlier government surveys. The primary means of navigational improvement on the upper Mississippi River remains dredging through the use of two government dredges and snag boats and the construction of wing dams. While a lock and dam at Meeker's Island was advocated earlier, the report argues that in addition to it, another lock and dam should be constructed near the mouth of Minnehaha Creek.

"Report of the Select Committee on Transportation-Routes to the Seaboard, with Appendix and Evidence." 43d Congress, 1st Session, Senate Report No. 307, Part 1. Washington, D.C.: Government Printing Office, 1874.

The first part of the famous Windom Committee report, this document argues that railways must be regulated and that one of the best means of regulation is through competition. Accordingly, Windom and his committee members recommended that water transportation be improved by the federal government to facilitate that competition. Among the recommendations are $16 million improvements on the Mississippi River consisting in part of the construction of reservoirs at the source of the river and the creation of a three- to five-foot channel above the Falls of St. Anthony and a four and one-half foot channel from that point to St. Louis.

"Report of the Select Committee on Transportation-Routes to the Seaboard, with Appendix and Evidence." 43d Congress, 1st Session, Senate Report 307, Part 2. Washington, D.C.: Government Printing Office, 1874.

This second part of the Windom Committee report contains nearly 1,000 pages of testimony and documentation supporting the conclusions reached in Part 1.

"Improvement of the Mississippi River." 45th Congress, 2d Session, House of Representatives Report No. 714. Washington, D.C.: Government Printing Office, 1878.

Concerned primarily with improvement of the lower Mississippi through improvements of levels or deepening of the channel, this report does note the importance of the upper Mississippi to national commerce.

"Report of the Select Committee of the United States Senate on the Mississippi River Improvements." 48th Congress, 1st Session, Senate Report No. 36. Washington, D.C.: Government Printing Office, 1884.

The result of a Senate resolution to examine the results of river improvement between Cairo and New Orleans, this report also examines stretches of the upper Mississippi and recommends a $1 million appropriation for improvement. Particularly helpful in this report is a sandbar-by-sandbar report of obstructions on the upper Mississippi and the improvements made since 1878 when the four and one-half channel project began.

"Report on the Internal Commerce of the United States." 50th Congress, 1st Session, House of Representatives Executive Document No. 6, Part 2. Washington, D.C.: Government Printing Office, 1888.

Contains a report by Frank Johnson entitled "Commerce of the Mississippi River from Saint Paul to Saint Louis," which describes the extent and importance of river traffic. Johnson considers number of steamboats and barges and reiterates the off-noted claim that the river works to temper the rates charged by railroads to the benefits of agricultural and commercial interests. An accompanying report by W. F. Switzler examines the volume of trade and type of produce of important river towns.

"Examination and Surveys of Rivers." 50th Congress, 1st Session, House of Representatives Executive Document No. 158. Washington, D.C.: Government Printing Office, 1889.

This report is the result of surveys of the Mississippi River between St. Paul and St. Anthony Falls and of the Minnesota River requested of the Army Corps by the River and Harbor Act of 1886. The Mississippi River section gives a historical background of previous improvement plans and finally advocates, through contemporary fieldwork, a study, the dredging of the river and construction of wing dams just below Minnehaha Creek followed by the construction of two locks and dams to facilitate commerce up to St. Anthony Falls.

"Report on the Commerce of the United States for the Year 1891. Part II of Commerce and Navigation: The Commerce of

the Great Lakes, the Mississippi River and Its Tributaries." 52d Congress, 1st Session, House of Representatives Executive Document No. 6, Part 2. Washington, D.C.: Government Printing Office, 1892.

In considering both the Great Lakes and Mississippi systems, the report concludes that both have a large tonnage of transport annually. The Mississippi River, however, provides an alternative to the railroads and moves through the United States' most important agricultural states. Although over 29.5 million tons were transported on the Mississippi in 1890, the report agues, with data to support it, that the total would be much increased if the improvements necessary to providing a reliable channel were made. Contains tabular data on number of boats, total commerce, and total produce on Mississippi River and in Mississippi Valley.

"Government Dams on the Mississippi River." 52d Congress, 1st Session, House of Representatives Executive Document No. 178. Washington, D.C.: Government Printing Office, 1892.

This document contains the letters requested by the House in regard to the destruction of federal government wing dams around Alma, Wisconsin, by employees of the Mississippi River Logging Company. It is a good example of conflicting interests of the river use and of extra-legal attempts to improve one group's interests.

"Report on the Mississippi River Floods." 55th Congress, 3d Session, Senate Report No. 1433. Washington, D.C.: Government Printing Office, 1898.

Within this large report of over 500 pages are the testimony of some rivermen who give their views of the progress of river traffic, the effect of reservoirs at the headwaters on flooding and on river traffic. Among those interogated are George Lamont and F. C. Denkmen, both of whom resided in Rock Island.

"Loose Logs, Steamboats and Rafts on Certain Rivers and Streams." 56th Congress, 1st Session, Senate Report No. 1035. Washington, D.C.: Government Printing Office, 1900.

Another example of conflict between the logging interests and steamboat interests. The issue in question is the 1899 River and Harbor Act which prohibited floating logs, timber and rafts except on certain streams. This document argues that those streams not under such prohibition should be extended beyond the St. Croix and Chippewa Rivers and portions of the Mississippi River to all rivers where logging is primary.

"Locks and Dams, Mississippi River, Between St. Paul and Minneapolis." 57th Congress, 1st Session, House of Representatives Document no. 164. Washington, D.C.: Government Printing Office, 1902.

Short notice of a projected cost overrun in the locks and dams to be constructed between St. Paul and Minneapolis.

"Improvement of the Mississippi River." 58th Congress, 2d Session, Senate Document no. 245. Washington, D.C.: Government Printing Office, 1904.

The report of the hearing held in 1904 before the Senate Committee on Commerce, the main emphasis of this long document is levee construction and maintenance on the lower Mississippi River. The upper river and its need for improvement to maintain commerce, however, is considered.

"Mississippi River Between Missouri River and St. Paul, Minn." 59th Congress, 2d Session, House of Representatives Document No. 341. Washington, D.C.: Government Printing Office, 1907.

Report of the Army Corps on the feasibility of a six-foot channel on the upper Mississippi River. Following the success of the four and one-half foot channel, the report argues that a six-foot channel can be attained through the continued use of wing dams to contract the stream width. The report actually argues against permanent dams because they would prohibit open-channel navigation. Good discussion of earlier river improvement and the construction of wing dams.

"Preliminary Report of the Inland Waterways Commission." 60th Congress, 1st Session, Senate Document No. 325. Washington, D.C.: Government Printing Office, 1908.

This report of the Inland Waterways Commission, which is over 700 pages long, examines every facet of inland water transportation including canals, the Great Lakes, and rivers. Moreover, it considers not only transportation improvements but conservation and water power. The report includes Theodore Roosevelt's document creating the Inland Waterway Commission, the findings and recommendations of the Commission itself, and sections on the characteristics of the Mississippi River and its tributaries and upper Mississippi River traffic.

"Mississippi River, St. Paul to Minneapolis, Minn." 61st Congress, 2d Session, House Document No. 741. Washington, D.C.: Government Printing Office, 1910.

A document that examines the viability of one high dam with a thirty-foot lift rather than two dams between St. Anthony Falls and Fort Snelling. Although Lock and Dam No. 2 is already built and in operation, the Board argues for the one lock and dam near Minnehaha Creek which will obviate the need for the former. The knotty legal questions are considered as well as the advisability of making a newly-built lock and dam structure dysfunctional, but the benefit of water power and a nine-foot channel override the objections.

"Mississippi River from Minneapolis to Lake Pepin." 69th Congress, 2d Session, House of Representatives Document No. 583. Washington, D.C.: Government Printing Office, 1927.

A report recommending the construction of a lock and dam at Hastings, Minnesota, in order to complete the six-foot chan-

nel project begun in 1907. Although dredging and wing dams had permitted the project to be 46 percent complete on the upper Mississippi by 1926, it was only 6.7 percent complete for the section above the St Croix River mouth owing to poor channel conditions. A lock and dam was found to be the only means to bring a six-foot channel in this river section. The report analyzes the river and the potential river traffic generated by a reliable six-foot channel to the Twin Cities and argues strongly for the Hastings dam.

"Mississippi River, Between Mouth of Missouri River and Minneapolis, Minn." 71st Congress, 2d Session, House of Representatives Document no. 290. Washington, D.C.: Government Printing Office, 1930.

One of the earlier surveys of the upper Mississippi in regard to a possible nine-foot channel, this report is rich in detail in the reasons behind a nine-foot channel on the upper Mississippi River and the tentative plan toward that end. The report examines the general situation on the upper Mississippi arguing that the postwar railroad rate increases and the use of the Panama Canal have unduly hindered commerce in the landlocked regions of the Midweest, a hindrance that would be poartially alleviated by a nine-foot channel. It analyzes the economics of river travel and concludes that a deep channel creates an economy of scale through the use of large towboats. Finally, it proposes a tentative canalization plan that eventually was adopted with modifications.

"Survey of Mississippi River Between Missouri River and Minneapolis." 72d Congress, 1st Session, House Document No. 137. Washington, D.C.: Government Printing Office, 1932.

A lengthy report on the plans for a nine-foot channel on the upper Mississippi River. This survey "is confined to a discussion of the engineering features of the project, consideration of alternative plans, a presentation of the plan recommended to give the desired channel, and an estimate of its cost" (p. 3). The volume describes in detail the existing situation on the upper Mississippi and provides a site-by-site explanation of the proposed dams, their type and their function. Since this is the initial full-scale nine-foot channel plan put before Congress, the report is a seminal document in the study of the history of the upper Mississippi River locks and dams.

"Amending Section 1 of the Rivers and Harbors Act." 72d Congress, 1st Session, House of Representatives Report No. 350. Washington, D.C.: Government Printing Office, 1932.

A short report explaining the amendment of the Rivers and Harbors Act of 1930 which ordered the procurement of a nine-foot channel. The amendment was resolved to correct an error which implied that the War Department Engineers were not authorized, in their discretion, to change the location and

design of the permanent structures from the tentative locations set forth in their report.

"Amending Section 1 of the Rivers and Harbors Act." 72d Congress, 1st Session, Senate Report No. 183. Washington, D.C.: Government Printing Office, 1932.
A short report which explains an amendment in the Rivers and Harbors Act of 1930 that ordered the procurement of a nine-foot channel. The change noted that the Chief of Engineers had the discretion to change the loction and design of the tentative lock and dam sites set forth in their earlier preliminary report.

"Mississippi River at Minneapolis, Minn." 77th Congress, 1st Session, Senate Document No. 54. Washington, D.C.: Government Printing Office, 1941.
A short review report recommending limiting vertical clearance of bridges for St. Anthony Falls project to twenty-six feet.

"Mississippi River at Minneapolis, Minn." 78th Congress, 2d Session, House Document No. 449. Washington, D.C.: Government Printing Office, 1944.
A short report that outlines work to be undertaken at the St. Anthony Falls lock and dam project after the war is over. The study also covers the revisions in local cooperation in altering civil structures.

"Mississippi River at St. Anthony Falls, Minneapolis, Minn." 85th Congress, 1st Session, House Document No. 33. Washington, D.C.: Government Printing Office, 1956.
A report which recommends the completion of the St. Anthony Falls lock system to create the Upper Harbor in Minneapolis. The study reviews the amount of commerce carried on the river and Minneapolis' need for terminal development. It also reviews the project at St. Anthony Falls.

## Secondary Sources

Anfinson, John. "History of Wing Dams." Unpublished report for the St. Paul District, U.S. Army Corps of Engineers.
A concise but comprehensive overview of the wing dams, the primary means of maintaining minimum channel depth from the late nineteenth century until the locks and dams were built in the 1930s. Anfinson gives a background of the legislation authorizing channelization and describes the materials, construction, function and use of the wing dams on the upper Mississippi.

Davis, Calvin Victor, ed. Handbook of Applied Hydraulics. New York: McGraw-Hill Book Company, Inc., 1952.
Describes different types of reservoirs and dams. Provides an extended discussion of spillway cret gates

including Tainter gates and roller gates which were components of the dams of the upper Mississippi.

Decker, Wilbur F. "Clearing for Action on the Upper Mississippi." Minnesota History, 19.2 (June 1938): 182-189

Written by the chairman of the Minneapolis Committee appointed by the Minneapolis Civic and Commerce Association to study the desirability of Mississippi waterway improvement in 1912, this article describes how Minneapolis businessmen determined that "every possible effort should be made to have the channel improved, dams and locks built, and harbor facilities provided." Reminisces on the work for preparing municipally-owned terminals and river improvement and recalls the opposition he received especially from milling interests.

Golze, Alfred R. Handbook of Dam Engineering. New York: Van Nostrand Reinhold Co., 1977.

A technical handbook which discusses spillway dams among other things. Not too helpful due to its technical nature.

Hartsough, Mildred L. From Canoe to Steel Barge on the Upper Mississippi. Minneapolis: University of Minnesota Press (for the Upper Mississippi Waterway Association), 1934.

A comprehensive history commissioned by the Upper Mississippi Waterway Association, to trace the use of upper Mississippi from the beginnings of European exploration leading up to federal approval of a nine-foot channel through construction of the lock and dam system. Importantly, the book serves both as a primary and secondary source of Mississippi River use and improvement. While describing the exploits of eighteenth-century Jesuit missionary reformers or nineteenth-century steamboat captains in rich detail, it also sketches the work of contemporaries such as Henrik Shipstead who advocated upper Mississippi River improvement which was coming to fruition only as the book was published.

Hill, Albert Kirchner. "Out With the Fleet on the Upper Mississippi, 1898-1917." Minnesota History, 37.7 (September 1961): 283-297.

Delightful personal history of Hill's childhood on a river improvement fleet on the upper Mississippi in the early twentieth century. Besides giving a description of her girlhood, Hill also describes the construction of wing dams by her father and grandfather's company, the riverboats that did exist between 1898 and 1917, and the dealings between Richtman and Kirchner (her family's firm) and the Army Corps of Engineers.

Hull, William J., and Robert W. Hull. The Origin and Development of the Waterways Policy of the United States. Washington: National Waterways Conference, Inc., 1967.

This book is puzzling since it should deal with such

large projects as the canalization of the upper Mississippi in the 1930s, but does not. Rather, congressional debates are emphasized and waterway improvement is treated in a very general way. The book, in short, is quite useful in some respects, but it is totally lacking in others.

Kane, Lucille M. "Rivalry for a River: The Twin Cities and the Mississippi." Minnesota History, 37.8 (December 1961): 309-323.

Provides a detailed description of the rivalry between St. Paul and Minneapolis engendered by the potential use of the Mississippi. the article examines in detail the tortuous path of the development of the Meeker Island lock and dam from the late 1850s, its construction and its destruction when Lock and Dam No. 1 was completed in 1917.

Lambert, John W., and Robert W. Hoogland. The Economic Impact of Waterborne Transportation on the Upper Mississippi River Basin. St. Paul: Upper Mississippi Waterway Association, 1975.

This report argues for continued waterway improvement due to its greater effectiveness than that of railroads. Included in the report is a short synopsis of the genesis of the nine-foot channel project. While it is quite short and basically simple, there are some helpful points in it.

McCartney, Kenneth H. "Government Enterprise: A Study of the Inland Waterways Corportion." Ph.D. dissertation, University of Minnesota, 1958.

An economic history fo the Inland Waterways Corporation that spans the development, construction and use of the Mississippi river locks and dams project in the thirties. Unfortunately, this seemingly important event is given little attention. Most useful for this project's purpose is the introductory history of river traffic.

Merritt, Raymond H. Creativity, Conflict and Controversy: A History of the St. Paul District, U.S. Army Corps of Engineers. Washington, D.C.: U.S. Government Printing Office, 1979.

A comprehensive history of the St. Paul district of the Army Corps of Engineers that places the district in the national context and spells out its major areas of jurisdiction in the upper Middle West. Although not written particularly well, the book contains a wide range of sources including contemporary newspapers and documents available at the National Archives. The building of the locks and dams on the upper Mississippi is placed in the context of the nine-foot channel issue. Instead of emphasizing the locks and dams themselves, however, Merritt stresses the effects they had on the Corps' bureaucracy which, of course, is the topic of his research.

Merritt, Raymond H. "The Development of the Lock and Dam System on the Upper Mississippi River." National

Waterway Roundtable (1980): 89-105.
A good overview of the events leading up to the establishment of the nine-foot channel made possible by the lock and dam system on the upper Mississippi River. Merritt traces the riverboat traffic for its earliest days and emphasizes the commodities carried by the steamboats. He describes the decline of the water traffic in the face of railway competition and argues that the ultimate decision to establish a comprehensive lock and dam system was a political one rather than one based on economic feasibility. He underscores this assertion by showing the continued Army Corps resistance to the plan in spite of presidential pressure.

Michael C. Robinson. "The Federal Barge Fleet: An Analysis of the Inland Waterways Corporation, 1924-1939." National Waterways Roundtable Proceedings. Washington, D.C.: U.S. Government Printing Office, 1980, pp. 107-125.
Robinson examines the Inland Waterways Corporation and argues that although the I.W.C. did not create a well-rounded common carrier service, it did play a key role in the revival of inland waterway transportation. The I.W.C. pioneered new designs and sizes of barges; it conducted experiments to determine the most efficient methods of moving the barges; it facilitated the construction of terminals; and it worked to achieve a degree of cooperation between railway and waterway carriers.

U.S. Army Corps of Engineers, St. Paul District. Final Environmental Impact Statement: Operation and Maintenance, 9-Foot Navigation Channel, Upper Mississippi River, Head of Navigation to Guttenburg, Iowa. N.p., 1974.
This 600-page report encompasses the development of the nine-foot channel and its effect on the historical, economic, archaeological and geological aspects of the upper Middle West. The report, in its comprehensiveness, details briefly the historical development of Mississippi waterway improvement leading up to the nine-foot channel.

U.S. Army Corps of Engineers, St. Paul District. "A 1976 Bicentennial Salute to St. Anthony Falls and the St. Anthony Falls Locks, Minneapolis, Minnesota." St. Paul, 1976.
A short, illustrated history of the St. Anthony district which explains its deveopment as an early milling center through the construction of locks completed in the 1960s.

U.S. Army Corps of Engineers. "The Nine-Foot Channel Project on the Upper Mississippi River." Washington, D.C.: U.S. Government Printing Office, 1981.
A short synopsis of the upper Mississippi River before improvement, the nine-foot project, and the positive commercial results of its completion.

Upper Mississippi River Comprehensive Basin Study Coordinating Committee. Upper Mississippi River Comprehensive Basin

Study. Vol. 5. Washington, D.C.: U.S. Government Printing Office, 1970.
This volume, which discusses flood control and navigation, is part of a comprehensive study of the upper Mississippi River. The report on navigation heavily emphasizes the commercial transportation on the river more than waterway improvements.

Winther, Oscar Osburn. The Transportation Frontier: Trans-Mississippi West 1865-1890. New York: Holt, Rinehart and Winston, 1964.
A good overview of transportational developments west of and including the Mississippi in the late nineteenth century. Since Winther is concerned with transportation, a worthwhile discussion of the competition between steamboats on the river and railroads is included.

St. Anthony Falls Lower Hydrostation and Wasteway No. 2

"St. Anthony Falls Water Power Plant." American Electrician, 10.5 (May 1898): 185-192.

Burch, Edward P. "The Utilization of Water Power for the Electric Railway System of Minneapolis and St. Paul." Official Proceedings of the Northwest Railway Club, 5.8 (April 1900): 10-36.
An excellent transcript of a speech delivered shortly after the lower dam hydrostation opened. Burch details the decision to build a dam at that point, the dam and station itself and the use of the power by the Twin City Rapid Transit Company.

"The Falls of St. Anthony Transmission." The Electrical Engineer, 23.456 (January 27, 1897): 107.
A short notice which announces the contract for electric utilization of the hydrostation at the lower dam given to General Electric. A technical discussion of the turbine types is given as is the notice that the Twin City Rapid Transit Company will utilize the power.

"The St. Anthony Falls Electric Power Transmission at Minneapolis." Electrical Engineer, 23.474 (June 2, 1897): 581-583.
A good account of the power station at the lower Falls of St. Anthony. The components of the dam and powerhouse are described including the dam, the powerhouse structure, headrace, water-wheels and electrical equipment.

"Water Power at Minneapolis." Electrical World, 29 (January 23, 1897): 149
A brief account of the completion of the hydrostation at St. Anthony's lower falls. The turbines and electrical equipment are briefly described.

"This is Great. A $750,000 Dam Soon to be Built at the Falls Means 12,000 Horse Power." Minneapolis Tribune, November 14, 1894, p. 17.

Article notes the proposed construction of a dam and power station below the Tenth Street bridge which will increate the water power available and allow the city of Minneapolis to move ahead of five other cities in water power.

"Power from Current to Current." Minneapolis Times, June 1, 1895, p. 10A.

Interesting article that traces the develpment of St. Anthony Falls up to its most recent addition, the lower falls hydroelectric power station. C. A. Pillsbury is interviewed and he reflects on his decision to build the new structure.

Minneapolis Tribune, April 12, 1890, p. 4.

Details plans of the Pillsbury-Washburn Milling Company to develop power at a dam just below Spirit Island. The article argues the flour milling industry could be doubled in size with the new supply of water power.

Minneapolis Tribune, November 4, 1890, p. 5.

This article tells of revived interest in building a second dam at Spirit Island that had been brought up a year before. Discusses the potential design of the dam and removal of housing in Bohemian Flats because of it.

"A New Minneapolis Era." Minneapolis Tribune, September 20, 1896, p. 21.

Reports that the masonry of the new power dam has been completed and again argues how important the new dam and poer will be to the city of Minneapolis.

"Last Stone Laid. Thomas Lowry and C. A. Pillsbury Complete the New Dam." Minneapolis Tribune, March 21, 1897, p. 1.

Article discusses the opening of the lower dam with synopses of the speeches of civic leaders given. The progres of construction is described as is the structure and dimensions of the dam and powerhouse.

Minneapolis Tribune, January 24, 1900, p. 7.

Article which reports the results of litigation against the lower dam. The District Court decided that the dam will remain undisturbed.

"Big Dam Is to Remain." Minneapolis Tribune, March 29, 1901, p. 2.

In this article, the decision of the Minnesota Supreme Court upholding the lower court decision of District Court in the litigation over the lower dam is discussed. The decision upheld the decision on exactly the same points stated by the District Court judge.

Minneapolis Tribune, March 30, 1901, p. 10.

This article, reporting the decision of the Minnesota

Supreme Court which upheld the District Court ruling on the lower dam, is similar to that reported the day earlier by the Tribune.

"An Extraordinary Project." Minneapolis Svenska Amerikanska Posten, May 21, 1895.
Notes the begining of the dam, its size and the amount of laborers employed on the project. The article also says that those "squatters" displaced will be employed on the project as partial compensation.

"Meeker Dam." Weekly Northwestern Miller, February 14, 1890, p. 171.
Notes interest in hydroelectric power at Meeker Island and at "the east channel near the Tenth Avenue bridge." Provides the magnate interested in the development and sets the idle power that could be developed in the area at 25,000 horsepower.

"St. Anthony Falls Water Power Improvements." Weekly Northwestern Miller, April 18, 1890, p. 423.
Notes the interest in the development of more water power near St. Anthony Falls. The presence of Richard H. Glyn, head of the English syndicate which owns the power, increased speculation that power development interest was increasing. Article provides a map and plans for the new power that would be generated by a lower dam.

Weekly Northwestern Miller, November 20, 1891, pp. 719-720.
Provides the arguments of Syndey T. Klein, English director of Pillsbury-Washburn, on the need for waterpower. Klein believes the power can be doubled by creating another dam and improving the facilities on the lower dam. He also notes other recent developments around St. Anthony Falls and the milling district.

Weekly Northwestern Miller, January 4, 1895, p. 6.
Notes the agreement that in the event of another dam being constructed at the lower falls, the streetcar railway company would buy at least 3,000 horsepower immediately. Thus, althogh the plan is old, this new agreement was deemed important enough to submit the proposition again to those who would be expected to furnish the necessary capital.

Weekly Northwestern Miller, May 17, 1895, p. 818b.
Article states that the lower dam is "an assured thing" since preliminary excavations were begun on May 16. Dimensions of the dam and the power generated as well as potential users is discussed.

Weekly Northestern Miller, March 6, 1896, p. 409.
Notes the construction of the new dam at St. Anthony Falls and argues that "there probably is no water power improvement in progress in the United States" which equals it in importance.

Weekly Northwestern Miller, November 22, 1899, p. 988.

Reports a trial in District court in which W. W. Eastman and others claim their riparian rights on the west river bank have been destroyed by the new lower falls power station. They ask that the dam be removed.

Weekly Northwestern Miller, April 3, 1901, p. 647.

This article reports the decision of the Minnesota Supreme Court upholding an earlier decision which favored the lower dam. A discussion of the two decisions is given.

## 6. REGIONAL HISTORY

The states of Iowa, Minnesota, and Wisconsin developed in stages as their natural resources were exploited to supply growing markets. Although Wisconsin was the first to receive territorial status, it was Iowa which was first to achieve statehood in 1846. The Mississippi River became a lifeline of commerce and the Iowa river towns, such as Burlington, Iowa's first capitol, thrived on trade and industry bequeathed by the river. Although such towns as Dubuque, LaCrosse, or Winona developed along the course of the river, however, it was Minneapolis and St. Paul, two cities in Minnesota, the last of the three states to achieve statehood, which evolved into the principal metropolitan areas of the upper Middle West. St. Paul was situated at the head of navigation while Minneapolitans enjoyed the Falls of St. Anthony, an important drop that could provide water power for sawmills and grain mills. By 1900, the population of Minneapolis numbered around 202,000 residents. (Blegen 1963: 449) As different modes of transportation developed, the Twin Cities remained economically and demographically important yet continued to be the most remote cities on the Mississippi waterway. Proponents of waterway improvement from the 1860s onward thus always had to consider these northernmost termini in Minnesota and these considerations constantly colored the nature and course of that improvement.

The rapid demographic and economic growth of the upper Middle West was accompanied by the development of transportation systems by which to market its products. The Mississippi River, of course, provided a natural route to the sea and the proliferation of river towns along its course were evidence of a lively commerce within the region. The periods of transportational development are best categorized according to the primary staples carried by the river commerce. Petersen has outlined six periods of the history of steamboating and they provide a starting point for examining the growth of river commerce. (Petersen 1946: 293-295; Petersen 1930: 227-228) Beginning with the Lead Period between 1823 and 1848, traffic expanded in the Immigration Period (1849-70) and the Grain Period (1870-90). The era described by Petersen as the Period of Decline (1890-1910) was followed by the Excursion Period (1910-1927) and the renaissance of the river, the Towboat Period, which began in 1927, and lasts to the present. (Petersen 1946: 293-295)

By analyzing these periods according to the staple commodity carried, we can evaluate the development of river traffic and identify its growth and decline which was followed in turn by another period of growth. Moreover, we can set these patterns in relation to the river improvement which will be discussed in the next section. For although the river and its ability to transport goods was essential to the pattern of economic development of the region particularly in the early periods of settlement, it was only through the settlement and production of staple commodities that the river could be of any use. Before examining the Lead Period, however, the prestaple era must be discussed. The evolution of river transports progressed from canoe to piroque, an enlarged dugout canoe, to bateau, a vessel wider through the middle than the pirogue with tapered ends, also called the Mackinac boat. These primitive transportation vehicles were followed by the keelboat and larger keelboats called barges. In 1808, only twenty-five to thirty barges were to be found on the Ohio and Mississippi Rivers, the largest not more than one hundred tons burden. (Hartsough 1934: 29-31) The design and construction of the keelboats was predicated on the shallow channels of the Ohio and Mississippi Rivers. The flat-bottomed boats created a small draft which permitted a surer travel during periods of drought and low water. With the development of steampower, the keelboat gave way to the steamboat, a vehicle that combined the flat-bottomed design of the keelboat with the greater regularity and dependability of steam power. The rise of the steamboat and decline of the keelboat occurred especially in the early 1840s. In 1841, for example, 143 steamboats and 109 keelboats arrived in St. Louis from the upper Mississippi River towns. Two years later, steamboat arrivals had nearly doubled to 244 while keelboats entered St. Louis only half as often at 55. And by 1846, 663 steamboats were counted in St. Louis arriving from upper Mississippi River towns. (Hartsough 1934: 57, 67)

The first steamboat to travel from St. Louis to Ft. Snelling was the Virginia, which weighed over 100 tons and measured around 120 feet long with a 22-foot beam. She arrived on May 10, 1823, loaded with government stores for the soldiers in addition to a few passengers. (Hartsough 1934: 50-52) The fur trade, even before this, had moved its goods increasingly down the Mississippi as Americans came to dominate the trade more and more. (Hartsough 1034: 63-66) An irregular trade developed wherein furs were taken down river, while steamboats carried troops, provisions and trade goods up. (Hartsough 1934: 63; Petersen 1932: 224; Petersen 1930: 228) The early trade, however, was small and sporadic. The population above St. Louis was so small prior to 1840 that the only boats coming up to the head of navigation at St. Anthony Falls were chartered either by the federal government to transport military supplies or by the American Fur Company to handle its goods. (Hartsough 1934: 53-54)

The main focus of river trade during this period was not the head of navigation, however, but the booming lead regions of southwestern Wisconsin, northwestern Illinois and eastern Iowa. By 1820, even before the Virginia had steamed to Ft. Snelling, the lead traffic between St. Louis and the lead region had commenced and it remained the most important factors in steamboating for over twenty years. (Hartsough 1934: 63-65) Between 1824 and 1829, for example, the lead mines produced 31,764,862 pounds, while 34,901,205 pounds were mined between 1830 and 1834. (Merritt 1980: 90) Lead production boomed after that period. While 11 tons were shipped in 1835, the figure reached 39 million tons by 1846. (Hartsough 1934: 65) By 1848, an amazing 472 million tons had been mined and shipped. (Merritt 1980: 90; Petersen 1930: 230)

Steamboat owners responded to such shipping opportunities. The volume of transportation was brisk: in 1854, for example, 672 steamboats arrived in Dubuque. (Merritt 1980: 90) The large trade led, in turn, to cutthroat competition. Bitter price wars were waged in the 1840s as steamboat lines vied for business. (Petersen 1930: 230) While competition decreased steamboat lines profits, another competition, ultimately more dangerous to the steamboat lines, was developing simulatneously. In the 1840s, lead increasingly was transported via rail to Milwaukee. (Hartsough 1934: 66) The competition between merchants in lake ports and traders in Mississippi River ports forced the latter to more vigorously agitate for river navigation improvements. The progress of the railroads, however, inexorably led to a decline in the steamboat lead trade. New Orleans' receipts reached their peak in 1846 when 785,000 pigs or about 27,475 tons arrived in that southern port. By 1857, the Milwaukee and Chicago railroad had connections with the river and even the year previously, the river was shipping less than half of the Galena lead field output. (Nesbit 1973: 115)

Fortunately for the rivermen, new opportunities in trade and commerce opened creating an even greater proliferation of steamboat traffic. St. Paul had become a major entrepot for trade goods. After little traffic prior to 1840, upwards of forty steamboats arrived in St. Paul every year shortly thereafter. (Hartsough 1934: 53-54) At least one boat was advertised as a regular packet between Galena and Ft. Snelling by 1847 and in 1848, Dr. Franklin was put in to the Galena-St. Paul service. (Hartsough 1934: 162) Between 1848 and 1857, the steamboat traffic expanded rapidly. In 1857, despite the financial panic, 98 boats made 1,026 trips to St. Paul. (Toole 1959: 251) That same year, up to twenty steamboats could be docked at the St. Paul levee at one time and fifteen to eighteen were common. (Hartsough 1934: 102) Steamboat arrivals in St. Paul peaked in 1858 when 1,066 arrivals were counted; thereafter, a gradual decline began which foreshadowed the end of the steamboat era. (Toole 1959: 251; Hartsough 1934: 100)

Petersen considers this period of rapid steamboat growth between 1849 and 1870 the "Immigration Period." (Petersen 1946: 293-295) Passengers' receipts on the steamboats, according to Petersen, exceeded those of freight and remained greater until a railroad line was built parallel to the river on the upper Mississippi River. (Petersen 1946: 293-295; Hartsough 1934: 75) Migrants rushing into Minnesota after the Indian treaties used the steamboats as a means of transportation. (Blegen 1939: 387) More opulent tours for vacationers were provided by the steamboat lines as well. George Catlin, who made the trip from St. Louis to Ft. Snelling and St. Anthony Falls in 1835, did much to popularize the scenery of the upper Mississippi valley. The "Fashionable Tour," as it came to be known, provided tourists a summer excursion, the most famous of which was the tour ironically celebrating the arrival of the railroad to the river in 1854. (Blegen 1939: 378)

Immigration and tourism, however, were not the only kind of commerce in this "Immigration Period." The agricultural products of those farmers who had been immigrants years before became an increasingly significant commodity. As early as 1859, the value of wheat exported displaced furs as the chief export from

Minnesota. (Ernst 1963-4: 125) Grain as taken to market beginning in September after it had been harvested and merchants attempted to ship it before the river froze around November. If it did not get shipped, the grain was stored for the following spring, a circumstance obviously to be avoided. (Ernst 1964-4: 126) The activities led to frenetic autumn activities and booming river towns. McGregor, now a sleepy village in northeastern Iowa, was a prosperous city during the height of the grain trade during the steamboat era. At its peak, McGregor counted millions of bushels of wheat in its annual receipts and contained a mile of warehouses along the river bank. At marketing time, a thousand teams and wagons could arrive in the town in a single day. (Hartsough 1934: 78) Many bushels of grain did not get shipped before winter so they were stored in the river towns. In 1860, for example, an estimated 200,000 bushels of grain awaited shipment before the opening of navigation in the towns between LaCrosse, Wisconsin, and St. Paul. Moreover, another 150,000 bushels accumulated before navigation opened. (Hartsough 1934: 103)

The upper Mississippi River was never as important to Wisconsin agriculture as it was to that of Iowa and Minnesota. A primary reason was the prevalence of swift water and falls on the Wisconsin rivers which flowed into the Mississippi that limited their usefulness for grain shipments. (Nesbit 1973: 196) By the 1860s, however, most of the upper Middle West and particularly Iowa and Minnesota were benefitting from the steamboat traffic that utilized barges to increase the payload. Some barges might carry 10,000 bushels of wheat and by 1866, over 180 barges plied their trade from St. Paul with a tonnage greater than that of the steamboats themselves. (Hartsough 1934: 115-116)

Like the commodities of lead and passengers before it grain increasingly was shipped by railroads to points east. Generous government land grants permitted railroads to expand throughout the upper Mississippi River valley, and obvious advantages of railroad shipment facilitated the decline of river traffic. Railroads, unlike river traffic, could be utilized throughout the year without having to consider low water, floods or a frozen route. Moreover, the tendency toward east-west travel necessitated by the Civil War and encouraged by the increasing demand for grain in Europe made the railroad route a geographically more logical one. (Hartsough 1934: 202-203) Finally, a belief developed that southern dampness damaged grain. (Hartsough 1934: 187) Whether true or not, such beliefs in conjunction with the economic and geographic advantages of east to west commerce enabled the railroad to dominate trade and travel as the century wore on.

In addition to these natural advantages, rivermen claimed that railroad magnates were unfairly competing with waterways. Since railroad companies were not constrained by nature in developing transportation routes, they profitted from overland routes that faced no direct competition. Railroads could thus cut rates running in competition with the rivers and recoup their losses on these overland lines. According to the 1874 Select Committee on Transportation Routes to the Seaboard, all rail rates were 44.4

percent higher in winter than summer and were 40 to 50 percent higher on routes of similar distances where no competition existed. (Hartsough 1934: 204) Cutting rates was only one means employed by railroads to inhibit steamboat traffic. Bridges advocated by railroad companies were doubly iniquitous structures. Not only did they signal increasing land transportation, but rivermen claimed that their span sizes worked to endanger water traffic. (Shippee 1920: 497) The most insidious acts by railroads, however, were their purchases of steamboat lines and water terminals, and their harassment of customers who divided shipments between riverlines and railways. (Decker 1918: 174)

Although rivermen claimed their virtue when compared with railroad magnates, their economic transactions were not always above reproach and, at times, paralleled railroad activities. The cutthroat competition that had led to price cutting and rate wars in the 1840s and '50s ended in bankruptcy and withdrawal from the river by many companies. Big steamboat lines controlled most upper Mississippi River traffic by the 1860s. In 1866, for example, Northwestern Packet Company or the Northern Line owned 44 of the 63 steamboats and 145 of the 180 barges arriving in St. Paul. (Hartsough 1934: 175) Moreover, in 1873, Captain W. F. Davidson gained virtual control over the entire steamboat business through the formation of Keokuk Northern Packet Company. (Winther 1964: 77)

As the railroads were stretched across the upper Middle West, the steamboat traffic had to adapt to changing conditions of commerce. Before the railroads reached the Mississippi River, of course, the steamboats and their barges could market goods freely by moving them down to St. Louis. Minnesota did not boast a single operating railroad until 1862 and did not have through freight connections to another state before 1867 so movement to a place of transshipment fell into the rivermen's hands. (Ernst 1963-4: 124) As the railroad infrastructure developed, however, the place of transshipment moved increasingly closer to the point of production. In 1858, for example, the railroad reached LaCrosse so the steamboats could ship to this Wisconsin port before the goods were put on the train. (Ernst 1963-4: 126; Shippee 1920: 496) In this period, the railroad and steamboat formed a symbiotic relationship. The railroads served as feeder and supplements to water traffic so that every time a railroad reached the river, the outlet for agricultural goods was increased. (Hartsough 1934: 196; Shippee 1920: 496)

The inexorable march of the railroads across the continent continued, however, as the first railroad bridge to span the upper Mississippi River in Rock Island opened in 1856. (Hartsough 1934: 196) Moreover, the first all-rail route from St. Paul to Lake Michigan was opened in 1867, a road from St. Paul to Lake Superior began operation in 1870, and a more direct route to Chicago from St. Paul was completed in 1871. (Hartsough 1926: 225) As long as the railroads could not entirely ship the staple commodities, the steamboats could survive. But railroads continued to capture a great share of the trade. Railroad lines were built to major Great Lake ports and by 1872 there were three railroad routes between the Twin Cities and Lake Michigan.

(Hartsough 1934: 225) Rails crossed the river and in 1887, fifteen bridges spanned the upper Mississippi. (Hartsough 1934: 196) When they began to parallel the Mississippi River connecting the river towns, rails forced the rapid decline of steamboat traffic. By 1876, the railroad link from LaCrescent, Minnesota, to McGregor, Iowa, was completed so that St. Paul was connected by railroad with Prairie du Chien. (Shippee 1936: 496) The dominance of the railroad was complete. (Ranev 1936: 388)

Railroad dominance meant the decline but not the absolute end of river traffic. Although only 17 percent of grain went south by river and rail as early as 1874, 138 boats still carried passenger licenses on the upper Mississippi River and its tributaries wit( an aggregate tonnage of 1,144.45 in 1886. Likewise, 66 towboats with a tonnage of 4,894 and 100 barges with an average tonnage of 174.15 plied their trade in the river. (Hartsough 1934: 118; House Executive Document 6, 1888: 15) Moreover, as late as 1888, 1,918,396 tons of freight and 1,438,616 passengers to and from St. Paul were waterborne. This commerce, however, was usually short-haul. (Winther 1964: 77-78) More illustrative is the fact that only 6 percent of the grain moved south from St. Louis by 1900. (Hartsough 1934: 187) The one surviving line, the famous Diamond Jo, which sought customers through its luxuriance, went under in 1911. (Winther 1964: 77-78)

Lumber was a major staple in the river traffic after grain had reached its height and as the decline in river traffic was occurring due to railroad competition. From the mid-nineteenth century into the first decades of this century, the immense pine forests of Wisconsin and Minnesota were logged off and the majority of the wood was floated down the river to sawmills stretching south to St. Louis. Indeed, an estimated 46,974,110,170 board feet was floated down the river at a value of $704,613,300. (Blair 1930: 290) The output of the upper Mississippi River above St. Anthony Falls reached a high of 678 million board feet in 1899 and totalled 11 million board feet between 1848 and 1899. (Blair 1930: 37) Likewise, the rich pineries of Wisconsin produced around 15 billion board feet which was floated down the river between its boom period of 1885 to 1905. In the peak year of 1892, 632,350,670 board feet alone was floated out of the Chippewa River. (Annual Report 1894: 1711; Merritt 1980: 91-92) Petersen has determined that in weight 306 times as much wood as lead was shipped with a value 47 times greater. (Petersen 1960: 290)

The rafting of lumber down the Mississippi River can be divided into two periods according to the type of power used on the rafts. The initial period, which lasted until the end of the Civil War, was typified by floating rafts without any motive power. (Petersen 1960: 292; Belthuis 1948: 115-155; Fries 1951: 55; Larson 1949: 6) The logging began, according to one source, in 1839 and by 1843, the first raft which consisted of four rafts tethered together, carried half a million board feet from Stillwater to St. Louis. (Fries 1951: 55) The first steamboat used to tow timber downstream appeared as early as 1848, but this second period of raftboating did not begin in earnest until after the Civil War when the use of steamboats to speed lumber traffic was initiated. (Petersen 1960: 292; Belthuis 1948: 115-155; Larson 1949: 86) With the construction of the J. W. VanSant in 1869, the raftboat period began. And it remained a busy period for years. Indeed, the demand for towboats to be used in floating down logs was so great that the Shaw Lumber Company even bought its own towboat in 1870 to be sure that its goods would make it to the sawmills in good time. (Petersen 1960: 292; Reynolds 1948: 148)

The lumber traffic created boom towns ideally situated on the river not unlike those towns that benefitted from the grain trade. While the Wisconsin rivers which feed into the Mississippi were not ideal for grain transportation, they were essential to the lumber industry. With a number of improvements, they "could hardly have been more useful to the industry had they been created by lumbermen expressly for lumbering" according to one authority. (Fries 1942: 25) The lumber was brought down the Mississippi River in stages. The first stage was the running of lumber down the Chippewa River to Read's Landing, Minnesota. In this booming village, smaller rafts were coupled since the Mississippi River channel was wider and the larger units continued south toward the mills. (Reynolds 1948: 146)

Read's Landing, of course, benefitted from its ideal location. Raftsmen usually stayed in town as the larger rafts were fashioned. Certainly the atmosphere was bawdy in town where the colorful yet coarse rivermen stayed in one of the seventeen hotels and boarding houses and undoubtedly visited one or more of the twenty-one saloons. (Hartsough 1934: 76-77) But other river towns benefitted as well. In spite of attempts of Wisconsinites to mill the lumber within their state, lumber producing centers sprung up along the course of the river. Hastings, Red Wing and Winona in Minnesota, and over two dozen mills in Iowa, the largest of which were located in Dubuque, Lyons and Clinton, processed the raw wood brought from the Wisconsin and Minnesota pineries. The W. J. Young and Company mill in Clinton had the capacity of milling 450,000 board feet in eight hours. (Kleven 1946: 190) In 1869, Iowa river towns received and distributed more than half the lumber produced in Minnesota and Wisconsin--a total of 450 million board feet. Four years later, central and northern Wisconsin shipped nine-tenths of its lumber by way of Mississippi River tributaries, much of it reaching St. Louis, the lumber metropolis. (Fries 1951: 78)

As the lumber industry grew, the logging interest attempted to control the rivers by removing obstructions, building dams, and storing and exchanging logs. (Raney 1935: 88) Since the rivers were "navigable highways," the companies had to get charters from the Wisconsin legislature which were granted in 1866. The charters permitted the construction of booms, piers and wing dams to facilitate the driving and rafting of logs as long as such improvements did not impede the operation of other boats on the streams. "The legislation cleared the way," according to one historian, "for the movement of Wisconsin softwood timber out of the state." (Hartman 1942: 70) Although the lumbermen remained the major lobbyists for improved Mississippi River facilities between 1870 and 1910, they were often at odds with steamboat interests. (Merritt 1979: 162) The Rivers and Harbors Act of 1899 resolved the question with a clause which absolutely forbid the floating of loose logs "in such manner as to obstruct, impede, or endanger navigation" in streams "actually navigated by steamboats." (Fries 1948: 446) Minnesota and Wisconsin congressmen, however, succeeded in exempting the important logging streams tributary to the Mississippi from this proviso. (Fries 1951: 57)

The raftboating period encompassed the height of the lumber trade. In 1873, Stephen Hanks counted 135 lumber mills between St. Paul and St. Louis and 680 rafts going through Davenport with an estimated total of 275 million board feet of lumber. (Hartsough 1934: 119) At the height of the raftboating period, ninety steamboats towed logs and lumber between St. Paul and St. Louis. And the log rafts were often very large. One log raft was 1,400 feet long while another in 1896 was measured at 1,550 feet long and 270 feet wide. (Meyer 1929: 126) The decline, beginning in the 1890s, however, was rapid. The lumber industry simply was running out of forests. (Hartsough 1934: 122) Due to the lack of trees, the number of log rafts passing Winona which had been 2,700 in 1884 plummeted to 3 in 1915 and 0 afterwards. (Shippee 1920: 470) The last lumber raft travelled in August of 1915 to Ft. Madison, Iowa, powered by the steamer Ottumwa Belle. (Blair 1930: 33) More importantly, the demise of the logging industry coincided with the end of a packet trade era. "The Upper Mississippi," noted one historian, "ceased to function as a transportation system." (Merritt 1980: 93)

The period between 1910 and 1927 has been called the Excursion Period due to the activities of the Streckfus Line excursion boats. (Petersen 1946: 293-295) Although it was also a time of commercial decline, it was also a period when the seeds of a later river commerce renaissance were sown. Whereas as many as 5,468 boats passed Winona in 1892, the figure had dropped rapidly in the early twentieth century so that fewer than 300 boats and still fewer barges passed by 1918. (Hartsough 1934: 185-186) Moreover, the goods that were carried were of a low trade. Between the Missouri River and Minneapolis, for example, sand, gravel, rock and crushed stone accounted for 76.7 percent of all traffic i. 1929. (Sumner 1931: 358) To add insult to injury, the largest traffic on the upper Mississippi River was created by the United States Army Corps of Engineers which kept the river in shape for commerce. The Rock Island District, for example, in 1918 had "19 steam towboats, eight hydraulic dredges, five dipper dredges, four gasoline screw launches, twelve small gasoline paddle launches, 48 motor skiffs, 233 barges, and 145 office boats, quarter boats, fuel flats, store boats, speed boats, derrick boats, grasshoppers, dump boats, houseboats, and drillboats." (Merritt 1980: 96)

Just as the railroad had contributed to the decline of the river traffic, so did changing economic and governmental factors hasten the return of the upper Mississipii as a highway of commerce. While the discussion of river improvement and the impetus for that improvement will be discussed in the next section, the roots of the renaissance of the river should be outlined here.

In addition to water improvement undertaken by the United States Army Corps of Engineers, a government carrier service, the Inland Waterways Corporation, was established in 1924 to succeed the Inland and Coastwise Waterways Service which, in turn, was established in the War Department in 1920 to take over the service begun in 1918 and operated under the United States Railroad Administration. Tonnage, as a result of federal government intervention, did increase in the 1920s. While the rate of increase was greater on the lower Mississippi and Ohio Rivers, the traffic between St. Paul and the Missouri River was 148.6 percent greater in 1928 than in 1918. (Sumner 1931: 356-358) As General T. Q. Ashburn noted in 1926: "The basic fact stands out that in 1900 common water carriage, as it formerly existed on the Mississippi River, had disappeared, its revival began in the twenties, and in 1926, more freight was transported upon the Mississippi River than ever before in its history." (Petersen 1972: 390-391)

This increase in river traffic ushered in the Towboat Period highlighted by the inauguration of the Federal Barge Line service on the upper Mississippi River in 1927, the building of modern terminals by city governments, and the nine-foot channel. (Petersen 1946: 293-295) While tonnage levelled off in the early years of the Depression, it grew rapidly in the later 1930s. (Hartsough 1934: 255) Moreover, although many of the commodities carried were of low grade (Annual Reports 1922: 1264-1267; 1935: 1906; Merritt 1980: 96), the Inland Waterways Corporation sought to obtain relatively high revenue freight. The I.W.C. in its 1930 Annual Report wrote: "If there is to be supplementation, and cooperation of rail, water and motor carriers, it is not going to be arrived at by taking the 'filler' cargo from one and giving it to another, or the high revenue cargo from one and giving it to the other." (Sumner 1932: 12)

As expected, the governmental improvements not only increased tonnage, but improved the economic health of the river towns. The increasing upper Mississippi tonnage compelled the Davenport Democrat on October 13, 1935, to project a "huge tonnage" that was destined to make the Quad Cities a "great industrial site." (Petersen 1972: 396) When the nine-foot channel was completed in 1939, the Federal Barge Line fleet and other private carriers brought the tonnage past the million mark. (Petersen 1972: 396) The deeper channel had allowed larger barges to ply their trade on the upper Mississippi. The Annual Report of the Inland Waterways Corporation in 1940 wrote that the average loading of coke and coal had reached 1,960 tons per barge and added that it was "the heaviest average loading of this commodity that the corporation has been able to accomplish." (Petersen 1972: 398)

Pressure from private firms led to the dissolution of federally-owned and operated barge lines, but the federal government had been successful in reviving the commerce on the upper Mississippi River. By 1946, for example, the tonnage already surpassed that transported during the height of steamboating on the upper Mississippi before the Civil War. (Petersen 1946: 295) In that year, three towboats could push as much freight upstream in a single trip as the boats of the Diamond Jo line averaged annually during the period 1900 to 1910. Likewise, the weight equal to the lead carried by the 365 steamboats between 1823 and 1848 could now be transported in one season by one tow, appropriately named the Herbert Hoover. (Petersen 1946: 300)

Traffic continued to increase. In 1961, the freight received in Minneapolis and St. Paul reached almost 3.5 million tons consisting primarily of coal, burner oils and gasoline while outgoing barge freight totalled over 900,000 tons. (Blegen 1963: 560-561) The number of towboats in 1972 was about equal to the number of steamboats in the heyday of steamboating. The tonnage, however, was different. In 1858, for example, twenty-three steamboats discharged 2,500 tons on the St. Paul levee; yet in 1972, the average is seven times that on a single trip. (Petersen 1972: 400)

As river traffic developed, declined and revived throughout this period, the federal government through various agencies, but primarily through the U.S. Army Corps of Engineers, was maintaining and improving the Mississippi River channel. Importantly, however, the expenditures in this effort were not set in relation to the use of the river. Indeed, as traffic declined near the turn of the century, expenditures increased rapidly. Yet pressure groups continually argued for river improvement in an attempt to provide competition for railroads and thus set a competitive pressure on their rates. In the next section, we will extensively examine the growth and development of river improvement on the upper Mississippi River culminating in the channelization of the river through use of locks and dams which ultimately led, along with other market forces, to the rival of the river.

## 7. HISTORY OF RIVER IMPROVEMENT

The Mississippi River and its tributaries have long been perceived as an ideal avenue of trade and commerce. One president, Herbert Hoover, reported that a predecessor centuries before had noted the importance of the river to American growth and argued for improvements. "Prompted by these actual observations," George Washington said, "I could not help taking a more contemplative and extensive view of the vast inland navigation of these United States, and could not but be struck with the immense diffusion and importance of it, and with the goodness of that Providence, which has dealt her favors to us with so profuse a hand. Would to God," he concluded, "we may have the wisdom to improve them." (Hoover 1928: 24) Likewise, James Madison was more specific when, according to Theodore Roosevelt a century later, he advocated the canalization of the Mississippi. (Theodore Roosevelt, Lakes-to-the-Gulf Deep Waterway Association 1907: 34) Unfortunately, for the river interests, the canalization of the Mississippi formed a long and tortuous path of interest group pressure, pork barrel legislation, market forces and public works until completion in the twilight of the New Deal.

Like riverboat traffic, the improvement of the upper Mississippi River can be periodized according to developments along its route. Raymond H. Merritt, in his study of the St.

Paul District of the U.S. Army Corps of Engineers, argued that the district's periods were largely based on the depth of the channel. After the "steamboat era" which lasted from 1830 to 1877 came the "four and one-half foot channel" period lasting from 1878 to 1906. The four and one-half foot channel consumed $11,676,356.76 in federal monies to maintain its depth. The "six-foot channel" period followed, lasting from 1907 to 1930 when Congress authorized a deepened channel through increased dredging and construction of wing dams and spent over $52 million in the process. The briefest period, according to Merritt, was the "nine-foot channel" period when (through the construction of locks and dams) the upper Mississippi River became a slackwater canal. Finally the period which lasts to the present day is called the "commercial and recreation waterway" period when commercial navigation returned to the upper Mississippi. (Merritt 1979: 157-158)

Such a periodization has obvious merits. It divides the improvement of the river into periods when the physical characteristics of the river were altered. And while this report will also rely on this basic periodization of river improvement, changes in the <u>mentalite</u>, and the rationalizations for funding river improvement among proponents were so important in each period that they must be explicated at the outset. The steamboat era (1830-1877) was a period of heavy use of the river in spite of the paucity of river improvement. Those agenices which argued that improvement was imperative were primarily state legislative bodies. Moreover, the improvement undertaken was spotty, designed to dredged here and there, and use snagboats in appropriate places so the shallow draught steamboats could make their way up and down the river.

The four and one-half foot period was similar to the days before major improvements since pressure groups remained state agencies by and large and because congressmen enacting the periodic rivers and harbors bills were oftentimes concerned simply with the pork-barrel legislation that could be enacted to aid their districts without primary concern for the long range or wider consequences of their actions. This period, however, presaged many changes in river policy to become more apparent in the later eras. The channel at four and one-half feet was largely the outcome of the Select Committee on Transportation Routes to the Seaboard (otherwise known as the Windom Committee) which studied the needs of the landlocked regions of the United States in order to better understand the needs of river and rail improvement. The Committee was intellectually tied to an earlier Whig tradition which argued that federally funded internal improvements would create a "system" or infrastructure that would in turn facilitate economic development. Accordingly, it urged railroad regulation and river improvement to naturally control railroad rates, both of which would aid the inner regions of the United States.

The next period realized the goal adumbrated in the late nineteenth century. While a six-foot channel was authorized, this was also the period when federal studies were undertaken to determine the long-range effects of river improvement. A development symptomatic of the Progressive Era, the six-foot channel was an attempt to provide a system of river improvement rather than periodic stop-gap meaures to control the river. Theodore Roosevelt, in forming the Inland Waterways Commission, revealed his concern for creating a transportational infrastructure not solely dependent on the railroad. By promoting the development of a revived river traffic, the railroad would be naturally regulated, the transportational infrastructure would be enhanced, and commerce, which would benefit all economic sectors, would be encouraged. While this period was an era when the Whig system was completed, it was also a time when pressure groups formed to argue the merits of Mississippi River improvement. Certainly pressure had existed before, but the early twentieth century was an era when specific organizations such as the Lakes-to-the-Gulf Inland Waterways Association or the National Rivers and Harbors Congress became prominent.

The nine-foot channel period was an extension of the six-foot channel era in terms of stress placed on a systematic river improvement. Indeed, the nine-foot channel was agreed upon because it remained consistent with the channel already completed on the Ohio River. Moreover, the dimensions of the locks on the upper Mississippi were designed to confirm with those also on the Ohio. Republican presidents, encouraged by river improvement pressure groups and politicians in the Middle West, continued to argue for a deeper channel throughout the twenties. And the authorization of the nine-foot channel was an achievement of the Hoover administration. Yet it was only through the efforts of the New Deal and Franklin D. Roosevelt that the canalization of the upper Mississippi River was completed so quickly. Carrying on the Federalist tradition, Hoover had desired canalization. But since its costs apparently were prohibitive to complete the project in one massive undertaking, the plan called for initial locks and dams to facilitate the six-foot channel that would become a part of the eventual nine-foot channel system. It was only through the administration of Roosevelt in the depths of the Great Depression that a Keynesian public works program was instituted to create employment for those without employment and to provide river improvement for those who desired an improved traffic infrastructure.

The nine-foot channel through the construction of locks and dams on the river was thus the culmination of numerous projects which steadily deepened the river. But as we examine each stage of development based on the river's depth, we must remember the background of such development in government policy and the conceptions behind river traffic creation. The systematic river improvement which arose out of the Progressive movement in the early twentieth century was complemented by the public works projects of the New Deal. If two presidents are to be credited with the canalization of the upper Mississippi through the creation of locks and dams along its course, the two very different figures of Hoover and Franklin Roosevelt must be named.

Steamboat Era:

As steamboats plied their trade up and down the upper

Mississippi River, they often faced the hazards and uncertainties of low water. Regular schedules were often impossible if droughts prevented the necessary runoff for river travel. St. Paul was the original head of navigation for steamboats. Below the city, however, was a narrow channel made more hazardous by swift currents until the Mississippi met the St. Croix and a wider river became divided by islands and bars which distributed the flow through chutes, secondary channels and sloughs. On the average, one bar every three miles seriously obstructed navigation during the low water season and often limited depths to three feet or less. In some years, the problem became even more acute. In 1864, for example, at extreme low water, a depth of only fifteen inches existed in stretches between St. Paul and the St. Croix River mouth. (Senate Report 36, 1884: IV; Annual Report 1930: Part 1, 1189) Moreover, before regular improvement began in 1878, larger boats simply could not proceed farther upsteam than LaCrosse or Dresback due to high sandbars where the maximum depth at low water was often not more than two and one-half feet. (Annual Report 1965: 1612; Thompson 1917: 301; House Document 341, 1907: 5)

Throughout settlement of the upper Middle West, newly arrived residents petitioned the federal government for river improvement. The Miners' Express of Dubuque in November of 1843 argued that "Congress should turn its attention to the improvement of Western waters--the people of the entire North West demand it, for it affects not only their own interest, but the trade of the whole valley of the Mississippi!! Let her representatives remember this, let them make for once an appropriation for the West, and if done, let us have no wasp-waisted dandies imported to oversee the work, but put it in the care of some sound old practical pioneer who will not waste the money in wild-goose pranks." (Iowa Journal of History and Politics 1916: 266) The tenor of the demand for improvement was often couched in anti-eastern terms, a regionalism that would color the arguments for waterway improvement up until the adoption of the nine-foot channel. The same editorial noted that "no part of the whole Union has paid more clear cash into the coffers of Uncle Sam, than the young and prosperous States of the West, bordering upon the mighty Mississipii and her tributaries. What return has the Government ever made to the pioneers for piling in their dollars and making the wilds of savage life 'bloom and blossom like the rose'? None whatever!!" (Iowa Journal of History and Politics 1916: 265) Likewise, the powerful eastern interests seemed to dominate the federal government so that "the fostering hand of Government has never been held out to the West, alone, unaided, she has had to contend against great obstructions and impediments;--while old and worn-out States which neither God nor nature seemingly ever designed for habitation or cultivation, have been the recipients of millions of dollars." (Iowa Journal of History and Politics 1916: 265-266) The editorial stressed the dangers of river travel noting that "within the last few years there has been more property destroyed upon our Western rivers than would clear them of snags, rapids, and all other obstructions!!" And it concluded that "our Government was kind enough to create an Agency to filch a fifth from the hard earnings of the laborious miner,--but Congress has never had magnanimity scarcely to vote one dollar for the removing of the obstructions of the Rapids, which are the great impediment to the transporting of our useful staple." (Iowa Journal of History and Politics 1916: 266)

In spite of these pleas for improvement, it was the state governments that played a dominant role in arguing for river improvement. The Minnesota state legislature continued to send memorials to the United States Congress pleading for river improvement. In 1856, for example, it wrote that "the magnificent resources of the Territory of Minnesota have been developed by the facilities which that great stream has afforded for its settlement and improvement by a hardy and industrious race of pioneer. Between Galena and St. Paul, daily lines of first-class steamboats ply during the season of navigation; but from St. Paul, or rather Ft. Snelling, to the town of St. Anthony, at the Falls of St. Anthony, there are serious impediments in the navigation of the river, which the petitioners think should be removed by the general government, in order to aid in the settlement of the country. . ." (House Report 72, 1856: 1) This stretch of river between Minneapolis and St. Paul would continue to be a battleground over river improvement until the initial lock and dam was built in the early twentieth century. While such structural improvement might have seemed a pipe-dream in the mid-nineteenth century to some, others had even more grandiose plans. "Some think that the Falls [of St. Anthony] might be removed with some expense," wrote the Daily Minnesotan on September 22, 1854, "so that boats could run uninterruptedly over them." (Kane 1966: 174)

Increasing requests for improvement did yield results for the early residents of the upper Middle West. As early as 1824 the United States government appropriated about $75,000 for the removal of snags from the Ohio and lower Mississippi Rivers to be conducted using snagboats by the Chief of Engineers of the U.S. Army. (Hartsough 1934: 48) The upper Mississippi would have to wait another forty years until improvement began. In 1867, two dredge boats were employed between the Rock Island Rapids and St. Paul deepening sandbars and removing snags. (Upper Mississippi River Improvement Association 1908: 112; Senate Report 307, 1874: Part 1, 211) Six years later, channel contraction using wing dams was begun. While the wing dams were built on the upper Mississipii River by private interests before 1840, the first government activity, which would develop into a large-scale program, began when the snagboat Montana constructed a wing dam at the head of Pigs Eye Island. (Upper Mississippi River Improvement Association 1908: 123) Later government wing dams were placed at Nininger Slough in 1875 and 1876. (Anfinson n.d.: 2) Later still, wing dams were begun at Beef Slough in 1878 in order to create a four-foot channel where low water points previously had ranged from thirty inches to three feet and at Smith's Bar (six miles below Prescott) in 1879. (Senate Report 36, 1884: IV, V) Until 1880, river contraction using wing dams in conjunction with dredging and snagging were the chief improvement work.

(Hartsough 1934: 262) But it remained fairly successful in maintaining a deepened channel. According to a 1874 report, a tnree to three and one-half foot channel had been achieved in most places. (Senate Report 307, 1874: Part 1, 211) Moreover, wing dams, probably because of such success, were extensively used in later projects. By 1927, 300 wing dams existed in the thirty-mile stretch between St. Paul and Prescott, 400 in the forty-mile stretch between Wabasha and Winona, and many others along the upper Mississippi. (Hartsough 1934: 262) Yet, in addition to wing dams, government engineers cleared river banks of trees, graded the banks down to prevent cave-ins, and anchored them down with willow mattresses weighted with rock. (Hartsough 1934: 262)

If the improvement was adequate to provide for steamboat travel, however, it was not capable of permitting rivermen to compete effectively with the growing railroad networks. Individuals were becoming increasingly concerned about the growth of the railroads and their ability to dictate prices. Governor Horace Austin of Minnesota in his 1870 inaugural address, for example, argued that railroads created by the state and given bountiful land grants refused to act "with any reference to the public good." T(ey based their rates, he continued, according to "how much can the producer be compelled to pay rather than not attempt to have his produce moved to market." (Lambert 1975: 5) Ironically, the concern in developing a minimum channel throughout the course of the Mississippi was not due to increased traffic, but to the fear that riverboat traffic would decline still further. That development which began with the Windom Committee report will be discussed next.

## The Four and One-Half Foot Channel Period:

Politicians, particularly those from the interior regions of the United States, continued to stress the inadequacy of transportation routes to the seacoast as the 1870s progressed. William Windom, senator from Minnesota, noted in 1873 that it was "an admitted fact" that transportation facilities to the coast were "totally inadequate." Moreover, he argued that those which did exist were controlled by "powerful monopolies who dictate their own terms to the people. The burdens they impose upon both consumer and producer are too grievous to be long endured." If the United States could cheapen transportation, however, "our products will command the markets of Western Europe. Then our agricultural interests, now crushed by a rapacious despotism, and dying from neglect, will revive; the tradesmen and manufacturers of the East will find a market for their goods, and the products of our corn, wheat and cotton fields will very soon pay our debts to foreign nations and turn the balance of trade in our favor." Windom emphasized that to the farmers forced to burn their summer corn for winter fuel because of prohibitive marketing costs, the question of cheap transportation "overshadows all others. Party lines and party platforms sink into utter insignificance in the face of questions involving the right to live." (Congressional Record, 3d Congress, Special Session 1874: 199)

Such was Windom's first call for a Select Committee on Transportation Routes to the Seaboard, the report of which was submitted to the Senate on April 24, 1874, for publication. In his speech to the Senate on that day, Windom summarized the Committee's conclusions. "Cheap and ample facilities for the interchange of commodities between the widely separated sections of our country, and with foreign nations," Windom argued, "constitute the prime conditions of national progress and prosperity. By reason of the failure of existing systems of transportation to fully meet these conditions, commerce is impeded, agriculture languishes, labor is inadequately rewarded, food is unnecessarily taxed, exportations are diminished, and nearly all the most important business interests of the country are depressed." (Congressional Record, 43d Congress, 1 Session 1874: 3335) Windom argued that competition between railways was "wholly unreliable and utterly inefficient" and that better rates would be obtained "only through competition under governmental control, and operating through cheaper means of transport than are now provided; and such cheaper means of transport can only be provided by the construction of double-track freight railways, or by the improvement and creation of water-routes." (Congressional Record, 43d Congress, 1 Session 1874: 3343)

For various reasons, the improvement of waterways was the remedy recommended by the Committee to achieve cheap transportation. Windom stated in his speech that "the uniform testimony deduced from practical results in this country, and throughout the commercial world, is, that water-routes, when properly located, not only afforded the cheapest and best-known means of transport for all heavy, bulky, and cheap commodities, but that they are also the natural competitors and most effective regulators of railway transportation." (Congressional Record, 43d Congress, 1 Session 1874: 3342) Among the four water-routes recommended for improvement was the Mississippi River which would be "improved, created, and owned by the Government, and stand as permanent and effective competitors with each other and with all the railways . . . within the range of their influence." (Congressional Record, 43d Congress, 1 Session 1874: 3344)

The 970-page Select Committee Report on Transportation Routes to the Seaboard reiterated Windom's conclusions. (Senate Report 307, 1874) Railroads, it argued, cut rates running in competition with the rivers and recouped their losses on other lines without direct competition. Accordingly, all rail rates were 44.4 percent higher in the winter than in the summer and were 40 to 50 percent higher on routes of similar distances where no competition existed. (Hartsough 1934: 204; Senate Report 307, 1874) The report stressed the savings in transportational costs that would accrue from waterway improvement. "Upon the completion of the entire improvement of the Mississippi River," it wrote, "wheat and corn can be transported from Minnesota, Iowa, Wisconsin . . . and other states above Cairo to New Orleans for an average of 12 cents per bushel, and that the cost from Saint Paul will not exceed 17 cents. The average rate from New Orleans to Liverpool . . . can be reduced . . . to 18 to 20 cents by the improvement of the mouth of the river." Thus the cost from St. Paul to Liverpool which in 1872 was 67.5 cents per bushel would be reduced to 39 cents. A total of at least $42 million in transportational cost savings would result. "But for the fact that large quantities of corn were unable to find a market," the report continued, "on account of the high transportation charges, the amount moved would have been very much greater." In other words, in addition to cheaper transportation which would benefit the upper Middle West, the producers would be able to market even larger surpluses due to lower fares. (Senate Report 307, 1874; Senate Document 325, 1908: 591-592) The Committee concluded that no plan for reducing transportation costs offered such immediate and effective results in proportion to the expenditures as improvement of the Mississippi River. (Senate Report 307, 1874; Hartsough 1934: 213) In view of increased competition for the railroads, cheapened transportation for the producer and consumer, the Committee recommended improvements designed to secure a five-foot channel at the lowest stages between St. Paul and St. Louis and four and one-half feet above St. Paul. (Senate Document 325, 1908: 586; Hartsough 1934: 213)

Reaction to the report in the upper Middle West was largely favorable. The Winona Republican praised the Committee's effort calling it a "bold and comprehensive scheme for establishing a permanent self-regulating system of cheap transportation under the auspices of the Nation." The St. Paul Daily Press concurred arguing that improved water routes would "emancipate the country from the chains of the railroad monopoly." LIkewise, the Minneapolis Tribune called the report "comprehensive as well as vigorous and lucid." Some papers praised Windom such as the St. Peter Tribune which congratulated him for having submitted "one of the most able and important reports that has been presented to the Senate for many years. . . . It has added much to his reputation as a profound thinker and a sound reasoner." Others noted the political implications of the plan. The St. Paul Pioneer called the report "the strongest Grange and anti-monopoly tract which has yet appeared in print." (Winona Republican, April 27, 1874; St. Paul Daily Press, April 29, 1874; St. Peter Tribune, May 6, 1874; St. Paul Pioneer, April 28, 1874)

Although Windom's actions were a watershed in the development of a plan for river improvement, he certainly was not the first individual or agency to recommend river improvement. In fact, the Windom Committee's report should be seen as the culmination of initial attempts to force federal improvement of the waterways. The Minnesota legislature, in one of its many memorials to the United States Congress, adumbrated Windom's argument in 1866. The Mississippi River, it wrote, "is now and will ever be and remain the great regulator and moderator of fare and freights among the rival carriers of the commerce of the west. All recollect with what haste and facility the various railroad lines combined to increase the cost of travel and double, and in some instances triple and quadruple, the cost of transporting the produce of the west during the late non-intercourse measures in the lower Mississippi. So enormous were their rates, that high as all kinds of produce were, the agriculturalists and other producers could not realize any remunerative returns, as all was swallowed up in commissions and freights, but which speedily receded as soon as the manacles of war were removed from the great fathers of waters." (Senate Miscellaneous Document 54, 1866: 3) Moreover, the railroads were "but the extensions of lines running east and west," it argued, "giving the commerce and intercourse of the country a sectional bearing and turning the trade over more expensive and unnatural channels. The north naturally wants what is produced or grown in the south, and the south wants what is grown or prduced in the north. To supply one section with the surplus which can be spared by the other, is just the business and appropriate office of commerce, and all the improvements of a growing and commercial people should be directed accordingly." (Senate Miscellaneous Document 54, 1866: 2)

Other memorials were more specific. As Minneapolis was developing as a major commercial center, complaints were often voiced in regard to the rapids below St. Anthony Falls. An 1868 memorial argued that "the States situated on the Mississippi River have contributed their share and paid their proportional part into the treasury of the United States for the improvement of the navigation of the Atlantic Coast, as well as that of the lakes. To your memorialists it seems to be a matter of even-handed justiced that some small appropriation [to say the least] should be made for the improvement of the navigation of the Mississippi River . . ." (Senate Miscellaneous Document 21, 1868: 1, 2) Specifically, the Minnesota legislature was concerned with the dangerous rapids and obstructions between Ft. Snelling and St. Anthony Falls, a stretch that "is so obstructed during the season of low water, by rocks and other impediments, being the most of the above-mentioned distance rapids, as to render it difficult and dangerous for navigation." (Senate Miscellaneous Document 21, 1968: 1) The solution, according to the memorialists, was a dam "to make slackwater navigation" to St. Anthony Falls during the entire season of navigation, a plan that had been recommended a year previously by a government study. With a lock and dam at Meeker's Island and the construction and operation of two dredges and snagboats, the stretch of river could be controlled. (House Executive Document 58, 1867: 2; Senate Miscellaneous Document 21, 1868: 1; see also House Miscellaneous Document 29, 1860, for another memorial that recommends improvement between St. Anthony Falls and Ft. Snelling)

The Windom Committee's recommendations were important, however, since they not only recommended a uniform channel depth, but because they advocated the first comprehensive plan that would be designed to benefit "the common good" of the United States. Moreover, the Committee emphasized that they were not interested in only one stretch of the river, but were arguing for a widespread development that belied the "pork-barrel" charges that had been levelled against the river improvement in the past.

