Historic Property Fact Sheet
Upper Mississippi River 9-Foot Navigation Project 1931-1948

The Upper Mississippi River (UMR) is an important prehistoric and historic route of transportation and settlement. Since the early 19th century, river channel improvements resulted from private, State, and Federal efforts, which primarily consisted of dam construction, dredging, and snagging. The River and Harbor Act of 1866 allowed for the funding of permanent improvements to the UMR for commercial traffic. The most extensive undertaking on the UMR was the federally-recognized 9-foot channel project. Authorized by River and Harbor Acts beginning in 1930, the UMR projects required a series of 29 locks and dams. The UMR 9-Foot Navigation Project was completed by 1940 to regulate low water levels, extended the navigation season, and maintain a minimum 9-foot channel depth with widths suitable for long-haul, common carrier service.

As part of the UMR, the Keokuk Lock, Dam, and Powerhouse Historic District was listed on the National Register of Historic Places (NRHP) in October 1978. This district was listed as a result of adverse effects to the dry dock, a contributing resource. To protect significant elements of the lock and dam system of the UMR during the Corps of Engineers (Corps) major rehabilitation program, the Programmatic Agreement, *Locks and Dams, 3 through 22, Upper Mississippi River*, dated May through August 1987, was executed by the Corps; State Historic Preservation Officers (SHPOs) of Illinois, Iowa, Minnesota, Missouri, and Wisconsin; and the Advisory Council on Historic Preservation. The UMR locks and dams 3 through 10 were determined NRHP eligible by the Keeper of the National Register of Historic Places (National Park Service) on February 25, 1986.

As a result of the major rehabilitation program on the UMR, the Corps contracted with the National Park Service to complete Historic American Engineering Record (HAER) documentation. The UMR HAER was accepted by the Library of Congress in November 1988, and sent to the SHPO signatories. In 1992, the National Park Service and the Corps published the results of the HAER documentation for the public in *Gateways to Commerce* (O'Brien, Rathbun, O'Bannon 1996). This publication provides the history, setting, relationship, and the significance of the Corps’ 9-Foot Channel Project on the UMR.

In 1998, the Corps’ St. Louis and Rock Island Districts contracted a study to complete the NRHP Multiple Property Nomination Registration forms for the UMR Federal navigation project. The NRHP, Nomination Registration Form for the UMR 9-Foot Navigation Project 1931-1948 was accepted in 2000 by the appropriate SHPOs. This nomination form recognizes 25 multiple property historic districts, delineates the district boundaries, categorizes the 158 contributing and 409 noncontributing resources within those districts, and defines architectural and engineering significance.

The Corps formally listed the UMR 9-Foot Navigation Project, 1931-1948 by execution of the Nomination Registration Form by the Illinois, Iowa, Wisconsin, Minnesota, and Missouri State Historic Preservation Officers; the Corps Headquarters Historic Preservation Officer; and the Keeper of the National Register of Historic Places on March 11, 2004 to achieve much-deserved international attention so that the Corps’ contribution to the nation’s engineering history for our significant waterways is ensured.

END
Final Report
National Register of Historic Places
Registration Form for the Upper Mississippi River
Federal Navigation Projects

Prepared by
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As a Subcontractor to
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Carbondale, Illinois

Prepared for
U.S. Army Corps of Engineers
Rock Island District

Under Delivery Order No. 0049
Contract No. DACW25-93-D-0012

Author/Historian
Mary Yeater Rathbun
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National Register of Historic Places
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Prepared for
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Rock Island District
Rock Island, Illinois

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Carbondale, Illinois

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April 2000
Cultural Resources Management Report No. 397

Mary Yeater Rathbun

This document details the history, property types, evaluation methods, and significance of 14 National Register historic districts within the Upper Mississippi River 9-Foot Navigation System. The system includes 25 National Register districts, which are found between Minneapolis, Minnesota, and Winfield, Missouri. This document is the culmination of six similar surveys of the 9-Foot Project and includes Lock and Dam Nos. 11 (river mi. 583.8), 12 (river mi. 556.7), 13 (river mi. 522.5), 14 (river mi. 493.3), 15 (river mi. 482.9), 16 (river mi. 457.2), 17 (river mi. 437.1), 18 (river mi. 410.5), 19 (river mi. 364.2), 20 (river mi. 343.2), 21 (river mi. 324.9), 22 (river mi. 301.2), 24 (river mi. 283.7), and 25 (river mi. 241.5). The 14 forms for these lock and dam National Register districts delineate district boundaries, categorize the 158 contributing and 409 noncontributing resources, and evaluate each districts contribution to patterns of transportation, maritime history, engineering, commerce, conservation, military, politics, economics, labor, and social history during the period from 1931 to 1948.
General Project Location.
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MULTIPLE PROPERTY DOCUMENTATION FORM
X New Submission  Amended Submission

A. Name of Multiple Property Listing

Upper Mississippi River 9-Foot Navigation Project, 1931-1948

B. Associated Historic Contexts

(Name each associated historic context, identifying theme, geographical area, and chronological period.)

Upper Mississippi River 9-Foot Navigation Project, 1931-1948

C. Form Prepared By

Name/Title: Mary Yoater Rathbun
Street & Number: 1792 Sandy Rock Road
City or Town: Hollandale
State: WI
Zip Code: 53544

D. Certification

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this documentation form meets the National Register documentation standards and sets forth requirements for the listing of related properties consistent with the National Register criteria. This submission meets the procedural and professional requirements set forth in 36 CFR Part 60 and the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation. (See continuation sheet for additional comments.)

Paul D. Roberts, Deputy FP, NPS
Signature of Certifying Official

3 December 2003
Date

Illinois State Agency or Society Official

6/18/08
Date

Powell J. Smith
Iowa State Agency or Society Official

June 12, 2003
Date
United States Department of the Interior
National Park Service
National Register of Historic Places
Multiple Property Documentation Form

X New Submission ___ Amended Submission

Mark A. Miles
Missouri State Agency or Society Official
07/15/03

Alicia J. Green
Wisconsin State Agency or Society Official
June 3, 2003

I hereby certify that this multiple property documentation form has been approved by the National Register as a basis for evaluating properties for listing in the National Register.

By
Signature of the Keeper
3/10/04

Date
United States Department of the Interior
National Park Service
National Register of Historic Places
Multiple Property Documentation Form

_ X_ New Submission ___ Amended Submission

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C. Form Prepared by

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name/title  _Mary Yeater Rathbun_

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street & number  _1792 Sandy Rock Road_____  telephone  _608-967-2144___

city or town  _Hollandale_____________state_WI_____zip code_53544_

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____________________________________________  ____________________________
Signature and title of certifying official  Date

____________________________________________
State or Federal agency and bureau

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____________________________________________  ____________________________
nature of the Keeper  Date
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The following National Register Registration Forms are being submitted with this Multiple Property Nomination Form. Others may be submitted at a later date.

1. Lock and Dam No. 11 Historic District
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3. Lock and Dam No. 13 Historic District
4. Lock and Dam No. 14 Historic District
5. Lock and Dam No. 15 Historic District
6. Lock and Dam No. 16 Historic District
7. Lock and Dam No. 17 Historic District
8. Lock and Dam No. 18 Historic District
9. Lock and Dam No. 19 Historic District
10. Lock and Dam No. 20 Historic District
11. Lock and Dam No. 21 Historic District
12. Lock and Dam No. 22 Historic District
13. Lock and Dam No. 24 Historic District
14. Lock and Dam No. 25 Historic District

1 This complex was listed on the National Register on April 22, 1976, under the historic name "Keokuk Lock and Dam" and common name "Lock and Dam Number 19." The registration form included here amends the form prepared by Larry McClean, Engineering Technician, Rock Island District, U.S. Army Corps of Engineers on March 23, 1976. The amended form establishes specific boundaries for the district and classifies the component resources as contributing or noncontributing. It also expands upon both the description and statement of significance portion of the 1976 form.
E. Statement of Historic Contexts

Name of Historic Context: Upper Mississippi River 9-Foot Navigation Project, 1931-1948

Introduction

This historic context describes the impact of patterns of transportation, maritime history, engineering, commerce, conservation, military, politics/government, economics, and social history on the 635.4 miles of the Upper Mississippi River from Lock and Dam No. 1 in the extreme southern portion of Minneapolis, Minnesota, to the place adjacent to Alton, Illinois, where, until 1990, Lock and Dam No. 26 was located. It covers the period from 1931 to 1948 (Section H).

All of the properties which could be nominated to the National Register of Historic Places in association with this historic context are located in one of 25 historic districts spanning the Upper Mississippi River at irregular intervals in the 616.1 miles from Lock and Dam No. 1 to Lock and Dam No. 25 in Winfield, Missouri (Section G).

All 25 of these historic districts have national significance under Criterion A in the areas of transportation, maritime history, commerce, conservation, military, economics, politics, and social history because they are components of the Upper Mississippi River 9-Foot Navigation Project. The project turned the once free-flowing river into an intracoastal canal, regulated and operated for the promotion of commerce. After the project was completed, commercial river traffic on the portion of the Upper Mississippi covered by this context increased from 2.4 million tons of freight in 1939 to 84.1 million tons in 1983. The Upper Mississippi was the fourth most commercially significant shallow draft, inland, or intracoastal waterway in the United States in 1986. Only the main stem of the Ohio River from Pittsburgh, Pennsylvania, to Cairo, Illinois; the Gulf Intracoastal Waterway from St. Mark’s, Florida, to Brownsville, Texas; and the Middle Mississippi (as the 214-mile portion of the Upper Mississippi between the mouth of the Missouri River and the mouth of the Ohio River at Cairo is sometimes called) carried more freight.1

This is a far cry from the Upper Mississippi River’s preproject status. In 1922, the Interstate Commerce Commission ruled that so little freight moved on the river that it offered no real competition to the railroads that ran along its banks. As late as February 1929, Major Charles L. Hall, the U.S. Army Corps of Engineers (Corps) officer in charge of the feasibility study for the project, reported that there was not enough commercial traffic on the river to convince him that a viable barge industry would develop even if a 9-foot channel was created. However, the Upper Mississippi River 9-Foot Navigation Project changed the river from a peripheral to a central artery of the commerce of the Nation.2

When built, the project served an approximately 171,500-square-mile area in the states of Minnesota, Wisconsin, Iowa, Illinois, and Missouri.3 For many, this area is still synonymous with the agricultural heartland of the Nation. The economic health of such a sizable chunk of the United States—a region as large as the nations of Germany, France, Italy, and Great Britain combined—undoubtedly has national significance.4

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significance. This significance is heightened by the common perception during the
time the project was planned and built that the region was the breadbasket for the
industrialized portions of the country. Although farmers still constituted the
country's single largest social and economic group when this project was built,
there was widespread awareness that this was changing. Both politicians and the
public thought a significant percentage of those who remained farmers lived in the
Upper Mississippi River drainage. In the period before 1948, the economic condition
of this vast domain depended primarily upon the prices obtained for food commodities
and the consequent buying power of its farmers. Its prosperity still depends to a
large degree on these factors. Transportation is a key to both commodity prices and
buying power.

Before the Corps placed the Upper Mississippi River 9-Foot Navigation Project
in operation, a process that occurred gradually between 1934 and 1940, this whole
area was effectively landlocked. Full-season, commercial, through navigation was
impossible on the Upper Mississippi River. The region was also at a competitive
disadvantage compared to the rest of the country in terms of railroad rates.
Although the long-haul trucking industry had emerged as a viable transportation
system, its real growth came after World War II, particularly after 1956 when
Congress authorized and began funding the creation of the Interstate Highway System.

In the 1920s, the Upper Mississippi River 9-Foot Navigation Project was promoted
as a way to alleviate the Nation's worsening farm crisis. It was also aimed at
allaying the inequities in commercial rail and water freight rates brought about by
the 1914 opening of the Panama Canal. Local and regional waterway boosters,
conspicuously including farmers, had been advocating construction of a 9-foot channel
in the Upper Mississippi since the 1890s. Therefore, the project offers a unique
window into American Populism as well as farm interest group politics during the
interwar years. It is also a wonderful vehicle for coming to understand both the
American Progressive Era and the Era of “Normalcy.” Progressive Theodore Roosevelt’s
efforts as President to professionalize water resource development decisions and
promote multiple uses of the Nation’s water resources impacted this system. Although
direct government aid was an anathema to the conservative Warren Harding and Calvin
Coolidge administrations, waterway improvements were an acceptable way to promote
the general good. The project was authorized by the Rivers and Harbors Act of 1930
during the presidency of Herbert Hoover, an Upper Mississippi River drainage native,
professional engineer, and strong waterway improvement advocate who combined basic
conservatism with a genuine humanitarian concern for the underprivileged.

By opening the northern reaches of the portion of the Upper Mississippi between
Minneapolis and Alton to commercial navigation from early April to late November and
the southern reaches from late March to late December, the 9-Foot Navigation Project
firmly fixed the axis of bulk freight transportation in the area it drained as north-
south, ending the flip-flopping between an east-west and north-south axis that had
been going on for at least 200 years. Settling the axis of trade for this massive
region had substantial effects on national patterns of agriculture, trade, commerce,
urban development, industry, transportation, and waterway improvement. The north-
south orientation of transportation in the Upper Mississippi drainage is reflected
in the traffic carried on what is known as the main stem of the Mississippi, which
combines the Upper Mississippi, the Middle Mississippi, and the Lower Mississippi
and extends from Minneapolis to New Orleans. The main stem of the Mississippi carried 327.6 million tons or 58 percent of all the freight carried on the inland and intracoastal waterways of the United States in 1986. When considered this way, the main stem of the Ohio ran a poor second to the Mississippi. The Ohio only carried 195.6 million tons or 34.9 percent, while the Gulf Intracoastal Waterway at 106 million tons (18.9 percent) was not even in the same league.4

The Upper Mississippi River 9-Foot Navigation Project also vividly reflects both the extent of and the limits on the role of the military in domestic affairs during the interwar years. The project placed control of access to this vital artery of transportation in the hands of the American military, specifically the Corps. The project was built during what might be called the Corps' "Golden Age," the period of its greatest waterway project construction, greatest organizational security, highest volume of work, largest area of responsibility, and maximum power. The 1933-1935 project work led to the Corps and individual officers' pivotal roles in the 1935-1940 national relief work effort and the 1938-1945 preparedness and rearrangement effort.

In addition to their Criterion A significance as part of the Upper Mississippi River 9-Foot Navigation Project, about a third of the historic districts which could be nominated to the National Register of Historic Places in association with this historic context also have national significance under Criterion A in the areas of economics, military, politics/government, and social history because their construction histories exemplify particularly clearly the role the Upper Mississippi River 9-Foot Channel Project had in the 1930-1940 national relief work effort and the effect that status had on the construction work. President Herbert Hoover's April and May 1930 support of the project's authorization was one of the first signs of his awareness of the real depth of the problem the country was facing. Hoover's response to the Great Depression evolved gradually between 1929 and 1932. In December 1929, he still held that the stock market crash was just another speculative panic in an otherwise sound economy. Hoover did not want to fund the Upper Mississippi River 9-Foot Navigation Project until things leveled out again. As late as March 1930, Hoover had been saying the crisis would be over in 60 days. Hoover's support of this project constituted one of his first anti-Depression measures and was typical of those he relied on early in the Depression. Despite the popular perception and the presentation of the issues in previous studies of this project, Hoover, not Roosevelt, was the first President to use the federal government to fight the Depression. As early as March 1931, Congress authorized Secretary of War Patrick J. Hurley to spend more than $52 million on river improvement projects that were justified as unemployment relief. In March 1932, President Hoover personally appealed to Congress to pass a bill appropriating $60 million for river and harbor projects intended to ameliorate unemployment. Significant amounts of this money went to the Upper Mississippi River 9-Foot Navigation Project under the Emergency Relief Appropriation Act of September 1932.5

Nevertheless, the New Deal administration of President Franklin Roosevelt will recast the project from a means of improving navigation into a massive public works project. Under Hoover, it had been a navigation improvement project that incidentally provided much needed employment opportunities. It became something else entirely in 1933. Gearing the construction work toward maximum employment rather than maximum efficiency meant some available construction technologies were
not used and others were modified. The complicated employment, recruitment, and labor requirements now inherent to the project also had consequences as contractors cut corners to stay profitable or sued the government for compensation for the work involved. Finally, the change in the purpose of this project was reflected in a modification of how the Corps was organized and functioned, the role that the Corps had in post-1935 Works Progress Administration (WPA) construction work, and the Corps post-1938 preparedness and rearmament responsibilities.

While the project's consequences for the Corps, the national economic recovery, and the region's business, commerce, and recreation were generally positive, its massive impact on the area's environment was not--an impact that Lieutenant Colonel Stephen M. Long of the Corps of Topographical Engineers had foreseen in 1856, that the Corps in the person of Major Hall tried to warn the country about in 1929, and that the American public at-large has only begun to become aware of since the 1960s. Subsequent events, up to and including the monumental flood of 1993, have proven that in this area Hall's conclusion (but not necessarily the reasoning that got him there) was correct. He was a better environmentalist than an economist. However, what happened during the course of the Upper Mississippi River 9-Foot Navigation Project more accurately reflects the tenor of the Nation and its feelings about politics, economics, technology, and the environment in the interwar years than Hall's protestations do.

The project's effect on the Upper Mississippi Valley environment also illustrates the evolution of technology and its impact on people and their environment. About two-thirds of the historic districts which could be nominated to the National Register of Historic Places in association with this context also have national significance under Criterion C in the area of engineering because they include the first or seminal developments in the technological history of American waterway improvement and river navigation. With the 9-Foot Channel Project, the Corps inaugurated a new era in slackwater navigation in the United States--the adoption of nonnavigable dams that incorporated both roller and Tainter gates. Ironically, the Upper Mississippi River 9-Foot Channel Project also resulted in the obsolescence, by the project's end, of combination roller and Tainter gate dams. Technological advances resulting from the research and development incidental to the design and construction of the project's locks and dams enabled the Corps to develop both submersible and nonsubmersible Tainter gates that nearly matched the capabilities of the roller gates and which were less expensive and more easily operated. The Corps creation of a new dam type and its subsequent obsolescence during the course of a single project dramatically illuminate the evolutionary nature of American engineering. Dam gates that were state-of-the-art at the beginning of the 9-Foot Channel Project were passé before the end of the project.