The most obvious achievement of the Windom Committee was the eventual approval of the four and one-half foot channel. (Cooley 1902: 29) This "permanent and systematic improvement" for the stretch between St. Paul and the mouth of the Ohio River was authorized on June 18, 1878, by Congress. (Anfinson n.d.: 2; Upper Mississippi River Improvement Association 1908: 123;

Hartsough 1934: 215; House Document 341, 1907: 5) This improvement, as the Windom Committee stressed, would force the railroads to charge competitive prices. (Annual Report 1884: 1552) Appropriations for improvement were made from year to year so the limited money available made it necessary to improve the localities where the greatest difficulties to navigation had been experienced, such as LaCrosse where the river threatened to take a course that would leave the city without a navigable channel. (Hartsough 1934: 269; Thompson 1917: 301-302) Improvement in these trouble areas was made through use of dredging, construction of wing dams which contracted the river, and construction of reservoirs in the north which increased its flow during periods of low water. (Hartsough 1934: 269; House Document 341, 1907: 2) Moreover, the Rivers and Harbors Bill of 1879 created a Mississippi River Commission to develop an overall plan for channel control. (Hill 1961: 284)

Although the four and one-half foot channel era encompassed the development of reservoirs and the initial stages of an upper Mississippi River lock and dam system, it was primarily a period of wing dams, dredging, and revetment. Wing dams and related shore protections were fabricated out of willow saplings and rock. In wing dams, the proportion of brush to rock was about two to one, although in stretches of strong current, the ratio of brush to rock could be doubled. The wing dam protruded from one or both banks of the river and forced the current to go around their ends which created a narrower channel with greater scour. When a river bank was endangered due to the greater velocity of the river, rock and brush shore protection was also constructed. Moreover, closing dams which cut off backwater channels were also built to maintain a greater flow in the main channel. (Anfinson n.d.: 1-4; Hill 1961: 287)

Most of the work was undertaken by the federal government under the auspices of the United States Army Corps of Engineers, but state governments did play a small role. In 1866, for example, the Wisconsin legislature granted authority for the construction of booms, piers and wing dams to facilitate the driving and rafting of logs on Wisconsin rivers which flowed into the Mississippi River, provided such improvements did not impede the operation of boats on the streams. "This legislation," notes a historian of the lumber industry, "cleared the way for the movement of Wisconsin softwood timber out of the state." (Hartman 1942: 70)

Even before the Windom Committee report stressed the need for improvements later adopted, a government study of river improvement in 1867 argued that by using dredges to control sandbars, a four-foot channel could be secured up to the mouth of the St. Croix River on the main Mississippi channel and then a three-foot channel up to Ft. Snelling. (House Executive Document 58, 1867: 2) One year later, another government study urged the use of two dredges and snagboats in the continuing years and argued for the use of wing dams. Wing dams had been unsuccessful on the Ohio river due to the wide range in its river stages, it noted, but they appeared to be useful on the Mississippi River. (House Document 247, 1868: 6)

Although wing dams were built as early as 1840 and the first attempt of permanent channel improvement by the federal government was made in 1873 at the head of Pigs Eye Island where navigation had been completely blocked, it was in the four and one-half foot channel period that wing dam construction flourished. The success at Pigs Eye Island through the efforts of the snagboat Montana convinced officials to employ snagboats for a portion of each season thereafter working in closing side chutes and building shore protection. (House Document 341, 1907: 5) Between 1878 and 1908, construction of wing dams increased still further. In keeping with limited funding provided by the federal government, the dams were concentrated in trouble areas of the river where flow was impeded. Over 1,000 wing dams were built in the first six pools of the upper Mississippi while in Pool 5A alone, about 140 were constructed. (Anfinson n.d.: 1) Likewise, between St. Paul and Prescott, a stretch of 32 miles, 251 dams, dikes and revetments and other work for controlling flow of water were erected between 1878 and 1908, while another 50 structures were built in the next twenty years. (Merrick 1909: 225; Hartsough 1934: 262) Finally, 257 dams were built between Read's Landing, Minnesota, and Minneiska, Minnesota, a stretch of only 20 miles, between 1866 and 1930. (Merritt 1979: 172)

Walter A. Blair, a long-time rafting pilot, noted the proliferation of the wing dams, not without some disdain. The first wing dam he could recall was constucted at the mouth of the Black River on the Mississippi in 1878. "Now [in 1930]," he wrote, "we have three hundred wing dams in the thirty miles between Prescott, Minnesota, and St. Paul. There are over four hundred between Winona and Wabasha, Minnesota, a distance of forty miles, and they are quite numerous all the way down the Mississippi . . ." (Blair 1930: 89) Although a rafting pilot might have viewed the wing dams which contracted the river's channel with some chagrin, the wing dams played an essential role. Congressional politics, for example, stalled Rivers and Harbors legislation between 1885 and 1887 and the river became nearly impassable in some sections. (Annual Report 1886: 250; Merritt 1979: 174)

Dredging became less important after the wing dams were constructed, but it was continued nevertheless. Bars which needed immediate temporary deepening were dredged; so were river bottoms which resisted the effects of a contracted channel. (Annual Report 1884: 1551; Anfinson n.d.: 5) Moreover, dredging worked as a natural complement to wing dam construction. A narrow cut through a sandbar facilitated the work of wing dams in increasing scour; conversely, in some cases, the dredged material was used for a foundation of a proposed wing dam. (Anfinson n.d.: 5; Annual Report 1912: 2147)

Success of river improvement was often praised by observers and usually rewarded with continued federal appropriations. In 1884, for example, the channel between St. Paul and the mouth of the St. Croix River, a continual trouble spot, was nearly two feet deep, an incredible improvement over the fifteen-inch channel that had existed only twenty years previously. Moreover, the trouble spots such as Smith's Bar, six miles below Prescott, were continually being improved. Likewise, the use of wing dams begun in 1878 around the Beef Slough created a four-foot channel which had once been as low as thirty inches. (Senate Report 36, 1884: IV, V) Because of the favorable results on improvement, moreover, appropriations continued to increase. In 1884, an allotment of $1,000,000 was recommended for the Mississippi River between the Illinois River and St. Paul. (Senate Report 36, 1884: XXIII). Up to January 1, 1887, the United States government had spent $1,263,205.02 on river improvement between St. Paul and the Des Moines Rapids. (House Executive Document 6, 1888: 18) After the stalled legislation between 1885 and 1887, Congress in 1888 provided a continuing appropriation to keep the dredges operating. (Merritt 1979: 174) Finally, beginning in 1888, work on the upper Mississippi was made a continuing project with annual appropriations of $25,000. (Upper Mississippi River Improvement Association 1908: 122)

The history of the Rivers and Harbors Bills in the late nineteenth and early twentieth centuries reveals the added concern for internal improvements. In 1890, the four and one-half foot channel project was extended from St. Paul to Minneapolis. Six years later, the largest approbriation up to that time was approved--a bill appropriating $70 million. Successful legislation in 1899, 1902 and 1905 was accompanied in 1901 by the failure of a bill that was filibustered to death. By 1907, however, another record was set when $80 million was set aside for river and harbor improvement. (National Rivers and Harbors Congress 1912: 13; U.S. Army Corps of Engineers 1974: 1) The year 1907 was a banner year for the upper Mississippi River as well. After expending $10.2 million, the four and one-half foot channel project had been completed. (House Document 341, 1907: 2; Hartsough 1934: 269) As John Lathrop Mathews pronounced in 1909, navigation on the upper Mississippi from the Minnesota River downstream was an actual fact. "With the work at the two rapids [the Des Moines and Rock Island Rapids]," he wrote, "and the regularizing improvements, a reliable channel, four feet six inches deep at low water, has been provided from St. Paul down to the mouth of the Missouri." (Mathews 1909: 161)

In addition to the contraction of the river through the use of wing dams and the like, more visionary projects were also undertaken in the four and one-half foot channel period. Early designs of regulating the river flow included a plan devised by Ellet which would construct storage reservoirs in the upper Mississippi River near its source. Not only would the reservoirs add to the flow of the water in dry seasons, they could be used to prevent floods in the spring. Ellet's design, which was first suggested in 1850, was improved although based on the same principle by Marshall Leighton, chief United States hydrographer, decades later. (Hartsough 1934: 263-264) Beginning in 1880 and again in 1899 and 1907, reservoir dam projects were approved. The three projects constructed six reservoir dams at the headwaters of the Mississippi which cost $1.5 million by 1925. But they served their purpose. The flow from the reservoirs could increase the stage of the Mississippi River at St. Paul by an average of one and one-half feet during low water months and by one foot during periods of protracted drought according to a 1927 report. (House Document 583, 1827: 11, 12)

More futuristic still was the incipient lock and dam projects. As early as 1867, a government report considered a lock and dam at Meeker's Island the only way to provide "a thorough improvement of the last two mile stretch" leading up to St. Anthony Falls in Minneapolis. The report called for a dam with a thirteen-foot lift at a total cost of $235,665.48. (House Executive Document 58, 1867: 30) Another government report issued twenty-two years later extended the project proposal. After an 1874 report had proposed a lock and dam with a lock chamber of 300 feet by 80 feet to extend navigation to the old steamboat landings below the Washington Avenue bridge, this 1889 study argued that only one lock and dam would not prove sufficient since the river had to be improved up to the initial lock and dam. (House Executive Document 158, 1889: 9) According to the researchers, the Mississippi River channel below Meeker's Island could be improved through dredging and contraction, but although this would benefit navigation, it would not meet the demands of an extensive river traffic. A more suitable improvement included traditional dredging and wing dam construction in addition to a lock and dam system that would create a four-foot channel. Up to a point 2,400 feet above the Minnehaha Creek mouth, improvement could be achieved through dredging and wing dams. From there to Minneapolis landings, two locks and dams were to be constructed. The first, called No. 1, would be built 2,400 feet above Minnehaha Creek with a nine and one-half foot lift. Lock and Dam No. 2 would be 4,510 feet above No. 1 and 1,100 feet below Meeker's Island and have a fifteen and one-half foot lift. The total cost would be $2,361,060.79. (House Executive Document 158, 1889: 9, 10)

The lock and dam project was the result of continual Minneapolis pressure on the federal government for river improvement in the reaches immediately below the city. In 1894, Congress finally passed a $1.466 million bill for the construction of two locks and dams between St. Paul and Minneapolis. (Fullerton 1906: 497) The plan included two locks and dams--one to be located near Meeker's Island, a short distance below the projected lower dam installation. Although begun in the four and one-half foot channel period, it was not completed until the six-foot channel era and will be discussed in the following section. (Kane 1966: 175)

Like the pressure exerted by Minneapolitans, other interest groups continued to apply pressure to speed the improvement of the upper Mississippi River. Recurring themes such as the importance of the Mississippi River valley to America both economically and politically, the unfair distribution of federal monies hindering the Middle West, and, most of all, the negative influence of the railroads in transportation costs were cited. The River Improvement Convention in 1879 in Quincy, Illinois, noted that the Mississippi River valley consisted of a majority of the population of the United States, a large majority of the agricultural produce, yet the Mississippi River received only 3 percent of the annual federal River and Harbors appropriations. The Convention urged increased appropriations, decided to establish a lobby in Washington, and went on record to favor such changes as a reservoir system in northern Minnesota. (Merritt 1979: 161)

Likewise, an 1891 report noted the predominance of Mississippi River valley agriculture, manufacture, mining and lumbering. It stated that although river traffic was declining, it still accounted for 29.5 million tons. And it added that "undoubtedly they would be greatly increased and the aggregate would be much more surprising and gratifying could such improvements of the channels be made as to insure a navigable depth of water at all times." (House Executive Document 6, 1892: LII-LXI)

The most grievous abuse to be corrected by river improvement, however, remained the excessive railroad pricing. In view of the decrease in river traffic, many argued that river improvement should occur not in spite of, but because of the declining use of the river. For it was the railroad that forced the river's decline and the success of the river improvement was not so much the degree to which tonnage carried on the river increased, as whether the railroad freight rates were reduced due to river competition. (Anfinson n.d.: 9) The river continued, its proponents argued, to play a role of tempering railroad rate charges. It was estimated in 1888 that the river reduced railroad rates by one-third. In the winter, for example, railroad rates were two to six times higher than when they had to compete with the river traffic. (Annual Reports 1886: 1618; 1884: 1552; House Executive Document 6, 1888: 17) Another memorial from the Minnesota legislature in 1885 indicated that Middle Westerners were well aware of the problem. The results of river improvement already attained, the memorial argued, "justify the belief that the well-directed lans of the engineers in charge can secure such a depth of water as will allow wheat to be transported from the Falls of St. Anthony to the Belize and put on board ships, to be conveyed to Europe, and flour to our South American and Mexican neighbors, at freight charge not to exceed one-third those now paid to reach the markets. Wheat at 8 cents per bushel [freight] on board ship at the Belize means $6,400,000 per year saved to Minnesota on her present production." (House Executive Document 6, 1888: 18; House Executive Document 6, 1892: XLVIII)

Not only were pressure groups happy with that progress of river improvement which was made, but they were quick to suggest other possible improvements. A speaker at the 1902 upper Mississippi River convention, for example, outlined a river improvement which would connect Lake Superior and the upper Mississippi. "This can be done," he said, "by pursuing the French policy of canalization by means of dams at suitable intervals. . . . Such a system applied to the upper Mississippi can produce at least 9 to 12 feet." (Cooley 1902: 29-30) In spite of such pipe dreams, the pressure groups that developed in the late nineteenth century and became stronger during the Progressive Era of the early twentieth, played a continual role of advocating improvement. That pressure resulted in a large-scale canalization of the upper Mississippi in the 1930s, nearly as visionary in 1902 as the canal between the Mississippi and Lake Superior.

Although many lobby groups argued for river improvement, they were not necessarily in agreement over the rationale for improvements or the improvements to be made. Since the timber trade was one of the major groups using the upper Mississippi River in the late nineteenth century, it was probably the principal lobbiest for improved facilities between 1870 and 1910. (Merritt 1979: 162; Anfinson n.d.: 2) Yet there existed a competition between steamboats and log rafts on the upper Mississippi River. Floating logs were hazardous for steamboats and river contraction which increased the depth of the river, also narrowed the stream for log rafters. Lumbermen kept close watch on the actions of the Army Corps to attempt to protect their interests. By 1899, however, the River and Harbors Act contained a clause absolutely forbidding the floating of loose logs or sack rafts "in such manner as to obstruct, impede or endanger navigation" in streams "actually navigated by steamboats." (Fries 1948: 446) The power of the timber interests were able to encourage Minnesota and Wisconsin congressmen to exempt the important logging streams tributary to the Mississippi from this provision. (Fries 1951: 57) They might have won that battle, but they lost the war since the river throughout the twentieth century would be maintained for the motorized boats. Moreover, this ruling facilitated the coming of the locks and dams. Had large river rafts not declined due to logged out pineries and federal rulings, the open river would not be able to be canalized.

The four and one-half foot channel period thus ended in 1907 with the successful completion of the project and the introduction of the new six-foot channel project. Through the contraction of the river using wing dams, and to a lesser degree dredging and reservoir construction, the river was adequately deepened. The period also represented a stage when progressive studies such as the Windom Committee would advocate river improvement to cheapen transportation and create competition for the railroads. Anticipating the Progressive Era, when government input would be used to regulate commerce and facilitate economic growth, the Committee in its report stressed the notion that river improvement was not designed for single interest groups but would benefit all regions. Moreover, the Committee advocated a system of improvement that would improve the Mississippi from the Twin Cities to its mouth rather than spotty improvements as the need arose.

Although the four and one-half foot channel project was a systematic improvement, however, limited funding forced it to concentrate on trouble areas on the river. Dredging proceeded in certain areas, locks and dams were built in others. Moreover, pressure groups were often interested primarily in their pet projects and legislators often used river improvement as "pork barrel" apropriations that did not necessarily improve the Mississippi River system, but provided work and funding for their districts. The embryonic lock and dam system, like other improvements, was also a spotty development. The two locks and dams authorized for the Twin Cities area were built to improve the commercial transportation systems of Minneapolis. Little concern was paid to continuing the lock and dam system. Indeed, it is illustrative that unlike the 1930s lock and dam project, Lock and Dam No. 1 was downstream from Lock and Dam No. 2. Like any period, however, the four and one-half foot channel project produced the seeds of the late river improvement projects. The positive government advocates would become a larger and more powerful group as the Progressive Era broke forth: the Middle Western concerns of isolation from the coast and the unfair pricing of the railroads would be exacerbated; the pressure groups would become stronger; and the notion of river contraction to deepen the channel still further would be proposed. In the next section, we will examine this period in relation to the changing economic needs of the upper Middle West, the developing rationalizations for river improvement, and the improvement itself.

The Six-Foot Channel Period:

Even before the four and one-half foot channel was complete on the upper Mississippi River, the River and Harbors Act of March 3, 1905, authorized the Secretary of War to make an estimate of the cost of securing a channel of six feet between St. Paul and the mouth of the Missouri River. (House Document 341, 1907: 1) The rationale for the study was one that had been used during channel improvement in the nineteenth century. The continued decline of river traffic made it appear that greater river depth was needed. (Hill 1961: 284) Although the United States government up to 1907 had spent over $208 million on improvement of the Mississippi River valley, the River and Harbors Act of March 2, 1907, adopted the six-foot channel project on the river from the Twin Cities to St. Louis. (Dunn 1910: 752; Hartsough 1934: 215, 270; Hill 1961: 284; House Document 583, 1927: 13)

The River and Harbor Bill of 1907 also designated three other lines of improvement on the Mississippi River. First, appropriations were made for general imporvement such as levees and navigation including maintenance of a nine-foot channel from Cairo, Illinois, to the Gulf. Second, appropriations were made for the improvement of the river from the mouth of the Ohio River to the mouth of the Missouri River. Third, a board was appointed to report the practicability and desirability of constructing a fourteen-foot channel from St. Louis to the Gulf. (Way 1908: 148) Most important for the upper Mississippi valley, however, was the six-foot channel project that was authorized in the $80 million 1907 appropriation, the largest river and harbor bill up to that point.

The six-foot channel project was initiated with a cost estimate of $20 million and was aimed at progressive improvement of the river so that a four and one-half foot channel would first be secured throughout the river during low water and gradual improvement would eventually increase it to six feet. (House Document 341, 1917: 2; U.S. Army Corps of Engineers 1974: 1) The methods used by the project were to be similar to those used in the four and one-half foot channel project. Protection of caving banks and channel contraction by means of wing, closing and trailing dams was to be used in addition to repairs of existing improvements. Dredging by itself was not considered practicable to secure and maintain a six-foot channel; instead, since dams made for a permanent six-foot channel, they were considerd primary and dredging secondary. (House Document 341, 1917: 3; Annual Report 1929: 1139) The faith in using channel contraction was based on the success of such methods in securing a four and one-half foot channel, a faith, as we shall see, that dissipated as the project progressed. (House Document 341, 1917: 12) Moreover, channel contraction was preferred in 1907 "not only because of its less cost, but also because it permits open-channel navigation, which is greatly to be preferred for rafts and large tows." (House Document 341, 1917: 4) The use of locks and dams, in other words, had not come of age as long as the timber trade was one of the primary users of the river.

Attaining the six-foot channel through river contraction, however, was to be achieved through a narrower river. According to the estimates prior to the project's adoption, channel widths would be reduced so that the river would be 300 feet wide between St. Paul and the mouth of the St. Croix, 600 feet wide between the St. Croix River and Lake Pepin, 525 feet between Lake Pepin and Alma, Wisconsin, 625 feet between Alma and Genoa, 700 feet between Genoa and the mouth of the Wisconsin River, and 900 feet between the Wisconsin River and the Rock Island Rapids. (House Document 341, 1917: 15)

In addition to being an era of a deeper river, the six-foot channel period was a period when issues adumbrated in the earlier era were elaborated upon. The presidential administration of Theodore Roosevelt, the period in which the six-foot channel was approved, stressed the need for a system of water improvement that would be undertaken to facilitate economic growth. In addition to this Progressive issue, other concerns that troubled politicians and civic leaders, particularly those in the upper Middle West, were not solved and, in many cases, were exacerbated. The rates charged by the railroad continued to be a bone of contention among many in the Middle West. The transportation charges, they argued, remained unfair and were sapping the economic strength of the commercial interests and producers of the upper Middle West. Other tranportation problems, moreover, were also developing. First, in addition to the high railroad rates, it became apparent that the railroad lines were overused to such a degree that transportation was slowed by clogged railway systems. If some other means of transporting goods was not created, many were concerned that the railroad would not be able to adequately serve the United States and especially those regions in the United States, such as the upper Middle West, which did not have other means of transportation.

Not only were railroads too expensive and over-burdened, but other transportational links were placing the Middle West at an even less advantageous commercial position. The Panama Canal, for example, was a federal project which used transportation between the east and west coasts. Although Middle Western, landlocked regions were supposed to benefit from its construction, the Panama Canal reduced the transportation costs between the east and west while the Middle Western areas profitted less, largely because river travel had nearly ceased to exist by the time of its opening.

The transportational problems of the Middle West did not decrease, but were exacerbated as the twentieth century and the six-foot channel period progressed. World War I further strained the already overburdened railroad infrastructure and the post-war agricultural depression was partially blamed on prohibitive transportation costs. Civic groups argued throughout the twenties that manufacturers would leave the upper Middle West if some waterway improvement beyond what then existed was not made.

Pressure groups and politicians responded to the transportational problems throughout the six-foot channel period. Not only were funds for upper Mississippi River improvement appropriated, but the federal government initiated a barge service federally-run and federally-funded in the late twenties. Moreover, arguments in favor of a canalized Mississippi River system became more vociferous as the twenties progressed and by 1930 a new, deeper channel period would begin.

Like earlier periods of improvement, then, the six-foot channel period prepared the way ideologically and politically for the nine-foot channel period to follow. By funding improvements to create a deeper channel, the federal government was recognizing the need for increased water transportation. Yet, by the later 1920s, it had become apparent that the six-foot channel was not adequate. It did not provide competition for the railroads; it was not extensive enough to encourage private firms to enter the water freight trade and thereby create a second type of transportation; and it possibly would never be completed through river contraction. In spite of failure, however, public pressure for some type of waterway improvement continued both among the civic groups and political leaders including the presidents of the 1920s.

In examining the six-foot period, therefore, the precedents of the four and one-half foot channel period must be considered. The system of internal improvements that Windom had argued must be systematic in the 1870s was enlarged upon by the Progressive Republican presidents such as Theodore Roosevelt and Herbert Hoover in the twentieth century. Likewise, the peculiar transportational uncertainties of the landlocked regions of the upper Middle West continued, actually becoming more acute, as the six-foot channel period progressed. More important, however, are the relationships between the six-foot channel period and the nine-foot channel period that followed. The six-foot channel was an attempt to deepen the Mississippi River in order to facilitate waterway traffic. But as problems for the Middle West remained while the six-foot channel project did not appear to be making adequate progress, a new, more complex and costly system was contemplated. The nine-foot channel would require locks and dams to achieve a slackwater navigation, a type of river system quite different from the river contraction methods used in the four and one-half foot and six-foot channels. Thus, although the six-foot channel project was important, its ultimate failure in conjunction with continued transportational problems and political pressure led to a radical project to deepen the channel still further.

Although Windom and his committee had committed itself to a systmatic waterway improvement, much of the development in the late nineteenth century remained haphazard. (Mathews 1907: 724; Mathews 1909: 17) Just as the six-foot channel was approved, however, the administration of Theodore Roosevelt also was attempting to create a more systematic waterway improvement policy. In 1907, he appointed the Inland Waterways Commission which broke away from the old policy to a new policy of conservation and considered broad-based and long-range improvements. (Mathews 1909: 17) Scholars have applauded Roosevelt's actions. "The modern story of waterway transportation," writes one, "began with the appointment of an Inland Waterways Commission by President Theodore Roosevelt. This commission found that the principal rivers of the United States were better adapted to the needs of the people than those of any other country." (Dimock 1935: 1; Mathews 1907: 724; Hartsough 1934: 213)

Roosevelt reiterated his beliefs in plans for systematic improvement in his speeches throughout the country. In 1907, for example, he said, "it is the part of wisdom to adopt not a jumble of unrelated plans, but a single comprehensive scheme for meeting all the demands so far as possible at the same time and by the same means. This is reason why the Inland Waterways Commission was created . . ." (Lakes-to-the-Gulf Deep Waterway Association 1907: 40; Way 1908: 147) Others were reaching similar conclusions at the same time. John L. Mathews argued that the necessary large plans were not made for river improvement. He felt the military engineer obtained "at West Point a training in civil engineering that has especially direction to military matters." The engineer, therefore, did not consider trade in his studies and he had no business experience. Likewise, congressmen recommended improvements for their local rivers so that money would be spent in their districts. (Mathews 1907: 723) Mathews concluded that the river improvement system was in chaos. There were no streams in America, he argued, having the same size locks throughout and hardly a single river having a uniform standard of lock chamber. The chaos was reflected in the Rivers and Harbors Committee's confession that although the nation was committed to river projects costing $500 million to complete, no logical order existed in completion, and no connection existed among the projects. (Mathews 1907: 726)

Another observer, eight years later, reached a similar conclusion. Although federal expenditures on river improvement since 1790 had amounted to over $300 million, congressional appropriations primarily recognized political, rather than economic, justification. "There is no greater obstacle to [waterway development's] serious promotion," the writer argued, "than the traditional prostitution of waterway projects to the political pirates who customarily derive their sustenance from the congressional pork barrel." (Hess 1915: 267, 268) James J. Hill, the St. Paul railroad magnate, also noted the need for improved waterways if the upper Middle West was to remain economically strong. "We need a systematic and scientific plan," he argued. "We have spent enormous sums in the past without appreciable results. . . . We must work to a definite end; and our method must be prescribed by past experience . . ." (Hill 1910: 12785) Hill illustrated his notion of systematic improvement by stressing that "waterways that are to play an important part in traffic must be deep waterways." A vessel that carried only 1,000 tons could not compete with a boxcar. Moreover, "waterway improvements should be . . . planned. Locate the trunklines first," argued Hill. "Open a way to the sea by the biggest, freest, most available outlet. Push the work as nature directs, from the sea coast up the rivers." (Hill 1910: 12768)

Like the report of Windom's Select Committee on Transportation Routes to the Seaboard before it, then, the 1908 report of the Inland Waterways Commission was a landmark document. Roosevelt, in introducing the report, stressed that "in extent, distribution, navigability and ease of use, [America's rivers] stand first, yet the rivers of no other civilized country are so poorly developed, so little used or play so small a part in the industrial life of the nation as those of the United States . . ." (Senate Document 325, 1908: iii; Dimock 1935: 1). According to the Commission's findings, the villain remained the railroads. "While the decline of navigation in the inland waterways was largely due to the natural growth and legitimate competition attending railroad extension," it wrote, "it is also clear that railway interests have been successfully directed against the normal maintenance and development of water traffic by control of waterfronts and terminals, by acquisition or control of competing canals and vessels, by discriminating tariffs, by rebates, by adverse placement of tracks and structures, and by other means." (Senate Document 325, 1908: 19)

Railroads remained in a position about which Middle Westerners had complained for decades. "So large a portion of railway traffic is free from water competition," the Commission continued, "that railways can readily afford to so reduce rates on those portions affected by such competition as to destroy the profits of the rail systems which recoup these reductions by higher rates elsewhere." (Senate Document 325, 1908: 20) Not only were high rates disadvantageous to those areas which were forced to rely solely on the railroads, but the railroads were apparently becoming unable to serve such rapidly developing landlock areas as the upper Middle West. "While the railways of mainland United States have been notably efficient in extending and promoting the production and commerce of the country," the Commission concluded, "it is clear that at seasons recurring with increasing frequency they are unable to keep pace with production or to meet the requirements of transportation." Moreover, "while navigation of the inland waterways declined with the increase in rail transportation during the later decades of the past century, it has become clear that the time is at hand for restoring and developing such inland navigation and water transportation as upon expert examination may appear to confer a benefit commensurate with the cost, to be utilized both independently and as a necesasry adjunct to rail transportation." (Senate Document 325, 1908: 19) The year 1907 thus not only saw the approval of the six-foot channel but the appointment of a commission that would set forth issues, with the approval of the president, which would be repeated again and again as the six-foot channel period progressed.

One of the major issues set forth by Roosevelt in the establishment of the Inland Waterways Commission was the potential decline of the railroads. "It is common knowledge," wrote Roosevelt when he established the Commission on March 14, 1907, "that the railroads of the United States are no longer able to move crops and manufactures rapidly enough to secure the prompt transaction of the business of the Nation, and there is small prospect of immediate relief. Representative railroad men point out that the products of the northern interior States have doubled in ten years, while the railroad facilities have increased but one-eighth, and there is reason to doubt whether any development of the railroads possible in the near future will suffice to keep transportation abreast of production. There appears to be but one complete remedy," he concluded, "the development of a complementary system of transportation by water." (Senate Document 325, 1908: 16)

Even before Roosevelt's pronouncement, signs indicated that the railroads were reaching their carrying capacities and that the carrying capacities could not be adequately enlarged to carry all possible commodities. In the winter of 1906-07, for example, an unprecedented congestion of railway traffic occurred. (Hess 1915: 274) Even more important than this isolated instance was the discovery that additional traffic on the railroads was being handled at an increasing unit cost of service and the relative increase extended to every important cost factor. Previously, the railroad business had been considered one of decreasing unit costs, but investigation of the Interstate Commerce Commission in 1914 revealed that the railroads had passed their summit of efficiency by 1906. (Hess 1915: 275) Not only were freight trains congested, but James J. Hill estimated that it would take 73,333 miles of railroads constructed in five years at a cost of $5.5 billion to relieve the situation. In spite of the fact that water transportation was actually at its nadir, the seeds of railroad decline were becoming apparent and many argued for waterway development. "Relief can come only by the government's undertaking a national system of improvement of its navigable waters," one observer concluded. "It is the best way that can be adopted for further regulating rail rates and assisting in extending the transportation facilities of the country." (Way 1908: 162) Another analyst argued that either railroad expenditures must increase by $20 billion or inland waterways by $1 billion. The latter, furthermore, would relieve the railways of long haul, bulky traffic, one of the prime causes of car shortage and terminal congrestion. (Hess 1915: 277) For most Progressives who advocated a rational government, the choice between railroad and waterway development was not a difficult one to make.

Still others were quick to point out the traffic problems of the railroads, their failure to adequately service commerce, and consequent need for waterways. Secretary of State Elihu Root, in 1907, said that "we have come to a point where the railroads of the country are unable to perform that function which is necessary to continued progress in the increase of our National wealth. Conditions are such that there is no human possibility that railroads can keep pace with the necessities of our natural production for the transportation of our products, and the one avenue that is open for us to keep up our progress is the avenue of water transportation." (National Rivers and Harbors Congress 1908: 17) Senator Newlands of Nevada concurred a year later. "Years ago the railways were competing with the waterways," he wrote, "and nearly drove them out of business. But the efforts of the railways to monopolize the carriage of cheap natural products carried in other countries by water, has resulted in congestion of traffic and virtual breaking down of the entire transportation system; and it is essential that we shall take immediate steps to supplement our railway system by a complete system of waterway transportation." (Hull 1967: 32)(

Other government agencies and even railroad magnates themselves viewed the new conditions with concern. The I.C.C. noted the need for transportation facilities in 1909. "It may conservatively be stated that the inadequacy of transportation facilities is little less than alarming; that its continuation may place an arbitrary limit on the future productivity of the land; and that the solution of the financial and physical problems involved is worthy of the most earnest thought and effort of all who believe in the full development of our country and the largest opportunity of its people." (National Rivers and Harbors Congress 1910: 59) James J. Hill argued that in spite of the crisis, railroads were not to blame. One main reason for the need to waterway improvement was what Hill called the check put on railroad expansion by legislation that repressed legitimate enterprise. In any case, the enormous pressure of traffic on terminal facilities and trunklines could not be duplicated except at prohibitive cost and waterway improvement was imperative according to Hill. (Hill 1910: 12779)

The increasing ineffectiveness of the railroads to carry the nation's commodities was particularly hazardous to those regions that were most dependent on them. The Middle West, as the river traffic continued to decline, fit that catetgory and its residents were quick to point it out. "A great public movement has arisen in the Mississippi valley," noted an advocate of waterway improvement. "Now that the ablest railroad magnates publicly confess the inadequacy of the railroads to meet requirements, the discontent has grown into a movement akin to revolt. . . . In some degree, the movement has assumed the form of a demand for recognition of the rights of the interior as against those of the seaboard. Five years ago, the plains people . . . mildly appealed," he concluded, "today they demand." (McGee 1907: 8576)

The failure of the railroads in the Middle West was coupled with the demand for waterway improvement. "No complete flowering of a modern civilization is possible in the interior of the continent," proclaimed Herbert Quick, "save by cheaper and easier transportation than railways can possibly afford. The car-shortage of 1906 and 1907 was the first crisis of many which we must suffer, unless our waterways are restored and maintained.

It was the first convulsion of a strangling commercial growth." (Quick 1909: v) Likewise, John Mathews in 1909 described the victory of the railroad over the steamboat, then argued that "today these railways are congested and outgrown, and for bulk freights, at least, we are being diven back to the waterways. And when the centre [i.e. the Middle West] is entirely populated, no thousand miles of railway that can be built there . . . will be capable of seving its trade. In that day these rivers will come into their own, and will prove as capable of absorbing the flood of commerce as of carrying of the torrents of rain and melting snow." (Mathews 1909: 4) Two years earlier, Mathews had stated a similar theme. The freight was too great for railroads to handle, and the Mississippi River system was under-utilized because of its poor condition. People in the Middle West "have demanded in anger and in astonishment first, an explanation of [the rivers'] inutility and, second, their immediate transformation into proper traffic arteries." (Mathews 1907: 722)

Although the Middle West was the region suffering most from the railroad shortages, however, many were quick to argue that improved transportation facilities mainly through waterway improvement would benefit the entire nation. Minneapolis remained the only city of its size that did not have water connections to ports. (Decker 1938: 183) And the industry that was growing in the Middle West could be used to trade for raw resources in South America. Certainly the eastern coast could not provide all the manufacture needed for that trade and railroads could not carry all the Middle Western produce. If the United States was to capture Latin American markets, therefore, it needed waterway development. (National Rivers and Harbors Congress 1912: 19-31)

The Progressive impulse was also apparent in many spokespersons' views of the relationships between the railroad and the waterway. In a sense, the destruction of the water trade by the railroads was shortsighted. "With the waterways functioning as they should," wrote Herbert Quick, "carrying cheaply the heavy freight and leaving the railroads free to take the higher classes in which there is more profit, there need not be car shortages. Relieved of the buren of freight they carry at no profit or at a loss, railways might reduce rates and still pay dividends high enough to make rail securities attractive investments." (Quick 1926: 336; Hess 1915: 263-265) The waterways were to be improved, but not to destroy the railroads as the latter had done to the river in the era of ruinous competition in the late nineteenth century. Rather, as the Inland Waterways Commission stated, improvement of waterways to relieve congestion as to be made through coordination of water and rail "as will insure harmonious cooperation rather than injurious opposition." (Senate Document 325, 1908: 20; Hartsough 1934: 213) Indeed, this symbiotic relationship would create the best results for the railroads, the waterway carriers, and most important of all, the nation. "It may be necessary for the Government, through its Interstate Commerce Committee, to compel such co-operation, to begin with," argued Frank Gates Allen in 1909, but soon after they both would seek each other. (National Rivers and Harbors Congress 1910: 96)

While the monopoly of transportation by railroads began to overburden the lines in the early twentieth century, it also exacerbated a situation about which farmers and merchants had complained for decades: high rates. Based on the Progressive weltanschuuang, proposals were made that the creation of viable waterways by the government would tend to lower rates and work to benefit the entire nation. Theodore Roosevelt set the tone when he said that "wherever a navigable river runs beside railroads the problem of regulating the rates on the railroads becomes far easier, because river regulation is rate regulation." (Lakes-to-the-Gulf Deep Waterway Association 1907: 36)

Studies affirmed such claims by the proponents of waterway improvement. An I.C.C. report found that railroad freight cost 7.8 mills per ton per mile while comparable figures on the Ohio River traffic were .76 mills and on the lower Mississippi River .67 mills. Both Joseph E. Ransdell and W. T. Bland, therefore, argued that water transportation was six times cheaper than rail freight charges. (Lakes-to-the-Gulf Deep Waterway Association 1906: 69; National Rivers and Harbors Congress 1912: 126-127; Senate Document 325, 1908: 314-374; Hartsough 1934: 204) Even Major Riche of the Army Corps of Engineers noted that rail prices were less where water competition existed. "Major Riche, who has charge of the improvement work on the upper Mississippi River," wrote one proponent of upper Mississippi improvement, "has unwittingly endorsed the chief contention of the National Rivers and Harbors Congress, that developed rivers and harbors will do more to solve the rate problem than all the laws enacted by the Federal or State legislatures." (Lakes-to-the-Gulf Deep Waterway Association 1907: 171-172)

Although water improvement would cost the government money, it was money well spent argued many observers. R. B. Way, for example, noted that in 1905, 4,089,319 tons of freight passed between St. Paul and the mouth of the Missouri River. Up to June 30, 1906, the government had spent $11,673,356.76 on improving this stretch of the river and $660,000 for maintaining the improvements. But since the railroads charged 50 percent more between St. Louis and St. Paul while the railroad rates to an inland point with no water competition was 200 percent higher, the funds invested in water improvement had been a good investment. (Way 1908: 157; Annual Report 1906: 465-466) Moreover, many argued that improvement should continue to maintain this benefit to commerce in the upper Middle West. Farmers, for example, argued that they were not hostile to railroads but they felt some railroad regulation was necessary. "We farmers," said John M. Stahl, president of the Farmers National Congress, "believe that the best way to regulate railway rates is to improve and make navigable the streams and rivers." (National Rivers and Harbors Congress 1908: 72) Furthermore, the decline in use of the Mississippi arose from the lack of a permanent channel, said Frank Gates Allen, "upon which boats and barge may be transported at any stage of the water during the open season." It was government's responsibility, he continued, "to manage and control the streams and, more specifically, establish a channel so that private capital would seek investment." (National Rivers and

Harbors Congress 1910: 95)

Although water traffic would perform a function of rate regulation, however, this did not mean that government rate regulation would be abrogated. A complex of rate regulation legislation had been enacted beginning with the Interstate Commerce Act of 1877. Railroads had been exempted by the Interstate Commerce Commission, however, from the need to observe Section 4 of the Act, which regulated the discrepancy beween long-haul and short-haul rates, where they faced water competition. (Hartsough 1934: 204) The final report of the National Waterways Commission in 1912 argued that the I.C.C. needed a larger measure of control over joint rates and physical connection between railroads and waterways, that Section 4 did not sufficiently protect the waterways and that additional legislation was necessary. (Hartsough 1934: 215) Waterway improvement proponents concurred. W. T. Bland, speaking before the National Rivers and Harbors Congress in 1911, stressed the duty of the government to protect boat lines from railroad rate cutting. The I.C.C., he urged, could be given the power to prescribe minimum rail rates where it is the railroads' purpose to destroy waterway competition. (National Rivers and Harbors Congress 1912: 126-127) Apparently, the pressure was successful for the Panama Canal Act of 1912 divorced the railroads from ownership of any competing water carriers. (Lambert 1975: 5)

Railroad executives usually did not agree with most of the conclusions of the waterway improvement advocates. How could those in favor of waterway improvement argue that waterways should be developed to regulate the railway freight rates in one breath and then urge that, after the waterways were developed, there should be legislation to prevent railroads from reducing their rates to monopolize traffic in the next breath, one railroad proponent asked. (Dunn 1910: 755) In addition to what they considered unfair regulation, however, railway proponents also used the Progressive argument that railways simply were more efficient. Railroads had entrenched themselves by their technical superiority as one railroad magnate boasted, "before the Mississippi River could compete for traffic with the railways, its sides and bottom would have to be lathed and plastered." (Hess 1915: 264) Secondly, railroad men argued that "waterways are unable to compete for freight which is of considerable value or which requires a speedy delivery. The superiority of the railways in handling high class freight is univresally admitted." Why develop waterways that could handle only low-value, bulk commodities? (Sumner 1932: 11) Third, they stressed that comparing American railroad and waterway traffic with Europe, as many waterway improvement proponents did, was fallacious. Europe's railroad rates, for one thing, were much higher than those in the United States and the necessary facilities for water shipment such as modern barges, convenient wharves, and loading and unloading appliances were more profuse in Europe so that water carriage there lost the element of uncertainty and delay so prevalent in America. (Hill 1910: 12781) Finally, the benefits that supposedly were to occur due to waterway improvement were illusory. An improved channel would not cheapen transportation if all costs were included, it would not regulate railway rates, and it would not provide needed additional transportation facilities in the best practicable way. (Dunn 1910: 750) Indeed, the $500 million proposed for inland waterways between 1910 and 1920 would build 5,000 miles of good, low-grade, double-track railway, a much better investment according to railway advocates. (Dunn 1910: 757)

The arguments between advocates of waterway improvement and those of the railroad would continue for decades, and, in a sense, remain to this day. With the approval of the six-foot channel, however, waterway promoters saw their argument by and large accepted by those in power in the federal government. For residents of the Middle West, however, the decresing efficiency of the railroads, their continued high cost, and the Middle West's landlocked position inclined even leading railroad men such as James J. Hill to praise the adoption of the six-foot channel project and continuing improvements.

The contest between railroads and waterways was not the only transportation issue that concerned Middle Westerners. August 15, 1914, the day the Panama Canal opened, was a day viewed with great alarm by merchants of the Middle West because the Canal "ruined" the region by putting it farther from the coasts. (Fortune 1931: 136) Before the Canal opened, spokesmen from the Middle West were optimistic. When the Panama Canal was completed, R. B. Way argued in 1908, traffic moving toward the Gulf of Mexico would be vastly increased. The Middle West would be 590 miles nearer San Francisco than New York City. And South America, which already purchased $40 million worth of American goods annually, much of it from the Middle West, would be nearer. (Way 1908: 161-162) John L. Mathews concurred. "We have arrived at a new epoch," he proclaimed in 1909. "The opening of Panama will more than double trade in that direction. . . . There only remains the proper transshipping terminal apparatus and proper boats to be provided, and these channels of the Mississippi will become the greatest carriers and the greatest arteries of our internal system." (Mathews 1909: 259)

Such optimism was tempered when the effects of the Panama Canal began to be felt. For one thing, the shortened distance between the east and west coasts tied them closer together as transportation costs decreased. Conversely, the rates paid by merchants and producers in the Middle West increased due to the monopoly of the railroads and inadequate water transport. (Wilcox 1931: 163; House Document 290, 1930: 10; Hartsough 1934: 219) A principal means of bringing benefits to the Middle West from the Panama Canal became an increasingly active project of river improvement. "The Panama Canal tied East and West together in shipping," wrote a Minnesota historian, "but the Middle West seemed to be at a disadvantage. . . . Commerce, it was believed, would be stimulated by river traffic between Minnsota and the Gulf--if only the river in its upper reaches, from St. Louis north, could be deepened and kept to a standard depth level." (Blegen 1963: 483) Moreover, since the Panama Canal was a government project that injured trade of the upper Middle West, it seemed only fair that the federal government should "improve the channel of the Mississippi as a partial compensation." (Decker 1938: 186)

By the early twentieth century, then, the issues in favor of water improvement were set. The problem of railroad freight rates, which had been lamented for decades by those dependent on the rails for transportation, continued into the new century. People from these same regions also began to face railroad car shortages and rail congestion as commerce continued to increase at a dizzying rate, a rate with which railroads could not contend. Certainly, this problem would not go away either unless changes were made. Finally, other international improvements, most obviously the Panama Canal which was heralded before its construction as a boon to the Middle West, created additional problems for commerce in the interior. Studies throughout the 1920s, as we shall see, indicated that these inequalities created by the Canal did not dissipate, but were exacerbated, as the century progressed.

These difficulties created serious challenges for leaders of the Middle West. Yet the region was politically strong and argued persuasively for improvements that would facilitate economic growth in the area. The states of Ohio, Michigan, Illinois, Indiana, Wisconsin, Minnesota, North Dakota, South Dakota, Iowa, Kansas Nebraska, and Missouri contained more than half of the farm property value in the United States in 1908, James J. Hill argued. They raised 69 percent of American wheat, 61.6 percent of its corn, 75.5 percent of its oats, 72.6 percent of its rye and barley. Moreover, their production would increase as the land was better utilized. "The getting of these food supplies out of the central basin and to their ultimate markets is essential to our economic welfare," he noted. (Hill 1910: 12783)

The solution to this puzzle remained the river. "Nature indicates that the commerce of the Middle West . . . should be carried in part by the Mississippi River," Hill continued. Between 1870 and 1910, $250 million was spent toward that end, but the river traffic declined. Still, in the future, "the congestion of a steadily increasing traffic will be relieved by turning a share of the business over to the towboat and the barge." The river <u>could</u> transport heavy and bulky articles, Hill concluded, where no haste was required and low rates were charged. And it could share with the railroads "the burden of moving a volume of domestic commerce that will soon tax all resources." (Hill 1910: 12785) Albert B. Cummins, Governor of Iowa, agreed. "If the Mississippi River, from St. Paul to New Orleans, had the depth of channel which, without undue expenditure, could be created and preserved," he argued, "open to every person or corporation that could build a boat or barge, it would force itself into the problem with an effect that cannot be overestimated." It would make shipments from the Middle West competitive; it would regulate the railroad, and it would further the transportational infrastructure. (Lakes-to-the-Gulf Deep Waterway Association 1907: 78)

Although these were principally the problems of the Middle West, however, they indirectly affected the whole nation. Stressing the Progressive arguments of the early twentieth century, proponents of waterway improvement noted that it would cheapen transportation and benefit both consumer and producers. Even before the six-foot channel was approved, Hill had argued that if a waterway carrying boats drawing six feet of water from St. Paul to New Orleans could be constructed and permanently maintained, they could carry grain in barges capable of holding 1,000 tons for two cents a bushel. (Lakes-to-the-Gulf Deep Waterway Association 1906: 9) Continued improvement would facilitate transportation and bring the nation closer together. Deepening the river in a heady age enamored with the benefits of technology would harness the powers of nature to the benefit of man. A 1907 article noted that the main reason for Mississippi River traffic decline was the lack of river regulation and "the river is as lawless as a monster of the jungle and not yet brought under human control." (McGee 1907: 8579) It is to that attempt to regulate and improve the upper Mississippi River that we shall next turn.

Although a number of the motivations for a deeper channel were new, the methods used by the United States government to provide that deeper channel were not. As was mentioned earlier, the six-foot channel was merely an extension of the four and one-half foot channel project. With the four and one-half foot channel nearing completion, experts decided that a six-foot channel was needed and concluded that it would be best achieved through additional river construction using such structures as wing dams and through supplemental dredging. As the six-foot project progressed, however, it was decided that certain stretches of the river simply could not be controlled through river contraction. In such cases, periodic locks and dams, which eventually would become part of the slackwater channel system in the 1930s, were constructed. Principally located near the Twin Cities, these locks and dams were aimed at providing a workable channel for the major metropolis of the upper Middle West. Yet although the Twin City locks and dams were a harbinger of the comprehensive system to come, they also illustrated one of the worst examples of "pork barrel" appropriations, an expenditure that thoughtful Progressive advocates of river improvement were now seeking to avoid.

The 1907 federal legislation for improvement of rivers and harbors was the largest such appropriation up to that point and for some time to come. An important element, of course, was the approval of the six-foot channel, but it also presaged increasingly active work in waterway improvement. The next Rivers and Harbors Act in 1909 set aside only $9 million, but in 1910 River and Harbors Acts were placed as annual supply bills. "In my judgment," stated Stephen M. Sparkman, chairman of the Rivers and Harbors Committee in the United States House, "one of the greatest reforms that has come in the matter of river and harbor legislation is the policy we recently adopted of annual bills." (National Rivers and Harbors Congress 1912: 14) Since the annual bill feature of the Rivers and Harbors Acts was adopted, no project could have a standing before the Rivers and Harbors Committee or the House of Representatives "unless it comes there with a favorable recommendation of the Engineer

Corps." Despite some grumbling that the power of the Army Corps of Engineers had been unduly augmented, Sparkman argued that it was the best system since the Corps investigated the project and estimated their costs. (National Rivers and Harbors Congress 1912: 15-16)

The primary appropriations for the upper Mississippi River in this period were set aside for the construction of wing or spur dams to narrow the main channel, closing dams for side chutes, rip-rap protection for cutting banks, and dredging to maintain the river. Wing dams were used after 1907 much as they had prior to that time. The six-foot channel, which was required to accommodate larger ships with deeper drafts and would possibly work to revive a declining river trade, thus was to be achieved by river contraction. Under the plan for a six-foot channel, existing wing dams had to be raised to a crest of four feet above low water and lengthened to reduce the channel width and thereby increase the scour. (Anfinson n.d.: 2; House Document 583, 1927: 13; Annual Report 1929: 1138) Wing dams were constructed up and down the upper Mississippi River. Over 1,000 wing dams, for example, were found in the first six pools of the river. (Anfinson n.d.: 1) In a sense, the contraction was successful. By 1917, for example, the six-foot channel between LaCrosse and Winona had been attained through further contraction of the channel from 800 to 625 feet by means of spur dams. (Thompson 1917: 306) Yet the "open" channel that had been established during the four and one-half foot channel period would not produce an adequate six-foot channel without additional work such as periodic locks and dams. (Mathews 1909: 158)

Dredging was an auxiliary activity to the river contraction. The cut through a sandbar working in conjunction with the wing dam created a deeper channel. The fleet used to maintain the river, however, was extensive. Between 1914 and 1940, in fact, the Corps of Engineers was responsible for the largest traffic on the upper Mississippi. The Rock Island District operated a fleet which contained 19 steam towboats, 8 hydraulic dredges, 5 dipper dredges, 4 gasoline screw launches, 12 small gasoline paddle launches, 48 motor skiffs, 233 barges and 145 office boats, quarterboats, fuel flats, store boats, spud bots, derrick boats, grasshoppers, dump boats, houseboats and drillboats. (Merritt 1980: 96)

Such an extensive fleet required a substantial appropriation. Indeed, between 1872 and 1930, the channel improvement between the Twin Cities and Cairo, Illinois, cost about $68,350,000. Yet deadlines to adequately create the channel continued to pass. The River and Harbor Act of June 25, 1910, for example, specified a time limit of twelve years for completion of the six-foot channel project. In 1922, however, the channel still was not six feet deep in most places and the project was amended, among other things, to provide for dredging channels to landing places on the main river and subsidiary sloughs. (House Document 583, 1927: 13) Throughout the 1920s, as we shall see, arguments for continued river improvement were refined while actual improvement in the six-foot channel project simply was not making adequate headway. Obviously, some alterations had to be made and they were found in a nine-foot slackwater channel project of the 1930s.

On some stretches of the river, however, dredging and contraction would not create a four and one-half foot channel, let alone a six-foot one. Government reports beginning in 1867 and again in 1874 and 1889 recommended some type of lock and dam project between Minneapolis and St. Paul to provide for navigation to the Falls of St. Anthony in Minneapolis. (House Executive Document 58, 1867: 2, 30; House Executive Document 158, 1889: 9) The 1889 report, authorized by the Rivers and Harbors Act of 1886, argued that the Mississippi River could be improved below Meeker's Island, near present-day Lake Street, through dredging and contraction of the channel. Although this would benefit navigation, however, it would not meet the demands of an extensive river traffic. An improvement was therefore recommended which combined dredging and wing dams to a point 2,400 feet above the Minnehaha Creek mouth and then two lock and dams to provide navigation to the Minneapolis landings. The first, designated No. 1, would be placed 2,400 feet above Minnehaha Creek with a nine and one-half foot lift. The second, No. 2, would be 4,510 feet above Lock and Dam No. 1 and 1,100 feet below Meeker's Island with a fifteen and one-half foot lift. The project, which would provide a four-foot passage, was estimated at a cost of $2,361,060.79. (House Executive Document 158, 1889: 9, 10)

Finally, after years of pressure on the federal government from interested parties in Minneapolis, the "Five-Foot Project in Aid of Navigation" was authorized by Congress on August 18, 1894. The project appropriated $1.466 million for the construction of two locks and dams which would facilitate navigation to Minneapolis, ironically at the twilight of the steamboat era. (Fullerton 1906: 497; Kane 1966: 175) The two structures were to be built near Meeker's Island and at the present site of Lock and Dam No. 1. Each provided a thirteen-foot lift. (Engineering Record 1912: 60; Engineering and Contracting 1913: 315-316) Neither were provided with the means to develop hydroelectric power. Although such small lifts would not have created a cost-effective power development, there was a more fundamental reason behind the decision. The first bill for the construction of a thirty-foot dam at the site of the present Lock and Dam No. 1 for navigation and hydroelectric power was brought before Congress in 1894 but was rejected on the grounds that power development was beyond the scope of the project--waterway improvement. (Jevne and Timperley 1910: 1)

Even without hydroelectric power, however, many seriously questioned why two locks and dams were being built when one would work just as well. One writer asked "why is the government building two dams between Minneapolis and St. Paul when one would serve as well and be less expensive both to maintain and to operate?" (Decker 1938: 182) His question was well-taken especially since the Army Corps of Engineers originally recommended a single dam. The answer, unfortunately, was found in an insidious civic rivalry and in pork barrel. Major Francis R. Shunk of the St. Paul district of the Army Corps of Engineers tried to state it delicately. "Now, as to the duplication of locks and dams," he wrote, "two instead of one. Connected with this matter is a secret history, upon which I propose as discreetly as may be to cast a little light. There is the city of St. Paul, and there is the city of Minneapolis. For physical reasons, a single lock must lie entirely within the limits of Minneapolis, or entirely within the limits of St. Paul, the tract crossed by the boundary line being unsuitable. Enough said. There are two locks. But I think I am right in saying that no officer of the corps of engineers has ever been in favor of these two locks. They were brought into being by local influence." (Beckjord, Davis and Gadsby 1909: 8-9) Moreover, it appears that the Fifth District Congressman from Minneapolis wanted a dam wholly within his district so he, too, backed the two lock and dam system. (Decker 1938: 182)

Pressure placed on goverment agencies to create a double lock and dam system to soothe jealousy that would have developed otherwise thus was apparently the primary reason for the two locks and dams. (Jevne and Timperley 1910: 7-8) Accordingly, the two lock and dam system was begun with Lock and Dam No. 2 at Meeker's Island constructed first. Completed in 1907, it was built at a cost of $736,851.71. (Decker 1938: 182) The second lock and dam, at the present site of Lock and Dam No. 1, was begun in 1909 and was under construction when the advisability of a single lock and dam was reconsidered. The wisdom of the Army Corps of Engineers was finally borne out as the plan was modified by Congress in June 1910. But the project had already cost $1,162,593 and alterations had to be made. (Engineering and Contracting 1913: 315-316) For one thing, Lock and Dam No. 2 had to be destroyed so as not to obstruct navigation. The section not destroyed would remain, as one observer put it, "as a lasting monument to jealousy of the two cities." (Jevne and Timperley 1910: 8-9) Indeed, Lock and Dam o. 2 was blown up in 1912 never having seen commercial use. (Decker 1938: 182)

The alterations on L[illegible] and Dam No. 1 were less drastic, but they provided interesting engineering challenges. The new project raised the lift from fifteen to thirty-five feet which would produce a nine-foot channel. The alterations, however, increased the depth of the channel below the dam from five to six feet and also raised the size of the lock walls by nineteen feet. The lock floor, which was already in place, was three and one-half feet thick, and had dimensions of 80 by 350 feet. It was made of cast beams from five to ten feet in width and rested directly on the river bed. Yet the floor had to be removed. To break up the floor, holes three feet deep were drilled in rows one and one-half to three feet apart. Light charges were used to break up the concrete. The steel supports were then cut apart using oxyacetylene torches. (Engineering and Contracting 1913: 316) The lock walls were raised without wooden forms that would have ordinarily required bracing timbers eighty feet and over in length. Instead, concrete blocks with interlocking edges were cast separately. They had recesses at each end into which a beveled tongue of long blocks were fit loosely. After lining up, bracing and tying into place, the space between the ends of the blocks was poured with grout. (Engineering Record 1912: 60) By

1913, the work had been completed so that lock walls were both raised nineteen feet and widened, and the old floor had been removed and a new one set in place six feet lower. (Engineering and Contracting 1913: 316)

Why were such major alterations made after the project had been approved under a two lock and dam plan? The main impetus for change was a revived interest in water power. As Mayor Haynes of Minneapolis noted in a letter to his City Council, there were three important points in the single lock and dam project. "1. The improvements," he wrote, "should be so made as to insure a uniform navigable channel for all kinds of river craft to the Minneapolis wharves. 2. Such improvements should also be made in a manner to conserve the largest possible amount of water power. 3. Said power when created should become the property of the city of Minneapolis, subject only to the right of our sister city to share therein upon payment of her proportion of expense incurred." (Beckjord, Davis and Gadsby 1909: 3) Moreover, a single dam, as the Army Corps of Engineers had argued in 1894, was less expensive to build, less expensive to maintain, and would move traffic faster since only one lock would have to be ascended in addition to the development of water power. (Beckjord, Davis and Gadsby 1909: 9; Engineering Record 1912: 60)

Renewed concern for hydroelectric power apparently developed at about the time of completion of Lock and Dam No. 2. As one contemporary wrote, when "Lock and Dam No. 2 was completed, the folly of the present arrangement was realized, and considerable agitation aroused to use the power which could be developed with the total available fall." (Jevne and Timperley 1910: 8) The modification, which would create water power, was considered a cost effective one which made it even more appealing. It would require an additional expenditure of $650,000 including $180,000 for flowage rights, but the high dam would create around 15,000 horsepower worth approximately $150,000 yearly. (Engineering Record 1912: 60; Jevne and Timperley 1910: 1; Engineering and Contracting 1913: 315-316)

Legal questions had to be resolved, however, since the Minnesota state constitution forbid cooperation with the federal government in internal improvements. (Jevne and Timperley 1910: 1) Moreover, the government would go no further initially than the construction of the foundation of the power house to a level with the crest of the dam. Provision was made so that whomever installed the power plant could use turbines of the horizontal or the vertical type and the cities of St. Paul and Minneapolis and the University of Minnesota organized a company with representatives to negotiate with the government for its development. (Engineering Record 1912: 60; Meyer and Brittin 1921: 7-14) As we will see in the following section which deals specifically with each lock and dam structure, the legal questions were ironed out and Lock and Dam No. 1, known as the "High Dam" because of its large head, was completed in 1917. It created a channel deep enough to extend navigation to the Washington Avenue bridge and made available 15,200 horsepower, becoming the first and only dam with hydroelectric power in the St. Paul district of the Army Corps of Engineers. (Kane 1966: 175)

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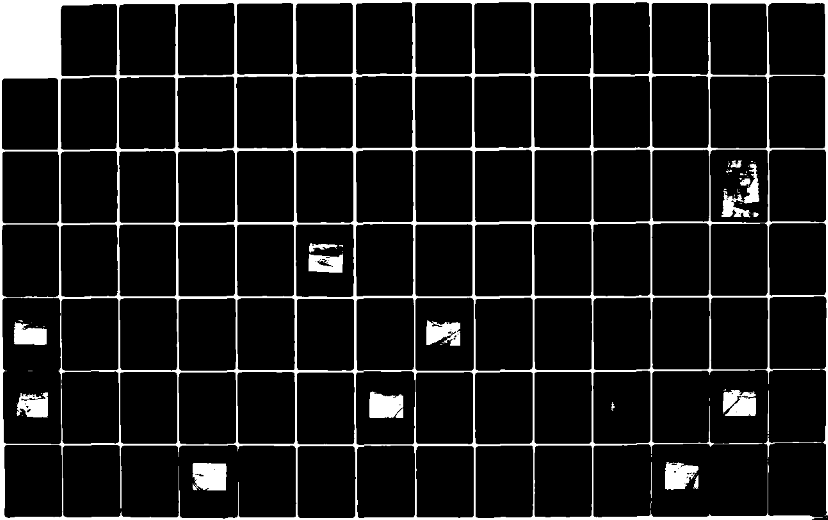
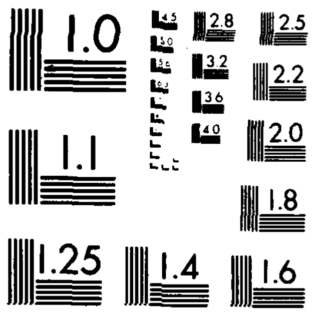





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

While Lock and Dam No. 1 created a nine-foot channel in the pool above it, navigation was not especially encouraged since the river below it was not nine feet deep and, in most cases, did not even provide a minimum six-foot channel. Around 1925, engineers reported this discrepancy and added that to open channel improvements were inadequate to create a six-foot channel between the mouth of the St. Croix River and Lock and Dam No. 1. (Hartsough 1934: 274) Indeed, a 1927 government study indicated that the six-foot channel project was only 46 percent complete and above the mouth of the St. Croix River it ws only 6.7 percent complete. Moreover, after twenty years of work, it was decided that a six-foot depth simply could not be secured in that section of the river by regulation work and dredging. (House Document 583, 1927: 3, 27) The most economical plan for extending the six-foot navigation to Lock and Dam No. 1, according to the report, was through the construction of a lock and dam near Hastings, Minnesota, which would extend the length of slackwater navigation on the upper Mississippi River. (House Document 583, 1927: 3)

First appropriations for the lock and dam, which would become Lock and Dam No. 2 when the slackwater system was implemented in 1930, were made in 1927. The structure was important not only because it continued the development of an incipient lock and dam system, but because it was similar to later locks and dams built below it a few years later. The lock was concrete with a steel gate; its initial dimensions were set at 80 by 320 feet with 7 feet over the miter sills at the lowest stages. The dam consisted of concrete tainter gate sections; earth embankments with concrete core walls built for that part of the length not occupied by the other structures; and a steel sheep piling cut off under all structures. The total length of the dam was 4,050 feet. (House Document 583, 1927: 35) The lock at the Hastings project was first used in 1930 shortly before the nine-foot channel project was approved. (Hartsough 1934: 274)

River improvement based around the six-foot channel project was occurring in a period of economic and demographic changes that made waterway transportation more essential. The concerns that the Middle West was declining because of inadequate transportation facilities adumbrated early in the century became increasingly pronounced after World War I. Moreover, river traffic that had been dormant for years began to revive during and after the war not because of proviate carriers, but due to government projects. While these events encouraged the maintenance of the six-foot project and laid the groundwork for the nine-foot project, pressure groups arguing for river improvement played an essential role throughout the century in advocating increased and improved transportation facilities for the valleys of the Mississippi, Missouri and Ohio Rivers.

One of the earliest pressure groups was the National Rivers and Harbors Congress organized in 1901 after the Rivers and Harbors Act had been killed by Senator Tom Carter of Montana who filibustered the bill to death. (National Rivers and Harbors Congress 1923: 3; Fortune 1931: 136) Carter, who destroyed what was called a "necessary" bill, said "I should not stand here for one moment in the way of the passage of this bill if its passage was demanded by any public interest whatever." Obviously, Carter struck a nerve since waterway improvement proponents were quick to organize a congress which sought to continue federal appropriations. The National Rivers and Harbors Congress, according to M. J. Sanders at its opening convention, was formed to combat statements such as Carter's and to demonstrate that the improvement of all streams and harbors which will justify by results the expenditure necessary is not only advisable, but of supremest importance and necessity to the commercial progress and welfare of the country." (National Rivers and Harbors congress 1901: 12)

Five years later, the National Rivers and Harbors Congress was reorganized and a campaign was begun to continually improve waterways and harbors. (National Rivers and Harbors Congress 1923: 3) The convention in Washington, D.C., saw its primary aim to give expression for regular annual appropriation of at least $50 million for river and harbor improvements. (McGee 1907: 8576-8577) The year 1906 also saw another pressure group convene in St. Louis as the Deep Waterways Convention. Over 1,300 delegates from 22 states participated and adopted a plan for a permanent organization--the Lakes-to-the-Gulf Deep Waterway Association. (McGee 1907: 8576) The following year, Theodore Roosevelt came to Keokuk, Iowa, and went down the river to Memphis to show his support for inland waterways at the Lakes-to-the-Gulf convention. In 1908, the convention attracted William Jennings Bryan and William Howard Taft, the presidential candidates. (Fortune 1931: 136) Not only were such pressure gorups powerful, but their rhetoric was specific. A song sung at the convention demanded "we want the ships a-running and lowering the rate/ Fourteen feet through the valley/ And if we get the water, we'll guarantee the freight/ Fourteen feet through the valley." (Lakes-to-the-Gulf Deep Waterway Association 1908: 172)

Civic leaders also continued to pressure for water improvement. The city of Minneapolis responded to signs of adversity caused by declining river traffic and potential declining waterway improvement appropriations. When Minneapolis lost its preferential rail rates based on potential navigation, a committee was formed to study river improvement in 1912 by the Minneapolis Civic and Commerce Association. (Decker 1938: 183) Businessmen continued to back a deepened channel and when fortunes changed and the government extended federally-funded barge traffic to Minneapolis, a "Minneapolis-to-Gulf day" was celebrated. (Blegen 1963: 484; Hartsough 1934: xiv-xv)

The rhetoric repeated over and over again by the water improvement advocates provides an illuminating example of the Progressive arguments that permeated the era. Theodore Roosevelt noted that railroad systems came to their full development as water transportation declined. But, he cautioned, "it is our business to see that the decline is not permanent." (Lakes-to-the Gulf Deep Waterway Association 1907: 34) River improvement, however, was not to be made merely for the sake of improvement. James J. Hill agued that all river improvement "should be part of a general scheme of coordinated improvement and conservation of resources." (Hill 1916: 12786) Moreover, that systematic improvement would result in general benefits for the nation. "Those who have given careful study to the waterway phase of the transportation problem," said Joseph E. Ransdell, "are earnestly requested to forward by all means in their power the dissemination of truth that the benefits to be derived are not confined to any single class but will fall like the dews of heaven upon rich and poor alike, upon the dwellers in every section whether situated upon waterways or not; for increase avenues of transportation add to the wealth, the opportunities, and the happiness of all." (National Rivers and Harbors Congress 1910: 8)

Although "the happiness of all" might have been increased through waterway improvement, the Middle West had the most to be gained judged by the rhetoric. The Mississippi valley is in closest proximity to the Panama Canal, noted Governor A. O. Eberhardt of Minnesota in 1909, and it provides a direct channel to the gulf, the Caribbean, and through the Canal to the Pacific. "How can the great Mississippi Valley," he continued, "so near at hand and waiting with products and merchandise to develop a great Pacific Ocean trade make use of this vast international waterway, if the channel of the Mississippi and its tributaries is not fitted for navigation?" (National Rivers and Harbors Congress 1910: 171-172) The waterway improvement groups certainly played an important role in putting continuing pressure on the government representatives. Moreover, they reflected the Progressive predilection to stress improvement that would create wide-ranging benefits to the nation. Still, as the twentieth century progressed, waterway improvement on the upper Mississippi River was not proceeding as successfully as had been hoped. More importantly, the problems that that improvement was intended to solve did not go away, but were actually exacerbated as World War I and its aftermath stretched the transportational infrastructure beyond its limits.

The effects of the war influenced the transportational networks, railroads, and the waterways in many ways. For one thing, the need to transport extensive war goods further clogged the already troubled railroad lines. Conditions became so severe that the federal government used the waterways to ship iron ore from the Twin Cities to St. Louis and coal in the other direction. Since railways were delayed in shipping the iron south for government war contracts, the government offered the use of some open barges and towboats belonging to the River Improvement fleet for use in the emergency. This example, according to one observer, confirmed the claims that water transport was cheaper than rails when good channels and proper handling facilities were provided. (Decker 1918: 176) Indeed, General william M. Black, Chief of Engineers of the U.S. Army and chairman of the Water Transportation Committee of the Council of National Defense, went so far as to say that "not one pound of freight should be shipped by rail that can be shipped by water." (Decker 1918: 176)

The war served as a watershed in waterway improvement because it not only exacerbated problems perceived for decades, but it forced an even more active federal government role in waterway development due to the exigencies of war. Rail freight rates, for example, increased during the war and afterward so that they were considered increasingly prohibitive. (National Rivers and Harbors Congress 1927: 31) Moreover, the federal government also began operating railroads and water transport was finally recognized as a helpful ally to rail lines.

The most graphic example of government wartime intervention in transportation was its effort to reestablish waterway commerce on the Mississippi River. Since the railroads were overburdened because of the need to transport troops and material sof war in addition to the increased commerce resulting from wartime production, a committee was formed to determine the feasibility of reviving the waterways. (Dimock 1935: 1; Robinson 1980: 107) This Committee on Inland Transportation concluded that, with proper terminal facilities, a large part of the rail-borne freight could be moved on water. Accordingly, in 1917, the United States Shipping Board alloted $3.9 million to build a towboat fleet for use on the Mississippi River between St. Louis and St. Paul. (Robinson 1980: 107; Decker 1918: 176) The Mississippi River project was placed under the aegis of the United States Railroad Administration in 1918. (Dimock 1935: 1; Sumner 1931: 355)

At the war's end, the government held a fleet of towboats and barges that either had to be liquidated or maintained. The Transportation Act of 1920 mandated the continued use of the fleet and transferred the barge service that served the Mississippi and Warrier Rivers to the War Department stating that it should continue operation as long as it demonstrated its possibilities to attract private capital. Section 500 of the Act, for example, stressed that "it is hereby declared to be the policy of Congress to promote, encourage, and develop water transportation service, and facilities in connection with the commerce of the United States, and to foster and preserve in full vigor both rail and water transportation." (Hartsough 1934: 239-240; Petersen 1972: 390)

Four years later, the Inland and Coastwise Waterways Service, which had been run by the War Department between 1920 and 1924, was succeeded by the formation of the Inland Waterways Corporation. (Sumner 1931: 355; Dimock 1935: 2) In arguing for continued support for the Inland Waterways Corporation, Colonel T. Q. Ashburn said it would create additional Mississippi River traffic. "And then many people who said this was pork barrel appropriation," he continued, "will be confounded because the amount of traffic that is going to flow up and down that [Mississippi] valley is going to be tremendous." (Robinson 1980: 11) Likewise, Ashburn, speaking two years later, argued that the I.W.C. was a "great holding company" made up of all citizens of the United States. (Petersen 1972: 390)

Ashburn's enthusiasm for direct government intervention in transportation facilities was not shared by everyone. Railroads felt it was unnecessary and unfair government intervention into the marketplac%. Moreover, in addition to the government activities, privately-owned carriers, many of which were attached to large steel, coal and petroleum companies, were making increased use of the Ohio and lower Mississippi Rivers. (Sumner 1931: 355) Yet, it seemed that the actions of the I.W.C. was having a beneficial effect on transportation rates. Upon determining that the barge line might begin operations between Minneapolis and St. Louis, the railroad paralleling the river got approval from the I.C.C. in 1922 to lower its rates. "The truth about the matter," said C. A. Newton, "is that the Barge Line upon the Mississippi has demonstrated that river navigation is practicable, and that it can afford to make rate which the rail lines of the country cannot afford to meet." The Barge Lines, he said, were still an experiment, yet they made money in spite of poor river terminals and lack of full river improvement. (National Rivers and Harbors Congress 1923: 119) Government regulations, furthermore, worked to set water and rail rates. The Inland Waterways Act of 1924 and the Shipstead-Denison amendment of 1928 provided that the I.C.C. should, upon application of the water carriers, order all connecting common carriers to join in setting up through routes and joint rate with reasonable differentials and equitable divisions. And in 1926, one of the first joint rates went into effect with the agreement between the Upper Mississippi Barge Line Company, the Inland Waterways Corporation and the Illinois Central Railroad. (Hartsough 1934: 243)

Most of the work of the Inland Waterways Corporation, however, was based in the lower Mississippi and Ohio Rivers. It was only later that the upper Mississippi towns enjoyed the benefits of government water services. The extension of the government service was initiated by a group of Minneapol)s businessmen who were concerned about transportation problems that their city faced. When the I.C.C. ruled in 1924 that the Mississippi River in Minneapolis was no longer justification for low railroad rates (see following sections for a more detailed description of transportational difficulties in the upper Middle West), civic leaders began to invetigate the reestablishment of river transportation that would reinstate that justification. (Hartsough 1934: x-xiii) In May of 1925, the Real Estate Board of Minneapolis under the leadership of S. S. Thorpe initiated steps to investigate the possibilities of again using the river. An appointed subcommittee met with representatives of the Inland Waterways Corportion in June to learn of operation of the Federal Barge Line on the lower Mississippi River and they were impressed with what they saw, according to a participant. (National Rivers and Harbors Congress 1927: 31) At the metting, the subcommittee conferred with Major General Harry Taylor, Chief of the Army Corps of Engineers and Brigadier General T. Q. Ashburn, chairman of the Inland Waterway Corporation. Taylor stressed that the upper Mississippi River had an adequate channel of at least four and one-half feet even in 1925 when a drought occurred in the region and that the Army Corps was somewhat dissatisfied that no attempts had been made to use the river from Minneapolis to St. Louis. Ashburn said, however, that the I.W.C. could not furnish equipment to initiate a service between Minneapolis and St. Louis. (National Rivers and Harbors Congress 1927: 32-33)

The Upper River Committee, as the committee was called, decided to capitalize their own company in 1925, named the Upper Mississippi Barge Line Company, with capital of $1 million. (National Rivers and Harbors Congress 1927: 32-33; Blegen 1963:

484; Hartsough 1934: 240) Moreover, since the act creating the I.W.C. made it the I.W.C.'s responsibility to extend service to the upper Mississippi River, the Upper Mississippi Barge Line Company brought suit against the I.W.C. The decision of the Judge Advocate General advised the I.W.C. to extend service on the upper Mississippi River so an agreement was reached between the I.W.C. and the UMBLC in which the former leased the equipment valued at $1.75 million and put it into operation. President Calvin Coolidge endorsed the plan on January 20, 1926, and five-year leases were begun. (Hartsough 1934: xiii-xiv; National Rivers and Harbors Congress 1927: 33)

On August 24, 1927, the S. S. Thorpe became the first towboat to reach Minneapolis under the auspices of the Inland Waterways Corporation. (Hartsough 1934: xiv) It travelled from St. Louis and on its way stopped and unloaded freight at Burlington, Davenport and Dubuque, Iowa; LaCrosse, Wisconsin; and Winona, Minnesota, among other cities. The S. S. Thorpe also loaded on freight destined for Minneapolis and St. Paul at those river towns. The freight also included "sugar direct from Cuba; hemp for binder twine manufacture and bag making; farm machinery, and the hundred and one items of merchandise absorbed by the people of the Northwest." (Commercial West 1927: 12)

The tow was met in the Twin Cities with celebration. A "Minneapolis-to-Gulf" day was declared and the renewed river traffic was praised. (Blegen 1963: 484) The resumption of freight transportation on the upper Mississippi River was called, in some ways, "the most auspicious happening of which the Twin Cities have taken cognizance in recent days. Successful navigation of the northern reaches of the Father of Waters means much to the business and commercial world of the metropolis located at its navigable source and more, it may be said, in passing, to the people who dwell here as a whole. In effect, it means "a lowering of living costs all along the line and, directly to the point, it means that some of the largest of the manufacturing establishments that have been in existence in Minneapolis and St. Paul for years will now be able to remain here and improve and develop their business enterprises, whereas they were on the point of removing to the East and South where more favorable freight rates could be obtained." (Commercial West 1927: 12)

The obvious benefits of river traffic were again stressed. Freight rate savings from Minneapolis-St. Paul to St. Louis for all-water on the Inland Waterways Corporation instead of all-rail ranged from 19 cents per hundred weight on Class 1 to 6 cents on Class 5. To New Orleans, the rates were 82 cents less per hundred weight on Class 1 and 59½ cents on Class 5. (Commercial West 1927: 12) A contemporary analysis noted that nearly $9 million had been spent on the Minneapolis High Dam, Hastings Lock and Dam, the towboats, and river terminals. But, it added, "this sum is only a drop in the bucket to what freight transportation on the Mississippi River will mean in economic saving and progress in the industries and arts, in commerce and banking by all the people of the great Mississippi Valley from its source in Minnesota to its traverse into the Gulf of Mexico at New Orleans." (Commercial West 1927: 13)

In addition to the S. S. Thorpe, a 600-horsepower craft, three other boats--the C. C. Webber, the John W. Weeks, and the General Ashburn--followed. These towboats were equipped with fifteen barges and were coordinated with movements on the lower river. The crafts were loaded light, however, because the channel still was not six feet deep in all places. (House Document 583, 1927: 2; Petersen 1972: 392) Although the system could not be fully utilized because of a shallow channel, the Twin Cities heralded the coming of the fleet since it reduced their sense of commercial isolation. "The establishment of the freight shipping system," wrote a commercial magazine, "now undertaking the negotiation of the Mississippi does not, of course, bring back the old glory and the old romance of the early steamboating days on the river, but it does bring back an assurance of the stabilization of freight rates on a considerably lower basis and the prevention of the increase in rates that was rapidly placing Twin city manufacturing plants to a decided disadvantage in comparison with those more advantageously situated as to enjoyment of joint water and rail rates." (Commercial West 1927: 12)

Satisfied with revived water transport, many civic leaders were not happy with the channel depth. After the barge line operated for awhile, it became apprent that a six-foot channel would not permit the operation of tows of sufficient cargo capacity to insure profitable common carrier operation or attract tonnage in sufficient volume to prove of substantial relief in reducing transportation costs in the upper Mississippi Valley. On June 1, 1928, in recognition of this need, the Upper Mississippi Barge Line Company withdrew from actual barge operation. It sold its fleet to the I.W.C. and began to devote attention to securing authorization of the extension of a nine-foot channel on the upper Mississippi River. (Hartsough 1934: xv) The government attempts to renew water freight transportation thus played an important role in illustrating the insecurity felt by commercial interests in the upper Middle West as well as serving as a catalyst for further water improvement, most obviously a nine-foot channel. Once water travel was proven feasible, pressure was increased on the government to provide better facilities. The increasing pressure just to begin water traffic, however, was based on difficulties perceived by commercial interests in the upper Middle West. These difficulties, many of which were present early in the century, were becoming increasingly acute after World War I, a subject to which we will next turn.