Moreover, one of the historic districts (Lock and Dam No. 19) also has significance under Criterion A in the areas of transportation and maritime history because it includes a rare remnant of the 4-foot channel on the Upper Mississippi River. Three of the historic districts (Lock and Dam Nos. 1, 2, and 19) may have significance under Criterion A in the areas of transportation and maritime history because they include remnants of the 4.5-foot channel era on the Upper Mississippi River, and one district (Lock and Dam No. 14) has significance under Criterion A in the areas of transportation and maritime history because it includes remnants of the 6-foot
channel era. Those contexts are only dealt with here as part of the background to the 9-foot channel project. They are not salient themes for all the resources associated with this multiple property submission. Therefore, the information necessary to those contexts for those properties is contained in the relevant historic district registration forms submitted with this multiple property documentation form.

The four historic districts that include hydropower generation facilities (Lock and Dam Nos. 1, 14, 15, and 19) also have significance under Criterion A in the area of maritime history. The national shift from single-purpose waterway projects to multiple-purpose waterway development, which these districts reflect, is one of the most important trends in American waterway improvement history.7 As representatives of this trend, these complexes also reflect American Populism and Progressivism. This multiple-purpose use theme; the background information for this context; pivotal commercial, military, and political events which impacted transportation and navigation on and the engineering of the 9-Foot Channel Project; and the national relief work associated elements of the project are discussed below.

**Improvement Patterns on the Upper Mississippi River**

In its natural form, after falling 74 feet over the Falls of St. Anthony in what is now downtown Minneapolis (4.9 miles upstream from the northern end of this context) the Upper Mississippi became a crooked, shallow river filled with shifting sand bars for its approximately 640-mile trek to Alton. It had an average depth of about 3 feet. Long dry spells frequently made the river too shallow to navigate, especially in the 200 miles between St. Paul, Minnesota, and Dubuque, Iowa, where the water could be less than 1-foot deep for months on end. During times of flood, these same reaches of the river were deep-flowing and turbulent.

At all times, the river's current was swift and treacherous through the Des Moines and Rock Island Rapids. The Des Moines River empties into the Upper Mississippi at Keokuk, Iowa. The Des Moines Rapids extended 11.25 miles upstream from Keokuk to Montrose, Iowa. There was no channel through the long stretch of shoal created by this single, continuous, rock shelf. This made the Des Moines Rapids extremely difficult, if not impossible, to navigate during low water stages. Even in high water, the five bumps in the rock strata, known as chains, presented a danger to all but those most intimately acquainted with this stretch of the river. The uniform rock layer from which the chains protruded meant that the ripples generally produced by obstructions did not appear on the surface of the water. The Rock Island Rapids, which extended 13.75 miles from the foot of Arsenal Island, Rock Island, Illinois, to Le Claire, Iowa, differed from the Des Moines Rapids. Here seven chains of rock stretching out into the river, some from one shore, some from the other, formed deep pools or channels of water twisting from one shore to the other. Strong currents flowed around the chains and across the channels and pools.

"Snags," trees and branches that storms had washed from the river's banks into waters, were also dangerous. Often these obstructions got deeply embedded in the river bottom. At low water, embedded snags were visible, but during the high-water periods when navigation was otherwise easiest, they could be in any part of the river, and no one could see them.
Despite these difficulties, Native Americans plied the Upper Mississippi River in small, light-draft crafts for hundreds of years before the coureurs de bois (unlicensed fur trader) Pierre Esprit Radisson and his brother-in-law Médard Chouart, sieur des Groseilliers, 29 Frenchmen, and six Native Americans entered the upper Mississippi in 1658. As early as A.D. 900, Native American cultures that had settled along the Upper Mississippi used boats that were suited to the river’s shallow depth and variable conditions. Canoes and piroques, which are hollowed-out logs, could either be paddled or poled, depending on the depth of the water. Maneuverable and easy for portage, these boats served the Native Americans well for local travel as well as for the long-distance transport of goods such as Minnesota pipestone, Wisconsin copper, and Illinois flint.

Although the French were the leading navigation improvers in seventeenth-century Europe,9 they never considered improving the Upper Mississippi River during the approximately 100 years that it was part of New France.10 There was no need to improve the Upper Mississippi below Alton. The Illinois River flows into the Upper Mississippi about 15 miles above Alton. The Missouri River empties into the Upper Mississippi about 5 miles below Alton. The cumulative infusion of water increased the flow of the Upper Mississippi enough between the mouth of the Missouri and the mouth of the Ohio that this reach of the Upper Mississippi was easily navigable most of the year.

The reach of the Upper Mississippi River north of Alton was a different story. But, as an economic dependency of Montreal from 1658 until 1818, it, too, did not merit improvement. Despite being a north-south flowing river, the primary axis of transportation in the area that the portion of the Upper Mississippi north of Alton drained remained east-west for the entire 160 years. If the French or their 1763–1818 successors, the British, were going to invest in navigation improvement, it would have made much less sense for them to invest in the improvement of a north-south element of an east-west11 system than to invest in the improvement of an east-west link. They did neither.

Although the French had political control of the entire Upper Mississippi until 1763, the axis of trade along the portions of the river above and below what is now Alton split in about 1720. Once Jean Baptiste Le Moyne, sieur de Bienville, founded New Orleans in 1718 as a strategic trading post with direct sea connections to France, the portion of the Upper Mississippi south of Alton became an economic dependency of New Orleans, and the primary axis of transportation in that portion of the river changed from east-west to north-south. After the axis of trade in the two portions of the Upper Mississippi River valley had firmly split, it is no longer useful to talk about “the French” in either area. Rather, there were the Louisianans and the Canadians, and the two competed for control of the fur trade of the Upper Mississippi drainage—a considerable prize.12

None of the French, Louisianans, or Canadians sent large groups of people into the part of the Upper Mississippi River valley north of present-day Alton. Except for a few individuals stationed at trading posts, missions, and military forts along waterways, they did not encourage settlement north of Vincennes anywhere west of Lake Michigan. Even before the area became Canadian,13 the few Frenchmen working in the area were as often born in present-day Canada as they were born in France, and
most of them remained on the move. Traveling in small bands, they sought to explore, map, and link an immense empire stretching from the St. Lawrence River to the Rocky Mountains and from Hudson’s Bay to the Illinois Country in a metropolitan system of commerce and trade tied to the world market through Montreal. In this very effective structure, the French and Canadians recruited, organized, administered, and kept the transportation and communication systems open, while the local residents of the area, be they Native American or Métis, did whatever actual work was to be done. Native Americans and Métis were the traders and middlemen as often as they were the actual fur trappers.\textsuperscript{6}

In the later years of the French Canadian fur trade, the Canadians went so far as to encourage the Native Americans and Métis to collect and bring bulk shipments of furs to them at major forts in Detroit, Mackinac, and Green Bay but also to more local posts along the Upper Mississippi such as Lincott’s 1730-1736 post near present-day Trempealeau, Wisconsin. The Native Americans and Métis sometimes even provisioned the trade, reequipping voyageurs on their way out to these posts and back to Montreal.\textsuperscript{15}

\textit{Voyageurs}, Native Americans, and Métis all generally took southwest to northeast diagonal routes from the Upper Mississippi to the Great Lakes. Even during the period between 1700 and 1738 when the Mesquawkie\textsuperscript{16} intermittently closed the Fox-Wisconsin Rivers route, the Brule-St. Croix Rivers route provided an alternate avenue to Montreal. Canadian-born fur trader Louis Jolliet and the French Jesuit missionary Father Jacques Marquette had “pioneered” the Fox-Wisconsin route from what is now Green Bay to Prairie du Chien, Wisconsin, in 1673, while Daniel Greysolon, sieur du Lhut, “opened” the Brule-St. Croix route from Lake Superior at a point between present-day Superior and Port Wing, Wisconsin, to present-day Hastings, Minnesota, in 1680. Although north of the portion of the river covered by this context, the portages which linked Lake Superior to the Upper Mississippi south of what is now Grand Rapids, Minnesota, by way of the St. Louis River offered an alternative to the Brule-St. Croix route.

Although later Frenchmen, Canadians, Native Americans, and Métis working the northern reaches of the Upper Mississippi did not use the Chicago Portage (the link between the Illinois River drainage and the Great Lakes) because the mouth of the Illinois was so far south, René-Robert Cavelier, sieur de La Salle, had brought the French metropolitan system of commerce and trade to the Upper Mississippi River by way of the Illinois River. La Salle may have built the first trading post on the Upper Mississippi near the mouth of the Wisconsin River in the late 1670s. In 1680, he certainly sent the Franciscan Recollect friar, Father Louis Hennepin, and two companions to explore the Upper Mississippi. They not only named the Falls of St. Anthony but also “discovered” the Native American lead diggings of what are now southwestern Wisconsin, northwestern Illinois, and northeastern Iowa. In 1685, Nicolas Perrot, a coureurs de bois born in New France, succeeded the men covered by La Salle’s grants from the crown on the Upper Mississippi. Perrot built a trading post, Fort St. Nicholas, at the mouth of the Wisconsin River near present-day Prairie du Chien, as well as a wintering post near present-day Trempealeau and a more permanent facility, Fort St. Antoine, along the east shore of Lake Pepin. He was interested in exploring the lead mine region and is the first European known to have traded with the Native Americans for lead. In about 1690, Perrot established a lead
trading post about 50 river miles south of his Prairie du Chien post and about 2 land miles west of present-day Potosi, Wisconsin. In 1693, Pierre Charles Le Sueur built trading posts along the Upper Mississippi. On August 25, 1700, he arrived in the lead mining region and visited Native American-operated mines near what is now the Wisconsin-Illinois border.17

Despite the well-known lure of the fur trade and its importance well into the nineteenth century in the settlement and development of the Upper Mississippi River valley, exploitation of lead deposits in the valley had much more to do with the eventual improvement of the river than the fur trade did. Lead is a heavy, bulky cargo, and big boats are required to move large quantities of it. Furs are light, and commercially significant quantities of them could be carried in the native crafts.18

The French had adapted quickly to the native crafts, but this does not mean that they did not try to "improve" them. By 1714, the French had developed freight canoes, *canots de maître*, which were much larger than their seventeenth-century predecessors, although still no where near large enough to transport commercially significant quantities of lead. They also added one craft to those from which rivermen could choose to navigate the unimproved river. The French developed the *batteau*, or Mackinac boat, which was a sharp-ended craft built of planks. If canoes, *canots de maître*, piroques, or *batteaux* carrying a few government officials, priests, fur traders, *coureurs de bois*, cargos of furs, and from time to time, a little lead could get through the route without too much difficulty, the French had no pressing economic need to improve navigation on the Upper Mississippi River beyond beating out portage paths around the rapids and shallow spots.

The natives even took care of most of this for them. The Sauk and Mesquawkie set up villages near the future sites of Nauvoo, Illinois, and Keokuk, Iowa (that is, on the east bank of the Upper Mississippi at the head and on the west bank at the foot of the Des Moines Rapids), as bases for guides and lighters around the rapids. They continued to offer these services during the brief interlude of British control of the east bank (1763-1783) and Spanish control of the west bank (1763-1802) of the Upper Mississippi River.19

Like the French and Canadians, the British and Spanish did not encourage settlement in the region. Although under their jurisdiction, the seeds sown by the French in the 1670s and 1680s matured into the first European community in the portion of the Upper Mississippi River valley covered by this context, Prairie du Chien. The first industrial operation in this reach of the river that required more sophisticated crafts than canoes, *canots de maître*, piroques, or *batteaux*, Julian Dubuque's lead mines, also sprang from seventeenth-century roots. However, the lineage of the increased complexity of the area's transportation patterns only reaches back to the early eighteenth century.

From 1763 to 1783, the east side of the river remained the official tributary to the newly British Montreal. Trade from the portion of the Upper Mississippi above present-day Alton did not shift to the more southerly British commercial centers of Philadelphia or Baltimore because the trip to them via the Ohio River was even longer than the trip to Montreal. Goods and pelts from this region flowed to Montreal.
through three main centers: Detroit, Grand Portage, and Mackinac. However, under the British, the natives were no longer expected to bring their furs to these main centers as they had during the later years of Canadian control of those centers. Rather, the British traders came to convenient meeting places, closer to where the Native Americans lived. Native Americans with furs to trade also came to these designated rendezvous points.20

Prairie du Chien was the most important rendezvous and distribution center for traders and Native Americans on the portion of the Upper Mississippi River covered by this context. Jonathan Carver, who visited the confluence of the Wisconsin and Upper Mississippi Rivers in 1766 and left a vivid account of the great gatherings, also described Prairie du Chien as a neutral trading village of about 300 families. By 1777, when Peter Pond attended the rendezvous, the Mesquawkie population, at least, had to be much larger because it included 300 to 350 warriors. This suggests a population of about 1,500 Mesquawkie alone. Some of these Mesquawkie warriors were surely part of the group of 950 Ho-Chunk21, Sauk, Mesquawkie, Menominee, and French-and British-descent traders whom British officers from Mackinac organized at Prairie du Chien and led down the Upper Mississippi to attack St. Louis and Cahokia in May 1780. Spain's 1779 entry into the Revolutionary War provoked this attack. The French residents of these communities on opposite sides of the river gave the British two of their few defeats in 1780. Not satisfied with this alone, the American commander at Kaskaskia, George Rogers Clark, sent Colonel John Montgomery and 350 men after the British force in July 1780. Unable to catch them, the American force returned to the Upper Mississippi and attacked Saukenuk, the Sauk and Mesquawkie village at the confluence of the Rock and Upper Mississippi Rivers which was allied to the British. The Native Americans, warned by village scouts, fled, but the Americans still burned Saukenuk, and its 800 plus acres of crops and some neighboring small villages to the ground.22

By 1781, Prairie du Chien could be considered a "European" settlement. How much of a community it was and the biases of those evaluating it are reflected in the fact that by 1800 it had a "total population of about 65." The rebuilt Saukenuk, on the other hand, which by 1800 was clearly the chief village for the Sauk and Mesquawkie, had thousands of people living in it. In 1818, when Prairie du Chien became the county seat of Crawford County, Michigan Territory, it only consisted of a fort, a maximum of 30 houses in the village, and a few farms on the prairie outside town, while Saukenuk included more than 100 multi-family lodges. However, Saukenuk was, as it had been since its founding in 1731, occupied only seasonally from April to November. Prairie du Chien was, in keeping with the European cultural formula, a year-round community.23

Although the main flow of goods to and from the Prairie du Chien rendezvous was east to west, the French Canadians now living on the west side of the river built the small north-south stream, which their Louisianian competitors had been struggling to develop for the past 40 some years, into a significant cross current. In 1764, newly arrived, French-born Pierre de Laclede Liguest founded St. Louis. His young stepson, Louis Chouteau, and a crew of 30 men built the village on a limestone bluff that formed the western bank of the Upper Mississippi. That bluff was the first elevated spot south of the junction of the Illinois, Upper Mississippi, and Missouri Rivers, that is, the first high point south of what is now Alton. Initially, Laclede envisioned
the village as the base for his fur trade operations on the Missouri River under the 8-year monopoly Louis XIV had granted him. The fact that this monopoly was useless in Spanish territory did little to impede either Laclede's or his village's success. Both Louisianian and Canadian fur traders flocked to this new commercial center which remained a tributary to New Orleans.

While Laclede and Chouteau exploited the Missouri River valley, both Louisianians and Canadians continued to work with their existing contacts north of the Missouri. They were so effective that in 1766 and 1767 British General Thomas Gage claimed that the majority of furs trapped in the Upper Mississippi drainage never reached British markets. He thought they ended up in France or Spain via New Orleans. Not only did British traders cooperate in this illegal trade but, according to George Croghan, a Scots-Irish trader, prominent British merchants provided the trade goods used to power it. Croghan said that the easier trip downstream to St. Louis and then New Orleans cost less, so there was more profit left for both the trader and the merchant backer. The reliability of this interpretation, but not the reality of British trader and merchant participation, is called into question by the fact that this did not seem to have helped the Louisianians in their efforts to compete for this trade in the preceding 40 some years.24

Interestingly enough, at the same time that Gage was complaining about British furs being siphoned off by the French living in Spanish territory, the Spanish government of Louisiana was convinced it, too, was being cheated out of its due. By 1767, Spanish traders were coming as far up the Upper Mississippi as Prairie du Chien to keep furs taken from Spanish territory west of the river from reaching the British traders at Prairie du Chien.25

Also on the Spanish side of the river, an extractive industry developed to the point that it added a significant flow to the north-south pattern of trade. During the American Revolution, lead was in chronically short supply. Until then, almost all the lead used in North America had been imported from Great Britain. The war kept British lead off the market in the areas at odds with England. Lead prices rose and, then, held after the war. Lead was used in the manufacture of many items besides shot. Printers' type, pipes, and weights were made from it, and it was an essential element in pewter and paint.