A new, more ominous difficulty, however, that compounded the transportational problems of the upper Middle West surfaced in the early 1920s. The railroads, when they entered the upper Middle West, had faced a "double-barreled competitive situation"--the river from Dubuque, St. Louis and the south and rail spurs and Lake Superior to the eastern markets. The Interstate Commerce Commission set rates that reflected the water competition and that "recognized the fundamental fact that the general welfare is best served by making all markets accessible to the producer, consumer, manufacturers, and distributor . . . ," according to a river improvement advocate. (Upper Mississippi

River Bulletin 1933: 3) The all-rail rates from the east and south were thus considerably less per ton-mile than to other cities not so favorably located with respect to water transportation. After many rate wars, "the entire freight rate structure was stabilized on this water competitive basis and for many years the Twin Cities enjoyed the benefits of being on a navigable stream with receiving scarcely a ton of freight over that natural highway of commerce." (House Document 583, 1927: 18)

On February 14, 1922, however, the Interstate Commerce Commission, in what became known as the Indiana Rate Case, wrote that "water competition on the Mississippi River north of St. Louis is no longer recognized as a controlling force, but its little more than potential." (Hartsough 1934: 220; Upper Mississippi River Bulletin 1933: 3; House Document 583, 1927: 18; National Rivers and Harbors Congress 1925: 178) This decision put the entire Middle West on a "dry-land" rate basis and railroad rates that had once been set low were permitted to be raised effective June 1, 1925, since a river on which no traffic of much imprtance occurred was no longer justification for low railroad rates. (Hartsough 1934: x-xiii; Upper Mississippi River Bulletin 1933: 3) This decision destroyed the favorable rate structure with which the upper Middle West had been blessed. Rates in the upper Mississippi valley rapidly increased from 33.3 to 100 percent. The rail rate between St. Paul and St. Louis, for example, that had been 63 cents in 1918 rose to $1.25 by 1925. (Upper Mississippi River Bulletin 1933: 3; Hartsough 1934: 220) The decision cost the Twin Cities alone an estimated $20 million. (National Rivers and Harbors Congres 1925: 178)

The Indiana Rate Case decision became the motivating force to reestablish water freight traffic to Minneapolis through the formation of the Upper Mississippi Barge Line Company. (Hartsough 1934: x-xiii) "Our only relief," stated one civic leader, "is to have actual navigation upon the Mississippi River" and the UMBLC was intended to achieve it and its corollary--the reinstatement of lower railroad rates. (National Rivers and Harbors Congress 1925: 178) With a new rate structure, the revival of water-borne freight suddenly became much more important to civic leaders of the Twin Cities. As an upper Middle West journal put it: "Freignt transportation on the upper Mississippi has been a much mooted theme in the minds of some of Minneapolis' leading business men for years. That its economical advantages were a fact none denied, but its feasibility was another matter. . . . nothing actually was accomplished, however, until approximately two years ago when the Minneapolis Real Estate Borad was confronted with the uncomfortable information that two of its largest and one of its oldest manufacturing institutions was about to pull up stakes and remove from the city because of increasing freight rates, due to the fact that there was no water competition to the all-rail rates of the railroad." (Commercial West 1927: 12)

In addition to changes in the rail rate structures, the effect of the Panama Canal and railroad congestion continued after World War I and, in a sense, worsened. The Panama Canal reduced the cost of transportation from coast to coast, but without adequate river improvement it did little to benefit the landlocked central interior regions. (Blegen 1963: 483; Hartsough 1934: 219; House Document 290, 1930: 9-10) The full effect of the completion of the Panama Canal was not evident until after the war; by then, the disadvantages of the Middle West were obvious. (Hoover 1928: 17)

The disadvantages imposed on the Middle West by the Canal were compounded by the total dependence of the region on the railroads. In addition to the rail rate structure that set the cities of the upper Mississippi valley at a disadvantage, railroad rates, due to higher wages and cost of materials, continued their climb which had begun much earlier than World War I. Herbert Hoover suggested the increasing rates served "to set a row of tollgates around the Middle West." (Hoover 1928: 17) The suggestion had figures to back it up. A. Lane Cricher, assistant chief of the Transportation Department of the United States Department of Commerce determined the effect of the Panama Canal and the increased rail rates. Changes in transportation costs between 1910 and 1930, he found, tended to place the east and west coasts nearer by approximately $2.25 per ton, using a staple commodity at fifth-class rates as a measure. Conversely, the "central west" moved over $3.00 a ton further away from the coasts. (Wilcox 1931: 163) Other figures were even more disturbing to advocates of the Middle West. Herbert Hoover, who remained a staunch supporter of river improvement, argued that "a given point in the Midwest has moved [because of the Panama Canal] 514 cents away from the Pacific Coast while New York has moved 224 cents closer to the Pacific. In the same period, this Midwest point moved 694 cents away from markets on the Atlantic seaboard and South America." (Hoover 1928: 18; Fortune 1931: 40) Moreover, a specific commodity such as steel moved from the Atlantic to the Pacific at from $4 to $7 a ton, while it moved from Chicago to Omaha, only 488 miles, at $8.40 a ton and from Omaha to Kearney, Kansas, only 200 miles, at $8.30 a ton. (Fortune 1931: 43)

Railroad congestion, moreover, continued to plague merchants and commercial interests in the Middle West. Since railroad lines had to carry lower classes of freight because of the lack of waterway transportation, they were burdened with freight on which their profit margins were small. The reports issued by the American Railway Association, furthermore, indicated that the car shortage in 1922 was the largest in history. Cars were breaking down faster than they were being replaced so that during 1920, 8,091 fewer cars were in operation by the end of the year. (National Rivers and Harbors Congress 1923: 28; Quick 1926: 336)

The fact that intercoast water rates were now less than the rate by rail from the interior to the coast created obvious problems for those in the Middle West. Farmers, who were amidst an agricultural depression in the 1920s, faced increasingly stiff transportation expenses. The upper Mississippi Valley produced over a billion bushels of grain annually and exported nearly 100,000,000 bushels. These exports had to be sold entirely through one market. "In this monopolization," a government report argued, "the grain producer has had little choice but to sell at one price to the one market." (House Document 290, 1930: 9) The increasing transportation costs, furthermore, placed the American farmer at a decided disadvantage in the international grain market. The competitive agricultural regions of the world--Australia, Argentina and India--all were closer to the seaboard than were American farmers and the higher costs to transport their goods effectively decreased the price the Americans could expect in the world market. (National Rivers and Harbors Congress 1925: 19; House Document 290, 1930: 10)

The cities also felt the ill effects of their inland position. The lower transportation rates for the seaboards and higher rates for the Middle Western businesses, Herbert Hoover argued, caused "certain types of Mid-West business to migrate to the seaboard. It steadily tends to establish manufacture nearer to seaboard and farther from the heart of agriculture, to the mutual disadvantage of both." (Hoover 1928: 18) Not only were businesses leaving the Middle West, but potential new firms were not locating there because of prohibitive transportation costs. (House Document 290, 1930: 9-10) The unfavorable business climate due to the inland position, moreover, was blamed by Middle Westerners as the cause of a declining population in the region. (Fortune 1931: 43)

Since the Twin Cities were the major metropolitan area affected by the disadvantageous rate situation, they were often singled out as an example. The Twin Cities were the only cities of its size that did not have water connections to ports. (Decker 1938: 183) This, in turn, led to the loss of much business on the west coast as the Panama Canal cheapened intercoastal rates. (Decker 1938: 185) Eastern cities also captured much of the processing of agricultural products once a trademark of the Twin Cities. Prior to the increase in the rail freight rates during an$ subsequent to World War I, for example, Minneapolis handled 80 percent of the northwest grain crop. By 1928, however, in spite of increasing grain harvests, Minneapolis flour output dropped and grain receipts declined. Buffalo, New York, meanwhile, increased its flour production well over four-fold between 1906 and 1928. (House Document 290, 1930: 13)

Some argued that the Twin Cities should accept their fate much to the chagrin of waterway improvement advocates. "A prominent Twin City transportation official," reported the Upper Mississippi River Bulletin, "stated recently that if Minneapolis and St. Paul are so situated from a transportation standpoint that they can no longer progress, there is nothing to be done about it--they must accept the situation as the inevitable penalty of their geographic location. What does this mean?" the journal asked. "It means either that our geographical location from a commercial standpoint is bad or that we of the Twin Cities should not utilize the advantages of our location to correct a transportation situation that is throttling our commercial life. History refutes the charge that our geographical location is bad and emphasizes our great natural advantage if we have but eyes to read and a will to determine our future, free from the dictation of aspiring individuals and absentee owners of our resources and businesses who are not primarily concerned with our welfare." (Wipred 1932: 2)

This article continued noting that some commercial decline had occurred in recent years. "It is true that we have in recent years witnessed the commercial supremacy of the cities of Minneapolis and St. Paul seriously questioned. The undeniable facts are only too evident. Those enterprises upon which the Twin Cities were built have passed away, or are to a greater or lesser extent, moving to more favorable locations. It is only necessary to call attention to what has happened or is happening to our lumber industry, flour milling, the manufacture of linseed oil, jobbing and the like, to realize that no time must be lost in correcting the present conditions unfavorable to the development of commerce and industry in the Twin Cities if we are to regain our former position as the commercial center of the Northwest." (Wipred 1932: 3)

Any talk of decline was related to the freight c ges that were crippling the upper Middle West. "Undoubtedl_ e greatest single factor affecting the commercial life of community is the cost of transportation," the article conc d. "When that cost becomes too high or is out of line with communities that are competitive, commerce stagnates anc e entire affected area suffers. While changes in methods of merchandising and the manufacture of such commodities as flour and linseed oil at points of consumption rather than at points of production, are factors which have adversely affected jobbing and manufacturing in the Twin Cities. I propose to show that the largest contributing factor has been and is the ever increasing cost of transportation, which, if continued, will reduce the Twin Cities to little more than prairie towns." (Wipred 1932: 3)

The obvious solution to these problems was continued and more extensive water improvement. By creating a competitor for the railroads, rates would be forced down. As Cleveland A. Newton said quite succinctly, "We are not interested in waterways. We are interested in rates." (Fortune 1931: 40) Others were even more to the point when they argued that river regulation was rate regulation. River transportation was also advantageous since it was better suited for the bulky, low-grade items that were shipped out of the upper Middle West. Grain, for example, which was transported from Minneapolis to New Orleans by rail, cost 34 cents per hundred weight in 1930. Although most grain was shipped via the developing Duluth port, the Minneapolis to New Orleans route by water would have cost only 19 to 21 cents per hundred weight, the cheapest rate available. (House Document 290, 1930: 13) A 1927 estimate, furthermore, determined that the annual commerce between the Twin Cities and St. Louis could reach 180,900 tons downstream and 223,800 tons upstream if river conditions were good, amounting to a total annual savings of $831,000. The items that could be transported on the river--grain, iron, lumber, paper, cotton, coal and petroleum--could reach an estimated $1.9 million annually with a tonnage of 1.4 million with improved transportation. Moreover, studies stressed that the main savings would be on the southbound traffic, especially on grain and flour. (House Document 583, 1927: 20, 39;

National Rivers and Harbors Congress 1925: 20; House Document 290, 1930: 13)

By freeing railroads of the burden of such bulky freight, some argued that water improvement would also benefit the railway industry. The overburdened rail system would be freed of the need to transport cheap items by further development of inland waterways and congestion would be lessened. (National Rivers and Harbors Congress 1923: 28) Cooperation between the rail lines and improved rivers, it was also argued, would benefit all concerned. Railroads were conveniently situated to act as feeders to an improved trunk water route if the lat4er were provided. (House Document 290, 1930: 10; Quick 1926: 336)

Such waterway improvement would aid the most beleaguered groups in the 1920s. The Middle West farmers, for example, could ship their grain more cheaply which would improve their declining grain trade. (Hartsough 1934: 222; National Rivers and Harbors Congress 1925: 18) Their place in the world grain market would thus be bettered if the upper Mississippi was improved. A federal government report, for example, argued in 1930 that "should the Mississippi be developed to the proportions of a trunk stream throughout, it would tend to equalize the competition between our Inland States and the agricultural regions of other countries more advantageous located near the oceans." (House Document 290, 1930: 10)

Many of the nation's politicians used the plight of the farmer as reason enough for waterway improvements. Herbert Hoover argued that "I believe the statement often made that . . . [by opening waterways] we shall decrease freight on grain to world market by ten cents a bushel is not far wrong. And by so doing we should increase the price of all grain to the farmer by ten cents per bushel and this ten cents is the profit end of the price. One season of such increase to our Midwest farmers would more than equal the entire capital outlay which we propose. I doubt if since the days when we transformed transportation from the wagon to the railroad have we seen so positive an opportunity to assist the propersity of the people." (Fortune 1931: 40) Presidents and interested legislators throughout the 1920s at least paid lip-service to waterway improvement which would aid the farmers. President Harding, for example, on June 22, 1923, said "the use of our inland waterways offers the one sure way to reduce carrying charges on basic materials, heavy cargoes, and farm products. Probably all of us acknowledge the urgent need of diminished costs on agricultural shipments and many bulk cargoes essential to the manufacturing industry." (Hull 1967: 33) Likewise, Calvin Collidge offered a similar campaign promise in 1924. "The farmer," he said, "should have the benefit of legislation providing for flood control and the development of inland waterways, better navigation east and south of the Great Lakes." (Hull 1967: 33)

Representatives of the Middle West sounded a more militant tone. Representative Kvale of Minnesota during the River and Harbors and Navigation Bill of 1925 argued "that the absorbing question for the farmers of the West is no longer one of production. The question of distribution is the vital problem; it demanded solution very soon. Trainloads of food are rotting on the ground merely because transportation rates are too high to warrant their carriage to market; when rates are substantially lowered the problems of the Northwest are more than half solved." (Hull 1967: 33-34) Others agreed noting that river improvement was essential. Representative Hull of Illinois said "the farmer today is clamoring for cheap transportation, and his only opportunity, in my opinion, is to utilize the rivers of the country." Representative Lozier of Missouri concurred. "When this inland waterways system is completed," he said, "the saving in freight costs each year will probably exceed the total cost incident to the improvement and development of all of our harbors and internal waterways. This expenditure will be returned every year in reduced freight rates." (Hull 1967: 34)

Like the farmers, the cities of the Middle West would also benefit from waterway improvement. Minneapolis, for example, would regain some of its grain trade lost to the eastern cities. Moreover, since improvements such as the Panama Canal were government projects and had injured the trade of Minneapolis, it seemed only fair that the government should improve the channel of the Mississippi "as a partial compensation." (House Document 290, 1930: 13; Decker 1938: 186)

While the Middle West was the region placed at the greatest disadvantage because of inadequate transportation facilities and thus the main advocate of waterway improvement, the arguments retained their Progressive claim that such improvement would be for the national good. By lowering transportation costs for American farmers, for example, the American share of the international grain market would be enlarged and all Americans would benefit. Moreover, the Progressive notion that any project should be part of a comprehensive, single system was also retained. "We must make these waterways into a full and completed transportation system," Hoover argued, "by joining up their broken links. I cannot listen too strongly upon the necessity of this full completion of the whole system, for every part bears a relation to every other part no matter how remote." (National Rivers and Harbors Congress 1925: 22) Hoover, in another place, asserted that this conception was a recent phenomenon. "The national mind perhaps, until in the past two or three years, has conceived waterways development as local projects of some immediate nearby improvement, instead of in the wide vision of a comprehensive system of 12,000 miles of connected inland water transportation." (Hoover 1928: 18)

Hoover's plan included the deepening of 9,000 miles of the Mississippi River and its tributaries to permit modern barge service. "Without such depths," he concluded, "our rivers are not waterways, they are drainage channels. (National River and Harbors Congress 1925: 21) Yet Hoover was optimistic. "We have developed that experience and skill by which we now assuredly control the floods, equalize the stream flow, curb the currents and channels, build great dams and reservoirs," he said. "We can proceed with a certainty of step which has not hitherto been possible. Today," he concluded, "we are sure of our results." (National Rivers and Harbors Congress 1925: 20)

Civic leaders in the upper Middle West shared that optimism, if waterways were adequately improved. Accordingly, many attempted to facilitate barge traffic not only through political prssure, but their own civic improvements. A major obstacle to upper Mississippi River commerce was the absence of adequate terminal facilities in urban areas. The Upper Mississippi Barge Line Company worked for suitable terminals. By 1928, Minneapolis, St. Paul and Dubuque on the upper Mississippi River had built municipally-owned terminals and Winona and LaCrosse had expressed interest. (National Rivers and Harbors Congress 1927: 345; Merritt 1980: 96-97)

In spite of the optimistic proponents of waterway improvement, some segments did not believe that waterway improvement was not the answer. First, some felt improvement was a boondoggle. While the total cost of improvement and maintenance of the six-foot channel from the Wisconsin river to Minneapolis between 1878 and 1930 was over $15 million or $1,305 per mile per year, for example, they noted that commercial traffic had actually decreased year by year until government dredging plants themselves becames the largest single carrier on the upper Mississippi River. (Merritt 1979: 165) Moreover, railway spokesmen were furious over government waterway plans because they subsidized their water competitors, were not really as cheap as waterway advocates proclaimed, and duplicated at public expense facilities already adequately provided by the railroads. (Fortune 1931: 39-40) More logicaly, the railroad men continued to argue, would be increased expenditures on the rails. An 1926 article noted that although railroad business had increased 800 percent in the previous forty years, it had been "serious legislative restraints" that had caused difficulty and that growing demands of commerce had caused railroads to suffer not from excessive traffic density but from a lack of sufficient tonnage. And if waterways were improved, the tonnage would decrease and the railroad system, which its proponents called the most economical transportation structure, would decline. The writer concluded that "what we need in this Middle West is not more methods of transportation, but better and more efficient development of the existing fcilities. . . . If the government subsidizes the railroads in the same way it subsidizes inland water transportation, economies could be produced to such a large extent that we would not be seeking the slow, inflexible, and inadequate means of transporting our goods by water, as against the modern, rapid, efficient, and flexible means of rail transportation." (Sargent 1926: 20)

Such arguments, however, year by year became less popular. The consensus clearly favored continued river improvement. Moreover, many recognized the need for a deeper channel and improved methods of river maintenance as the six-foot channel project failed to make satisfactory progress. Between 1872 and 1930, channel improvement from the Twin Cities to Cairo, Illinois, had cost about $68,350,000. (Fortune 1931: 41) Annual appropriations, furthermore, were generally increasing. After World War I, the Mississippi Valley Association continued to promote inland waterways. The pro-improvement voting bloc in the U.S. Congress was strong enough to boost the 1922 river improvement appropriations from $27.5 million to the $43.5 million recommended by the Army Corps of Engineers. Before the end of the Coolidge administration, the Rivers and Harbors Bills' annually appropriated $50 million, one-third of which went into the Mississippi River system. (Fortune 1931: 137)

In spite of all the expenditures, the six-foot channel project was not being completed. Many places were not six feet deep and worse yet had little prospect of reaching that depth with the contemporary methods. Moreover, time was passing the six-foot channel project by. As a government report stated, "the present 6-foot project and the methods of prosecuting it were designed to aid types of river trade which have become obsolete; the project is certainly inadequate for present needs. The people of the Mississipi Valley desire the improvement of the river to the dimensions of a trunk line stream so that cargoes loaded at Minneapolis, St. Paul or other river points may proceed to New Orleans or other points on the lower Mississippi or Ohio without breaking bulk; and, similarly, the upstream traffic may not be hampered by the transfer from the large lower river barges to the smaller barges used above at an intermediate terminal which is at present necessary." (House Document 290, 1930: 11) In other words, a uniform depth from New Orleans to the head of navigation was necessary in order to benefit adequately the northern metropolitan areas.

Towboat technology was also improving which provided a greater need for deeper channels. The large tows and powerful towboats that were being developed for commercial use on the Ohio and lower Mississippi Rivers could not be used on the upper Mississippi River unless the channel there was deepened, deepened not only to the required six feet, but to a depth compatible with the lower river. (U.S. Engineer Department 1938: 1) Finally, the development of privately-owned water carriers would have been more effectively encouraged with a reliable, if not a deeper, channel. A board studying the upper Mississippi improvement, for example, asserted that dependable facilities had to be assured if increased fleet activity was to be maintained. Private interests would not tend to invest capital in barges and shippers would not entrust their goods to river commerce unless they were confident that shipments would move without delay at all times during the navigation season. "The present channel," the report concluded, "offers no such facilities." (House Document 137, 1932: 16)

River contraction to create a deeper channel simply was not succeeding, yet overriding concerns emphasized the need for channel improvement. The solution, it seemed, was the development of a lock and dam system, the beginning of which had already been created near the Twin Cities. Such slackwater navigation systems had been successful in other areas. Immediately before the upper Mississippi River project, for example, a nine-foot channel had been created on the Ohio river through a lock and dam system. Yet the idea of a lock and dam system on the upper Mississippi River was older than that. Lyman E. Cooley spoke on the improvement of the upper Mississippi in 1902, arguing that the river was "the most improvable of streams and could be canalized by the aid of locks and dams for a depth of twelve feet." By 1908, he suggested the channel could be fourteen to sixteen feet through a similar system. (Upper Mississippi River Improvement Association 1908: 151)

In the next section, we will discuss the nine-foot channel project which was based on a series of locks and dams stretched along the length of the upper Mississippi River. An understanding of the genesis of that system, however, must be sought in the six-foot channel period that preceded it. Not only were the initial locks and dams built in Minneapolis and Hastings to facilitate a faltering six-foot channel project, but the intellectual, economic and technological basis for slackwater navigation was laid in this period. Upper Middle Western civic leaders clamored for increased water improvement citing declining economic influences, as barges were becoming larger and engines more powerful which would make the six-foot channel obsolete before it was ever completed.

A powerful influence in recognizing the need for waterway improvement, as we have seen, was Herbert Hoover. As Secretary of Commerce, he made a waterways survey in 1923. In 1925 and 1926, he spoke for waterways at Kansas City and Minneapolis, and in 1928 he spoke in St. Louis. A year later, he officiated as president at the opening of the Ohio River. It is fitting that in 1930 he was president when the decisive Rivers and Harbors Bill was passed to create a nine-foot channel. Some contemporaries felt Hoover's advocacy of river improvement was politically defined. "Herbert Hoover shrewdly won votes from the Valley people," Fortune magazine asserted, "by letting his engineering enthusiasm go on a project of debatable economic merit." (Fortune 1931: 137) While political feasibility certainly played a role, we must also stress the Progressive lines of thought that were rooted in the Whig notion of internal improvements before it. The nine-foot channel would improve commerce and lead to the economic benefit of the nation, went the argument. Moreover, by insisting upon a consolidated program which systematically improved the waterways, the channel would more likely become an integrated transportational system. As we will see in the next section, however, while the mentalite expressed by Hoover led to the approval of the nine-foot channel lock and dam system, it was a new line of thought brought to the White House by Franklin D. Roosevelt that facilitated its rapid completion.

## The Nine-Foot Channel Period:

The creation of the nine-foot channel reflected a transition in federal government economic philosophy. The Whig and Progressive notions of internal improvement had been at the forefront of the justifications of waterway development. Theodore Roosevelt and, later, Herbert Hoover, called for a better channel to facilitate commerce throughout the nation. And it was during Hoover's administration that the nine-foot channel was approved. But under Hoover's plan, the nine-foot channel project was to be completed over a long period, just as the four and one-half and six-foot channel before it. Hoover obviously desired waterway improvement, but he did not advocate the immense expenditures cf federal monies that a rapid completion would require. The Keynesian philosophy of Franklin Delano Roosevelt, however, differed in this very important philosophical tenet. In the depths of the Great Depression, a public works scheme was developed which would provide work and wages for the millions of unemployed. The locks and dams, which were the basis of the nine-foot channel, became part of that scheme. The millions of dollars appropriated to build the locks and dams of the upper Mississippi speeded up the completion of the nine-foot channel by decades and brought about the renaissance of river traffic years earlier than Hoover would have dared dream.

Reports throughout the later 1920s stressed the failure of the six-foot channel. The Annual Report of the Chief of Engineers in 1927 declared that the project was about 65 percent complete and three years later it was about 85 percent completed in the St. Paul district. (Annual Reports 1927: 1064; 1930: 1197) Such progress was not considered adequate and the Board of Engineers for Rivers and Harbors concluded in 1930 that "the existing project for a 6-foot channel has not yet been completed and commerce is undoubtedly handicapped at the present time. Work already authorized and in progress may be expected to improve existing conditions to some extent." (House Document 290, 1930: 6)

The changing needs of the region were often stressed. "The present 6-foot project and the methods of prosecuting it," one 1930 report noted, "were designed to aid types of river trade which have become obsolete; the project is certainly inadequate for present needs. The people of the Upper Mississippi Valley," it continued, "desire the improvement of the river to the dimensions of a trunk line stream so that cargoes loaded at Minneapolis, St. Paul or other river points many proceed to New Orleans or other points on the lower Mississippi or Ohio without breaking bulk . . ." (House Document 290, 1930: 11; Hartsough 1934: xiv-xv) The same report reiterated elsewhere in the text that the six-foot project was "not adapted to modern needs." "Conceived in 1878," it wrote, "when navigation of the river was largely log rafts and in the movement of relatively high class freight at high cost in single packet boats or in small tows." The six-foot depth was "a self-limiting one and should be modified at once to the end that all permanent work shall be of such a character as to provide for the future expansion of commerce along the lines of greatest economy." (House Document 290, 1930: 49) In essence, it had become apparent that the six-foot channel, if it were completed, would be inadequate for movement of the large tows and powerful towboats being developed for commercial use on the Ohio and lower Mississippi Rivers, and that commerce probably would not develop on the upper Mississippi River to an extent justifying further improvement unless a nine-foot channel were provided. Either the channel had to be deepened or any further improvement would be purposeless. (U.S. Engineer Department 1938: 1) Moreover, Lytle Brown, Major-General and Chief of Engineers, wrote that it was impracticable to secure this necessary adequate channel by regulation and dredging. (House Document 137, 1932: 1) Clearly, a new project with a greater depth using new technologies was needed.

Concern about the failure of the six-foot project and arguments for continued improvement resulted in government studies on the upper Mississippi River in the late 1920s. The Rivers and Harbors Act of March 3, 1925, contained an item providing for a preliminary examination and survey of the "Mississippi River from Minneapolis to Lake Pepin, with a view to improvement by the construction of locks and dams." Since the Army Corps of Engineers believed that the section between the St. Croix mouth and the head of navigation could not have a six-foot channel maintained simply through river regulation, other methods were considered. (House Document 583, 1927: 7) Two years later, Congress authorized surveys of the upper Mississippi River aimed at the eventual creation of a nine-foot channel in that year's River and Harbor Act. (Hartsough 1934: 6)

The Army Corps initially was not strongly in favor of the plan. The preliminary report of the Rock Island District survey of the Mississippi from Minneapolis to the Missouri River mouth argued that the project was not economically feasible. (Merritt 1980: 97) The government report remained equivocal when it concluded "while not convinced of the advisability of the improvement, [the Board of Engineers for Rivers and Harbors] recommends a survey to determine the cost of providing a dependable 9-foot channel between the mouth of the Illinois River and Minneapolis 200 feet wide in straight reaches and at least 300 feet wide at bends." (House Document 290, 1930: 7)

Once the nine-foot channel became a definite issue, opinion was divided over the advisability of the project. The Army Corps maintained a neutral public profile, but opposed the plan according to one historian. Raymond H. Merritt argues that the decision to press on with a nine-foot channel was an "unprecedented decision in water resource development" since it was not based on a "viable economic feasibility study," it had not been recommended by the Corps, and it was a plan that did not originate at the district level. (Merritt 1980: 89, 100) Instead, Merritt argues, it was a plan primarily of a political nature undertaken by President Hoover. (Merritt 1980: 100) As we have seen, however, there was reason to support the improvement on economic grounds and one wonders if Hoover's decision was merely political. Moreover, if the Corps was hesitant early in the planning stages, they soon were adamant barkers of the channel improvement.

Environmental interests did not maintain a low public profile, however, during the debates on the issue. Henry B. Ward, president of the Izaak Walton League, argued that "one of the largest and one of the most potentially productive wildlife refuge and recreational areas on the entire continent" would be destroyed if a slackwater navigational system were built. Major Charles L. Hall, District Engineer of Rock Island, concurred when he told the School of Wildlife Protection in McGregor, Iowa, that canalization of the upper Mississippi would drive away animals, diminish game, fish and produce a "succession of stagnant or sluggish pools." (Merritt 1979: 196) An environmentalist opponent in the Winona Republican Herald was more colorful. "We are still against the alleged 9-foot channel under the dam form of construction," it wrote. "We are now more firmly convinced than ever that it will be a gigantic commercial failure and will be impossible to maintain without spending millions of dollars each year in dredging operations. It will completely destroy bass fishing on the river and will form a series of badly polluted pools that will look like a lot of link sausage on a map and smell worse than said sausage if they were left exposed to the present heat for a week. The scenic attraction of the river," it concluded, "will be completely wiped out." (U.S. Army Corps of Engineers 1974: 113)

Proponents of the potential channel were just as quick to back the plan and castigate those who opposed it. Business and political leaders, for example, were outraged by the report of Major Hall which indicated that the project was not economically feasible as well as his remarks that it was environmentally hazardous. The Minneapolis Journal argued that his "duties are neither floral nor faunal, but engineering." (Merritt 1979: 197; Merritt 1980: 97) The tried and true arguments for the nine-foot channel were also stressed. Commerce would be stimulated by river traffic between Minnesota and the Gulf, it was believed, only if the river could be deepened and kept at a standard depth. Moreover, the nine-foot channel on the Ohio River that was authorized in 1910 and completed in 1929 made the upper Mississippi incompatible with the deep draft barges on the Ohio and lower Mississippi unless a nine-foot depth was maintained in the north. As one proponent put it, "compatibility of river channels was as crucial to water navigation as standardization of rail gauges were to railroad networks." (Blegen 1963: 483; Merritt 1980: 96-97) As Hoover stressed in his speech celebrating the opening of the Ohio River to nine-foot navigation, modernizing every part of our waterways would show economic justification in aid of the farmers and industries of the Middle West and would work to establish private enterprise in substitution for government operation. (Wilcox 1931: 162-163)

In addition to older arguments for an improved channel, other, more ingenious justifications were set forth. Halleck W. Seaman of Clinton argued in 1930 that river improvement on the Mississippi would aid national defense. "Should this country be attacked by a coalition of two or more first-class European powers," he said eleven years before Pearl Harbor, "with Japan in the Pacific, and should they break through our naval defense on either one or both of our ocean coasts, then by falling back upon the Mississippi our forces could hold out indefinitely and bid defiance to the world. We could starve out an invading enemy," he concluded, but only if the river were easily navigable. (U.S. Army Corps of Engineers 1974: 112)

The proponents for increased river improvement, with the backing of the president, clearly had the upper hand. In fact, on May 29, 1929, James G. Wood, Secretary of War, appointed a special board of engineers to survey the upper Mississippi and reevaluate a report by Major Hall, who continued to oppose the implementation of the nine-foot channel. The report, which was published as House of Representatives Document No. 290 in the

71st Congress, 2nd Session, remains the principal early examination of the project to come and will be examined at length. (Merritt 1979: 196; House Document 290, 1930: passim) Document 290 noted the reasons for failure of the six-foot channel project, many of which have already been cited in this report. The project was conceived in a different period when commerce was based on steamboats and log rafts and when a different economic structure was present. While packet lines once would have run on an irregular schedule, the larger diesel tows needed a clear channel and a regular schedule of commerce in order to compete with other forms of transportation in the twentieth century. (House Document 290, 1930: 11, 49) In short, the six-foot project unduly handicapped the upper Mississippi Valley. (House Document 290, 1930: 6)

Although the six-foot channel was failing to meet present needs, however, that did not mean improvement should cease. Indeed, there were many reasons for even more extensive improvements. Establishment of a nine-foot channel would increase waterborne shipments. It was estimated that 4,500,000 tons of grain with an annual estimated saving of $4 million in transportation costs might occur. Four million tons of coal from West Virginia might be shipped up the upper Mississippi with a possible saving of from $2-4 million. Moreover, 500,000 tons of iron ore and other commodities such as gasoline could also be shipped at a savings. (House Executive Document 290, 19  : 2, 4; Hartsough 1934: 222-223) The improvement of the stream to nine feet, which would create this transfer of goods, would fit in well with the other recent improvements. The Ohio River system which had been recently completed opened a nine-foot channel through a lock and dam system to Pittsburgh and plans were being made to improve the Missouri River to its greatest feasible depth. "Reliable and economical navigation," the report noted, "is not practicable on a depth of less than 6 feet but would be assured by a depth of 9 feet." All plans, therefore, were made with the assumption of a nine-foot channel, the upper Mississippi among them. (House Document 290, 1930: 3)

Not only would improved commerce permit better marketing conditions of goods out of the upper Mississippi Valley, but industry would be attracted to the Middle West. The improvement of the upper Mississippi would "encourage the establishment of industrial plants nearer the available markets in that valley, where heretofore little diversified activity has been found," the report noted. (House Document 290, 1930: 10-11) The equalization of competition, in short, would create a more decentralized industrial situation. But again, this equalization would only occur if private water carriers were attracted to the new waterway which would be facilitated only by a deeper channel. A 1908 report predicted that the long-haul transportation on a five and one-half foot draft was 50 percent more expensive than on an eight and one-half foot draft on the Ohio River, a projection which was confirmed when the nine-foot channel there was secured. (House Document 290, 1930: 19) As the size and draft of the barges or tows became greater, the net cargo they could carry increased at a more rapid rate than their capital and operating expenses. Accordingly, it was argued "that a real improvement of the upper Mississippi must provide for channel dimensions which will accommodate downstream tows of from 8,000 to 14,000 tons cargo capacity and upstream tows of from 6,000 to 8,000 tons or, in other words, that the improvement should correspond in all respects to Ohio River or better standards." (House Document 290, 1930: 9, 22)

Convinced that a nine-foot plan was necessary, the report went on to define the difficulties and advantages of various possible projects. Generally, a nine-foot channel would have to be achieved over a period of years. Although still a six-foot channel project, all permanent structures from that point on were to be built "with a view of being adapted without reconstruction or relocation to plans for an ultimate 9-foot depth . . ." (House Document 290, 1930: 3) It was apparent, however, that river contraction was no longer feasible as a method of water improvement. "The safe manipulation of [big eight and one-half foot draught towboats] at medium and high stages," the report wrote, "when currents are strong requires channel widths at least equal to the length of tows with 50 percent widening or more at bends. The minimum low water channel . . . must be at least one-half the length of tows for tows of economical proportions. . . . In the planning of the improvement of any great stream with a view to securing increased navigation facilities at low water by regulation it is imperative that these desiderata for medium and high-stage navigation be not sacrificed by too extensive construction of wing dams." (House Document 290, 1930: 21, 22)

Five methods were considered for upper Mississippi River channel improvement, including regulation with present flow (an open river); regulation with increased flow (reservoirs); a combination of dams, reservoirs, and regulations; a combination of dams and regulations (partial canalization); and complete canalization through locks and dams. (House Document 290, 1930: 31) After examining the pros and cons of all five potential projects, "it [was] evident that the only reliable and most economical method for obtaining a depth of 9 feet for a reasonable free and unrestricted channel in any reach above Quincy [Illinois is] by canalization." (House Document 290, 1930: 37) Reservoirs could not maintain a nine-foot channel without canalization, but the headwaters reservoirs already constructed would be invaluable during periods of low water in aiding natural flow and were "considered a vital part of any navigation scheme adopted . . ." (House Document 290, 1930: 37) Other improvements, such as wing dams, however, would have to be abandoned.

In spite of favoring a system of locks and dams, the board noted that natural conditions were not particularly favorable to their construction. The upper Mississippi River valley was flat and wide with numerous villages and small cities elevated not far above ordinary high water. At only one point between Hastings and the Wisconsin River, for example, did the opposite bluffs reach to less than two miles from each other. Railroads followed the river and at many points were just above high water and at larger river cities, industrial developments lined the stream closely. Because of the small leeway between natural high water and improvements along the river and because of the small range of annual stages (21 to 26 feet), "it is essential that any dams constructed be designed so as not to increase flood stages appreciably." (House Document 290, 1930: 5, 37) Moreover, hydropower did not appear feasible since it did not offset costs of implementation. Thirdly, many dams would have to be built on pile foundations on a sand, gravel and silt bed. The final disadvantage, not a primary concern of the upper Mississippi region, was the complication that a permanently increased low water would create for the levee structures already in place below Muscatine. (House Document 290, 1930: 37)

Special attention was paid to the Ohio River locks and dams system, recently completed and also an achievement during the Progressive Era, and lessons it could teach engineers beginning another slackwater navigational system. On the Ohio, for example, the dams were all movable except in the upper reaches where fixed dams were needed for special reasons and at Louisville where navigation over the falls was hazardous. Since the greatest periods of long haul downstream towing on the lower Ohio was during the open river season when stages permitted speed of movement and when sizes of tows were entirely unrestricted by locks, the Ohio dams were lowered with the rising river and navigation had an unrestricted channel. Such a plan might also be applied to other waterways with similar characteristics. (House Document 290, 1930: 20) Moreover, in an attempt to bring about some sort of standardization, the board recommended that locks built on the upper Mississippi conform to standards of the Ohio and Monongahela Rivers. Accordingly, above the Hastings lock and dam, the Monongahela standards with tow lengths of from 350 to 700 feet, lock widths of 56 feet, and channel widths of from 200 to 800 feet were to be applied. From Hastings inclusive throughout the St. Paul district, the upper Ohio River standards were recommended with tow lengths of from 500 to 700 feet, lock widths of 110 feet, navigable passes in dams if movable of from 400 to 600 feet, and channel widths of from 300 to 1,600 feet. (House Document 290, 1930: 23)

Some recommendations, such as compatibility with the Ohio River system dimensions, were strongly backed. Other suggestions were less concrete and a series of feasible plans were given. While the construction of locks and dams was strongly recommended between the Hastings dam and the mouth of the Wisconsin River, their possible locations and size were given in three schemes. Scheme I included 7 low dams with heads of 9 to 11 feet, all of the movable type on pile foundations, with locks of 110 by 600 feet, a navigable pass of 450 feet and a weir of the Chanoine or Boule type for regulating the pool and facilitating operations of the pass. Possible power development in this plan was insignificant, but its principal advantage was that flowage damage would be minimal. (House Document 290, 1930: 5, 40) Scheme II would include three high dams with heads from seventeen to twenty-three feet and one low dam. It would necessitate the use of Tainter gates or roller gates for spillways since the larger heads would prevent the use of wicket-type dams. The main advantage was the creation of power made economically feasible by the large heads.

But the major drawback was increased flowage damage, a very important consideration in view of the geography of the upper Mississippi. A third scheme was the possible combination of the low dam and high dam schemes. (House Document 290, 1930: 5)

Since flood heights could not be increased to any extent, low dams appered to be of greater advantage. High dams would have to have been constructed with very long spillways and consequently increase costs. Moreover, as open river navigation had to be preserved at high stages, the board recommended movable low dams. Noting that one of the hydraulic characteristics of the Mississippi River was the rare occurrence of sudden rises in the river, it was argued that the use of movable dams would be particularly favorable and would require few adjustments of the wickets. "The normal course of events," the board wrote, "would be to raise the dams when high water falls in the late spring or the early summer, to keep them up until ice conditions force the abandonment of the river by navigation in November. In many years," the board argued, "there will be no necessity for a complete lowering of tne dams during the entire navigation season." (House Document 290, 1930: 37-38)

With this plan in mind, a two-stage project was recommended. The first step was the construction of seven locks and dams--numbers 4, 5, 6, 7, 8, 9 and 15--"to provide a good through six-foot channel regardless of the contemporary invesetigation on the possibility of obtaining a depth of 9 feet." These new improvements were so located that they would be fully capable of being introduced as component parts of the future nine-foot channel without major alterations. The second step would be the construction of those dams where a six-foot channel already existed with dredging and maintenance, but where they would have to be built in order to create a nine-foot channel when that occasion arose. Lock and Dam numbers 3 and 10 were the only two structure in that category in the St. Paul district. Estimated costs of the first step were $50,332,000 while the second step would cost an estimated $48,091,000. Annual maintenance would require an appropriation of $1,950,000. (House Document 290, 1930: 48)

The board stressed, however, that all conclusions were tentative and no concrete recommendation was considered advisable until further study was undertaken. Indeed, Scheme I was adopted largely to facilitate the cost estimtes required in the report. (House Document 290, 1930: 7, 42) And, as we will see, many changes were made in the final project. Although the framework of an upper Mississippi River lock and dam system was set in this report, new locks and dams were added, earlier recommended locations were changed, and the structure types of the dams were

As the engineers studied the viability of a nine-foot channel, political lobbiests were busy working to see that it came to fruition. The priority projects of the Army Corps of Engineers sent to President Hoover on April 30, 1930, did not include the nine-foot channel project, yet political pressure continued. Civic journals in the upper Middle West kept close tabs on the progress of rivers and harbors legislation. The <u>St. Paul Association Weekly News Bulletin</u>, for example, reported in

May of 1930 that the nine-foot channel in the Mississippi River from St. Paul to St. Louis, one of its major projects, "has been advanced to a position which seems to insure authorization by the Congress in the pending Rivers and Harbors bill. By a vote of 15 for and only 4 against the Commerce Committee of the Senate, in executive session, on Wednesday, May 21st, approved an amendment to a bill, sponsored by the upper Mississippi Valley interests, modifying the existing 6-foot project to a 9-foot depth. While there will undoubtedly be some opposition from the floor of the Senate," it concluded, "it is felt that the decisive action of the Commerce Committee foreshadows passage of the 9-foot project amendment." (St. Paul Association Weekly News Bulletin 1930: 2) The News Bulletin was correct. When President Hoover dragged his feet on the nine-foot channel issue, Senator Henrik Shipstead of Minnesota succeeded in having the proviso for the nine-foot channel in the upper Mississippi written in the Rivers and Harbors Act which became law on July 3, 1930. (Hartsough 1934: 276-277) The victory was a great one for commercial interests in the upper Middle West. And Raymond H. Merritt has attributed its success largely to those interests, including the Mississippi Valley Association, the Minneapolis Real Estate Board, the Mississippi and St. Croix Improvement Commission, and the congressional representative of Minnesota, in addition to President Hoover and his secretary of war. (Merritt 1979: 198) Shipstead was not finished, however. He advocated a bond issue of $500 million to make possible the completion of the inland waterway program. Although this Mansfield-Shipstead bill failed to pass the Hoover administration, the Minnesota legislature maintained its pressure by memorializing Congress to pass the bill. (Hartsough 1934: 277-278; Merritt 1979: 198). Although such rapid completion of the project would have to wait for the Works Progress Administration of the Roosevelt administration, Congress did appropriate $7.5 million to begin work. (Fortune 1931: 41)

The item as it appeared in the Rivers and Harbors Act of 1930 read:

> The existing project is hereby modified so as to provide a channel depth of 9 feet at low water, with widths suitable for long-haul common-carrier service, to be prosecuted in accordance with the plan for a comprehensive project to procure a channel of 9-foot depth, submitted in House Document 290, Seventy-first Congress, second session; and the sum of $7,500,000, in addition to the amounts authorized under existing projects, is hereby authorized to be appropriated for the prosecution of initial works under the modified project: Provided, That all locks below the Twin City Dam shall be of not less than the Ohio River standard dimension.

Since $6,270,000 had been authorized under the then-existing projects, prosecution of initial works was limited to $13,777,000. (U.S. Army Corps of Engineers 1974: 2; Blegen 1963: 484; Annual

Report 1931: 1206; House Document 137, 1932: 2-3) The upper Mississippi canalization, however, was a comprehensive plan--a recommendation Progressives had been making for decades--so the whole project would presumedly be completed at less expense than other projects such as the Ohio River lock and dam system. (Hartsough 1934: 265) The project, however, did alter the Army Corps of Engineers in the St. Paul district; as one historian writes, "the Rivers and Harbors Act of July 3, 1930, completely changed the structure, personnel and objectives of Corps activities." (Merritt 1979: 187)

The final report of the plan for canalization of the upper Mississippi was published in 1932 as 72d Congress, 1st Session, House Document No. 137. In it, the old considerations of the need for a nine-foot channel were reiterated. Private interests, it argued, would not invest in tows unless a dependable channel were developed; an adequate channel could not be created only by regulation and dredging; and reservoirs would be too expensive. Accordingly, Lytle Brown, major engineer of the Chief of Engineers, wrote, "I recommend that the project for the improvement of the upper Mississippi River from the mouth of the Missouri to Minneapolis be adopted as follows: A channel of 9 feet depth and of adequate width will be provided between the mouth of the Missouri and the Northern Pacific Railroad bridge at Minneapolis, Minn., by the construction of a system of locks and dams, supplemented by dredging in accordance with plans prepared under direction of the Chief of Engineers, at a total estimated cost of $124,000,000. I recommend, also, the authorization of the appropriation of the entire sum required for the completion of the project." (House Document 137, 1932: 1, 10, 16)

While these recommendations were not earth-shaking, the report provided for a number of changes in the preliminary report. Since a system of low dams was determined to be the best possible method, hydroelectric power would not be profitable. "All possible power is purely secondary," the report wrote, "due to low heads and the rapid cutting down of head as the flow increases from the low-water discharge." (House Document 137, 1932: 6) The potential energy at the individual sites from Dam No. 4 to Dam No. 15 inclusively varied from 20,000,000 to 370,000,000 kilowatt-hours annually, but the cost of development and the difficulty of absorbing these amounts of secondary energy in any market then existing within possible reach made the production of power at any of the navigation dams "a possibility only for the very remote future." (House Document 137, 1932: 24)

Furthermore, after studying terminal development, the report argued that navigation should be improved only up to, and not beyond, the Falls of St. Anthony. The present terminal in Minneapolis, completed in 1927, was under the Washington Avenue bridge on the right side of the river and about .3 mile below the extreme head of navigation. The terminal presently covered about 4.7 acres but the area was not navigable. The project, however, included dredging from bank to bank from a point 1,500 feet below the Washington Avenue bridge to the Northern Pacific bridge to give a depth of nine feet at a cost of $450,000. This improvement would provide an adequate nine-foot channel and turning basin and was considered high priority since it would relieve a congested situation at the terminus. (House Document 137, 1932: 32-33, 93-94) If more terminal development was to proceed, however, there was ample space at and below tne mouth of the Minnesota River, in St. Paul, and about ten miles below the Washington Avenue bridge. While the board thus considered tne reach between the Washington Avenue bridge and the Northern Pacific Railway bridge to be part of the project adopted in the 1930 River and Harbor Act, therefore, it was concluded "that the costly and difficult works required to carry navigation above St. Anthony Falls are not justified at the present time." (House Document 137, 1932: 48) That improvement would have to wait a few decades longer.

House Document 137 finalized the placement of locks and dams that had been roughly placed in the earlier 1930 report. The sequence of improvement was to be based on a plan that would progressively improve the channel. Localities which were presently wholly inadequate for existing commerce were to be improved first followed by improvement at less critical sections. As had been stressed previously, the works necessary for the nine-foot channel were divided into groups such that, if completed in order, a safe and reliable channel of six feet or better would first be obtained and subsequent construction undertaken over a long stretch of time would eventually result in a nine-foot channel. (House Document 137, 1932: 7, 10) Furthermore, the number and location of the dams were determined by such factors as the profile of the river, width at dam sites, flowage damage, foundation conditions, and difficulty of construction. (House Document 137, 1932: 5) Some dam locations, such as Lock and Dam No. 10, had been altered since House Document No. 290 had been published in 1930 and others were added such as Lock and Dam No. 5A.

The order of improvement was also similar to that suggested earlier, but the 1932 report categorized the improvement sequence much more specifically. According to the plan, four groups of works were divided according to their need. Group A, projects to be completed first, included in order of priority, the purchase of three dredges, additional study, the dredging of pools No. 1 and 2, construction of Locks and Dams No. 4 and 5, and the second lock at Dam No. 1, and the purchase of site and flowage rights for the dams in Group B. The order of completion of Group B was Lock and Dam Nos. 6, 5A, 7, 8, 3 and 9. Lock and Dam No. 10 was th% only project that would be part of the St. Paul district in Group C. While the second lock at Lock and Dam No. 2 was the only work in the northernmost Army Corps District in Group D, it was also the lowest priority of the whole system. (House Document 137, 1932: 7, 28-29) The estimate cost for the work was as follows:

| | |
|---|---|
| Second Lock, Twin City Lock and Dam | $1,300,000 |
| Second Lock, Hastings Lock and Dam | $1,500,000 |
| Lock and Dam No. 3 | $3,502,487 |
| Lock and Dam No. 4 | $3,910,821 |
| Lock and Dam No. 5 | $3,921,413 |

| | |
|---|---|
| Lock and Dam No. 5A | $3,863,772 |
| Lock and Dam No. 6 | $3,017,063 |
| Lock and Dam No. 7 | $4,445,934 |
| Lock and Dam No. 8 | $4,551,613 |
| Lock and Dam No. 9 | $4,158,294 |
| Lock and Dam No. 10 | $3,721,800 |
| Removal of wing dams | $ 228,700 |

Flowage damages arising out of the dam system was estimated at $12,395,092 and 176,514 acres. (House Document 137, 1932: 26, 27) Finally, provision was made for the eventual construction of a second lock at all sites. In planning for future development, provision was also made for a steel sheep pile diaphragm extending up and downstream at right angles to the dam so that an adequate cofferdam closure could be made when the second lock was under construction. (House Document 137, 1932: 98-99)

While the basic framework for the locations of the locks and dams as well as their priority was maintained from the earlier report, the finalized project drastically changed the dam structure types. Below the Twin City Dam (No. 1), a non-navigable type of dam with a combination of Tainter and roller gates in addition to a fixed earth dam was proposed. This type of dam was selected instead of the Ohio River type with navigable pass that had been suggested earlier as a possibility. The non-navigable type of dam was selected in preference to the wicket type used on the Ohio River primarily to assure greater dependability in operation and maintenance, but also because it was less expensive and better suited to the Mississippi River's characteristics. With non-navigable dams, the space between the piers could be readily bulkheaded and unwatered so that necessary repairs could be made to the crest gates. While the wickets of the navigable type could be renewed without much difficulty or interruption to navigation, the renewal of the sills was very difficult, if not impossible. (House Document 137, 1932: 2) Secondly, the danger of erosion below the dam was lessened by operating a sufficient number of gates at part gate opening so that the discharge was spread in a thin sheet over a relatively long length of spillway. (House Document 137, 1932: 96) Thirdly, although the first cost of non-navigable dams was somewhat greater than the navigable type, it was less expensive to operate since no maneuver boat and no large operating force was required for its manipulation. (House Document 137, 1932: 21) Fourthly, the extreme range between high and low water stages on the Ohio River that could be as great as sixty-nine feet and the long duration of stages permitting open-river navigation made the wicket type of dam attractive there. Hydraulic characteristics on the Mississippi did not impose such requirements. The movable dams consisting of crest gates operated mechanically from a fixed bridge was practicable on the Mississippi where gates could be lifted above extreme high water. This operation was more dependable and less hazardous than the wicket type which had to be manipulated by boats often working under precarious conditions. (House Document 137, 1932: 95) The Mississippi River thus was such that the advantages of a wicket type of dam could not be exploited, while the advantages of the non-movable dam could. Finally, the construction of these dams, the report argued, "may be made to increase fish production and to better fish conditions in the upper Mississippi River if proper cooperation be given by those interested in fish conservation." (House Document 137, 1932: 21, 68)

The dams were to be equipped with Tainter and roller gates. Tainter gates were the best type of crest gates available, but due to the wider openings to provide passageway for floating ice, a sufficient number of roller gates were necessary. Both gate types were to be standardized as much as possible. Tainter gates were to be one size only, probably thirty feet long and fifteen feet high. Economy in weight was sacrificed to some extent with the use of heavy rolled members rather than light trusses in the Tainter gate design, but such a design presented the smallest possible surface for the formation of ice. The gates would be operated by movable electric hoists. (House Document 137, 1932: 96, 97) The roller gates in this early plan would be of one length at all sites--100 feet--but because of varying characteristics at different sites, they would vary from eighteen to twenty-six feet in height. The details of the gates, the report noted, would be practically identical with those manufactured by the S. Morgan Smith Company for the New England Power Construction Company's hydroelectric plant at Bellows Falls, Vermont. These gates would be operated by fixed electric hoists at each pier. (House Document 137, 1932: 97)

Mississippi River locks were to be patterned largely after those already in place on the Ohio River. Not only were all the main locks below Hastings Lock No. 2 to have the Ohio River standard of 110 feet wide by 600 feet long, but lock gates would be of the same vertically-framed miter type with similar operating machinery. Lock sills in general were set at an elevation of eleven feet or more below pool elevation. They were to be filled and emptied by longitudinal culverts in the base of the walls requiring only four valves for each lock unlike the Ohio River locks which were filled by seventeen valves above the center-line of the dam at right angles to the lock and emptied through an equal number. The change was made because it was felt that the four valves would provide greater dependability and require less maintenance than the Ohio River's thirty-four valves. (House Document 137, 1932: 6, 98) The details of the valves and operating machinery had not yet been designed when the report was published. Three types, however, were under study including stoney roller valves as used in the Panama Canal, butterfly valves as used at Emsworth Dam on the Ohio River, and Tainter gates as used on the Welland Canal. (House Document 137, 1932: 98) More generally, since navigation required locks to be located in fairly straight stretches so as to avoid low currents and to afford easy up and downstream approaches, the sites were chosen accordingly. (House Document 137, 1932: 20)

While this report basically set the priorities and design of the locks and dams on the upper Mississippi River, Congress changed the wording of the Rivers and Harbors Act of 1930 to permit further alterations in the plans. Approved on February 24, 1932, by the Seventy-second Congress in its First Session, Public Resolution No. 10 added the clause that a comprehensive plan for the nine-foot channel should be prosecuted in accordance with the plan submitted in House Document No. 290 "or such modification thereof as in the discretion of the Chief of Engineers may be advisable." (Annual Report 1932: 1108) This change was made due to the timing of plans and apropriations. The Chief of Engineers offered his recommendation of the project on December 9, 1931, which altered the plan that had been part of the project approved in 1930. (Annual Report 1933: 678) This Resolution permitted change in designs of locks and dams as the needs arose.

More importantly, the beginning of the New Deal increased appropriations and thereby speeded up work on the project. While initial works were limited to $13,770,000, additional funds of $33,500,000 were allotted to the project from Roosevelt's National Industrial Recovery Act in 1933. (Annual Report 1933: 675; Blegen 1963: 484) At the end of fiscal year 1933, the project was only about 8 percent completed as a whole but it saw more rapid development in the following years. (Annual Report 1933: 680) By the end of fiscal year 1934, the total of additional funds allotted by the Federal Emergency Administration of Public Works amounted to $50,500,000, due to an additional $17 million appropriated by the Public Works Administration on July 12, 1934. Nearly half the money needed to complete the project, according to the Corps estimate of $124,000,000, was now appropriated. (Annual Report 1934: 784) The cost of new work in the St. Paul district of the Army Corps of Engineers during the fiscal year of 1934 totalled $7,282,711.07, of which $2,088,701.97 came from regular funds and $5,194,009.10 came from Public Works funds. (Annual Report 1934: 790) The nine-foot canalization was about 16 percent complete at the end of the fiscal year 1934, but since dams near the head of navigation were of highest priority, progress was most rapid in the St. Paul district. Not only were the Twin City Lock and Dam and the Hastings Lock and Dam finished, but the locks at site Nos. 4 and 5 were complete and the dams were nearly half-finished. Moreover, work in some form had begun on all sites so far approved except for Lock and Dam No. 3. (Annual Report 1934: 785)

Further changes in the project and its administration were made in the River and Harbor Act of August 30, 1935. The lower limit of the project was made the mouth of the Missiouri River, further improvement of the harbor at St. Paul was authorized, and, most importantly, the entire sum required for the completion of the project was appropriated. Since the estimate for new work was revised upward in 1935 to $148,117,000, this was an important allotment. (Annual Report 1935: 894) Previously prosecuted with Public Works and Emergency Relief funds, the 1935 River and Harbor Act shifted the project to regular funds. (Annual Report 1935: 894) The project was about 33 percent complete at the end of fiscal yaer 1935 and on June 30, 1935, 136.2 out of the 222 miles between the Northern Pacific Railroad bridge in Minneapolis and the mouth of the Wisconsin River afforded a nine-foot channel or better. (Annual Report 1935: 904, 905) Moreover, locks were complete at site Nos. 1, 2, 4, 5, 5A, 6, 7, 8, 9 and 10, and work on the dams was progressing as well. Locks and Dams Nos. 4 and 5 were opened to navigation in 1935. (Annual Report 1935: 894)

The following year the project was about 50 percent complete. While no sites were opened to navigation in 1936, work was in progress on the construction of Locks No. 3, Dam No. 5A, Dam No. 6, Dam No. 7, and Dam No. 8, as well as improvement of the harbor at St. Paul and clearing pool areas 5A, 6 and 7. (Annual Report 1936: 892) In 1937, more important developments occurred in the project. Under the River and Habor Act of August 26, 1937, the project was modified to rectify damages that might have been caused on the levee districts bordering the Mississippi. More importantly for the upper Mississippi, the Act provided for the extension of the nine-foot channel above St. Anthony Falls in accordance with the plan offered in House Document 137 subject to changes found advisable by the Chief of Engineers. The plans were now laid for the improvement advocated for decades that would extend navigation 4.6 miles upstream beyond the Falls to provide better harbor facilities. Although final approval of the plan, incorporating certain changes found advisable by the Chief of Engineers, was given by the Board of Engineers for Rivers and Harbors on February 8, 1938, the project was not begun until well after World War II. (Annual Reports 1937: 918; 1938: 1048; U.S. Army Corps of Engineers 1974: 2)

Five additional locks and dams were opened to navigation in fiscal year 1937, three of them--Lock and Dam Nos. 5A, 6 and 7--in calendar year 1936. Dam No. 7 was placed in operation on April 19, 1937, while Dam No. 8 was first operated on April 26. (Annual Report 1937: 919; Wood 1937e: 18) By 1938, the project was complete except for the second lock at Lock and Dam No. 3 and the locks on the newly appropriated St. Anthony Falls project. Lock and Dam Nos. 3 and 9 had been opened in calendar year 1938 and, while work still remained to be done on structures south of the St. Paul district, the upper Mississippi River finally functioned as a canalized stream. (Annual Report 1938: 1049)

Actual work did not begin on the St. Anthony Falls project until 1948 when construction of the Lower Lock and Dam with a twenty-five foot lift began. After the Upper Lock with a forty-nine foot lift was completed in 1963, the first boat passed through the Upper Lock in September of that year (see below for more discussion of the St. Anthony project). (Department of the Army Corps of Engineers 1976) The effects of the nine-foot project were felt much earlier than the St. Anthony Falls project, however. As early as October 12, 1932, for example, the Interstate Commerce Commission officially recognized that water competition had been restored on the upper Mississippi River. Sharp reductions in the rates of all iron and steel freight from the Chicago and St. Louis territories to the Twin Cities and Duluth were justified by the I.C.C.; one of the reapsons for pressure to create a nine-foot channel had been achieved. (Upper Mississippi River Bulletin 1933: 3) The improvement did not only lower rail rates, since waterway tonnage continued to increase. When the nine-foot channel was complete in 1939, the Federal Barge Line fleet and other private carriers brought tonnage past the million mark. Such developments led to heady optimism. The

Davenport Democrat, for example, predicted that a "huge tonnage" was destined to make the Quad Cities a "great industrial site." (Petersen 1972: 396, 397) After World War II, river tonnage had reached a point where one towboat carried a payload in one season equal in weight to all the 365 steamboats between 1823 and 1848. (Petersen 1946: 300) And by 1966, tonnage on the upper Mississippi had reached 40,902,907, an increase of nearly 1,608 percent over 1939. (U.S. Army Corps of Engineers 1981) After decades of political lobbying, years of engineering and construction work, and millions of federal dollars, the upper Middle West finally had another transportation link to the coasts.

The nine-foot channel, as we have seen, was based on the construction of locks and dams. After decades of river construction to achieve a deeper channel, a system of slackwater navigation developed, at first slowly, until the entire upper Mississippi had been provided twenty-six locks and dams, ten of which were in the St. Paul district. Since these structures were the keystone to a nine-foot channel, they will be examined in detail in the following section.

## LOCKS AND DAMS OF THE UPPER MISSISSIPPI-ST. PAUL DISTRICT

The locks and dams built on the upper Mississippi form a system that provides slackwater navigation and a nine-foot channel for commerce on the river from 4.6 miles above the Falls of St. Anthony to Alton, Illinois. The system as it exists today, however, was not part of a comprehensive scheme throughout its development. Two locks and dams were built before a comprehensive system was adopted by the federal government. Moreover, a nine-foot channel had been obtained for the vast majority of the upper Mississippi River before funds were appropriated to provide navigation above the St. Anthony Falls. Since there were basically three periods of development, which were undertaken for different reasons, we will discuss each period separately. The three eras not only reflected different plans of waterway improvement, but changes in engineering technology which were reflected in the structure types of the locks and dams. Accordingly, the period before the approval of the nine-foot channel, which included the construction of the Twin City and Hastings Locks and Dams (subsequently known as Lock and Dam Nos. 1 and 2), will be discussed first, followed by the nine-foot channel period during which Lock and Dam Nos. 3 through 10 were built. Finally, the third period when navigation was extended above St. Anthony Falls will be examined.

### Pre-Nine-Foot Channel Period:

Lock and dam structures had been advocated for decades before the first construction began on the stretch of the river below the Falls of St. Anthony. To be located in areas of poor river conditions, the lock and dams were to be built in specific places to solve localized problems. In short, the occasional locks and dams were not part of a comprehensive system, but isolated stop-gap measures. As Minneapolis developed as a milling center, the rough river conditions between St. Anthony Falls and Ft. Snelling was the first region where water improvement through locks and dams was advocated. As early as 1857, a lock and dam was planned for an area near Meeker's Island to improve navigation. Civic rivalries between St. Paul and Minneapolis and disagreement between the Minneapolis Mill and navigation interests, however, delayed the completion of the plan. (Kane 1966: 92-97)

But political pressure continued. A memorial from the Minnesota legislature in 1866 called for a lock and dam below the Falls of St. Anthony to facilitate commerce to that point. Up to 1857, it noted, steamboats "of average tonnage" made regular trips between St. Louis and within two and one-half miles of the Falls. But the panic of 1857, serious droughts, and the Civil War slowed commerce and St. Paul now was the head of navigation. (Senate Miscellaneous Document 54, 1866: 1) Government reports agreed that locks and dams were the only method that would provide reliable navigation below St. Anthony Falls. In spite of arguing for dredging and wing dams to control navigation, an 1867 report considered a lock and dam at Meeker's Island the only way to create "a thorough improvement of the last two mile stretch." The dam, according to the plan, would have a thirteen-foot lift and cost $230,665.48. (House Executive Document 58, 1867: 30) One year later, another report wrote that further surveys made it appear that another lock and dam with a thirteen-foot lift would be required near the mouth of the Minnehaha Creek and would cost abot $235,000. A single lock and dam might extend navigation to the old steamboat landings below the Washington Avenue bridge in Minneapolis, but the river had to be improved up to the initial lock and dam, so a second structure near Minnehaha Creek was necessary. (House Document 247, 1868: 9; House Executive Document 158, 1889: 9) In 1873, the federal government appropriated $25,000 to begin construction of a lock and dam below Meeker's Island--the first appropriation toward construction of a lock and dam in the St. Paul district. Civic rivalry remained a major stumbling block in its construction, however. The lock and dam was not built for years, but, importantly, the basic plans for a two lock and dam system had been laid. (Wood 1938c: 3; Kane 1966: 92-97)

The project was finally approved in the River and Harbor Act of August 18, 1894. It provided for two locks and dams, one to be located just above the mouth of Minnehaha Creek and 3.7 miles above the Minnesota River with a lift of 13.3 feet; the other 2.9 miles above the first structure and 2.2 miles below the Washington Avenue bridge with a lift of 13.8 feet. Both lock chambers were to be 80 by 334 feet. (Annual Reports 1910: 629; 1929: 1137; Wood 1938c: 3) The structures would provide for a minimum channel depth of five feet. Congress authorized the construction of Lock and Dam No. 1 and the completion of Lock and Dam No. 2 (near Meeker Island ) in the River and Harbor Act of March 3, 1899, at a total cost of $1,166,457 for both locks and dams. (Annual Report 1910: 630; Merritt 1979: 142) The project, however, was modified by the River and Harbor Act of March 2, 1907, which approved a six-foot channel and thereby forced the lock and dams to provide a six-foot rather than five-foot channel below St. Anthony Falls. The lift of the two dams had to be increased although funds for this work were not initially provided by Congress. (Annual Reports 1910:" 629-630; 1929: 1139; Kane 1966: 175)

Lock and Dam No. 2 was completed in 1906 and in operation on May 1907, over a decade before Lock and Dam No. 1. It was constructed first because navigation on the river above it was difficult and hazardous even under the most favorable conditions and virtually impossible at low stages of the river. The River and Harbor Act of March 3, 1909, however, provided for the examination of the river as a potential source of hydroelectric power. (Annual Report 1910: 630) The Report of a Special Board of Examination of Mississippi River between St. Paul and Minneapolis concluded a year later that a single dam would be more beneficial than the twin lock and dam system already in the works. A dam with a lift of about thirty feet "would give a depth of 9 feet at the head of navigation at Minneapolis, which would probably meet the needs of all future navigation; it would be easier and cheaper to maintain and operate; would provide better facilities for the passage of vessels; and would create a valuable water power . . ." (Annual Report 1919: 630; Kane 1966: 175; Engineering and Contracting 1913: 315; House Document 741, 1910: 3, 4) The Board noted the knotty legal questions of changing from a system of two locks and dams already under construction to one high dam, but recommended the latter nevertheless. (House Document 741, 1910: 12) Their recommendations were approved in the River and Harbor Act of June 25, 1910, which revised the design of Lock and Dam No. 1 so that it would have a lift of about 30 feet rather than 13.3 feet as it had been previously planned. It also obviated the need for Lock and Dam No. 2 which was subsequently destroyed. (Annual Reports 1910: 630; 1929: 1139; Kane 1966: 175) The design and construction of Lock and Dam No. 1, which is discussed more fully below, had to be altered to create a greater lift, but by 1910 the modified structure was already about 30 percent complete. Lock and Dam No. 1 was put in operation seven years later. (Annual Report 1910: 630; Wood 1938c: 3)

After Lock and Dam No. 1 was complete and the six-foot channel project was in progress, it became apparent that although a good nine-foot channel was achieved above the lock and dam, not even a six-foot channel could be secured in the stretch of river below the dam and above the mouth of the St. Croix River. Just as Lock and Dam No. 1 had been necessary to provide minimum navigation requirements to Lock and Dam No. 2 in the earlier project, so would another lock and dam be needed to make Lock and Dam No. 1 a useful water improvement. (House Document 583, 1927: 3; Hartsough 1934: 274) A government report published in 1927 argued that a six-foot depth could not be secured in that section of river above the mouth of the St. Croix merely by regulating work and dredging. "The most economical plan for extending 6-foot navigation to the Twin City Lock and Dam," it concluded, "appears to be by the construction of a lock and dam near Hastings, Minn." (House Document 583, 1927: 3) The River and Harbor Act of January 21, 1927, accepted the report's advice and approved a lock and dam at Hastings, which ultimately became the second lock and dam in the nine-foot channel system. (Annual

Report 1928: 1111) The lock at Hastings was first used during the 1930 season and the dam, finished in late 1930, was actually completed after the nine-foot project had been approved. (Hartsough 1934: 274; Wood 1938c: 3; U.S. Engineer Department 1938: 3)

The locks and dams at the Twin Cities and Hastings, because they were built before the nine-foot channel project structures, differed from Lock and Dam Nos. 3 through 10. Since Lock and Dam No. 1 was built thirteen years before its counterpart in Hastings, however, the latter was actually closer in design to those that followed than the first lock and dam. Dam No. 1, for example, is the only fixed type dam in the system. Moreover, it is the only structure with an adequate lift to presently create hydroelectric power. These structural differences are related to the different political plans behind each lock and dam. The first two lock and dams built were both stop-gap measures taken to solve specific problems in different stretches of the river. Because the waterway problems became acute at different times, the engineering knowledge differed and the plans of each lock and dam reflected it. Much different from the basically uniform pattern of lock and dam structure that followed, the locks and dams at the Twin Cities and Hastings will next be discussed in turn.

Lock and Dam No. 1 (Twin City Lock and Dam):

The Twin City Lock and Dam, located about 847.6 miles above the mouth of the Ohio River, was the northernmost structure in the lock and dam system until the locks at St. Anthony Falls were completed in the mid-twentieth century. (Annual Report 1936: 881) Partly because it was the first structure built, that eventually became part of the lock and dam system, it has many unique features. The lift of 35.9 feet was the largest until the upper lock at St. Anthony Falls was constructed. It is the only dam in the St. Paul district with hydroelectric power production. The dam is the only fixed type dam constructed in the nine-foot channel project group. Before the construction of the St. Anthony Falls locks, Lock No. 1 was the only lock with dimensions of 56 by 400 feet. Finally, Lock and Dam No. 1 is one of two structures with a double lock system. (Annual Report 1939: 1149)

The construction of Lock and Dam No. 1 had a long, torturous path from 1894 to 1932. The revision from a two lock and dam system to a single lock and dam especially complicated construction around 1910. The lock walls and floor had already been poured when the plan was altered and alterations had to be made in their depth of the floor. The completion of the lock, dam and power house took seven years and the lock and dam was operational on June 30, 1917. Then the lower gate of the lock collapsed on August 19, 1929, which closed navigation until repairs could be made. Work quickly commenced on the gate which was completed on September 30, 1930. Due to the collapse, it was decided that twin locks should replace the single lock so that traffic would never be disrupted. A second lock was included in the nine-foot channel project construction as a Priority A structure and was completed in 1932. After about twenty-five years of construction, Lock and Dam No. 1 was finally completed. (Annual Reports 1930: 1202; 1931: 1217)

The design of Lock No. 1 varies less from later locks in the project than Dam No. 1 does from its dam counterparts. With a foundation of sandrock sand, gravel and broken limestone, the lock consists of concrete walls and base and steel miter gates. When built in the 1910s, the lock walls were built without forms which was a novel feature of construction at the time. (Engineering Record 1912: 60) The lock, which is situated on the south side of the river, is 56 feet wide and 400 feet long, smaller than the locks that eventually were built below it, but consonent with the standard that were developed on the Monongahela River during the Ohio River lock and dam project. (Annual Reports 1916: 1104; 1928: 1136; House Document 290, 1930: 23)

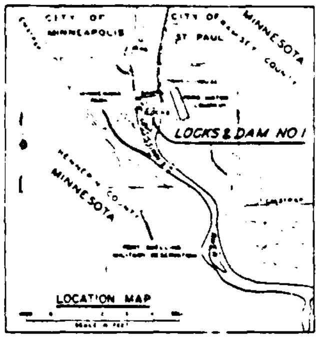
The original design of Dam No. 1 was an attempt to utilize the new Ambursen type dam in modified form. Major Francis R. Shunk, who designed the lock and dam, thus became the first officer of the Army Corps of Engineers to design and build a hyrdo-electric dam in the United States. (Merritt 1979: 143-146; Engineering Record 1912: 60) The length of the fixed overflow crest was 574 feet and on the north side was the foundation of a power house which measured 152 feet. The dam was built on a pile foundation and had a width of sixty-one feet at its base and apron of eighty feet. (Annual Report 1928: 1137; Engineering and Contracting 1913: 317; Wood 1938c: 5) The height of the dam was limited since the elevation of the backwater would not exceed that of the tailwater of the Twin City Rapid Transit Company's dam below St. Anthony Falls. (Fassen and Swedberg 1911: 13) The head of over thirty feet, however, was great enough to provide hydroelectric possibilities that were exploited beginning in 1924. The dam was novel in a number of ways. First, it was hollow with decks made up of narrow reinforced concrete slabs. Moreover, molds were used for casting concrete slabs and a combination of concrete separately cast and concrete molded in place were used in constructing the dam. Finally, special mechanical devices for handling and placing the concrete slabs and beams were utilized. (Engineering Record 1912: 60; Engineering and Contracting 1913: 315)

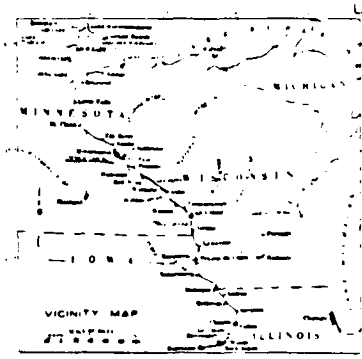
Due to the hydro-power capabilities, a separate power house was also constructed. The federal government, however, was not interested in producing power under its auspices, but considered some sort of lease to a private firm more appropriate. Accordingly, construction plans went no further than the foundation of the power house of a level with the crest of the dam. Due to the possibility of developing at least 15,000 horsepower provision was made so that whoever installed the power plant could use turbines of the horizontal or the vertical type. (Engineering Record 1912: 60; Merritt 1979: 143-146) As early as 1912, the cities of St. Paul and Minneapolis and the University of Minnesota organized a company with representatives of each to negotiate with the federal government for the development of the power plant. (Engineering Record 1912: 60) The cities eventually individually tied for the rights to the power before the Federal Power Commission. (Meyer and Brittin 1921: 13) It was the Ford Motor Company, however, which received the license from the Federal Power Commission to develop power with a maximum installed capacity of 18,000 horsepower. (Annual Report 1929: 1140) The hydroelectric plant which consisted of four water wheels with a capacity of 4,500 horsepower each connected to four generators was installed and placed in operation in July of 1924. (Annual Reports 1928: 1138; 1929: 1140; 1930: 1194)

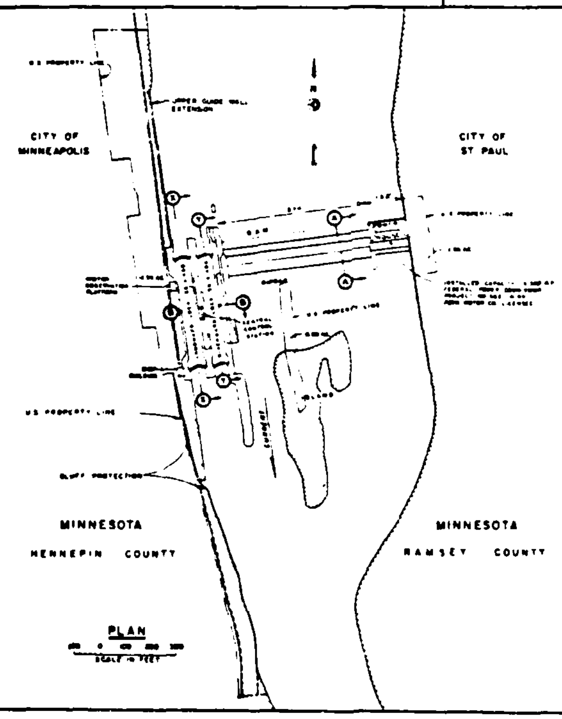
Lock No. 1--Construction History:

Construction of the locks at site No. 1 can be divided into three periods: before the single dam was approved; construction of the lock as part of a high dam system; and construction and repair of the locks during the nine-foot channel project. The dam and first lock were both constructed by Northern States Constracting Company. (Wood 1937a: 15) Work on the lock when it was part of a two lock and dam project encountered a number of difficulties. High water, for example, prevailed in the spring of 1908 so that work was delayed. Construction was resumed on July 9, 1908, and the lock chamber was completed in November of that year. (Annual Report 1909: 1641) Work was suspended on the lock in the spring of 1909 pending action on the proposed modification of the project. When the project was altered on June 25, 1910, structural changes on the lock cnstruction already carried out were necessary. (Annual Report 1910: 1800) The masonry of Lock No. 1 had been completed, according to earlier specifications, but now changes in the concrete work were necessary. The old lock floor had to be lowered six feet and the lock walls had to be increased in height. The heavy concrete floor was blasted out and a new floor laid by the end of fiscal year 1911. This entailed a "unique" construction technique since the floor was removed without disturbing the lock walls. (Annual Report 1911: 1973; Engineering and Contracting 1913: 315) The lock walls were also raised in a rather unique fashion for the era in which they were built. Wooden forms would ordinarily have required bracing timbers eighty feet or over in length. Instead, the lock was designed so that concrete blocks with interlocking edges were cast separately. They had recesses at each end into which a bevelled tongue of long blocks fit loosely. After lining up, bracing and typing into place, the space between the ends of the blocks was poured with grout. (Engineering and Contracting 1913: 315; Engineering Record 1912: 60) Work on increasing the height and thickness of the lock walls was about 70 percent completed at the end of fiscal year 1911 and practically finished a year later. (Annual Reports 1911: 1974; 1912: 2180)

Work did not progress quickly after that time. The lower gates at the obsolete Lock No. 2 were taken down and placed upon blocking in readiness to be floated downstream for use as upper gates of Lock No. 1. By fiscal year 1913, the river wall was completed as were the filling in between the walls and floor. The group and concrete were forced into place

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**POOL ORDINARILY MAINTAINED AT EL. 725 BY FLASHBOARDS

*OLD UPPER GUARD SILL IN RIVERWARD LOCK ONLY

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN

## LOCKS & DAM NO 1

SCALE AS SHOWN

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT ST PAUL MINN

CORPS OF ENGINEERS U.S. ARMY

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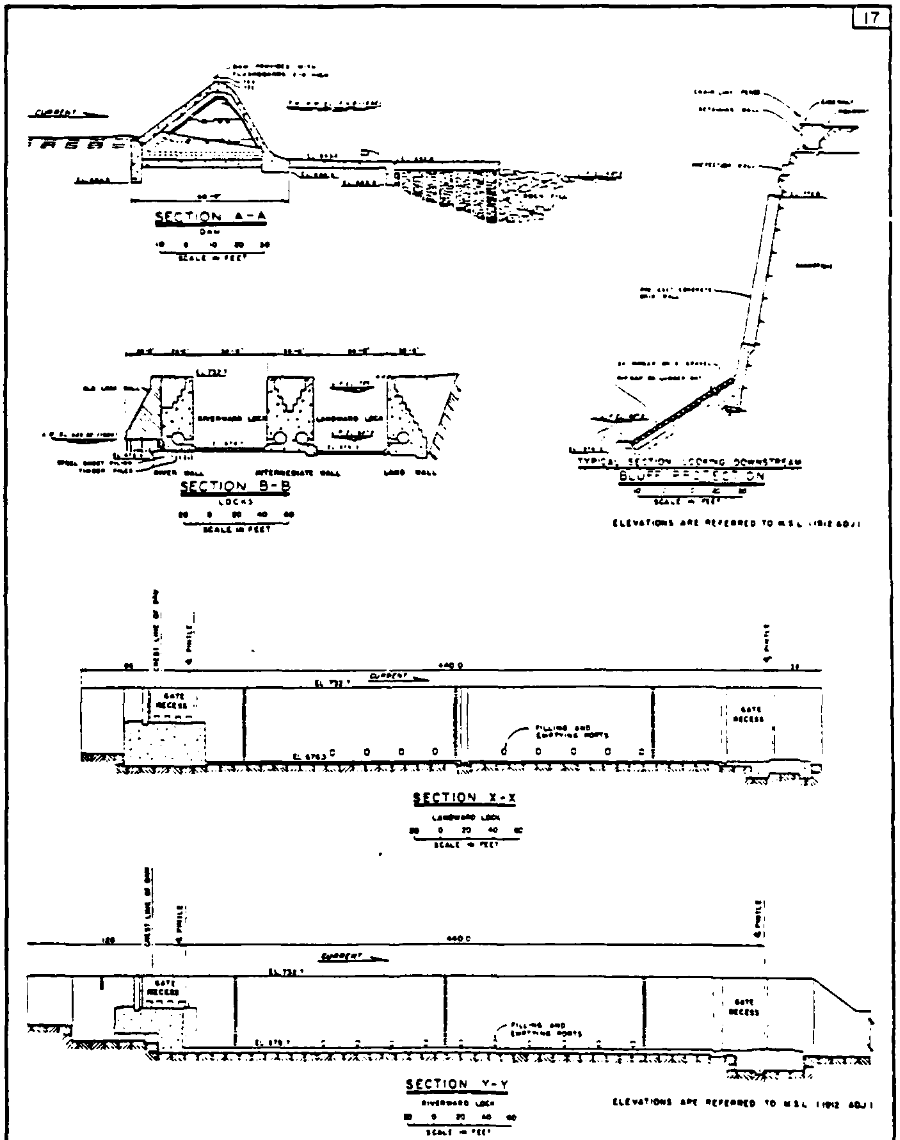


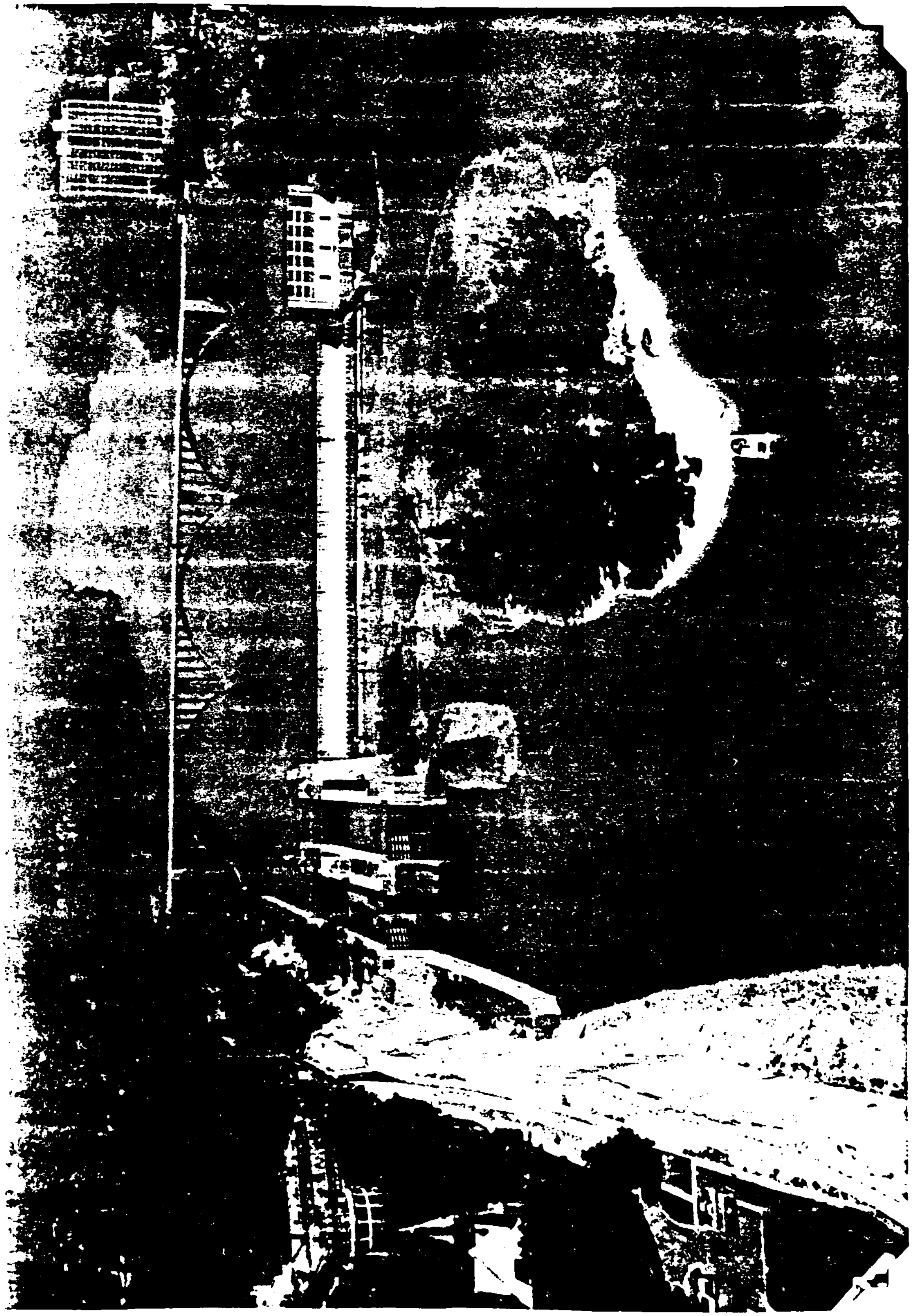

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

LOCKS & DAM NO. 1

IN 2 SHEETS SCALE AS SHOWN SHEET NO. 2

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.

LOCK AND DAM NO. 1



by a concrete air gun designed and constructed for the work. The upper gate still was not in place in 1913 although the lock was 96 percent complete. (Annual Report 1912: 2180; 1913: 2422) Problems of high water in June of 1914 did not as adversely affect lock construction as it did the dam, but by the end of fiscal year 1915, the lock was still only 98 percent completed. (Annual Report 1915: 1029, 2784) By 1917, retaining walls both above and below the lock were completed. The two leaves of the lower gate of the abandoned Lock No. 2 had been floated down the river and placed in position as the upper gate of Lock No. 1. At the close of the fiscal year, one leaf of each gate could be operated mechanically so it was possible to pass boats that did not exceed thirty-eight feet beam through the lock. Ceremoniously, navigation was formally opened by the passage of U.S. Lighthouse tender Dandelion through the lock, a trip between St. Paul and Minneapolis made by the "district engineer officer and prominent citizens of both cities." (Annual Report 1917: 2734)

The original lower gates of the lock gave way on August 19, 1929, and a third period of lock development at site No. 1 began. Repair of the first lock began and plans were initiated which would create two locks so such disruption of navigation would not occur again. Moreover, the lock chamber would be altered from 80 by 334 feet to the standard Monongahela size of 56 by 400 feet. Work on the original lock began when two rock-filled crib cofferdams were constructed to permit investigation of the reason for the gate failure. The investigation commenced on September 18, 1929, and was completed by November 1. Reconstruction of the lock began on January 4, 1930, was sufficiently complete to permit lockages on September 11, 1930, and was finally finished on September 30. (Annual Reports 1930: 1201; 1931: 1217; House Document 137, 1932: 94)

The second lock was built under contract with A. Guthrie and Company and was funded with maintenance and improvement funds. The contract was awarded and work started on March 3, 1931. By the end of fiscal year 1931, all ground had been cleared and excavation was underway. The upper and lower cofferdams had been built but not yet unwatered and the contract as a whole was about 19 percent complete. (Annual Report 1931: 1211, 1217; Wood 1937a: 15) By May 28, 1932, construction had sufficiently progressed so that navigation could pass and a twin lock system existed in the Twin Cities long before most single locks were completed below it. (Annual Report 1932: 1113)

Dam No. 1--Construction History:

Like Lock No. 1, Dam No. 1 was built under contract with Northern States Contracting Company. Although little work had been done on the dam before the project was modified to a single dam system, flood waters frequently plagued the dam construction after the high dam design was confirmed. (Wood 1937a: 15) By the end of fiscal year 1911; the cofferdam for the power house was about 50 percent complete and excavation had begun on the power house. Meanwhile, plans for the hollow dam of Ambursen type were approved in mid-June 1911 and preliminary work had been done. (Annual Report 1911: 1974)

One year later, three sections of the dam measuring forty-eight feet including the apron and protection near the locks wall had been completed. The cofferdam, which was built large enough to include the power house foundation and eight sections of the dam, was also complete and work on placing concrete in the foundation of the power house had commenced. (Annual Report 1912: 2180) By the end of fiscal year 1913 another section of the dam, which measured sixteen feet, had been built at the power house end in connection with the abutment at that end. Moreover, work that year resulted in the partial completion of buttreses for two other sections, the completion of thirty-two linear feet of floor and apron and the driving of eighty-five linear feet of steel cut-off wall. Moreover, 259 reinforced concrete deck beams were cast. The power house foundation showed even greater progress. The pile foundation had been driven and the draft tubes and two and one-half of the penstocks were built with the remaining one and one-half penstocks 80 percent completed. (Annual Report 1913: 2422)

Despite the progress made, flood waters began to do considerable damage in 1914. At the end of fiscal year 1914, the power house foundation had been completed. Nine sections of the dam, measuring 144 feet at the power house end were partly built including eight sluiceways. The cofferdam enclosing this section was then removed and the river allowed to flow through the sluices and power house before construction on a second cofferdam was begun. This cofferdam, which enclosed the remaining section of the dam, was built to an elevation of 734 feet. Excavation commenced in early April, but high water flooded the coffer between May 4 and May 23. Work began again after the water receded and some concrete was placed on the floor of the dam, but high water again suspended work on June 8. By June 29, water had reached elevation of 736.8 and the longitudinal section near the sluiceways broke and the water took out the lower cofferdam and undermined the three end sections of the partially completed dam at the power house side of the river. Although the dam was scheduled for completion in 1914, flooding damage destroyed any possibility for that completion date. (Annual Report 1914: 935, 2428)

By July 20, 1914, the river had fallen sufficiently to permit work to commence again. A new cofferdam which enclosed about 270 feet of the dam on the lock side was built using a part of the old cofferdam as the upper portion. Attempts to excavate material deposited by the high water with a suction dredge were unsuccessful because tree bark clogged the pump most of the time. Loose material finally was removed with the use of drag scrapers. By March 20, 1915, the cofferdam was completed except for filling the closing section of about 120 feet. Six days later, however, the river rose and took out the trestle work of the closing section and about forty feet of the completed coffer. (Annual Report 1915: 1029, 2783-2784)

The river was not low enough until August to begin closing the gap in the upper cofferdam. The opening had become about 120 feet wide as the flow of practically the whole river passed through the space which created a very swift current. The current eventually was checked, however, by dumping rock at each end of the opening and the cofferdam was completed. Work in the cofferdam consisted of driving steel and rond piles, but backwater from the Minnesota River in March 1916 drowned the work and the water did not adequately recede until August. (Annual Reports 1916: 1104-1105, 2637-2638; 1917: 2733) By August 21, 1916, the coffer was sufficiently unwatered to begin construction work once again. By the end of September, the floor of the dam was completed, the injured sections and buttresses of the dam having been blasted down and buried in the new concrete. Two months later, the buttresses were all built and ready to receive the covering beams. By April 1, 1917, the covering beams were all set and grouted and the concrete crest cast was in place. The annual spring flood reached its peak on April 7, but with the eight sluiceways of the dam, which measured six feet by six feet, and all the openings of the power house foundation wide open, the depth of water passing over the crest of the dam was only 5.1 feet. No material damage was done to the dam and, according to the Army Corps Annual Report, "the structure withstood the severe test remarkably well." (Annual Report 1917: 2733, 2734) After the arpon was extended 40 feet on the western 224 feet of the dam, the dam was basically complete. (Annual Report 1917: 1138, 2734) The only fixed dam built on the upper Mississippi waterway improvement had proven to be quite problematical. Engineers would provide plans, however, which would not create such extreme difficulties when the major dam building would begin a score of years later.

Lock and Dam No. 2:

Lock and Dam No. 3, it will be recalled, was designed to create an adequate channel leading up to Lock and Dam No. 1. Engineers reported that a six-foot depth could not be secured simply through regulating work and dredging, so appropriations for a second lock and dam were made in 1927. (House Document 583, 1927: 3; Hartsough 1934: 274) After a survey determined that the proposed lock and dam site was adequate and borings were made to determine the nature of its foundations, plans were begun to build Lock and Dam No. 2 at a site 1.3 miles above Hastings, 815.2 miles above the mouth of the Ohio River, and 32.4 miles below Lock and Dam No. 1. (Annual Reports 1927: 1067; 1936: 881)

Lock and Dam No. 2, built after Lock and Dam No. 1 and before the major structures in the nine-foot channel project, acts as a sort of engineering link between the two. For although the structure at Hastings with its lift of 12.2 feet is in many ways similar to the projects that would follow, there were distinct differences. Plans for the lock and dam structure were devised and on April 19, 1928, the Chief of Engineers recommended that the dimensions of the lock be 110 by 500 feet and that the original estimate of $3,780,310 be revised upward to $4,000,000. By resolution, the Committee on Rivers and Harbors of the U.S. House of Representatives requested on May 22, 1928, that work begin at once and that the lock dimensions be approved. The dimensions of the lock thus did not fit the scheme later set forth in the later nine-foot channel plan. It was only when a second landward lock of 110 feet by 600 was built that dimensions at Lock and Dam No. 2 conformed to the system. (Annual Reports 1928: 1113; 1929: 1139; House Document 290, 1930: 25; House Document 583, 1927: 35)

Dam No. 2 was also unique in a number of ways. The control gate section was comprised wholly of twenty Tainter gates rather than the combination of roller gates and Tainter gates common in the latter structures (see nine-foot channel section for discussion of these gate types). Moreover, a 100-foot Boule section, located between the Tainter gate section and the lock, completed that part of the dam spanning the low-water channel. Like Dam No. 1, Dam No. 2 had hydroelectric power capacities, but power was developed only for normal operation of the lock and dam structure. An earth dike completed the dam structure spanning 4,050 feet. (Wood 1938c: 5; House Document 583, 1927: 35; House Document 137, 1932: 95) Originally, the plan called for the Boule pass section to be replaced by a second lock. Plans were changed, however, so that the second lock, which became the main lock, was built landward of the original and the Boule section was retained. (House Document 137, 1932: 95) The lock and dam fulfilled its role providing navigation to the Twin Cities so that with its completion, a channel of 9 feet and minimum width of 300 feet with easy curves was provided from the dam to St. Paul. (House Document 290, 1930: 25)

Lock No. 2--Construction History:

Like Lock No. 1, the construction of lock section of No. 2 spanned a long period owing to the two lock configuration. While the first lock at site No. 2 was completed in 1930, work did not even begin on the second lock until 1941, and it was not put in operation until 1948. Plans for the lock and dam were completed and a contract with Fegles Construction Company to construct the lock was entered into on October 16, 1928. (Annual Report 1929: 1140; Wood 1937a: 15) At the end of fiscal year 1929, the lower guide wall, the upper miter sill, and about 120 feet of the upstream end of the lock had been completed. A temporary channel had been dredged so navigation could continue during construction. (Annual Report 1929: 1140) By the end of the next fiscal year, the lock and guidewall was complete except for a gap in each lock wall left open for a construction track. The gates had been delivered and erected in place. (Annual Report 1930: 1194, 1195) The lock was placed in operation on July 1, 1930. (Annual Report 1932: 1120)

Work on the second lock in Lock and Dam No. 2 was part of the nine-foot project, but it was of low priority and work did not comence until well after the system was functioning. Moreover, plans to begin the lock were continually pushed back. As early as 1935, the Chief of Engineers Report projected $1,500,000 for work on the auxiliary lock to begin in

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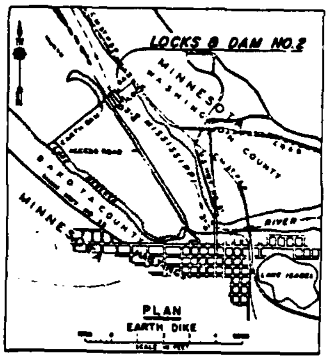
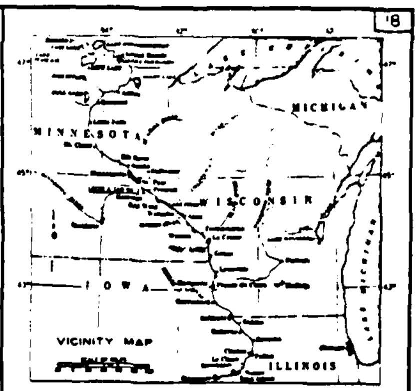
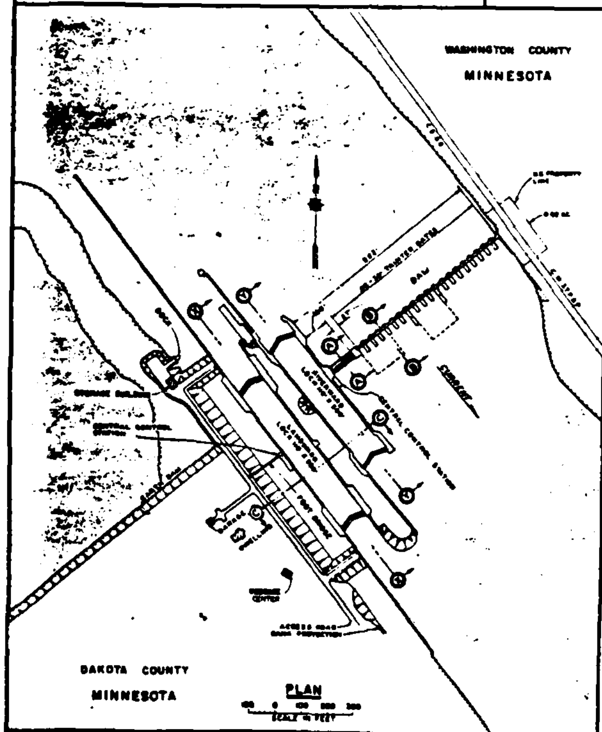


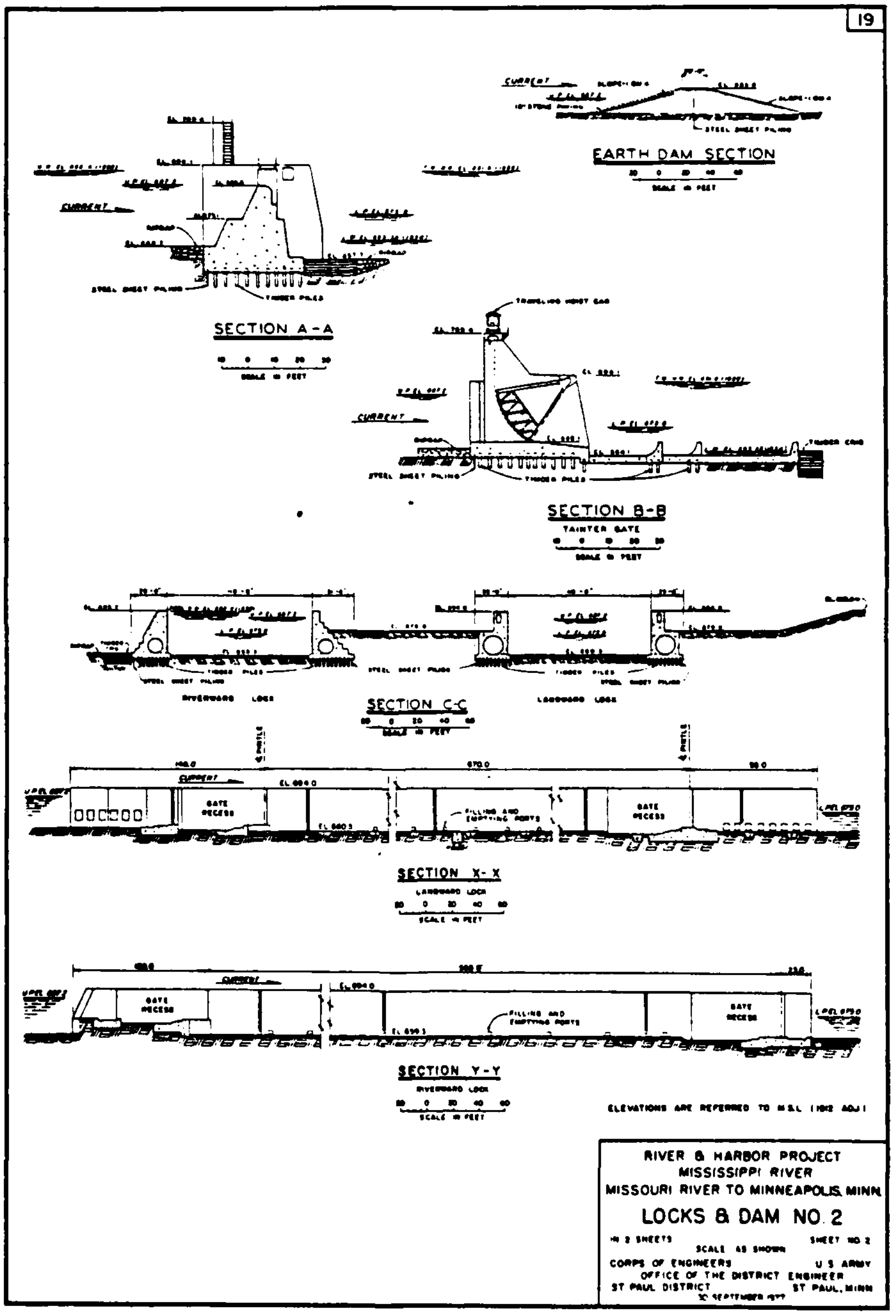

| | RIVERWARD LOCK | LANDWARD LOCK |
|---|---|---|
| DEPTH ON UPPER GATE SILL - | 16.0 FT (U.P. EL. 687.2) | 22.2 FT (U.P. EL. 687.2) |
| DEPTH ON LOWER GATE SILL - | 15.0 FT (L.P. EL. 675.0) | 13.0 FT (L.P. EL. 675.0) |
| ELEVATION UPPER GATE SILL - | 671.2 | 665.0 |
| ELEVATION LOWER GATE SILL - | 660.0 | 662.0 |

ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ.)

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

## LOCKS & DAM NO. 2

IN 2 SHEETS SHEET NO. 1
SCALE AS SHOWN
CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.


19
EARTH DAM SECTION
CURRENT
STEEL SHEET PILING
SECTION A-A
SCALE IN FEET
TIMBER PILES
TRAVELING HOIST CAB
SECTION B-B
TAINTER GATE
SCALE IN FEET
SECTION C-C
RIVERWARD LOCK
LANDWARD LOCK
GATE RECESS
FILLING AND EMPTYING PORTS
SECTION X-X
LANDWARD LOCK
SECTION Y-Y
RIVERWARD LOCK
ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ.)
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.
LOCKS & DAM NO. 2
IN 2 SHEETS
SCALE AS SHOWN
SHEET NO. 2
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT
ST. PAUL, MINN.

LOCK AND DAM NO. 2

fiscal year 1937. The next year's report pushed back plans to 1938, while the Annual Report of 1937 called for $2,000,000 to be spent in the following year. Work did not begin, however, and by fiscal year 1938, work on what would become the main lock with dimensions of 110 feet by 600 feet was not expected until fiscal year 1940. In the Annual Report, the price tag had reached $2,325,000 and work again was delayed, set to begin in fiscal year 1941. (Annual Reports 1935: 912; 1936: 902; 1937: 934; 1938: 1070; 1939: 1167)

Work commenced in that year and by July 1, 1941, the foundation and masonry of the landward lock was 3 percent complete. One year later, the lock was considerably farther along in construction. The cofferdam had been completed and unwatered, all piling had been driven except for sections of the steel sheet piling in the cut-off wall and the round timber piling in another area of the lock. Concrete placing had begun and was 52 percent completed. (Annual Reports 1941: 1134; 1942: 1025) By mid-1943, although the foundation and lower approach dredging was finished, the remaining work, which included 97 percent of upper approach dredging, was deferred for the duration of World War II. Construction recommenced on April 25, 1946, the guide walls and dredging was completed, gate machinery was set in place, and the second lock was opened on July 7, 1948. (Annual Reports 1943: 940-941; 1946: 1393; 1947: 1399; 1949: 1410)

Dam No. 2--Construction History:

Like the first lock, the dam at site No. 2 was built under contract with Northern States Contracting Company. Work on the dam was largely done in the second half of 1929 and in 1930. By July 1, 1930, all work within the first movable dam cofferdam, which included the Boule section and the first six Tainter gates sections, was completed with the exception of placing of concrete on the operating bridge. Concrete work on this part of the dam was done in the depths of winter and temperatures were as low as -2° when the concrete was placed. This cofferdam was removed and a second cofferdam was constructed. By the end of the fiscal year, all work in this section, which included the last six Tainter gate section and the abutment, was completed except for placing the concrete for the superstructure of two piers and the bridge, placing of steel for two bridge sections, and the erection of five Tainter gates. (Annual Report 1930: 1194; Wood 1937a: 15)

While the final cofferdam, which included the central Tainter gate sections had been completed by the end of fiscal year 1930, construction in the enclosure was carried on in the final half of 1930. Although the lock and dam structure was scheduled for completion on January 1, 1931, it actually was finished one month early and it was opened to navigation on November 30, 1930. (Annual Report 1931: 1211; House Document 290, 1930: 25; Wood 1937a: 15)

Other Work:

Lock and Dam No. 2 was designed with a power house that would not create large amounts of energy, but would supply the units of the lock and dam itself with the necessary operating power. (Wood 1938c: 5) The power house and foundation for power house machinery were completed under contract by the end of fiscal year 1930. (Annual Report 1930: 1195) Other work included the construction of two lockkeepers' dwellings, garage, and service building completed on June 13, 1931. Moreover, the esplanade, which was increased from 162 square feet to 330 feet by 440 and a roadway to Hastings were completed by the end of fiscal year 1931. (Annual Report 1931: 1211)

Nine-Foot Channel Period:

Unlike the earlier period, the locks and dams built during the nine-foot channel period were part of a comprehensive plan and were based on new commercial and engineering considerations. Public pressure to deepen the channel to place the Middle West in a better commercial situation were combined with the development of diesel-powered river vessels of greatly increased power and efficiency. The construction of the nine-foot channel between Minneapolis and the mouth of the Illinois River was approved in 1930 and modified in 1932. In the 1932 report (House Document No. 137, 72d Congress, 1st Session), it was recommended that a channel of nine feet be provided between the mouth of the Missouri River and the lower Northern Pacific Railroad bridge below St. Anthony Falls through the construction of locks and dams and supplemented by dredging. (U.S. Army Corps of Engineers 1974: 2; U.S. Army Corps of Engineers 1981; U.S. Engineer Department 1938: 3)

Plans for the locks and dams were based on the characteristics of the Mississippi River and the state of the art of waterway improvement engineering. The river banks of the upper Mississippi were low and subject to overflow during flood stages. The flood plain varied from a width of one-half mile to five miles, generally increasing downstream, and was mainly bordered by steep bluffs. The main hydrological characteristics of the river were regularity of the stream-flow cycle, infrequency of sudden rises of magnitude, and relatively low flood stages. (U.S. Engineer Department 1938: 1) Such conditions were considered in the decision to use newly-developed ideas in lock and dam construction like the roller gate and Tainter gate which were being used and found satisfactory in the United States and Europe. Moreover, electrical "push-button" control of large mechanical installation was in the process of perfection. (U.S. Army Corps of Engineers 1981; U.S. Army Corps of Engineers 1974: 2; Davis 1952: 297, 315) Moreover, the locks and dams already built in Minneapolis and Hastings had to be integrated into the plan.

Because of the low banks of the river, its relatively wide and extensively cultivated flood plain, and the close encroachment of railroads and towns on the river channel precluded the construction of high dams, a series of low dams were designed for construction on the upper Mississippi. Moreover, since deep natural depths were not available for a sufficient period of the navigation season, movable dams which could be lowered to the bed of the stream by means of a derrick boat and operating crew such as those built on the Ohio River were not deemed feasible for the upper Mississippi. Furthermore, the range of stage of the river between low water and maximum flood stage was not great while ice conditions on the upper Mississippi were on occasion severe. Plans were thus made to construct, at reasonable cost, a series of low dams with gates which might be lifted above the high water plain during flood periods and whose movable gates could be readily operated during periods of low winter temperatures and would provide wide openings for the passage of ice. Accordingly, a combination of roller gates and Tainter gates were used in the project since they were considered best adapted to these natural conditions. (U.S. Engineer Department 1938: 6)

The typical lock and dam structure in this period thus consisted of a lock which had a standard 100 foot by 600 foot chamber at the river bank together with the upper gates and a short section of the riverward wall of a future auxiliary lock. In addition, a control gate section normally occupied the entire width of the low-water channel while a non-overflow earth-fill dike which might contain a fixed concrete spillway, extended to the bluffs of the river. (U.S. Engineering Department 1938: 7; Wood 1938c: 4) The control gate section which controlled the pool elevation was comprised of a roller gate section normally located near mid-channel, flanked on one or both sides by a section of Tainter gates.

The supporting structure for the gates consisted of concrete piers resting on piling driven into the sand and gravel bed of the river, since suitable rock foundations were not available at most sites. These foundations were called "perhaps the most interesting features of design." (Wood 1938c: 6) The structures were practically all founded on wood piles which had to be designed to resist both vertical and horizontal forces. Vertical loads were thus apportioned by the usual method, but elaborate tests were conducted to determine the lateral resistance of vertical wood piles. Where lateral resistance was not sufficient to prevent horizontal movement of the structures, the requisite number of batter piles were driven. In order to resist uplift, the heads of piling were notched or otherwise provided with anchorage in the concrete sills which resulted in a considerable saving in the amount of concrete required. Care was exercised in investigating the type of foundation material at all sites. In general, tests indicated that the stream bed was composed of sand, silt and gravel in varying proportions. Dam No. 3, however, provided a notable exception since the entire river bed there was found to be a deposit of silt which showed a marked tendency to flow under load. The bed of silt thus had to be dredged out and replaced with clean river sand. (U.S. Engineering Department 1938: 7)

The piers, which rest on the foundation, were surmounted by a service bridge along which a locomotive crane operated for the placing or removal of emergency bulkheads to enable unwatering and for removal of ice and logs which might lodge against the gates. Concrete sills at approximately the elevation of the river bed occupied the spaces between piers. A concrete apron, with a series of baffle piers, and a belt of heavy stone protection extended downstream to dissipate the energy of the water flowing through the gate openings and to protect the river bed from scour. Seepage through the porous foundation was checked by a steel sheet-pile diaphragm at the upstream toe of the sill. A similar diaphragm penetrating a lesser depth into the foundation at the downstream end of the apron provided a line of protection against undermining by scour. (U.S. Engineering Department 1938: 7)

Every dam was provided with a combination of roller and Tainter gates, except Lock and Dam No. 3, which consisted entirely of roller gates. Roller gates consisted of large steel cylinders which rolled on tracks, slightly inclined from the vertical, embedded in recesses in the concrete piers. The diameter of the cylinder was less than the nominal height of the gate opening, the remainder of the height being made up of one or two aprons attached to the cylindrical drum. Ring gears attached to each end of the gate engaged racks forming a portion of the track. The gate was raised and lowered by means of a specially-designed chain wrapped around one end of the cylindrical drum and actuated by a hoist housed in a building on top of the pier. A permanent hoist was provided for each gate. (U.S. Army Corps of Engineers 1974: 5; U.S. Engineering Department 1938: 8; Wood 1938c: 4; U.S. Army Corps of Engineers 1981) The roller gate was somewhat more costly than the Tainter gate, but it possessed the advantage of ruggedness under ice conditions. Moreover, since roller gates could be more economically constructed to greater lengths than other types of gates, they provided larger openings for passage of ice and less obstruction of the waterway opening due to the smaller number of supporting piers. Roller gates at the first dams built were designed so that water could be discharged only by raising the gate from the sill and passing all flow underneath. Later gates in Dam Nos. 3 and 9 were designed so that they could be submerged five feet below the normal level of the pool so that even heavy ice could pass over the top. (U.S. Engineering Department 1938: 9; Wood 1937c: 7)

Tainter gates, on the other hand, consisted of watertight segments of a cylinder supported at each end by radial arms rotating on pins anchored in the supporting piers. The first Tainter gates designed for the nine-foot channel project on the upper Mississippi were of the simplest type, thirty-five feet in length with skin plating only of the upstream side. In later designs they were made submersible for passing ice and drift. The final designs were increased in length to sixty feet, and gates eighty feet in length were designed for Dam No. 24, the final dam constructed in the project. The Tainter gates were operated by two methods, both of which used chains attached to each end of the gates as a lifting medium. On three dams, they were operated by specially-designed hoists travelling on the overhead service bridge. The chain pull was equalized by suitable mechanism and locking devices installed in the bridge were provided to hold the gate in any desired position. On the other dams with fewer Tainter gates of larger size, operation was completed by individual hoists located within the service bridge. One hoisting unit was located over each end of the gate and were powered through line shafting by a si.gle motor placed at the center of the service bridge span. (U.S. Engineering Department 1938: 9-11; U.S. Army Corps of Engineers 1974: 5; U.S. Army Corps of Engineers 1981; Wood 1938c: 4)

The permanent hoists for movement of both roller and Tainter gates were operated by electric motor. Gate openings were varied as desired by means of remote electrical control and indicators showed the position of the gate. Both gate types, which were to be used in regulation of the pools during winter months, were equipped with electric heaters. The electric power used in operation of the locks and dams usually was purchased from the public utility or municipal plant serving the local community. Emergency standby service was provided by a gasoline-engine-driven generator. But at Dam No. 2 a hydroelectric unit, as part of the project, was the normal source of power, with purchased power and a generator as standbys. (U.S. Engineering Department 1938: 12)

Both roller and Tainter gates could be adjusted to control pool levels in times of normal and low flows. During flood periods the gates were lifted entirely above the water level and the dam structure which caused only slight obstruction to the flow of the river. (U.S. Army Corps of Engineers 1974: 5; U.S. Army Corps of Engineers 1981) The nine-foot channel was controlled through the use of a control point some distance above the dam which was established in each pool area. In normal operation, control-gate openings were adjusted to the flow of the river to maintain at the control point a predetermined water-surface elevation which assured the minimum required depth throughout the slackwater channel. During periods of low flow, gate openings were small and the slope of the water-surface above th dam was negligible. As the flow increased, however, gate openings were extended, the water-surface immediately above the dam falls remained fairly constant at the control point and rose in the upper end of the pool. As the flow increased, therefore, the slope of the water surface in each pool increased until a point was reached when all control gates were raised out of the water permitting the stream to seek its flood stage as if no dams existed. As the flow subsided, control gates were lowered and again became effective in maintaining normal pool elevation. (Wood 1938c: 5)

The pools created by the dam also necessitated locks which provided for navigation between two bodies of water at different elevations. The lock chambers were formed by two concrete walls parallel to the bank, closed at the ends by large steel miter gates. The lock walls, particularly the landward wall, were extended a distance up and down the stream for the chamber proper to serve as guide walls for large tows preparing to enter the lock. The lock gates were pairs of large structural steel leaves which mitered vertically to form

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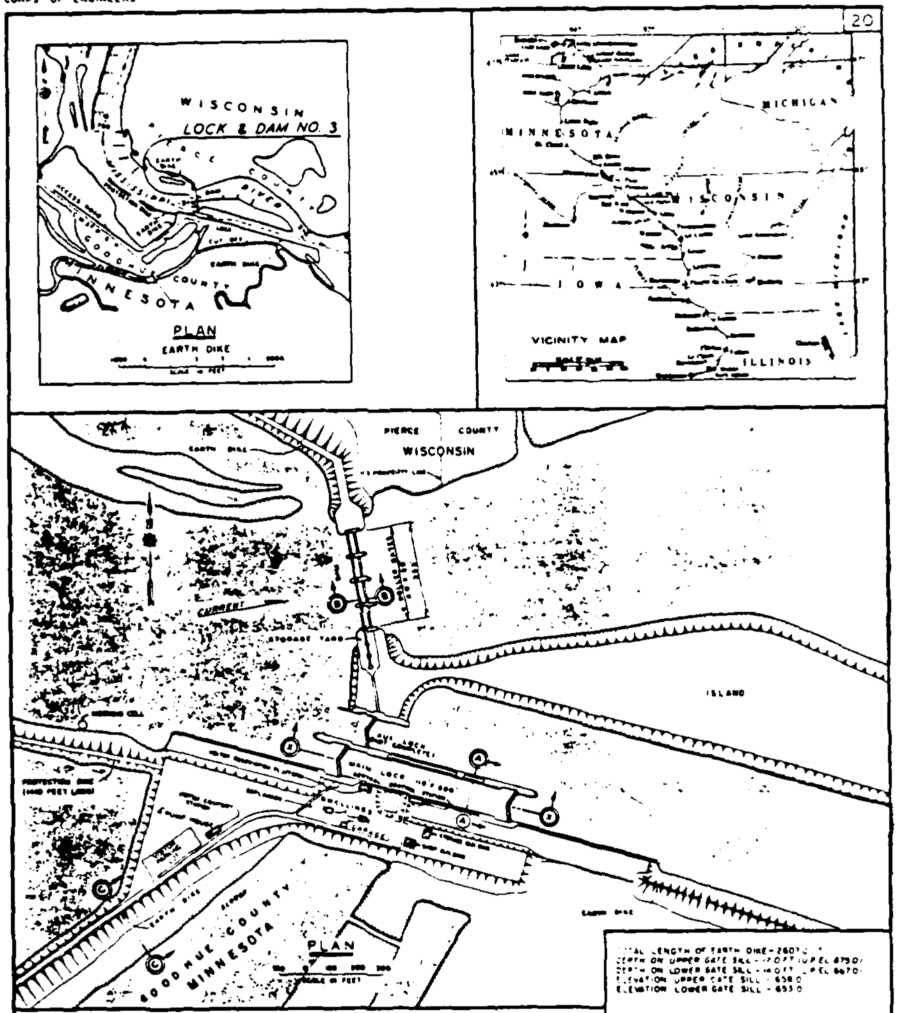



TOTAL LENGTH OF EARTH DIKE – 2607.0 FT
DEPTH ON UPPER GATE SILL – 17.0 FT (U.P. EL. 675.0)
DEPTH ON LOWER GATE SILL – 14.0 FT (L.P. EL. 667.0)
ELEVATION UPPER GATE SILL – 658.0
ELEVATION LOWER GATE SILL – 653.0

ELEVATIONS ARE REFERRED TO M.S.L. 1912 ADJ.

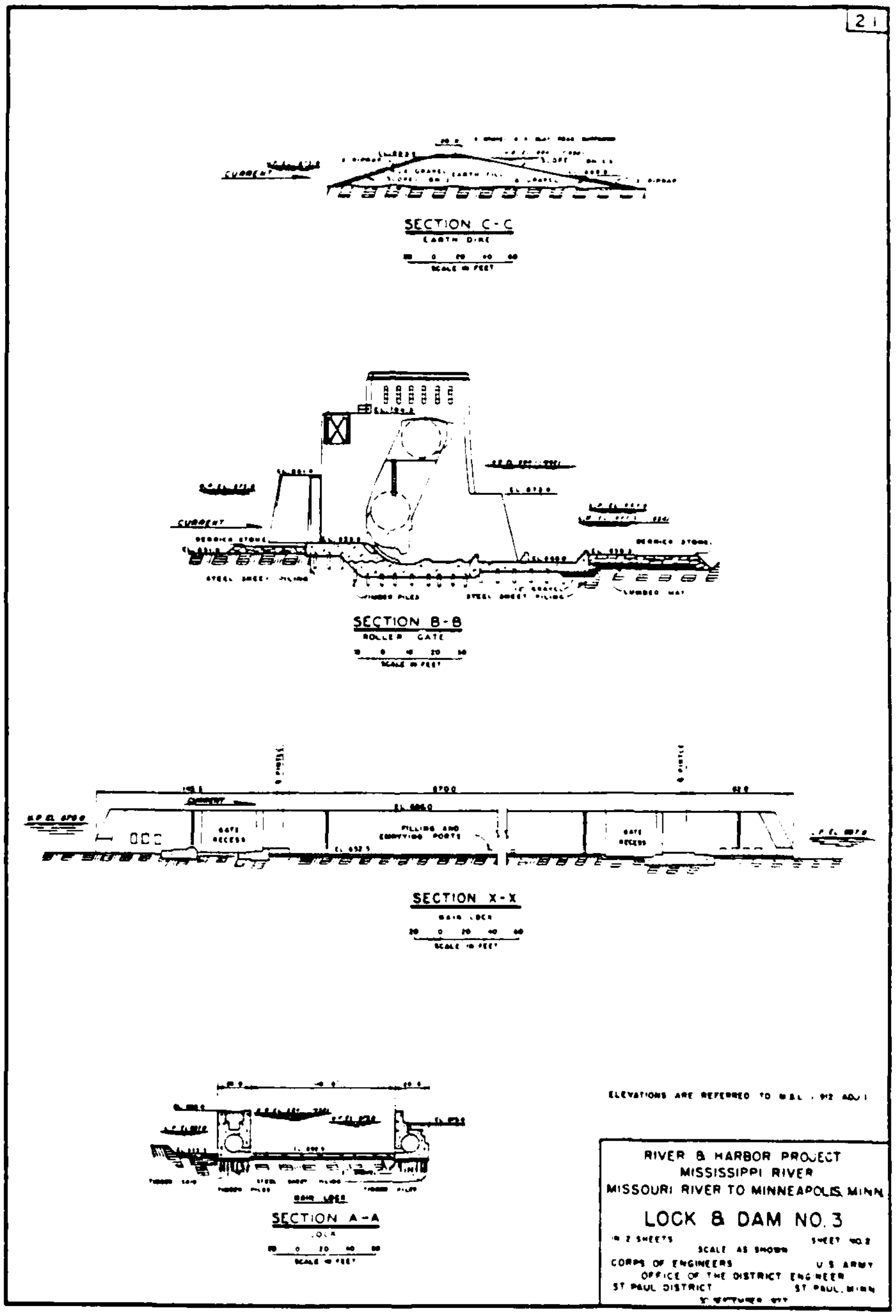
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

LOCK & DAM NO 3

IN 2 SHEETS SHEET NO

SCALE AS SHOWN

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL MINN.
[illegible] SEPTEMBER 19[illegible]


21
CURRENT
SECTION C-C
EARTH DIKE
SCALE IN FEET
SECTION B-B
ROLLER GATE
SCALE IN FEET
SECTION X-X
SCALE IN FEET
SECTION A-A
LOCK
SCALE IN FEET
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.
LOCK & DAM NO. 3
IN 2 SHEETS
SCALE AS SHOWN
SHEET NO. 2
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT
ST. PAUL, MINN.

a "V"-shaped arch pointing upstream at the end of the lock chamber. They swung on pintles and gudgeon pins which acted as hinges at the lock walls. The machinery which operated the miter gates consisted of motor-operated gears connected with the gate by a strut. Operation was remotely controlled by means of master switches installed in weather-proof cabinets on the lock walls at the miter gates. Limit switches were provided to automatically retard to stop the gate at or near the end of travel. (U.S. Engineering Department 1938: 12-13)

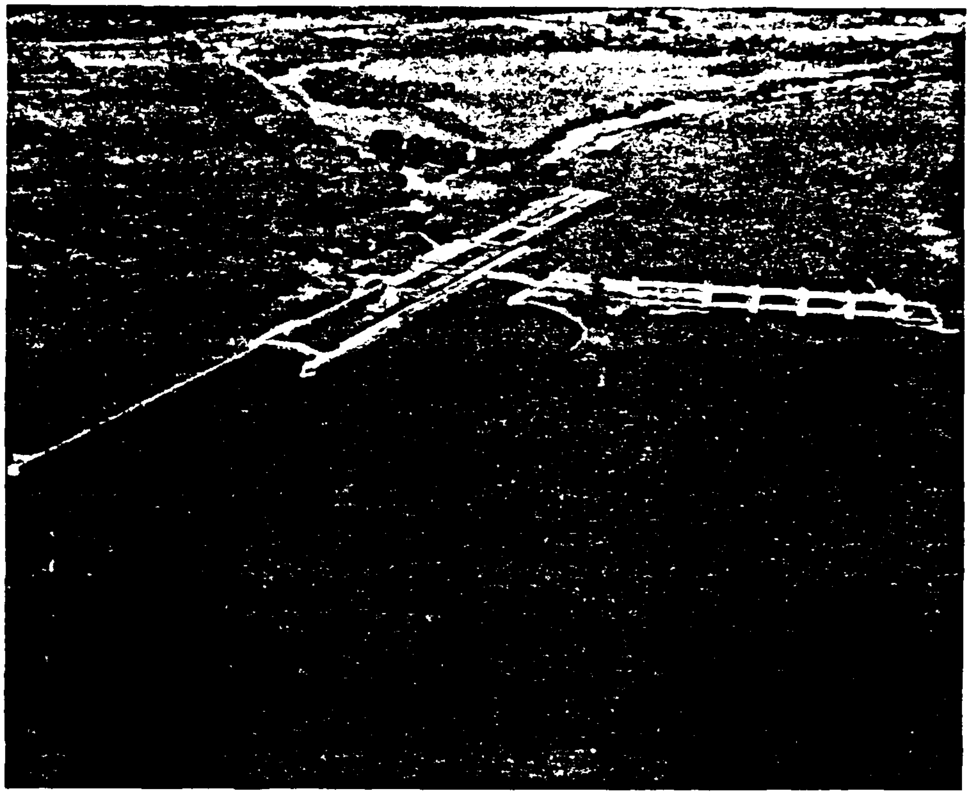
Water level in the locks was altered, based on the principal of gravity, through the use of large tunnels or culverts within and extending the entire length of the walls of the locks connected by a series of ports with the lock chambers. A single large valve at each end of the culvert controlled passage of water from the upper pool to the lock or from the lock to the lower pool. The valves were somewhat unusual in that each was a small Tainter type gate set in a well in the lock wall and arranged to control the tunnel opening in the wall. The valves were operated by motor driven gears with remote electrical control. Stop-logs or bulkheads could be dropped into slots in the wall upstream and downstream of each valve to permit unwatering for removal or repair. The section of the riverward wall of future auxiliary locks that were constructed provided for filling of these locks by similar arrangement of tunnel, valves and ports in the riverward wall. (U.S. Engineering Department 1938: 13-14; U.S. Army Corps of Engineers 1974: 5) In general, the lock section measured 110 feet by 600 feet. (Wood 1938c: 4)

The lock and dam projects in this nine-foot channel period all had at least some of these general features; many had all of them. Design of each structure was simplified by such uniform plans. Extensive research, moreover, was conducted, the results of which aided each project. Hydraulic model tests of problems in design involving stream flow and correlated subject were carried out in the sub-office at the Hydraulic Laboratory at Iowa City in conjunction with the University of Iowa. Furthermore, studies on paints and painting, records of scour and settlement observations, and tests on internal temperatures of concrete and composition of undisturbed soil samples were made which would aid future construction. (Wood 1938c: 7; Nelson 1935: 25-26) In spite of the common features, however, each project had its own design based on geographic and geological needs. The next section will examine each lock and dam of the nine-foot project in turn.

Lock and Dam No. 3:

The site of Lock and Dam No. 3 is at the outlet of Vermillion Slough, about six miles above Red Wing, Minnesota, and about forty-four miles below St. Paul. The valley at this point is approximately three miles wide between high sandstone bluffs. The river is about 600 feet wide at normal levels but at extreme high water, the width can reach two and one-half miles. During construction, the site was not located near an improved highway, the access being over a side road joining Highway 61

LOCK AND DAM NO. 3



about three miles west of the Cannon River. The nearest railroad was a westbound track about 3,000 feet from the lock on the Minnesota side of the river and owned by the Chicago, Milwaukee, St. Paul and Pacific Railroad. (Wood 1938b: 12)

The site for Lock and Dam No. 3 was selected since it was probably the best location for a lock above Lake Pepin. Moreover, it was above the city of Red Wing which obviated possible flowage damage to that town. The dike of the site was designed to intercept the Cannon River, diverting it into the pool of the dam since it was considered undesirable, because of silting and bar building, to allow this river to discharge into the lower pool. The spillway was divided into two parts by an island which was intended to permit division of the discharge between the two channels. This would provide the most favorable conditions to navigation since it would eliminate objectionable currents and bar building below the lock. (House Document 137, 1932: 99)

Since the channel around the Lock and Dam No. 3 site was stable and since Lock and Dam No. 4 would provide a nine-foot channel if dredging were undertaken when it was completed, Lock and Dam No. 3 had a low priority. In fact, it was in Group B of the plan and although it was the eighth of nine locks and dams scheduled for completion in the St. Paul district, it was actually completed last. The lock and dam structures, however, contain a number of novel features, partly because they were built so late and engineers could employ newer techniques. (House Document 137, 1932: 100) First, as was mentioned earlier, the dam was the only one built in the nine-foot channel project which consisted solely of roller gates. Secondly, the structure rested on artificially-placed foundation material. Finally, the dam abutments were constructed using Type Z steel sheet piling walls, the first use of this section of piling in the St. Paul district. (Wood 1938c: 5; Lidicker 1937: 12) These features of the lock and dam, in addition to the basic construction of the structures, will be discussed in turn.

Lock No. 3--Construction History:

The lock at site No. 3 was planned to be built before its dam. The St. Paul district proposed in the 1934 report of the U.S. Army Corps of Engineers that $2,000,000 be spent in the upcoming year on the lock. (Annual Report 1934: Part 1, 799) In the following year, funds from the Emergency Relief Appropriation Act of 1935 were made available for its construction. (Annual Report 1935: Part 1, 904) Accordingly, the work as advertised on June 24, 1934, included the construction of an access road about 1½ miles long, a main lock 110 feet by 600 feet, upper and lower guide wall, the upper gate bay of an auxiliary lock, central control station, an earth-dike 2,600 feet long, and the relocation of Vermillion Slough in a new channel about 3,500 feet long. Bids were opened on July 23, 1935, and Spencer, White and Prentis, Inc., a firm located in New York, N.Y., was the successful bidder at $2,168,048.55. A contract with that firm was entered into on August 5, 1935, and approved on September 5, 1935. The original date set for completion was December 2, 1936. (Wood 1937a: 15; Wood 1938b: 12)

Actual work on the contract awarded to Spencer, White and Prentis was begun on August 6, 1935, when the site was cleared of the timber around it. (Wood 1938b: 13) Subcontracts were awarded to the LaCrosse Dredging Company which placed the hydraulic fill for the earth-dike by September 25, 1935, and to Fred J. Robers, who completed a cut-off channel to divert the flow of the Vermillion Slough before any of the cofferdam fill could be placed on September 19, 1935. The cofferdam consisted of earth-dike sections, the greater portions of which were placed hydraulically with material removed from the lock area. Unwatering was considered completed on December 20, 1935. Considerable repair work, however, was necessary to keep the cofferdam in shape. The contractor was forced to permit the cofferdam to flood twice during work to minimize damage from high water. (Wood 1938b: 13)

The driving of steel sheet piling, which had a three-eighths inch web, measured fifteen inches center to center of interlock, and weighed thirty-one pounds per square foot of wall in place, began on February 29, 1936. Most of the piles were driven at night since cranes were employed on other operations during daylight hours. Driving was comparatively easy, especially for the initial fifteen feet of penetration. (Wood 1938c: 14) Crib-fill riprap and derrickstone as well as the concrete aggregate were furnished by Hallett Construction Company of Crosby, Minnesota. (Wood 1938b: 14)

By the end of fiscal year 1936, all preliminary work had been completed. The cofferdam had been constructed and unwatered, practically all piling had been driven in the cofferdam, concrete work had commenced, the access road had been completed, the earth-dike had been finished, excavation of the cut-off channel had been completed, and the embankment island and esplanade were in the works. The report of the Chief of Engineers figured that the contract was about 49 percent complete at a cost of $1,184,590.86. (Annual Report 1936: Part 1, 885-886)

Ten changes were made in the original plans as work progressed, the most extensive of which occurred when excavation within the cofferdam area disclosed an inadequate foundation to sustain horizontal loads. The contractor was given additional time to complete the contract extending the due date to May 5, 1937. (Wood 1938b: 15) The lock gates were fabricated, assembled and erected by the Independent Bridge Company of Neville Island, Pennsylvania, and the project was considered complete on April 13, 1937, the costs for that year being $1,335,281.35. (Annual Report 1937: 924; Wood 1938b: 15)

Dam No. 3--Construction History:

Exploratory borings of Dam No. 3 revealed that the stratum of silt, sand and plastic clay encountered in the lock area also extended beneath the proposed site of the dam. Since it was highly improbable that the piling driven into this material would afford adequate resistance to horizontal loads, it was decided that the stratum of plastic material should be removed and replaced with clean river sand. Approximately 200,000 cubic yards of material were removed and replaced by 130,000 cubic yards of sand, a task completed by November 9, 1936, by the United States government. The St. Paul district requested $3,200,000 for construction of the dam during fiscal year 1937, and since the sand was in place, advertisement inviting bids for the construction of Dam No. 3 was issued on November 20, 1936. The bids were opened on December 18. 1936, and the A. Guthrie and Company of St. Paul was the successful bidder. The contract was made on January 8, 1937, and Notice to Proceed was acknowledged on January 19, 1937, establishing the completion date as February 23, 1938. The work demanded in the contract included construction of the movable gate section of the dam consisting of four eighty-foot roller gates between concrete piers, a storage yard, all operating machinery, and an earth-fill dike about 1,372 feet long on the Wisconsin side of the river. (Annual Report 1935: 913; Wood 1938b: 15, 16; Wood 1937a: 15)

Work on the dam began on February 2, 1937, and by April 1, clearing, construction of a flood relief channel and bridge and trestle across the lock chamber were practically completed. Cofferdam construction began on April 28, the downstream arm and a portion of the upstream arm consisting of two parallel rows of steel sheet piling with sand fill. The cofferdam was completed on June 2, when Ferd J. Robers, a sub-contractor, placed the last of the fill and initial unwatering was finished on June 14, 1937. After numerous test piles had been driven by the general contraction in the course of preliminary operations, practically all timber and Type "A" steel sheet piling could be driven in June and July. Next, the first shipment of steel from the Lakeside Bridge and Steel Company arrived on July 2, and since the concrete plant could be purchased by Guthrie from Spencer, White and Prentis, the lock contractor, considerable preparatory work was avoided. The first concrete was placed on July 15, 1937. (Wood 1938b: 16)

Both the Minnesota and Wisconsin abutment wing walls were constructed of "Z" piling. The use of Type "Z" steel sheet piling wall involved its first use in the St. Paul district and one of the first in the Corps of Engineers. (Lidicker 1937: 12) The piles were driven to form and each end pier was an immense U-shaped enclosure at each end of the structure. The use of the steel sheet piling wall in place of a concrete gravity or reinforced counterfort section was made possible by the tremendous stiffness and resistance to bending which was the principal characteristic of the Type "Z" piling. The strength resulted from the shape of the piling which gave it the name "Z", for when one "Z" pile was interlocked with another, the result was to place the maximum amount of metal away from the neutral axis of the pile, thereby giving it great strength. Since Type "Z" piling was first rolled by steel mills only two years before Dam No. 3 was constructed, it could be used only on the later dams in the nine-foot project for use in designs which needed great resistance to bending within the piling itself. (Lidicker 1937: 12; Wood 1938b: 17)

The construction of Dike "A" was sub-contracted to Ferd J. Robers, who began top soil excavation early in August 1937, and started pumping the embankment fill on August 24. By November, all Class "B" concrete was placed, both abutments were complete, fill on Dike "A" was complete except for some final grading, and all derrickstone and protection mats were in place. New Year's Day of 1938 marked the point when all work within the cofferdam was complete and the cofferdam was flooded. And by February 10, 1938, all work except final grading of the esplanade and a few minor items was complete and the dam was completed on March 30. (Annual Report 1938: 1052; Wood 1938b: 17, 18)

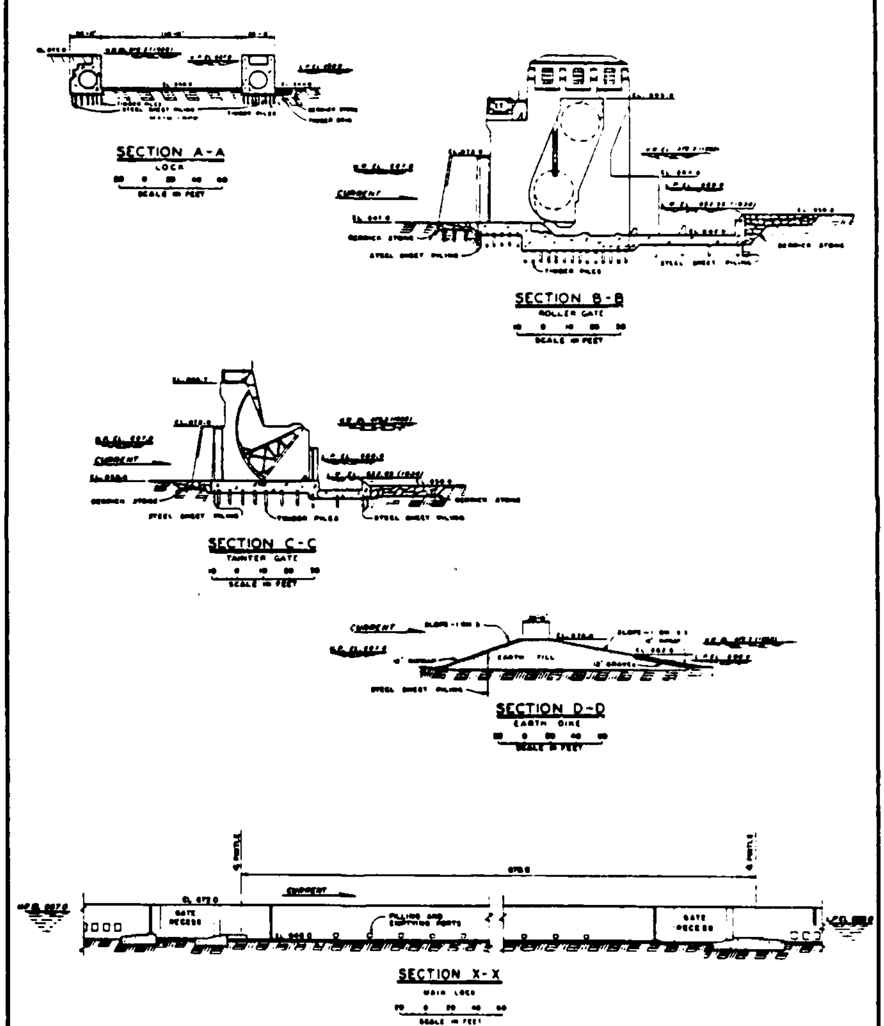
Other Work:

In addition to the main lock and dam structure, other minor buildings and improvements were made at the site of Lock and Dam No. 3. Work on the Hastings and Island Road was entered into on April 21, 1938, and completed on August 4, 1938, although some alterations were made in November. Moreover, the lockkeepers' dwellings and garage storehouse began in fiscal year 1938 and were completed in calendar year 1940. (Annual Reports 1938: 1053, 1062; 1939: 1152)

Lock and Dam No. 4:

Lock and Dam No. 4 is situated in the city of Alma, Wisconsin, about 100 miles below Minneapolis and 752.8 miles above the mouth of the Ohio River. The city of Alma lies along the bank of the river which is about 800 feet wide at this point at normal stage although the width can be increased to about 2,000 feet at high water. The main line of the Chicago, Burlington and Quincy Railroad was adjacent to the left bank of the river when the lock and dam was under construction while the right bank was nothing but sand flats overgrown with brush and willows with occasional higher ground covered with timber. The lock is close to the shore of the left bank. The movable portion of the dam extends from the river wall of the lock westward a distance of 1,367 feet from which point an earth-dam extends to the right bluff an additional 5,485 feet. (Annual Reports 1933: 676; 1939: 1149; "History of Construction Lock No. 4" 1934: 1; "History of Construction Dam No. 4" 1935: 1)

Lock and Dam No. 4 is historically significant since it was the first structure designed and completed under the nine-foot channel slackwater channel project. Because of the poor channel between the Chippewa River mouth and the site--the "worst channel above the Wisconsin River" mouth--the lock and dam was given a priority of A and was scheduled as the first lock and dam to be completed. (House Document 137, 1932: 7, 102) The site of the dam was also unique in that it was situated below Lake Pepin which might have provided storage in a pond that had a total length of 40.4 miles. The Chippewa River enters from the left about eleven miles above the site. It carried large quantities of sand into the Mississippi River and thus caused a poor channel between its mouth and the site. The



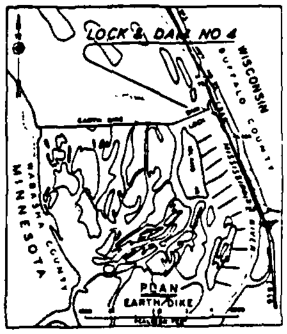

ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ.)

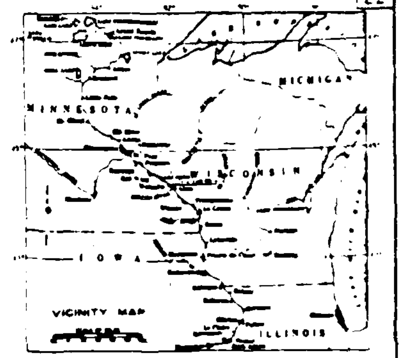
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

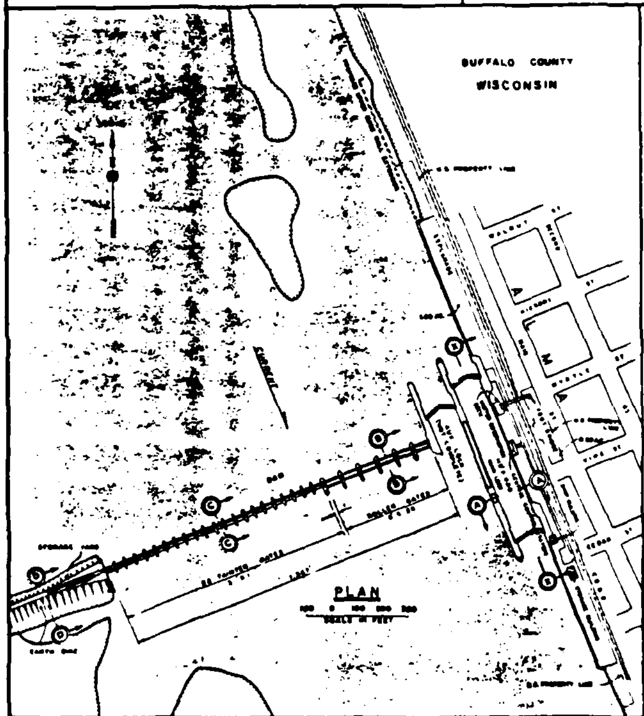
LOCK & DAM NO. 4

IN 2 SHEETS SCALE AS SHOWN SHEET NO 2

CORPS OF ENGINEERS U S ARMY
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT ST PAUL, MINN.




TOTAL LENGTH OF EARTH DIKE 5460.0 FT
DEPTH ON UPPER GATE SILL - 17.0 FT (U.P. EL 667.0)
DEPTH ON LOWER GATE SILL - 13.0 FT (L.P. EL 660.0)
ELEVATION UPPER GATE SILL - 650.0
ELEVATION LOWER GATE SILL - 647.0

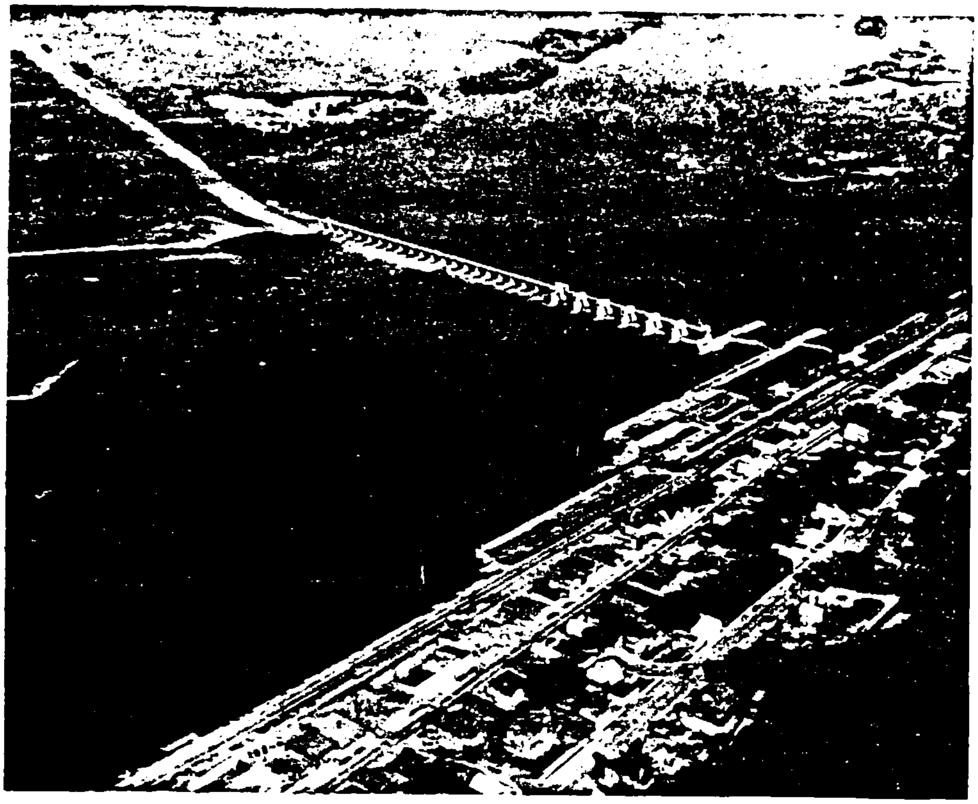
ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ)

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN

LOCK & DAM NO 4

IN 2 SHEETS SHEET NO 1
SCALE AS SHOWN
CORPS OF ENGINEERS U S ARMY
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT ST PAUL MINN
30 SEPTEMBER 1977

LOCK AND DAM NO. 4



dam, by causing a backwater in the Chippewa, was planned so that it would cause a backwater in the Chippewa and would result in the deposition of this sand in the Chippewa Valley during low water and thus aid dredging. Ultimately, the possibility of diverting the Chippewa River into Lake Pepin and thus relieving the Mississippi River of its sand for years was considered. (House Document 137, 1932: 100-101) The lock and dam, completed in July 1935, was called "the first of its type to be constructed" by a contemporary source. (Upper Mississippi River Bulletin 1935: 1)

The original design of the dam provided for four roller gates with clear openings of 20 by 100 feet for ice passage, due to the acute ice problem that existed in the area. The dimensions were altered, however, so that six roller gates twenty feet high and sixty feet wide were constructed. Supporting piers and six concrete control houses in which were housed the individual gate operating machinery completed the structure. The Tainter gate section included twenty-two gates which measured thirty-five feet wide and fifteen feet high which were operated using a gasoline power hoist which travelled along the top of the bridge of the dam on rails. (House Document 137, 1932: 102; Upper Mississippi River Bulletin 1935: 1) The lock chamber had the dimensions of 110 feet by 600 feet standardized in the nine-foot project. Its concrete floor was twenty-four inches thick and was filled and emptied by tunnels in the lock walls measuring fourteen inches in diameter. The water was controlled by great valves at either end and flowing from the tunnels into the lock chamber through numerous openings in the lock walls along the floor of the lock chamber. (Upper Mississippi River Bulletin 1935: 1)

Lock No. 4--Construction History:

Work on Lock No. 4 was projected to begin in late 1931 with the funds originally appropriated under the plan. The project was first advertised on October 17, 1931, but legal difficulties with the Chicago, Burlington and Quincy Railroad delayed the bidding process. On September 20, 1932, the contract was again advertised for bids for the main lock and guide walls, the upper river bay, upper miter-gate sill and poirie dam foundation for the auxiliarly lock. Bids were opened on October 20, 1932, the low bidder being the Ouilmotte Construction and Engineering Company of Chicago with a bid of $835,785.71. The contract was dated November 19, 1932, and was approved by the Chief of Engineers on December 12, 1932. Notice to Proceed was received by the contractor on December 20 and the date of completion was set for December 20, 1933. (Annual Reports 1931: 1215; 1932: 1114; Wood 1937a: 16; "History of Construction Lock No. 4" 1934: 1-2)

After some preliminary work, construction of the cofferdam began on December 14, 1932, the first task being the driving of a row of round piles forming the inside of the cofferdam. Land disputes with the C. B. and Q. Railroad continued, but the cofferdam was completed on March 16, 1933. The driving was comparatively easy with the exception of the piles in the land wall and part of those in the miter sill and poirie dam of the main lock, where numerous boulders were encountered. The first round piles were driven at the upper end of the cofferdam on February 24, 1933. The piling in the lower guide wall was driven intermittently between February 27 and June 22, with two delays due to high water. All the piling was driven with a No. 1 hammer and the driving as easy with the exception again of those piles in the land wall. A jet was used in the driving except those piles in the wall where a jet could not penetrate the material at all. The penetration of the piles in the land wall averaged about twenty feet. All the timber was obtained from the surrounding country and consisted mostly of oak with some maple or hickory. ("History of Construction Lock No. 4" 1934: 7, 8, 9, 12, 17, 18, 19)

The placing of concrete was begun in the upper end of the river wall foundation on May 17, 1933, and work was carried on continuously to the lower end of the river wall. The foundation of the river wall was completed on May 28, the intermediate wall on June 28, and the land wall on July 7. By the end of fiscal year 1933, the project was about 47 percent complete. The high forms were poured progressively downstream and the river wall was completed on July 28, with the exception of some of the grouting, the intermediate wall on September 26, and the land wall on October 7. The lock gates were in place by December 11, 1933, and the Tainter valves were erected in the first half of December. In the meantime, work was begun to remove the cofferdam beginning on November 10, 1933, that removal was completed on January 5, 1934, and the lock was considered completed at a total cost of $952,000. (Annual Report 1933: 678; Wood 1937a: 16; "History of Construction Lock No. 4" 1934: 28, 29, 36, 37, 41, 42)

Dam No. 4--Construction History:

Dam No. 4 was included in funds allotted under the National Industrial Recovery Act in the New Deal. The project was advertised on August 22, 1933, as a job that would include construction of three cofferdams, including maintenance and removal, concrete masonry of the complete structure, roller gates and Tainter gates, including fixed hoists for operation of roller gates, and an earth-fill dike constructed by hydraulic methods. Bids were opened on September 22, 1933, and the low bid by United Construction Company of Winona totalled $2,012,972.53, under the $2,200,000 allotted by the federal government. The contract was dated October 7, 1933, was approved by the division engineer on November 16, and Notice to Proceed was received by the contractor on November 20, 1933, with a date of completion set as April 4, 1935. (Annual Reports 1933: 683; 1934: 789; "History of Construction Dam No. 4" 1935: 3)

First construction on the contract operation began on October 11, 1933, while work on the earth-dike began on October 18, when brush and trees were removed from the dike area. Construction on the dam proper began on October 27, when the first cofferdam was begun and by December 29, it was completed and unwatered. The driving of round piles in cofferdam No. 1 was begun on January 4, 1934, and steel pile driving was begun on January 17. Both tasks were completed by March 31, 1934. The placing of concrete in the first cofferdam was begun on March 26, 1934, and was carried on continuously until a sharp rise in the river on April 4 delayed operations about five days. The placing of concrete was completed, however, on August 30, 1934. By the end of fiscal year 1934, all preliminary work had been done, excavation and work on the cofferdam practically completed and the earth-dike built. The contract as a whole was about 40 percent complete. (Annual Report 1934: 789; "History of Construction Dam No. 4" 1935: 7, 8)

On July 17, 1934, the construction of the river arm of the second cofferdam was begun by connecting the upper and lower arms of the first cofferdam to the upstream and downstream ends. After this connection was completed, work of the removal of the first cofferdam was begun and construction shifted to the second. The driving of round and steel piles was started on August 22 and the placing of concrete, which was begun on August 31, was carried on simultaneously with pile driving operations until October 25, when the latter was completed. As soon as the concrete work had advanced sufficiently, the erection of steel was begun with the placing of the bridge girders and the remaining Tainter gates. All steel erection was complete by February 15, 1935. The rising river which crested on March 28, 1935, was used to carry away the fill from the cofferdam and by May 20, 1935, the second cofferdam was totally removed. The dam contract was considered complete on June 26, 1935. (Annual Report 1935: 898; Wood 1937a: 16; "History of Construction Dam No. 4" 1935: 8, 9)

Other Work:

Small contracts were let and completed in calendar year 1935. A contract for construction and installation of the power, control and lighting system was completed on July 8, 1935. Construction and delivery of a locomotive crane, under a contract entered into January 28, 1935, was completed by July 1 as well. The first contract for construction and delivery of a Tainter gate hoist was completed on April 24, 1935. (Annual Reports 1935: 899; 1936: 884) A contract to construct lockkeepers' dwellings was entered into on April 16, 1937, and finished on November 17, 1937. Likewise, the contract to build the storehouse, entered into on October 9, 1936, was fulfilled by July 17, 1937. Finally, the esplanade and parking area was completed on June 14, 1938. (Annual Reports 1937: 922; 1938: 1052)

Lock and Dam No. 5:

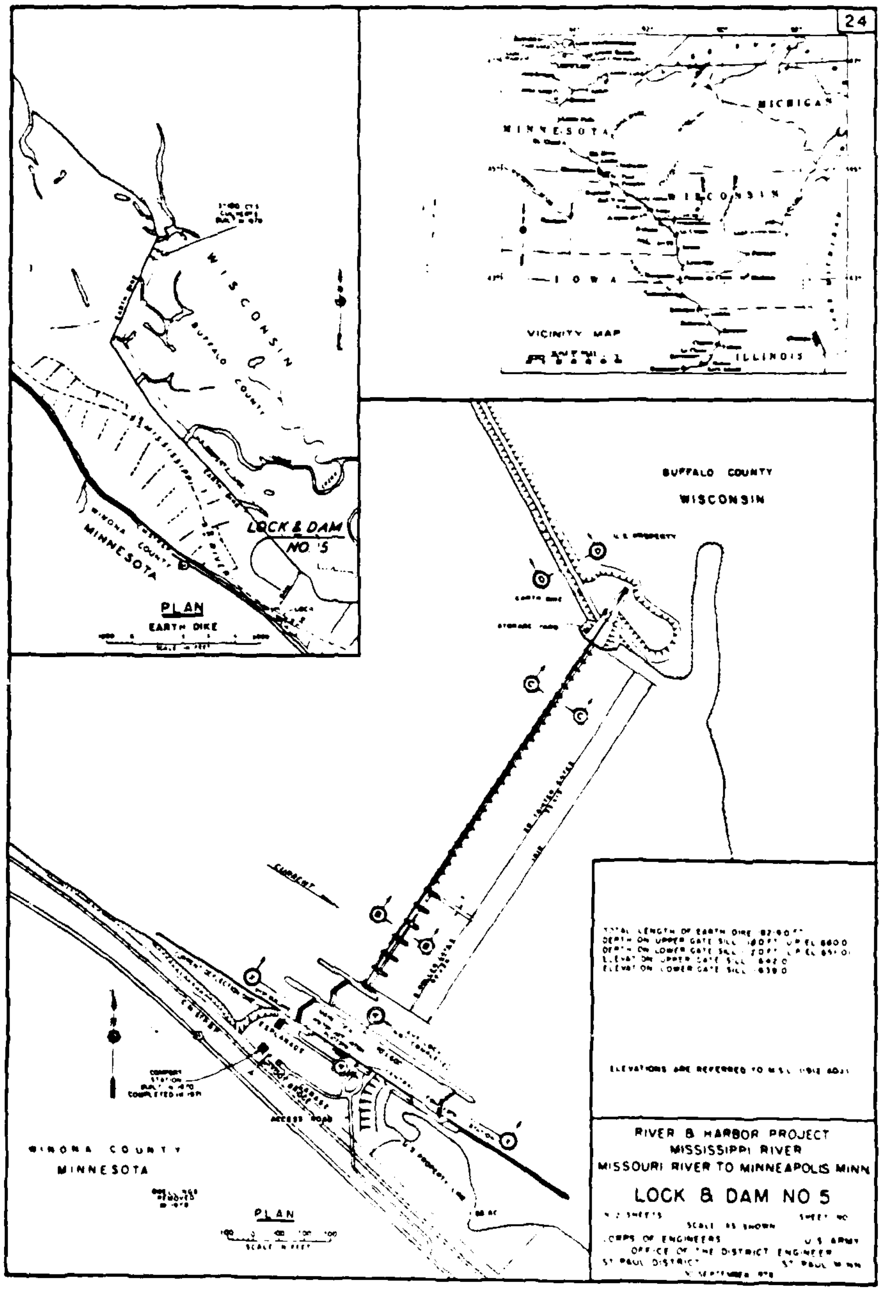
Lock and Dam No. 5 is located about 5.5 miles upstream from Fountain City, Wisconsin, about 114.5 miles below Minneapolis, and about 738 miles above the mouth of the Ohio River. The river valley at this point is approximately 2.5 miles wide and the main river channel is at the foot of bluffs on the Minnesota side. The Mississippi is nearly 800 feet wide at the site, but during high water it sometimes extends to a width of 2 miles. The lock and dam was accessible during construction by the Chicago, Burlington and Quincy Railroad on the Wisconsin side and by the Chicago, Milwaukee, St. Paul and Pacific Railroad and U.S. Highway 61 on the Minnesota side. (Wood 1937b: 9)

The river in and around the site of Lock and Dam No. 5 had been a problem area for decades. At the time of construction, the river stretch between Dam No. 4 and 5 had one point at which dredging had to be done twice annually to maintain a six-foot channel, four points where it had to be dredged annually, and five points where it had to be dredged bi-annually. Lock and Dam No. 5, therefore, was in the Priority A group and was the second dam scheduled for completion behind Lock and Dam No. 4. (House Document 137, 1932: 103) The lock and dam structure reflected many of the standardized characteristics of the works in the nine-foot project. The main lock, which measured 110 feet by 600 feet, and the upper bay of an auxiliary lock were placed in the main channel adjacent to the Minnesota shore. The movable gate section of the dam is 1,619 feet wide and consists of a roller gate section and a Tainter gate section. There are six roller gates which measure twenty feet by sixty feet and twenty-eight Tainter gates thirty-five feet wide and fifteen feet high, all of which are situated between concrete piers and an overhead steel deck type service bridge. The roller gate section was designed in order to utilize the main channel area as fully as possible for the discharge of flood waters and passage of running ice. From the abutment on the Wisconsin side, an earth-fill dike continues upstream 3.5 miles to high ground. The normal head is 9 feet with upper pool elevation 660 and lower pool elevation 651 feet. (House Document 137, 1932: 102; Wood 1937b: 9)

Lock No. 5--Construction History:

The foundation conditions, determined by borings made at the site prior to construction work, indicated that the foundation piling for the lock as well as the movable gate section of the dam would penetrate a layer of fine sand. Plans for the construction of Lock No. 5 were made before the National Industrial Recovery Act provided for millions of dollars of public works on the upper Mississippi. The Annual Report of the Chief of Engineers proposed new work expending $1,000,000 of the funds allotted in the River and Harbor Act of 1930 which authorized the nine-foot channel to begin in fiscal year 1934. (Annual Report 1932: 1118) Invitation for bids were issued on October 27, 1932, and the bids were opened on November 29. The Edward E. Gillen Company of Milwaukee came in with the low bid at $783,528.17, although bids ranged up to $1,087,618.53. A contract was made with the Gillen Company on December 19 and Notice to Proceed was acknowledged on January 6, 1933. The contract stipulated that the project should be completed 365 calendar days after receipt of Notice to Proceed, so the original day of completion was set at January 6, 1934. (Wood 1937b: 10)

The contractor, however, was quite slow in beginning


24
MICHIGAN
MINNESOTA
WISCONSIN
IOWA
ILLINOIS
VICINITY MAP
WISCONSIN
BUFFALO COUNTY
MINNESOTA
LOCK & DAM NO. 5
PLAN
EARTH DIKE
BUFFALO COUNTY
WISCONSIN
CURRENT
WINONA COUNTY
MINNESOTA
PLAN
ELEVATIONS ARE REFERRED TO M.S.L.
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN
LOCK & DAM NO 5
SCALE AS SHOWN
CORPS OF ENGINEERS
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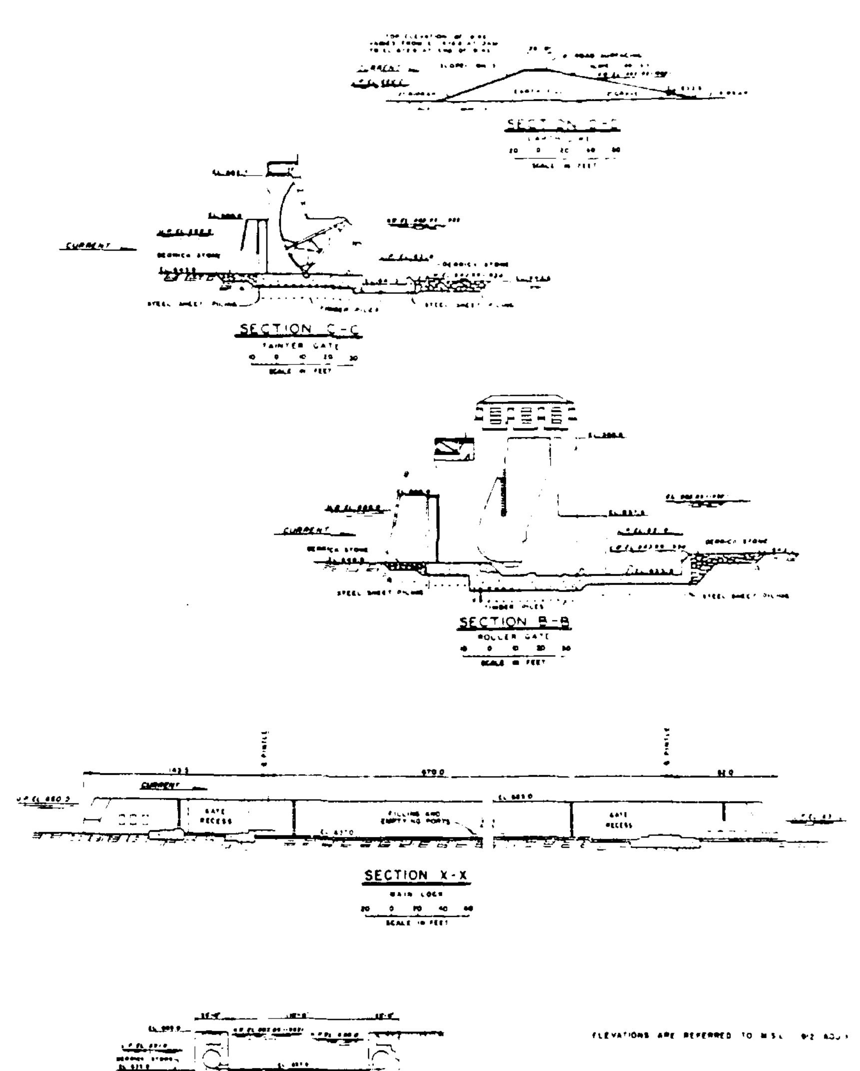



ELEVATIONS ARE REFERRED TO M.S.L. 1912 ADJ.