Then, in 1788, Spain began offering extensive land grants, equal trading privileges, and the right to sell their produce at high prices in royal warehouses to French and American nationals willing to establish new farms or businesses west of the Upper Mississippi. Knowing of the sporadic, small scale, French-Native American lead trade which had been going on for nearly a century, Julian Dubuque, a trader who had worked in the Ste. Genevieve Lead District,26 moved upriver in 1788. After settling in the area where the city which bears his name is located today, Dubuque got permission from the Sauk, Mesquawkie, and Miami to mine lead on both sides of the river. The Spanish confirmed this arrangement with a grant authorizing him to mine on their side of the river where his main operations were located.27

Unlike the mines in the Ste. Genevieve District worked by European immigrants and African American slaves, Dubuque employed Louisianian and Canadian Frenchmen, Mètis, and Native American miners. The scale of his operations can be judged by the
fact that, by the time of his death in 1810, he employed hundreds of Native American miners. Dubuque's death nearly ignited a war between these Native Americans and the Americans. When the Sauk, Mesquawkie, and Miami gave Dubuque the right to mine, they considered that right specific to him and good only so long as he remained in the area and was alive. His heirs sold his title to the land and his mining rights, as specified in his Spanish land grant, to a group of Americans. When those Americans arrived at the mines in 1811, the Sauk, Mesquawkie, and Miami would not even let them land their boats. Nicholas Boyle, the United States Native American agent from Prairie du Chien, mediated the dispute. He got the Native Americans to let the American miners take Dubuque's equipment from the mines and convinced the Americans to leave with it.28

Initially, Dubuque had transported his lead down river in Native American crafts, piroques, but as the scale of the operation grew, larger vessels became essential.29 Flatboats came into use first. Flatboats were essentially large wooden boxes from 15 to 50 feet long with high sides and an awning-like overhang at one end under which passengers could shelter themselves when it rained. Obviously, such crafts were not "portageable," so they could not be used for east-west trade in the Upper Mississippi River valley. This was not a problem for Dubuque who had no desire to trade with either the British or the Americans. His was a French/Spanish operation aimed at markets and merchants in St. Louis and New Orleans. Because flatboats depended on the current for motive power, they were also almost impossible to use for upstream navigation. This was also acceptable in the early lead mining industry, because mine operators such as Dubuque needed to export much more than they needed to import. The fact that the flatboats could be dismantled at the end of the downstream trip and the lumber from which they had been constructed sold, initially added to their attraction. However, as the mining operations grew bigger, the nickels and dimes produced from the sale of the flatboat materials became less significant to entrepreneurs of Dubuque's scale. Not having to build a new boat for each shipment of ore became more important.

Keelboats, introduced into the trade in 1802, met this need. Keelboats were the most sophisticated craft on the Upper Mississippi prior to the arrival of steamboats in the 1820s. Keelboats evolved from batteaux. They were named for their keels because these rigid longitudinal timbers were what made the boats capable of withstanding scraping over sandbars and bumping into snags. The keel was the feature that adapted these boats so well to the portion of the Upper Mississippi north of present-day Alton. From 30 to 75 feet long and 5 to 10 feet wide, these shallow-draft, flat-bottomed vessels were pointed on both ends. This meant they could, just as canoes, piroques, and batteaux, be poled or pulled upstream. Capable of carrying from 15 to 40 tons, most keelboats had a single cabin filling the entire boat except for small decks at each end and narrow walkways running the full length of the outside edge of the boat. Keelboats had masts and sails which were used whenever possible, but much of the time they were propelled by crewmen standing at the prow, repeatedly ramming long, iron-tipped poles into the stream bed, and wading the boat upstream under their feet. Where the current was swiftest, a line of boatmen resorted to cordelling (putting the crew ashore to pull a rope attached to the bow or mast) and warping (tying the rope to an upstream tree and pulling from
the deck of the boat). A keelboat trip from New Orleans back up river to the lead mines at present-day Galena, Illinois, took a month.\textsuperscript{36}

Just like flatboats, keelboats could not be portaged. The greater the use of keelboats and flatboats, the stronger the north-south axis of trade became on the portion of the Upper Mississippi River covered by this context.

By the time the Louisiana Purchase of 1803 brought both shores of the river under American political control, the existence of the lead mines on both sides of the Upper Mississippi was well known—both those in the Ste. Genevieve Lead District of what is now Missouri and in what became known as the Upper Mississippi Lead Mine District of what are now southwestern Wisconsin, northwestern Illinois, and northeastern Iowa. However, the Democratic-Republicans were a majority in Congress, and their distrust of strong government led them to oppose any extension of federal power. That meant that they opposed federally sponsored internal improvements. Some went so far as to maintain that federal spending for internal improvements was unconstitutional. With far too little population for there to be states along the Upper Mississippi, territorial government minimal and tentative, and federal sponsorship ruled out, waterway improvements had to wait. The federal government had to restrict itself to securing full title to the land on both sides of the river from the Native Americans, exploring the river, reporting on the condition of the natural waterway, and describing the character of waterborne commerce.

In March 1804, the United States took possession of the Louisiana Purchase in a ceremony in St. Louis. Almost immediately, General James Wilkinson, Commander-in-Chief of the western Army who was stationed at St. Louis awaiting appointment as territorial governor of Louisiana, turned his attention to clearing title to as much land as possible. By federal law, which was established in 1785, land could not be sold to individuals until it had been surveyed into the rectangular grid system of 6 mile square townships; each is composed of 36 sections of 640 acres. It was Congressional policy in 1804 that before land could be surveyed, it had to be purchased from the Native Americans who claimed it or ceded by them to the United States, usually in a peace treaty ending a military action.

The Sauk and Mesquawkie controlled the east side of the Upper Mississippi from the mouth of the Wisconsin River to the mouth of the Des Moines River and had hunting grounds claims all the way to St. Louis on the west side of the river. Late in the fall of 1804, Wilkinson and William Henry Harrison, Governor of the Indiana Territory to which the land east of the river belonged, succeeded in getting a small delegation of minor village chiefs to sign a treaty ceding all Sauk and Mesquawkie territory east of the Upper Mississippi to the United States on the condition that the Sauk and Mesquawkie could remain on the land as long as it belonged to the United States (that is until individual settlers purchased it from the government—although that is clearly not how the Sauk and Mesquawkie understood it).\textsuperscript{31}

Wilkinson and Harrison had no lever to push the Ho-chunk, who controlled the east side of the Upper Mississippi from the mouth of the Wisconsin to the mouth of the Black River (near present-day La Crosse); the Anishinabe,\textsuperscript{32} who commanded the east bank of the Upper Mississippi from the mouth of the Black to the mouth of the St. Croix (the land on either side of the Chippewa River valley); and the Sioux,
Osage, and Pawnee, who dominated vast territories on the west side of the Upper Mississippi, into ceding any of their land at that time. Meanwhile, increasing numbers of American pioneers were pushing into unsurveyed portions of the Indiana Territory west of the Wabash River. These hardy pioneer homesteads on unsurveyed lands spread steadily west and north.

This increasing population pressure forced the Sauk, Mesquawkie, Ho-chunk, and Anishinabe to hunt farther and farther beyond the western banks of the Upper Mississippi. This brought them increasingly into conflict with one another and with the Sioux, Osage, and Pawnee. Warfare and the need for mediation in conflicts between the groups became endemic. The Native Americans expected the American military, as the official representatives of the President, to assume the role of mediator in these disputes as the French, British, and Spanish had filled for over 130 years. Taking on this role could, as it had in the case of the Sauk and Mesquawkie, provide the Americans with the opportunity to force cessions from the tribes.

So, Wilkinson began considering stationing troops at Prairie du Chien, a point on the Sauk, Mesquawkie, Ho-chunk, and Sioux territories all met, and at the Falls of St. Anthony, a well-known point within the area where the Ho-chunk, Anishinabe, and Sioux often came into conflict. In August 1805, Wilkinson sent Lieutenant Zebulon M. Pike, a sergeant, two corporals, and 17 privates up the Upper Mississippi from St. Louis to wherever Pike determined to be the river's source. Pike's mission was to locate potential sites for military posts that would give their commanders maximum latitude as mediators in Native American disputes. He also had orders to formally purchase those sites from the Native Americans. In addition to confirming the importance of the Prairie du Chien and the Falls of St. Anthony vicinities as key points, Pike purchased two tracts of lands for military reservations—one at the mouth of the St. Pierre River (now known as the Minnesota River) and one at the mouth of the St. Croix River. The St. Pierre River site, although close to the Falls of St. Anthony, was about 5 miles downstream where a high bluff on the west side of the Upper Mississippi offered commanding views over both rivers. The St. Croix River site, like the Prairie du Chien site, was an entry point to an important east-west trade artery. Despite starting in St. Louis, working south to north, and traveling by keelboat which reinforced his north-south orientation, Pike and his contemporaries still perceived the Upper Mississippi as part of an east-west trade and transportation pattern.11

The Sauk, Mesquawkie, Kickapoo, and Potawatomis certainly still looked toward an east-west trade now that Americans had replaced the French and Spanish in St. Louis. Representatives of these tribes traveled regularly to Drumond Island in Lake Huron or Ft. Malden just a few miles across the river from Detroit to trade and meet with British government representatives. However, most of these trips were made by land rather than by water as is witnessed on what was known by the 1820s as the Great Sauk Trail across Illinois, Indiana, and Michigan to Ft. Malden.14

Pike, unlike the Native Americans, was looking toward a north-south trade route. His north-south orientation was evident in the fourth fort site Pike recommended—the one chosen to fulfill Wilkinson's order to find a fort site between St. Louis and Prairie du Chien which would allow supervision of the increasingly
anti-American Sauk and Mesquawkie. The Sauk and Mesquawkie villages which had been at either end of the Des Moines Rapids since the days of the French fur trade still existed. Sauk lighters from these villages relieved Pike's expedition boat of 31 heavy barrels of supplies so that the boat could cross the rapids. Pike recommended a site on the west side of the river a little less than 4 miles above the foot of the Des Moines Rapids, but with a good view of the central section of the rapids, for the fourth fort.35

In addition to these fort sites, one of the natural features Pike reported finding between Prairie du Chien and the mouth of the Rock River was an abundance of lead. When Thomas Jefferson's secretary of the treasury, Albert Gallatin, learned of this, he became interested in both the Upper Mississippi lead mine region and the Ste. Genevieve Lead District. Gallatin understood the Nation needed a domestic lead supply and saw a way to assure this while simultaneously raising money to help offset the costs of administering the new lands brought into the country by the Louisiana Purchase. In 1807, Congress empowered the General Land Office of the Treasury Department to keep ore-bearing public domain lands off the market and to issue permits for mining and smelting on them in return for 10 percent of the processed lead. The General Land Office did not collect its rent from the miners directly. Rather, it licensed certain smelters and then decreed that miners operating on public domain lands could only sell their ore to those smelters. These licensed smelters only paid the miners for nine-tenths of the ore they delivered to them. Land Office officials collected their one-tenth of the processed ore from the smelters without paying for it.

The Land Office initially only applied the law in the Ste. Genevieve Lead District because there were no smelters to be licensed in the Upper Mississippi Lead Mine District. Dubuque was not officially operating on public domain land; he had a Spanish land grant. However, the miners in the Ste. Genevieve District successfully fought the application of the law to them, winning the right in 1827 to purchase their lead lands. "But, the emerging upper Mississippi district provided a ready field for the application of the federal leasing system."36

Meanwhile, in 1808, the United States had begun building Ft. Madison at Pike's site along the Des Moines Rapids. This alarmed the Sauk and Mesquawkie. The army tried to calm their fears by saying they were only building a government trading post, one of the things the Sauk chiefs requested in their 1804 negotiations with Wilkinson. The Native Americans decided they did not want a trading post if it meant stationing troops in their territory. Tensions mounted to the brink of war before the Sauk and Mesquawkie backed down.37

Simultaneously, more and more lead was coming down the river from the Upper Mississippi Lead Mine District. In 1810, legendary keelboat captain Henry Shreve took 70 tons of lead from the Dubuque area down to New Orleans where he cleared a profit of $11,000—a tidy sum in that day and age. These were not the only keelboat loads of lead to leave the area in 1810, the year of Dubuque's death. The United States Secretary of War estimated three strikes in the region, worked by 500 Native Americans, produced 500,000 pounds of lead that year "most of which had gone into the British trade." For although the east side of the Mississippi had officially been
transferred to the United States in 1783, it remained British in sentiment, loyalty, and occupation for another 30 years until after the War of 1812.\textsuperscript{38}

In the 1780s, the British had more than made up for the slow start they had in their competition with the Louisianians and Canadians for control of the fur trade along the Upper Mississippi. Not only the British at Ft. Malden and on Drummond Island but also the British commander at Fort Michilimackinac continued to mediate differences among Native American groups and honor and give gifts to the Native Americans who came to the fort. In short, they carried on the role the French had played from 1658 until 1763 in the "middle ground." The commander of Michilimackinac quit first in October 1796, when the American army took over his fort. Even after that, British subjects were free to travel over United States water routes and portages until war broke out between the countries in June of 1812. Without an American presence on these routes to enforce a ban on their travel, British traders continued to work the area until the end of the war and, in some cases, beyond.

The Northwest Fur Company, founded at Montreal in 1783, dominated trade along Upper Mississippi above present-day Alton until 1798 when some of its disgruntled traders left and formed their own company, the XY Company. In 1806 the companies remerged. Robert Dickson, the Northwest Fur Company representative in Prairie du Chien and at the Falls of St. Anthony, was particularly instrumental in keeping trade flowing to the British through the end of the War of 1812. In fact, he and his Ho-chunk, Anishinabe, and Sioux allies were part of Lieutenant Colonel William McKay's force of 400 Native Americans and 150 British troops which captured the newly established American Ft. Shelby on St. Feriole Island at Prairie du Chien on July 20, 1814, renamed it Ft. McKay, and held it until May of 1815—more than 6 months after the war had ended. General William Clark (of Lewis and Clark Expedition fame and 1814 territorial governor of Missouri) and 150 men built Ft. Shelby in May and June of 1814 on a site atop a huge Native American mound along the east bank of the river.\textsuperscript{39}

From September 5 to 9, 1812, 200 Ho-chunk, supported by some Sauk and Mesquawkie, laid siege to Ft. Madison, but they were unable to breach the walls. Then in November 1812, when Sauk and Mesquawkie peace (civil) chiefs returned from a Washington, D.C., conference, they told their people that the President of the United States had promised them the American factor (government sanctioned trader) at Ft. Madison would supply them with provisions on the Native American’s promise to pay for the goods in the spring with furs and stay out of the war between the United States and Great Britain. When the Native Americans arrived at Ft. Madison, the factor said he could not, by law, supply them on credit. Almost simultaneously, a British trader arrived at the Saukenuk and supplied the Native American still there on credit. Many of the Native Americans, not surprisingly, sided with the British, and traveled east to serve in a variety of anti-American campaigns directed out of Detroit. However, they did not attack Ft. Madison again. After the fall of Ft. Shelby, the Des Moines Rapids, as designated by Ft. Madison, marked the northern extent of United States influence on the Upper Mississippi.\textsuperscript{40}

Obvious British control extended to the foot of the Rock Island Rapids, with less visible control exercised intermittently in the area between the two sets of rapids. The British did not build their own fort at the foot of the Rock Island Rapids; rather, they reinforced Saukenuk. There was little action in this area until
1814. Native Americans, under the leadership of a war leader whose name later became infamous, Black Hawk, defeated an American force of three keelboats and two supply boats under the command of Major John Campbell encamped on an Upper Mississippi River island near the village on June 14, 1814. On September 4, 1814, a group of 1,000 warriors armed with British-supplied artillery pieces also soundly defeated the American counterattack force of more than 400 regulars and militiamen under the command of Major (later President) Zachary Taylor. Taylor's troops retreated nearly 120 miles to a 90-foot bluff on the east side of the Upper Mississippi, which was about 2 miles below the foot of the Des Moines Rapids (the location of present-day Warsaw, Illinois). There they built Ft. Edwards in September 1814. They, however, abandoned it by the end of October 1814, retreating to St. Louis in the face of Sauk and Mesquawkie pressure.41

By the end of the War of 1812, a more auspicious climate for internal improvements had begun to develop in the United States. The Republicans (as Jefferson's and Gallatin's Democratic-Republicans were now called) had split into two factions; the Westerners were beginning to reconcile federally financed internal improvements with their opposition to strong government. Moreover, while the Republicans retained their majority in Congress, the Federalist minority, which always favored federal internal improvements, was larger than it had been in years. Notwithstanding this, the federal government did not immediately focus on the Upper Mississippi River. Many congressmen felt it was more important to connect the Upper Ohio River valley, a more populous area, with the East than to tap the largely unsettled heartland. After all, in 1815 steamboats were already making the run from New Orleans to the Ohio; while there was not even a single steamboat on the Upper Mississippi for another 5 years. The first commercial traffic was 8 years in the future.

Before steamboating came to the Upper Mississippi, the river had to be Americanized. In 1815 the Ottawas, Potawatomis, and Anishinabes ceded their claims to the Upper Mississippi lead mine region, but since the majority of the land in the district actually belonged to the Ho-chunk, Sauk, and Mesquawkie, that was not particularly important. But in May 1816, the Sauk and Mesquawkie signed a peace treaty with the Americans in St. Louis, confirming the cession of 1804. That same month, the army began building Ft. Armstrong on an island at the mouth of the Rock River (that is, adjacent Saukenuk) and Ft. Crawford at Prairie du Chien to signal the end of British control of those pivotal points. Ft. Crawford was built on the site of Ft. Shelby/McKay which the British burned to the ground when they evacuated it in 1815. The army also returned to complete Ft. Edwards, the fort Zachary Taylor's troop had begun constructing at the foot of the Des Moines Rapids. Government-operated factories (public trading houses which sold goods to Native Americans, similar to the one established at Ft. Madison in 1808) were also established at Ft. Armstrong, Ft. Crawford, and Ft. Edwards in 1816 so that the Native Americans would not have to trade with the British. Established from the Rock River to Prairie du Chien were private American traders, such as George Davenport and Amos Farrar of Davenport, Farrar and Farnham, agents of the American Fur Company.42

Finally, in 1820-13 years after Robert Fulton's pioneer steamboat made its first successful trip-Brevet Major Stephen H. Long brought steamboating to the Upper Mississippi north of Alton. Long had built his light-draft survey and exploration boat, the Western Engineer, in 1819 and had begun the exploration of the Trans-
Mississippi West, a task Secretary of War John C. Calhoun had assigned the Corps to which Long was attached. After launching the 75-foot by 13-foot stern-wheeler in Pittsburgh and taking it to St. Louis by way of the Ohio River, Long’s first exploratory voyage was up the Missouri. In 1820, Major Long and the Western Engineer steamed to the foot of the Des Moines Rapids. That same year, the Fifth Infantry, under Lieutenant Colonel Henry Leavenworth, began construction of Ft. Snelling (then known as Ft. Anthony) at the mouth of the Minnesota River.\footnote{3}

Meanwhile, in 1819, exploitation of the lead reserves on the east side of the river had begun to expand. The Native Americans were working the “Buck Lead” diggings from which it was estimated they took several million pounds of lead, and European traders began to arrive. Jesse Shull, operating for a Prairie du Chien firm; Dr. Samuel Muir, representing Davenport’s operation; and Francois Bouthillier, an independent French trader, were all settled in the area. Moreover, A. P. Van Matre established a smelter during the summer of 1819. \footnote{4}

In 1821, Congress decided to shift responsibility for public domain mining from Government Land Office to the Army’s Bureau of Ordnance which established regulations for the Upper Mississippi Lead Mine District, collected royalties from smelters both above and below St. Louis, and stockpiled the lead collected at an arsenal in St. Louis. In January 1822, the army began actively promoting the northern lead region, seeking lessors for public domain lands in northwestern Illinois. The first two men to answer the ads were Moses Meeker, a white lead manufacturer from Cincinnati who brought a crew of 43 to the district in 1823, and James Johnson, a native of Kentucky who had been operating in the district without a license since 1819. Then settlement began to boom. By August 1824, so many prospectors and miners had been attracted to the Upper Mississippi lead mine region by these promotional efforts and the general news of the richness of the lead deposits in the area that the Bureau of Ordnance assigned a separate Superintendent of Mines, Lieutenant Martin Thomas, to the region. Thomas had the authority to grant mining permits and leases within the 5 square leagues that the federal government then defined as the Upper Mississippi Lead Mine District. \footnote{5}

This area did not encompass the entire 3,000 square miles where lead was mined in the nineteenth century because it could only include lands which had already been ceded to the government by all the Native American groups which had claims to it. The Ho-chunk had not ceded their lands when the Ottawa, Potawatomis, and Anishinabe had in 1815 or when the Sauk and Mesquawkie did in 1816. The Ho-chunk still claimed land in the Lead Mine District. Therefore, the federal government reserved all the country north of a line from the southern end of Lake Michigan to the Mississippi for the Ho-chunk. For the sake of both the Ho-chunk and the miners, the army had to find a way for people on the ground to identify this imaginary line. They settled on a prominent, easily identifiable, east-west elevation in the prairie roughly paralleling the post-1818 Illinois border from west of the Fever River (the historic name for the river which runs through Galena, Illinois, the commercial center for the region) to West Branch of the Pecatonica River south of present-day Browntown, Wisconsin.