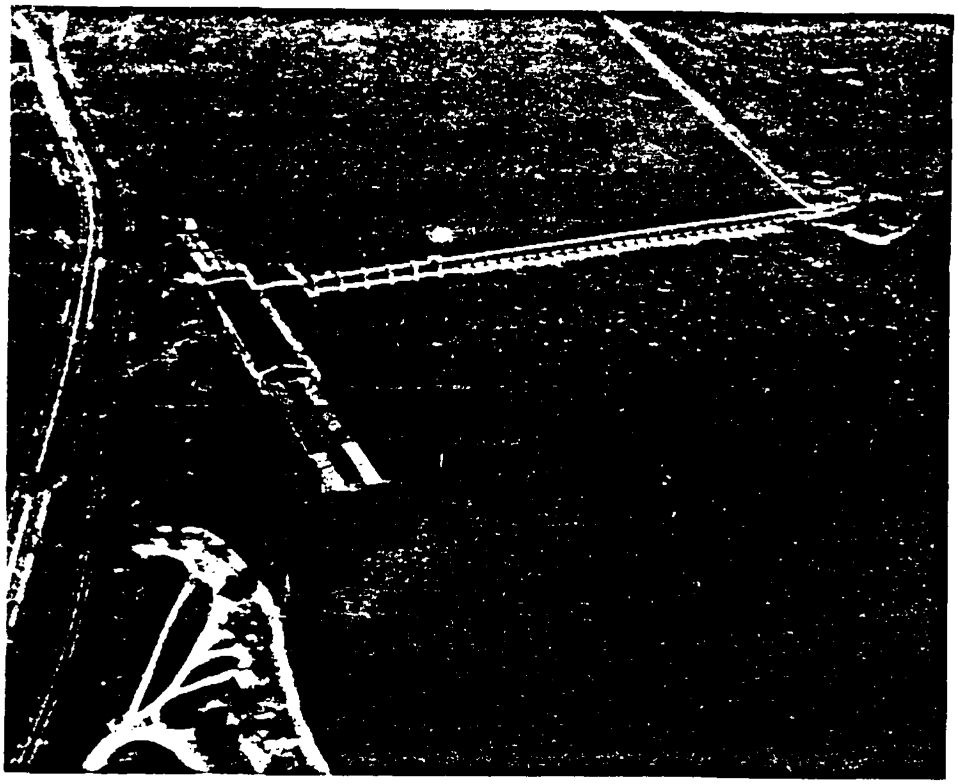
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

LOCK & DAM NO. 5

SCALE AS SHOWN

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.

LOCK AND DAM NO. 5



operations. Nearly three months were lost since the contractor's plant failed to arrive on the job and work did not begin until April 21, 1933. At the end of fiscal year 1933, the project was only 12 percent complete. (Annual Report 1933: 679; Wood 1937b: 10) Problems also were incurred in the unwatering of the cofferdam which resulted in another month's delay. Next, the driving of timber piling began with a total of 166,863 linear feet driven to an average depth of 29.7 feet. All timber piles were driven without the aid of a jet. The 89,845 square feet of steel sheet piling which was then driven was followed by the placing of 57,469 cubic yards of concrete. The lock was placed in operating condition on March 7, 1934, and the last work was completed at a total cost of $900,000 on June 16, 1934, fully 161 days after the original date set for completion. (Annual Report 1934: 788; Wood 1937b: 9, 10; Wood 1937a: 16)

Dam No. 5--Construction History:

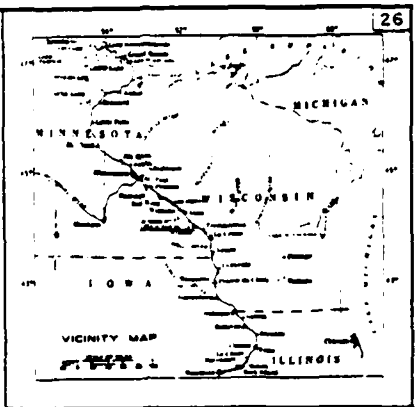
Unlike Lock No. 5, Dam No. 5 was a part of the public works program under the National Industrial Recovery Act approved on June 15, 1933, and the dam was Project No. 3 under the Public Works Administration. (Wood 1937b: 9-10) Of the $33,500,000 allotted from the Act, $1,775,000 was earmarked for the Dam No. 5 project. Invitations for bids for the construction of the dam were issued on September 2, 1933, and bids were opened on September 26. The Merritt-Chapman & Whitney Corporation of Cleveland, Ohio, was the lowest of three bids at $1,791,198.56. (Annual Report 1933: 683; Wood 1937b: 10) The contract was entered into on October 5, 1933, Notice to Proceed was acknowledged on October 18, and date for completion was set at April 21, 1935. Work was started on October 9, 1933, and good weather and normal or below normal river stages favored operations. But in April of 1934, the river rose rapidly so that the cofferdam had to be intentionally flooded. At the end of fiscal year 1934 all preliminary work had been done. Cofferdam Nos. 1, 2 and 3 were built and unwatered, work had begun on the foundation, and the Tainter gates had been completed and erected. Approximately half of the timber piles measuring 161,793 linear feet were driven with the aid of a jet, but in no cases was jetting permitted for the last five feet of penetration. (Annual Report 1934: 789; Wood 1937b: 9, 10, 11) After the nine months of work, the project was about 48 percent complete. (Annual Report 1934: 789) High water again delayed construction for a short time in March of 1935. Moreover, work was delayed when the fabricating plant of a steel sub-contractor failed to construct the roller gates by the designated time. By the end of fiscal year 1935, however, the contact was about 98 percent complete with the only remaining work being half of the construction of six operating houses and painting the roller gate machinery and the deck of the service bridge. In fact, the dam had been placed in operation on May 10, 1935. The dam was completed on December 9, 1935, at a total cost of $2,331,000. (Annual Reports 1935: 899; 1936: 885; Wood 1937a: 16; Wood 1937b: 11)

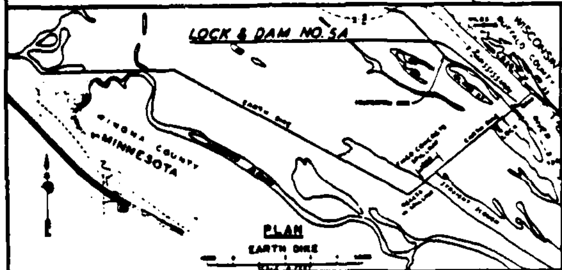
## Other Work:

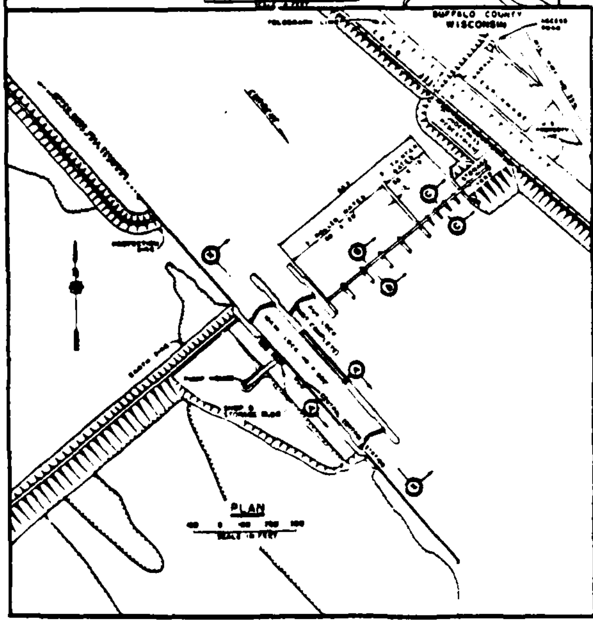
A contract to improve discharge and construct an earth-dike was entered into on October 10, 1933, and by the end of fiscal year 1934, it was 50 percent complete. That contract was completed on April 22, 1935. (Annual Reports 1934: 789; 1935: 899) Other completed contracts included those for the construction of a water-stage recorder house below Alma, Wisconsin, at a cost of $1,971.94, and finished on May 16, 1935; construction and delivery of a Tainter gate hoist completed April 24, 1935; construction and installation of the power, control and lighting system on October 25, 1935; construction and delivery of the locomotive crane; and construction of an access road on the Minnesota side completed on November 22, 1935. (Annual Reports 1935: 898, 899; 1936: 885, 886) Finishing touches included contracts for a storehouse completed on July 17, 1937, an access road on the Wisconsin side on August 25, 1937, and travelling Tainter gate hoist on May 24, 1938. Finally, a contract entered into on August 14, 1937, by the Rock Island District for lockkeepers' dwellings and a garage pumphouse was completed on May 31, 1939. (Annual Reports 1937: 922; 1938: 1052; 1939: 922)

## Lock and Dam No. 5A:

Lock and Dam No. 5A was not part of the tentative plan published in the preliminary report for a nine-foot channel, but it was added by the time House Document 137 was published in 1932. The dam was necessitated by the city of Winona, about three miles below the site. If Dam No. 6 had been built without No. 5A, its pool would have been quite large and flowage damage to Winona would have been prohibitively expensive. Lock and Dam No. 5A, with a lift of 5.5 feet, is situated approximately 728 miles above the mouth of the Ohio River and about 124.5 miles below Minneapolis. (Annual Report 1933: 676; 1939: 1149) The adopted location, in a slough back from the main channel, permitted utilization of the entire main channel for spillway purposes, and also eliminated some curvature above the lock. The lock is not located on the main bank, but on the left edge of Islands 67 and 68, with an average of 600 feet of water between the proposed auxiliary lock and the Wisconsin shore. In time of high water, this distance was increased to about 1,000 feet. The dam, which consists of five roller gates with dimensions of eighty by twenty feet and five Tainter gates thirty-five by fifteen feet, is situated between the lock and the Wisconsin side of the river. The structure also included a thousand-foot overflow concrete spillway across Straight Slough and an earth-dike was an overall length of 5,344 feet connecting a stub dike. ("History of Construction Lock No. 5A" 1935: 1; "History of Construction Dam No. 5A" 1936: 1; House Document 137, 1932: 103; Wood 1938c: 5) Since Lock and Dam No. 6 would improve most of the problem areas above it, Lock and Dam No. 5A was given a relatively low "B" priority and was the fourth structure scheduled for completion. (House Document 137, 1932: 103)




TOTAL LENGTH OF EARTH DIKE - 20533.0 FT
DEPTH ON UPPER GATE SILL 8.0 FT
DEPTH ON LOWER GATE SILL
ELEVATION UPPER GATE SILL 633.0
ELEVATION LOWER GATE SILL 633.0

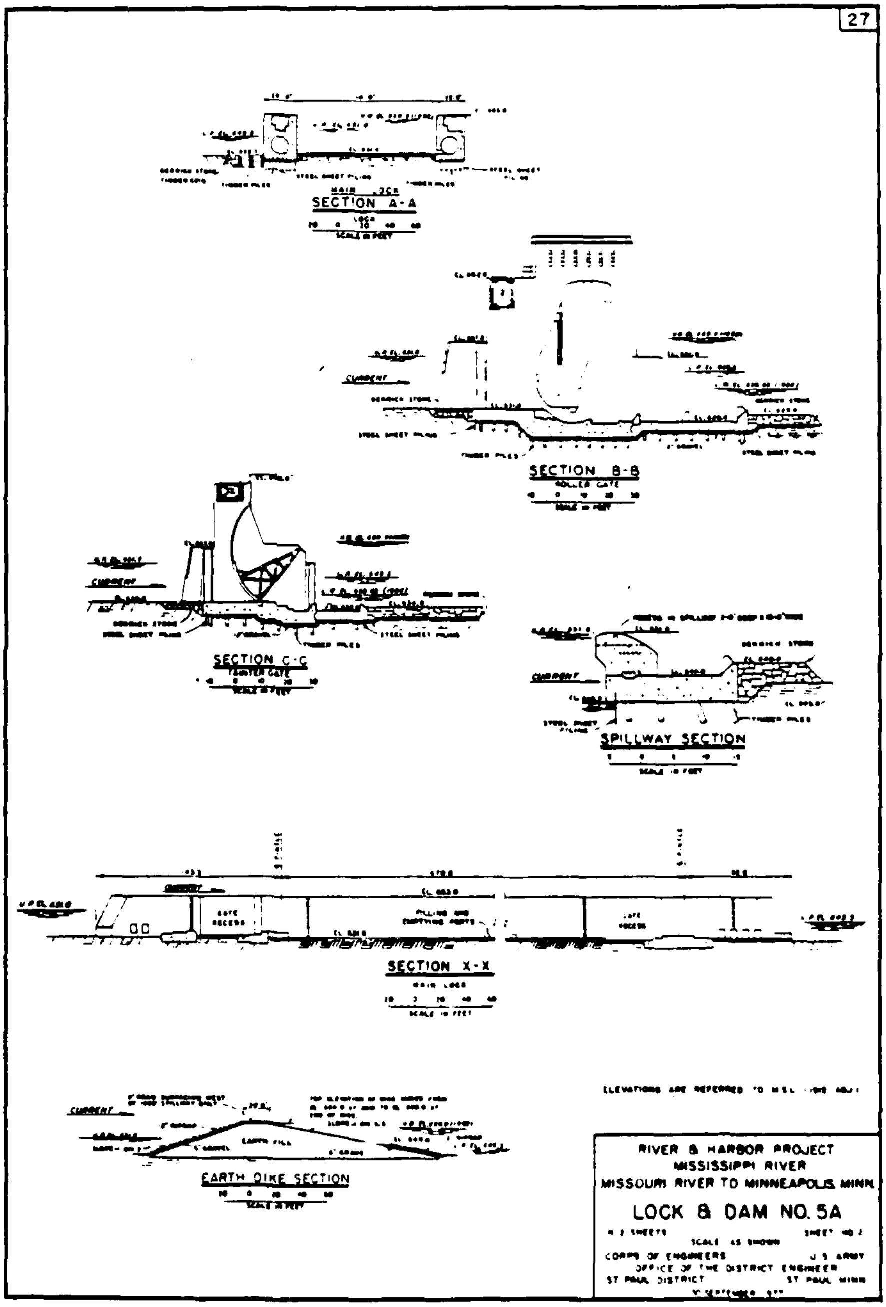
ELEVATIONS ARE REFERRED TO M.S.L. 1912 ADJ.

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN.

LOCK & DAM NO. 5A

SCALE AS SHOWN SHEET NO.

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL MINN.


SECTION A-A
SCALE IN FEET
SECTION B-B
ROLLER GATE
SCALE IN FEET
SECTION C-C
TAINTER GATE
SCALE IN FEET
CURRENT
SPILLWAY SECTION
SCALE IN FEET
SECTION X-X
MAIN LOCK
SCALE IN FEET
EARTH FILL
EARTH DIKE SECTION
SCALE IN FEET
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN.
LOCK & DAM NO. 5A
SCALE AS SHOWN
CORPS OF ENGINEERS
ST PAUL DISTRICT

Lock No. 5A--Construction History:

Bids for the construction of Lock No. 5A were opened on December 8, 1933, and McCarthey Improvement Company of Davenport, Iowa, was low bidder with a price of $1,404,580.02. The contract was dated December 22, 1933, and was approved on January 4, 1934. Notice to Proceed was received by the contractor on January 10, and the original completion date was fixed as January 10, 1935. The bid was lower than the appropriation fixed by the National Industrial Recovery Act in 1933 at $1,420,000. (Annual Reports 1933: 683; 1934: 789; Wood 1936b: 17; "History of Construction Lock No. 5A" 1935: 3)

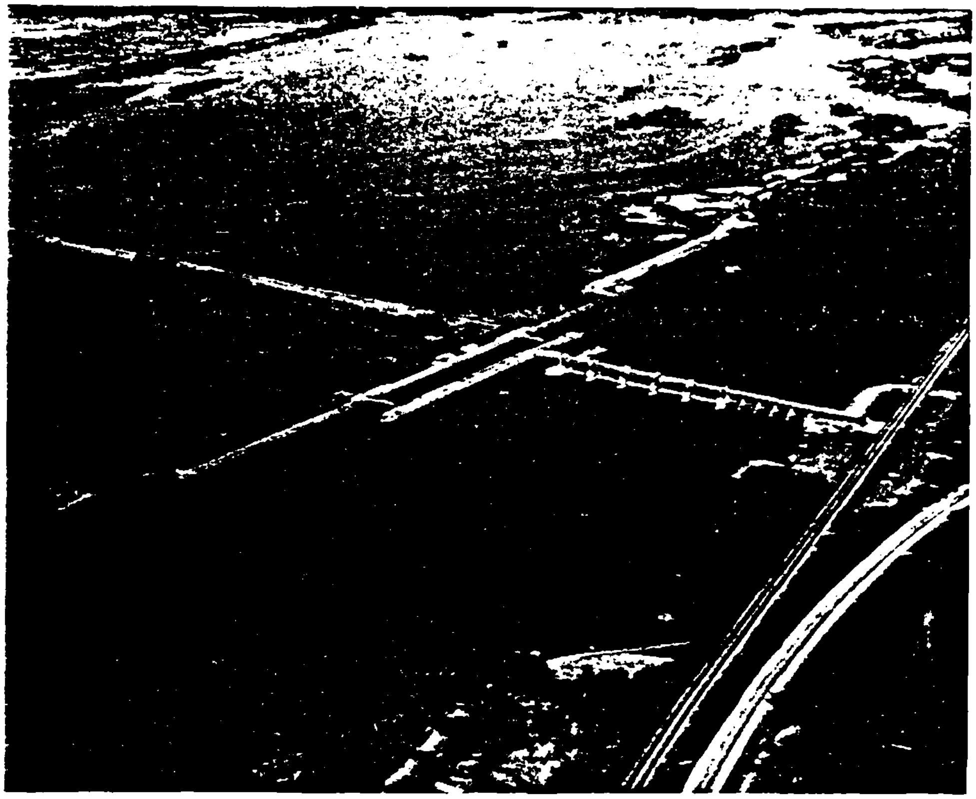
Contract operations began on January 3, 1934, and continued with only six days real delay due to inclement weather. The remote nature of the lock site also presented problems. Workers encountered difficulty in getting to and from work during the winter. Before a construction road was built, the only means of access was using a skiff with an outboard motor or walking across the ice. In fact, a reserve supply of food was always kept on hand at the main office in case it was impossible to get home at night. (Pugh 1935: 8-9; Wood 1936b: 17) The contractor appeared on the site December 22, 1933, and work started on January 3, 1934. Preliminary work, which included the construction of a railroad spur and a construction road, began on January 6, 1934, and finished on March 10. In the meantime, construction of the cofferdam began on February 19 and was completed on April 9; the project was delayed ten days in the driving of the steel while waiting for the dredge to complete its work inside the cofferdam. Unwatering, which began on April 13, was completed three days later. The driving of the permanent steel piling was started on April 28 and was completed on October 27, while the driving of wood piles started on May 3 and was completed on September 1. A total of 258,755 linear feet of timber piling was driven while the permanent steel sheet piling was driven a total of 93,910 square feet. ("History of Construction Lock No. 5A" 1935: 6; Wood 1936b: 18) At the end of fiscal year 1934, all preliminary work had been done and the contract was about 44 percent complete. (Annual Report 1934: 789)

Concrete work, which included the placing of 65,333 cubic yards of concrete, began on May 17, and was completed on November 9, 1934. The control house was started on September 18, 1934, and completed on February 15, 1935. In the meantime, work began on the removal of the cofferdam on October 25, 1934, which was completed on January 11, 1935, during which time there were no delays. Cleanup was finished on February 15, 1935, and on that day, the contract was considered complete after a total of 409 calendar days and an expenditure of $1,600,000. (Annual Report 1935: 899; Wood 1937a: 16; "History of Construction Lock No. 5A" 1935: 6-7; Wood 1936b: 18)

Dam No. 5A--Construction History:

Among the Public Works funds allotted for the fiscal year 1934 were $1,750,000 for the construction of Dam No. 5A. Invitations for bids for the construction of the dam were

LOCK AND DAM NO. 5A



issued on November 20, 1934, and bids were opened on December 20, 1934. The United Construction Company of Winona was the successful bidder at $1,563,954.05. Notice to Proceed was acknowledged on March 12, 1935, and the original completion date was fixed as September 12, 1936. (Annual Report 1934: 797; Wood 1937a: 16; Wood 1936b: 18)

United Construction Company appeared on the job on January 22, 1935, and started work on February 4, 1935. Work was completed in 564 days in spite of delays caused by high water in April, July and August of 1935 and cold weather from January 22 to February 24, 1936. Construction began on a cofferdam for the Tainter gate section on February 20, 1935, and was completed on April 10, when the coffer had been unwatered. The driving of round timber piling in the first cofferdam began on April 16 and was completed on May 25, after 1,356 piles had been driven. Steel sheet piling was carried on over a similar time period beginning on April 12 and completed July 8. Concrete work on the cofferdam area began on May 10 and was completed on September 5, 1935. (Wood 1936b: 18; "History of Construction Dam No. 5A" 1936: 15, 16)

The second cofferdam saw construction begin on July 3, 1935, and completion on August 15. By the end of fiscal year 1935, the project was 30 percent finished. Work continued with the driving of round timber piling on August 19, 1935, and completed on October 1, 1935. Steel sheet piling driving began on August 16, 1935, and was finished on October 27, 1935. Finally, concrete work began on September 12, 1935, and was completed by May 26, 1936. A total of 152,300 linear feet of timber piling was driven in the project, 91,000 square feet of permanent steel sheet piling, and a total of 36,500 cubic yards of concrete placed. On August 20, 1936, all work on the dam was finished and on August 31, 1936, the project was accepted by the government as complete. The contract had been altered by twenty-two change orders and modifications which allowed a total time extension of eighty-nine days. The dam was placed in operation on July 6, 1936, and by November 3, the upper pool had reached an elevation of 647.95. (Annual Report 1937: 924; "History of Construction of Dam No. 5A" 1936: 15, 16; Wood 1936b: 18, 19; Wood 1937a: 16)

Other Work:

Other contracts on the project included the earth dike covering 4.05 miles which was let to the Minneapolis Dredging Company on October 16, 1934, and completed on May 19, 1936. A contract for the construction and installation of the power, control and lighting system was entered into on June 10, 1935, and completed on September 3, 1936. Finally, contracts were entered into on August 14, 1937, by the Rock Island district for lockkeepers' dwellings and a garage pumphouse and was completed on August 22, 1938. (Annual Reports 1935: 899; 1936: 885; 1937: 924; 1938: 1053; 1939: 1153; Pugh 1935: 9)

Lock and Dam No. 6:

The site of Lock and Dam No. 6 is approximately .3 miles below the business district of the village of Trempealeau, Wisconsin, about 137.8 miles below Minneapolis, and about 714 miles above the mouth of the Ohio River. The lock was located adjacent to the left bank of the river, the lock face of the land wall being approximately 100 feet from the bank at normal stages of the river. The dam was designed to extend from the Chicago, Burlington and Quincy Railroad on the left bank to the Chicago, Milwaukee, St. Paul and Pacific Railroad on the right bank. The river was one-quarter of a mile wide, but during ordinary high stages the width increased to approximately 2,000 feet. The valley was approximately one mile wide and at flood stages, the river occupied most of that expanse. The floodplain was borderd on both sides by ranges of steep sandstone bluffs. During construction, the main line of the Chicago, Milwaukee, St. Paul and Pacific Railroad and U.S. Highway 61 occupied the valley location along the foot of the hills on the right bank, while the Chicago, Burlington and Quincy Railroad was similarly located on the left bank. ("History of the Construction of Lock No. 6" 1935: 1; "History of the Construction of Dam No. 6" 1936: 1; Wood 1936a: 19)

The structure at site No. 6 follows patterns set in the nine-foot project. The lock measured 110 by 600 feet, similar to all locks below site No. 1 and had similar functioning machinery in addition to a planned auxiliary lock. The dam, as was usually the case, was composed of three distinct types of construction: an earth-fill embankment, a movable gate section of concrete and steel, and a concrete spillway section. The earth-fill portion extended both between the Chicago, Burlington and Quincy Railroad and the land wall of the lock and between the normal right bank of the river and the Chicago, Milwaukee, St. Paul and Pacific Railroad. The latter portion of the earth-dike was divided by the concrete spillway which stretched about 1,000 feet long midway in the dike. The earthfill which was composed largely of river sand totalled about 3,700 feet in length, while the concrete spillway section was of the fixed type. The movable gate section, with a normal head of 6.5 feet, extended from the river wall of the lock across the river channel proper to the normal right bank, a total distance of 904 feet. This section was composed of five steel roller gates eighty feet in length and fifteen feet in diameter and ten steel Tainter gates thirty-five by fifteen feet, all supported between sixteen reinforced concrete piers and closing upon steel seal-beams embedded in concrete sills with concrete aprons extending downstream. Since the valley and main channel was narrow at the site and because a lock and auxiliary lock occupied so much of the main channel, the movalbe section consisted of half as many roller gates as possible and to care for running ice. (House Document 137, 1932: 104; "History of the Construction of Lock No. 6" 1935: 2; "History of the Construction of Dam No. 6" 1936: 1) The six-foot channel between site Nos. 5A and 6 was better than average, so Lock and Dam No. 6 was given a priority superior to 5A, but still in Group B. (House Document 137, 1932: 104)

Lock No. 6--Construction History:

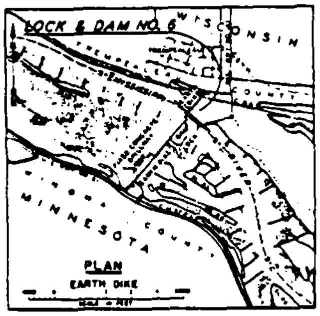
Construction of Lock No. 6 was included as part of the funds allotted from the National Industrial Recovery Act of 1933. Accordingly, invitations for bids for the construction of the lock were issued on October 11, 1933, and opened on November 2, 1933. Spencer, White and Prentis, Inc., of New York City, was the successful bidder with a bid price of $1,272,271, slightly below the $1,420,000 appropriated. The contract was entered into on November 13, and was approved by the Chief of Engineers on December 22, 1933. Notice to Proceed was received by the contractor on December 22 and one year from that date was fixed as the completion date. (Annual Report 1933: 683; "History of the Construction of Lock No. 6" 1935: 3; Wood 1936a: 19)

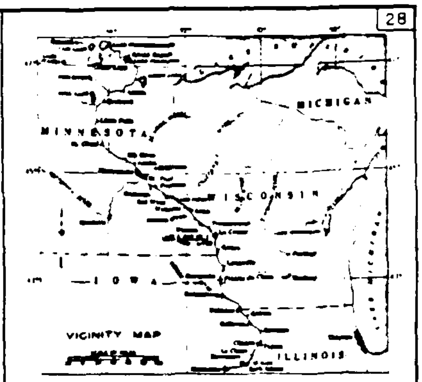
Construction of the cofferdam, which was of the sand-filled box type, commenced on December 16, 1933. Due to favorable conditions, the cofferdam was completed on March 3, 1934. Unwatering was accomplished with a system of three twelve-inch electric centrifugal pumps each set up in an individual pumphouse. Initial unwatering began on March 5, 1934, with a single pump. By March 7, a second pump was started and on March 15, the third pump began use and the unwatering was completed on that day. the permanent steel sheet piling began on March 24, 1934, on the upper end of the wall progressing downstream. After 92,559 square feet had been driven, the task was complete on June 29. Round timber piling, which consisted of elm, maple and oak from the vicinity of the site, was first driven on April 5, 1934, within the cofferdam on the land wall. Driving throughout the locks was not very difficult with the exception of the intermediate wall, under which a stratum of coarse gravel was encountered about 100 feet south of the upper miter sill and extending 150 feet downstream. Driving was accomplished with two new skid type timber pile drivers built on the job by the contractor and was completed on August 21, 1934, after 228,311 linear feet had been driven. ("History of the Construction of Lock No. 6" 1935: 3, 9, 13, 15, 16, 17; Wood 1936e: 20)

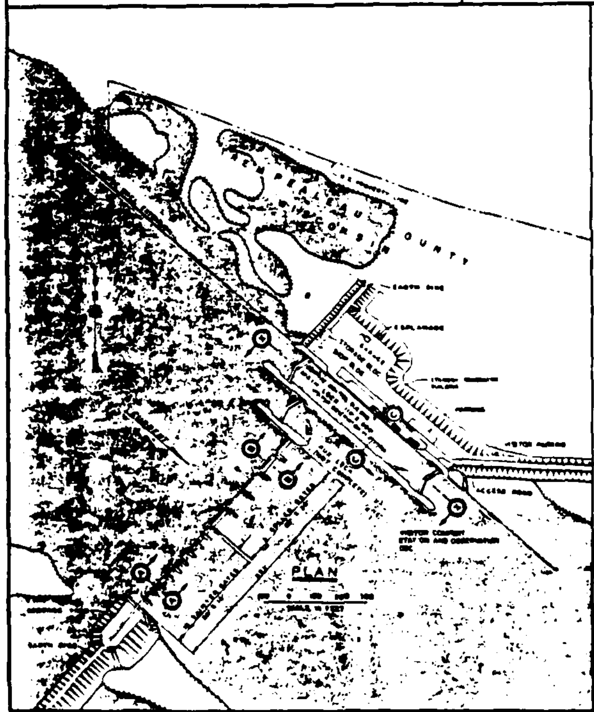
Concrete placement began on May 15, 1934, near the land wall. It continued for 139 days without delay and consumed 64,430 cubic yards of concrete. Concrete work not only involved the lock itself but work on the central control station which was poured beginning on September 27. The concrete placement wsa completed on November 13, and before it was finished, installation of the gates had begun on August 24, and completed on November 8. In the meantime, the flooding of the cofferdam and the subsequent removal was begun on October 11, 1934. By February 3, 1935, the lock was considered complete. ("History of the Construction of Lock No. 6" 1935: 3, 17, 23, 25, 28, 33; Wood 1936e: 19)

Dam No. 6--Construction History:

Dam No. 6 was included in works to be completed in fiscal year 1935 and invitations for bids for its construction were issued on September 1, 1934. The bids were opened on




TOTAL LENGTH OF EARTH DIKE
DEPTH ON UPPER GATE SILL
DEPTH ON LOWER GATE SILL
ELEVATION UPPER GATE SILL
ELEVATION LOWER GATE SILL

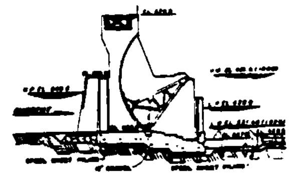
ELEVATIONS ARE REFERRED TO M.S.L.

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN.

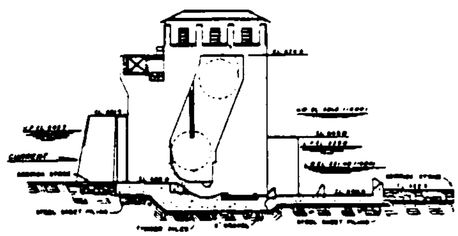
LOCK & DAM NO. 6

SCALE AS SHOWN SHEET NO.

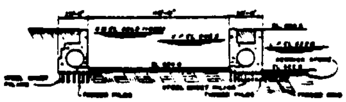
CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL MINN.



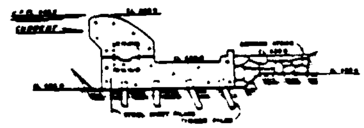
SECTION A-A
TAINTER GATE
SCALE IN FEET



SECTION B-B
ROLLER GATE
SCALE IN FEET

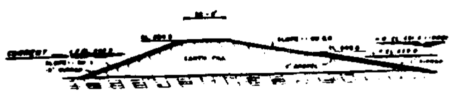


SECTION C-C
SCALE IN FEET



SPILLWAY SECTION
SCALE IN FEET

SECTION X-X
MAIN LOCK
SCALE IN FEET



EARTH DIKE SECTION
SCALE IN FEET

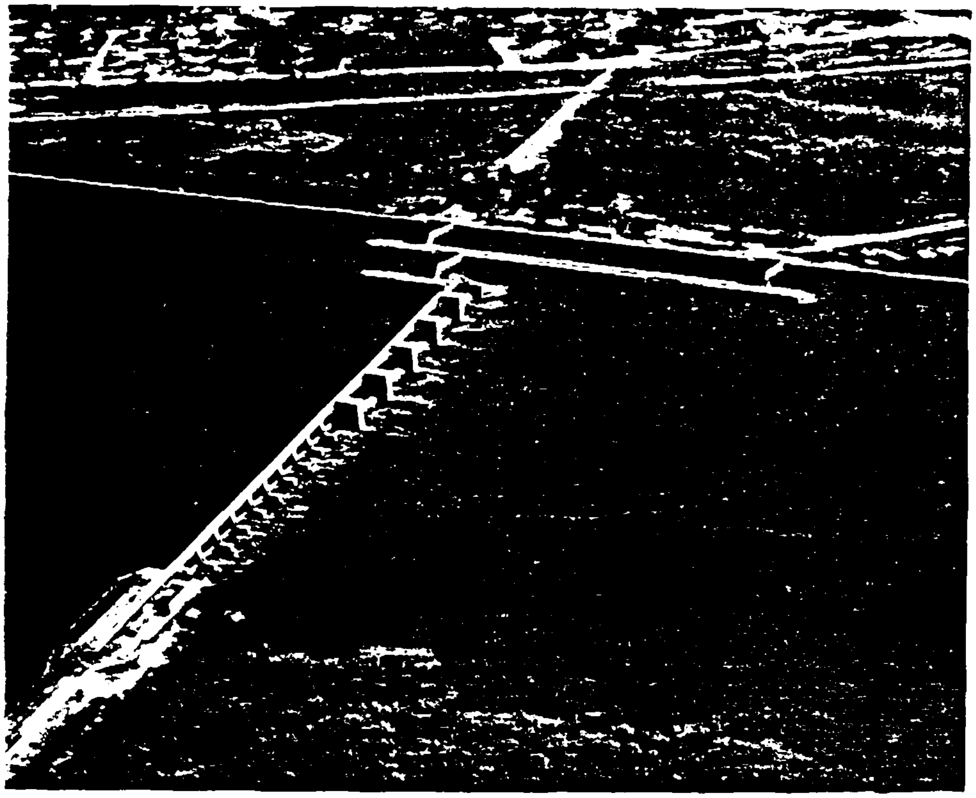
ELEVATIONS ARE REFERRED TO M.S.L.

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

LOCK & DAM NO. 6

SCALE AS SHOWN
CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.

LOCK AND DAM NO. 6



October 2, and Spencer, White and Prentis, Inc., constructor of the lock, was low bidder at $1,668,442.36. Notice to Proceed was acknowledged on November 16 and the original completion date was set as May 19, 1936. Operation commenced on October 15, 1934, the first work consisting of clearing the site for the earth dike. Since Spencer, White and Prentis also built the lock, the same plant used on the lock construction was employed at the dam. ("History of Construction of Dam No. 6" 1936: 8; Wood 1936e: 20; Annual Report 1934: 798)

Construction of cofferdam No. 1, which enclosed seven acres, commenced on November 7, 1934, and was completed on December 24. Its unwatering was accomplished using two twelve-inch electric centrifugal pumps between January 10 and 25, 1935. The second cofferdam, which enclosed about three and three-fourths acres was completed between July 3 and August 22, 1935. Unwatering for this cofferdam began on August 14, 1935, and was finished two weeks later. Steel sheet piling driving began February 8, 1935, and was conducted until October 29 after 103,138 square feet had been driven. The round timber foundation piles for Dam No. 6 were of an assorted variety including elm, maple, hickory, ash, oak, yellow birch and pine. they were driven with two skid-type, standing leads, pile driver rigs equipped with Vulcan No. 1 steam hammers. Driving began on February 5 and, after a few delays due to cofferdam leakage, was completed on October 8, 1935. ("History of Construction of Dam No. 6" 1936: 8, 13, 17, 19, 32, 33, 34; Wood 1936e: 20; White 1935: 6-8)

Concrete placement began on April 12, 1935, with the footing for pier 15 inside the fist cofferdam. It was continued for 157 work days during which 37,580 cubic yards were placed. By the end of fiscal year 1935, all the preliminary work had been done, cofferdam No. 1 had been cosntructed and unwatered, all pile driving complete in the cofferdam, all concrete pours in Tainter gate section made, eight of ten Tainter gtes substantially erected, and eight spans of service bridge partially completed. The contract on the whole was 38 percent finished. After the movable parts had been set in place, the cofferdams were removed. Although the dam was placed in operation on June 30, 1936, additional work continued in cofferdam removal and the contract was completed on August 20, 1936. (Wood 1936a: 20; Annual Report 1936: 885; "History of Construction of Dam No. 6" 1936: 9, 35, 40, 72, 75)

Other Work:

A group of contracts augmented the central structures of the lock and dam. A contract for the construction of an earth-dike north of the Chicago, Burlington and Quincy Railroad was entered into on May 17, 1935, and completed on June 18. The contract for an access road entered into on May 22, 1935, was completed on May 25, 1936. The contract for the construction and installation of the power, control and lighting system was entered into on May 31, 1935, and completed on October 19, 1936. Finally, a contraction entered into August 14, 1937, by the Rock Island district for the lockkeepers' dwellings and a

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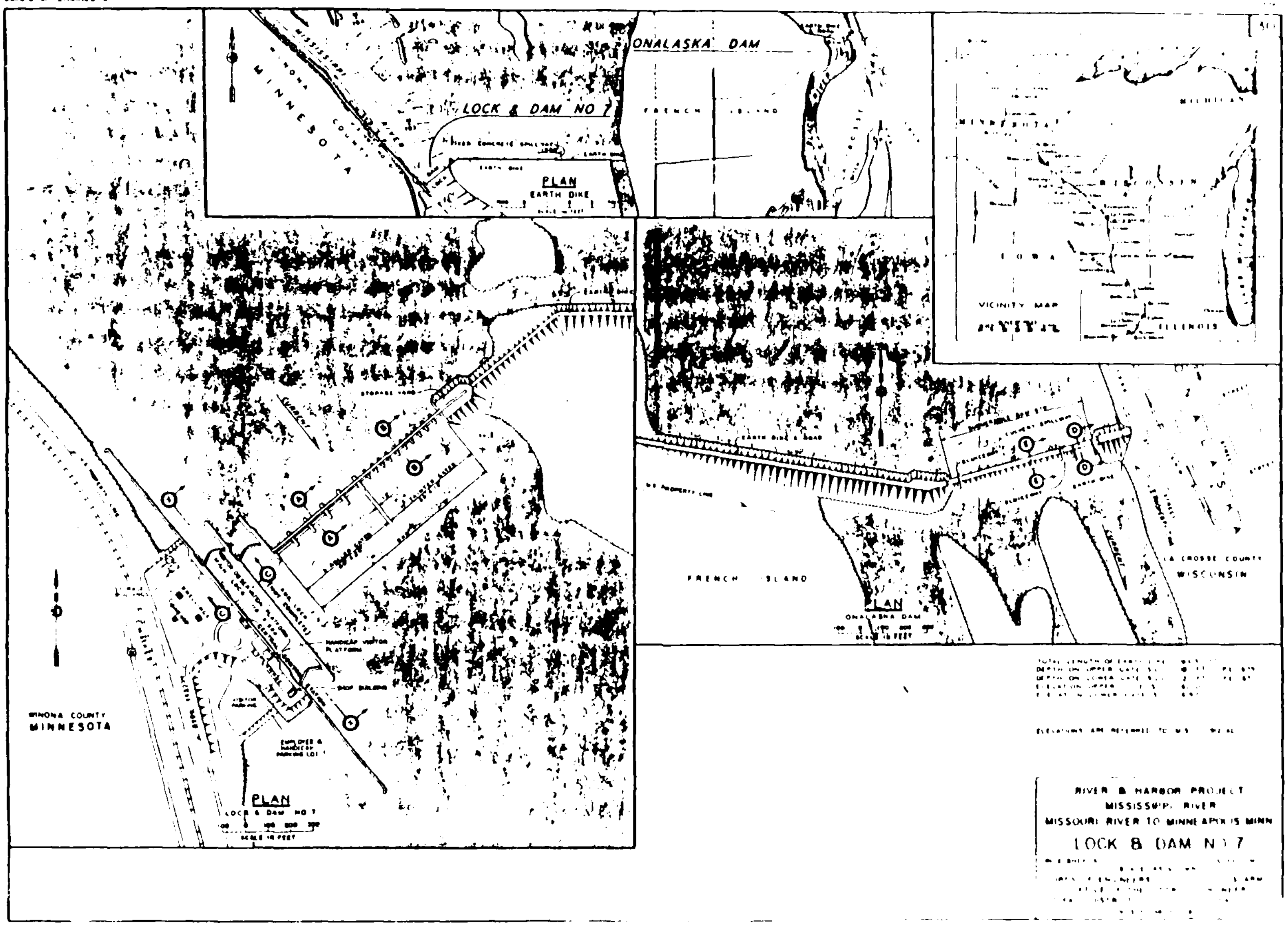



RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS MINN
LOCK & DAM NO 7

garage pumphouse was completed on August 22, 1938. (Annual Reports 1935: 900; 1936: 885; 1937: 924; 1938: 1053; 1939: 1153)

Lock and Dam No. 7:

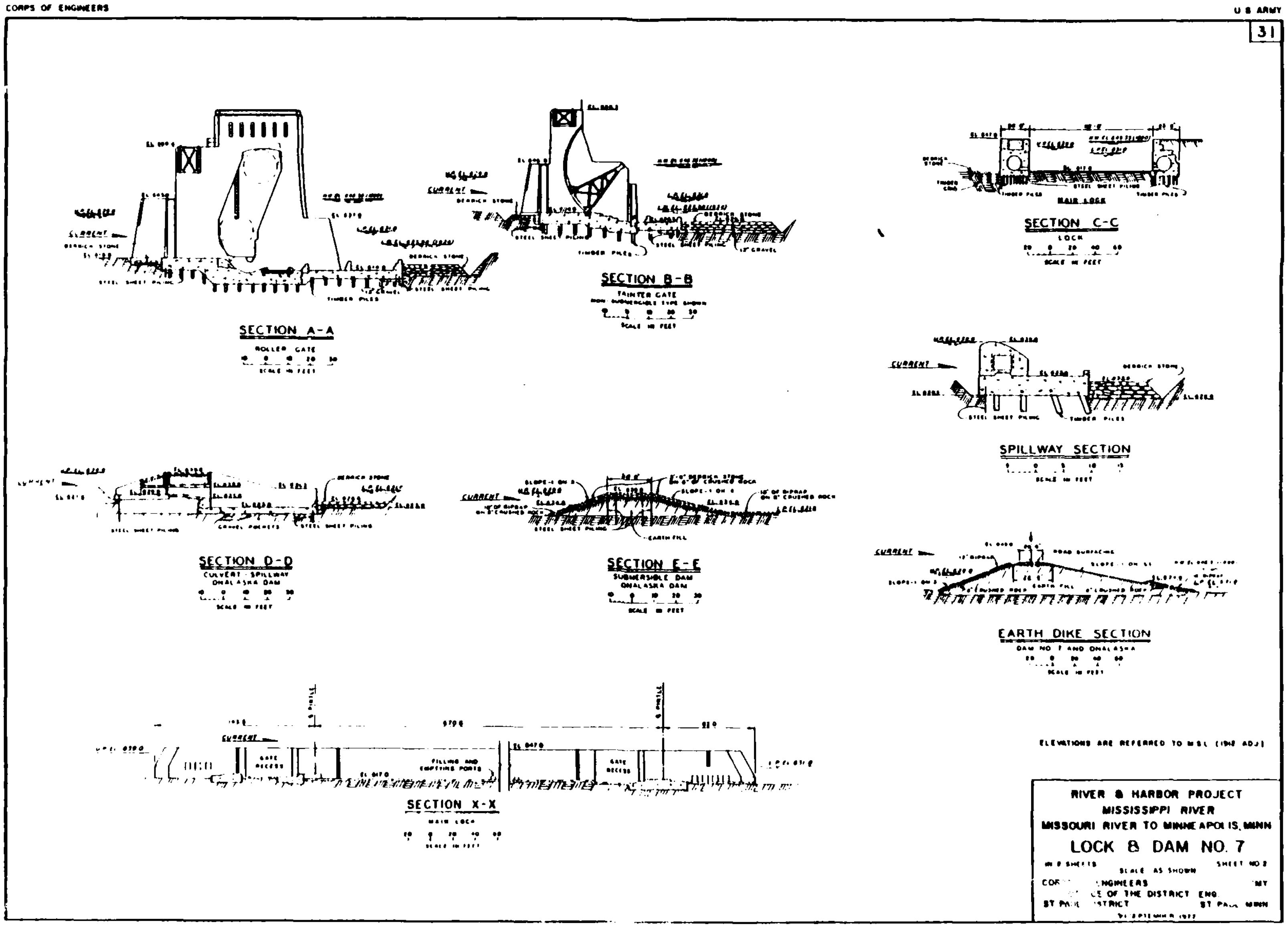
Lock and Dam No. 7 is situated about 150.5 river miles below Minneapolis and about 137 miles by highway from St. Paul. The lock is on the Minnesota side of the river. The river channel at this point, which is about 4.7 miles above LaCrosse, Wisconsin, at normal river stage is about 1,000 feet wide although high water has increased it to about a 4,000 feet width. A strip of high ground, called French Island, lies inland about 3,000 feet from 4he channel on the Wisconsin side. Between this and the bluffs, the Black River flows in a southerly direction. The town of Onalaska, Wisconsin, is situated on the Black River due east from the lock and dam site. (Wood 1937c: 16)

A lock and dam structure was needed in the vicinity of LaCrosse according to initial research on the nine-foot project. But because of the great damage that would occur to the city of LaCrosse, no site in or below the town was feasible. Moreover, since the city and other conditions limited the pool elevation of Lock and Dam No. 8 below, it was necessary to construct Dam No. 7 as close to LaCrosse as possible. The channel immediately upstream from LaCrosse is crooked and did not offer suitable lock sites. The eventual site of Lock and Dam No. 7, however, at the foot of Dresbach Slough which was reopened to provide the upper approach, was the best possible place. (House Document 137, 1932: 104) Since dredging provided a six-foot channel above the Lock and Dam No. 7 site, when the lock and dam project was being investigated, construction was given a relatively low priority. Lock and Dam No. 7 was put in the B group and it was the fifth lock and dam completed in the nine-foot channel project out of the nine in the St. Paul district. (House Document 137, 1932: 105)

The design of Lock and Dam No. 7 was heavily influenced by the presence of French Islnd which was used as a natural dike. An earth dike 9,003 feet wide was constructed which stretched from one end of French Island near the lock and dam across to the Wisconsin side where a fixed submersible dam 670 feet wide was built adjacent to Onalaska, Wisconsin. This dam contained sluiceways for overflow. On the Minnesota side between Winona County, Minnesota, and French Island, the main lock and dam structure was constructed. The lock consisted of the standardized main lock with dimensions 110 feet by 600 feet with an uncompleted auxiliary lock. The dam utilized five roller gates which measured eighty feet wide and twenty feet high and eleven Tainter gates, thirty-five feet by fifteen feet. (House Document 137, 1932: 105; Wood 1938c: 5) The lift of the lock was set at eight feet. (Annual Report 1935: 895)

Lock No. 7--Construction History:

Funds allotted from the National Industrial Recovery Act for fiscal year 1934 included a contract to construct Lock No. 7 for up to $1,420,000. (Annual Report 1933: 683) The work to


CORPS OF ENGINEERS
U S ARMY
31
SECTION A-A
ROLLER GATE
SCALE IN FEET
SECTION B-B
TAINTER GATE
SCALE IN FEET
SECTION C-C
LOCK
MAIN LOCK
SCALE IN FEET
SPILLWAY SECTION
SCALE IN FEET
SECTION D-D
CULVERT SPILLWAY
ONALASKA DAM
SCALE IN FEET
SECTION E-E
SUBMERSIBLE DAM
ONALASKA DAM
SCALE IN FEET
EARTH DIKE SECTION
DAM NO. 7 AND ONALASKA
SCALE IN FEET
SECTION X-X
MAIN LOCK
SCALE IN FEET
CURRENT
STEEL SHEET PILING
TIMBER PILES
DERRICK STONE
EARTH FILL
GATE RECESS
FILLING AND EMPTYING PORTS
ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ.)
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN
LOCK & DAM NO. 7
SCALE AS SHOWN
OFFICE OF THE DISTRICT ENG.
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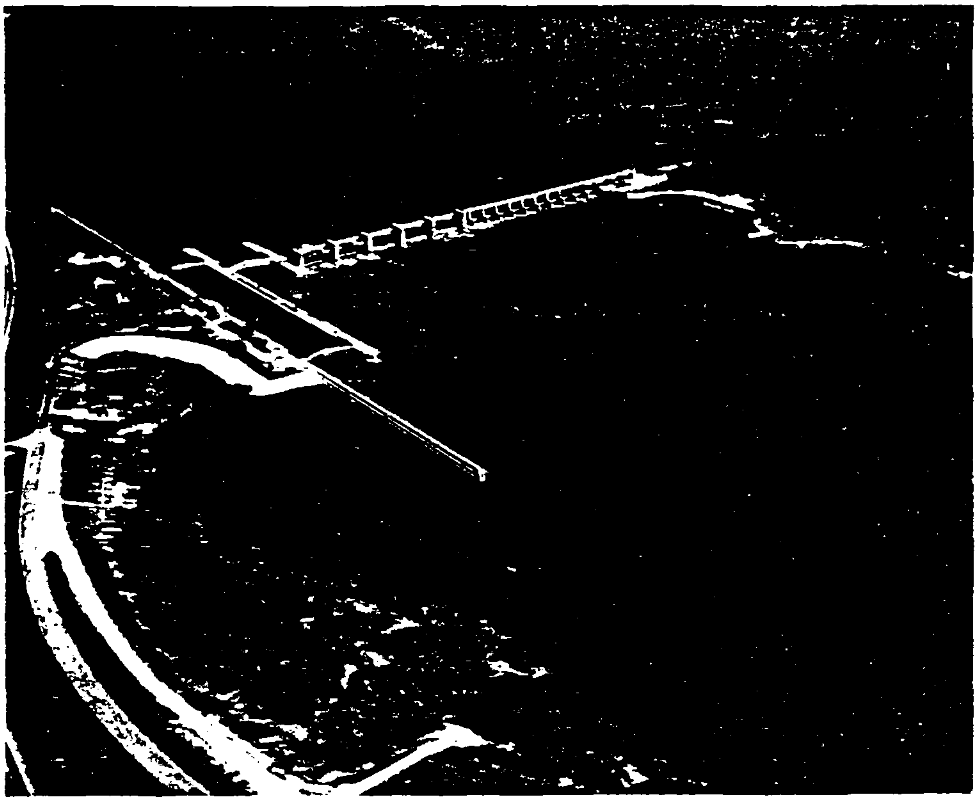
LOCK AND DAM NO. 7



be done, according to the advertisement for bids, consisted of supplying all labor, plant and materials and constructing the main lock of standardized dimensions with guide walls, miter gates and valves, the upper gate bay, upper miter gates and poiree dam foundation of an auxiliary lock of possible future dimensions of 110 feet by 360 feet, central control station and all necessary operating machinery. Bids, which were advertised on October 12, 1933, were opened on November 3 and Nolan Brothers of Minneapolis offered the low bid at $1,319,989. The contract was signed on November 16, approved by the Chief of Engineers on February 6, 1934, and the government Notice to Proceed was issued on February 7, with completion date established as February 6, 1935. (Wood 1937c: 16)

Before the contactor could begin, U.S. Dredges Cahaba and Pelee dredged a temporary channel outside the area that would be occupied by the cofferdam in order to permit river traffic to continue during construction. Nolan Brothers began moving equipment and building roads on November 22, 1933. The cofferdam, which comprised a 932 linear foot enclosure, was begun on December 15, 1933, and completed on April 30, 1934. It was of the semi-cellular type designed by the Inland Steel Company of Chicago consisting of sixty-six complete cells and an upper and lower approach wall consisting of a single row of steel sheet piling. Initial unwatering of the cofferdam began on April 29 with two, twenty-inch pumps used with a capacity of 10,000 gallons per minute. These pumps were soon supplemented by six others ranging in size from ten to twelve inches and unwatering was completed on May 31, 1934. By the end of fiscal year 1934, all preliminary work on the lock had been completed. The contract was considered about 22 percent complete at a cost of $357,767.73. (Annual Report 1934: 789; Wood 1937c: 17)

All timber piles were obtained were the surrounding country within a radius of ninety miles from the site. Piles were mainly oak, hard maple, elm and hickory and were delivered to the site by truck. Driving was accomplished with a Vulcan No. 2 steam hammer and was a comparatively easy task except in areas around the upper guide wall where boulders and rocks were encountered. (Wood 1937c: 17) Timber piling, which took 220 days lasting from April 20, 1934, to November 26, 1934, was followed by concrete work. The concrete plan for Lock No. 7 was electrically operated with two bins for an aggregate of 70 cubic yards capacity and two one-yard mixers. Work began on June 11, 1934, and after 64,070 cubic yards of concrete had been formed, the task was completed on March 11, 1935. Between October 12, 1934, and April 1, 1935, the cofferdam was removed and the lock was placed in safe operating condition on the latter date. Other work was finished by April 18, and the lock was completed at a total cost of $1,516,762. (Annual Report 1935: 900; Wood 1937c: 17, 18; Wood 1937a: 16)

Dam No. 7--Construction History:

Construction of Dam No. 7 did not proceed as smoothly as that of its corresponding lock. Although the completion date was originally established as December 30, 1936, time extensions were granted due to change orders and modifications setting the completion date back to April 10, 1937. funds from federal Emergency Relief funds were earmarked for Dam No. 7 in fiscal year 1936, totally $2,480,000 for work between August 1935 and December 1936, the original completion date. (Annual Report 1935: 911) The work involved in the construction of the dam consisted of furnishing all plant, labor and material and constructing the movable gate section of the dam, a 1,000 foot reinforced concrete spillway, the storage yard, dredging of certain areas above and below the date, and placing portions of an earth-fill dike. Invitations for bids were issued on July 9, 1935, and they were opened on August 8, 1935. Warner Construction Company of Chicago was awarded the bid at $1,945,591.07. The contract was dated August 20, 1934, approved by the Chief of Engineers on September 4, 1935, and Notice to Proceed was acknowledged three days later. (Wood 1937c: 18; Wood 1937a: 16)

Work began on September 4 and by September 11 construction of the cofferdam, that would enclose the Tainter gate section, was started. The two cofferdams, totalling a 1,004 linear foot enclosure, were of the cellular type of steel sheet piling with sand fill. Initial dewatering of the Tainter gate section cofferdam (No. 1) began on November 15 and with four pumps operating, it was completed ten days later. Cofferdam No. 2, enclosing the roller gate section, was constructed much later beginning on April 19, 1936, and completed on June 6. (Wood 1937c: 19; Wood 1937a: 16)

The round timber piling used in the dam consisted of trees native to the locality. The driving of the 159,092 linear feet of timber piling was accomplished using a Vulcan No. 2 and Super Vulcan hammers and penetration of the piles averaged about thirty feel below cut-off elevation. Over 40,000 cubic feet of concrete was used in the operation between December 6, 1935, and November 13, 1936. It was mixed in an electrically-operated plan that had two units of two cubic yards capacity each. The concrete was conveyed from the mixer in buckets on dinkey flat cars oropelled by dinkey locomotives. (Wood 1937c: 19)

Although the contract was about one-quarter complete on January 1, 1936, weather problems delayed progress in early 1936. Work was interrupted due to unseasonably cold weather between January 18, 1936, and February 22, 1936, when temperatures were rarely above -20° F. Moreover, on March 22, ice on the river broke up and swept away part of the construction trestle. Reconstruction of the trestle began on March 24 and was nearly completed in a week. Floodwaters on March 27 reached an elevation of .02 feet about pay height of cofferdam No. 1 but no damage resulted. (Wood 1937a: 16; Wood 1937c: 20)

Initial dewatering of the second cofferdam, which enclosed the roller gate section, began on June 8, 1936, and was completed in eleven days. Work begar in the cofferdam No. 2 on June 10, but concrete activity reached its peak during August and September 1936, during which time the maximum quantity of concrete used in any one day was attained on August

1, with 987 cubic yards. The second cofferdam was removed by November 30, 1936, and by January 30, 1937, all work on the dam, with the exception of installing the locomotive crane on the service bridge, was complete. Assembly and installation of the crane was completed on April 7 and the dam was placed in operation on April 15, 1937. (Annual Report 1937: 923; Wood 1937c: 19, 20)

Other Work:

Since the plan of Lock and Dam No. 7 called for a wide earth dike, separate contracts were made with other companies to complete these sections. The Minneapolis Dredging Company received the contract to construct the earth-dam it completed on October 13, 1936. Bilhorn, Bower and Peters received the contract to construct the Onalaska Dam, a submersible dam on the Wisconsin side on December 4, 1935. Work commenced on January 2, 1936, by the end of fiscal year 1936, all preliminary work had been done, the cofferdam had been constructed and unwatered, and work on pile driving and excavation was well underway. The contract was completed on December 15, 1936. (Annual Report 1936: 886; Wood 1937a: 16, 17) Other structures related to the lock and dam were also constructed in the area. Construction of stage recorder houses was completed on November 27, 1936, at a cost of $3,612.05. The temporary access road was completed on May 5, 1938. And the lockkeepers' dwelling and garage pumphouses were completed in February 1940. (Annual Reports 1937: 923; 1938: 1053; 1939: 1153, 1162) Total estimate cost of Lock and Dam No. 7 was set at $5,805,000 in 1939. (Annual Report 1939: 1149)

## Lock and Dam No. 8

The site of Lock and Dam No. 8 is near Genoa, Wisconsin, about 174 miles below Minneapolis and about 679 miles about the mouth of the Ohio river. During construction of the lock , which is on the Wisconsin side of the river, it was accessible by car on Wisconsin Highways 35 and 56, and by rail over the main lines of the Chicago, Burlington and Quincy Railroad. the river at the site was about 1,200 feet wide at normal stages, but floods spread over the low land lying along the Minnesota shore and could reach a width of more than 12,000 feet. The Wisconsin side was bordered by precipitous sandstone bluffs on which scrub oak and pines grew in many places. (Wood 1937d: 16)

The site of Lock and Dam No. 8 was not dictated by unusual river features so much as simply the need for a suitable lock location in that stretch of the river. A good six-foot channel was available if dredging continued so the site was given a relatively low priority in the nine-foot channel project. But in Group B, Lock and Dam No. 8 was the sixth project scheduled for completion. Like most projects on the upper Mississippi, the lock was designed with the standard 110 by 600 foot lock and a combination of roller and Tainter gates. With ten standard-sized Tainter gates measuring 35 feet wide and 15 feet high, and five roller gates also with the standard size of 80 feet wide by 20 feet high, the dam spanned the 934.5 feet of the river at that point. (House Document 137, 1932: 105-106; Wood 1938c: 5) The lift on this project was a relatively large eleven feet. (Wood 1938c: 5)

Lock No. 8--Construction History:

Construction of the lock was included in the program for Public Works as Project No. 13 under the National Industrial Recovery Act. Work was scheduled for fiscal year 1934 when $1,420,000 was allotted for its construction. (Annual Report 1933: 683; Wood 1937d: 16) Initial work, moreover, boded well for the project. Results of borings made at the site indicated that material in the stream bed, excepting a portion under the land wall of the lock, was composed of fine sand, gravel and traces of clay. Boulders and broken sandstone, however, were encountered in some cases under the land wall of the lock. (Wood 1937d: 16)

Before construction of Lock No. 8 could commence, a dredging project was necessary. The navigable channel at the site had been maintained adjacent and parallel to the Wisconsin shore. Since the lock was to be constructed in this region, a temporary channel had to be dredged so navigation could continue before the cofferdam was begun. The contract, which was awarded to the LaCrosse Dredging Corporation of Minneapolis, also included the dredging of a temporary discharge channel at Lock No. 9. The decision was made to complete dredging at No. 9 first so the temporary channel at No. 8 was not completed until June 21, 1934. (Wood 1937d: 16, 17)

The work provided under the specifications for the construction of the lock consisted of supplying all labor, plant and materials and constructing a main lock with upper and lower guide walls, miter gates and valves, the upper gate bay, upper miter gates and poiree dam foundation of an auxiliary lock of possible future dimensions of 110 feet by 360 feet, a central control station and all necessary operating machinery. Bids were invited on November 8, 1933, and opened on November 28. Of the six bids submitted, the Jutton-Kelly Company of Milwaukee was low bidder at $1,421,762.90. The contract was dated December 7, 1933, and the official Notice to Proceed was acknowledged on December 21, 1933. The originally established completion date was December 21, 1934, but was extended by various modifications of the contract. (Annual Report 1934: 789; Wood 1937d: 17; Wood 1937a: 17)

Construction did not begin until December 19, 1933, and completion of other structures preliminary to actual contract operations such as office and camp buildings, sidings, barges did not occur until early April 1934. The cofferdam, however, which had dimensions of 934 linear feet was begun on February 9, 1934, and completed on April 23. The cofferdam consisted of two parallel rows of steel sheet piling driven into the river bed and tied by steel tie rods connecting a single row of eight-inch by sixteen-inch wallers. No ciruclar cell or cross diaphragm reinforcement was used. The upper arm was clay-filled by truck and the river and lower arms were sand-filled by suction dredge and crane equipped with clam shell bucket.

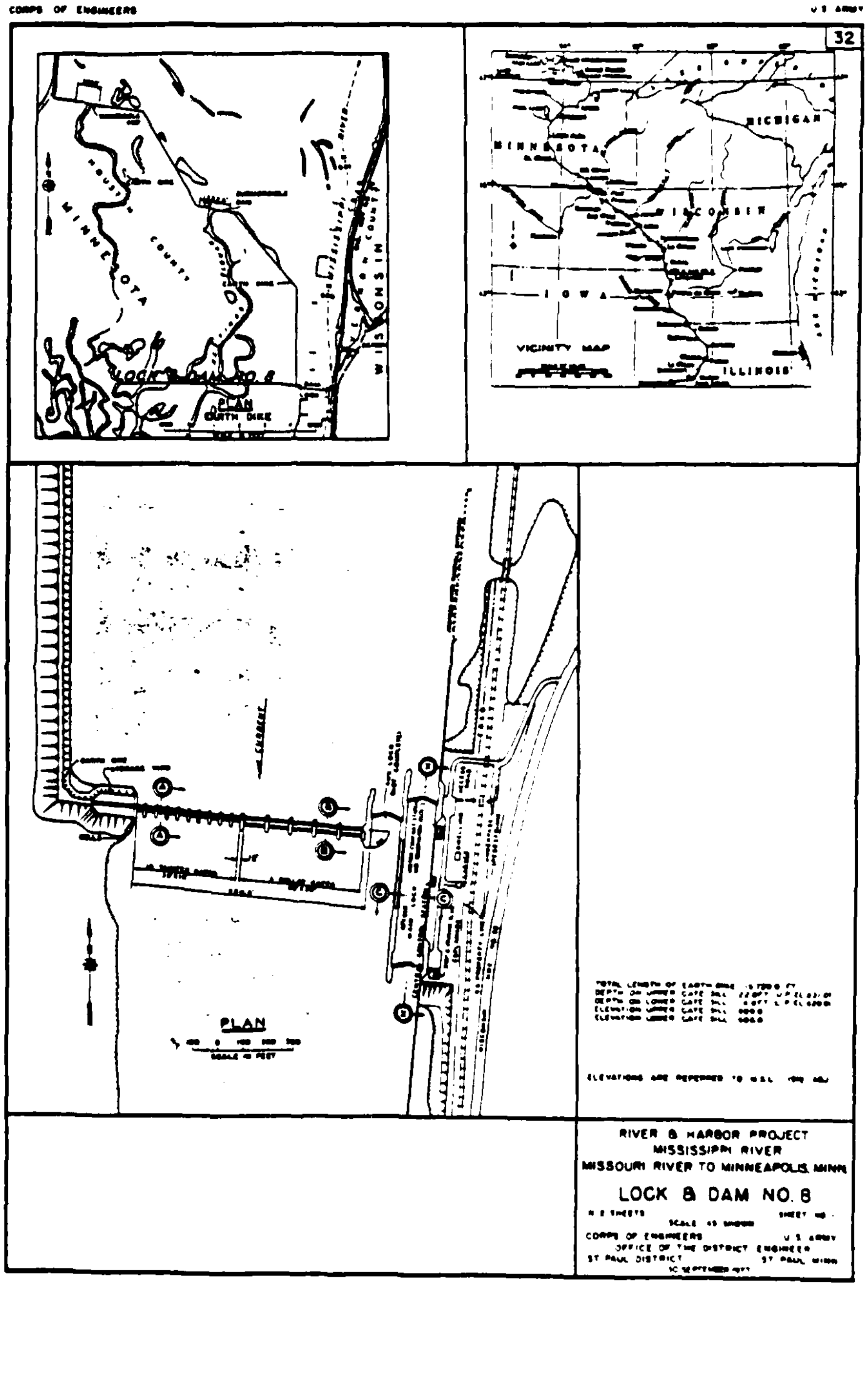
Unwatering was accomplished with twelve-inch pumps electrically driven. By the end of fiscal year 1934, the contract was 29 percent complete at a cost of $482,856.52. (Annual Report 1934: 789; Wood 1937d: 17)

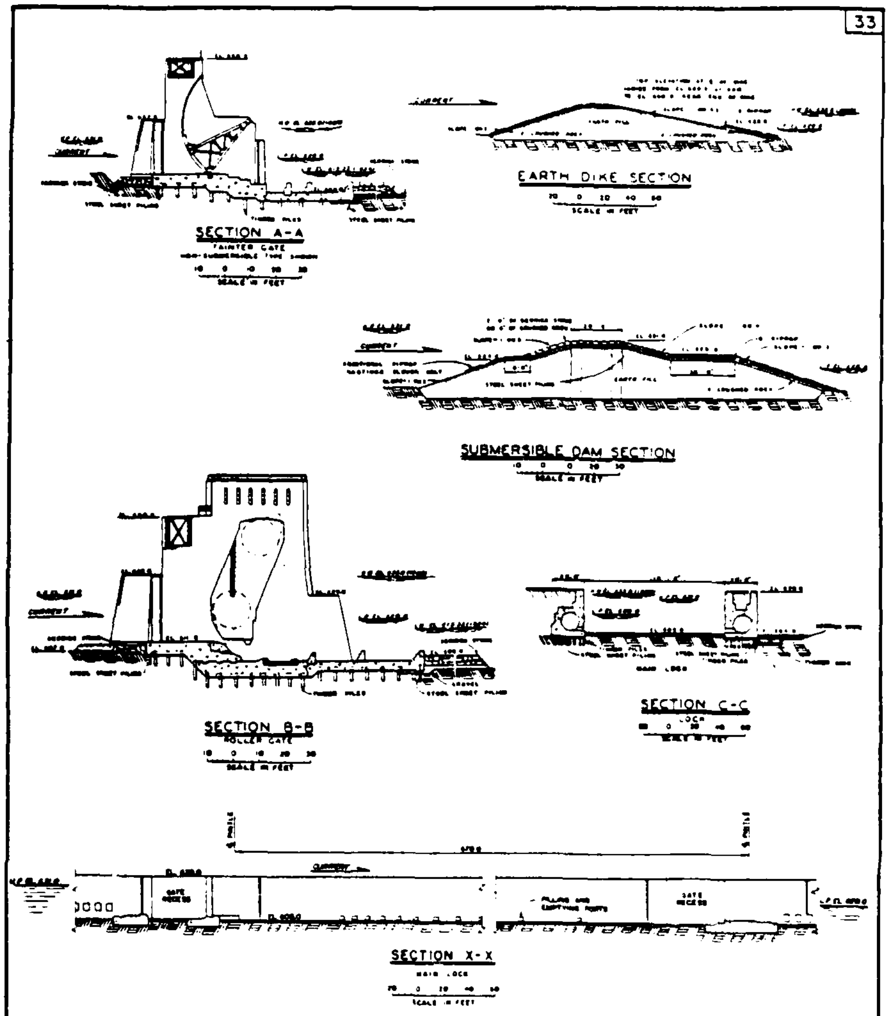
Nearly all of the round timber piling driven was obtained locally. Native hardwoods, especially oak and some maple, were trucked to the site while some oak from southern Illinois and pine from northern Wisconsin was delivered by rail. The driving of timber piling began on May 25, 1934, and was completed on November 5 after 219,695 linear feet had been driven. (Wood 1937d: 17, 18) Concrete work lasted 175 days beginning on June 21 and used 68,751 cubic yards. The cofferdam was removed between January 2, 1935, and March 4, 1935, and the lock and upper gate bay of the auxiliary lock was considered complete on the latter date. Total costs of the lock construction were $1,696,190. (Annual Report 1935: 900; Wood 1937d: 18; Wood 1937a: 17)

Dam No. 8--Construction History:

Plans for construction of Dam No. 8 were adumbrated in the 1934 Annual Report of the Chief of Engineers as $3,000,000 was projected for its construction during fiscal year 1936. By 1935, a more definite $2,155,000 was alloted from the Emergency Relief funds to begin construction of the dam in September 1935. (Annual Reports 1934: 799; 1935: 911) The work provided under the original plans and specifications for the construction of Dam No. 8 consisted of furnishing all plant, labor and materials and constructing the movable gate section of the dam, two reinforced concrete spillways with lengths of 1,200 and 800 feet, the storage yard, dredging certain areas above and below the site and placing portions of an earth-fill dike. An invitation for bids on the work was issued on July 19, 1935, and when the bids were opened on August 20, Siems-Helmers, Inc., of St. Paul, was the lowest at $2,047,003.69. A contract dated August 29, 1935, was executed in favor of Siems-Helmers, Inc., which acknowledged the official Notice to Proceed on September 14, 1935. Work was scheduled for completion on January 6, 1937, but the contact was modified by various change orders allowing a total of 118 days additional time. The most notable change order was No. 5 which deleted the reinforced concrete spillways from the contract and substituted a submersible dam tc be constructed of earth-fill over cells of steel sheet piling, the surface of the fill to be protected by derrickstone closely placed and grouted. (Annual Report 1936: 886; Wood 1937d: 19; Wood 1937a: 17)

Equipment and material for the construction of temporary structures and roads began arriving at the site on September 17, 1935, and by November 1, all temporary buildings were complete. The LaCrosse Dredging Corporation, which had subcontracted for the dredging of the river, began operations in the first cofferdam area on September 27. The lift span across the main lock chamber, the concrete plant and the first cofferdam were completed in December and initial unwatering of the first cofferdam began on December 10 with six forty-horsepower


CORPS OF ENGINEERS
U.S. ARMY
32
PLAN
EARTH DIKE
MINNESOTA
WISCONSIN
MICHIGAN
IOWA
ILLINOIS
VICINITY MAP
PLAN
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.
LOCK & DAM NO. 8
SCALE AS SHOWN
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT
ST. PAUL, MINN.




ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ.)

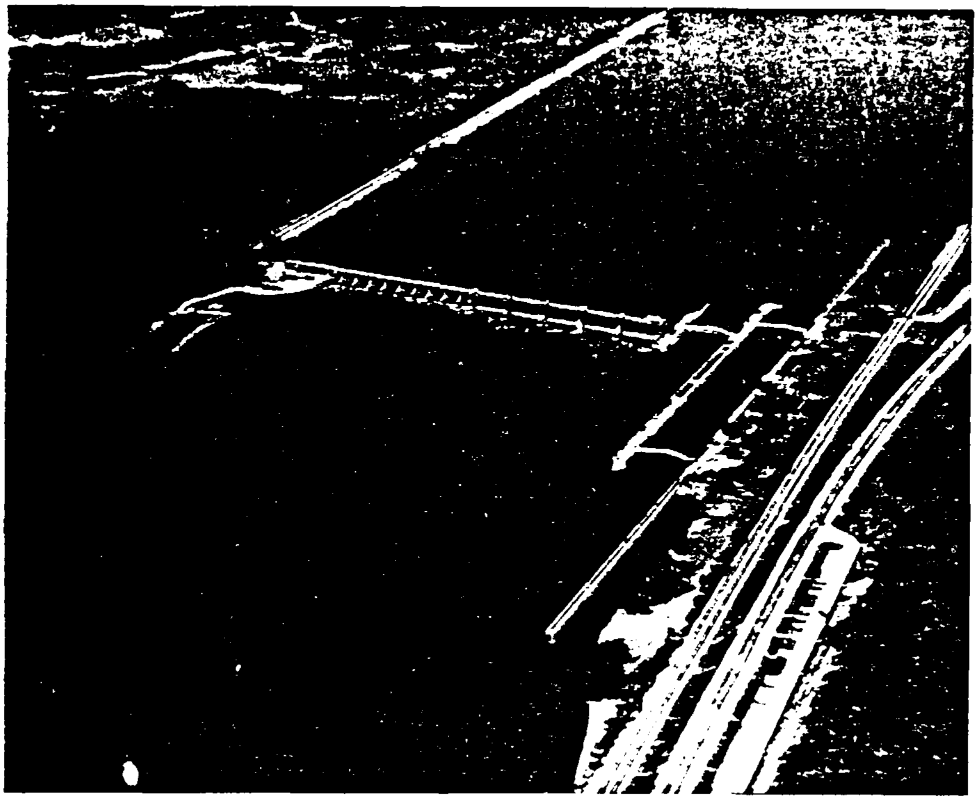
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

LOCK & DAM NO. 8

IN 2 SHEETS SHEET NO. 2
SCALE AS SHOWN

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.

<u>LOCK AND DAM NO. 8</u>



electrically-driven pumps in operation. By January 1, 1936, when unwatering was complete, the project was 17 percent complete. (Wood 1937d: 19; Wood 1937a: 17)

Like the work on Dam No. 7, construction at Dam No. 8 was adversely affected by weather in the winter of 1937. Extremely cold weather in January and February handicapped contract operations although no time was lost due to cold weather. Moreover, the river started to rise late in February and by March 17, the river in the vicinity was free of ice excepting a two-mile stretch immediately above the dam. This ice held until about March 20, when travel over the service trestle was suspended due to its weakened condition. On March 21, the trestle was swept away and the contractor suspended operations allowing the cofferdam to fill to lessen damages. Eleven and one-half days were lost due to flooding of the cofferdam and damage to the service trestle. In spite of the difficulties, the second cofferdam was completed and unwatered by August 15. Moreover, by the end of fiscal year 1936, all preliminary work had been completed, cofferdam No. 1 had been constructed and unwatered, pile driving in cofferdam No. 1 was completed and work on excavation and concrete work was well advanced so that the contract was considered about 41 percent complete. (Annual Report 1936: 886; Wood 1937d: 19, 20)

Concre4e work in the second cofferdam began about September 1, 1936. By December 1, all mass concrete to the elevation of the operating houses was in place. Activity in placing concrete reached its peak in September and October, during which time more than 800 cubic yards was placed on certain days. Concrete work was finished on February 3, 1937; 42,638 cubic yards had been placed. On April 1, 1937, the second cofferdam had been removed and the dam was completed on April 30. (Annual Report 1937: 925; Wood 1937d: 20, 21; Wood 1937a: 9)

Other Work:

The ne[illegible] for an earth dike and basic facilities at the Lock and Dam [illegible]. 8 site was usually filled through contracts. Construction of the earth dike, for which $582,000 was allotted in 1935, was completed by LaCrosse Dredging Company through a contract awarded August 13, 1935. Work began on August 26 and the contract was 30 percent complete by January 1, 1936, and finished on December 13, 1936. (Annual Reports 1935: 911; 1936: 886; Wood 1937a: 17) By June 21, 1937, the construction and installation of the power, control and lighting system was complete and the locomotive crane was in place by July 28, 1937. Finally, a contract entered into on August 14, 1937, by the Rock Island district for construction of the lockkeepers' dwellings and a garage pumphouse was completed on August 22, 1938. (Annual Reports 1937: 923; 1938: 1053; 1939: 1153)

Lock and Dam No. 9:

Lock and Dam No. 9 is situated about 3.2 miles below the town of Lynxville, Wisconsin, about 205 miles below Minneapolis, and about 648 miles above the mouth of the Ohio River. The main lock follows the standardized dimensions of 110 feet by 600 feet and is located on the left bank of the river. The dam consists of a roller gate section of five gates eighty feet wide and twenty feet nigh and a Tainter gate section which includes eight units thirty-five feet by fifteen feet. A submersible dam with a crest of 1,100 feet in length at upper pool elevation and an earth-fill dike about 7,500 feet long is also part of the design. When the structures were under construction, they were accessible over County Road F which connected with Wisconsin No. 35 at Lynxville and Prairie du Chien and by rail on the main line of the Chicago, Burlington and Quincy Railroad whose main line ran along the left bank within 200 feet of the land wall of the lock. (Wood 1938a: 7; Wood 1938c: 5) Lock and Dam No. 9 with its nine-foot lift was not of high priority according to the original plan and the site was chosen largely because of its excellent lock situation. Since a very good six-foot channel was available between Dam Nos. 8 and 9, the latter was put in Group B and was the second to the last project scheduled for completion. (House Document 137, 1932: 106) Although Lock and Dam No. 9 was completed before Lock and Dam No. 3, it was not until the later 1930s that it was in operation.

Lock No. 9--Construction History:

The construction of Lock No. 9 was included in the approved program for public works under the National Industrial Recovery Act approved on June 16, 1933. Provision was made for $1,420,000 for its construction that would be carried out between December 1933 and December 1934. (Annual Report 1933: 683; Wood 1938a: 7) Advertisements for bids for the Lock No. 9 contract were issued on November 24, 1933, and they were opened on December 15, 1933. The Walter W. Magee Company of St. Paul as low bidder received the contact. The contract was entered into on December 29, 1933, was approved on January 17, 1934, and Notice to Proceed was acknowledged by the contractor on January 22, 1934. The completion date was originally established as January 22, 1935. The work, according to the contract, consisted of supplying all labor, plant and materials, and constructing a main lock of the usual dimensions with guide walls, miter gates and valves, the upper gate bay, upper miter gate and poiree dam foundation of an auxiliary lock of possible future dimensions of 110 feet by 360 feet, central control station and all necessary operating machinery. (Wood 1938a: 7, 8)

Work on the lock began when the Walter W. Magee Company began moving in equipment on January 12, 1934. Since the railroad tracks of the left bank of the river were so near, a considerable fill was required in order to provide room for storage of materials and location of the plant. Work on the fill began on January 15. Moreover, in order to provide a navigable channel during construction of the lock, a temporary discharge channel was dredged along the right bank by LaCrosse Dredging Company and was completed on May 9, 1934. (Wood 1938a: 8) Construction of the cofferdam, which included a 932 linear foot enclosure, began on March 4 and by May 19 was complete. The cofferdam was of the box type with a steel sheet

AD-A137 119 HISTORICAL RESOURCES EVALUATION ST PAUL DISTRICT LOCKS AND DAMS ON THE MI..(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT J GJERDE SEP 83 3/4

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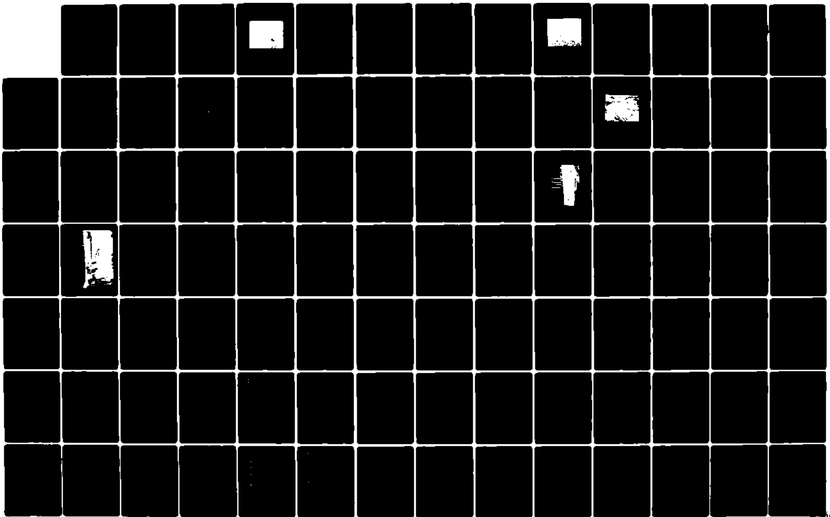
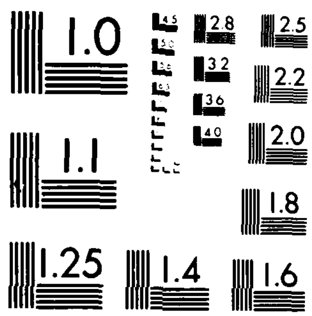
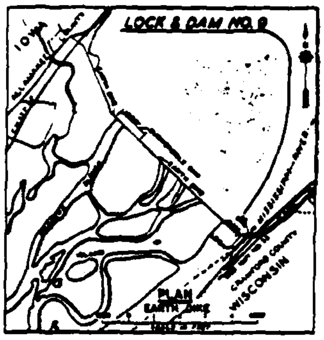
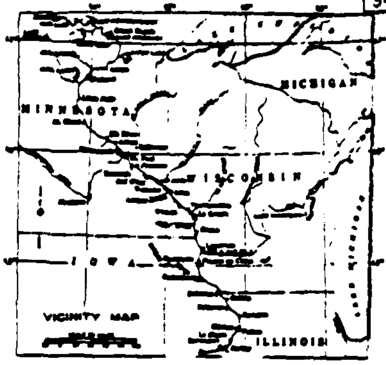


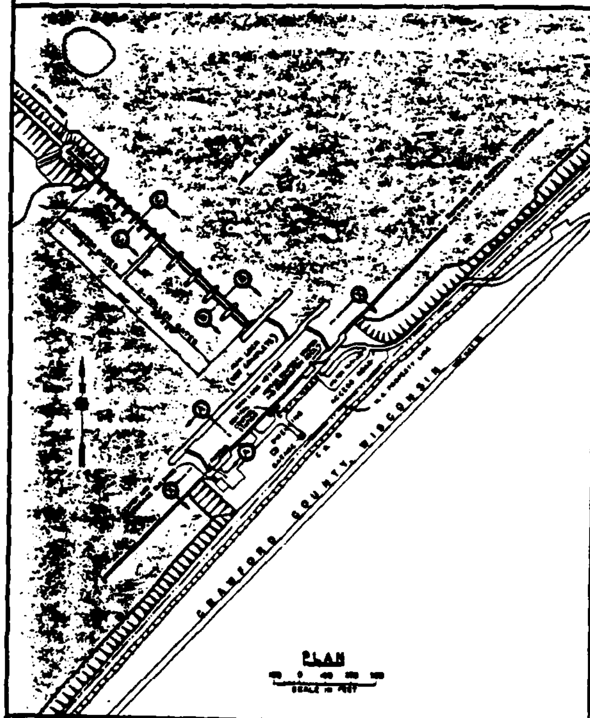



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

34



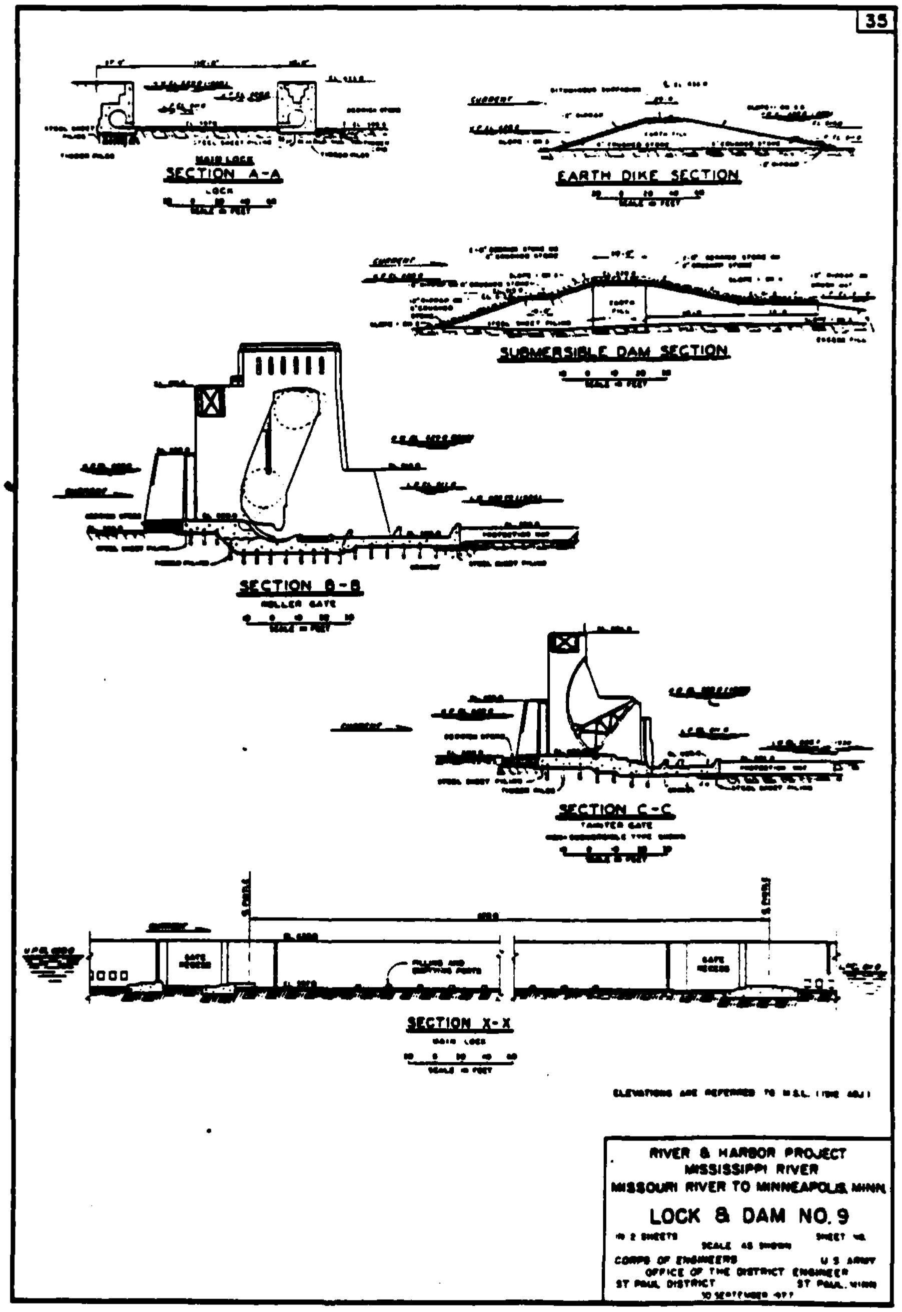

TOTAL LENGTH OF EARTH DIKE - [illegible] FT.
DEPTH ON UPPER GATE SILL - [illegible]
DEPTH ON LOWER GATE SILL - [illegible]
ELEVATION UPPER GATE SILL - [illegible]
ELEVATION LOWER GATE SILL - [illegible]

ELEVATIONS ARE REFERRED TO M.S.L. [illegible]

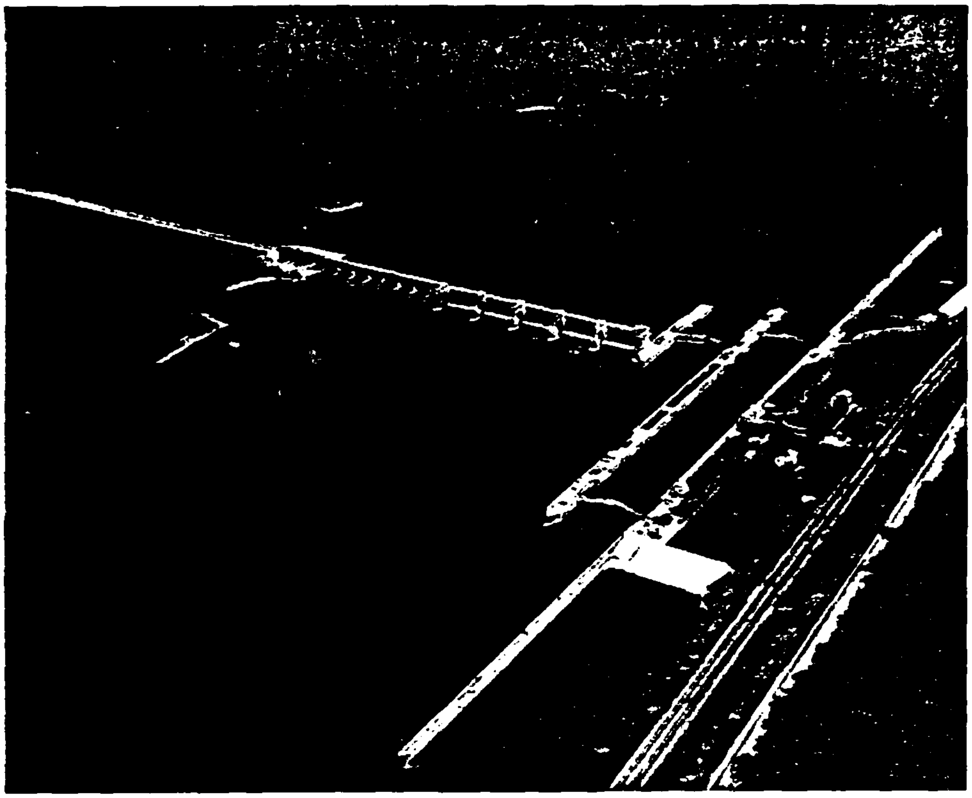
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

# LOCK & DAM NO. 9

[illegible] SHEETS SHEET NO. 1
SCALE AS SHOWN
CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN.
10 SEPTEMBER [illegible]


35
SECTION A-A
LOCK
EARTH DIKE SECTION
SUBMERSIBLE DAM SECTION
SECTION B-B
ROLLER GATE
SECTION C-C
TAINTER GATE
SECTION X-X
MAIN LOCK
ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ.)
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.
LOCK & DAM NO. 9
IN 2 SHEETS
SCALE AS SHOWN
SHEET NO.
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT
ST. PAUL, MINN.

LOCK AND DAM NO. 9



piling outer wall and a timber inner wall. The clear width between the walls was about twenty-five feet. The cofferdam fill was placed almost entirely by hydraulic dredge and the material was excavated from the cofferdam enclosure. Initial unwatering of the cofferdam was accomplished in six days using four, eight-inch pumps, one ten-inch pump, and a ten-inch electric suction dredge. By the end of fiscal year 1934, most of the preliminary work had been completed including the cofferdam which had been built and unwatered, excavation which was practically completed, and work on the foundation which had been begun. The contact was 17 percent complete at a cost of $321,103.08. (Annual Report 1934: 789; Wood 1938a: 8, 9)

Most of the round timber piles driven were obtained from the surrounding country in the vicinity of the structure. Approximately 8,700 timber piles were used varying in length from 30 to 55 feet. The total linear footage of the timber piling, a task which took 151 days from June 8, 1934, to November 12, 1934, amounted to 299,000 feet. (Wood 1938a: 8, 9) Concrete work lasted from June 26, 1934, until January 26, 1935. The concrete plant set-up consisted of two electrically operated Rex Mixers, two Double and one Single Pumpcrete Machines with six-inch pipe lines and the necessary conveyor systems. A total of 84,164 cubic yards of concrete was set in the lock. (Wood 1938a: 8, 9)

Removal of the cofferdam began on February 4, 1935, and after eighty days it was completed. Time extensions totalling seventy-one days had been granted for completion of the work. Final inspection and acceptance were made on April 19 and the contract was considered completed on April 24, 1935, at a total cost of $1,745,746. (Annual Report 1935: 900; Wood 1938a: 9; Wood 1937a: 17)

Dam No. 9--Construction History:

The construction of Dam No. 9 was planned for fiscal year 1936 in the 1934 Report of the Chief of Engineers. By 1935, the date was pushed back to fiscal year 1937 although projected expenditures on the dam had remained $3,00,000. (Annual Reports 1934: 799; 1935: 913) Advertisements for bids for the dam's construction were issued June 9, 1936, and the bids were opened on July 7. The United Construction Company of Winona was awarded the contact with a low bid of $1,878,169.02. A contract with the firm was signed on July 15, 1936, and Notice to Proceed was acknowledged by the contractor on August 13, 1936. The completion date was originally established as June 4, 1938. The work involved in the construction of the dam consisted of furnishing all plant, labor and materials and constructing the movable gate section of the dam complete with all operating machinery, a storage year, the submersible dam and portions of the earth-fill dike. (Annual Report 1937: 923; Wood 1938a: 10; Wood 1937a: 17)

Contract work on the dam was started on July 23, 1936, when eleven men were employed on clearing operating in the storage yard area. Construction of the cofferdam, an 869 linear foot enclosure, began on August 6, 1936. Cofferdam No. 1, which was of the "box" type, was constructed near the right bank, was completed on August 18, and was initially unwatered by August 31. This cofferdam, which enclosed about 446 linear feet of the work, was the area where the Tainter gate section was constructed. Work on the second cofferdam began on January 16, 1937, and was completed in 113 days on May 9, 1937. Unwatering of cofferdam No. 2 began on the day of its completion and initial unwatering was finished on May 15. (Wood 1938a: 10, 11)

The driving of timber piling, which took 370 days, began on the first cofferdam on September 4, 1936, and was completed on November 11. Piling work on the second cofferdam, of course, came later beginning on May 20, 1937. By September 8, 1937, the timber piling was complete and by October 21, the steel sheet piling was finished. The first concrete for the dam was placed on October 13, 1936, and by January 1, 1937, when the contract as a whole was about 33 percent complete, the Tainter gate section had been totally placed. Concrete work began in cofferdam No. 2 on May 20, 1937, and by the end of fiscal year 1937, the first concrete in the roller gate section of the dam had been placed. By the end of fiscal year 1937, the contract as a whole was about 62 percent complete. (Annual Report 1937: 923; Wood 1938a: 10, 11; Wood 1937a: 17)

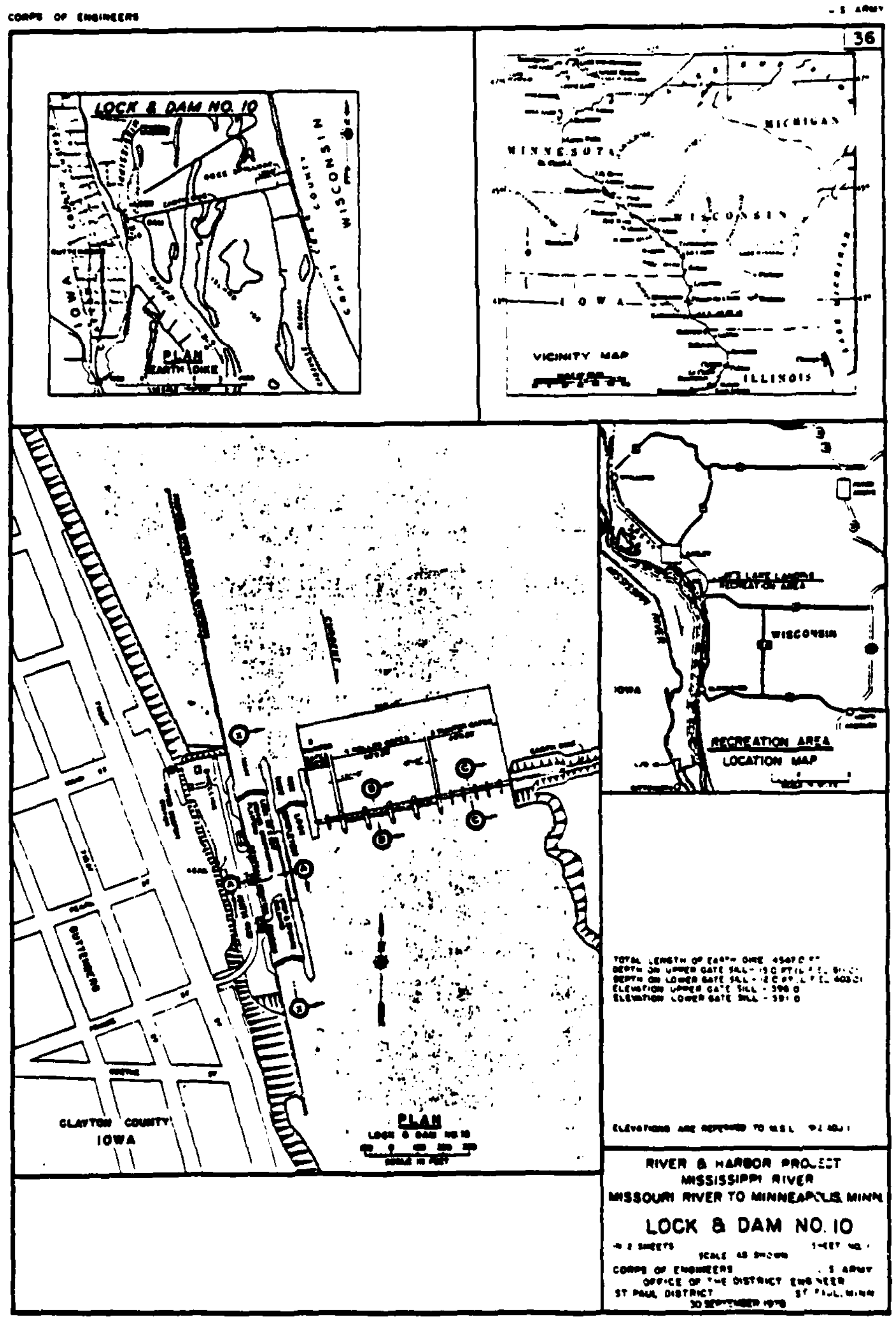
Concrete work continued until completion on November 6, 1937, 389 days after it had begun. A total of 32,766 cubic yards of concrete was formed on the project including a record 1,108 cubic yards which went into the forms on July 22, 1937. the final steel sheet piling in the second cofferdam was pulled on December 17, 1937, and the cofferdams were totally removed by New Year's Eve 1937. The contract was considered complete on May 13, 1938. (Annual Report 1938: 1053; Wood 1938a: 10,11; Wood 1937a: 17)

Other Work:

The contract for the earth-fill dike was awarded the K-M Construction Company of Dubuque on July 29, 1936, and operations began on August 20. By the end of fiscal year 1937, it was 53 percent complete and on November 10, 1937, the operation wsa totally finished. (Annual Reports 1937: 923; 1938: 1053; Wood 1938a: 10; Wood 1937a: 17) Other projects completed included the power, control and lighting system on May 13, 1938; the locomotive crane on April 16, 1938; initial fill, esplanade and access road on September 7, 1938; and the well on March 9, 1939. A contract for the lockkeepers' dwellings and garage pumphouse was 69 percent complete by the end of fiscal year 1939 and was completed in February 1940. (Annual Reports 1938: 1053-1054; 1939: 1153, 1163)

Lock and Dam No. 10:

Lock and Dam No. 10 is located adjacent to the city of Guttenburg, Io7a, 615.1 miles above the mouth of the Ohio River and 245.9 miles below Minneapolis. The lock is located on the west or Iowa side of the Mississippi. The dam extends from the river wall of the lock to the Wisconsin shore. In so doing it


CORPS OF ENGINEERS
36
LOCK & DAM NO. 10
WISCONSIN
IOWA
PLAN
EARTH DIKE
MINNESOTA
MICHIGAN
WISCONSIN
IOWA
ILLINOIS
VICINITY MAP
RECREATION AREA
LOCATION MAP
WISCONSIN
IOWA
CLAYTON COUNTY
IOWA
PLAN
LOCK & DAM NO 10
SCALE IN FEET
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
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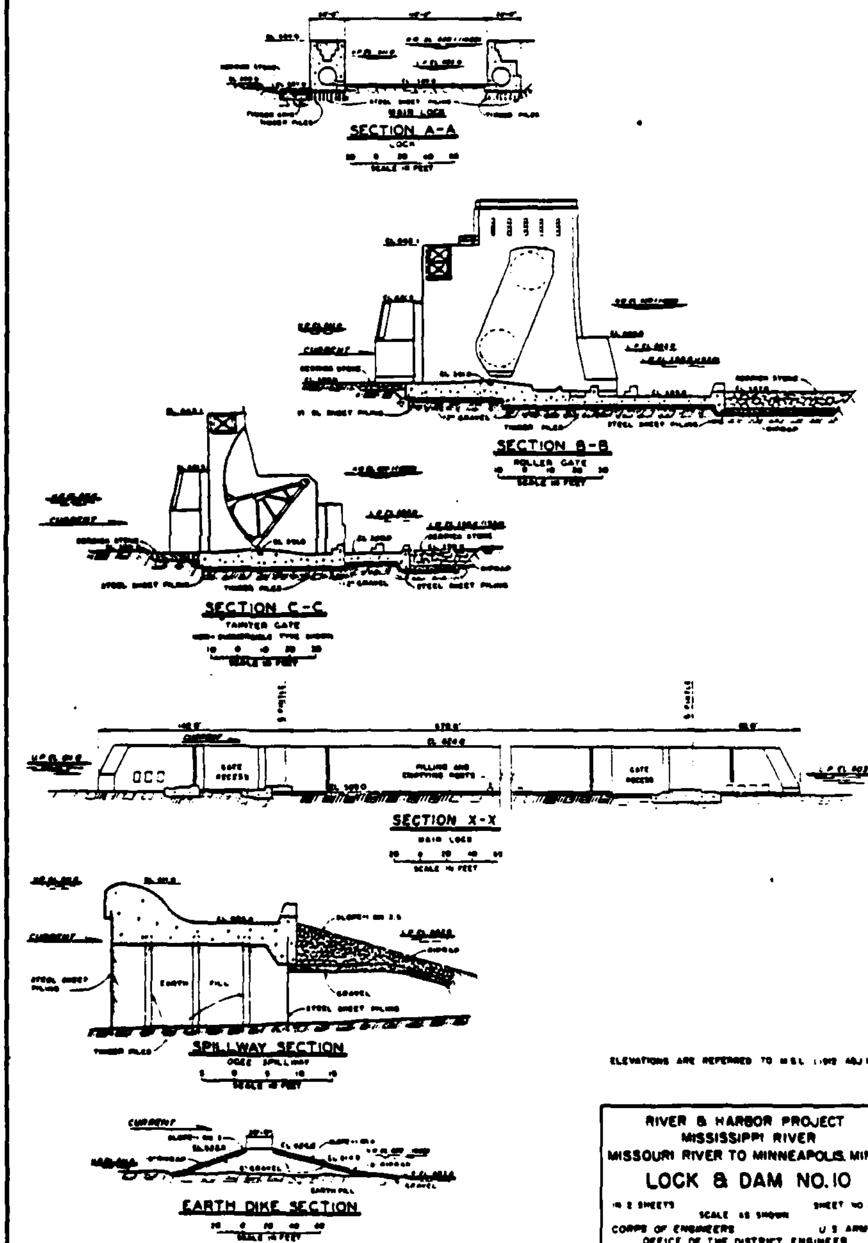
LOCK & DAM NO. 10
SCALE AS SHOWN
CORPS OF ENGINEERS
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT



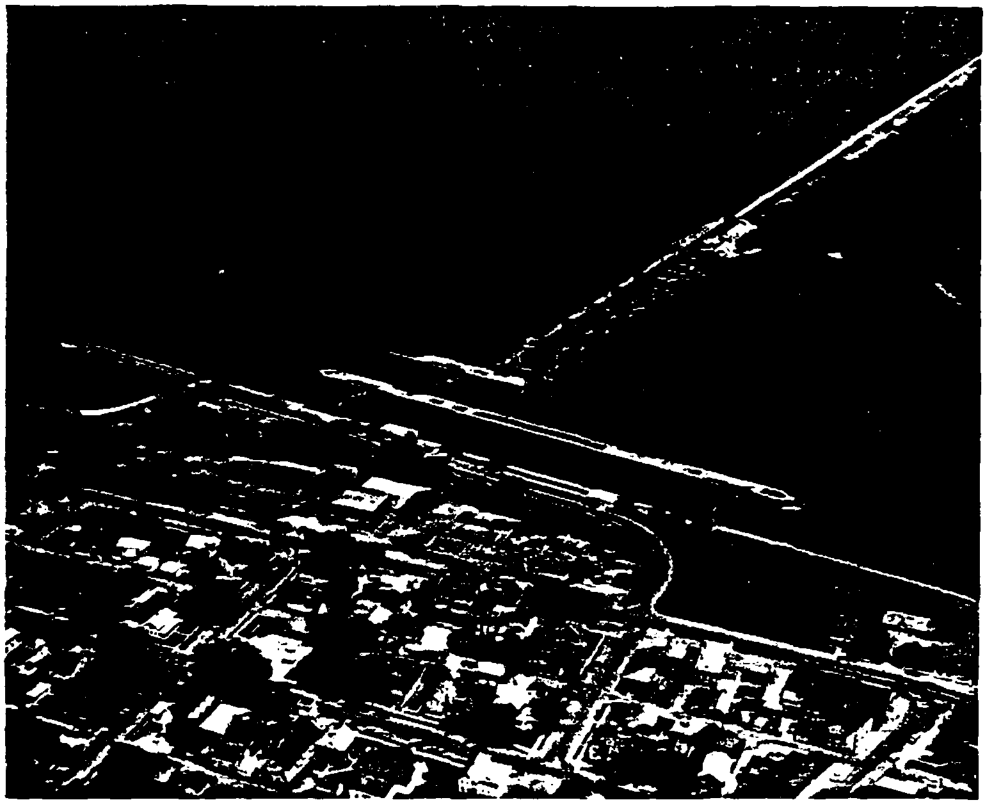

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.

## LOCK & DAM NO. 10

IN 2 SHEETS — SHEET NO 2
SCALE AS SHOWN

CORPS OF ENGINEERS — U S ARMY
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT — ST PAUL, MINN

LOCK AND DAM NO. 10



crosses the main channel of the river, Island No. 189, and the old channel known as Cassville Slough. The reach of the river in which the lock and dam is situated extends approximately north and south through an alluvial valley, about two miles wide, with high bluffs on both the Iowa and Wisconsin sides. Originally the main current of the river was in Cassville Slough adjacent to the Wisconsin shore. During the development of the six-foot channel, however, rock closing dams were built across it thus diverting the main channel to the Iowa side. The dam across Cassville Slough remained intact when construction of Lock and Dam No. 10 began, and was located about 1,300 feet downstream from the new dam. ("History of the Construction of Lock No. 10" 1938: 4; "History of the Construction of Dam No. 10" 1938: 1)

Lock and Dam No. 10's history is unique in two respects. First, its location was changed to Guttenburg after further study revealed the desirability of the new site. Second, the jurisdiction of Lock and Dam No. 10 was changed from the Rock Island district to St. Paul district after it had been built. In the report of the Special Board of Engineers, the location of Lock and Dam No. 10 was fixed at Cassville, Wisconsin, 24.4 miles below the mouth of the Wisconsin River and 1.1 miles below the mouth of the Turkey River. The lock was on the Wisconsin side and the dam design called for four roller gates to provide for passage of ice and heavy drift at flood stages. The location was selected to give good lock approach with minimum maintenance dredging below. The foundation was not an important factor since it was of similar character throughout. The overflowing of valuable agriculture land in the Turkey River valley was to be prevented by diverting the stream into another channel which emptied below the dam. (House Document 137, 1932: 106-107) Subsequent research determined that locating the lock and dam at Cassville would do serious damage to Guttenburg located about eight miles upstream. The area lying between the business district and the higher land in the rear of the town was sufficiently low that it would be flooded by the new lock and dam. By moving the site adjacent to Guttenburg, damage to the town would be averted and the costly diversion of the Turkey River would be avoided. ("History of the Construction of Lock No. 10" 1938: 3) Moreover, by a general order of the Chief of Engineers dated August 5, 1939, the lower boundary of the St. Paul district was extended southward from the mouth of the Wisconsin River to a point 614 miles above Cairo, Illinois, which added 17 miles of the Mississippi and Lock and Dam No. 10 to the jurisdiction of the St. Paul district. (Old Man River 1939: 11)

The structure of Lock and Dam No. 10 also has some unique aspects. The dam consists of three integral parts: a movable gate section, a dike embankment, and a fixed ogee spillway section. The movable section is noteworthy because although it contains both Tainter and roller gates, the former are separated into two sections which surround the roller gates. Two of the eight Tainter gates which measure forty by twenty feet are located at the westerly end of the dam while the remainder are at the eastern end of the section. The gate on each end of the movable section is of the submersible type which permits constant spillage from the pool in order to prevent excessive accumulation of floating debris. Each Tainter gate has independent operating machinery. In the middle of the movable section are four roller gates, measuring eighty feet by twenty feet. Each of these non-submersible gates is operated by an independent hoist mounted on the pier. The earth dike is situated between the movable section and the ogee spillway on the Wisconsin side. This spillway, which measures 1,200 feet, is located on the north end of Cassville Slough. ("History of the Construction of Dam No. 10" 1938: 3-8) The lock structure includes the conventional usable lock with a chamber of 600 by 110 feet and the planned auxiliary lock, which when completed would have a usable length of 360 feet and a width of 110 feet. The locks were equipped with the standard steel miter gates which opened upstream. ("History of the Construction of Lock No. 10" 1938: 6)

Lock No. 10--Construction History:

Construction of Lock No. 10 was projected for fiscal year 1934 from funds allotted from the National Industrial Recovery Act. Known as Public Works Project No. 15, advertisements for bids were made on January 3, 1934. When the bids were opened on January 30, 1934, Hanlon and Okes of St. Paul was low bidder at $1,363,304.45, slightly below the $1,420,000 allotted for the project. Notice to Proceed was made on February 26 and the completion date was set for February 28, 1935. Hanlon and Okes, however, did not "show exceptional skill or efficient management in the prosecution of the work" according to the Army Corps report. The building of guide walls, which should have been done during low water season in the late summer and early fall, were built during the cold winter season when it was practicable to work only on occasional warm days. The excavation was handled in a haphazard way, the material generally being handled several times before it was finally disposed of. Accordingly, the date of completion was extended to April 8, 1935, and the contract was finally completed on May 29, 1935. ("History of the Construction of Lock No. 10" 1938: 13, 14)

Actual construction of the cofferdam for the lock was begun on March 8, 1934, and was completed on May 5. The work was delayed about ten days during the latter part of March because of high water and running ice. Excavation within the cofferdam began on March 20, before the cofferdam was completed with the pumping of sand from the excavation area into the cofferdam wall as fill. On May 16, shortly after the cofferdam was unwatered, three cranes equipped with dragline buckets were moved in and started on excavating. The excavated material was disposed of as esplanade fill and later as back-fill around the structure. The building of timber cribs for guide walls was begun on the upper guide wall on May 15, and the work was finally completed for the lower guide wall on November 2, 1934. By the end of fiscal year 1934, all preliminary work had been done and the contract was about 18 percent completed. ("History of Construction of Lock No. 10" 1938: 25; Annual Report 1934: 791)

The first timber piles for the foundation were driven on May 29, 1934, and they reached their peak in July when 3,115 were driven before work fell off. By November 23, timber pile driving was complete. Moreover, the driving of permanent steel sheet piling was begun on June 11 and completed on September 12, 1934. The first concrete was placed on June 23, 1934, forty days after the cofferdam had been unwatered. The placing reached its peak in October 1934, when 23,222 cubic yards were placed. The work was completed on March 26, 1935, six days after the removal of the cofferdam had begun. The cofferdam was totally removed by April 29 and after miscellaneous tasks, such as the completion of the central control station, were finished, the lock was opened on May 29, 1935. ("History of Construction of Lock No. 10" 1938: 25-26; Annual Report 1935: 901)

Dam No. 10--Construction History:

The construction of Dam No. 10 was scheduled to begin in October 1934, according to the Army Corps' timetable. The contracting process, however, was somewhat delayed since the advertisement for bids did not occur until December 8, 1934. The contract called for the construction company to furnish all equipment, labor and material to construct the movable portion of the da-. When the bids were opened on January 9, 1935, McCarthy Improvement Company of Davenport, Iowa, came in low at $1,946,075.80, well below the $3,000,000 applied to the project. Notice to Proceed was acknowledged on February 7 by the contractor and the date set for completion of the contract was February 26, 1937. (Annual Report 1934: 795, 798; "History of Construction of Dam No. 10" 1938: 8-9)

Equipment arrived at the site on February 11, 1935, and the clearing of timber on Island 189 began the following day. Construction of the field office, warehouses and machine ship was started early in March as was the removal of top-soil from the area to be occupied by the dike embankment. Construction of cofferdam No. 1 commenced on March 26 and was completed on May 13. The following day unwatering of the cofferdam began. The driving of round timber piles began on May 27 and steel sheet pile driving began on the 28th. The erection of forms began on June 11 and the first concrete was placed on June 18. The driving of timber piles in the first cofferdam was completed on June 25, and the driving of steel sheet piling on June 29. By July 1, the contract was 16 percent complete. ("History of Construction of Dam No. 10" 1938: 20-21; Annual Report 1935: 901)

Concrete and steel work continued in the storage area during the removal of the cofferdam which was completed on October 8. In the meantime, work was progressing intermittently on the dike embankment which was finally completed on September 2, 1936. Moreover, work on the construction of the spillway was begun on June 10, 1935, with the excavation of the west abutment. The work was completed on June 18 and two days later the contractor started driving steel sheet piles which were completed for the entire spillway on August 1. After the steel cells were filled, and the timber was driven, the placing of concrete commenced on August 15 and was finished on September 23, 1935. ("History of Construction of Dam No. 10" 1938: 21)

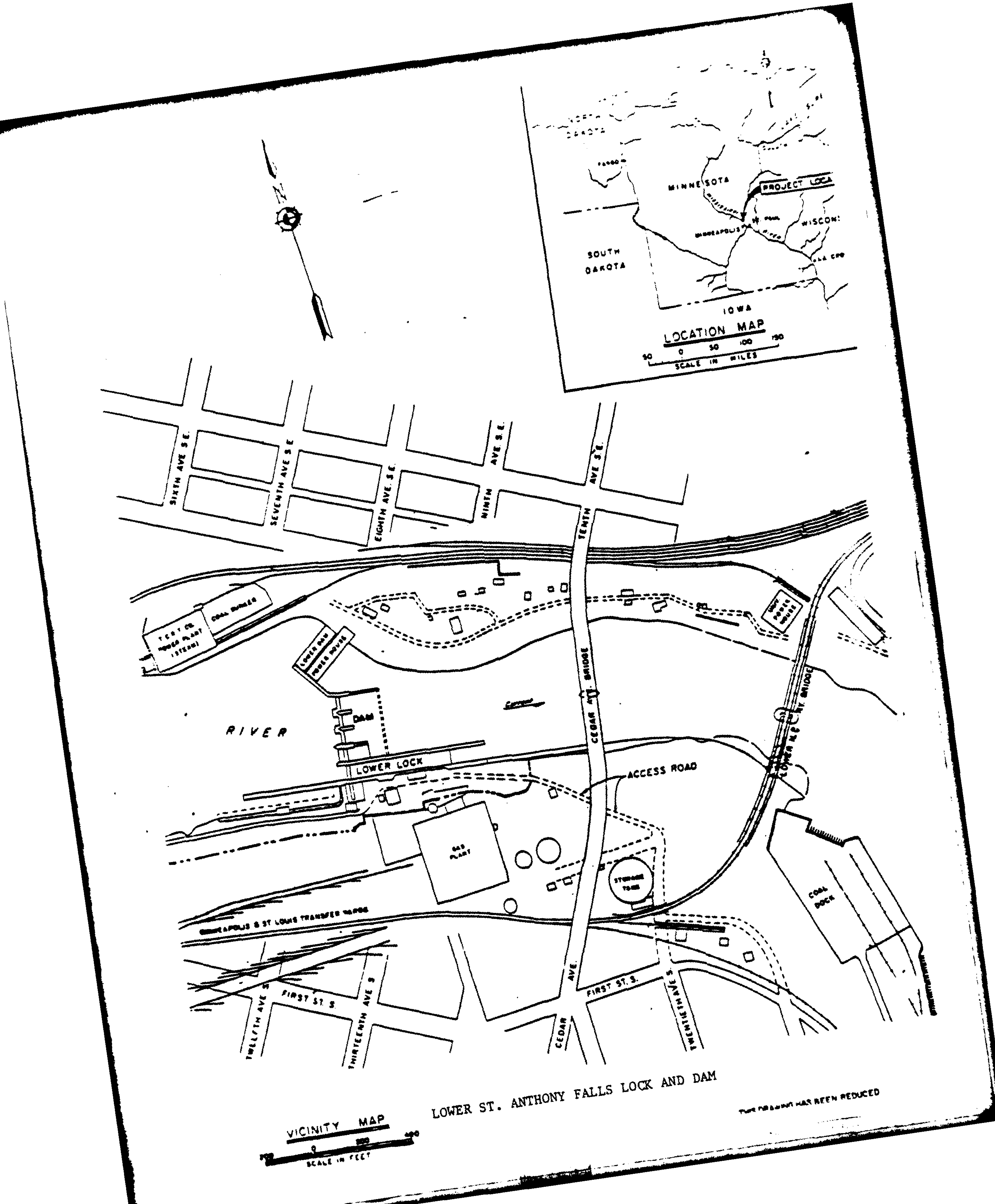
Construction of the second cofferdam began immediately after the first cofferdam had been removed. After it was completed on November 2, problems delayed unwatering until November 19. The timber pile driving the cofferdam began on November 29 and was completed on January 2, 1936. Moreover, the driving of steel sheet piles in this cofferdam was started on December 5 and completed on January 15, the work being carried on concurrently with the placing of concrete which had begun on December 9, 1935. The erection of gates and service bridge was started on April 13, 1936, which was as soon as was possible after the ice moved out of the river in the spring to permit barge delivery of the steel. The lower river arm of the cofferdam failed on May 16 with only about three weeks of work remaining. Work within the cofferdam was resumed on June 15. By the end of fiscal year 1936, the contract was about 91 percent complete. The only remaining work was concrete placement which was completed on July 11 and steel erection which was finished on July 15. The second cofferdam was removed beginning on July 14 and completed on August 18. The contract was officially accepted on December 15, 1936. ("History of Construction of Dam No. 10" 1938: 22; Annual Reports 1936: 887; 1937: 927)

Other Work:

Other contracts associated with Lock and Dam No. 10 included construction of the locomotive crane which was completed on October 26, 1936, and the installation of power, control and lighting system completed on April 2, 1937. Moreover, later contracts including the construction of the lockkeepers' dwellings and a garage was finished on April 30, 1938, while the esplanade works were completed on July 30, 1937. (Annual Reports 1937: 925; 1938: 1055)

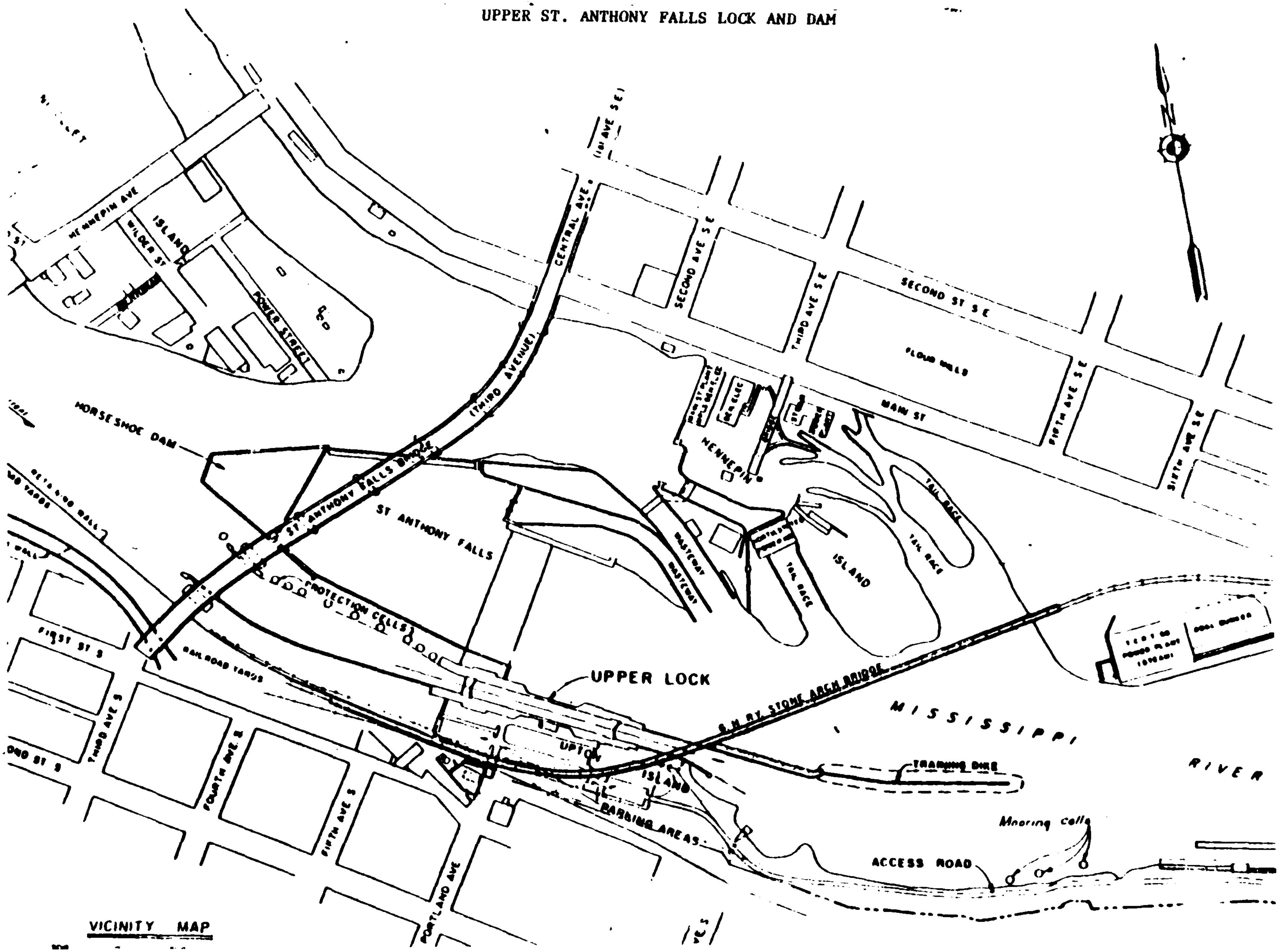
Post-Nine-Foot Channel Period:

Extension of navigation above St. Anthony Falls was suggested as early as the mid-nineteenth century. After the "High Dam" was completed, however, Minneapolitans began a lobbying effort that was more persistent. The lock and dam had been created to provide navigation to Minneapolis, they argued, but once river traffic reached that point, the harbors around the falls were inadequate. The harbors of Washington Avenue, which were called something "comparable to having a road stop at the edge of town," by one resident, could be replaced by an area of placid river flats untroubled by flood waters where three miles of wide shoreline on either side of the river would make an ideal harbor. (Kane 1966: 175) The obvious problem in this plan, however, was the Falls which fell seventy-four feet. How could a lock system be constructed which was cost-effective

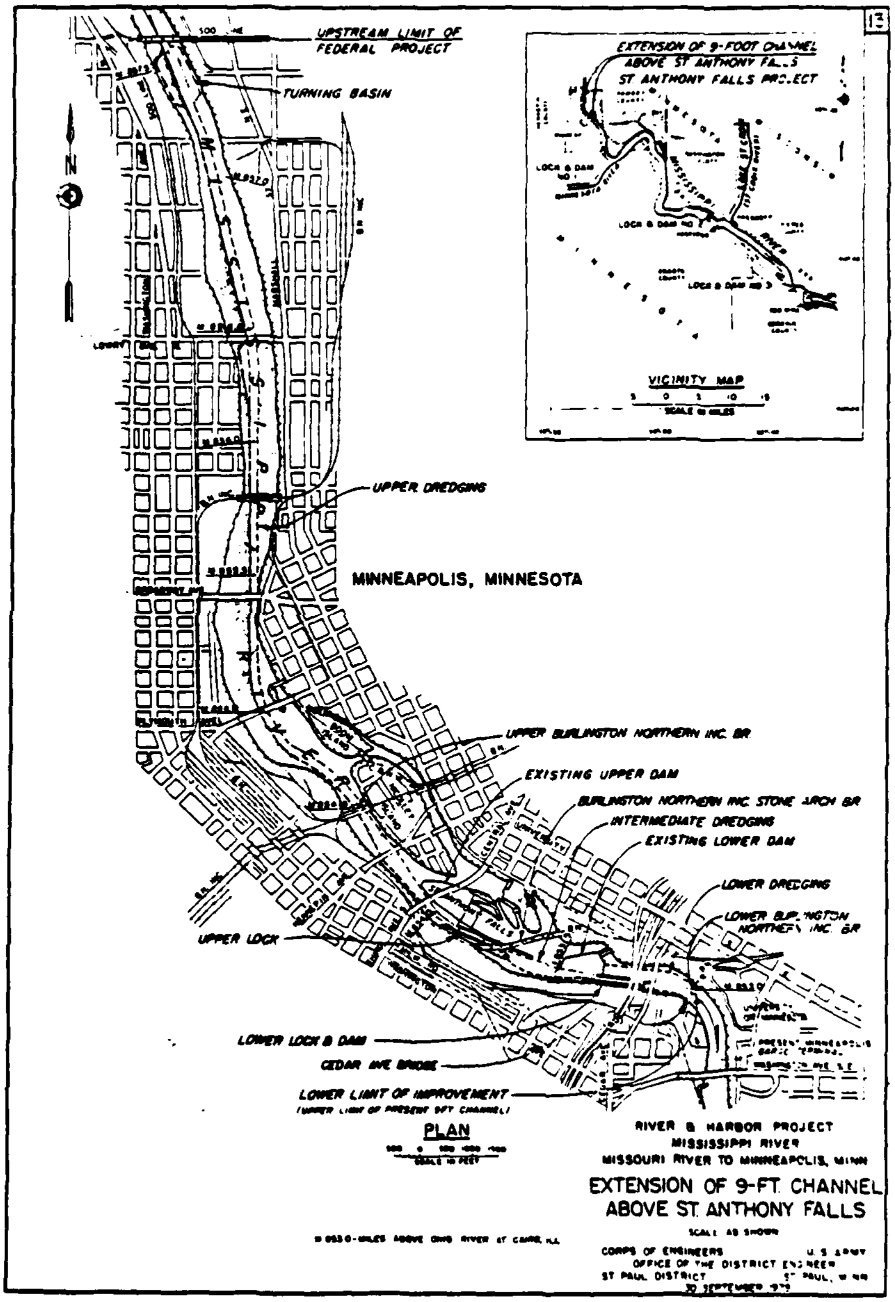



LOWER ST. ANTHONY FALLS LOCK AND DAM

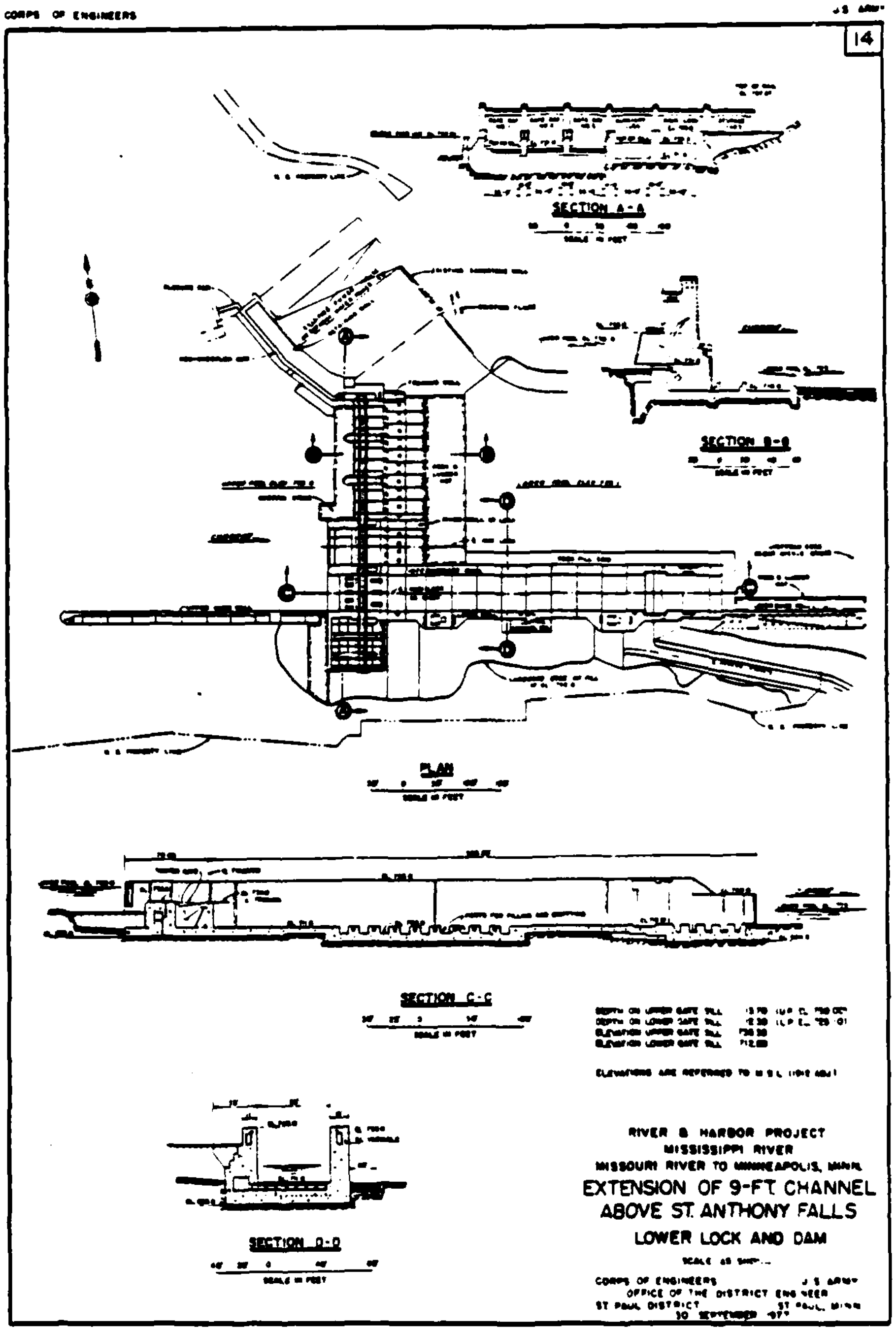
UPPER ST. ANTHONY FALLS LOCK AND DAM

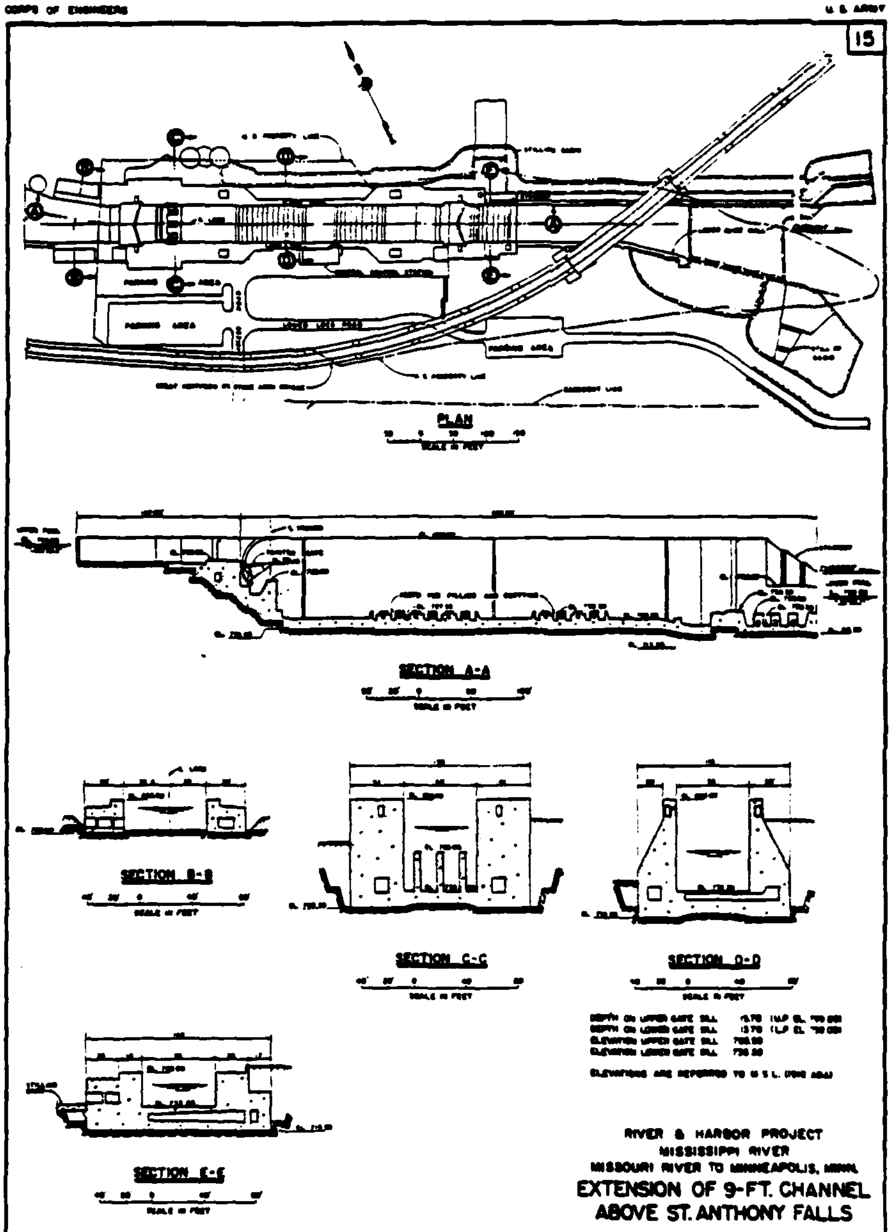



VICINITY MAP


UPSTREAM LIMIT OF FEDERAL PROJECT
TURNING BASIN
UPPER DREDGING
MINNEAPOLIS, MINNESOTA
UPPER BURLINGTON NORTHERN INC. BR
EXISTING UPPER DAM
BURLINGTON NORTHERN INC. STONE ARCH BR
INTERMEDIATE DREDGING
EXISTING LOWER DAM
LOWER DREDGING
UPPER LOCK
LOWER LOCK & DAM
CEDAR AVE BRIDGE
LOWER LIMIT OF IMPROVEMENT
PLAN
VICINITY MAP
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN
EXTENSION OF 9-FT. CHANNEL
ABOVE ST. ANTHONY FALLS
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT

CORPS OF ENGINEERS




CORPS OF ENGINEERS
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PLAN
SECTION A-A
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SECTION C-C
SECTION D-D
SECTION E-E
RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN.
EXTENSION OF 9-FT. CHANNEL
ABOVE ST. ANTHONY FALLS
UPPER LOCK
SCALE AS SHOWN
CORPS OF ENGINEERS
U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST PAUL DISTRICT
ST PAUL, MINN
30 SEPTEMBER 1977

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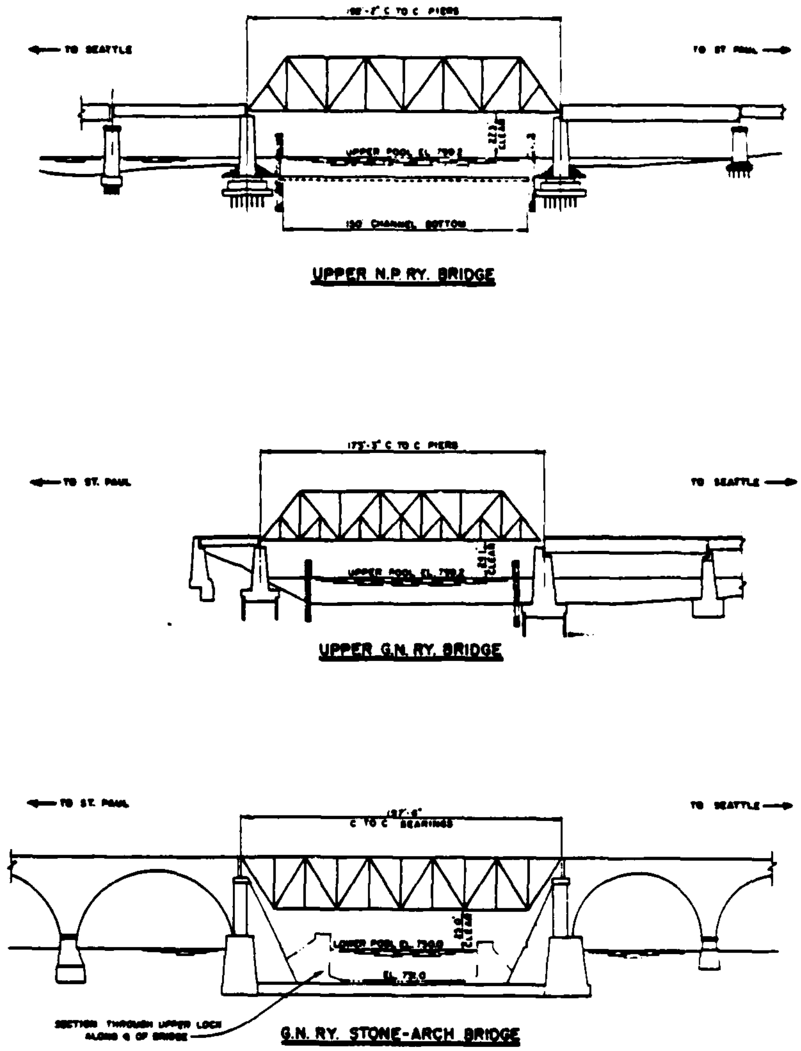



ELEVATIONS ARE REFERRED TO M.S.L. (1912 ADJ)

RIVER & HARBOR PROJECT
MISSISSIPPI RIVER
MISSOURI RIVER TO MINNEAPOLIS, MINN
EXTENSION OF 9-FT. CHANNEL
ABOVE ST. ANTHONY FALLS
ALTERATIONS TO R.R. BRIDGES

SCALE IN FEET

CORPS OF ENGINEERS U.S. ARMY
OFFICE OF THE DISTRICT ENGINEER
ST. PAUL DISTRICT ST. PAUL, MINN
30 SEPTEMBER 1977

in view of such an obstacle? The initial nine-foot project study argued that locks to provide navigation above St. Anthony Falls was not a suitable project. Harbor facilities which could be created in St. Paul or on the Minnesota River, was a more cost-effective plan according to reports generated in the nine-foot channel planning.

Minneapolitans continued to pressure for the construction of what became known as the Upper Harbor, however, and in the Rivers and Harbors Act of August 26, 1937, that pressure came to fruition. According to the Act, the nine-foot channel was to be extended above St. Anthony Falls, subject to such changes as were found advisable by the Chief of Engineers and the final approval of the plan by the Board of Engineers for the Rivers and Harbors, to provide adequate terminal facilities for the city. That final approval of the plan, incorporating certain changes found advisable by the Chief of Engineers, was given by the Board of Engineers for Rivers and Harbors on February 8, 1938. (Annual Report 1938: 1048; Department of the Army Corps of Engineers 1976) The initial plan called for two locks to have lifts of 26.4 feet in the lower and 49.7 feet in the upper structures while initial estimated cost totalled $8,673,000. In keeping with the standardized system, the lock chambers were to measure 56 by 400 feet, similar to the lock at site No. 1 below them. (Annual Report 1938: 1049; Wood 1938c: 5) The initial work which was planned for fiscal year 1940 included design of the locks at a total cost of $101,000 with work in the following year totalling $3,845,500 including dredging below the lower lock and above the upper lock and construction of the lower lock. Moreover, the Minneapolis City Council voted to provide $1,774,000 for the project on May 5, 1939. (Annual Report 1939: 1161, 1167; Merritt 1979: 148) World War II and legal difficulties, however, intervened. The project was delayed and cost estimates zoomed upward. Work on the lower lock did not begin until 1950 and the final project was not completed until 1963. In the meantime, opponents to the plan became increasingly vociferous against its completion. Although the locks of St. Anthony Falls were an impressive engineering feat, questions about the need for the locks were still asked when they opened a quarter century after they had been approved.

In addition to World War II, which delayed the project, it is questionable whether the locks would have begun any sooner because litigation arose concerning their construction. While the locks had been authorized, it remained to be determined who was responsible for paying the cost of altering bridges and public utility structures, which were privately owned, that would be affected by the project. Legal restrictions prevented the city of Minneapolis from assuming the responsibility. By early 1944, however, the difficulties were overcome by a proposal under which the federal government would assume the costs of alteration and Minneapolis would contribute $1,100,000 to the first total cost of the project as a whole. Even with this hurdle overcome, the Secretary of War ruled that the project was not approved as a wartime project. The

Minneapolis Tribune felt it should be given priority in any local postwar public construction program. "In the period of readjustment which the postwar years will bring to Minneapolis," it argued, "production costs will become an even greater factor in the competitive struggle. Labor costs can be little reduced and they should not be reduced in the form of wages. That being the case, we shall have to look to more efficient manufacturing methods and cheaper transportation to meet this problem and the completed upper harbor will contribute much to its solution." (Minneapolis Tribune 1944: 12; House Document 449, 1944: 6)

In March of 1945, President Franklin D. Roosevelt signed the omnibus River and Harbors Bill that authorized postwar construction of the Upper Harbor. The Upper Harbor was one of 291 projects in the $381,968,000 bill which gave the congressional approval necessary for beginning construction work soon after the war. The bill contained no appropriations, however, but it did circumvent the legal problems that had plagued the project. This new measure made it impossible for the city of Minneapolis to contribute the $1,100,000 for making required changes in railroad bridges and utility cables at the harbor site to be put toward the estimated $8,259,000 initial costs of the project. Instead, the federal government would pay for changing bridges and cables, and Minneapolis' contribution would merely be an expenditure of public funds on a public project. (Wilson 1945: 1)

It was not until mid-1948, however, that plans were set to begin work. Colonel W. K. Wilson, Jr., district engineer at St. Paul, noted that he could not advertise for bids until a week after the city had transferred its $1,100,000 to the city's Upper Harbor fund. Since the city council was asked to hand over the funds on July 30, 1948, it was expected that actual digging could begin on September 1, 1948. (Minneapolis Tribune 1948: 1) As time passed, the estimated cost of the locks climbed. By 1950, when construction work began on the lower lock, the estimates stood at over $20 million, two and one-half times the expense projected in 1940 (see table below). (Annual Reports 1940: 1155; 1945: 1259; 1950: 1441; 1955: 1076; 1960: 1248; 1965: 1072)

Estimated Cost of Each Lock and Dam, Including Work in Pool and Flowage Damages

| | Upper Lock | Lower Dock |
|---|---|---|
| 1940 | $ 4,628,000 | $ 3,631,000 |
| 1945 | $ 4,510,000 | $ 3,749,000 |
| 1950 | $10,254,500 | $10,222,900 |
| 1955 | $18,486,800 | $12,413,200 |
| 1960 | $18,834,000 | $13,066,000 |
| 1965 | $18,505,000 | $12,395,000 |

And as the costs estimates and actual expenditures continued to climb, many increasingly came to question the wisdom of the project.

Despite a new wave of doubt surrounding the Upper Harbor, plans continued for construction and in 1948 Congress appropriated $1,000,000 for the first phase of the project, and added another $1,717,000 in October of 1949. This money, of course, was in addition to the $1,100,000 turned over the Army corps by the city of Minneapolis which was earmarked chiefly for the alteration of bridges to provide proper vertical clearance. While proponents optimistically stressed that "to state the exact truth about this Harbor is likely to expose us to the charge of exaggeration" and opponents called it a "pipe dream," the project finally was begun in earnest in 1950, thirteen years after its original approval. (Kane 1966: 176, 179; Minneapolis Tribune 1944: 12; Greater Minneapolis 1953: 23) In 1953, the federal government allotted another $3.5 million for work and by 1956, the lower lock and dam had been completed. In that year, the initial phase of the next step was begun--the planning and construction of the upper lock and dam. The paperwork was financed by a $400,000 appropriation and the upper lock would be in the planning stage for two and one-half years before actual construction would get underway. (Greater Minneapolis 1953: 23; Minneapolis Star and Tribune 1956: 1)

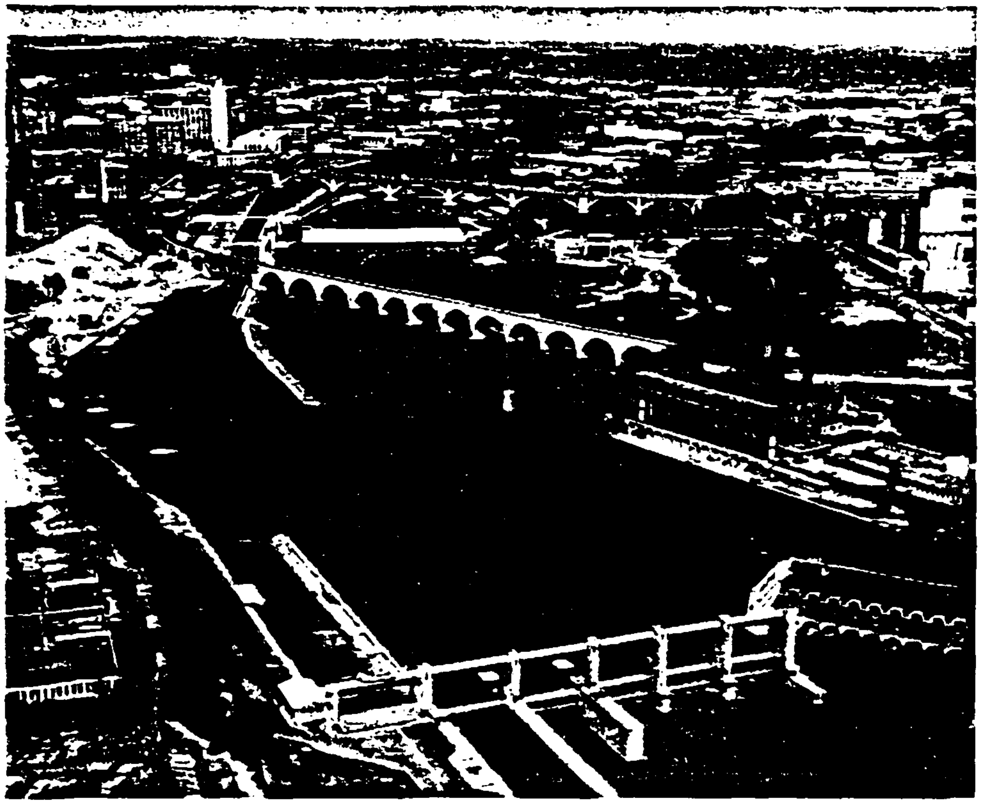
Between completion of the lower lock and the approval of construction of the upper lock which would complete the system, however, the Upper Harbor faced yet another test. Congress had to decide on the appropriations for local public works. After expending $11 million with another $19 million needed to complete the project, the public works appropriations subcommittee in both houses of congress heard arguments for and against the Upper Harbor in 1957. Stuart W. Rider, Jr., representing ten railroads serving the city, spoke against the project. Since the upper lock had not begun, Rider felt it was a logical time to cut off federal funds. He noted that the benefit-cost raito estimated by the Corps of Engineers in recommending the project was $1.03 to $1.00, or $1.03 in savings of transportation costs for every dollar in federal funds spent to complete the project. But that survey was completed in April of 1956 and since then, three changes had "stripped" the Upper Harbor project of its "economic justification." First there developed plans to deepen the Minnesota River channel 14.7 miles from its mouth at the Mississippi and to develop the 2,100 acre Valley Industrial Park. This project, which would cost $2,500,000, was cheaper and had a higher benefit-cost ratio. Second, there had been a sharp reduction in the molasses rail rates which returned most molasses shipments to the railroads. Finally, a reduction of rail rates on sand and gravel meant that "not one pound of sand and gravel will be transported by barge." (Donaldson 1957: 100)

The proponents of the Upper Harbor felt it was unjustified to end the project after $11 million had been spent. The Minneapolis area had to look ahead, according to Phillip E. Paquette. "It's like buying shoes for a growing boy. We've got to plan now for twenty-five years from now. The project," he concluded, "is perfectly justified if you think to the future." (Donaldson 1957: 100) Other time-proven arguments were also set forth again. The Upper Harbor was an ideal place for terminal facilities. With its wide shoreline on either side of the river, the Upper Harbor ws ideal for warehousing and docking facilities. The crowded and cramped position of the sixteen-acre Minneapolis harbor, on the other hand, kept the amount of water-borne commerce handled there to an average of 584,000 tons per year during the 1950s. This traffic was not sufficient to keep pace with the growth of water commerce elsewhere on the river nor able to meet the expanding water transportation needs of Minneapolis and the upper Middle West. And as Paquette stressed, one had to look to the future. The potential benefit of the project was based on fifty years of usage. Land transportation alone had become totally inadequate so attention had to be directed to air or water transportation. Moreover, the upper Middle West and particularly the Twin Cities were booming. According to Paquette, an eastern industrialist stated that "the next twenty-five years belong to the Upper Midwest." The Upper Harbor thus would facilitate transportation in this growing region. (Donaldson 1957: 100; Paquette 1960: 51; Greater Minneapolis 1953: 23)

One wonders about the validity of the proponents' arguments. Even if the upper Middle West was booming and even if water transportation was a necessity, that did not mean that the warehousing districts being developed on the Minnesota River and in St. Paul could not be exploited. Moreover, the reasons for the Upper Harbor often sound somewhat strained. Paquette, for example, noted that the locks would not only open the river to commercial navigation, but it would promote recreational activities on the river, a somewhat shallow reason to spend $40 million. Still, all local Minnesota Congressmen including Senators Humphrey and Thye and Representative Judd and Weir worked on behalf of the project. Moreover, Brigadier General P. D. Berrigan, the north central division engineer of the Army Corps, noted that the traffic estimates that would use the harbor were "much too low." With these influences, the Upper Harbor project got the go-ahead in 1956. (Donaldson 1957: 100; Paquette 1960: 51)

After the lower lock and dam had been completed, work began on the upper lock in 1959. This project provided many engineering challenges since the lift was 49.2 feet, the largest of any locks on the upper Mississippi and special construction techniques had to be employed. All parts of the structure, for example, had to be tied together with reinforcing concrete to prevent differential settlement. (Department of the Army Corps of Engineers 1976) Dredging of the river that had never been used before also presented problems. The Army Corps faced the unenviable task of removing 1,001,400 cubic yards from the river bottom between the upper lock and the new terminal not to mention the dredging that had been required up to the lower lock and between the lower and upper locks. The Upper Harbor also required raising or modifying fifteen bridges including one new bridge on Lowry Avenue that was built. The project was completed in 1963. (Kane 1966: 176; Merritt 1979: 149)

# ST. ANTHONY FALLS LOCKS AND DAMS



The Upper Harbor project was opened with pomp and circumstance. The first barges moved through the locks on September 21, 1963, and the structures were dedicated in colorful ceremonies attended by politicians and engineers who pushed for the project's completion. Representative John A. Blatnik, Minnesota representative, who was chairman of the House Subcommittee on Rivers and Harbors, said that Minnesota will now have "one of the finest industrial complexes." "It is not just going to serve downtown and industrial Minneapolis," he continued, "it is the tip of a whole water network which runs into the southern hemisphere." With the locks' opening, another spokesperson said Minneapolis had "one of the best inland harbors in the United States." (St. Paul Dispatch 1963: 3; Paquette 1960: 52)

But doubts still remained. Despite the ceremonies at the St. Anthony Locks, the first barge scheduled through the locks carried a load of pipe that was to come back down the river destined not for the tip of the southern hemisphere, but around the corner up the Minnesota River to a dock at Savage, Minnesota. Senator Eugene McCarthy said unenthusiastically that "I think all of us have known this is a marginal project. But we are accepting the judgment of the engineers that the project would repay what we put into it." Commissioner Brigadier General James C. Marshall, Minnesota's state highway commissioner, added, "We never could justify the project except as a work relief project." McCarthy stressed, however, that he thought "the project would look better as the years go by. It in no way interferes with development taking place in St. Paul or on the Minnesota River." Perhaps he was right. No one doubted the engineering feats of the project. The Upp%r Lock at St. Anthony received an award in 1963 from the National Society of Professional Engineers as one of the "seven wonders of Engineering in Minnesota." Likewise, the Office of Chief of Engineers of the Army Corps awarded the St. Paul district the "Distinguished Engineering Achievement Award" for Design of the Upper Lock and Upper Harbor Development in 1966. Just as important, river traffic through the locks was substantial. By 1968, river traffic totalling 1,459,639 tons moved through the new facility and the hope remained that it would continue to increase so that the millions spent on the project could be justified. (Department of the Army Corps of Engineers 1976; St. Paul Dispatch 1963: 3; Merritt 1979: 149)

St. Anthony Falls Lower Lock and Dam:

The lower lock and dam at St. Anthony Falls is located on what was once the lower rapids but which were altered when a dam was constructed to capture hydroelectric power in 1897 (see discussion below on the lower falls hydro station). The lock was built on the right side of the river and measures 56 by 400 feet, consistent with the lock cham"er on Lock No. 1 below it. The dam, which replaced the old dam at the site, contains four Tainter gate sections. Each Tainter gate measured fifty-six feet wide and nineteen feet high and is operated by a fixed electric house mounted in the service bridge. The Tainter gates, which had prevailed in earlier sites below the dam, were chosen because they would not raise flood heights in the spring. (Engineering News-Record 1951a: 38; Minneapolis Tribune 1948: 1) This section of the dam is 290 feet long from the first pier to the site for the planned auxiliary lock which is adjacent to, and riverward of, the lower lock. In addition, a 230 foot non-overflow section was constructed which joined with Pier No. 1 and angled upstream tying in to the upstream and riverward corner of the foundation of what was then the St. Anthony Water Power Company's powerhouse. (Engineering News-Record 1951a: 38)

The design of the lower structure had some novel features, which were heavily influenced by careful studies conducted by the Army Corps of Engineers. Borings were made to learn more about rock formation. Engineering models were built during an intensive study of the hydraulic problems. The models, based on studies conducted at the University of Minnesota's St. Anthony Falls laboratory located a short distance from the site, simulated river conditions in the stretch of the river from the Washington Avenue bridge to the Hennepin Avenue bridge. (Engineering News-Record 1951a: 39; Greater Minneapolis 1961: 17) Data obtained was used in determining the design and location of the locks and dams. Current conditions under the existing and modified regime of the river were observed. Placement of the principal structures were studied to effect the best possible navigation conditions consistent with the least detriment to the operation and safety of power installations, bridges and other properties adjacent to the river. Protective devices were provided when indicated by the models to be necessary. (Greater Minneapolis 1961: 17)

The hydraulic system for the lower lock accordingly was modified from the standard Mississippi River locks. First the lock would be filled and emptied through a single wall discharge diffuser system with tunnels in the walls and openings in the floor. The upper gate of the lower lock, moreover, was equipped with a submersible Tainter gate rather than the conventional miter gate. The Tainter gate was adopted in order that the lower lock could be used as an auxiliary controlled spillway during flood periods and expedite filling of the lock chamber. The Tainter gate was electrically operated while the miter gates were moved by hydraulic pressure above. (Engineering News-Record 1951a: 38; Greater Minneapolis 1961: 38)

Lower Lock and Dam--Construction History:

The lower lock with its twenty-five foot lift, and dam were constructed between 1950 and 1956 by Johnson-Kiewit, a joint venture of the Al Johnson Construction Company of Minneapolis and the Peter Kiewit Sons' Company of Omaha. (Engineering News-Record 1951a: 39; Engineering News-Record 1951b: 43) The construction faced many unusual problems posed by unique geological formations, tricky unwatering of the construction area, and proximity to urban developments, but the construction company surmounted them as work progressed.