Unfortunately, when minerals were present, the fact that they were north of the ‘dividing ridge’ and, consequently, on Ho-chunk land was a technicality most of the prospectors and miners attracted to these opportunities simply ignored. Not only
did the prospectors and miners ignore Ho-chunk rights and treaties, but the population explosion they created also decreased the already much diminished supply of game available to the Native Americans, forcing them to hunt farther and farther from home—that is, farther and farther into the territory controlled by other tribes. The result was increasing conflict between Native American groups.

Meanwhile, in 1822 private traders had replaced the American government factors who had been set up in 1808 at Ft. Madison and in 1816 at Ft. Crawford and Ft. Armstrong. Evidently, the government felt that they had completed their job of taking the fur trade along the Upper Mississippi away from the British. The factors had been specifically forbidden to trade whiskey with the Native Americans and to grant credit to them. Neither restriction shackled the operations of the private traders. Their world collapsing around them, the Native Americans of the Upper Mississippi embraced both with disastrous enthusiasm.

That same year, 1822, Congress further increased the potential population pressure on the area by authorizing the State of Illinois to build the Illinois and Michigan (I & M) Canal. Connecting Lake Michigan to the Illinois River by way of the old Chicago Portage re-emphasized the east-west axis of trade. It would link all the areas with access to the Illinois River to the Erie Canal that was nearing completion in New York. Construction of that canal began in 1817 and finished in 1825. Congressmen from Maryland and Pennsylvania wanted what east-west trade existed to remain tied to the Ohio River, thus keeping it in the hands of the Baltimore and Philadelphia merchants rather than New York or Boston merchants who would benefit from a Great Lakes-based trade. Congressmen from Louisiana and Mississippi feared trade would be diverted from New Orleans; Congressmen from the brand-new State of Missouri were concerned trade to and from the Upper Mississippi and the Missouri would turn northeast before it got to St. Louis. All of these congressmen opposed the Illinois project. They need not have worried because, despite this authorization, construction did not begin until 1836, and the canal was not open to traffic until 1848.46

The next year, 1823, powered commerce came to the Upper Mississippi when the Virginia, a passenger and supply boat, was able to pass both the Des Moines and Rock Island rapids and go all the way up to Ft. Anthony (later known as Ft. Snelling). By 1823, a few squatters had settled near the fort. But, the crew of the boat saw more of Ft. Anthony. Upon leaving that fort on her way upstream, the Virginia got stuck on a rock in the Rock Island rapids and hung there for 2 days until a rise in the water floated her off. The Virginia had better luck both on her return trip and on her second journey from St. Louis to Ft. Anthony later that same summer.

The year 1824 was even more important for waterway improvement on the Upper Mississippi. The Supreme Court's landmark Gibbons vs. Ogden decision temporarily squashed constitutionally grounded opposition to federally financed inland waterway projects, and Congress authorized the President to assign the Corps to specific projects which examined road and canal improvements important to the Nation's commerce and defense and to projects that would improve and maintain seaports and internal waterways as a benefit to navigation.47 For several years, however, the efforts of the Corps were directed exclusively to improving the Lower Mississippi and Ohio.
Meanwhile, the non-native population in the Lead Mine District kept growing. It jumped from 200 people working under 69 permits in 1825 to 2,084 people in 1827. In 1826-1827, this population pressure forcing Native Americans along the Upper Mississippi to hunt farther and farther into territory controlled by other groups led to a conflict between the Ho-chunk and the Anishinabe, in which the Ho-chunk thought the American government supported their enemy. The two groups wanted the commander of Ft. Snelling, as the official representative of the American government, to assume the role of mediator in their dispute as various French officials, Canadian officials, and then Richard Dickson for the British had done for close to 150 years. Once the Native Americans got the commander to act, the Ho-chunk did not like his resolution of the situation.

Both the Algonquian-speaking Anishinabe and the Siouan-speaking Ho-chunk shared the same common cultural formula for dealing with combat deaths that the Sauk and Mesquawkie held. In this particular dispute, eight Anishinabe had been killed by Ho-chunk from a village on the east bank of the Upper Mississippi between Prairie du Chien and La Crosse. The commander of Ft. Snelling demanded the surrender of four Ho-chunk. Rather than "covering" the dead hunters with American government gifts to Anishinabe and sending the surrendered Ho-chunk back to their village as a "good father" would have done, the commander turned the four Ho-chunk over to the Anishinabe who killed them. Red Bird, a relative of one of the four executed Ho-chunk, led a war party against the Anishinabe attempting to retaliate for this "injustice." Unfortunately, from his point of view, the Anishinabe soundly trounced Red Bird's war party.

Shortly thereafter, when an American trader denied credit to one of his villagers, Red Bird interpreted this act as a further insult to tribal honor. In retaliation, in Prairie du Chien on June 28, 1827, Red Bird killed Registre Gagner and Solomon Lipcap as representative Americans. Taking an 8 gallon barrel of whiskey from these traders' stores, Red Bird returned to his village. That night a keelboat, the O.H. Perry, grounded on a sand bar near the village. A fight broke out between the villagers and the keelboat crew in which four crewmen and seven Ho-chunk died.

In response, the Americans, acting out of their own cultural formula which placed primary emphasis on punishing only the individual who had given offense, rapidly deployed a large force of regular army troops and volunteer militia under the command of General Henry Atkinson. Red Bird surrendered on September 3, 1827, before this force could fire a single shot.

During the same year, 1827, as this so-called Winnebago War or Red Bird Incident, 7 million pounds of lead came down to St. Louis from Galena, mostly on keelboats. On August 1, 1829, the Ho-chunk ceded the land from the "dividing ridge" north to the Fox-Wisconsin rivers route to the United States. By 1829, the white population of the Upper Mississippi River Lead Mine District was over 10,000, including 4,059 diggers and 52 licensed smelters who produced 13 million pounds of refined lead. Galena was the busiest steamboat landing north of St. Louis. The time had come for the federal government to begin considering improving the Upper Mississippi for navigation.
In February 1829, Lieutenant Napoleon B. Buford, using troops from Ft. Armstrong, conducted the first federal study on improving the Upper Mississippi River. He reported that, except for the two reaches of the river obstructed by the Des Moines and Rock Island Rapids, steamboats with a 4.5-foot draft could navigate the whole river 4 months a year. Buford considered improving navigation at these two spots in two different ways: building lateral canals around them and blasting channels through them. Although building canals around rapids was a common 1820s approach to improving them, Buford foresaw unspecified "almost insurmountable" problems in building them at these two spots. He concluded that the river would be navigable by steamboats 8 months a year if channels were blasted through the two sets of rapids.51

Just as Buford finished his study, however, things changed considerably in the Lead Mine District. During the winter of 1829, the price of lead fell from $5 to $1 per hundred pounds. Both the mining activity and population of the Lead Mine Region dropped precipitously and stayed that way until after the Black Hawk War of 1832. Not coincidentally, federal consideration of improvement of the Upper Mississippi also virtually disappeared during these years.

The Black Hawk War began and ended at sites on the Upper Mississippi River. It began at Saukenuk. In defiance of an 1831 agreement to stay on the west side of the Upper Mississippi River, on April 6, 1832, about 800 Sauk and 100 Mesquawkie crossed the river. Joined by Kickapoo and Ho-chunk, the constantly moving group of about 2,000 included less than 600 mounted warriors. Decimated by disease, starvation, and battle, only about 500 men, women, and children were left when they reached the Upper Mississippi near present-day Desoto, Wisconsin, on August 1, 1832. No more than 150 survived the Battle of Bad Ax on August 2. The battered band was caught between 1,200 troops, led by the same General Atkinson who had put down the Ho-chunk during the Red Bird Incident, and the U.S. Army steamboat, The Warrior. The slaughter continued for 8 hours. Sharpshooters lined the shore. Men, women, children, and the wounded fled into the water where, caught in the cross fire, most died. Most of those who made it across the river were hunted down by the Sioux Chief Wabashaw and his 150 man war party recruited in advance by the Americans in the event that some of Black Hawk’s followers managed to make it across the river.

With the perceived Native American menace along the Upper Mississippi below La Crosse eradicated, the population of the Upper Mississippi valley was poised to grow again. Many, especially those of New England and New York ancestry—which were a group increasingly important in the settlement of northern Illinois, eastern Iowa, and Wisconsin as the 1830s and 1840s progressed, looked to reinforce east-west trade and transportation. Not surprisingly, the residents of the growing communities along Lake Michigan hoped to become embarkation points for settlers moving out into the state and to become markets and embarkation points for the products of the hinterland. For example, a group of Green Bay promoters tried to capitalize on the population growth they expected by digging a channel at the portage between the Fox and Wisconsin Rivers. The canal was deep enough to pass a canoe by 1835, but the work was abandoned in 1836 due to high water. Nothing more was done on it until 1850.

A similar awareness of opportunities unfolding may have also fueled the 1834 discussion of building a canal from the Great Bend of the Illinois at Hennepin to the Upper Mississippi River upstream from Rock Island. Linked with the still proposed
but unbuilt I & M Canal, which would connect the Illinois River to Lake Michigan, an Illinois-Upper Mississippi Canal would replace the direct east-west trade and transport routes which had been made obsolete by flatboats, keelboats, and steamboats.

Meanwhile, in 1831, the price of lead had begun to rise again. By 1836, lead production was increasing proportionally, "making tremendous leaps in the next three years." By 1840, the District was producing more than 50 percent of all the lead in the United States. Lead production continued to increase in the 1840s, reaching its zenith in 1845. Between 1823 and 1848, steamboats carried more than 472 million pounds of lead valued at over $14 million dollars down the Upper Mississippi River from these mines. Despite this volume, the river was not the only means for getting the lead out of the Upper Mississippi Lead Mine District. In the late 1830s and 1840s, smelters began turning more and more to land transportation to carry their pigs of lead to Lake Michigan, bypassing all the Midwestern river communities, in route to white lead factories in Buffalo and other industrial centers down the Erie Canal.52

Not surprisingly, the federal government again became interested in improving the Upper Mississippi for navigation. In 1836, Brigadier General Charles Gratiot, the Chief of the Corps who had ordered Bufford's 1829 survey and whose interests in the Upper Mississippi Lead Mine District were substantial enough that one of the major mining communities bore his family's name, decided to send his foremost western rivers expert, the same Captain Henry M. Shreve who had made a tidy profit hauling lead out of the district 25 years before, to reexamine the situation at the Des Moines and Rock Island Rapids. Bufford had been an artillery officer on topographical duty; Shreve, on the other hand, had been a legendary figure on the Mississippi River for over 25 years. Since 1826 he had served as Superintendent of Western Rivers for the Corps. Shreve recommended not only trying to improve the Rock Island Rapids. He was convinced it would be cheaper to put good pilots who really knew these waters on the government payroll, station them at the head and the foot of the rapids, and have them thread boats through the mazes of channels and pools.53

At the Des Moines Rapids, Shreve recommended that the Corps develop a plan to allow circumnavigation of the worst section of the rapids by way of a 90-foot-wide lateral canal along the Iowa shore. Shreve contended that such an improvement would not interfere with navigation while it was being built and that the shore would both serve as one side of the canal and be a guide for pilots. The next summer, General Gratiot sent a 30-year-old lieutenant, Robert E. Lee, and a 21-year-old second lieutenant, Montgomery Meigs, out from Washington to develop the plan. Intending to begin their examination of the two rapids at the north end of the Rock Island Rapids, they steamed north from St. Louis only to run aground on the rock of the Des Moines Rapids and have to abandon their government boat. Perhaps this accounts for their rejection of Shreve's plan. Lee and Meigs found the rock of the Des Moines Rapids too intimidating. They estimated three times as much rock would need to be excavated to create a lateral canal as would be needed to widen the natural channel to 200 feet and increase its depth to 5 feet. They thought improving the natural channel through the Rock Island Rapids would be easier.54
Improvement Work Begins: 1838-1866

In 1838, Lee and a new assistant, Horace Bliss, found the tasks were not as easy as Lee and Meigs had thought. The work continued in 1839 but with inadequate funding. The end result was a 4-mile-long, 50-foot-wide channel that was 5-feet deep. That left nearly 8 miles of channel to build, and the little that was finished needed widening by 150 feet. The 1838 shift in responsibility for waterway improvement from the Corps under Chief of Engineers Gratiot to a newly recreated, separate Corps of Topographical Engineers, combined with the worsening of the national economic depression which had begun in 1837, probably explains why the work was not continued.55

By the early 1840s, things were becoming more complicated than anticipated in the Upper Mississippi Lead Mine District. Some of the shallowest lead deposits had already been mined out. As the decade went on, more and more mines began reaching the water table. Those miners dependent on strong backs and brute force alone began going out of business first. The California Gold Rush in 1847 enticed many of this kind of miner away. Production, even by the technologically more sophisticated, continued to dwindle until the national depression of 1857 when many mines were abandoned. Some reopened after the Civil War when lead prices were high; however, in reality by then the Upper Mississippi lead boom was over.

Just as the lead mining industry began to disappear as a source of river traffic, the lumber industry began to assume its place. The difference in the products of the two industries and the way in which they were transported were reflected in the improvements planned for the river. So were the needs of the other new river users, the immigrants traveling west into the new state of Iowa and the territory that would become, in the next decade, the state of Minnesota.

Between 1840 and 1860 the population of Iowa alone swelled from 43,112 to 674,913. While in Minnesota, Minneapolis was settled in the 1840s. The village of St. Anthony, on the east side of the falls, was established in 1849 by lumberjacks who built a sawmill. The village of Minneapolis, on the west side of the falls, was established in 1852. The two merged under the name Minneapolis in 1872. St. Paul was also established in 1840 when several families and the Canadian trader Pierre Parrant left Ft. Snelling and moved east. The community was at first called Pig's Eye, which was Parrant's nickname, but it was renamed in 1841 after the residents built a chapel. St. Paul was incorporated as a town in 1849 when it had 640 citizens. By 1860, it boasted a population of more than 10,000 people. Between 1870 and 1900 Minneapolis and St. Paul expanded from a combined population of 33,096 to the eighth largest metropolitan area in the United States with a population of 365,783.