Construction of the lower lock and dam began on July 17,

1950. Work on the first cofferdam, which enclosed the power plant of the St. Anthony Water Power Company and the northern two piers of the new dam faced some difficulty. The cofferdam, made up of steel sheet pile cells in the river arm, was exposed to the river current. The upstream and downstream arms of the cofferdam, those tying the ends of the river arm into the river bank, were earth fills. The seventeen cells in the river arm were driven about two feet into the sandstone in a previously excavated trench. Although the cofferdam was well built, two twelve-inch electric pumps were unable to unwater it. Investigation disclosed that the inflow was coming through seams in the sandstone beneath the lower ends of the cofferdam cells. To correct this trouble and insure excavating in a dry environment, the contractors decided the only thing to do was to drive a full-circle of steel sheet pile cut-off wall inside the original cofferdam. This cut-off wall was driven right through the sandstone eleven feet below the deepest excavation. Later, flood waters on the Mississippi rose so high at the site in the spring of 1951 that it was necessary to flood the cofferdam shutting down work for one and one-half months. (Engineering News-Record 1951a: 39; Engineering News-Record 1951b: 39, 43; Annual Report 1951: 1233) Such delays set the project far behind schedule and by the end of fiscal year 1951, the construction was only 5.5 percent complete. (Engineering News-Record 1951a: 39; Annual Report 1951: 1233)

Attempts to make up for lost time were partially successful in the following year. Work in the first cofferdam was substantially completed incuding construction of the training wall, non-overflow section of the dam and piers one and two. Moreover, construction of cofferdam No. 2, which enclosed the remaining portion of the movable section of the dam, had been started. (Annual Report 1952: 1171; Engineering News-Record 1951a: 39) By the end of fiscal year 1953, progress continued since the project moved from 20.9 to 41.9 percent complete. Construction of Pier 4 in cofferdam No. 2 was partially completed and the cofferdam for the lock area--cofferdam No. 3--was constructed during the year. The rock apron through Pier 2 and downstream of Pier 4 was placed and fabrication of the gates and machinery was carried on and completed units were shipped and stored. (Annual Report 1953: 1041; Engineering News-Record 1951a: 39)

The construction, however, still remained behind schedule. The construction was supposed to be completed by December 31, 1953, according to the original plans, but by July 1, 1953, it was only 65.7 percent complete. In the previous year, construction had been entirely in cofferdam No. 3, which included the lock area. By the end of fiscal year 1954, work had included the completion of the lock structure except for the central control station and gate adjustment, substantial completion of the dam and erection of the Tainter and miter gates. In all, the contract was 85.7 percent complete. (Annual Report 1955: 1083) The following year saw the basic completion of the contract. The guide walls were completed, and work continued on the central control station, and was initiated on cofferdam removal, plcing backfill, testing gates and miscellaneous items. By September 1956, the lower lock and dam was complete. (Annual Reports 1956: 1254; 1957: 1211; Minneapolis Star and Tribune 1956: 1)

St. Anthony Falls Upper Lock:

A timber apron over St. Anthony Falls had been built in the 1870s to stop the upstream progression and to preserve the falls. In 1951, a flood destroyed the timber arpon and it was replaced by a more permanent concrete apron. Since this fixed dam was in place, the Upper Harbor project on the upper falls needed only to construct a lock to extend navigation. But with a lift of 49.2 feet, the single lock provided many engineering challenges and cost over $18 million to build. Originally, construction on the upper lock was to begin when the lower lock had progressed sufficiently in about 1951. But delays at the lower site and continuing questions about the desirability of the project delayed work until November 1959. (Minneapolis Tribune 1948: 1; Greater Minneapolis 1961: 30) Like the lock below it, the chamber measured 56 feet by 400 feet, but unlike it, both gates were of the miter type. Hydraulic studies also facilitated the construction of the lock. (Greater Minneapolis 1961: 31)

Upper Lock--Construction History:

The contract for the upper lock was awarded to the joint company, formed to build the lower lock and dam, between Al Johnson Construction Company and Peter Kiewit Sons' Company. Ground was broken in November of 1959 and early work concentrated on excavation of ledge limestone, temporary roads, cofferdams and the training dike. Again like the lower lock, the construction of the upper lock presented many engineering problems. The terrain of the upper lock, for example, was particularly hard to prepare. Prevented from dynamiting for city safety reasons, the task of removing a tough limestone cap was solved by dropping a five-ton frost ball, followed by drilling wedging, and bulldozing the pieces. Next, the cofferdam was built and it, too, was problematical. It consisted of steel sheet piling interlocked and filled with sand and rock. Because of the highly permeable material, however, unwatering at first proved difficult. Fifty-two foot-long deep-seated sheet piling was driven inside the cofferdam to fifty feet below the river level. The sheet piling was jetted with high pressure jets specially designed by the contractor. By the end of fiscal year 1960, the project was about 9 percent complete. (Annual Report 1960: 1256; Greater Minneapolis 1961: 31; Construction Craftsman 1963: 12)

With this complete, and excavation for the bed of the lock carved out to forty feet below the water level, the unwatering of the construction area was performed. Water was pumped through filtered sumps to depths of twenty-eight feet. Below that, it was removed through a series of filtered wall points jetted into position at locations six feet inside the steel wall. In fiscal year 1961 construction and unwatering of cofferdam Nos. 1 and 2 was completed and concrete pouring began. During pouring operations, extra heavy reinforcing steel was embedded in the concrete to give added strength to the floor and walls. The heaviest steel bars were two and one-fourth inches in diameter and thirty-five feet in length, reported to be the "largest ever used in this area." Wooden panel forms were built in sections to hold and form, section by section, the concrete monoliths that would become the walls of the lock. In fiscal year 1961, about 800,000 cubic yards of concrete was placed bringing the contract as a whole to about 53 percent complete. (Annual Report 1961: 1327; Construction Craftsman 1963: 14; Greater Minneapolis 1961: 31)

By mid-1962, foundation and masonry work for the lock structure was basically complete and the erection of the Tainter and miter gates was also brought to virtual completion. Work remained on the lower guard and guide walls, but the project as a whole was over four-fifths complete. (Annual Report 1962: 1354) This work continued in the followig year and by July 1, the project was 96 percent complete with only cosmetic work remaining. The lock was dedicated by civic and political leaders on September 21, 1963. (Annual Reports 1963: 1207; 1964: 1104; St. Paul Dispatch 1963: 3)

Other Work:

The St. Anthony Locks and Dam project required two major tasks in conjunction with the construction of the locks and dam. The river had to be dredged to provide the channel with a depth of 9 feet and a width of 150 feet and bridges had to be altered to enable river traffic to move under them. The dredging, which required the removal of over a million cubic yards of sand, gravel, rocks, snags, stumps, logs and other objects obstructive to navigation, was completed in a series of projects. The first contract began in the fall of 1948 when 40,000 cubic yards were dredged just below the falls. Next, a second contract completed in November of 1950 removed 280,000 cubic yards of material in the approach to the lower lock and dam. Finally, in June of 1961, a portable hydraulic dredge eighty feet long and thirty feet wide moved in to deepen the final three and one-half miles of the channel above the Upper Lock, a project completed in fiscal year 1963. Both the dredging contracts between 1948 and 1950 were performed by Dunbar and Sullivan Dredging Company of Detroit. (Annual Reports 1951: 1233; 1961: 1327; 1963: 1207; Engineering News-Record 1951a: 38, 39; Greater Minneapolis 1961: 15)

Fifteen bridges had to be altered in the project that would permit navigation with a vertical clearance of twenty-six feet. Some merely needed additional pier protection such as the Northern Pacific Railroad bridge, while others, such as the Minneapolis-Western Railroad bridge, were completely dismantled since they were obsolete. (House Document 33, 1956: 14; Senate Document 54, 1941: 6) The most extensive alteration was made to the Stone Arch bridge near the construction site. Under a contact with Johnson-Kiewit, a portion of the bridge was rebuilt to make room beneath it. The alteration involved removing a pier and two adjoining arches and installing a steel truss span so that rail traffic could continue on the bridge on an uninterruptive basis. Contract work began in fiscal year 1961 and was brought to completion in fiscal year 1963. (Annual Reports 1961: 1327; 1963: 1207; Greater Minneapolis 1961: 30)

8. LOWER ST. ANTHONY FALLS HYDROSTATION AND WASTEWAY NO. 2:

The basis for the development of hydroelectic power on the lower falls of St. Anthony was set when the Minneapolis Mill and the St. Anthony Falls Water Power Company were purchased by a single firm, the Pillsbury-Washburn Flour Mills Company, Ltd. This new firm controlled not only most of the developed water power at the Falls, but also the rights to the undeveloped water power below them. It was in this section just below the main falls, called the St. Anthony Rapids before the power was developed, that the dam and powerhouse were built to harness the power unleashed by the river. (Kane 1966: 146; Burch 1900: 13; Electrical Works 1897: 149) One journalist, prone to the hyperbole of his day, wrote that the lower hydrostation "marks the achievement of a great enterprise, in scope and character second only, perhaps to the hydraulic work which has made the waters of Niagara the servant of a vast territory." (Electrical Engineer 1897: 581) The hydrostation probably was not that important, but it was a significant development in the creation and diffusion of electric power. Moreover, its construction led to litigation regarding riparian rights that eventually found its way to the Minnesota Supreme Court.

Shortly after the Pillsbury-Washburn Flour Mills Company was formed, rumors began to circulate that the lower rapids would indeed be developed. The Weekly Northwestern Miller, for example, reported in April of 1890 that the proposed plans to further develop Minneapolis water power were receiving wide circulation. Speculation, moreover, increased when Richard H. Glyn, head of the British syndicate which owned much of the new firm, appeared in Minneapolis. (Weekly Northwestern Miller 1890b: 423) Two months before, the Weekly Northwestern Miller had discussed the possibility of developing power at the St. Anthony Rapids or at Meeker Island. The plan for the former included the construction of a dam across the east channel of the river and diversion of the water into it. In the April report, the plan was altered so that a canal would be built in addition to a dam and that water would be diverted through it in order to create the power. (Weekly Northwestern Miller 1890a: 171; Weekly Northwestern Miller 1890b: 423)

In either case, the optimism about the power potentialities led to some exaggeration. One early report argued that 25,000 horsepower could be created, two and one-half times what eventually was produced. While the later canal plan noted that the only 12.000-horsepower would be developed from the fall of twenty-two feet, it argued that the 1,200 foot long dam constructed of stone, and 300 and 400 foot canal would cost only $500,000. (Weekly Northwestern Miller 1890a: 171; Weekly Northwestern Miller 1890b: 423) The Minneapolis Tribune also reported the potential plansfor new power at the St. Anthony Rapids and declared that "there is no reason . . . why the flour milling business of Minneapolis should not be increased to twice its present size with a new supply of cheap and reliable water power." (Minneapolis Tribune 1890: 4)

Reports on the potential construction of the dam and power plant ebbed and flowed in the early nineties. Speculation was partly based on the knowledge that "quite a lump of money" had been set aside at the time of the Pillsbury-Washburn Company merger for the improvement of the power in addition to the confidence of Senator C. C. Washburn that such power would be developed. Rumors resurfaced in November of 1890 when the Minneapolis Tribune reported that the project "which was agitated about a year ago, was revived and the indications now are that the millers intended to carry out the scheme reported at that time." Work, according to the paper, would begin in the spring of 1891. Although the plans were not totally complete, the dam would be about twenty feet high and a canal or raceway would be built necessitating the removal of the shanties occupying Bohemian Flats below it. The cost of improvement was a more realistic $1,000,000 and water power developed was set at 50 percent of the total power then being produced at the falls. The Tribune noted, however, that the improvement would not be used by the present mills and the "ultimate result will naturally be its utilization for new manufacturing enterprises." The principal rumor was that the street railway company would use the power, a rumor which later came true. (Minneapolis Tribune 1890: 5)

Yet another year later in 1891, talk about hydroelectric power development at the lower falls continued. Sydney T. Klein, a British director of Pillsbury-Washburn, in an interview of November 20, 1891, argued that water power could be improved still further than had been done in the past few years and possibly double the available power by building another station and improving the facilities that already existed at the upper dam. There was great demand for water power, he argued, due to the high price for fuel for producing steam power in the area. Moreover, the recent changes in ownership of the two water power interests which merged into one company was of "incalcuable" importance since, instead of competing with one another, they could now cooperate to create the best possible design. (Weekly Northwestern Miller 1891: 719) Talk and planning continued. The erection of a dam at the lower rapids was determined to be the most feasible plan and arrangements were made for the construction work. Those arrangements, however, were not completed before the great economic crash in 1893. The directors of the Pillsbury-Washburn Company became nervous as the Depression worsened and as the British capitalists in the firm were particularly concerned, the project was delayed. (Minneapolis Times 1894: 17)

Finally, plans were finalized to construct a dam and power station in 1895. "This is great," the Minneapolis Times trumpeted in its headline, adding that "one of the immense improvements, the like of which makes a metropolis thrive and increase in supremacy along her particular lines of greatness, )s on the tapis for Minneapolis." The plan, according to the Times, were to increase water power by 12,000 horsepower or one-quarter of what already existed. Again hyperbolic, the paper noted that "by this improvement the city will become supreme as a manufacturing point; it will have the greatest utilized waterpower in the country." The Times reported that Charles A. Pillsbury was on his way to Europe to meet with the British capitalists in London and finalize plans. (Minneapolis Times 1894: 17)

The Weekly Northwestern Miller reiterated the enthusiasm for the power development. "There probably is no water power improvement in progress in the United States," it wrote, "which equals in importance the new dam that is now in construction for the further development of the power at Minneapolis." (Weekly Northwestern Miller 1896: 409) The Minneapolis Times, in spite of its earlier ebullience, coyly suggested that such important work was being carried on with self-confidence. "With a dignified silence, befitting the greatness of the work," it noted, "C. A. Pillsbury and other wealthy citizens of this great and far-famed city, are unostentatiously erecting one of the largest structures of its kind in the country. . . . They are building a new dam across the river in order to utilize the great water power existing there, and hitherto unemployed. It is a great undertaking, both from a financial and engineering point of view and one that, in the boom days of our great city, would have been heralded by press and public far and wide. That was when our town was young and, like all young people, loved to tell all it knew with an unbounded enthusiasm delightful to see; but now that we are more sedate, we go ahead and do things without letting our left hand know what our right hand doeth . . . and that is why [Pillsbury] had men and teams at work on his present great enterprise before the press and public knew he really meant to dam the stream and utilize its power." (Minneapolis Times 1895: 10A)

The plans to build the dam and lower hydrostation were heavily influenced by the desire of the Twin City Rapid Transit Company to utilize the power. In early 1895, it was reported that should the power be developed, the streetcar company would contract to take and pay for 3,000 horsepower the moment it was ready for use. C. A. Pillsbury immediately brought the proposition to appropriate funds before the stockholders in London. The construction of the dam, powerhouse and other appurtenances would cost about $750,000, but the Twin City Rapid Transit Company would immediately lease the power since it would provide a savings of thousands of dollars over the steam power presently used. Thomas Lowry, president of the streetcar company, accompanied Pillsbury to London to assure the stockholders that the investment was a good one. As the Weekly Northwestern Miller succinctly put it, "the project of thus further developing the power of the falls is not a new one, as the plans and estimates now in existence were made three or four years ago. The only new element in it is the proposal of the street railway company to take power, and this was deemed of enough importance to warrant the submission, at this time, of the proposition to go on with the improvements, to those who would be expected to furnish the necessary capital." (Weekly Northwestern Miller 1895a: 6)

The negotiations with the Twin City Rapid Transit Company, however, reached a snag shortly after the meeting with the London capitalists and were declared off. But the English stockholders were convinced of the feasibility of the plan and the substantial returns to be obtained, so they took the matter up and decided to proceed with the improvement and to handle the power distribution through their own company. They thus cabled to C. A. Pillsbury from London and he quietly inaugurated the work. (Weekly Northwestern Miller 1895b: 818b) As the work commenced, agreements were finally reached with the Twin City Rapid Transit Company which signed a forty-year lease which scaled the charges to variable production. For each of the first 6,000 horsepower the annual rental was $23, for the next 3,000, $10, and for over that amount, nothing. (Electrical Engineer 1897b: 581; Kane 1966: 154; Electrical World 1897: 149; Electrical Engineer 1897a: 107; American Electrician 1898: 185) The street railway company owned and operated four steam plants with a capacity of 11,500 horsepower, but with the water power, they could consolidate their steam power into one large power station, enjoy the savings due to cheap water power, decreased labor expense, repair expenses and distribution costs. (Electrical Engineer 1897a: 107; Burch 1900: 23)

Even the ethnic community was thrilled with the hydro-station. Svenska Amerikanska Posten on May 21, 1895, called it "an extraordinary project." Emphasizing the creation of jobs, the Swedish paper noted that one hundred men were presently working on the project and about one thousand eventually would be employed. Moreover, it reported that many of the "squatters" who were driven from their homes by condemnation of the Bohemian Flats would, as a compensation, receive employment at the dam-building project for a period of two years, an interesting pro quid quo in an era before large-scale federal government intervention. (Svenska Amerikansak Posten [Minneapolis] 1895)

William de la Barre, who was the hydraulic engineer of the project, planned construction beginning in 1895. Work on what was termed "De la Barre's Folly" by some was completed two years later at a total cost of $953,332. The general plan of construction was to build a dam directly across about two-thirds of the main river, then making an obtuse angle run diagonally across towards the east bank to a power station at the foot of the headrace. The walls of the headrace were built first, and on the dry east bank the great waste gates were installed and the power station foundations were completed all during 1895. (Kane 1966: 154; Burch 1900: 13)

In 1896, the water of the entire river was deflected form its old bed into the new canal near the power station and sent through the waste gates and also under the power station. A cofferdam was then built across the old bed of the river. The main dam, which was located about 2,200 feet below the main falls, was started and was nearly completed before the winter ended the season's construction. In the spring of 1897, a disastrous flood, amounting to 60,000 cubic feet per second, swept away the coping and other portions of this section. In repairing this break, a rock-filled, timber-framed approach, lined with steel plate was built in front of this section of the main dam, in order to ease the battering which piers, logs and ice gave the structure. (Burch 1900: 13)

The last stone in the new dam was laid when William de la Barre, acting as master of ceremonies, permitted Thomas Lowry and Charles A. Pillsbury to guide the final block of granite near the west end of the dam. Each made short speeches celebrating the opening. Lowry, for example, argued that the completion of the dam marked one of the great engineering feats of the present century, that nothing like it had ever been accomplished before, and that it had surpassed in significance even the great Niagara. The others were not quite so dramatic. (Minneapolis Tribune 1897: 16) The Minneapolis Tribune said the hydrostation would usher in "a new Minneapolis era." "Through the construction of this dam," it wrote, "is to be suddenly added to the industrial potency of Minneapolis another water power of some 10,000 horsepower capacity, and a power that will be steadier and more reliable at all seasons than the power at the falls. . . . The important fact is that a power equal to 10,000 horsepower is to be added to the physical energy of Minneapolis to be applied to industrial operation, effecting a saving of the enormous amount of coal or other fuel that would be required to produce such a power. The discovery of a coal mine in this vicinity would be counted a fact of great significance," the paper concluded. "But in this new operation of water power, we have, in effect, a perpetual coal mine--one which will never by exhausted, for its power will continue so long as the ages roll and the power of gravitation endures." (Minneapolis Tribune 1896: 21)

On the eve of that new Minneapolis era, however, a group led by A. H. Hedderly and William W. Eastman brought suit against the water power companies for removal of the dam. They claimed that the ripanian rights attached to their 2,500 feet frontage on the west bank of the river had sufficient water to create 4,000 horsepower. The water power companies decided to contest the suit rather than seek a compromise, the result of which found that the power house and dam could remain undisturbed in a decision rendered in January of 1900. According to Judge Simpson of the District Court, de la Barre's contention that the Hedderly tract had no water power potential was correct and the case was dismissed. (Kane 1966: 155, 204, 203)

The case was taken to a higher court by Hedderly and Eastman and in March of 1901, the Minnesota Supreme Court upheld all the points used by the lower court to render its ruling. The power station and dam could remain, which was obviously good news to their owners who had invested nearly $1 million in them. Both trials were significant in Minnesota's judicial history. The first trial in District Court was notable because of its great length, consuming twenty-one days and the voluminous technical testimony. The record of the appeal was the longest and most complicated which the Supreme Court had ever taken including over 2,000 printed pages in addition to 120 maps and exhibits. These trials presaged an era when technical decisions become commonplace. (Weekly Northwestern Miller 1901: 647; Minneapolis Tribune 1901a: 1; Minneapolis Tribune 1901b: 10)

The Lower Hydrostation and Dam Structures:

The system of the hydrostation and dam at lower St. Anthony Falls can be grouped around three components of the system: the dam, the powerhouse structure and the internal machinery within the powerhouse. Although all three components were in use for decades, the powerhouse structure is the only one intact.

In the original plan in 1895, the dam was to be 820 feet long. The completed dam, however, in actuality measured 1,085 feet. The dams varied in height from fourteen to sixteen feet above the river bed. Below the superstructure was a three-foot base of concrete thirty-eight feet wide. The base was especially well reinforced by a rubble rock and concrete dike construction in the sandstone below the crest line and at the toe of the dam to prevent undermining. The face of the dam was perpendicular while the downstream side was sloped to ease the momentum of the water and discharge it horozontally, thus preventing an undertow which might be dangerous for the structure. At the bottom, therefore, the dam was eighteen feet wide while at its top only seven feet. (Minneapolis Tribune 1897: 1; Weekly Northwestern Miller 1895: 818b; Burch 1900: 16) The main structure was of limestone from the quarries on the east bank of the river. The facings were made of St. Cloud granite. The coping was lined with skeleton steel plate and the base of the dam with steel rails in fifteen-foot lengths laid side by side in cement. (Burch 1900: 16)

Despite this basic plan, the 1,085 feet of the dam contained a group of different features as it spanned the river. The powerhouse was built out in the river in a southwesterly direction actually forming part of the dam. At the river side of the powerhouse was a log sluice, 6 feet wide and 200 feet long with stone wall and concrete bottom covered with railroad iron laid in cement. From the log sluice the dam began in a westerly direction up the river. This section was fifty feet long, twelve and one-half feet above the bed of the river, and extended sixteen feet below the river bed. Between this section and the second were two bear-trap gates each fifty feet long operated by water pressure. The first section of the dam was of solid masonry. The second section, 444 feet long and 14 feet above the river, was similar to the first. The third section ran almost directly south and measured 366 feet. It was thirteen feet above the river bed and had almost the same general construction as sections one and two with granite coping. Between this section and the bank of the river was another bear-trap gate fifty feet wide, similarly constructed to the two on the powerhouse side of the river. Between the bear-trap gate and the bank was a second log sluice similar in character to the one on the other side. (Burch 1900: 16; Electrical Engineer 1897: 582; American Electrician 1898: 187)

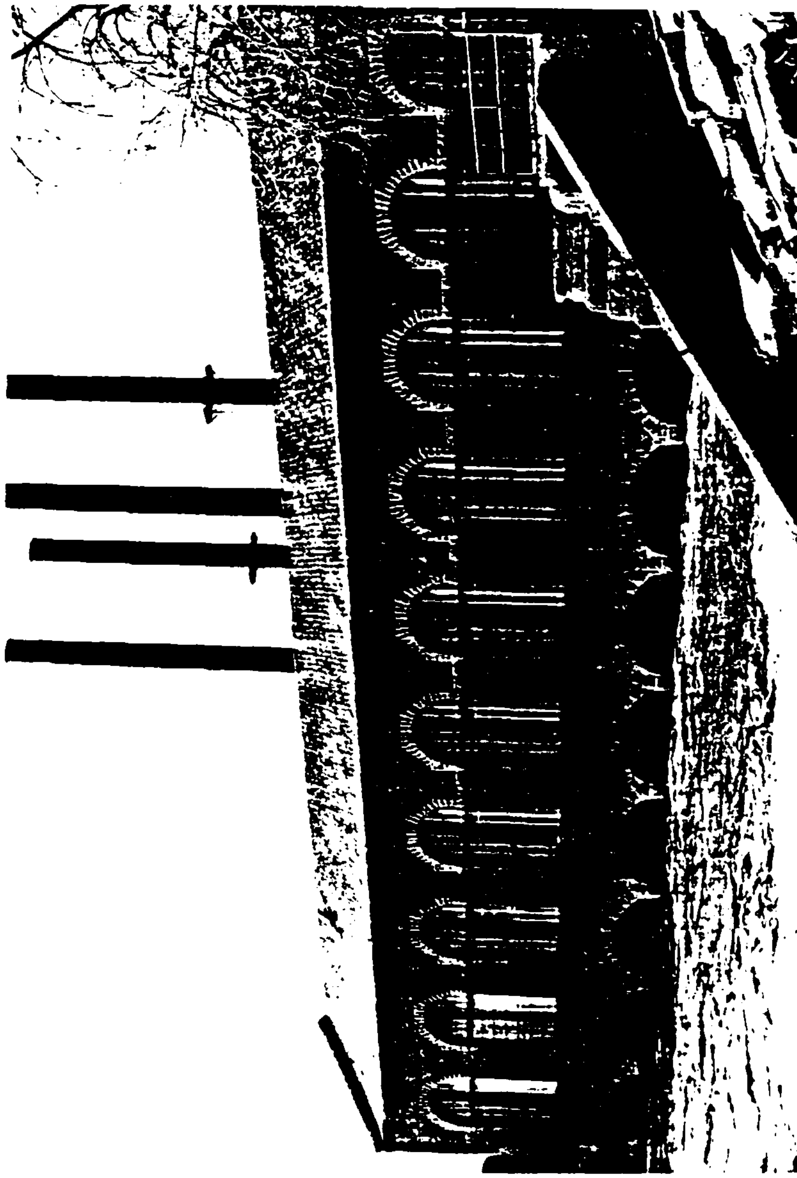
The powerhouse was situated on the northeast side of the Mississippi, about 100 feet below the Tenth Avenue bridge and just below the milling district. It formed 200 feet of the dam, but inside was one large room 250 feet long, from 45 to 55 feet wide, and 50 feet high. The station was heated by electric heaters and a twenty ton travelling crane was provided. The wheel chambers were outside the powerhouse proper and ran nearly its entire length. The steel chamber was 43 feet wide making the width of the powerhouse and wheel chamber 100 feet. A drop of between sixteen and twenty-two feet at the powerhouse provided plenty of power to turn the wheels, of which a total of forty could be placed in the building. (Minneapolis Tribune 1897: 1; Weekly Northwestern Miller 1895: 818b; Burch 1900: 16; Electrical Engineer 1897: 583)

The powerhouse was built on solid sandstone. First, a concrete base, the present tail-race floor and foundation for the tail-race arches, was laid two feet thick under the power-station. The turbine chambers and the tail-race arches were spaced horizontally twenty feet apart from center to center. Large sluice gates allowed a bypass from the water in front of the chambers to the race below. In front of the entrance to the turbine chambers, a structural steel framework was formed to support the racks that prevented the entrance of floating logs, bark and ice. (Burch 1900: 16) The building was supposedly of fireproof construction, the framework and roof trusses and roof of tile covered with cement, finished with roofing slate and galvanized iron cornices. (Electrical Engineer 1897: 482)

In the water chamber were the main water wheels for the plan manufactured by Stillwell-Bierce and Smith-Vaile Company and were of the Victor type. Each power unit consisted of four such horizontal turbines each 42 inches in diameter and running at a speed of 130 revolutions per minute. The capacity of each unit was approximately 1,150 horsepower on 20 feet acting head at 130 revolutions per minute. The turbines were set about halfway between the elevation of water in the head and the tail-race. The method of installing the wheels was considered an "innovation in low head work and forms and an exceedingly compact and efficient unit." (American Electrician 1898: 189) The optimal speed of 130 revolutions per minute was maintained by the governors manufactured by Lombard Water Wheel Governor Company. (American Electrician 1898: 189) Since the turbine ran best at that speed, thse centrifugal governors controlled the turbine gate openings. (Burch 1900: 19)

Each 1,150 horsepower turbine was directly connected to a 1,000 horsepower electric generator, the turbine shaft passing through a water-tight flume cover into the generating room. All the electrical apparatus installed in the plant was manufactured by the General Electric Company. In the main station were installed 700 kilowatt three-phase generators. These

LOWER HYDRO STATION--ST. ANTHONY FALLS



General Electric machines were "of the well known" type built of aminae thoroughly insulated from each other by a coating of japan. All the electric power was carried to a switchboard in the gallery. The station switchboard was designed to have two separate sets of busbars so the operating electrician could run any particular machine on either of the two busbars. The electrician thus could start the generation of current, vary amount and read from the meters the amount developed. By means of switches, varying amounts were sent to the different sub-stations of the railway company to meet the changing conditions of load and service. One contemporary noted that "exhaustive study was made of the most modern electric plants in the country for the most improved methods of transmitting and distributing large blocks of power over long distances." (Burch 1900: 28)

Given the 10,000 horsepower at the dam, the problem was to convert the power into electrical energy that could be distributed over two cities. Generation and transmission for sixty cars near the point was achieved through 2,000 horsepower using low-voltage direct current. The transmitting of the large blocks of current over long distances required alternating current. Accordingly, 8,000 horsepower was sent to four sub-stations as far away as St. Paul, using the alternating current. The need to use small conductors and high pressures in order to transmit blocks of electric power as far a nine miles necessitated the use of 12,000 volts of pressure, extraordinarily high for the time. In fact, this "was the highest pressure heretofore carried for heavy power distribution in underground cables, and many were the prophesies of failure." (Burch 1900: 28-29) Both the transformers and rotary converters were very similar to those used in the transmission between the Niagara Falls powerhouse and the powerhouse of the Niagara Street station of the Buffalo Street Railway. (Electrical Engineer 1897: 583) A local paper summed up the structure of the station thus: "In many respects the scheme which will be used is the most perfect, and at the same time is said to be the best that has ever been tried in the world. Everything has been done with the idea of economy of friction and power. It has all been the work of William de la Barre, and will stand as a monument to his ability as an engineer." (Minneapolis Tribune 1896: 21)

The lower falls hydrostation certainly was of importance. One observer argued that this was the first case where energy was transmitted so long a distance at such a higher pressure underground. Moreover, this transmission went to a large inter-urban road, what one man called "the longest electric railway in line in the world." (Burch 1900: 33) The performance of the station, however, was anticlimatic following the optimism at the opening of the station and the hyperbole during its construction. As we have seen, when the hydrostation was built, it was thought it would be sufficient for the needs of the street railway company and that there would be surplus power available for other purposes. Within four years, however, its capacity was outgrown. The Twin City Rapid

Transit Company built a steam station at the east end of the Tenth Avenue bridge adjacent to the water powerstation. Steam power was increased to 60,000 kilowatt capacity. When the Twin City Rapid Transit Company finally abandoned the lower dam plant, they were converted for the use of Northern States Power which upgraded the system. Moreover, the dam was removed when the federal government built the lower lock and dam in the Upper Harbor project. The original machinery of the hydrostation is no longer in use and the hydrostation stands empty used only for storage. The framework of the structure, however, is still used by N.S.P. for power generation. Outdoor units built by the Leffel Company have been added to the system. Positioned upstream from the original intakes, they create power thereby eliminating intakes into the powerhouse itself. (Kane 1966: 174)

Wasteway No. 2:

After St. Anthony Falls nearly dissipated into a series of rapids in the late 1860s, attempts were made by the city of Minneapolis to secure federal monies to maintain that important cateract. In 1870, Congress appropriated $50,000 to preserve the St. Anthony Falls by building an apron to protect them. (Kane 1966: 76) Throughout the latter part of the nineteenth century, work was continued to preserve the falls. Floods still occurred and logs and ice battered the dam. When management was unified under the Pillsbury-Washburn Flour Mills Company, Ltd., the quibbling that had once occurred between competing firms was ended because of unified management. William de la Barre, hydraulic engineer for the company, noted in a letter to a London stockholder in 1898, that "we keep up eternal attention and vigilance and permit nothing to get away from us that human skill can stay." He was able to repair the apron which was damaged in the 1891 and 1894 floods and in 1894 he built the first spillway costing $105,000 to carry flood waters over the falls. Another flood in 1897 made a second spillway appear necessary. Built at a cost of $150,000, it was located on the left bank of the river. (Kane 1966: 149)

Wasteway No. 2, as it became known, had walls and headgate piers built of masonry stone and the slope on the lower end built of timber. Five headgates built of timber with motor controls were completed in 1898. This wasteway was partly redecked with timber and bottom slope and partly riprapped with derrickstone in 1952 replacing the timber that had been washed out in 1952. The structure stands much as it did earlier on the falls. (C. E. Pinak, Superintendent of St. Anthony Falls Water Power Company to A. R. Renquist, Legal Department of Northern States Power Company, March 5, 1953)

## 9. RESULTS AND EVALUATION

The Mississippi River has been an extremely important factor in the history of the upper Middle West, a factor that is too often ignored or understated. Important landmarks such as Fort Snelling at the confluence of the Mississippi and Minnesota Rivers stand in mute testimony to the importance of the rivers in early trade. The city of Minneapolis, the metropolitan center of the upper Middle West, was settled around St. Anthony Falls, the largest cateract along the length of the river which provided necessary water power. The City of Mills could only become so because of the Falls which, as we have seen, were still being developed for water power as late as 1897. The river not only provided power for manufacturing, but it lent itself to use as a transportational artery. Towns, which were once great commercial points centered around the connection between land and water, still dot the river shore. Some urban areas have persisted, but log rafting centers such as Reed's Landing or grain entrepots such as McGregor have declined from the thriving era they once knew.

For while the river was an important transportational route, land transportation, particularly in the form the railroads, eventually superceded the importance of the river. In an era of untrammeled free enterprise, the railroad companies were able to destroy the commerce on the Mississippi. After the pineries of the north gave out, the river traffic largely ceased around the turn of the century. That did not mean the river was not important, however, as rates set by the Interstate Commerce Commission were often based on the competition that could exist between the river and the rail. Political and civic leaders in the upper Middle West continually were calling for improvements of the river which might revitalize the once-great river traffic since "river regulation was rate regulation." But if traffic were not revived, at least the improvement would maintain their cities' status on a "wet-land" rate basis.

Only decades after the railroad had become supreme, however, difficulties were becoming more and more apparent in its transportational services to the upper Middle West. Periods of railroad congestion and car shortages revealed only too clearly that the railways were becoming less capable of handling the transportation needs of the upper Middle West. With the waterway trade prostrate, civic leaders became more vociferous in calling for improvement of the Mississippi River to encourage private carriers. Moreover, as the rail rates increased and railroads became more crowded, the Panama Canal opened which reduced the transportation costs between the American coasts. Middle Westerners argued that transportational developments were in effect setting up toll gates around their region. Finally, the Interstate Commerce Commission decided that the river was no longer a factor in influencing rates in the early 1920s. Recognizing what had been fact for decades, the Indiana Rate Case ruled that railroads no longer needed to reduce their rates in order to compete with the waterway. The upper Middle West, including the Twin Cities, were considered dry-land areas and rates zoomed upward.

The import of these developments was not lost on the civic and political leaders in Iowa, Minnesota and Wisconsin. These states, in addition to the others in the Mississippi Valley, possessed considerable political clout. Residents of the Mississippi Valley, for example, constituted over one-half of the population of the United States in the early twentieth century and produced the vast majority of its agricultural goods. Fears were developing, however, that the Middle West would lose much of the economic importance it possessed if some transportational changes were not made. Population was declining in the region and many attributed it to fewer industries locating in the region due to the prohibitive transportation costs. More frightening, other industries already present were relocating in order to lower their fixed costs of transportation.

Clearly, some improvement had to be made to facilitate non-land transportation. Development of the Mississippi River as an artery of commerce was one method that was advocated again and again by these spokespersons for the region. While regulation of the railroads remained an important goal, the waterway as another source which would move goods out of the region in lieu of the clogged railroad lines was stressed.

Throughout the development of these increasingly acute socio-economic concerns, waterway improvement projects were being carried on. Based on river contraction in order to increase river depth, attempts to achieve a six-foot channel were proving to be more apparent failures as the years passed. Stretches of the river which simply could not be adequately improved through contraction saw the construction of the first locks and dams to create slackwater navigation. A lock and dam in the Twin Cities was approved as early as 1894. Moreover, another structure was built near Hastings, Minnesota, in order to permit reliable navigation to the initial lock and dam in the later 1920s. While the Ohio River was being improved through a series of structural improvements, it began to appear that a systematic improvement would also be necessary on the upper Mississippi. By 1930, a plan using locks and dams to eventually create a nine-foot channel through systematic improvement was adopted. The structures, which would first create a reliable six-foot channel, were to be built first followed by those which would increase the depth to nine feet. All work, however, was aimed at the ultimate creation of a good nine-foot channel on the upper Mississippi.

This plan was the culmination of years of political pressure during and after an era when the Progressive movement had held sway. Premised on the notion that rational governmental actions could improve the functioning of the American system, the systematic improvement is a good example of that rationale. By comprehensively improving the Mississippi River through government action, commerce would be aided particularly in the Middle West. But although that improvement benefitted the Middle West most by providing an alternative transportational link, it also aided the entire nation by improving commerce. Moreover, the lock and dam plan was systematic. With a comprehensive method of improvement, engineering was improved and costs were lessened. The basic structure of each lock and dam had standard components. The lock chamber conformed to a standard size while most dams had a movable section, an earth-dike, and a spillway. In the movable section, basically standard Tainter gates and roller gates were utilized as the environment dictated.

Finally, the construction of the upper Mississippi River locks and dams is a good example of the change in federal government ideology. During the Hoover administration, the plan was for the locks and dams to be built slowly since costs were prohibitive to construct them in one single massive undertaking. The Roosevelt administration, which took office in the depths of the Great Depression of the 1930s, on the other hand, used the nine-foot channel project as a public works project covered in the National Industrial Recovery Act.

Every structure under survey, with the exception of Wasteway No. 2, could be nominated to the National Register of Historic Sites. Lock and Dam No. 1, for example, was the first major permanent lock structure on the upper Mississippi with a view toward improving navigation. It was of the modified Ambursen type dam and was constructed using rather new techniques of concrete placement. Moreover, it is the first dam in the St. Paul district which produces massive quantities of hydropower and only one of three that is in operation today to do so. Structural changes, however, have been made to the lock. The total rehabilitation, which cost $17,947,520, was recently completed. (Annual Report 1980: 29-32) As the photograph indicates, the control station on the lock has undergone considerable modification although the basic morphology of the lock structure has been retained. The dam and its novel Ambursen type has remained unchanged. Likewise, Lock and Dam No. 2 was built prior to the nine-foot channel project and serves in many ways as a prototype for the locks and dams to follow since its movable section consists of Tainter gates that would be frequently used in dams on the upper Mississippi. Finally, the locks and dam at St. Anthony Falls were marvelous engineering achievements which completed the nine-foot project particularly as Minneapolitans had envis-ioned it with an Upper Harbor above the Falls.

In view of the historical and architectural developments of waterway improvement, however, the locks and dams built during the massive nine-foot channel project of the 1930s are more fitting nominees to the National Register. They vividly represent the need for waterway improvement perceived by the upper Middle West which culminated in their construction. They illustrate the Progressive notion of systematic improvement through comprehensive waterway improvement. And they are a graphic example of the public works project undertaken during the Great Depression. Architecturally, they also represent that comprehensive system. Each lock and dam contains an unique configuration of basically standardized components and none has undergone any large-scale alteration. The movable section usually is composed of a combination of Tainter gates and roller gates according to the hydrology and geography of the site. The lock is a standard size, part of a standardization that began in the Ohio River project. Moreover, through the scientific use of hydraulic study, the system was ably constructed to improve navigation with as little alteration in other aspects of river usage as then was possible. A

LOCK AND DAM NO. 1
AFTER IMPROVEMENTS (1952)

hydraulic laboratory in Iowa City was the site of many studies which improved the system. (See Nelson 1935: 25-28) Finally, the comprehensive, systematic nature of the project allowed an economy of scale which permitted the whole project to be less expensive than earlier improvements such as the Ohio River project.

Within the comprehensive project, each lock and dam structure has its own unique characteristics which make it historically or architecturally significant. Lock and Dam No. 3, for example, was one of the later structures built, it has an artificially laid foundation, and the movable section consists solely of roller gates. Lock and Dam No. 4 is especially historically significant since it was the first project approved in the nine-foot channel era. Likewise, Lock and Dam No. 5 was built early in the project during the New Deal and it is the site of Franklin D. Roosevelt's historic visit in 1934 (which, incidentally, was the place where Minnesota Governor Floyd B. Olson met Roosevelt to discuss the violent Minnneapolis streetcar strike). (See Old Man River 1934: 1-2) Lock and Dam Nos. 5A, 6, 7, 8 and 9 are less important historically, but they still represent the comprehensive nine-foot channel project. Finally, Lock and Dam No. 10 is historically significant, like the other structures, because it was part of the important nine-foot channel project. Moreover, its design differs in that its roller gates are flanked by two separate sections of Tainter gates in the movable section of the dam. In spite of the importance of each structure, however, the strength of the system of improvement is greater than the sum of its constituent parts.

Finally, the hydroelectric station at the Lower Falls of St. Anthony was a significant development both in terms of the history of Minneapolis and in the technology of water power development. Its construction was permitted by the merger of two important hydropower companies and it resulted in litigation that produced the most voluminous testimony in the history of the Minnesota court system up to that point. Technologically, the hydrostation represents the most recent attempt to create power at St. Anthony Falls. Used to supply one of the largest inter-urban railway systems, power was transmitted a distance that some claimed was the highest pressure yet attained in underground transmission.

## 10. RECOMMENDATIONS

This report recommends that the Lock and Dam Nos. 3 through 10 should be nominated as a thematic resource to the National Register of Historic Sites. For the above reasons, these nine structures are of an extreme import to the transportational history of the upper Middle West. Moreover, carried out in a systematic fashion, all the locks and dams in this recommendation possess similar features which permitted the system to be completed at less expense, but with greater efficiency to later transportation. As far as can be determined, this was the first comprehensive system which used Tainter and roller gates to control a river. Both types of spillway crest gates had been used previously. The roller gate was developed in Europe also and its use spread rapidly to the United States. The Tainter gate originated in the North woods and was first made of timber. Owing to the unique characteristics of the river, a combination of gates was used to better control its flow.

If this thematic resource is to be nominated, however, further study should be undertaken by the Rock Island and St. Louis districts of the Army Corps of Engineers on the lock and dam structures that were built to the south of Lock and Dam No. 10. This research will uncover the historic and architectural importance of the locks and dams which were built somewhat later. My belief is that the locks and dams built in this district are of greater importance because they were built earlier and better reflect the initial structural design of the lock and dam system. Even Lock and Dam Nos. 3 and 9, for example, had modifications built into them which are not found on earlier structures such as Lock and Dam No. 4. If the Army Corps does not deem it advisable to conduct more research, a single structure might be considered for nomination. The best example, in my opinion, would be Lock and Dam No. 4, which was the first built and a good example of a combination of Tainter and roller gates in the structure. As I have tried to stress, however, a thematic nomination would be a more advisable course of action and I recommend that further work be undertaken to the south.

The Lower Dam Hydro Station is also recommended for inclusion on the National Register. Although this single structure is not as significant as the great Mississippi Lock and Dam system, such informed agencies as the Minnesota State Historic Preservation Office believe the station may be eligible for inclusion on the *National Register* of Historic Places based upon its age, architecture, and function as well as its relationship to the St. Anthony Falls Historic District. Moreover, as this report has tried to show, it was an important historic and technological site and its very location as the last power on the St. Anthony Falls is significant in itself.

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## 12. APPENDIX

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SCOPE OF WORK
HISTORICAL RESOURCES EVALUATION
ST. PAUL DISTRICT LOCKS AND DAMS
ON THE MISSISSIPPI RIVER

## 1.00 INTRODUCTION

1.01 The Contractor will undertake a historical resources investigation of the 13 locks and dams located on the Mississippi River within the St. Paul District, Corps of Engineers (Upper and Lower St. Anthony Falls, and Locks and Dams 1, 2, 3, 4, 5, 5A, 6, 7, 8, 9, and 10), to determine their potential for nomination to the National Register of Historic Places as a thematic resource.

1.02 This historical resources investigation partially fulfills the obligations of the St. Paul District regarding cultural resources, as set forth in the National Historic Preservation Act of 1966 (Public Law (P.L.) 89-665), the National Environmental Policy Act of 1969 (P.L. 91-190), Executive Order (E.O.) 11593 for the Protection and Enhancement of the Cultural Environment (Federal Register, 13 May 1971), the Archaeological Conservation Act of 1974 (P.L. 93-291), the Advisory Council on Historic Preservation "Procedures for the Protection of Historic and Cultural Properties" (36 CFR Part 800), the Department of the Interior guidelines concerning cultural resources (36 CFR Part 60) and applicable Corps of Engineers, regulations (ER 1105-2-50), "Environmental Resources," Chapter 3, "Historic Preservation."

1.03 The guidelines and regulations mentioned above establish the importance of Federal leadership, by the various responsible agencies, in locating and preserving cultural resources within project areas. Specific steps to comply with these laws, particularly as directed in P.L. 93-291 and E.O. 11593, are being taken by the Corps "to assure that Federal plans and programs contribute to the preservation and enhancement of non-federally owned sites, structures and objects of historical, architectural, or archaeological significance." A part of that responsibility is to locate, inventory, and nominate to the Secretary of the Interior all such sites in the project area that appear to qualify for listing on the National Register of Historic Places.

1.04 Executive Order 11593 and the 1980 amendments to the National Historical Preservation Act further direct Federal agencies ". . . to assure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished or substantially altered." In addition, the Corps is directed to administer its policies, plans, and programs in such a way that federally and non-federally owned sites, structures, and objects of historical, architectural, or archaeological significance are preserved and maintained for the inspiration and benefit of the people of the United States.

1.05 This historical resources investigation will serve several functions. The report will be a planning tool to help the Corps meet its obligations to preserve and protect our cultural heritage. It will be a comprehensive, scholarly document that not only partially fulfills federally-mandated legal requirements but also serves as a scientific reference for future professional studies. The report will also identify sites that may require additional investigations and that may have potential for public-use development. Thus, in terms of the sources examined and the conclusions reached, the report must be analytical, not just descriptive.

## 2.00 PROJECT DESCRIPTION

2.01 In response to the Water Resources Development Act of 1976, the St. Paul District, Corps of Engineers, is participating in the National Hydroelectric Power Study.

2.02 The 13 locks and dams on the Mississippi River between Minneapolis, Minnesota, and Guttenberg, Iowa, form a significant aspect of this study. Seven of these lock and dam complexes are being evaluated for hydropower conversion. During coordination for the hydropower study, the Minnesota, Wisconsin, and Iowa State Historic Preservation Officers expressed their desires that all 13 locks and dams be considered for a Thematic Group Format submission to the National Register of Historic Places.

2.03 The designations and locations of these 13 locks and dams (from north to south) are as follows:

a. Upper St. Anthony Falls Lock and Dam. Downtown Minneapolis, Minnesota, between river miles 853 and 854.

b. Lower St. Anthony Falls Lock and Dam. Downtown Minneapolis, Minnesota, between river miles 852 and 853.

c. Lock and Dam 1 (also known as the Ford Dam). Between Minneapolis and St. Paul, Minnesota, between river miles 847 and 848.

d. Lock and Dam 2. Near Hastings, Minnesota, between river miles 815 and 816.

e. Lock and Dam 3. Near Red Wing, Minnesota, at river mile 797.

f. Lock and Dam 4. At Alma, Wisconsin, near river mile 753.

g. Lock and Dam 5. Above Fountain City, Wisconsin, near river mile 738.

h. Lock and Dam 5A. Near Winona, Minnesota, at approximately river mile 726.

i. Lock and Dam 6. At Trempealeau, Wisconsin, near river mile 714.

j. Lock and Dam 7. At LaCrosse, Wisconsin, between river miles 702 and 703.

k. Lock and Dam 8. Near Genoa, Wisconsin, at approximately river mile 679.

l. Lock and Dam 9. Near Harper's Ferry, Iowa, at approximately river mile 648.

m. Lock and Dam 10. At Guttenberg, Iowa, near river mile 615.

2.04 The study area will include each lock and dam structure plus any other building and site associated with it.

3.00 DE⁻⁻NITIONS

3.01 For the purpose of this study, the historical resources investigation will include a literature and records search and review plus an intensive study of the St. Paul District's thirteen locks and dams.

3.02 "Literature and records search" is defined as a search for written reports, articles, files, records, etc., published and unpublished (found in private, local, State, and Federal depositories), pertinent to the historical resources investigation to be carried out for this particular project. The purposes of the literature and records search are to familiarize the Contractor with the culture history of the study area and past investigations carried out in the area, and to provide this information in a summarized form to the agency requesting the search. While existing data could be extensive, the literature and records search should be as comprehensive as possible in providing a usable body of data for the purposes outlined above.

3.03 "Literature and records review" is defined as the review and evaluation of the pertinent literature and records examined under section 3.02 of this scope of work. The purpose of the literature and records review is to provide the sponsoring agency with the Contractor's professional opinion on the quality, nature, and extent of the sources identified in the literature and records search.

3.04 "Intensive study" is defined as an in-depth evaluation of the historical resources under investigation. This evaluation includes using the information acquired from the literature and records search and review to present a detailed description of each lock and dam, an evaluation of the significance of each lock and dam individually, an assessment of the significance of the locks and dams as a thematic resource, and the preparation of a Thematic Group Format submission to the National Register of Historic Places. The submission will identify those locks and dams that best represent the theme or themes identified, if there is a theme upon which such a nomination can be based.

3.05 "Thematic Group Format submission" for nominating properties to the National Register applies to a finite group of resources related to one another in a clearly distinguishable way. These resources may be related to a single historic person, event, or developmental force. (See Federal Register Vol. 46, No. 220, Monday, 16 November 1981, 36 CFR Part 60, National Register of Historic Places Interim Rules, pp. 56183 to 56195.)

## 4.00 Performance Specifications

4.01 The Contractor will use a systematic, interdisciplinary approach to conduct this study. The Contractor will provide specialized knowledge and skills during the course of the study, including expertise in history, history of science and technology, architectural history, and oral history.

4.02 The extent and character of the work to be accomplished under this contract will be subject to the general supervision, direction, control, review, and approval of the Contracting Officer.

4.03 Techniques and methodologies used during the investigation must be representative of the current state of knowledge for their respective disciplines.

4.04 The Contractor must keep standard records that will include, but will not be limited to, field notebooks, site survey forms, field maps, and photographs.

4.05 The recommended professional treatment of accumulated field inventory forms, HAER (Historic American Engineering Record) inventory forms, field maps, and photographs is curation and storage at an institution that can properly insure their preservation and that will make them available for public research and view. The Contractor will coordinate this process with the Minnesota, Wisconsin, and Iowa State Historic Preservation Officers.

4.06 The Contractor must provide all materials and equipment that may be necessary to expeditiously perform those services required of the study.

### Literature and Records Search and Review

4.07 The Contractor must obtain information and data for the literature and records search from, but will not be limited to, the following sources:

a. Published and unpublished reports and documents such as books, journals, theses, dissertations, manuscripts, newspapers, historic maps, and city records.

b. Site files and other information held at the Minnesota, Wisconsin, and Iowa Historical Society Libraries and Archives; the State universities in the relevant States; plus material available from county and local historical societies.

c. Consultation with other professionals familiar with cultural resources in the area.

d. Consultation with individuals concerned with local history in order to identify and define local interest and perceptions of significance.

4.08 A study and evaluation of previous historical study documents of the area, including the date, extent, and adequacy of these past works, as they reflect on the interpretation of what has been done in the area, must be undertaken and summarized in the Contractor's report. This review will be in either the form of an annotated bibliography or a narrative summary of the material examined.

Intensive Study

4.09 The National Register criteria for evaluation (36 CFR Part 60) will form the basis upon which the Contractor will make judgements about National Register significance.

4.10 The Contractor will identify, if possible, a theme or themes that make the locks and dams eligible for inclusion on the National Register of Historic Places. Not all thirteen locks and dams may fit the selected theme or themes but those that do should be clearly related to each other and to the theme(s).

## 5.00 GENERAL REPORT REQUIREMENTS

5.01 The Contractor will submit the following types of reports, which are described in this section and in section 7.00: progress reports, draft contract report, final contract report, and a popular report.

5.02 For each reference discussed in the technical contract report, the Contractor must cite the author, date, and page numbers.

5.03 The Contractor's technical report must include, but will not necessarily be limited to, the following information:

a. Title Page: Note the type of investigation undertaken, the historical resources assessed, the project name and location (county and State), the date of the report, the Contractor's name, the contract number, and the name of the author(s) and/or Principal Investigator, the signature of the Principal Investigator, and the agency for which the report is being prepared (the St. Paul District, Corps of Engineers).

b. Abstract: An abstract of findings, conclusions, and recommendations. This must not be merely an annotation.

c. Table of Contents.

d. List of Figures.

e. List of Plates.

f. Introduction: Identify the sponsor (Corps of Engineers) and the sponsor's reason for the study; provide an overview of the sponsor's project; define the location and boundaries of the study area (with regional or State and area-specific maps); reference this scope of work (to be included in the appendix to the Contractor's report); identify the institute that did the work, the number of person-days/hours spent during the study, the dates when the various types of work were conducted, and the repository of records.

g. Theoretical and Methodological Overview: Describe and state the goals of the Corps and the study researcher, the theoretical and methodological orientation of the study, and the research strategies applied to achieve the stated goals.

h. Research Methods: Describe the specific historical activities undertaken to achieve the stated theoretical and methodological goals. Include all research methods, techniques, and disciplines employed plus a rationale or justification for specific methods and decisions.

i. Literature and Records Search and Review: Describe in detail the methodology and sources used for the literature and records search, and review (describe and evaluate) all information and data recovered. Include bibliographic information at the end of the report. This description and review will include a summary and evaluation of previous historical studies of the project areas and region, including the researchers, date, extent, adequacy of the past work, and study results.

j. Regional History: This subsection will include a brief summary of general historical developments in the Upper Mississippi River Valley from the time of earliest Indian-white contact through the present.

k. History of River Improvement: This subsection will begin with a general history of improvements on the Upper Mississippi before 1900. The period after 1900 will be dealt with in a detailed manner with special attention to why the locks and dams were constructed, the type of construction used, and the impact of this construction on regional and national commerce.

l. Results and Evaluation: Discuss and evaluate the results of the study with regard to the significance of each lock and dam, separately and as a group, in terms of local, regional, and national history.

m. Recommendations: Make recommendations on the potential or probable eligibility of each lock and dam, indirectly and as a thematic resource. If the Contractor's assessment is that no significant resources, individual or thematic, exist, the methods of investigation and reasoning that support the conclusion(s) will be presented.

n. References: Provide standard bibliographic references (Journal of American History) for every publication cited in the report. References not cited specifically in the report text will be listed in a separate "Additional References" section.

o. Appendix: Include the scope of work, resumes of all personnel involved, all correspondence derived from the study, all State or National Register site forms, all testing forms, and any other pertinent report information referenced in the text as included in the appendix.

5.04 Failure to fulfill these report requirements will result in the rejection of the report by the Contracting Officer.

6.00 FORMAT SPECIFICATIONS

6.01 The Contractor must submit to the Contracting Officer the photographic negatives for all black-and-white photographs in the final report.

6.02 All text materials will be typed, single-spaced (the draft reports should be space-and-one-half or double-spaced), on good quality bond paper, 8.5 inches by 11.0 inches with 1.5-inch binding and bottom margins and 1-inch margins on the top and other margin, and will be printed on both sides of the paper.

6.03 Information will be presented in textual, tabular, and graphic forms, whichever are most appropriate, effective, or advantageous to communicate the necessary information.

6.04 All figures and maps must be clear, legible, self-explanatory, and of sufficiently high quality to be readily reproducible by standard xerographic equipment, and must have margins as defined above.

6.05 The final report cover letter will include a budget of the project.

6.06 The draft and final reports will be divided into easily discernible chapters, with appropriate page separations and headings.

6.07 All maps will be labeled with a typed or drafted caption/description, a north arrow, a scale bar, township, range, map size, and dates, and the map source (e.g., the USGS quad name, project map title, or published source) and will have proper margins. Maps too large to be incorporated in the report may be folded and inclosed at the back of the report or be a separate submittal. Fold-out maps within the report text are acceptable.

6.08 All sites will be recorded on the HAER site forms (to be included in the appendix). Inventoried sites will include a site number. However, if temporary site numbers will be used in either the draft or final reports, they must be substantially different from the official site designations to avoid confusion or duplication of site numbers. Known sites shall have their State site forms and other forms (e.g., National Register) updated and included in the appendix.

7.00 MATERIALS PROVIDED

7.01 The Contracting Officer will furnish the Contractor with the following materials:

a. Access to any publications, records, maps, or photographs on file at the St. Paul District, Corps of Engineers.

b. One set of plan maps and engineering diagrams of each lock and dam.

c. Historic American Engineering Record (HAER) Inventory Forms for each structure examined.

d. One loan copy of any pertinent Corps planning document that may be useful, in the opinion of the Contracting Officer.

8.00 SUBMITTALS

8.01 The Contractor must submit reports according to the following schedules:

a. Progress Reports: On the first of each month, the Contractor must submit a brief progress report outlining the work accomplished that month and any problems or needs that require the attention of the Corps.

b. Draft Contract Report: Ten copies of the Contractor's draft report must be submitted on or before 120 days after contract award. The draft contract report will be reviewed by the Corps of Engineers, the State Historic Preservation Officer, the State Archaeologist, and the National Park Service. The draft contract report will be submitted according to the report and contract specifications outlined in this scope of work.

c. Final Contract Report: The original and 15 copies of the Contractor's final report will be submitted 30 days after the Contractor receives the Corps of Engineers comments on the draft contract report. The final contract report will incorporate all the comments on the draft contract report.

d. Popular Report: The Contractor must submit a draft popular report with the draft contract report, and both will be reviewed by the Corps of Engineers. Fifteen copies of the final popular report must be submitted with the Contractor's final report. The popular report must be condensed version of the contract report that would be of interest to the general public. This report will provide an overview of the protohistory, history, and architecture of the project areas and region, a brief review of the work conducted in the area and the reasons (both professional and managerial) why the work was conducted, and the results of the completed survey.

e. Site Forms: All newly completed and updated State site forms will be submitted to the appropriate State agency.

8.02 Neither the Contractor nor his representatives will release any sketch, photograph, report, or other material of any nature obtained or prepared under the contract without specific written approval of the Contracting Officer prior to the acceptance of the final report by the Government. After the Contracting Officer has accepted the final report, distribution will not be restricted by either party except that data relating to the specific location of extant sites will be deleted in distributions to the public.

9.00 METHOD OF PAYMENT

9.01 Requests for partial payment under this fixed price contract shall be made monthly on ENG Form 93. A 10-percent retained percentage will be withheld from each partial payment. Upon approval of the final contract report by the Contracting Officer, final payment, including previously retained percentage, will be made.

Curriculum vitae.

Jon Alan Gjerde

3341 43rd Ave. S.
Minneapolis, MN 55406

b. February 25, 1953
Married; one child.

tele: 1-612-724-5779

Education:

PhD. University of Minnesota (History), 1982.
M. A. University of Minnesota (History), 1978.
B. A. University of Northern Iowa (History and Philosophy and Religion), 1975; graduated with highest honors.

Professional experience:

Research associate, Immigration History Research Center, St. Paul, 1982-83.
Research assistant, Charles Babbage Institute for the History of Information Processing, University of Minnesota, 1982.
Teaching assistant, Department of History, University of Minnesota, 1978-79.
Research assistant, Iron Range Historical-Cultural Survey under the direction of Russell R. Menard, professor of history, University of Minnesota, 1978-79.
Research assistant, Minnesota Historical Society, St. Paul, 1978-82.
Teaching assistant, Department of History, University of Minnesota, 1977-78.
Teaching assistant, Department of History, University of Minnesota, 1976-77.
Teaching assistant, Department of History, University of Minnesota, 1975-76.

Grants and awards:

Doctoral Dissertation Fellowship, University of Minnesota, 1980-81.
Doctoral Dissertation Special Grant, University of Minnesota, 1980-81.
Fulbright-Hays Travel Grant, 1980-81.
American Scandinavian Foundation Fellowship - Crown Princess Märtha Friendship Fund, 1980-81.
Norwegian Emigration Fund of 1975 Grant, 1980.
Merchants Scholarship, University of Northern Iowa, 1978-79.
Tuition Scholarship, University of Minnesota, 1978.
Merchants Scholarship, University of Northern Iowa, 1976-77.
Carpenter Scholarship, University of Northern Iowa, 1975.

Doctoral dissertation title:

"Peasants to Bourgeoisie: The Migration from Balestrand, Norway to the Upper Middle West, 1844-1900."

Publications:

"The effect of community on migration: three Minnesota townships," Journal of Historical Geography, 5 (1979), 403-422.

"The Norwegians," in They Chose Minnesota: A Survey of the State's Ethnic Groups, (St. Paul, 1981), 220-247 (with Carlton Q. Qualey).

"Appendix on Statistics," in They Chose Minnesota, 593-595.

Book reviews in American Studies (Winter, 1980) and Minnesota History (Spring, 1981).

Papers presented:

"Information flows and community formation among Norwegian immigrants," presented at the Upper Midwest Ethnic Studies Association, October 7, 1978.

"Social and economic adaptation in the transfer of Norwegian agricultural immigrant settlement in the United States," presented at the American Historical Association convention, December 30, 1980.

"The rural immigrant community and the changing socioeconomic structure of the Upper Middle West," presented at the Minnesota History Workshop, April 21, 1981.

October 31, 1982

John Anfinson
Contact Person
Corps of Engineers
1135 USPO and Custom House
St. Paul, MN 55101

Dear Mr. Anfinson,

Please accept this October progress report for the cultural resources investigation of the thirteen locks and dams on the Mississippi River project. In general, satisfactory progress has been made and is outlined as follows:

1. Search for and investigation of the secondary literature of the general and transportational history of the Upper Middlewest is nearly complete with approximately one half day of work remaining.

2. Search for and investigation of the primary and secondary literature of the Upper Mississippi River improvement in the twentieth century, including a background of the political pressure for river improvement and that improvement itself, has begun. The evidence of widespread and well-developed pressure groups to advocate improvement has been somewhat of a surprise in terms of its magnitude. Quite a bit of work remains to be done.

3. Search for and investigation of the primary and secondary sources and literature of design and construction of the thirteen locks and dams has just only begun.

4. Composition of the report has not yet begun.

No particular problems have been encountered. My only requests are 1) a partial payment of $2000 to defray costs of field work, materials, and labor; and 2) the possibility of investigation through a computer search for lock and dam sources that might enlarge my literature base. I hope this report satisfactorily informs you of my progress. If you have any questions, please feel free to contact me.

Sincerely,

Jon Gjerde

Jon Gjerde
Contractor

November 15, 1982

John Anfinson
Contact Person
Corps of Engineers
1135 USPO and Custom House
St. Paul, MN 55101

Dear Mr. Anfinson

The following is a detailed budget request for this month that you requested.

| | |
|---|---|
| Travel (35¢/mile) | $ 210 |
| Accomodations | $ 150 |
| Miscellaneous expenses (photocopying, etc.) | $ 100 |
| Wages | $1540 |
| TOTAL | $2000 |

Thank you. Research progresses well.

Sincerely,

Jon Gjerde

Jon Gjerde

December 1, 1982

John Anfinson
Contact Person
Corps of Engineers
1135 USPO and Custom House
St. Paul, MN 55101

Dear Mr. Anfinson,

Enclosed is my November progress report for the cultural resources investigation of the thirteen locks on the Upper Mississippi River. Progress has continued but a long bout with the flu and colds has put me behind schedule by about one week. Hopefully, I will catch up over this month. Particular lines of progress are as follows:

1. Search for and investigation of the secondary literature of the general and transportational history of the Upper Middlewest is complete.

2. Search for and investigation of the primary and secondary literature of Upper Mississippi River improvement in the twentieth century, including a background of the political pressure for river improvement and that river improvement itself, is nearing completion. An adequate understanding of river improvement pressure groups has been gained and work with legislative government documents is nearly complete. Probably about three days of work remains.

3. Search for and investigation of the primary and secondary sources and literature of design and construction of the thirteen locks and dams is progressing. Work at your archives and other historical institutions is on the agenda.

4. Composition of the report, which I scheduled to begin today, will not begin for another week due to my delays.

5. I have used to date about 140 sources in the investigation.

I received the partial payment requested for this month and am enclosing another budget request for next month. I want to wish you a merry Christmas and remind you, that if you have any questions, to contact me.

Sincerely,

Jon Gjerde

December budget request:

| | |
|---|---|
| Travel | $ 70 |
| Miscellaneous | $ 200 |
| Wages | $1230 |
| TOTAL | $1500 |

January 1, 1983

John Anfinson
Contact Person
Corps of Engineers
1135 USPO and Custom House
St. Paul, MN 55101

Dear Mr. Anfinson,

Please find enclosed the December progress report for the cultural resources investigation of the thirteen locks on the upper Mississippi River. Progress has been satisfactory although I am still slightly behind schedule. Moreover, the propsed addition to the project will create additional work but also will provide more time. Specific lines of progress are as follows:

1. Search for and investigation of the secondary literature of the general and transportational history of the upper Middle West is complete.

2. Search for and investigation of the primary and secondary literature of the upper Mississippi River improvement in the twentieth century is complete.

3. Search for and investigation of the primary and secondary sources and literature of design and construction of the thirteen locks and dams is nearing completion. It is in this area that concentration will be focused in the upcoming weeks.

4. The report's composition is about one-third complete.

5. Work on the supplemental project has not yet begun pending final approval.

If you have any questions, please feel free to contact me.

Sincerely,

Jon Gjerde

February 1, 1983

John Anfinson
Contact Person
Corps of Engineers
1135 USPO and Custom House
St. Paul, MN 55101

Dear Mr. Anfinson,

Please find enclosed my January progress report for the cultural resources investigation of the thirteen locks and dams on the upper Mississippi and two sites in the St. Anthony Falls Historic District. Progress has been good on the lock and dam project, but research on the Lower Dam Hydro Station and Wasteway No. 2 has been slowed by inability to find adequate source material. Specific lines of progress are as follows:

1. Search for and investigation of the secondary literature of the general and transportational history of the upper Middle West is complete.

2. Search for and investigation of the primary and secondary literature of the upper Mississippi River improvement in the twentieth century is complete.

3. Search for and investigation of the primary and secondary sources and literature of design and construction of the thirteen locks and dams is complete.

4. Composition of the report is about 75% complete; over 160 of text have been written.

5. Search for and investigation of literature on the supplemental project has begun with some success, but more primary material is needed and has not year been discovered. Composition of the supplemental report has not yet begun.

By this time next month, I will have forwarded my draft contract report to you. Enclosed also is the February budget request. If you have any questions, please feel free to contact me.

Sincerely,

Jon Gjerde

February budget request:

| | |
|---|---|
| Clerical work | $ 375 |
| Photocopying (10x250x.10) | $ 250 |
| Miscellaneous | $ 250 |
| Wages | $1700 |
| TOTAL | $2575 |

(Total budget expenses requests so far, February inclusive: $6075.)

DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
1135 U S POST OFFICE & CUSTOM HOUSE
ST PAUL, MINNESOTA 55101

REPLY TO
ATTENTION OF:

August 19, 1983

Planning
Environmental Resources

Dr. Jon Gjerde
3341 43rd Ave South
Minneapolis, Minnesota 55406

Dear Dr. Gjerde:

Enclosed are comments on the draft report, Historical Resources Evaluation: St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls.

From a review of this report, it is apparent that the contractor has undertaken extensive research and has thoroughly reviewed available data. The information from your research and report will provide the basis for future environmental assessments on historical resources in the Mississippi River Valley and will enable us to proceed with our determination of the National Register of Historic Places significance of the locks and dam complexes in our District.

Enclosed, also, are comments from the State Historic Preservation Offices of Minnesota, Wisconsin, and Iowa as well as those of the St. Louis District, Corps of Engineers. It is the contractor's responsibility to either change the report to conform with the criticisms of these outside agencies and the St. Paul District or explain why they are not relevant. This explanation should be provided in a separate letter (which will be included in the correspondence appendix).

If you have any questions, please contact John Anfinson of my staff at (612) 725-7632.

Sincerely,

Robbin L. Blackman

Enclosures

Robbin Blackman
Acting Chief
Environmental Resources

COMMENTS ON A DRAFT REPORT, HISTORICAL RESOURCES EVALUATION
ST. PAUL DISTRICT LOCKS AND DAMS ON THE MISSISSIPPI RIVER
AND TWO STRUCTURES AT ST. ANTHONY FALLS

1. Cover Page: Add date of completion.

2. Table of Contents: Subdivide the chapter on "River Improvements", and number all the chapters.

3. Records and Sources Review: An excellent example of how this section should be done.

4. Regional History: A very good overview.

5. History of River Improvement: Briefly define "Whig Tradition".

6. Page 169, last sentence of paragraph 2: With regard to the roller gates, should the number of lengths be 2 and the span of those lengths be 60 and 80 feet?

7. Page 180, line 8, paragraph 2: Should the number be 56 or 80 feet? See page 183, lines 6 and 7, paragraph 3.

8. Page 188, lines 4 and 5, paragraph 2: Fill in the dates.

9. Page 201, paragraph: Should "Construction History" be added after "Dam No. 3?

10. Page 205, line 8, paragraph 1: Should the sentence read "feet" instead of "inches"?

11. Page 206, line 4, paragraph 2: Should the sentence read "intermediate" or "immediate"?

12. Map number 28 is missing.

13. Pages 223-225 repeat pages 219-223.

14. Bottom of page 233 is blank.

Results and Evaluations

15. Page 278, lines 4-6, paragraph 1: How significantly has Lock or Dam No. 1 been altered?

16. Page 278, lines 6-8, paragraph 1: Upper SAF produces 91.5 million KwH. Lower SAF produces 52.3 million KwH. Lock and Dam No.1 produces 87.0 million KwH.

17. Page 278, line 15, paragraph 1: Does the sentence refer to only one of the two locks and dams or both?

18. Page 279, lines 1 and 2, paragraph 1: The phrase "unduly affecting other aspects of river usage" may be questioned by ecologists.

Recommendations

19. Page 280, line 11, paragraph 2: "the river" or "a river"?

20. Page 281, paragraph: The Minnesota State Historic Preservation Office believes the Lower Hydro Station may be eligible for inclusion on the National Register of Historic Places based upon its age, architecture, and function as well as its relationship to the St. Anthony Falls Historic District. Given their position, it might be best if the statement "albeit with less enthusiasm" were deleted or further explained.

HABS/HAER Inventories

21. Lock and Dam No. 1, section 16, line 2: Is "somewhat novel" the best description?

22. Lock and Dam No. 2, section 7, line 2: Xerox copy is illegible.

23. Lock and Dam No. 6, section 16, lines 2 and 3: Sentence punctuation needs to be changed.

24. Lock and Dam No. 7, section 13, last line: gap after "Nolan Brothers."

25. 3.04 of the Scope of Work calls for the completion of a Thematic Group Format nomination form: A nomination form and guide are enclosed.

26. There are numberous typographical errors and misspellings in the report which need to be corrected.

27. The Popular Report is an excellent example of the type of summary which the St. Paul District finds most useful for the general public.

28. The Popular Report has several typos to be corrected.

IOWA STATE HISTORICAL DEPARTMENT
OFFICE OF HISTORIC PRESERVATION

ADRIAN D. ANDERSON, Executive Director
STATE HISTORIC PRESERVATION OFFICER

May 4, 1983

Mr. Wayne A. Knott
Chief, Environmental Resources
Planning Division
St. Paul District, COE
1135 U.S. Post Office & Custom House
St. Paul, MN 55101

RE: Review and Comments on draft report entitled, '<u>Historical Resources Evaluation, St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls</u>'

Dear Mr. Knott:

The report prepared by Jon Gjerde is an excellent piece of work that we would urge to be repeated for the portions of the system administered by the Crops of Engineers, Rock Island District. The research is sufficient, the text clear and informative, and the findings well expressed. From the information presented, we concur that Lock and Dam Number 10 at Guttenberg may be eligible for nomination to the <u>National Register of Historic Places</u> as part of an overall thematic nomination. We recognize, however, that actual nomination may be more appropriate after completing a study of lock and dam structures to the south of Guttenberg. Hopefully, such a survey will be completed in the near future.

Thank you for allowing us a chance to comment and review the draft report. If you have any questions about our recommendations or comments, please do not hesitate to contact our office.

Sincerely,

Ralph J. Christian

Adrian D. Anderson, Executive Director
State Historic Preservation Officer

ADA/spj

MINNESOTA HISTORICAL SOCIET
FOUNDED IN 1849 · Cedar Street St. Paul Minnesota

25 May 1983

Mr. Wayne A. Knott
Chief, Environmental Resources
Planning Division
Department of the Army
Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Knott:

RE: Planning Environmental Resources
Historical Resources Evaluation
St. Paul District Locks and Dams
on the Mississippi River and Two
Structures at St. Anthony Falls.

MHS Referral File Number: P-921

Thank you for the opportunity to comment on the draft report entitled Historical Resources Evaluation, St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls.

This office finds the report to be a comprehensive study of the transportational use of the Mississippi River and the economic, political and social forces which affected the change seen today. The research is thorough and the material is presented in an orderly and comprehensible fashion.

However, this office has one comment regarding the recommendations made on page 280 of the report. These recommendation state that the locks and dams number 3 through 10 be nominated to the National Register of Historic Places. While all the locks and dams have notable engineering and technological features which make them potentially eligible for nomination consideration, it is the opinion of this office that the criteria used to draw this conclusion be re-examined to determine if a more precise ranking can be made regarding the individual eligibility of the locks and dams.

We look forward to receiving the final draft of this report.

Sincerely,

Dennis A. Gimmestad

Russell W. Fridley
State Historic Preservation Officer

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

LMSPD 9 May 1983

SUBJECT: Nomination of Mississippi River Locks and Dam to the National Register of Historic Places

Commander
U.S. Army Engineer District, St. Paul
1135 U.S. Post Office & Custom House
St. Paul, Minnesota 55101

1. This letter is in response to your request that we evaluate recommendations offered in Historical Resources Evaluation, St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls, Locks and Dams in Minnesota, Wisconsin, and Northern Iowa by Jon Gjerde. The report was prepared for St. Paul District under Contract No. NCSPD-ER-R-45.

2. It is the opinion of the St. Louis District that Mr. Gjerde has produced an illuminating and interesting report and that historical research of this nature should be encouraged by the Corps of Engineers. We note that the report recommends nominating Mississippi River Locks and Dams Nos. 3 through 10 to the National Register of Historic Places as a thematic resource. The report also recommends that further study be undertaken of locks and dams in the St. Louis District, assumedly with the intent of including St. Louis District locks and dams in such a nomination.

3. We do not concur in these recommendations. Of the four Mississippi River locks and dams in the St. Louis District (Nos. 24 through 27), none is older than 50 years. Construction of Lock and Dam No. 24 was begun 20 July 1936, and the project was placed in operation 12 March 1940. Lock and Dam No. 25 was begun 12 November 1935 and placed in operation 18 May 1940. Work on Locks and Dam No. 26, the District's oldest, began 13 January 1934, and the project became operational 1 May 1938. Lock and Dam No. 27 was not begun until 19 July 1947, and was not operational until 7 February 1953. Furthermore, Locks and Dam No. 26 is currently being replaced by a new structure, located downstream of the original Locks and Dam No. 26.

4. As you know, circumstances in St. Paul District are not much different. Locks and Dam No. 1 and the St. Anthony Falls Power Station are the only developments which pre-date 1930. Locks and Dams 2 through 10 all became operational during the 1930's, and the St. Anthony Falls locks and dams were completed even later.

5. The National Register criteria of eligibility are very exclusive regarding historical properties less than 50 years old, and the Mississippi River locks and dams completed after 1933 do not seem to be of such importance as to meet the requirements for nominating properties less than 50 years old.

6. We further believe that Mr. Gjerde's assessment would not support the National Register eligibility of the locks and dams, regardless of their ages. In the report, Mr. Gjerde argues (page 2) that the Mississippi River locks and dams "were only approved and constructed due to an intricate historical development of waterway improvement needs and a comprehensive plan for river development."

7. Specifically, Mr. Gjerde believes that the completions of transcontinential railroads and the Panama Canal created an unfavorable transportation and rate structure in the Mississippi Valley and that dissatisfaction in the Midwest led to political outcry demanding an improved inland waterway. The progressive economic philosophy of the Hoover Administration, says Mr. Gjerde, was sympathetic to these concerns and caused a systematic improvement plan to be developed. The rapid construction of the locks and dams during the 1930's reflected a change in governmental ideology from Hoover's deliberate, systematic notions to the public works philosophy of the Roosevelt Administration during the Great Depression.

8. Mr. Gjerde apparently believes that this assessment demonstrates that the Mississippi River locks and dams are "associated with events that have made a significant contribution to the broad patterns of our history (36 CFR 60.6), one of the criteria which identify National Register eligibility."

9. It is the opinion of the St. Louis District that although Mr. Gjerde's assessment is valid at face value, it ignores the fact that inland waterway improvement is actually a product of much more diffuse historical circumstances. Throughout his report, Mr. Gjerde stresses that economic considerations, not political ones, culminated in the waterway improvement, and that these considerations can be isolated to the first couple of decades of this century. This is really not the case. The Army Engineer Department was involved and interested in improving western rivers at least as early as the 1820's, and during the Tyler Administration the executive branch considered the nation's large rivers to be "national highways" that possessed military and commercial value. During the Pierce Administration Secretary of War, Jefferson Davis, believed that navigable rivers belonged to the Federal jurisdiction and were essential to the nation. The Army engineers recognized, long before the legislative branch did, that inland navigation was important to national expansion and could best be facilitated with large, carefully planned (compare Gjerde's "systematic") improvements. What hampered the Army engineers was a conservative interpretation of the constitution, which did not explicitly provide for Federal jurisdiction of the inland waterways. In short, the mechanism and ideology which culminated in inland waterway development were in place before Mr. Gjerde allows.

LMSPD 9 May 198

SUBJECT: Nomination of Mississippi River Locks and Dam to the National Register of Historic Places

10. Finally, a "thematic group" nomination to the National Register still would require that each lock and dam be eligible, on its own merit, for the National Register. We believe this not to be the case, and recommend no further work at this time.

GARY D. BEECH
Colonel, CE
Commanding

HISTORIC PRESERVATION DIVISION

June 9, 1983

Mr. Wayne A. Knott, Chief
Environmental Resources Planning Division
St. Paul District, Corps of Engineers
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

SHSW: 198-83
RE: Thematic Survey of Locks and Dams on the Mississippi River

Dear Mr. Knott:

Our staff has reviewed the draft report entitled Historical Resources Evaluation, St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls by Jon Gjerde.

The report contains insufficient information for us to comment on Mr. Gjerde's recommendation that Locks and Dams Nos. 3 through 10 be nominated to the National Register. In addition, the report does not meet the requirement in the Scope of Work for a Thematic Group Format Submission.

The report documents in considerable detail the political and economic events leading up to the construction of the present system of locks and dams on the Upper Mississippi River as well as describing the actual construction of these structures. The report fails, however, to identify explicitly the historic themes that the locks and dams represent or provide sufficient comparative information to adequately evaluate the significance of these structures, either individually or as a group, in accordance with the National Register criteria (36 CFR Part 60.4).

For example, Mr. Gjerde states that the locks and dams are significant in the area of engineering for the advanced technology incorporated in their design. He does not, however, explain in what ways the design of the locks and dams on the Upper Mississippi River were an improvement over the design of earlier locks and dams, and remarks in passing that some of the design features were similar to those of structures built earlier on the Ohio River. The report should identify specifically the significant characteristics of each structure and explain how these characteristics contribute to its historical and engineering significance.

Mr. Gjerde does not discuss the changes that have been made to the locks and dams since their original construction nor how these changes may have affected their historical integrity. The inclusion of such information is important for two reasons. First, it would be necessary to demonstrate significant loss of integrity to justify Mr. Gjerde's recommendation that only nine of the thirteen locks and dams be considered for nomination to the National Register. Second, this information is essential to evaluate the potential impact currently proposed rehabilitation plans may have on the National Register eligibility of the locks and dams.

Finally, the report does not constitute an adequate Thematic Group Format Submission as called for in the Scope of Work. The information necessary for such a submission consists of: 1) a completed nomination form (NPS Form 10-900) giving a description of the theme or themes chosen and an explanation of how the component properties relate to the theme(s), 2) attached inventory forms which include brief descriptions, statements of significance, and geographical data for all individual properties (which in the present instance would include not only the locks and dams themselves, but any associated buildings or other structures), and 4) accompanying visual documentation including maps and current photographs of all individual properties. A copy of the National Park Services' draft guidelines for the preparation of Thematic Group Nominations is enclosed for your information.

If you or your staff would like to discuss this matter further, please contact me at (608) 262-2732.

Sincerely,

Richard W. Dexter

Richard W. Dexter
Chief, Registration & Compliance Section

RWD:lkr

Enclosure

October 10, 198[illegible]

Robbin Blackman
Acting Chief
Environmental Resources
Department of the Army
St. Paul District, Corps of Engineers
1135 U. S. Post Office & Custom House
St. Paul, Minnesota 55101

Dear Mr. Blackman,

Thank you for your comments on the draft report, Historical Resources Evaluation: St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls. Your careful reading of the text enabled me to correct obvious oversights and errors that I might otherwise have missed before completing the final report. I have made the necessary corrections which I feel indeed does improve the final product. I also profited from the review of outside agencies from the Iowa, Minnesota and Wisconsin State Historic Preservation Officers and the St. Louis District Corps of Engineers. Although many of their comments were germane to the specifications of the contract, however, others either criticised the report for not undertaking work that was not required by the scope of work or were, in my opinion, irrelevant or incorrect. Accordingly, I will review their comments in turn.

The comments by Mr. Anderson, the Iowa State Historic Preservation Officer, were by and large favorable, about which I was very pleased. His argument that the nomination of the locks and dams to the National Register of Historic Places would be strengthened if those structures below Guttenburg were studied as well is, I believe, a very good one. Since such study was not specified in my report, I would recommend that the St. Louis and Rock Island district undertake separate studies so that some agreement can be reached between the State Historic Preservation Officers of the various states. I was also pleased with the comments of the Minnesota State Historic Preservation Officer. Mr. Gimmestad's major recommendation was a ranking of the Locks and Dams for historic importance. While that might be undertaken in subsequent research, the scope of work specifically requested "an assessment of the significance of the locks and dams as a thematic resource" (3.04), which was supplied. Although I did rank single structures as the most important, I did not give a thorough ranking, and that could be completed by future work.

The comments of Mr. Beech of the St. Louis District Corps of Engineers and of Mr. Dexter of the Historic Preservation Division of the State Historical Society of Wisconsin were more critical. Mr. Beech, first of all, notes that Locks and Dams 3 through 10 are not fifty years old and therefore are not eligible for the National Register. Yet the fifty year rule has been waived for numerous structures devised and built during the New Deal. The Massive Timberline Lodge in Oregon, the Techwork Home District in Georgia, and the Rising Hail Colony in South Dakota, for example, all of which were built in the 1930s as a result of the New Deal have been entered. Furthermore, it is my opinion that the Locks and Dams as I have described them do "seem to be of such importance as to meet the requirements for nominating properties less than fifty years old." As I attempted to show, the project was a massive undertaking reflecting a shift in government planning utilizing a unique lock and dam design for slackwater navigation in the United States. This project is comparable to the Techwood Home District mentioned above which was the first federally funded public housing in the United States representing the federal government's first attempts to eradicate slum housing on a grand scale. The nine foot project, of which the Locks and Dams were a direct result, was also a federally funded undertaking to improve transportation on a grand scale, the first of which was undertaken during the New Deal. Ultimately, ours is a difference of opinion of the importance of the locks and dams that must be taken up by other agencies. It is ironic that it is Mr. Beech who is mitigating the importance of a history-making project of which he remains such a significant part. I stand by my recommendation.

Mr. Beech's criticisms under number 9, I feel, miss the point of the entire report. He argues that the "mechanism and ideology which culminated in inland waterway development were in place before Mr. Gjerde allows." The report clearly argues that the nine-foot channel project was the culmination of a long history of advocacy of waterway improvement in the legislative and executive branches. It notes that George Washington and James Madison both saw the importance of the Mississippi as an artery of commerce (pp. 79-80). It describes the Whig tradition, which through a broad construction of the Constitution hoped for internal improvements to increase the governmental infrastructure and facilitate national commerce (p. 81). Likewise, the report bases the development of the Windom Committee in the 1870s on earlier Whig proponents of internal improvements (p. 81). Although there were early advocates of waterway improvement, the Army Corps among them, legislators and presidents soon more vigorously saw the need for waterway improvement as the Middle West faced prohibitive freight rates, a declining railroad system, and worsened hopes for commerce in relation to the coasts. Occurring during a Progressive movement that desired government intervention to improve the public good (much like the Whig tradition before it), the demands did indeed become more adamant as more people began to accept the government's role outside its duties strictly defined in the constitution. The nine foot channel, approved during the Hoover adminstration but implemented with accelerating speed during the Roosevelt period, does indeed reflect these changes. It is important to note, contrary to Mr. Beech's argument that Leaders in the Army Corps were dragging their feet by 1930 while it was the executive branch under Hoover that pushed the lock and dam system creating a nine-foot channel (see Merritt: 1980 in bibliography). Moreover, I doubt if Mr. Beech would argue that anyone prior to the Great Depression would have dreamed the channel would have been created with such rapidity, a direct result of the New Deal and a changed view or government intervention. In short, I am not arguing that the governmental advocacy of internal improvement began during the Progressive movement. The scope of work only asked for "a general history of improvements on the Upper Mississippi before 1900" which was provided. But it does seem obvious that during the first three decades of the twentieth century, government intervention for reasons explicated in the report did increase, increase to such a degree that ultimately it was the executive branch which forced the Army Corps to undertake a project in waterway improvement with which it did not agree.

Finally, I am unsure that "a 'thematic group' nomination to the National Register still would require that each lock and dam be eligible" as Mr. Beech states. I feel there are some Locks and Dams of more value than others, but each has its own merit that would permit it to be entered individually. Of course, I contend that the sum is greater than the parts and thematic nomination would make more sense.

Some of Mr. Dexter's criticisms were well-taken, and appropriate changes and additions have been made. The thematic nomination to the National Register was not included in the draft report (my oversight) and is included in the final report. Attached inventory forms, however, were appended to the draft report in the form of HABS-HAER Inventory which is part of a Thematic Nomination. Finally, as I thought I made clear, the blank pages which, in the Table of Contents were termed "List of Plates," are where photographs are placed in the final report. Unfortunately, the photographic work was not completed when the draft report was due and was thus ommitted.

While a portion of Mr. Dexter's criticisms revealed a close reading of the report, many of his other observation indicated that he simply had not taken a close look at the content or argument of the text. He states that I failed "to identify explicitly the historic themes that the locks and dams" represented. Yet over one hundred pages (pp. 79-174) were devoted to the history of river improvement on the Upper Mississippi when it was placed in a national context of increased federal government input and activism. As the conclusion noted on p. 278, the nine-foot project exemplifies the Progressive ideology and its Keynesian New Deal successor. Mr. Dexter argues that I fail to explain in what ways the design of the locks and dams were an improvement over earlier structures and that I remark "in passing" that the design was similar to the Ohio River system. First, following the notion of improving utility of water systems, I noted that the Ohio River system was used as an example for later improvements (pp. 160-1). It was logical to view other designs before making final plans for another system. But as I state on pp. 168-9, a different dam configuration was adopted due to the peculiar nature of the Upper Mississippi River. The question is not necessarily that of improved design since we are dealing with two river systems. The Mississippi River lock and dam system, if placed on the Ohio, would certainly not be an improvement and vice versa, since each lock and dam system was a unique configuration using the most advanced hydraulic studies of the day to design a system best suited to the character of the river. Second, Mr. Dexter states that the report does not "identify specifically the significant characteristics of each structure." Yet on pp. 191-98, I give a generic description of the component parts of each lock and dam structure in the nine-foot channel period before specifically dealing with each separate lock and dam.

Finally, Mr. Dexter contends that an inadequate discussion is given to changes made to the original structures. In some respects, his criticism is well-taken. I have made appropriate changes to indicate the recent changes made on Lock and Dam No. 1. In my research, I examined the annual reports of the Army Corps and found no major structural change in any of the Locks and Dams recommended for nomination to the National Register. Each lock and dam complex is a large plant and further research could have been undertaken to have determined structural changes to, say, the lockkeeper's house or the access road, but in view or limited resources provided by the contract I did not deem such minute study appropiate or feasible.

In conclusion, I am fully confident that the specifications stated in the Scope of Work have been fulfilled. But as in any historical inquiry, there are gaps mandated by lack of resources and time. Accordingly, I would recommend that the Army Corps undertake more extensive research. It would seem appropriate, for example, to undertake a study of the other locks and dams on the Mississippi River not under the jurisdiction of the St. Paul District to determine their historic value. Likewise, more intensive research could be undertaken to augment the broad outlines of the history of river improvement on the Upper Mississippi sketched in this report.

This report was budgeted at $8080. The cost break down is as follows:

| | |
|---|---|
| Photography | $ 58.00 |
| Typing | 600.00 |
| Photocopying | 393.50 |
| Hired labor | 100.00 |
| Travel | 210.00 |
| Direct labor costs- 70 days @ $100/day | 6718.50 |
| TOTAL | $ 8080.00 |

I trust you will benefit from its contents and that it will provide you further avenues of study. I enjoyed undertaking the research and hope that you will enjoy the final product. Thank you.

Sincerely,

Jon Gjerde

Form No. 10-306 (Rev 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

# NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM
FOR FEDERAL PROPERTIES

FOR NPS USE ONLY
RECEIVED
DATE ENTERED

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

## 1 NAME

HISTORIC
Locks and Dams 3 through 10 on the Upper Mississippi

AND/OR COMMON

## 2 LOCATION

STREET & NUMBER

__NOT FOR PUBLICATION

CITY, TOWN

__ VICINITY OF

CONGRESSIONAL DISTRICT

STATE | CODE | COUNTY | CODE

## 3 CLASSIFICATION

| CATEGORY | OWNERSHIP | STATUS | PRESENT USE | |
|---|---|---|---|---|
| __DISTRICT | X PUBLIC | X OCCUPIED | __AGRICULTURE | __MUSEUM |
| __BUILDING(S) | __PRIVATE | __UNOCCUPIED | __COMMERCIAL | __PARK |
| __STRUCTURE | __BOTH | __WORK IN PROGRESS | __EDUCATIONAL | __PRIVATE RESIDENCE |
| __SITE | **PUBLIC ACQUISITION** | **ACCESSIBLE** | __ENTERTAINMENT | __RELIGIOUS |
| __OBJECT | __IN PROCESS | X YES: RESTRICTED | X GOVERNMENT | __SCIENTIFIC |
| x Thematic Group | __BEING CONSIDERED | __YES: UNRESTRICTED | __INDUSTRIAL | X TRANSPORTATION |
| | | __NO | __MILITARY | __OTHER |

## 4 AGENCY

REGIONAL HEADQUARTERS: *(If applicable)*
St. Paul District Corps of Engineers, Dept. of the Army

STREET & NUMBER
1135 U.S. Post Office & Custom House

CITY, TOWN
St. Paul __ VICINITY OF

STATE
MN 55101

## 5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC. St. Paul District Corps of Engineers

STREET & NUMBER
1135 USPO and Custom House

CITY, TOWN
St. Paul, MN 55101

STATE

## 6 REPRESENTATION IN EXISTING SURVEYS

TITLE Historical Resources Evaluation. St. Paul District Locks and Dams on the Mississippi River and Two Structures at St. Anthony Falls Contract #NCSPD-ER-

DATE
September 15, 1983 __FEDERAL __STATE __COUNTY __LOCAL

DEPOSITORY FOR SURVEY RECORDS St. Paul District Corps of Engineers

CITY, TOWN
1135 USPO and Custom House, St. Paul

STATE
MN 55101

## 9 MAJOR BIBLIOGRAPHICAL REFERENCES


Hartsough, Mildred, From Canoe to Steel Barge on the Upper Mississippi. Minneapolis: University of Minnesota Press, 1934.

U.S. Engineer Department, The Upper Mississippi River Navigation Improvement. St. Louis: U.S. Division Engineer, 1938.


## 10 GEOGRAPHICAL DATA on separate HAER forms

ACREAGE OF NOMINATED PROPERTY

UTM REFERENCES

A ZONE EASTING NORTHING B ZONE EASTING NORTHING

C D

VERBAL BOUNDARY DESCRIPTION

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

| STATE | CODE | COUNTY | CODE |
|---|---|---|---|
| Iowa | | Clayton | |
| Minnesota | | Goodhue, Wabasha, Winona, | |
| Wisconsin | | Buffalo, Trempealeau, Vernon, Crawford | |

## 11 FORM PREPARED BY

NAME / TITLE

Jon Gjerde — DATE 9-15-83

ORGANIZATION

312 Raymondale Dr. Apt. C — TELEPHONE (213) 449-2908

STREET & NUMBER

South Pasadena, CA 91030

CITY OR TOWN — STATE

## 12 CERTIFICATION OF NOMINATION

STATE HISTORIC PRESERVATION OFFICER RECOMMENDATION

YES____ NO____ NONE____

STATE HISTORIC PRESERVATION OFFICER SIGNATURE

In compliance with Executive Order 11593, I hereby nominate this property to the National Register, certifying that the State Historic Preservation Officer has been allowed 90 days in which to present the nomination to the State Review Board and to evaluate its significance. The evaluated level of significance is ____National ____State ____Local.

FEDERAL REPRESENTATIVE SIGNATURE

TITLE DATE

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

DATE

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST: DATE

KEEPER OF THE NATIONAL REGISTER

## 7 DESCRIPTION

| CONDITION | | CHECK ONE | CHECK ONE |
|---|---|---|---|
| XX EXCELLENT | __DETERIORATED | XX UNALTERED | XX ORIGINAL SITE |
| __GOOD | __RUINS | __ALTERED | __MOVED DATE______ |
| __FAIR | __UNEXPOSED | | |

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

Locks and Dams 3 through 10 were the first structures built on the Upper Mississippi River to create a 9 foot channel during a massive public works project undertaken during the New Deal. While other locks and dams had already been built, they were not part of the nine foot channel project nor were they designed as part of a comprehensive design which utilized similar component parts including a movable dam type consisting of Tainter and roller gates and uniform lock dimensions. Since the river channel varied at each lock and dam site, however, these component parts were part of individual designs at each site. The entire project resulted in a slackwater navigation on the upper Mississippi River. Moreover, although a few other rivers in the United States such as the Ohio have extensive navigational improvements, the system on the Upper Mississippi is the only one to have a combination of roller and Tainter gates determined by engineers at the time of construction as the best design in view of environmental constraints.

The survey of the sites was conducted by Jon Gjerde in a contract for the St. Paul District Corps of Engineers (Contract Number NCSPD - ER - R - 45). Historians, architectural historians, geographers, and historians of technology were consulted. Other locks and dams were not included either because they were built before (locks and D[illegible] 1 and 2) or after (St. Anthony Falls Upper and Lower) the New Deal project with its novel design or were not within the confines of the contract specifications (Lock and Dams 11 through 26).

Individual inventory forms are included.

## 8 SIGNIFICANCE

| PERIOD | AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW | | | |
|---|---|---|---|---|
| _PREHISTORIC | _ARCHEOLOGY-PREHISTORIC | _COMMUNITY PLANNING | _LANDSCAPE ARCHITECTURE | _RELIGION |
| _1400-1499 | _ARCHEOLOGY-HISTORIC | _CONSERVATION | _LAW | _SCIENCE |
| _1500-1599 | _AGRICULTURE | _ECONOMICS | _LITERATURE | _SCULPTURE |
| _1600-1699 | X ARCHITECTURE | _EDUCATION | _MILITARY | _SOCIAL/HUMANITARIA |
| _1700-1799 | _ART | _ENGINEERING | _MUSIC | _THEATER |
| _1800-1899 | X COMMERCE | _EXPLORATION/SETTLEMENT | _PHILOSOPHY | X TRANSPORTATION |
| X 1900- | _COMMUNICATIONS | _INDUSTRY | X POLITICS/GOVERNMENT | _OTHER (SPECIFY) |
| | | _INVENTION | | |

SPECIFIC DATES　　　　BUILDER/ARCHITECT

STATEMENT OF SIGNIFICANCE

Concern for improving transportation facilities had long been a concern of Middle Western political leaders. By 1930, a plan using locks and dams to eventually create a nine-foot channel through systematic improvement was adopted by the United States government. The plan was the culmination of years of political pressure during and afte an era when the Progressive movement had held sway. Premised on the notion that rationa governmental actions could improve the functioning of the American system, the improveme on the Upper Mississippi is a good example of that rationale. By comprehensively improving the Mississippi River through government action, commerce would be aided particularly in the Middle West. Although that improvement benefitted the Middle West most by providing an alternative transportational link, however, it also aided the entire nation by improving commerce. Moreover, the lock and dam plan was systematic with a comprehensive method of improvement, engineering was improved and costs were lessened. The basic structure of each lock and dam had standard components. The lock chamber conformed to a standard size while most dams had a movable section, an earth dike and a spillway. In the movable section, basically standard Tainter and roller gates were utilized as the environment dictated. Finally, the construction of the Upper Mississippi River locks and dams is a good example of the change in federal government ideology. During the Hoover administration (1929-1933), the plan was for the locks and dams to be built slowly since costs were prohibitive to construct them in one single massive undertaking. The Roosevelt administration, which took office in the depths of the Great Depression, on the other hand, used the nine-foot channel project as a public works project covered in the National Industrial Recovery Act.

Locks and Dams 3 through 10 were completed less than fifty years ago. Yet they illustrate properties "that are associated with events that have made a significant contribution to the broad patterns of our history," one of the criteria used to exempt the 50 year rule. Like other WPA and CCC projects that have already been listed on the National Register, Locks and Dams 3 through 10 are of historical importance reflecting a changing federal response to national problems.

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1 SITE I D NO

2 NAME(S) OF STRUCTURE: Lock and Dam No. 1

5 ORIGINAL USE: lock and dam

7 CLASSIFICATION:

| | | | | |
|---|---|---|---|---|
| ~~SPEC STRUCT: DAM T~~ | 9 | 7 | 9 | 6 |
| SPEC STRUCT: DAM R | 9 | 7 | 9 | 7 |
| TRANS: CANAL N.A. | 5 | 4 | 9 | 4 |

9 RATING: 1

10 DATE: 1908-17 modified-10

3 SITE ADDRESS (STREET & NO): Minneapolis, MN (see 12 below)

6 PRESENT USE: lock and dam

8 UTM ZONE: 15 EASTING: see below NORTHING:

11 REGION:

4 CITY/VICINITY: Minneapolis-St. Paul COUNTY: Hennepin-Ramsey STATE: Minnesota

SCALE 1:24 1:62.5 OTHER: QUAD NAME: St. Paul West

12 OWNER/ADMIN ADDRESS: St. Paul district, Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

| | Easting | Northing |
|---|---|---|
| A: | 484000 | 4973160 |
| B: | 484160 | 4973240 |
| C: | 484980 | 4973260 |

This lock and dam was built over a long span of time. Begun in 1908, its design was modified in 1910, and it was completed in 1917. When the lock failed in 1928, a second lock was added and completed in 1932. The structure consists of two locks with chamber widths of 56 by 400 feet, a modified Ambursen dam, and power house from which hydroelectric power is generated. The lock and dam is still in operation and has undergone some major upgrading between 1981 and 1983. It was designed by the Army Corps of Engineers and constructed by Northern States Constracting Co. The second lock was built by A. Guthrie and Co. The lift of the lock is 35.9 feet

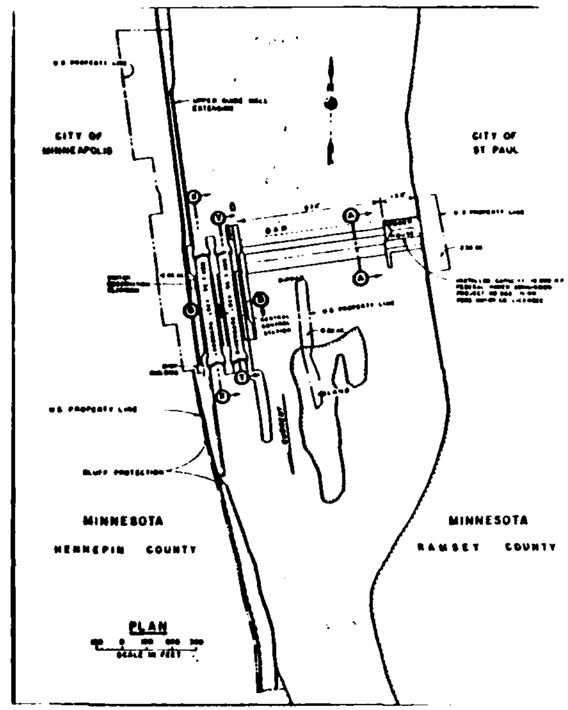
14 CONDITION: [X] EXCELLENT [ ] GOOD [ ] FAIR [ ] DETERIORATED [ ] RUINS

15 DANGER OF DEMOLITION? (SPECIFY THREAT) [ ] YES [X] NO [ ] UNKNOWN

16 SIGNIFICANCE

This was the first lock and dam structure built on the Upper Mississippi River and remains one of the few which generate hydropower. The modified Ambersen dam is novel and the construction methods included use of formed concrete that were set in place with grout.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES - HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district, Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis" <u>Old Man River</u> (January, 1937), 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY Jon Gjerde | AFFILIATION contractor - Army Corps | DATE Feb. 28, 1983

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1 SITE ID NO

2 NAME(S) OF STRUCTURE
Lock and Dam No. 2

5 ORIGINAL USE
lock and dam

7 CLASSIFICATION
SPEC STRUCT: DAM T — 9 7 9 6
TRANS: CANAL N. A.
5 4 9 4

9 RATING
1

10 DATE
1928-30

3 SITE ADDRESS (STREET & NO)
Hastings, MN (see 12 below)

6 PRESENT USE
lock and dam

8 UTM ZONE: 1 5 | EASTING: see below | NORTHING

11 REGION

4 CITY/VICINITY: Hastings (1.3 miles above) | COUNTY: Dakota | STATE: Minnesota

SCALE 1:24 1:625 OTHER | QUAD NAME Prescott, Minn.

12 OWNER/ADMIN ADDRESS
St. Paul district, Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC

| | Easting | Northing |
|---|---|---|
| A: | 510200 | 4956400 |
| B: | 510800 | 4956320 |
| C: | 510700 | 4955700 |

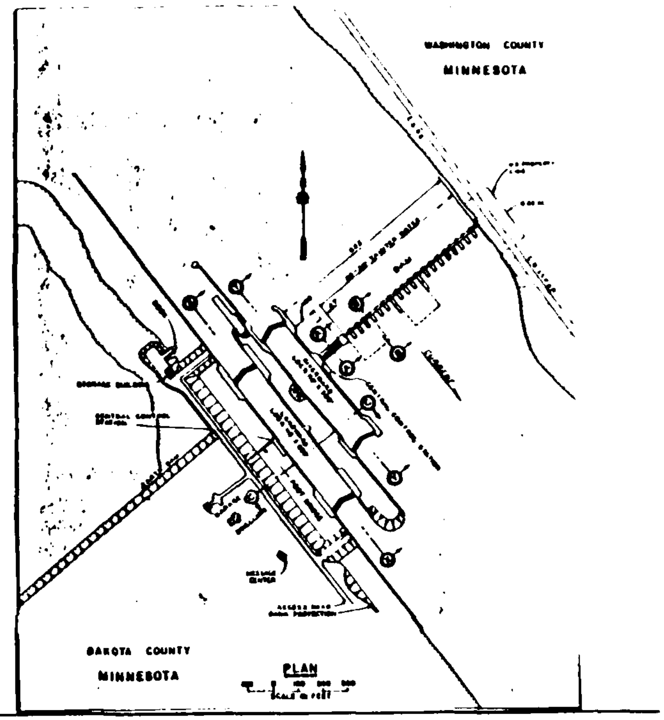
This lock and dam was built in the late 1920s to facilitate transportation between Hastings, Minnesota and the Twin Cities. The structure consists of two locks, the second one built between 1941-48, which measure 110 x 600 and 110 x 500. The second lock has the larger chamber and is considered the main lock. The dam includes a movable section, an earth dike, and a spillway. The most important section is the movable section which consists of twenty Tainter gates in addition to a Poiree section. The structure was designed by the Army Corps of Engineers and was constructed by Siems-Helmers Inc. The lift of the locks is 12.2 feet

14 CONDITION ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15 DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16 SIGNIFICANCE
This was the second lock and dam constructed on the Mississippi and the first to utilize Tainter gates, a movable gate type which would become prevalent when the nine-foot channel project was adopted for the Upper Mississippi River in 1930.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ NO ☐ YES, UNLIMITED ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ COUNTY ☐ NHL ☐ LOCAL ☐ HABS ☐ OTHER ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district, Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis" Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

| 22 INVENTORIED BY | AFFILIATION | DATE |
|---|---|---|
| Jon Gjerde | contractor = Army Corps | February 28, 1983 |

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1 SITE I D NO

2 NAME(S) OF STRUCTURE: Lock and Dam No. 3

5 ORIGINAL USE: lock and dam

7 CLASSIFICATION: SPEC STRUCT: DAM R | 9 7 9 7
TRANS: CANAL N. A. | 5 4 9 4

9 RATING: 1

10 DATE: 1935-38

3 SITE ADDRESS (STREET & NO): Red Wing, MN (see 12 below

6 PRESENT USE: lock and dam

8 UTM ZONE: 1 5 | EASTING: see below | NORTHING

11 REGION

4 CITY/VICINITY: 6.1 miles above Red Wing | COUNTY: Goodhue | STATE: Minnesota

SCALE: 1:24 | 1:62.5 X | OTHER | QUAD NAME: ~~Red Wing, Minn.~~

12 OWNER/ADMIN ADDRESS: St. Paul district, Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC

| | Easting | Northing |
|---|---|---|
| A: | 531100 | 4939350 |
| B: | 531100 | 4939750 |
| C: | 531300 | 4939400 |

This lock and dam was built beginning on August 5, 1935 and was completed in 1938, becoming the tenth lock and dam structure in the St. Paul district of the Army Corps of Engineers. It includes a main lock which measure 110 by 600 feet, a standard size for the Upper Mississippi and an auxiliary lock which has not been completed. The dam includes a movable section, an earth dike and a spillway. The movable section contains four roller gates which measure 80 by 20 feet. The structure was designed by the Army Corps of Engineers, the lock was constructed by Spencer, White, and Prentis, and the dam was built by A. Guthrie and Co. The lock has a lift of 8 feet.

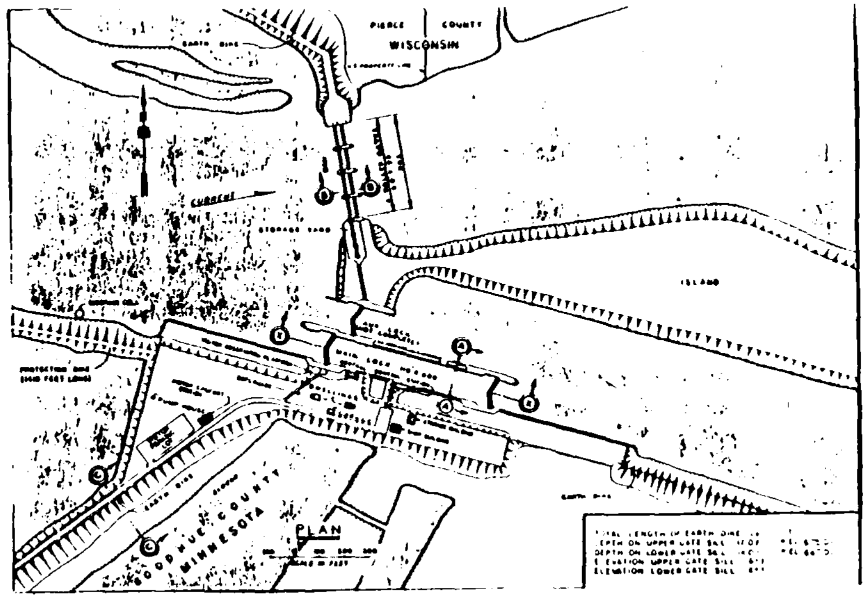
14 CONDITION: ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15 DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16 SIGNIFICANCE

The dam is the only one in the St. Paul district that has no Tainter gates, excepting the Twin City Dam (Lock and Dam No. 1) which was built before the nine-foot channel project. Moreover, the foundation is artifically placed and the abutments were constructed using Type Z steel sheet piling walls, the first use of the section piling in the St. Paul district. Finally, the structure is significant because it is part of the nine foot channel project.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES LIMITED ☐ YES UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES - HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district, Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis" Old Man River (January. 1937) 14-20
William Z. Lidicker, "Mississippi River - Lock and Dam No. 3" Old Man River (September, 1937) 12-14.
Chief of Engineers Annual Reports.

| PREPARED BY | AFFILIATION | DATE |
|---|---|---|
| Jon Gjerde | contractor - Army Corps | February 26, 1983 |

AD-A137 119 HISTORICAL RESOURCES EVALUATION ST PAUL DISTRICT LOCKS AND DAMS ON THE MI..(U) CORPS OF ENGINEERS ST PAUL MN ST PAUL DISTRICT J GJERDE SEP 83 4/4

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END
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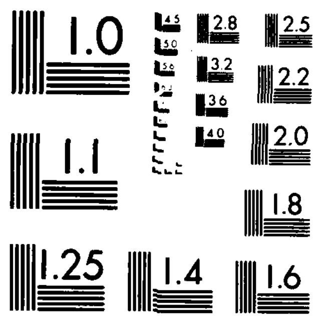



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

2. NAME(S) OF STRUCTURE: Lock and Dam No. 4

3. SITE ADDRESS (STREET & NO): Alma, Wis. (see 12 below

4. CITY/VICINITY: Alma — COUNTY: Buffalo — STATE: Wisconsin

5. ORIGINAL USE: lock and dam

6. PRESENT USE: lock and dam

7. CLASSIFICATION:

| | | | | |
|---|---|---|---|---|
| SPEC STRUCT: DAM T | 9 | 7 | 9 | 6 |
| SPEC STRUCT: DAM R | 9 | 7 | 9 | 7 |
| TRANS: CANAL N. A. | 5 | 4 | 9 | 4 |

8. UTM ZONE: 15 — EASTING: see below — NORTHING:

SCALE: 1:24 X — 1:62.5 — OTHER:

QUAD NAME: Alma, Wis.

9. RATING: 1

10. DATE: 1932-35

11. REGION:

12. OWNER/ADM N ADDRESS: St. Paul District, Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13. DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

| | Easting | Northing |
|---|---|---|
| A: | 585640 | 4908160 |
| B: | 586280 | 4908200 |
| C: | 586160 | 4908520 |

This lock and dam was built between 1932 and 1935 as part of the nine-foot channel project on the Upper Mississippi River undertaken by the Army Corps of Engineers. It includes a main lock which measures 110 by 600 feet, the standard size for the Upper Mississippi and an auxiliary lock which has not been completed. The dam includes a movable section and an earth dike. The movable section contains 22 Tainter gates and 6 roller gates. The structure was designed by the Army Corps of Engineers, the lock was constructed by Ou8lmette Construction Co., and the dam was built by United Construction Co. The lift of the lock is 7 feet.

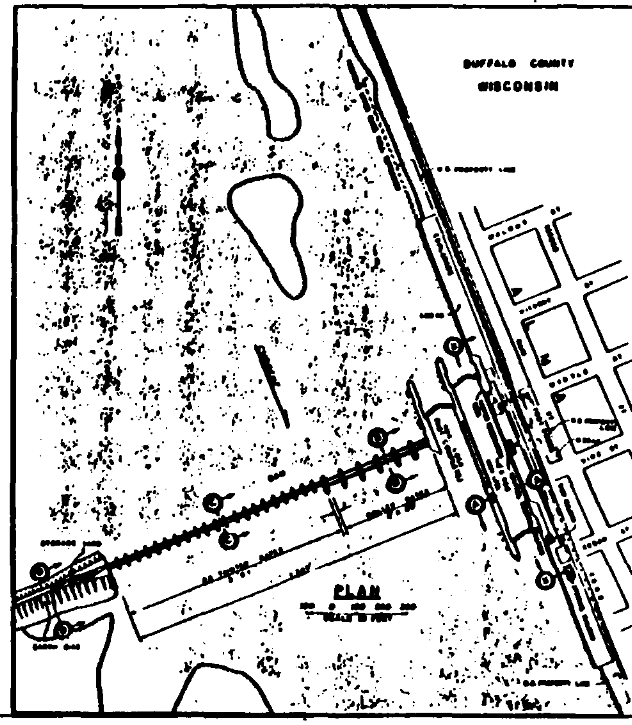
14. CONDITION: [X] EXCELLENT [ ] GOOD [ ] FAIR [ ] DETERIORATED [ ] RUINS

15. DANGER OF DEMOLITION? (SPECIFY THREAT) [ ] YES [X] NO [ ] UNKNOWN

16. SIGNIFICANCE

This lock and dam was the first constructed as part of the Upper Mississippi River nine-foot channel project. It contains the standard items on most of the lock and dam structures in this project including the lock and the movable section which includes roller and Tainter gates.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYR ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis" Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY Jon Gjerde | AFFILIATION contractor - Army Corps | DATE February 26, 1983

# HABS/HAER INVENTORY

1. SITE I.D. NO

2. NAME(S) OF STRUCTURE: Lock and Dam No. 5

3. SITE ADDRESS (STREET & NO): Fountain City, Wis (see 12 below)

4. CITY/VICINITY: Minneiska   COUNTY: Wabasha   STATE: Minnesota

5. ORIGINAL USE: lock and dam

6. PRESENT USE: lock and dam

7. CLASSIFICATION

| Classification | |
|---|---|
| SPEC STRUCT: DAM T | 9 7 9 6 |
| SPEC STRUCT: DAM R | 9 7 9 7 |
| TRANS: CANAL N. A. | 5 4 9 4 |

8. RATING: 1

10. DATE: 1932-35

UTM ZONE: 1 5   EASTING: see below   NORTHING:

11. REGION

SCALE: 1:24 X   1:62.5   OTHER

QUAD NAME: Cochrane, Wis

12. OWNER/ADMIN ADDRESS: St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13. DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC

| | Easting | Northing |
|---|---|---|
| A: | 595420 | 4890720 |
| B: | 595320 | 4889900 |
| C: | 594960 | 4890200 |

This lock and dam was the second one constructed in the nine-foot channel project on the Upper Mississippi River undertaken by the Army Corps of Engineers in the 1930s. It includes a main lock which measures 110 feet by 600 feet, the standard size for the Upper Mississippi locks and an auxiliary lock which has not been completed. The dam includes a movable gate section which contains 28 Tainter gates measuring 15 by 35 feet and six roller gates which measure 80 by 20 feet. The structure was designed by the Army Corps, the lock was constructed by E. E. Gillen Co., and the dam was built by Merritt-Chapman & Whitney Corp. The lift of the lock is nine feet.

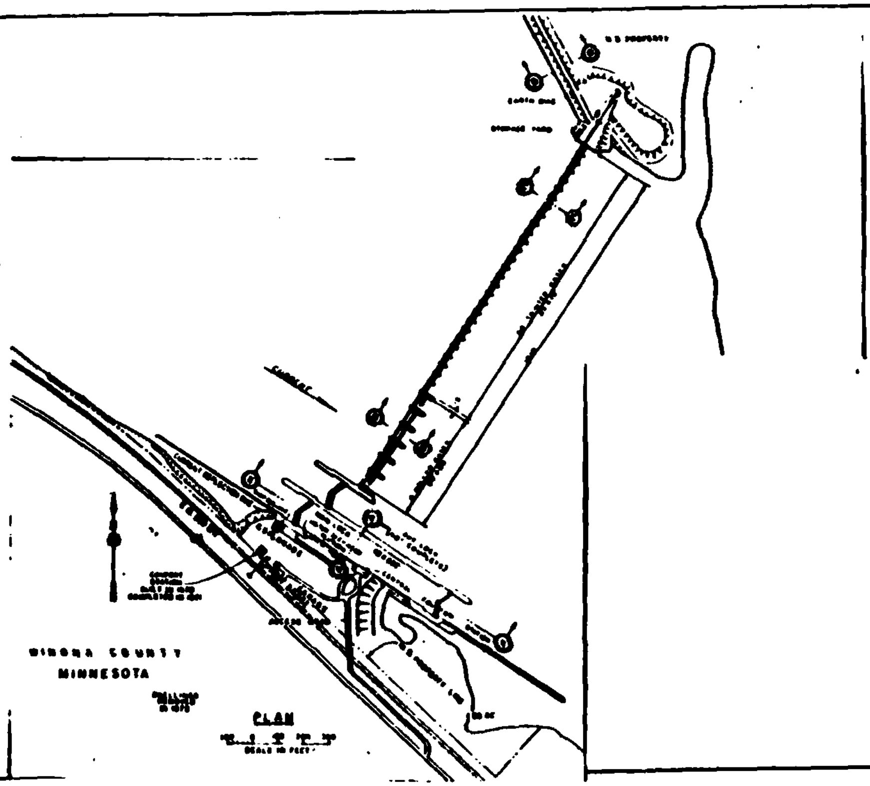
14. CONDITION: ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15. DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16. SIGNIFICANCE

This lock and dam structure is significant since it was part of the nine-foot channel project. It is also the site of Franklin D. Roosevelt's visit in 1934.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEY ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis," Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY Jon Gjerde

AFFILIATION Contractor = Army Corps

DATE February 26, 1983

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

| 2 NAME(S) OF STRUCTURE | 5 ORIGINAL USE | 7 CLASSIFICATION | | 9 RATING |
|---|---|---|---|---|
| Lock and Dam 5A | lock and dam | SPEC STRUCT: DAM T | 9 7 9 6 | 1 |
| | | SPEC STRUCT: DAM R | 9 7 9 7 | 10 DATE: 1933-36 |
| **3 SITE ADDRESS (STREET & NO)** | **6 PRESENT USE** | TRANS: CANAL N. A. | 5 4 9 4 | |
| Winona, MN (see 12 below) | lock and dam | 8 UTM ZONE: 1 5 — EASTING: see below — NORTHING: | | 11 REGION |

| 4 CITY/VICINITY | COUNTY | STATE | SCALE | QUAD NAME |
|---|---|---|---|---|
| 3 miles above Winona | Winona | Minnesota | 1:24 / 1:62.5 / OTHER | Winon West, Minn |

12 OWNER/ADMIN ADDRESS

St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

| | Easting | Northing |
|---|---|---|
| A: | 606140 | 4882400 |
| B: | 606200 | 4882800 |
| C: | 606540 | 4882540 |

This lock and dam is part of the nine-foot channel project on the Upper Mississippi River approved in 1930 and carried out through the New Deal. It includes a main lock which measures 110 feet by 600 feet, the standard size for the Upper Mississippi locks, and an auxiliary lock which has not been completed. The dam includes a movable section, an earth dike, and a fixed concrete spillway which measures 1000 feet. The movable section contains five roller gates which measure 80 by 20 feet and five Tainter gates which measure 35 by 15 feet. The structure was designed by the Army Corps, the lock was constructed by McCarthy Improvement Co.. and the dam was built by United Construction Co. The lock has a lift of 5.5 feet.

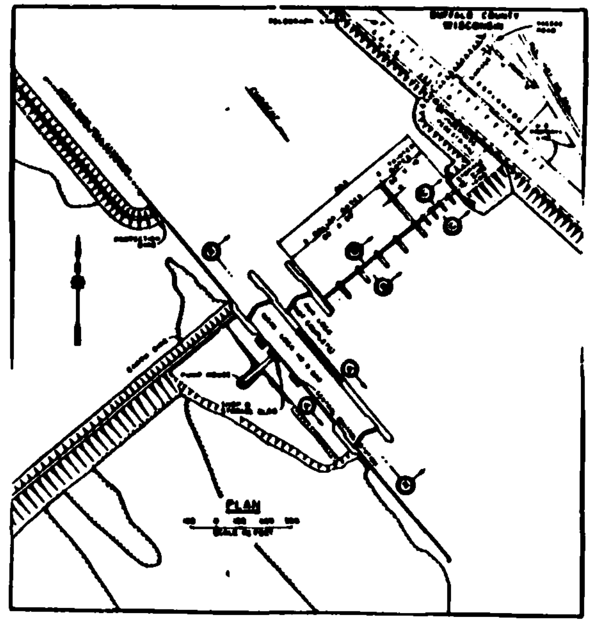
14 CONDITION: ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15 DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16 SIGNIFICANCE

Part of the nine-foot channel project, this structure was the fourth completed in the project. It conforms to the standard structure types used in the nine-foot channel project, but has a unique configuration.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19. PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20. EXISTING SURVEY? ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis" Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY Jon Gjerde

AFFILIATION Contractor - Army Corps

DATE February 26, 1983

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

| 2 NAME(S) OF STRUCTURE | 5 ORIGINAL USE | 7. CLASSIFICATION | | 9 RATING |
|---|---|---|---|---|
| Lock and Dam No. 6 | lock and dam | SPEC STRUCT: DAM T | 9 7 9 6 | 1 |
| | | SPEC STRUCT: DAM R | 9 7 9 7 | 10 DATE: 1933-36 |
| **3 SITE ADDRESS (STREET & NO)** | **6 PRESENT USE** | TRANS: CANAL N. A. | 5 4 9 4 | |
| Trempealeau, Wis. (see 12 below | lock and dam | 8 UTM ZONE: 15; EASTING: see below; NORTHING | | 11 REGION |

4. CITY/VICINITY: Trempealeau COUNTY: Trempealeau STATE: Wisconsin

SCALE 1:24 X 1:62.5 OTHER

QUAD NAME: Pickwick

12 OWNER/ADMIN ADDRESS
St Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

| | Easting | Northing |
|---|---|---|
| A: | 625040 | 4872500 |
| B: | 625560 | 4872700 |
| C: | 625240 | 4872980 |

This lock and dam is part of the nine foot channel project on the Upper Mississippi River approved in 1930 and undertaken during the 1930s. It includes a main lock which measures 110 feet by 600 feet, the standard size for the Upper Mississippi River locks, and an auxiliary lock which has not been completed. The dam includes a movable section, an earth dike, and a concrete spillway which measures 1000 feet. The movable section contains ten Tainter gates which measure 35 by 15 feet and five roller gates, the standard 80 by 20 size. The structure was designed by the Army Corps of Engineers and the lock and dam were built by Spencer, White, and Prentis, Inc. The lift measures 6.5 feet.

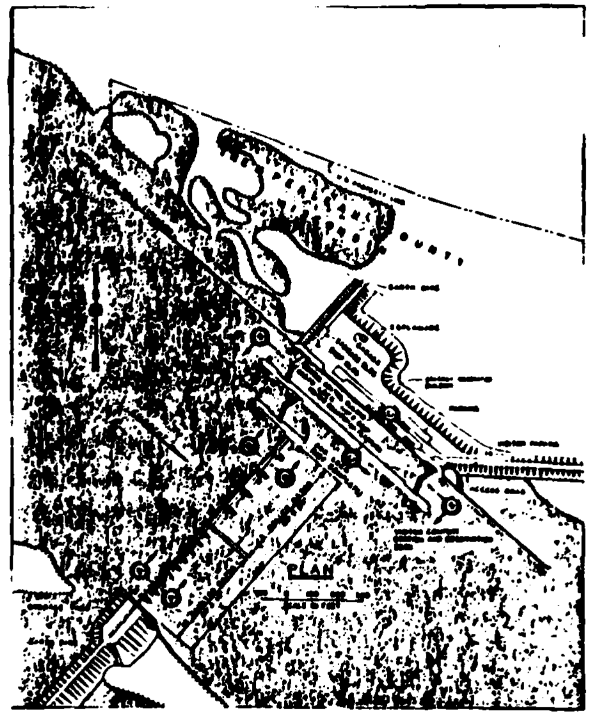
14 CONDITION ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15. DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16 SIGNIFICANCE

This was the third structure completed in the nine-foot project, a waterway improvement of extreme importance to the Upper Middle West. Moreover, the standardized structure types, of which this lock and dam evidences, made for a more efficient water improvement scheme.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis," Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

| 22 INVENTORIED BY | AFFILIATION | DATE |
|---|---|---|
| Jon Gjerde | Contractor - Army Corps | February 26 1983 |

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

2. NAME(S) OF STRUCTURE: Lock and Dam No. 7

5. ORIGINAL USE: lock and dam

7. CLASSIFICATION:

| | |
|---|---|
| SPEC STRUCT: DAM T | 9 7 9 6 |
| SPEC STRUCT: DAM R | 9 7 9 7 |
| TRANS: CANAL N. A. | 5 4 9 4 |

9. RATING: 1

10. DATE: 1933-37

3. SITE ADDRESS (STREET & NO): Dresbach, Minn. (see 12 below)

6. PRESENT USE: lock and dam

8. UTM ZONE: 15 EASTING: see below NORTHING:

11. REGION

4. CITY/VICINITY: Dresback COUNTY: Winona STATE: Minnesota

SCALE 1:24 1:62.5 OTHER

QUAD NAME: LaCrescent

12. OWNER/ADMIN ADDRESS

St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St Paul, MN 55101

13. DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

| | Easting | Northing |
|---|---|---|
| A: | 637220 | 4858440 |
| B: | 636980 | 4857960 |
| C: | 636760 | 4858260 |

This lock and dam was the sixth structure completed in the Upper Mississippi River nine-foot project. It includes a main lock which measures 110 by 600 feet, the standard size for the Upper Mississippi locks, and an auxiliary lock which has not been completed. The dam includes a movable section, an earth dike, and a submersible fixed dam which is 670 feet long. The movable section contains five roller gates which the standard 80 by 20 dimensions and eleven Tainter gates 35 by 15 feet. The structure was desinged by the Army Corps of Engineers, the lock was constructed by Nolan Brothers Incorp., and the dam was built by Warner Construction Co.

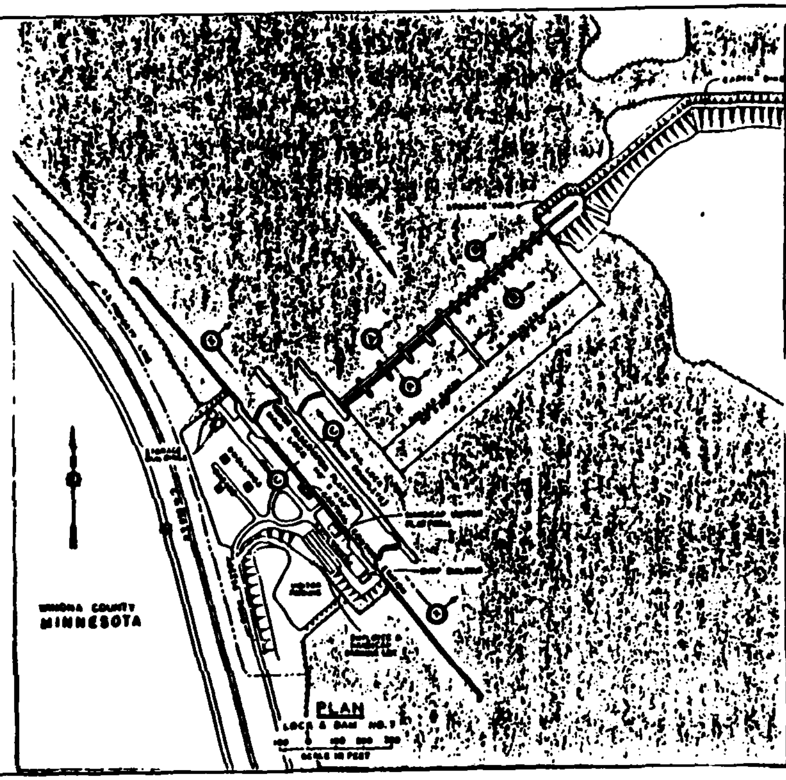
14. CONDITION: [X] EXCELLENT [ ] GOOD [ ] FAIR [ ] DETERIORATED [ ] RUINS

15. DANGER OF DEMOLITION? (SPECIFY THREAT) [ ] YES [X] NO [ ] UNKNOWN

16. SIGNIFICANCE

This lock and dam was part of the nine-foot project in which a series of locks and dams were built to create a slackwater navigation on the Upper Mississippi with a river depth of nine feet. The standardized structure types in the project provided a greater efficiency of construction.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis," Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY Jon Gjerde | AFFILIATION Contractor - Army Corps | DATE February 26, 1983

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

2 NAME(S) OF STRUCTURE: Lock and Dam No. 8

5 ORIGINAL USE: lock and dam

7. CLASSIFICATION:

| Classification | |
|---|---|
| SPEC STRUCT: DAM T | 9 7 9 6 |
| SPEC STRUCT: DAM R | 9 7 9 7 |
| TRANS: CANAL N. A. | 5 4 9 4 |

8 RATING: 1

10 DATE: 1933-37

3 SITE ADDRESS (STREET & NO): Genoa, Wis (see 12 below

6 PRESENT USE: lock and dam

9. UTM ZONE: 1 5 EASTING: see below NORTHING:

11 REGION

4. CITY/VICINITY: Genoa COUNTY: Vernon STATE: Wisconsin

SCALE 1:24 1:62 5 OTHER: QUAD NAME: Stoddard

12 OWNER/ADMIN ADDRESS: St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

This lock and dam was part of the nine-foot channel project on the Upper Mississippi River authorized in 1930 through the construction of permanent structures that would provide for slackwater navigation. The lock measures 110 feet by 600 feet, the standard size for the Upper Mississippi River locks. There is also a planned auxiliary lock which has not yet been completed. The dam includes a movable section, an earth dike, and a fixed submersible dam. The movable section contains ten Tainter gates 35 by 15 feet and five roller gates, 80 feet by 20 feet. The structure was designed by the Army Corps of Engineers, the Jutton-Kelly Co. built the lock, and Siems-Helmers Co. constructed the dam.

| | Easting | Northing |
|---|---|---|
| A: | 643200 | 4825100 |
| B: | 643300 | 4825750 |
| C: | 642750 | 4825500 |

14 CONDITION: [x] EXCELLENT [ ] GOOD [ ] FAIR [ ] DETERIORATED [ ] RUINS

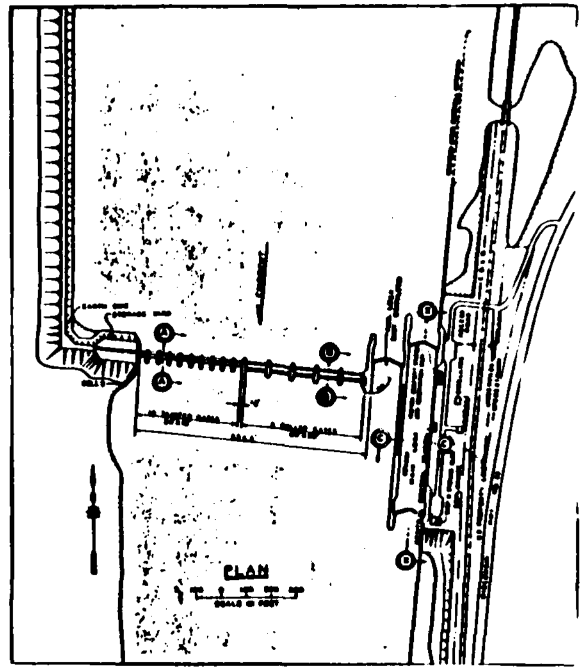
15 DANGER OF DEMOLITION? (SPECIFY THREAT) [ ] YES [x] NO [ ] UNKNOWN

16 SIGNIFICANCE

This lock and dam was part of the nine-foot project in which a series of locks and dams were built to create a slackwater navigation on the Upper Mississippi with a river depth . The standardized structure types in the project provided a greater efficiency of construction.

10-908 2/82

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis," Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

| 22 INVENTORIED BY | AFFILIATION | DATE |
|---|---|---|
| Jon Gjerde | Contractor - Army Corps | February 26, 1983 |

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

| 2 NAME(S) OF STRUCTURE | 5 ORIGINAL USE | 7 CLASSIFICATION | | 9 RATING |
|---|---|---|---|---|
| Lock and Dam No. 9 | lock and dam | SPEC STRUCT: DAM T | 9796 | 1 |
| | | SPEC STRUCT: DAM R | 9797 | 10 DATE: 1933-38 |
| 3 SITE ADDRESS (STREET & NO): Lynxville, Wis (see 12 below) | 6 PRESENT USE: lock and dam | TRANS: CANAL N. A. | 5494 | |

8 UTM ZONE: 15 | EASTING: see below | NORTHING | 11 REGION

4 CITY/VICINITY: Lynxville | COUNTY: Crawford | STATE: Wisconsin

SCALE 1:24 1:25 OTHER | QUAD NAME: Prairie du Chien

12 OWNER/ADMIN ADDRESS

St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

| | Easting | Northing |
|---|---|---|
| A: | 654300 | 4785500 |
| B: | 654600 | 4786100 |
| C: | 654100 | 4786500 |

This lock and dam the ninth one completed in the nine-foot channel project on the Upper Mississippi River authorized in 1930. The lock measures 110 feet by 600 feet, the standard size for the Upper Missssissippi locks. There is also a planned auxiliary lock which has not been completed. The dam includes a movable section, an earth dike, and a submersible dam of about 1350 feet. The movable section contains eight tainter gates of the standard 35 by 15 foot variety and five roller gates of 80 by 20 feet. The structure was designed by the Army Corps of Engineers, the lock was built by the W. W. Magee Co., and the dam was constructed by United Construction Co.

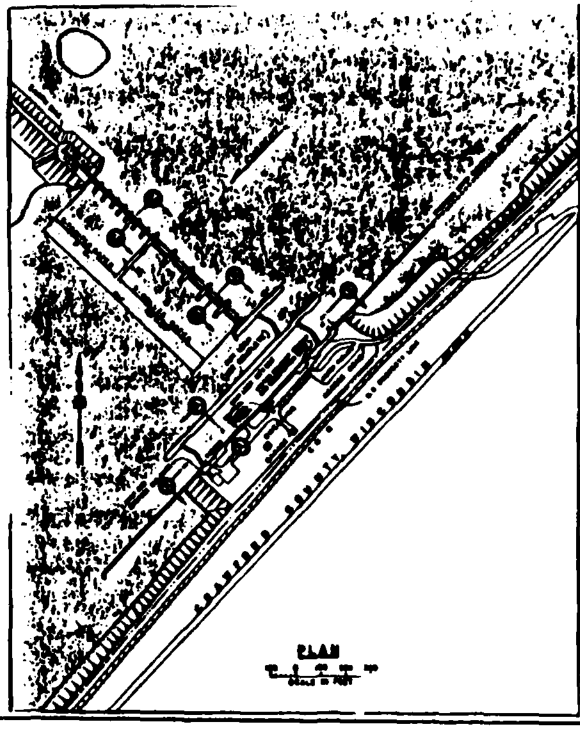
14 CONDITION ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15 DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16 SIGNIFICANCE

This lock and dam was part of the nine-foot channel project in which a series of locks and dams were built to create a slackwater nativation on the Upper Mississippi with a river depth of nine feet. The standardized structure types in the project facilitated greater efficiency of construction.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEY ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis," Old Man River (January, 1937) 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY: Jon Gjerde

AFFILIATION: Contractor = Army Corps

DATE: February 26, 1983

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

2 NAME(S) OF STRUCTURE: Lock and Dam No. 10

3 SITE ADDRESS (STREET & NO): Guttenberg, Iowa (see 12 below)

4 CITY/VICINITY: Guttenberg — COUNTY: Clayton — STATE: Iowa

5 ORIGINAL USE: lock and dam

6 PRESENT USE: lock and dam

| 7 CLASSIFICATION | | | | |
|---|---|---|---|---|
| SPEC STRUCT: DAM T | 9 | 7 | 9 | 6 |
| SPEC STRUCT: DAM R | 9 | 7 | 9 | 7 |
| TRANS: CANAL N. A. | 5 | 4 | 9 | 4 |

9 RATING: 1

10 DATE: 1933-36

8 UTM ZONE: 1 5 — EASTING: see below — NORTHING:

11 REGION

SCALE 1:24 X 1:62.5 OTHER — QUAD NAME: Guttenberg

12 OWNER/ADMIN ADDRESS: St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13 DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC

| | Easting | Northing |
|---|---|---|
| A: | 655800 | 4738320 |
| B: | 656080 | 4738700 |
| C: | 655680 | 4738800 |

This lock and dam was part of the nine-foot channel project on the Upper Mississippi authorized in 1930. The lock measures 110 feet by 600 feet, consistant with the Upper Mississippi lock sizes. The dam includes a control section, an earth dike, and a ogee spillway 1200 feet long. The control section consists of eight Tainter gates and four roller gates with the standard dimensions of 35 x 15 and 80 x 20 respectively. The lock and dam was designed by the Army Corps of Engineers.

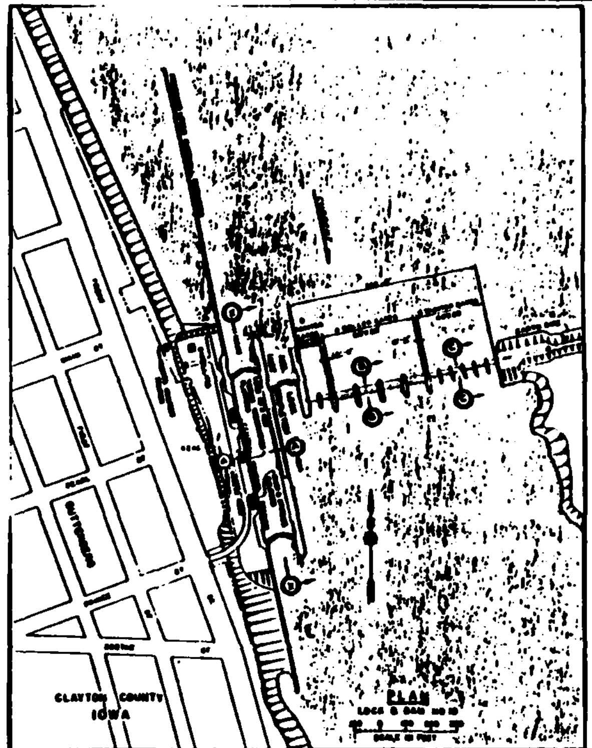
14 CONDITION: ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15 DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☐ NO ☐ UNKNOWN

16 SIGNIFICANCE

This lock and dam was part of the nine-foot channel project in which a series of locks and dams were built to create a slackwater navigational system on the Upper Mississippi with a river depth of nine feet. The dam is somewhat unique in that it is the only structure in the St. Paul district where two sections of Tainter gates or on either side of the roller gate section. Usually, all of the gate types are together.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☐ YES ☒ NO ☐ NAME

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul distric Army Corps of Engineers archives.
L. E. Wood, "9 Foot Channel - Missouri River to Minneapolis" <u>Old Man River</u> (January, 1937), 14-20.
Chief of Engineers Annual Reports.

22 INVENTORIED BY Jon Gjerde | AFFILIATION Contractor = Army Corps | DATE February 26, 1983

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

2. NAME(S) OF STRUCTURE: St. Anthony Falls Lower Lock and Dam

5. ORIGINAL USE: lock and dam

7. CLASSIFICATION: SPEC STRUCT: DAM T — 9 7 9 6; TRANS: CANAL N. A. — 5 4 9 4

8. RATING: 2

10. DATE: 1950-56

3. SITE ADDRESS (STREET & NO): Minneapolis, MN (see 12 below)

6. PRESENT USE: lock and dam

9. UTM ZONE: 1 5 — EASTING: see below — NORTHING:

11. REGION:

4. CITY/VICINITY: Minneapolis — COUNTY: Hennepin — STATE: Minnesota

SCALE 1:24 1:62 5 OTHER — QUAD NAME: St. Paul West

12. OWNER/ADMIN ADDRESS: St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13. DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS ETC.

This lock and dam was built to extend navigation above the St. Anthony Falls and to complete the nine-foot channel project. Approved in 1937, the lower lock and dam was built between 1950 and 1956. With a lift of 26.9 feet, the lock measures 56 by 400 feet, consistant with lock sizes in this stretch of the river. There is also a planned auxiliary lock. The dam is composed entirely of Tainter gates, four in all. It was constructed after an earlier dam built for water power was removed. The powerhouse on the left side of the river was retained and put in the design which was undertaken by the Army Corps of Engineers.

| | Easting | Northing |
|---|---|---|
| A: | 480320 | 4980400 |
| B: | 480660 | 4980380 |
| C: | 480540 | 4980620 |

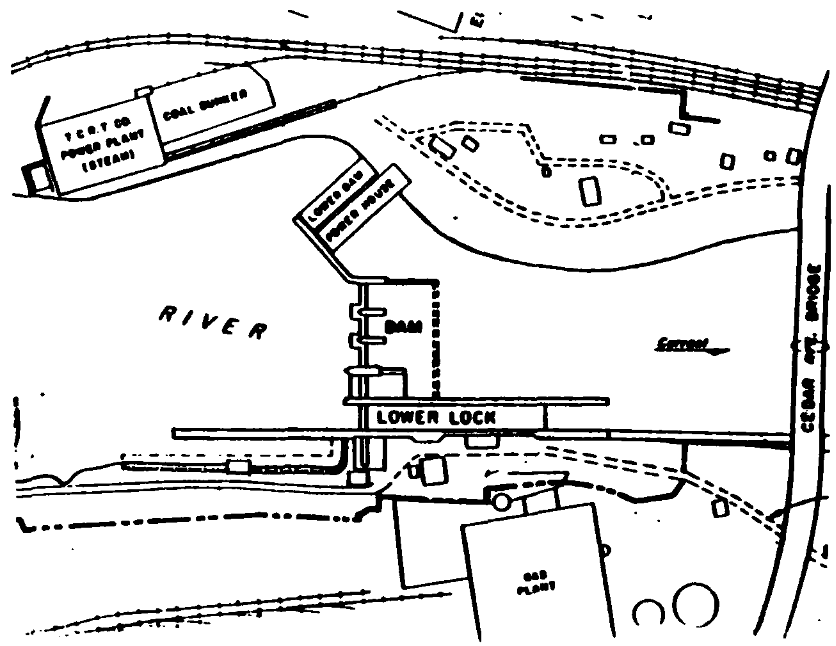
14. CONDITION: [X] EXCELLENT [ ] GOOD [ ] FAIR [ ] DETERIORATED [ ] RUINS

15. DANGER OF DEMOLITION? (SPECIFY THREAT) [ ] YES [X] NO [ ] UNKNOWN

16. SIGNIFICANCE

The lock is unique for instead of having two miter gates, the upper gate is a Tainter gate type which discharges flood waters with greater efficiency. The design also permits rapid filling and emptying of the lock chamber.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☒ YES ☐ NO ☐ NAME St. Anthony Falls Historic District

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ YES, UNLIMITED ☐ NO ☐ UNKNOWN

20 EXISTING SURVEY'S ☐ NR ☐ NHL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
Lucille Kane, The Waterfall that Built a City (St. Paul, 1966).
Chief of Engineers Annual Reports.

| 22 INVENTORIED BY | AFFILIATION | DATE |
|---|---|---|
| Jon Gjerde | Contractor - Army Corps | February 26, 1983 |

# HABS/HAER INVENTORY

U.S. Department of the Interior
National Park Service
Washington, DC 20240

1. SITE I.D. NO

2. NAME(S) OF STRUCTURE: St. Anthony Falls Upper Lock

5. ORIGINAL USE: lock

7. CLASSIFICATION: TRANS: CANAL N. A. 5 4 9 4

9. RATING: 2

10. DATE: 1959-63

3. SITE ADDRESS (STREET & NO): Minneapolis, MN (see 12 below

6. PRESENT USE: lock

8. UTM ZONE: 1 5 EASTING NORTHING

11. REGION

4. CITY/VICINITY: Minneapolis COUNTY: Hennepin STATE: Minnesota

SCALE 1:24 1:62.5 OTHER

QUAD NAME: Minneapolis South

12. OWNER/ADMIN ADDRESS: St. Paul district Army Corps of Engineers, 1135 USPO and Custom House, St. Paul, MN 55101

13. DESCRIPTION AND BACKGROUND HISTORY INCLUDING CONSTRUCTION DATE(S), PHYSICAL DIMENSIONS, MATERIALS, MAJOR ALTERATIONS, EXTANT EQUIPMENT, AND IMPORTANT BUILDERS, ARCHITECTS, ENGINEERS, ETC.

This lock was built to extend navigation above the Falls of St. Anthony and to complete the nine-foot channel project. Approved in 1937, it was not built until after the lower falls lock and dam and was not completed until 1963. The lock has a lift of 49.2, the largest on the Mississippi River. Its lock chamber measures 56 by 400 feet. The lock was designed by the Army Corps of Engineers.

| | Easting | Northing |
|---|---|---|
| A: | 479840 | 4980600 |
| B: | 479600 | 4980740 |
| C: | 480540 | 4980660 |

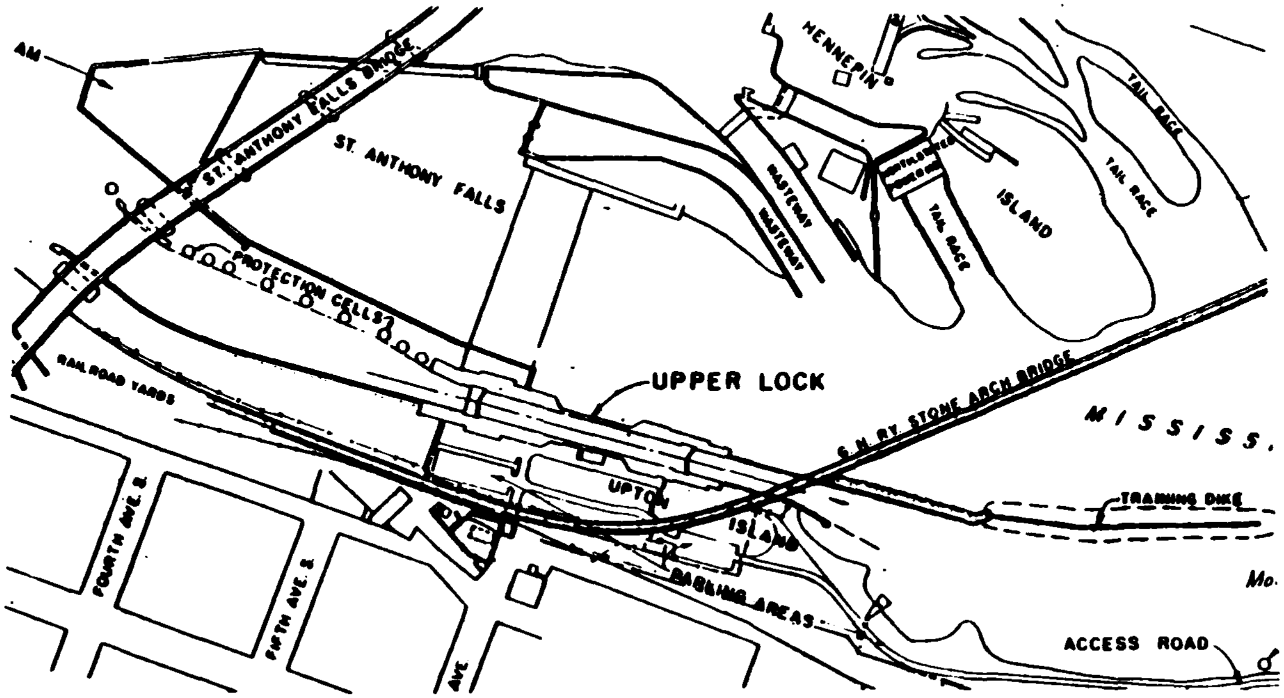
14. CONDITION: ☒ EXCELLENT ☐ GOOD ☐ FAIR ☐ DETERIORATED ☐ RUINS

15. DANGER OF DEMOLITION? (SPECIFY THREAT) ☐ YES ☒ NO ☐ UNKNOWN

16. SIGNIFICANCE

With the largest lift on the Mississippi River, special attention was required in building the cofferdam and unwatering. Moreover, in an urban area, dynamiting was prohibited so the foundation had to be dug using a ball.

17 PHOTOS AND SKETCH MAP OF LOCATION




18 LOCATED IN AN HISTORIC DISTRICT? ☒ YES ☐ NO ☐ NAME St. Anthony Falls Historic District

19 PUBLIC ACCESSIBILITY ☒ YES, LIMITED ☐ NO ☐ YES, UNLIMITED ☐ UNKNOWN

20 EXISTING SURVEYS ☐ NR ☐ NRL ☐ HABS ☐ HAER-1 ☐ HAER ☐ NPS ☐ STATE ☐ COUNTY ☐ LOCAL ☐ OTHER

21 REFERENCES—HISTORICAL REFERENCES, PERSONAL CONTACTS, AND/OR OTHER

St. Paul district Army Corps of Engineers archives.
Lucille Kane, The Waterfall That Built A City (St. Paul, 1966).
Chief of Engineers Annual Reports.

| 22 INVENTORIED BY | AFFILIATION | DATE |
|---|---|---|
| Jon Gjerde | Contractor - Army Corps | February 26, 198- |

FINAL POPULAR REPORT

# HISTORICAL RESOURCES EVALUATION
# ST. PAUL DISTRICT LOCKS AND DAMS
# ON THE MISSISSIPPI RIVER

Locks and Dams in Minnesota, Wisconsin, and northern Iowa

Jon Gjerde
for the St. Paul District, Corps of Engineers

Contract Number NCSPD-ER-R-45

September 15, 1983

Jon Gjerde

Travel on the Mississippi River evokes many images of a distant past. We might think of Mike Fink, the mythical keelboatman, who travelled on the Ohio and Mississippi Rivers early in the nineteenth century. We might think of characters in Mark Twain's fiction--the Tom Sawyers or the Huck Finns--who lived near and eventually travelled on the Mississippi in their youth. And when we think of the boats, we usually focus on the steamboat, that legendary carrier, that plied its trade from St. Paul to New Orleans in the mid-nineteenth century. In spite of all this, however, it is well to remember that the great period of river commerce is occuring today. The giant towboats and barges that slowly move up and down the river carry a tonnage larger than the steamboat captains would have dared dream.

The historical path from the steamboat to the barge has been one of great transportational change. Although the steamboat was king early in the settlement of the Upper Middle West, the railroad eventually supplanted it. Ribbons of steel crisscrossed the agricultural regions of Minnesota, Wisconsin, and Iowa proving to be a better means of transportation. The railroad could run year round, while the river froze. It could service areas that were not blessed by good river sites and after its technology was refined, the railroad was faster and more reliable than the steamboat. Railroad magnates, moreover, were carving their empires in an era of untrammeled capitalism and they at times used unscrupulous means to drive the rivermen out of business. By charging higher rates over land routes, they could cut their freight charges on lines that competed with the river. Likewise, the railroads were uncooperative with steamboat companies in transferring freight or guilding terminals. The steamboat eventually was forced to go the way of the canoe, piroque, and keelboat before it and the railroad eventually reigned supreme.

After about thirty years of supremacy, however, the railroad ceased to be as efficient as it once had been. Farmers and merchants had been complaining about prohibitive railroad rates for years, but only in the first decade of the twentieth century did the unit cost of transportation via the rail begin to increase. In 1906-1907, an unprecedented railway car shortage revealed all too clearly that the glory days of the railroad would not last forever. Civic leaders in the Middle West began to clamor for other means of transportation that would ease the burden of the railroad and cheapen transportation costs. Other developments only made that need more imperative for the Middle West. The Panama Canal, which opened in 1914, made transportation between the Atlantic and Pacific Coasts cheaper as ships no longer had to go around Cape Horn. Without river transportation, however, people in the Middle West had little opportunity to benefit from it. Thus while rail rates were increasing and railway cars were in increasingly short supply, the Coasts were linked closer together.

As time passed, the transportational problem for the Upper Middle West was only exacerbated. World War I caused the rail lines to be even more over-burdened and railroad cars to be in ever shorter supply as war and domestic goods were transported around the nation. The problem became so acute that the federal government was forced to develop its own fleet of waterway carriers to transport domestic and war goods, a fleet that continued after the war had ended. Moreover, an Interstate Commerce Commission decision in the 1920s ruled that travel on the Upper Mississippi was no longer reason for lower rail rates. The Indiana Rate Case, as it was called, put cities such as Minneapolis and St. Paul on a dry-land rate structure and rail rates were permitted to increase. Clearly, as Middle Western political leaders noted, the region faced serious transportational difficulties which would lead to even greater outmigration of industry and population if nothing was done.

Water improvement was carried out by the Army Corps of Engineers throughout these years. In 1878, a project was approved which would create a 4 1/2 foot deep channel on the Mississippi River. By contracting the river through the construction of dams near the shore, the main channel would be deepened. When this project was complete in the early twentieth century, another project, approved in 1907, used similar methods to deepen the channel yet further to six feet. The six-foot channel project, however, was not as successful as its predecessor. Many trouble spots simply could not be improved using river contraction. In certain places, such as in south Minneapolis and Hastings, Minnesota, lock and dam structures were built to provide the improvement that was necessary. Still, an unreliable river did not bode well for the establishment of water carriage businesses that depended on a reliable channel for their livelihood. In spite of a declining railroad network, therefore, waterway service did not appreciably increase.

The ideological seeds for further development, however, were planted in these eras. As early as the early 1870s, Congressional studies stressed the need for a rational system of waterway improvement to provide competition for the railroad. With two competing transportational systems, the argument went, rates would be reduced and service would be improved. These ideas found their fruition in the Progressive Era of the early twentieth century. The government's function, according to many Progressive proponents, was to provide an infrastructure which would facilitate economic growth. A system of waterway improvement, for example, would aid the producers and merchants and thereby aid the country. Moreover, the best system was a comprehensive system rather than isolated measures which did not fit into a whole. Thus a Mississippi-wide system of improvement was to be sought. More specifically, the peculiar problems of the Middle West were also being stressed. A rational system of comprehensive waterway improvement was necessary, but it was particularly important to this region which faced extreme transportational hardships.

By the 1920s, political pressure became more vociferous and widespread. Presidents at least paid lip service to the necessity of water improvement until President Herbert Hoover, a longtime advocate of waterway improvement, finally pushed the nine-foot channel project through Congress. Passed in 1930, this project was a radical departure from earlier Mississippi River improvements. Since contraction was not working, a system of locks and dams were to be constructed which created a reliable slackwater navigation from New Orleans to Minneapolis. In other words, by placing dams along the river, the water would backup deepening the channel. Moreover, with a series of dams, locks were necessary to raise the watercraft at the sites. The project was expensive and was to be completed over a number of years. Initial locks and dams were to be built to provide at least a six-foot channel. The later structures would fill in the system and create the long-dreamed-of nine foot deep waterway.

The Great Depression and the New Deal of Franklin D. Roosevelt changed all that. As part of the National Recovery Industrial Act, the locks and dams in the nine foot channel project were to be built not only to improve transportation, but to provide employment for the millions of unemployed. Construction of the locks and dams went swiftly in the 1930s and by 1939, the project for the St. Paul district of the Army Corps of Engineers was complete. Nine massive locks and dams had been built to span the Mississippi in these years. The two structures in the Twin Cities and Hastings which had been built earlier were fit into the system. Likewise, the nine-foot channel was extended above the Falls of St. Anthony in an addition to the project approved in 1937 and completed in 1963. In the meantime, navigation increased with a new reliable channel. And the sizes of the barges today are immense. A tow of 20,000 tons of freight on twelve to fifteen barges power by a diesel towboat now makes the same'trip with greater assurance than did the smaller steamboats of a century ago,

The locks and dams on the Upper Mississippi are therefore important since they represent the culmination of a long debate over permanent waterway improvement that the Middle West so desparately needed, they represent the idea of systematic, comprehensive transportation networks advocated by the Progressives, and they represent the public works undertaking by President Roosevelt in the New Deal. Architecturally, they are also significant. The Upper Mississippi was an admittedly difficult river on which to create a lock and dam system. The flood plain could be large while in other places, towns and industries hugged the shore. Both circumstances created problems for planners. After extensive study, the location of the locks and dams were made, partly with the help of hydraulic studies which illustrated the effect of the waterway improvements on other river uses.

Moreover, since the project was a systematic one, similar design is recognizable in all the locks and dams. The locks have a common chamber size and their gates are of a similar type based on a miter system. At Lock and No. 2 and below, the chamber measures 110 feet by 600 feet, while above that point, the locks are 56 by 400 feet. Since the flood plain was wide in some places, the dam often consisted of three different parts. An earth dike and concrete spillway permitted the main channel to remain somewhat consistant while the control section, the main part of the dam, regulated the flow in the main channel. The control section is composed of two types of movable gates which impede the flow of the river to such a degree as to maintain the nine-foot channel. Most dams have Tainter gates and roller gates of basically consistant design from dam to dam, which are moved to create the desired impediment to the river's flow. The Tainter gates, originally developed in northern Wisconsin, were cheaper to build, but in most cases, the larger roller gates were necessary to handle the flow of ice and logs. Thus although the configuration of each lock and dam is unique, these similar components are usually found in each, graphically illustrating the systematic nature of the nine-foot channel project.

The locks and dams dotting the Upper Mississippi River are thus of extreme importance to the historical development of the Upper Middle West. Possibly not as romantic as a surviving steamboat, the lock and dam, which facilitated the revival of river commerce on the Mississippi, is probably more significant. Moreover, the structures themselves are interesting, an engineering accomplishment of comprehensive, massive scale, that permitted the less expensive yet more efficient construction of waterway improvement. For these reasons, the locks and dams built in the 1930s as part of the New Deal--Lock and Dam Nos. 3 through 10--are recommended to be included on the National Register of Historic Sites.

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