Once American settlement reached the treeless prairies west of the Upper Mississippi River, the demand for lumber soared. The limited stands of timber in the Upper Mississippi valley itself had virtually disappeared by the 1840s. But, the great northern white pine forest of the Upper Midwest extended to the headwaters of rivers that drained into the portion of the Upper Mississippi covered by this context: the Wisconsin, Chippewa, Black, and St. Croix, as well as the Upper Mississippi north of the Falls of St. Anthony. These rivers provided the ideal vehicle for getting the products of that forest to the Upper Mississippi and from there to market. Logging began in earnest in the 1840s. The Chippewa River valley,
containing one-sixth of the pine timber west of the Appalachians, became the most important of these logging regions.56

Also, in the 1850s, the first railroads reached the Upper Mississippi. The Rock Island Line reached the river in 1852. By late 1853, the Chicago and Alton Railroad, which had begun on the banks of the river in 1847, reached Bloomington, Illinois. For the first time it was possible to travel by train from the Upper Mississippi River to New York City: the Chicago and Alton to Bloomington, the Illinois Central to La Salle, the Chicago and Rock Island to Chicago, and what in time became the Pennsylvania Railroad east from Chicago.57

Although the Illinois Central did not reach the Upper Mississippi at Galena until 1854, the prospect of its arrival changed the Dubuque harbor improvement, begun in 1844, to one that “obviously has for its object the opening of a navigable channel leading from the main business landing of Dubuque, directly across the Mississippi to the contemplated terminus of the westerly branch of the Illinois Central Railroad” by 1853 when work resumed on it. The Dixon Air Line, built by the Galena and Chicago Union, reached the river at Fulton, Illinois, in 1855, and the Chicago, Burlington and Quincy reached the Upper Mississippi at Quincy, Illinois, in 1856. The Milwaukee and Mississippi Railroad arrived in Prairie du Chien in 1857, while the Milwaukee and La Crosse reached the Upper Mississippi in 1859.58

These railroads initially increased river traffic. The Rock Island Line immediately established steamboat connections from its terminus to St. Louis and St. Paul and, in 1856, built the first railroad bridge across the Upper Mississippi. Given the economic depression of 1857, most of the other railroads could not afford to build a bridge across the river right away. This panic was particularly hard on railroad companies. For example, every railroad in Wisconsin defaulted on its bonds in 1857. Railroad companies consolidated and reorganized during the Civil War.59

The closing of the Lower Mississippi to northern shipping during the early years of the Civil War funneled many grain shipments to the east-west oriented railroads. They carried the grain from the fields of Minnesota and Iowa as well as those of southern Wisconsin and northern Illinois to Lake Michigan ports for shipment via the Erie Canal to New York and other eastern population centers. For example, between 1860 and 1865, the volume of freight and grain shipped from Prairie du Chien to Milwaukee increased over sixteen-fold. Chicago was similarly served by grain coming up the Illinois River. To some degree, St. Louis and New Orleans never recovered from this blow.60

With the railroads stalled on the east bank of the river, the river-reverting to its familiar 1658-1918 role-acted as a north-south feeder for the east-west oriented railroads. As William Cronon explained, “Alton was perfectly located to capture downstream traffic from the river and shunt it toward the Lake Michigan before it could reach St. Louis . . . .” Senator Stephen A. Douglas made the same point in the 1850s when he explained that although the Illinois Central extended from Chicago to Galena, its ability to funnel goods into and out of Chicago was much more important than its north-south capabilities. Train service from the East had reached Chicago in 1852, while the Great Lakes had provided a waterborne link to the
East forever. The Corps had, however, improved this access considerably in 1834 when it improved the Chicago Harbor at federal expense. 61

Downriver commercial interests began to respond to this shift in the axis of trade and transportation as soon as the Rock Island Line reached the river because upriver traffic immediately saw the advantage that the rail line offered. The Des Moines Rapids were still time consuming and expensive to pass. By the 1850s, Americans were doing all the lightering at the Des Moines Rapids, and they kept it all in a 10- to 12-inch-deep channel close to the Iowa shore. Small, horse-drawn flatboats could carry 100 to 200 tons of goods from Keokuk to Montrose in 6 hours with "luck and eight horses." In 1853, steamboat owners had to pay $1.25 per ton for this service. They could get goods lightered downstream for $1 per ton. Relieved of their cargos, steamboats drawing less than 24 inches of water could then pass the rapids and reload for their trip on up or down the river. Because of the amount of traffic on the river, steamboats had to wait their turn for men to off-load, transfer, and reload their goods at each end of the rapids. For this unskilled labor, the steamboat owners had to pay what at the time was considered to be the princely wage of $1.25 per day per individual in addition to the lighterage fees. The villages of Keokuk and Montrose, fully aware of their strategic locations, were the focus of both of these lucrative businesses.62

Even after paying all this money, the steamboat owners were not assured that their cargo would get through. Seven steamers wrecked between Keokuk and St. Paul in 1853. Among those wrecks, two of them fell victim to the Rock Island Rapids and one to the Des Moines Rapids. The average loss per boat, including wages and freight, was $50,000—a significant sum now but a gigantic one in 1853.63

Once the Rock Island Railroad had reached the shore, rather than go to this expense, delay, and risk, upriver shippers could just have their goods off-loaded once and loaded on the railroad for shipment as far east as necessary. Not only Keokuk and Montrose, but also Alton, St. Louis, Cincinnati, Pittsburgh, Philadelphia, and New Orleans lost out. Not surprisingly, Congress responded immediately. Each further upriver rail connection that was completed, that meant more risk was cut out for the steamboat owners and the more river towns were cut out of the commercial equation. Galena, the 1854 terminus of the Illinois Central, is about 100 miles upstream from Rock Island, and Fulton, the 1855 terminus of the Galena and Chicago Union's Dixon Air Line, is between the two—not coincidentally directly across the river from Clinton, Iowa, the only large town on the river between Dubuque (Galena's commercial successor in its region) and the Quad Cities. Delay was not acceptable.

Once more the government acted. In 1852, under President Millard Fillmore, Congress appropriated $90,000 for improving navigation below the Des Moines Rapids and $100,000 for work on the Des Moines and Rock Island Rapids. The act also created an Office of Western Rivers Improvement under the Corps of Topographical Engineers.64 Major Stephen H. Long, who had brought steamboating to the Upper Mississippi 30 years before, became the superintendent of that office. In 1853, Major Long assigned one of his assistants, Lieutenant Gouverneur K. Warren, to examine the rapids again and recommend a course of action. The 23-year-old Warren, who was familiar with the rapids because of his work on the famous Humphreys-Abbot Mississippi Delta Survey (which despite its name covered nearly the entire upper and lower rivers),65 was in
a difficult situation. He knew that the Dartmouth-educated Long and self-educated Shreve were contemporaries with a history of seeing things differently. Not only was Long Warren's superior, but he was also a scientific engineer of the sort that was in vogue. In 1843, Long had reviewed West Pointer Lee's work and decided that Lee's rejection of Shreve's lateral canal idea was correct.

Yet, in 1849, Samuel R. Curtis, another West Point-trained waterway improvement engineer, in his role as Chief Engineer of the Navigation and Hydraulic Company of the Mississippi Rapids, had examined the issue and sided with Shreve. Curtis was a widely respected, if visionary, waterway improvement engineer. He had been at the United States Military Academy with Lee but graduated 2 years before Lee. However, unlike Lee, Curtis did not remain in the "hide-bound, traditional" military. He resigned from the army after 1 year of post-school active duty to become Chief Engineer of the Muskingum River Improvement Organization in Ohio. He consistently advocated the use of the most innovative technology—waterway improvement technology—which the Corps did not, in most cases, adopt until 40 years after Curtis experimented with and applied it. For example, Curtis tried to create his first slackwater navigation system in 1832—the same year that the French Corps des Ponts et Chausséeslicer Thenard made the first innovations in dam technology which allowed the development of the modern moveable dam.66 The moveable dam, as discussed below, is the heart of a slackwater navigation system. Thus, in 1854, before Lee had made his name as a combat commander, Curtis, who had briefly returned to the military to command the Ohio Militia during the Mexican War, was a much more impressive figure to a career military officer.67

With a skill that would have served an American representative at the Court of St. James, Warren recommended in 1854 that while Shreve's and Curtis' lateral canal might eventually be the permanent solution to the Des Moines Rapids problem, current work should be limited to deepening the natural channel. That work would be useful immediately, no matter how little or how much of it was finished, whereas a canal would do no good until it was entirely completed—no sure bet given appropriation patterns in the recent past. Warren agreed with Buford, Shreve, and Lee that the Rock Island Rapids were much easier to improve.68

Contractors began work in 1854 in accord with Warren's conclusions, but it was under the supervision of Major John G. Floyd. Before the end of that year, Floyd realized that the work would take "forever."69 Yet, it continued unchanged through 1856.70 Although Congress appropriated an additional $200,000 for improvement of the Des Moines Rapids on August 16, 1856, no further work was done on either the Des Moines or Rock Island Rapids from the close of the 1856 season until after the Civil War.71

Although government improvement work had stopped, private interests continued to try to improve the river in those immediate pre-Civil War days. It was through these efforts that the first bank-to-bank lock and dam structure across the reach of the Upper Mississippi River included in this context was proposed. A group of Minneapolis businessmen, organized by territorial Judge Bradley B. Meeker into the Mississippi River Improvement and Manufacturing Company, came up with the idea of building a lock and dam below the Falls of St. Anthony. In 1857, the Minnesota
territorial legislature granted the company permission to proceed. Unfortunately, the Panic of 1857 delayed their start until after the Civil War.

Meanwhile, other water routes were also being improved to compete with the east-west oriented railroads. The State of Illinois finally opened the long-touted I & M Canal in 1848. In 1850, a private group began work on a second canal at the portage between the Fox and Wisconsin Rivers. The one begun in the 1830s had never been completed. In 1856, the State of Wisconsin completed enough of this new 2.5 mile long canal for a small steamboat to pass between the two rivers. However, by then the canal had to compete with already existing railroads, rather than going into virgin territory before the railroads as the I & M had been able to do.

Other waterways in the northern part of the area covered by this context, such as the Chippewa, St. Croix, Wolf, Black, La Crosse, Upper Wisconsin, and the reach of the Upper Mississippi north of the Falls of St. Anthony, were more important for commercial development of the region and for the use of the Upper Mississippi below the falls than either the I & M Canal or the Fox-Wisconsin Portage Canal because they served the lumbering districts of the "Great North Woods." Starting in the 1840s, whole, unsawed logs were the most important lumber-related commodity carried on the Upper Mississippi River, and these logs came to the river by way of these smaller feeder rivers. In the 1850s, "booming and improvement" companies began preparing large log rafts for mills downriver. The process continued into the turn of the century. Much of the lumber in these rafts was actually sawed boards. Prior to 1860, the largest rafts used on the Upper Mississippi contained from 300,000 to 500,000 board feet of lumber. By 1865 some rafts were carrying as much 1 million board feet. In 1870, a Chippewa Falls mill sent a raft to St. Louis carrying 2.5 million board feet. Such a raft took up 3 or 4 acres of water surface. For most of the 1870s, the rafts averaged from 75,000 to 1 million board feet.72

Until the mid-1860s, the rafts floated downriver on the current. By 1873, however, over 70 steamboats were engaged in pushing lumber rafts to market on the Upper Mississippi. In this same period, barges also came into common use for carrying other commodities-most particularly grain. Grain transportation was extraordinarily important on the Upper Mississippi from the 1860s to the 1890s. Barges allowed a substantial increase in the tonnage hauled by one boat and crew. They could also be lashed together and pushed by the same boat. Moreover, the system had a railroad-like flexibility; a barge could be added or dropped at points along the way without great delay. Use of both of these innovations, raft boats and barges, was hindered by the rapids, shifting channels, and the long low-water season on the river. However, in the 1850s and 1860s Upper Mississippi River improvement advocates ignored the channel and the shallowness of the water. They focused primarily on the need to eliminate the two sets of rapids as obstructions to navigation.73

The federal government was in no position to respond to this pressure until the Civil War was over in 1865. It also had to forge an instrument that could really do the job. Neither the Corps of Topographical Engineers nor the Corps had enough men, officers, or resources to undertake large scale engineering jobs, even if a war had not been in progress. Also, wartime experience was showing that the division between the two units was no longer appropriate. In March 1863, for the final time, Congress
recombined the Corps of Topographical Engineers and the Corps of Engineers into a single Corps of Engineers, and President Abraham Lincoln appointed Major General Andrew A. Humphreys as Chief of the combined unit. Humphreys was one of the Nation's foremost experts on both the Upper and Lower Mississippi Rivers. From 1850 to 1861 he had been one of the leaders of what has been characterized as the first truly scientific studies of these rivers. Then, in 1866, Congress authorized the transfer of supervision of the United States Military Academy at West Point from the Corps of Engineers to the army at large and increased the authorized maximum number of officers allowed in the Corps to 100. This revitalized force could provide any kind of engineering service Congress chose to authorize.

Wartime experience had also demonstrated the strategic importance of America's inland rivers. Many people continued to view postwar waterway improvement projects as military engineering projects with significant secondary civil applications. This attitude influenced Congress to pass the Rivers and Harbors Act of June 23, 1866. In this act, Congress directed the Chief of Engineers to review all pre-Civil War waterway projects and to plan additional projects of value.

Meanwhile, new obstructions to navigation, especially navigation by large lumber rafts and multi-barge rigs, began appearing on the river. The railroad companies also emerged from the Civil War able to conquer the challenges they had been unable to meet in the ante-bellum period. For example, the Dixon Air Line was finally able to cross the Upper Mississippi in 1865 with the next two crossings at Burlington, Iowa, and Quincy, Illinois, following in 1866. Other railroad bridges followed in close order: 1869-1870 at Winona, Minnesota; 1874 at Prairie du Chien, Wisconsin; 1875-1876 at La Crosse, Wisconsin; 1882 below the mouth of the Chippewa River; and 1885 and 1899 at Prairie du Chien, Wisconsin. These bridges had to be navigated around and through. The rafts and barges could no longer meander over the entire surface of the river at will. Major Floyd, who had been supervising the Corps improvement works on the Des Moines and Rock Island Rapids, declared in 1856, the year the Rock Island Line bridge crossed the Rock Island Rapids, that it was "useless to do any more work there [on the Rock Island Rapids] as long as the bridge remains to obstruct navigation. I look upon that bridge, as now located and constructed, being situated at the narrowest part on the rapids, where the current has the greatest velocity, and the piers at an angle to the current, to be a greater obstruction to the navigation of the Rock Island Rapids than all the balance of the rapids besides."

The 4-Foot Channel Era: 1866-1876

In the Rivers and Harbors Act of June 23, 1866, Congress expressly appropriated $400,000 for improvement of the Upper Mississippi River with the aim of securing a 4-foot channel between St. Paul and St. Louis. Congress specifically stipulated that $200,000 of this be used to improve navigation through the Des Moines Rapids, $100,000 for the Rock Island Rapids, and $100,000 for other channel improvements and studies of the river north of the mouth of the Missouri. To carry out this mandate, July 31, 1866, Chief of Engineers Humphreys ordered now Major G. K. Warren to St. Paul with instructions to do three things: 1) survey the Upper Mississippi and its major tributaries north of the Rock Island Rapids, 2) determine the best way to create a 4-foot channel from the Falls of St. Anthony to St. Louis, and 3) ascertain
"the best manner of bridging the Mississippi from St. Paul to St. Louis so as to occasion the least obstruction to navigation." Warren had been working on the Upper Mississippi intermittently since 1850 when he served under then Captain Humphreys on the Mississippi Delta Survey, and as discussed above, in 1854 he played a major role on the river in designing the plan of improvement for the Des Moines and Rock Island Rapids that Major Floyd had carried out from 1854 to 1856. However, rather than assigning Warren to develop a plan for improving these rapids, on August 6, 1866, Humphreys assigned that task to Brevet Major General James H. Wilson. Despite his lower rank, Warren, who had also been a Brevet Major General during the Civil War, was to concentrate on the big picture (overall strategies), while Wilson was to develop a detailed plan for a specific improvement.77

In less than 6 months, by January 21, 1867, Warren had decided that the lock and dam which the Mississippi River Improvement and Manufacturing Company had proposed in 1857 should be built at Meeker's Island. He saw pooling enough water behind this lock and dam to make a 13-foot difference in elevation between the downstream side of the dam and the upstream pool as the only way to provide "a thorough improvement in the last two mile stretch" of the river between that island and the Falls of St. Anthony. Warren estimated the cost of this structure at $235,665.48. Unfortunately, as a later commander of the St. Paul District explained, "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." In his 1868 final report, Warren recommended building not only the Meeker's Island lock and dam but also a second lock and dam about 2 miles further downstream near the mouth of Minnehaha Creek—that is, almost exactly where the Corps built Lock and Dam No. 1 over 40 years later.78

Warren was just as quick to determine the best way to create a 4-foot channel from Meeker's Island south to St. Louis as he had been to determine the best way to provide an adequate channel from Meeker's Island to the Falls of St. Anthony. His January 21, 1867, report recommended that such a channel be created simply by employing the traditional tools the Corps had been using to improve western rivers since 1824: snagging, dredging, and the construction of wing dams. Snagging was done by specially built boats that rammed waterlogged snags embedded in the river bottom. Using the weight of the boat, the power of the engines, and the force of the current, the snags were pulled out of the riverbed and winched up onto the boat decks for sawing into manageable chunks that could be used to fire the boat's boilers. Dredging is similar in philosophical approach to snagging. Specially equipped boats use different machines (in Warren's work on the Upper Mississippi mainly scrapers designed in the 1820s by Stephen H. Long) to remove loose silt, sand, and earth from a river's bottom and banks. Long's scraper depended on the current to carry dislodged material downstream. Other systems bring the sediment to the surface, usually in a bucket, and deposit it on other boats or barges that haul it to dumping sites. Wing dams extend from a bank of a river toward the channel. Their purpose is to narrow the channel, thereby increasing the velocity of the water passing through and, hopefully, causing removal of obstructions to the channel by the scouring action of the river itself. If nothing else, by forcing the water into the channel, the depth of the channel is somewhat increased. Although Major Long had worked out the basic principles of fluvial hydraulics of contraction works and the initial forms wing dams took in 1824 and 1825 on the Ohio River, Warren had less
faith in wing dams than in snagging and dredging for improving the Upper Mississippi River. But, eventually the Corps built them by the hundreds on the river—especially in the 4.5-Foot Channel Era. 79

In a far less tactful move than his 1854 report, in 1868 Warren also recommended that the Corps study "the practicality of forming large reservoirs on the headwaters of the Mississippi to aid in keeping navigation at low stages"—in short, exactly what the illustrious civilian engineer Charles S. Ellet Jr. had been proposing and equally influential civilian engineer W. Milnor Roberts (who, as discussed below in relation to General Wilson's work at the Des Moines Rapids, had just been on a board of engineers with Warren the year before) had been opposing since the 1850s. Ellet saw the creation of artificial reservoirs on tributary streams as an alternative to slackwater systems based on locks and dams for improving rivers for navigation. He thought a reservoir system would also help control floods. Stephen H. Long and Andrew A. Humphreys (the Chief of Engineers who had given Warren the assignment) were the principal contemporary engineers opposing Ellet's theories from a flood control point of view. 80

Congress authorized Warren to conduct this study, and his 1870 report considered the construction of 41 reservoirs on the St. Croix, Chippewa, Wisconsin, and Mississippi Rivers. Many in Congress did not favor this idea as they saw these reservoirs as direct aid to the logging, milling, and water power industries of the area. In 1878, Congress authorized the Corps to examine the impact of a reservoir system on navigation below the Falls of St. Anthony. Captain Charles J. Allen, the officer in charge of this survey, recommended building an experimental dam at Lake Winnibigoshish. He anticipated it would increase water levels between St. Paul and Lake Pepin during summer low water periods. Although the dam was built in 1883 and 1884 and led to the appropriation of further funds for other reservoirs, the effect it and the five reservoirs authorized as a result of its construction had on navigation below St. Paul is not clear. 81

It took Warren much longer to put his conclusions on the best way to bridge the Upper Mississippi before the public than he had taken to put his plans for improving navigation on it before them. His bridge report turned into a book-length manuscript that was not published until 1878-8 years after he had transferred from Upper Mississippi to Great Lakes engineering. By that time railroad bridges spanned the river at St. Paul, Winona, La Crosse, Prairie du Chien, Dubuque, Clinton, Rock Island, Burlington, Keokuk, Quincy, Hannibal, and St. Louis. The report, which became the standard reference for Corps policy for the next 50 years, recommended that all bridges over the Upper Mississippi be 100 feet higher than the high water level at the point they spanned the river and allow 500 feet of open water between the piers. 82

Meanwhile, from 1829 to 1866 the Corps had spent $335,000 on the improvement of the Des Moines Rapids, had only removed about 25,000 cubic yards of rock, and still not have a channel 50 feet wide and 5 feet deep for the full 11.25-mile length of the rapids, let alone one 200 feet wide—the goal that had been set in 1837. Obviously, the approach had to be changed. In 1866 General Wilson, stationed at Keokuk, opted for what then Lieutenant Warren had indicated in 1854 might be the permanent solution to the problem. Wilson recommended the construction of a lateral
canal around the Des Moines Rapids. This recommendation was probably taken from that made by Samuel Ryan Curtiss in 1849. Wilson's civilian assistant D.C. Jenne prepared the actual plans and estimates that the new Chief of Engineers Richard Delfield presented to the House of Representatives in February 1867. The Senate, leery of the plan because all previous surveys had rejected the idea of a canal, appropriated $500,000 to the implementation of a plan developed by a special board of engineers. The board, composed of Wilson, Warren, Thomas Jefferson Cram (who had been working on the Upper Mississippi since at least 1843 when he designed extensive but never-built improvements for the St. Louis harbor), Lieutenant Colonel John N. Macomb (Superintendent of Western Rivers Improvement outside the Ohio), Captain Peter C. Hains (Wilson's assistant who had actually conducted the survey of the Rock Island Rapids in the fall of 1866), and W. Milnor Roberts (who was by then simultaneously developing plans for the improvement of the Ohio River for the Corps), met in April. In May 1867 the board submitted a report recommending that Wilson's and Jenne's plan be built. Wilson oversaw the construction of the Des Moines Rapids Canal from the beginning of construction in September and October 1867 until his retirement from the army in October 1870 to become vice-president of the St. Louis and Southeastern Railroad. Simultaneously, Lieutenant Colonel William F. Reynolds relieved Colonel Macomb as Superintendent of the Office of Western River Improvement. Macomb took over construction of the Rock Island Arsenal Bridge from Warren in May 1870. In October 1870, he replaced Wilson in charge of the improvements at the Rock Island and Des Moines Rapids. Macomb delegated his responsibilities at the Des Moines Rapids to Major Amos Stickney. By 1872, most of the prism and the guard lock at the upstream end of the Des Moines Rapids Canal and the middle lift lock, 2.5 miles above Keokuk, had been completed, but the lift lock at Keokuk was still under construction. The canal was completed in 1877. The Des Moines Canal Bullnose, a contributing resource in the Lock and Dam No. 19 Historic District, is a remnant of this project. It was the downstream end of the downstream lift lock of this canal. The lock was built between 1870 and 1874.

Improvement of the Rock Island Rapids took even longer. Except for the removal of a few isolated rocks, the project was completed in 1886. It had begun in September 1866 when General Wilson had sent Captain Hains to Rock Island to examine the rapids there and recommend a plan of improvement. After completing his field work, Hains convened a board of engineers to develop a plan. The board, which met in December 1866, included Jenne (the civilian responsible for the actual work on the Des Moines Rapids), James Worral, and W.F. Shunk (Worral and Shunk were civilians who had actually conducted Wilson's survey of the Rock River). The board recommended improving the existing steamboat channel to 200 feet wide by 4 feet deep by excavating pieces of rock from the various chains. The first work began in September 1867.

While these projects were underway, congressional support for internal improvement continued to grow. This support is reflected in Congress's actions such as the 1870 authorization for a survey for an east-west oriented canal from the Great Bend of the Illinois at Hennepin to the Upper Mississippi River upstream from Rock Island. Similarly, in 1872 the federal government took over construction of the canal connecting the Fox and Wisconsin Rivers, completing it in June 1876. Further emphasizing the east-west axis of trade, in 1873 the Green Bay and Western Line opened the first direct rail connection between Green Bay and the Upper Mississippi.
Meanwhile, in 1873 Colonel Macomb assumed responsibility for the improvements Major Warren had been overseeing north of the Rock Island Rapids. Macomb expanded from simple wing dams to more complex contraction works. He built the first improvement to the river which is still in place, although now no longer visible. Macomb supervised the construction of a closing dam across the chute between Pig's Island, 5 miles downstream from St. Paul, and the eastern bank of the river. A closing dam is very similar to a wing dam, only it concentrates the water even more by totally cutting the flow off to side chutes and backwaters.

In 1874, the Select Committee on Transportation Routes to the Seaboard (also known as the Windom Committee after Minnesota Senator William Windom) issued a 970 page report on its study of the needs of landlocked regions of the United States. This committee clearly saw federally funded internal improvements creating a system intended to facilitate economic development. It urged railroad regulation and river improvement to control rail rates. Not unaware of Senator Windom's geographic interests, Ulysses S. Grant, who also hailed from the banks of the Upper Mississippi -he was elected to the presidency from his Galena, Illinois, home-appointed a special presidential commission to study the Mississippi River system. It worked the next 5 years developing comprehensive systematic plans for the river.

Simultaneously, the railroads began to encroach upon the river's monopoly in the transportation of lumber from the "Great North Woods." The first logging railroad in Wisconsin was built in 1875 and 1876. Mills using the railroads to ship their product directly to the customer no longer had to worry about water damage in route. This does not mean, however, that rafting logs and sawed lumber did not continue. Raftboats were so thick on the Upper Mississippi River in the later part of the nineteenth century that they presented a hazard to other traffic.

Federally funded regional improvements got another boost following the "Compromise of 1877" which gave Republican Rutherford B. Hayes the victory in the disputed presidential election of 1876. Hayes' avowed support of internal improvements helped elect him. It was also important to the 1878 passage of the congressional authorization for the Corps to create a 4.5-foot channel in the Upper Mississippi River from St. Paul to St. Louis.

The 4.5-Foot Channel Era: 1878-1907

The 4.5-Foot Channel Project was not a unified set of new improvements. It was the formal enunciation of a goal to be accomplished by centralizing, continuing, and extending the program of improvements already in progress—mainly snagging, dredging, and contraction works. Not only did Major Warren's bridge report come out and the reservoirs he promoted get built, but Congress created the Mississippi River Commission during this 4.5-Foot Channel Era. Composed of seven Corps officers appointed in 1879, the Commission turned out its first report in 1880. That report called for the construction of channel improvements from Minneapolis to New Orleans.

However, an 1882 Corps report on the proposed Hennepin Canal connecting the Great Bend of the Illinois River with the Upper Mississippi showed that, despite all this work, the primary axis of trade and traffic in the region was still east to
west. The Corps documented the fact that cheap transportation from the Upper Mississippi to the east was more important than cheap transportation to New Orleans.

By the late 1880s, there were 15 railroad bridges across the Upper Mississippi between Rock Island and St. Paul, and river traffic had begun to decrease drastically. It was in the same period that the Chicago, Burlington and Northern completed its line along the east side of the Upper Mississippi all the way from Quincy, Illinois, to Prescott, Wisconsin (across the river from Hastings, Minnesota). The 1890s marked the victory of rail over waterborne transportation for long-distance hauls.

Nonetheless, in 1890 the Corps began construction of the Hennepin Canal. It was completed 1907. In 1894, Congress authorized the Corps to build two locks and dams near Meeker’s Island to extend navigation on the Upper Mississippi River from St. Paul to the Falls of St. Anthony in Minneapolis. Construction began on the first one, known as Lock and Dam No. 2, at Meeker’s Island. It took until 1899 for Congress to authorize a site for Lock and Dam No. 1. Rather than being near Meeker’s Island, the final site selected was farther downstream at the place Major Warren had suggested in 1868, near the mouth of the Minnehaha. Also as Major Warren had recommended in 1868, each of the two structures was to create an approximately 13-foot difference in elevation between the pools on either side of it.

Construction did not begin on Lock and Dam No. 1 until Lock and Dam No. 2 was completed in 1906 and opened to traffic in 1907. Even then, local pressure forced Congress to authorize a new study of why two locks and dams were needed to improve such a short stretch of river, less than 5 miles. On September 25, 1907, the special Commission which had conducted this study reported that the current dams were not high enough to allow for the generation of hydroelectric power and recommended that a new special board of engineers be formed to examine modifying Lock and Dam No. 1 to allow for the generation of hydropower. Work had already begun on Lock and Dam No. 1 when, in 1909, Congress authorized the Corps to convene this board. Despite the lateness of the hour, in 1910 the board recommended modifying the structure to one creating a difference of over 30 feet in elevation between the water surfaces on either side and providing lockage to vessels requiring a 6-foot navigation channel. This size "head" of water behind the dam would be enough to generate hydroelectric power. It would also mean that Lock and Dam No. 2, just opened in 1907, would be flooded out. When the modified Lock and Dam No. 1 was completed in 1917, the Corps removed Lock and Dam No. 2 from the river so it would not interfere with navigation.

The Moline Lock, designed by the Corps between 1902 and 1905, also hooked to an island: Arsenal Island in the Quad Cities. However, it was quite different from both Lock and Dams Nos. 1 and 2 in Minneapolis. By 1900, the rest of the river had been improved to a point that the Rock Island Rapids were again a problem. Because the Moline and Duck Creek chains of rock had the steepest slopes and swiftest current in the Rock Island Rapids, the Corps began its new improvements there. The Moline Lock, built between 1905 and 1908, dealt with this reach of the rapids. The Moline Lock preserved open water navigation on the Rock Island Rapids even though by 1902 sawmill operators such as the Weyerhaeusers had already moved their headquarters north to Minnesota and begun exploring investment opportunities in the far West because the source of logs for Rock Island-Moline operations was almost used up.
Neither the lock nor the lock in combination with its two appurtenant dams extended all the way across the river.68

The Moline Lock lies right along the Davenport side of Arsenal Island, just upstream (east) of the Rock Island Arsenal Country Club and Golf Course. Two cored concrete dams formed a single line from the upstream end of the lock down the middle of the river to an area 3 miles farther upstream. There, at low-water shallows funneled the bulk of the water in the Upper Mississippi toward the Illinois side, thus increasing the channel south of the dam to a 6-foot navigable depth. Although authorized and initially designed during the 4.5-Foot Channel Era, these structures were, as noted above, not completed until 1908, by which time Congress had authorized a new goal for the river. Therefore, the Corps modified the structures to provide this greater depth before opening them to navigation. The 9-Foot Channel Lock and Dam No. 15 construction project demolished a section of the Moline Lock dam, approximately 1 mile east of the Moline Lock, so that vessels could follow a new main channel from the Illinois side of the river just east of the Moline waterfront to the Iowa side at Bettendorf. Using this route, vessels bypassed the Moline Lock entirely, traveling north of the lock along the Iowa shore and entered one of the two 9-Foot Channel Project locks at Complex No. 15.69

Long before that happened, Montgomery Meigs, a civilian engineer for the Rock Island District and son of the Montgomery Meigs who had helped Robert E. Lee plan the first improvement of the Des Moines Rapids, in 1903 approved the Keokuk and Hamilton Water Power Company's plan to be a bank-to-bank structure at the foot of the Des Moines Rapids-123 river miles downstream from the Moline lock. The complex included a nonnavigable dam in the very heart of the navigable section of the river, but it also included a lock which would solve the long-standing navigation problem of the Des Moines Rapids. The dam would pool so much water over the rapids that navigating through them and for nearly 35 miles upstream would be no problem for vessels with a 6- or 9-foot draft. In all, the dam assured modern commercial depth navigation for about 46 river miles from Keokuk to north of Burlington, Iowa. The lock would provide the elevator to the next level for boats of 9-foot draft or less.70

Meigs acknowledged that 15 percent of the downstream traffic still went directly over the Des Moines Rapids rather than passing through the existing canal and locks. But, he also noted that the percentage of traffic using open river navigation was declining rapidly. Meigs predicted it would continue to do so as the Upper Midwest lumber industry declined and the lumber marketing and processing facilities upstream from Keokuk increasingly came to dominate what was left of the business. By 1902, there was only one sawmill left below Keokuk, and as discussed above, those still operating as far north as Moline were also on their last legs. At the dawn of the twentieth century, lumbering operations in the Upper Mississippi drainage had begun to dwindle. The pineries were nearly exhausted. As hardwoods became more and more important to the industry, the importance of water transportation declined. Hardwoods were not suitable to rafting. Once they became waterlogged, they sank.

Meigs also endorsed the plan because of new advances within the shipping industry. Developments in barge and towboat technology had made it possible to haul grain in less cumbersome fleets. Moreover, long-distance packet boat operators had lost their battle with the railroads almost entirely. By 1903, packet boats were no
longer a significant user group on the Upper Mississippi River. As a result, Meigs advised Congress that a Keokuk installation with a nonnavigable dam with one lock, rather than the three in the existing canal, would save time for the vast majority of river users.

In February 1905, Congress gave permission to the Keokuk and Hamilton Water Power Company to build its dam and power plant. By allowing this project, Congress and the Corps cleared the way for the later 9-Foot Channel Project. The Keokuk project, completed in 1914, established the precedent for nonnavigable dams on the already highly traveled section of the Upper Mississippi River, not just in a stretch that was unnavigable without a slackwater system. It also showed that the free-flowing river could be interrupted in midstream without unacceptable damage to the river, surrounding lands, or economics. The entire bank-to-bank structure, including the dam, two power houses, a lock, and a dry dock, is still extent. Those resources contribute to the Lock and Dam No. 19 Historic District described in a separate National Register Nomination Registration Form that is part of this multiple property submission.91

The 6-Foot Channel Era: 1907–1930

The River and Harbors Act of March 2, 1907, authorized the creation of a 6-foot channel in the Upper Mississippi from the Falls of St. Anthony to the mouth of the Missouri River. As discussed above, although Lock and Dam No. 1 in Minneapolis, the Moline Lock, and the Keokuk Lock and Dam were all authorized before this, all conformed to this standard before they opened for navigation in 1917, 1908, and 1914, respectively.

Two main structures were added to the waterway in the 6-Foot Channel Era. One continued the tradition of open-water navigation, while the other extended the slack water navigation system which was coming into being at the head of navigation 34 miles downstream. The one preserving open-water navigation began first.

In 1905, just as construction on the Moline Lock was beginning, the Corps turned its attention to developing a plan for dealing with the upper stretch of the Rock Island Rapids, the Le Claire section. As early as 1888, a Corps Board of Engineers had developed a plan to allow circumnavigation of the Le Claire section of the Rock Island Rapids (the 3.6 miles from Smith Island to Le Claire) via a lateral canal along the Illinois side of the river. Nothing was done with these plans at that time because other reaches of the river were more difficult to navigate than the already somewhat improved Rock Island Rapids. After all, as discussed above, the Corps had been working on this reach of the river since 1854. However, once the Moline Lock was under construction, the Corps pulled out and dusted off the 1888 plans for a lateral canal. The twentieth-century Corps engineers moved the canal to the Iowa side of the river for several reasons. The improved channel through this stretch of rapids was on the Illinois side of the river. This channel could continue to be used while a canal was being built on the other side of the river and at high water even after the canal had been built. In other words, moving it preserved open-water navigation best. Also, a canal on the Iowa side could be ½ mile shorter. Finally, incorporating Smith Island, a long narrow piece of land near the Iowa shore, into the design as part of the lateral canal would save another mile of construction.
The 1907 authorization to build a 6-foot channel also specifically included authorization for a lateral canal around the Le Claire section of the Rock Island Rapids.  

In 1913, the Corps developed specific plans for the lateral canal, lift lock, and closing dam. Congress authorized construction of the project on March 5, 1914. However, the outbreak of war in Europe dashed any hopes for a quick construction start up. By the summer of 1920, when construction had still not begun, the Cincinnati Division of the Corps took the opportunity to reexamine and revise the designs for the lock, dam, and canal. Contractors built these structures and their appurtenance between 1921 and 1924. Because this lock, closing dam, and portions of the lateral dam are contributing features of the Lock and Dam No. 14 Historic District, they are described in that National Register Registration Form included in this multiple property submission. 

In 1917, before construction had begun on the Le Claire Lateral Canal, the greatly modified Lock and Dam No. 1 went into service. As soon as it opened for navigation, it became apparent that although the structure created a dependable channel (a 9-foot channel instead of the authorized 6-foot channel) upstream from it, the situation between it and the mouth of the St. Croix River was unsatisfactory. There was no dependable 6-foot channel between Lock and Dam No. 1 and the Minnesota-Wisconsin line at Hastings, Minnesota, and Prescott, Wisconsin. The situation was not quite as bad between the mouth of the St. Croix and the mouth of the Chippewa River, but keeping a 6-foot channel open there was also difficult. In February 1925, the new U.S. Army Corps Chief of Engineers, Major General Harry Taylor, asked the Senate’s Rivers and Harbors Committee to authorize a reexamination and survey of the stretch of the Upper Mississippi between Lock and Dam No. 1 and the mouth of the Chippewa River with a view towards the construction of a slackwater navigation system. The committee agreed to do so, and the Rivers and Harbors Act which President Calvin Coolidge signed into law on March 25, 1925, authorized this study. The St. Paul District conducted this study in 1925 and 1926 on funds advanced by the Upper Mississippi Barge Lines Company. On December 14, 1926, the Corps recommended that the best way to secure a 6-foot channel in that section of river would be through the creation of a slackwater navigation system created by a lock and dam at Hastings, Minnesota. 

Claude I. "Pete" Grimm, the chief of the Corps Central Engineer Division’s Engineering Design Force in Cincinnati, Ohio, took charge of the design of the Hastings, Minnesota, structure in 1927. He replaced the standard Chamion weir section of a contemporary Ohio River dam with a nonnavigable dam (discussed below in detail because other engineers from the Corps Ohio River work changed the dams proposed for the Upper Mississippi River 9-Foot Channel Project navigable to nonnavigable in late 1929 and early 1930). Grimm used a Tainter gate crest (also discussed below) on this dam. However, in late 1928 after he had completed the design for the Hastings dam, he began exploring the idea of using roller gates for the moveable crest of the Kanawha River dams he was just beginning to design. The Kanawha is a West Virginia tributary of the Ohio. Grimm’s designs for these dams, which did include roller dams, were finished almost simultaneously with the Upper Mississippi River design team’s plans for Lock and Dam No. 15.

41
Built in 1928 and 1930, Grimm's Upper Mississippi River lock and dam at Hastings, Minnesota, is now known as Lock and Dam No. 2. The dam includes a 100-foot-wide navigable pass adjacent to the lock as well as the 20 Tainter gate moveable crest. It has been frequently called "a sort of engineering link" between the kinds of dams the Corps had been building on the Ohio River for 60 years and the kind of dams the Corps would begin to build on the Upper Mississippi in 1930.96

While this lock was under construction, on August 19, 1929, the lower gate of Lock No. 1 collapsed. This led to the decision to create a second lock at Lock and Dam No. 1 so that traffic would never have to be halted again for the repair of a lock; there would always be a spare. This decision may have had a great deal to do with the duplicate locks which were included in the 9-Foot Channel Project which began being designed on May 29 of that same year. The second lock at Lock and Dam No. 1 was built as part of the 9-Foot Project. Completed in 1932, it was the first project structure placed in operation.

Between 1872 (during the 4-foot Channel Era when Major Stickney's command of the incomplete Des Moines Rapids Canal had been separated out of channel improvements) and 1930, the federal government had expended $68,350,000 for channel improvements on the Upper Mississippi River.97

Building a Slackwater Navigation System on the Upper Mississippi, 1930-1940

The Upper Mississippi River 9-Foot Navigation Project, as designed and built by the Corps between 1929 and 1940, transformed 635.4 miles of free-flowing river into a slackwater navigation system.

River improvement engineers use navigation lift locks and moveable dams to build slackwater navigation systems in rivers. The engineers design structures to span the entire width of a river, from bank to bank. These structures include one or more locks and one or more dams, but they can also include hydroelectric facilities and incorporate islands and bridge abutments. Contractors build several of these bank-to-bank structures at sites chosen by the engineers. Each bank-to-bank structure is at a higher elevation than the one below it.

Water pools behind each structure, deepest at the end nearest the structure that creates the pool and shallowest upstream at the next structure in the series. The moveable gates within at least one of the dams in each bank-to-bank structure regulate the upper pool depth, ensuring enough water for navigation throughout the entire length of the pool while guarding against flooding. Sometimes spillways in one or more of the nonmoveable dams or a nonmoveable overflow dam in a structure help with this depth regulation function. Instead of the river becoming more shallow the farther upstream one goes, it has become a series of slackwater lakes which are all equally deep at their shallow ends.

Slackwater navigation systems are often compared to stairways. The "treads" are the slackwater lakes, or navigation pools, created by the bank-to-bank structures, while the structures are the "risers."
A water surface must link the upper and lower pools. In all slackwater navigation systems, when boats are going upstream and when they are going either direction during times when the water level is low, navigation lift locks provide this water surface. Navigation lift locks can be thought of as water elevators. They have massive fixed sides and large moveable gates at each end. When closed, the gates create the equivalent of an elevator “car.” The water in the chamber serves as the “floor” of that “car.” Vessels float up or down as that “floor” moves up and down.

To move up the river from a lower elevation to a higher one, a vessel enters the lock chamber from the lower pool while the upstream lock gates are closed. The water in the lock chamber is then at the level of the lower pool because the chamber constitutes an extension of the lower pool at that time. When the vessel is inside the chamber, the downstream gate is closed behind it. Water is allowed to flow via gravity from the upper pool into the lock chamber until the water level in the chamber and the vessel riding on that water are at the level of the water in the upper pool. The upstream gate is then opened, and the vessel moves out into the upper pool.

To move a vessel from a higher elevation to a lower one, the procedure is reversed. With the downstream gate closed, the vessel moves into the lock chamber. The water level in the lock chamber is the same as that in the upper pool because now the chamber constitutes an extension of the upper pool. When the vessel is inside the chamber, the upstream gate is closed behind it. The water in the chamber is permitted to drain out, and the vessel is lowered as the water level declines. When the level of water in the chamber reaches that of the lower pool, the downstream gate is opened, and the vessel moves out into the lower pool.

There are essentially two kinds of slackwater navigation systems. They can be distinguished by the way that they allow vessels to go downstream during periods of high water. One system uses navigable dams, and the other uses nonnavigable dams. Some or all of the moveable gates or “wickets” on a navigable dam can be laid flat across the dam’s masonry sill. The sill of a navigable dam is set into the riverbed. Therefore, when the wickets are laid flat across it, they do not stick up much, if any, from the riverbed and are certainly well below the water level during high-water river stages. Consequently, river traffic can pass directly over the lowered wickets, that is, over the top of the dam, when the water level in the river is high.

The Special Board of Engineers that created the first full-scale 9-foot channel plan for the Upper Mississippi River chose navigable dams. This six person team, which began work on May 29, 1929, was composed of Major Charles L. Hall, Rock Island District Engineer; Lieutenant Colonel Wildurr Willing, St. Paul District Engineer; Major Jon Gotwells, St. Louis District Engineer; Brigadier General Thomas H. Jackson, Hall’s, Willing’s, and Gotwells’ immediate supervisor as Western Division Engineer; and Lieutenant Colonel George R. Spaulding, Louisville District Engineer who was at that time supervising the completion of the Ohio River 9-Foot Channel Project.98

On September 9, 1929, Acting Chief of Engineers Brigadier General Herbert Deakyn removed General Jackson from the board. On October 10, 1929, the new Chief of Engineers, Major General Lytle Brown, created the Upper Mississippi Valley
Division (UMVD) to supervise 12 districts including the St. Paul, Rock Island, and St. Louis Districts. The Division was to be headquartered in St. Louis with Colonel Spaulding as Division Engineer. Spaulding selected William Horatio McAlpine to be Head Engineer of the UMVD. McAlpine had been Spaulding’s principal civilian assistant on the Ohio River project. On October 15, Colonel Spaulding removed Major Hall from the now five-person board planning the project and replaced him with McAlpine.99

At the time of his transfer to the UMVD, McAlpine was considered to be the Nation’s expert in river improvement. He had been the principal civilian providing technical leadership continuity on the Ohio River 9-Foot Channel Project since 1912, that is, for 17 years. Although ultimate responsibility for the Corps civil works and military construction units rests with the Corps military officers, individual projects—no matter how big—were generally overseen by a civilian. The normal tour of duty for a military officer was 3 years. Consequently, a district’s or division’s top management changed frequently. It was the long-term civilian employees like McAlpine who provided continuity. As head of the UMVD design team, McAlpine became one of the principal engineers of the Upper Mississippi River 9-Foot Channel Project.100

McAlpine’s career with the Corps spanned over 50 years. Born in Massachusetts in what turned out to be a key year for the design of the Ohio River 9-Foot Project, 1874 (see below), he began his government service in 1899 as a hydrographic surveyor. By the time he retired from the Corps in 1954, he had served on numerous special projects including work as a consultant to the Panama Canal Office, the Port Peck and Bonneville Dam projects, and the Tennessee Valley Authority. Achieving the highest civilian post in the Corps, McAlpine was awarded the Emblem for Exceptional Civilian Service in 1946.101

By the end of November 1929, Spaulding and McAlpine had begun reassembling the old Ohio River design team in the St. Louis headquarters of the UMVD. Among the engineers transferred from Louisville to St. Louis were Lenvik Ylvisaker and Edwin E. Abbott. Like McAlpine, Ylvisaker had a degree from the Massachusetts Institute of Technology. In Louisville, Ylvisaker had been McAlpine’s right-hand man, and he served in a similar position in the UMVD. Edwin Abbott was Ylvisaker’s assistant.102

The Ohio River project, begun in 1878 and completed in August 1929, employed navigable dams. Unlike the Upper Mississippi, especially the Upper Mississippi between Dubuque, Iowa, and St. Paul, Minnesota, the Ohio experienced long periods of high water that permitted extended intervals of open water navigation but necessitated dams capable of passing large amounts of water. Coal shipment by barges, begun in 1866, was still on the increase on the Ohio and its tributaries in 1929. Fleets of barges, bound to a single towboat by a complex system of cables and chains, can operate most efficiently and inexpensively the less often they have to be broken up and reassembled. Thus, the more open river navigation available to them, the better their owners and operators like it. Wicket dams, such as the 51 Chanoine wicket dams the Corps built on the Ohio River, served these purposes well.

These dams take their name from Jacques Henri Maurice Chanoine who was Chief of the French Corps des Ponts et Chaussées in 1874 when Colonel William E. Merrill brought the idea to the United States and applied it to the first Ohio River bank-to-bank structure, the Davis Island Lock and Dam in Pittsburgh. Chanoine had
originally conceived the wicket design in 1852 and used it on 37 dams, mostly on the Upper Seine and Yonne Rivers, in the succeeding 20 years. Although located considerably north of the Ohio, the climate along the Upper Seine and Yonne is moderated by the proximity of sea. So, the weather in northern France, southwestern Pennsylvania, and the southern ends of Ohio, Indiana, and Illinois is remarkably similar. Moreover, coal barge tows traveling to Paris were the core of traffic on the Upper Seine and the Yonne, just as they were on the Ohio in and out of Pittsburgh.103

It was natural that the Special Board of Engineers that created the first full-scale 9-foot channel plan for the Upper Mississippi should consider similar dams for the Upper Mississippi project, even before the creation of the UMVD. These dams had become the standard of American Corps dam design in the 40-some years since Merrill imported the idea. When Spaulding, McAlpine, Yavisaker, and Abbott had taken over the technical leadership of the board but not yet gotten to know the Upper Mississippi River intimately, it would be ridiculous to expect anything but the project they had worked on for over 15 years to be their model. Therefore, when on December 29, 1929, Chief of Engineers Brown departed from ordinary practice by releasing an advance copy of the board’s still incomplete report, it called for moveable dams with navigable passes (meaning the space in the dam through which vessels passed at high water stages—there are longer wickets in this section of the dam) and Chanoine type weirs (dams, over which water flows—with shorter wickets) for regulating the pools and facilitating operations of the passes. Just as all the dams on the Ohio at that time, all of the moveable parts of these Upper Mississippi River dams could have been laid down on the bed of the river. They would have permitted greater areas for open-water navigation during high-water stages and would have offered less obstruction to the passage of water during floods than the Hastings, Minnesota, structure then under construction across the Upper Mississippi.104

However, conditions on the Upper Mississippi were quite different than those on the Ohio, the Upper Seine, and the Yonne. The problem on the Upper Mississippi was making sure there was enough water for navigation most of the time, not just for short intervals between deep floods. By the time the interim report was published as House Document 290 on February 15, 1930, the UMVD design team had already concluded that the relatively short high-water stage in most reaches of the Upper Mississippi made ensuring open-river navigation during those stages insufficiently important to rule out consideration of nonnavigable dams. The design team had already begun to consider changing the plan to nonnavigable dams. With nonnavigable dams, all river traffic must pass through the lock, regardless of how high the river’s flow.105

Nonnavigable dams are also often called pier dams or crest dams because a crest of moveable gates erected between piers is superimposed on their sills. These sills are not set down into the riverbed. Rather, they stick up from the bottom and function as permanent weirs, ensuring a minimum pool level above the dam at all times. This was a decided advantage in many places on the Upper Mississippi. In these places, maintaining a deep enough pool for fully loaded modern boats and barges navigate was difficult even during high-water stages. The banks of the river were so low and the valley so wide that the water would spread out rather than backing up during the comparatively shallow floods on the Upper Mississippi.
Just as Merrill had in 1874, this team turned abroad for new ideas in 1930. But this time their eyes went to Germany rather than France. The continental climate in the southern German hills more closely approximated the conditions on the Upper Mississippi than that of southern Ohio, Indiana, and Illinois, or northern France. The ability of equipment to operate under sustained subzero conditions was not a major problem to be dealt with on the Ohio or the Upper Seine. Winter ice gorges posed a serious threat not only to any dams engineers might build on the Upper Mississippi but also to private property along the riverbank. In the spring, the river's flood water carried heavy drift. The Upper Mississippi's low banks, densely farm bottom, and the proximity of towns and railroads to the river precluded the use of any structure which increased the natural flood level more than 12 inches. Therefore, the 9-Foot Channel Project engineers had to find a structure that would pass the maximum amount of water quickly during floods, simultaneously keep enough water behind the dams for modern navigation, and also pool the maximum amount of water behind the dams in the long low-water periods to ensure full-season navigation. All these needs were similar to those engineers working on the Rhine and its two branches, the Main and the Neckar, also had to meet. Moreover, the commercial navigation on these rivers more closely resembled that on the Upper Mississippi than that on the Ohio or the Upper Seine. Coal was not mined within its drainage nor used in the factories at its head of navigation. Hydropower spun the wheels that generated wealth in the mills of Minneapolis (see below, Tapping the Power of the Upper Mississippi).

Also unlike the dam gates on the Ohio, dam gates in Minnesota and Wisconsin have to be operated when there is still significant ice on the river. Skilled laborers, working from a temporary runway placed on a series of metal trestles stretching across the entire river or from a derrick boat, operate wicket gates. Hazardous on an ice-free river, the danger and difficulty are greatly increased in the kind of weather conditions prevailing on the northern reaches of the portion of the Upper Mississippi to be improved for navigation. Because the floods on the Upper Mississippi were relatively shallow, it was physically possible, again unlike on the Ohio where the floods are so deep and strong, to build permanent, fixed bridges toward the tops of the piers (above maximum flood heights) from which the dam gates could be operated. However, wicket gates could not be operated from them-no one could reach all the way down to the sill of the dam from an above flood level bridge. To use this system, other gates which could be operated from these fixed bridges had to be used.

Although initially more expensive to build, pier dams with gates operated from a fixed bridge are easier, cheaper, and less hazardous to operate than wicket dams. They also are more dependable, allow more accurate control of pools, and are more easily repaired with less hindrance to navigation. For example, the space between the piers can be blocked off with bulkheads and dewatered for easy repair of both the crest gate and the sill. Wicket gates can be repaired rather easily, but repair of their sills is very difficult or impossible without interrupting navigation. By 1902, the Corps had learned at the Davis Island Dam on the Ohio River—the northernmost dam in that system—that when wicket gates remained up in the winter, ice piled up against the wickets causing damages to the sill below them. Gates operated from a fixed bridge can also be opened part of the way; wicket gates on a dam are either open or shut—although one dam can have wickets of several heights, some of which the water
must flow over while others are down entirely. However, the ability to allow a little water to pass over the whole dam rather than a lot over a few places means that gates operated from a fixed bridge protect the dam from downstream scour and hydraulic jump. On the Upper Mississippi, where many of the structures had to be founded on sand, this was another advantage.108

Early twentieth-century engineers in Germany, just as their American counterparts, had their choice of several types of moveable crest gates that can be operated from a fixed service bridge: vertical lift gates, Tainter gates, sector gates, and roller gates. Yet, more often than not, they chose roller gates for dams on the Rhine, Main, and Neckar. During the first 30 years of this century, roller gates could be built at lengths greater than any of the other types of moveable gates suitable for pier dams. Greater length gates allowed maximum clear opening through which running ice, drift, and flood waters could pass. The longer lengths also meant fewer piers, which also served as obstacles to the flow of water and everything it carried with it. The gates' massive construction, operating machinery, and ability to be raised also suited them particularly well for installations in shallow rivers in continental climates. The ruggedness of the gates assured their positive operation under the most severe conditions. Roller gates bear on the broad end of a cylinder rather than on a small pivot as Tainter and sector gates do.109

Dr. Max Karstanjen, Director of the Maschinenfabrik Augsburg-Nurnberg Company (MAN), had developed roller gates at the turn-of-the-century in Germany. European engineers, particularly those in Germany and Scandinavia, adopted the design almost immediately. Two German companies, Krupp and MAN, controlled basic patents for the gate. By 1930, European engineers had been using roller gates in dams extensively for over 25 years. However, only 10 such structures had been built in the United States.110

Simply defined, a roller gate is a cylindrical, metal tube that lays across the water between two concrete piers. The first roller gates on the Upper Mississippi were nonsubmersible. When lowered, a nonsubmersible roller gate rests directly on the dam's concrete sill, holding back the water. When raised, the gate allows water to flow freely beneath it. A single dam can have several roller gates, each of which can be operated independently. Each gate raises and lowers by means of a multiple side-bar chain mechanism, similar to an enormous bicycle chain. The solid ends of each roller gate are fitted with sprockets which engage inclined racks attached to the piers. As an electric motor housed within one of the piers hauls in the chain, the gate moves slowly up the racks. Only one end of the drum is driven; the other end merely rides up the racks.111

A roller gate's trussed cylinder provides strength and makes the gate very rigid along its longitudinal axis. The inherent strength of roller gate drums permitted construction of long gates with an economic use of metal. An early improvement to the basic design was the attachment of a curved steel apron to the lower side of the gate which reduced the required drum diameter and permitted use of waterproof timber or rubber seal. The ends of a roller gate are equipped with flexible steel shields, the lining of which fit the slightly inclined planes of the faces of the piers. Water pressure keeps the end shields tight against the piers; and yet, clearance between the linings and the pier faces is ensured as soon as the
roller has risen a few feet. The design of the seals, both side and sill, also meant that roller gates were less likely to leak than other moveable gates.\textsuperscript{112}

The first roller gates in the United States were used on flood control and irrigation projects. In 1914, the Washington Water Power Company used three roller gates for spillway crest control at a dam located on Long Lake near Spokane, Washington. The U.S. Bureau of Reclamation Service followed suit soon, first with a small roller crest at its Lucky Peak Reservoir near Boise, Idaho, and then in 1916 with a seven roller gate crest on its Grand Valley Diversion Dam near Palisade, Colorado.\textsuperscript{113}

With the Grand Valley Diversion Dam, Reclamation Service engineers established the basic form for American roller gate dams. Reclamation Service engineers also, somewhat unexpectedly, gained considerable experience in the fabrication and erection of the gates. In September 1913, the Reclamation Service contracted MAN to design and fabricate roller gates for this dam. By May 1914, the company had developed a set of plans and fabricated some parts in Germany. However, the outbreak of World War I in Europe in August 1914 prohibited MAN from completing the work. As a result, Frank Teichman, a Reclamation Service engineer, hurriedly reworked the German plans, and the Riter-Conley Manufacturing Company of Pittsburgh fabricated the gates. Elevations and sections of the Grand Valley Diversion Dam show the basic form of the piers and the service bridge to be the same as those in Dam No. 15 on the Upper Mississippi River 9-Foot Channel Project. The architectural style of the Grand River Dam’s piers are also clearly direct precursors for Dam No. 15’s roller gate piers.\textsuperscript{114}

In December 1928, Pete Grimm, the Corps engineer who had designed the Hastings lock and dam on the Upper Mississippi, went to Hawley, Pennsylvania, to inspect roller gates in operation at the Electric Bond and Share Company’s Wallenpaupack Plant. Presumably he shared his impressions with his colleagues on the Ohio River 9-Foot Channel Project design team, if not at that time, once they had moved onto the Upper Mississippi River project in late 1929. That group included Spaulding, McAlpine, Yvilsaker, and Abbot. In February 1930, UMVD team members McAlpine and Yvilsaker and ex-member Major Hall, now commander of the Rock Island District, went to the New England Power Association’s new power plant on the Connecticut River at Bellows Falls, Vermont, to see roller gates in action for themselves. The fact that the team was close to deciding to use nonnavigable dams with a roller gate crest after this visit is reflected in the legislation Minnesota Representative William I. Nolan proposed in March 1930 to give the Corps the right to make changes in the type and location of the Upper Mississippi River 9-Foot Channel Project dams. Therefore, that this provision was not included in the amendment that Minnesota Senator Henrik Shipstead proposed to the version of the Rivers and Harbors Act which the House passed on April 25, 1930, suggests that either the decision was not firm by then or mentioning the proposed change would have complicated things that it was already going to be difficult to pass the amendment through Congress.\textsuperscript{115}

The team had to have decided fairly soon after that because by December 22, 1930, they had a complete enough set of plans for a roller gate structure, Lock and Dam No. 15 in Rock Island, Illinois, developed to present them to the public. By April 11, 1931, Yvilsaker and Abbot were visiting the firm which manufactured the
roller gates for the Bellows Falls installation, S. Morgan Smith of York, Pennsylvania, to discuss their building the roller gates for Lock and Dam No. 15. On April 23, 1931, the Corps was sure enough of the final form this dam would take to let the contract for the construction of the adjoining locks. 116

Lock and Dam No. 15 is unique among those in the project in that it only includes roller gates: nine, 100-foot by 20-foot, nonsubmersible roller gates and two, 16-foot by 100-foot nonsubmersible roller gates. The next structure that the UMVD team designed, Lock and Dam No. 4 in Alma, Wisconsin, in 1931 included four, 20-foot by 100-foot nonsubmersible roller gates and 25, 15-foot by 35-foot Tainter gates. 117

However, the plan for Lock and Dam No. 4 was so different from the plan Congress had authorized in July 1930 that the Chicago, Burlington and Quincy Railroad successfully sued the federal government for planning to build an unauthorized structure. 118 To allow not only the specific lock and dam at issue, but also the whole system, to be built, Congress had to pass a joint resolution giving the Corps the right at its professional discretion and without additional approval, to alter the plans for individual structures and the system as a whole. President Hoover signed this resolution into law on February 24, 1932, just about a month before Merrit-Chapman-Whitney completed the first structure in the system, the main lock at Lock and Dam No. 15. 119

It is a good thing the amended authorization was so broad because the Corps continued to make major changes, such as eliminating an entire lock and dam complex from the system (what would have been Lock and Dam No. 23), after February 1932. 120 Despite this deletion, the Upper Mississippi River 9-Foot Navigation Project still included 26 locks and dams (23 new and three old) because between 1930 and 1932 the Corps added one more lock and dam to the system (Lock and Dam No. 5A). 121

One of the most important of these changes was the decision to go from nonsubmersible to submersible roller gates. One of the reasons the Corps had chosen to use roller gates was that they can be raised above the water. The engineers were leery of submersible gates, such as some types of sector gates, because they were concerned about excavating places in the riverbed into which the gates would be lowered. They expected these excavations to fill up with sediment. However, events forced them to change their minds. 122

Construction on Lock and Dam No. 15 began on February 8, 1932, and by 1933 enough gates were in operation for the engineers to learn that floating ice could not pass underneath the gates unless they were raised approximately half the distance from the sills to the surface of the upper pool. Opening the gates this far during freezing temperatures when the Upper Mississippi is usually low, lowered the upper pool below the depth needed for navigation by vessels drawing 9 feet of water. The practice also adversely affected the natural habitat of the upper pool and created problems below the dam apron and stilling basin. Opening the gates so wide produced a very concentrated flow which would cause very serious erosion on the dams founded on sand. As a result, project engineers reconsidered the use of submersible roller gates that would allow ice, debris, and flood waters to pass over, rather than under, the gates. 123
The development of submersible roller gates was the most significant innovation in roller gate design to emerge from the 9-Foot Channel Project. Corps engineers refined and improved the design and operation of roller gates throughout the course of the Upper Mississippi River Project. These innovations resulted in the development of a decidedly American-style submersible roller gate.

The Corps first used submersible roller gates on the Upper Mississippi at Lock and Dam No. 4. Because of the court case, Lock and Dam No. 4 was not built from the 1931 plans. The engineers used the time to tinker with the design. As built by Ouimotte Construction and Engineering Company of Chicago beginning in November 1933, Lock and Dam No. 4 consists of six, 20-foot by 60-foot, submersible roller gates, rather than the four longer gates originally planned, 19, 35-foot by 15-foot, nonsubmersible Tainter gates, and three, 35-foot by 15-foot, submersible Tainter gates. All nine submersible gates, six rollers and three Tainters, were submersible to a depth of 3 feet. Treadwell Construction of Midland, Pennsylvania, designed and built the roller gates. McClintic-Marshall Corporation of Chicago installed both the rollers and the Tainters.124

The St. Paul District installed gates that submerged even further, 5 feet, at Lock and Dam Nos. 3 (near Redwing, Minnesota) and 9 (below Lynxville, Wisconsin), both of which went online in May 1938, 3 years after Lock and Dam No. 4. This change was made so that the especially heavy loads of ice projected for those locations could easily pass over the gates. However, both the Tainters and the rollers at Lock and Dam No. 5 (near Minnieska, Minnesota), which was completed the same year, 1935, as Lock and Dam No. 4, only submerged 3 feet. While Lock and Dam No. 6 (Trempealeau, Wisconsin) and Lock and Dam No. 5A (above Winona, Minnesota), completed a year later in 1936, have 3-foot submersible rollers, none of their Tainter gates are submersible. Lock and Dam Nos. 7 and 8, which went online in April 1937, again had 3-foot submersible rollers and both submersible and nonsubmersible Tainters.125

Rock Island District staff made many of the design modifications relating to submersible roller gates. As noted above, the construction of Lock and Dam No. 15 within that district demonstrated the problems associated with nonsubmersible gates. Although Lock and Dam Nos. 20 (near Canton, Missouri) and 16 (Muscatine, Iowa), which were designed in August 1933 and September 1934, were equipped with the original German-designed, nonsubmersible roller gates, the district design team soon modified this basic design. By this time, because of the conversion of the works to an employment relief project (see below, "Another Multiple Use, the Upper Mississippi River Produces Jobs"), the staff of each individual district was designing their own structures based on MacAlpine’s, Ylvisaker’s, and Abbot’s UMVD designs for Lock and Dam Nos. 15, 4, 5, and 20.

The Rock Island District staff designed their first submersible roller gates in 1935 for Lock and Dam Nos. 11 (Dubuque, Iowa) and 18 (near Gladston, Illinois). These gates submerge 8 feet. A nonsubmersible roller gate had only one sill level; the gate when lowered against the sill forms a bottom seal. But the new submersible roller gate had two sill levels: a higher upstream level and a lower downstream level which were joined by a curved section of concrete. The Corps designed the submersible roller gate to either rest next to the higher level of the sill-to form a bottom seal -or slide along the curved section of concrete until it reached the lower level. At
the lower level, the gates at Lock and Dam Nos. 11 and 18 are 8 feet below their normal closed position.

The new submersible roller gate did not totally solve the scour or water elevation problems of the upper pool that had manifested themselves at Lock and Dam No. 15. As a result, the Corps engineers attempted to mitigate these problems by reducing the depth to which the gates submerged. The roller gates at Lock and Dam No. 21 (Quincy, Illinois), which went on line in July 1938, only submerged 4.67 feet, but the engineers were still dissatisfied. In 1936, the Corps designed roller gates for Lock and Dam No. 22 (near Saverton, Missouri) that submerged 8 feet. But, in this design, the engineers also incorporated a Poiree dam trestle the same height as the downstream fender on the adjoining piers. The Corps set the dam trestle units immediately downstream from downstream level of the sills. As a result, the trestle units acted as weirs. In 1937 the Corps hired Worden-Allen Company of Milwaukee to furnish enough Poiree dam trestles to retrofit the dams in all three districts built before Lock and Dam No. 22. Still the Rock Island District was not happy enough with this solution to include it in its new designs. For its last three dams, Nos. 13, 16, and 17, the district engineers once again reduced the submersible depth to 4.67 feet.126

With these two changes—going from all roller gates to a combination of rollers and Tainter’s and the use of submersible rollers and Tainter’s—the UMVD had essentially developed dam configuration that inaugurated a new era in slackwater navigation in the United States. These nonnavigable dams incorporating both roller and Tainter gates are what most clearly distinguish the Upper Mississippi River 9-Foot Channel Navigation Project from other river improvement projects. They are the both first and last American dams of this type. Technological advances made during this project by the people designing and building this project made combination roller and Tainter gate dams obsolete by the time the last project structures were built.

The project made this style of dam obsolete largely because of the innovations in Tainter gate design that were made as a result of the project. By the end of the project, the Corps had developed Tainter gates that were so advanced that they made roller gates obsolete.

Viewed from the side, a Tainter gate and its armature look like a pie-shaped wedge: a lengthwise segment of cylinder with triangular arms extending from each end. The cylindrical section of the gate forms the damming surface. While a roller gate is lifted up and down, the arms of a Tainter gate pivot on pins attached to the supporting piers. The Corps opened and closed the first Tainter gates on the Upper Mississippi River by means of a cable or chain attached to the lower side of the gate shield and driven by machinery located above the gate on the dam’s service bridge. The shape of the gate was such that the water pressure behind the gate had very little effect, and the hoist machinery merely had to overcome the dead weight of the gate. By the end of the project, Corps engineers had eliminated this hoisting method in favor of a system operated by a line shaft and motors.127

North American hydraulic engineers had been using radial gates based on the same principles as the Tainter gate for over 100 years by the time the Upper Mississippi design team began incorporating them into its designs. Tainter gates
are of American origin. As early as 1827, when Captain Marshall Lewis applied for a patent on his semicircular, cast iron gate turning on pivots connected to the gate by arms, he admitted he had not designed a new gate type but merely made some important improvements in what was already known as the "common paddle gate."

Refinements in Tainter gate design continued throughout the nineteenth century. Jeremiah Burnham Tainter patented the gate system in 1885. In 1889, Major William L. Marshall became the first Corps officer to use Tainter gates, adopting a manually operated version of them for use on a moveable dam across the Rock River between Rock Falls and Sterling, Illinois.128

Tainter gates are economical and simple to fabricate, erect, and operate. But there was still room for improvement when the UMVD design team began assimilating them into the its Upper Mississippi River designs in 1932 and 1933. At first, Corps engineers considered Tainter gates too small and too unreliable in terms of operation under adverse conditions to be used in principal spillway sections of the dams. In addition, most American Tainter gates averaged 30 to 35 feet in length. Given the Corps requirements for a 100-foot gate that operated reliably under all kinds of conditions, Corps engineers initially designed the main section of the dam with roller gates and completed the moveable portion with a series of Tainter gates. The engineers had discovered that three or four 100-foot-long roller gates situated in the thread of the stream were all that were necessary to pass ice, drift, and flood waters satisfactorily.129

During the 9-Foot Channel Project, the Corps developed several innovations in Tainter gate design. Prior to the project, engineers believed that Tainter gates, like the original German-designed roller gates, should be raised above the water rather than submerged. However, the Corps work in developing submersible roller gates eventually resulted in the design of a submersible Tainter gate. Corps engineers designed many of the 9-Foot Channel dams, such as Nos. 20 and 16, to include both submersible and nonsubmersible Tainter gates. The earliest form of the nonsubmersible Tainter gate was comprised of a drum-type gate with steel skin plates on the surveyed waterside face. The waterside face of the submersible gate was identical to that of the nonsubmersible gate. However, the Corps engineers modified the submersible gate to include an additional overflow plate that arched back downstream from the top of the gate.

In May 1935, Corps engineers initiated a new kind of submersible Tainter gate at Lock and Dam No. 18. On this new gate, steel skin plates totally surrounded a steel truss frame. The Corps designed the gate to be the shape of a three-quarters ellipse; the back of the gate face was convex rather than concave. The streamlined steel shell of this new gate protected the gate's steel framework from ice damage and provided a smooth, unobstructed surface for the water that passed over the gate in its submerged position.

The 9-Foot Channel Project engineers had conducted model studies that indicated that the earlier, drum-type gates created "a negative pressure on the crest that may cause vibration and excessive fatigue, or corrosion of the metal." Manufacturers, however, found the new elliptical-shaped gates to be difficult to build, and the truss framing required the distortion of certain connecting angles. As a result,
Corps engineers revised the framing, substituting a girder frame for the truss frame. Lock and Dam No. 11 was the first representation of this more sophisticated, elliptical, Tainter gate design.

Despite scour problems, Rock Island District engineers incorporated the elliptical Tainter gate into the five dams founded on sand that were designed after Lock and Dam No. 18. The engineers also continued to test new designs. At Lock and Dam No. 22, district engineers added elliptical shields to both ends of that dam's one submersible Tainter gate. When the gate was submerged, the shields prevented water from seeping between the gate and the piers. The Corps followed up on this experiment. In 1939, the Corps Hydraulic Laboratory at Iowa City made 19 models of Lock and Dam No. 22's submersible gate and conducted 157 tests on them in order to develop a satisfactory stilling basin for submersible Tainters, as well as a design for improved Tainter gate hoisting machinery and operation.130

At Lock and Dam No. 22, the Corps also introduced a new type of nonsubmersible Tainter gate. Like the submersible elliptical gate, the new nonsubmersible gate was totally surrounded by steel siding. But, rather than being elliptical, the gate was shed-shaped, similar to the nonsubmersible Tainter gates that had metal sheathing only on one side. The Corps apparently wanted the improved longitudinal registry, increased strength, and ruggedness of the elliptical Tainter gate but did not need, at dams founded on bedrock, the scour diminution offered by the submersible gate. Also, because of the bedrock foundation, it would have been very expensive for the Corps to have constructed the two-level sills necessary for submersible gates. The Rock Island District used these new, nonsubmersible, Tainter gates exclusively in Lock and Dam No. 14 which was founded on bedrock.

Submersible elliptical Tainter gates and nonsubmersible arched Tainter gates supported the construction of gates at unprecedented lengths. Corps engineers were soon building Tainter gates at lengths of 60 feet. Eventually, Lock and Dam No. 24 (Clarksville, Missouri) employed Tainter gates that were 80 feet long.

The Corps designed Lock and Dam No. 24 in December 1937. With this dam, constructed in 1938-1939, the Corps attained its highest level of Tainter gate technology during the 9-Foot Channel Project. Corps engineers incorporated 1,580 foot long Tainter gates into the 1,340 foot long moveable portion of this dam. The large size of these gates and the relatively ice-free conditions that characterize this stretch of the Upper Mississippi, convinced Corps engineers to entirely eliminate roller gates from the dam.131

The Corps designed the Tainter gates at Lock and Dam No. 24 to be fully submersible and elliptical in section. Project engineers selected elliptical design because it permitted the shell of the gate to act as a beam between the end supports, eliminating the need for extensive internal bracing and framework. The design also reduced both the quantity of steel required to fabricate the gate and its operational weight. An additional reduction in weight, as well as an improvement in corrosion resistance, resulted from the use of high tensile, phosphorous chromium steel for most moveable portions of the gates.
Lock and Dam No. 24 represented a vast improvement in Tainter gate design. Within the space of a few years, the Corps had improved the design of the Tainter gates so dramatically that roller gates, the principal engineering feature discussed in early technical articles related to the 9-Foot Channel Project, were entirely superseded by a cheaper, simpler, and more reliable gate type. These developments made roller gate technology obsolete, effectively bringing to an end the short history of combination roller-Tainter gate dam construction in America.

Alterations Begin Before System Completed: 1935-1938

On January 5, 1934, Ouimet Construction and Engineering Company of Chicago completed the construction of the first lock in the system built on a timber pile foundation, Lock and Dam No. 4. On March 7, 1934, Edward E. Gillen Company of Milwaukee, Wisconsin, brought the second lock founded on piles, Lock and Dam No. 5, into operating condition. By May, the Corps engineers realized that the land walls of these locks did not have adequate stability to resist the horizontal thrusts imposed by the back-filling necessary to create the lock esplanades. Both St Paul District Engineer William Z. Lidicker and St. Louis District Principal Engineer Lawrence B. Feagin conducted a series of tests on groups of piles subjected to static and cyclical loadings. Lidicker's tests, conducted in July 1935, gave the engineers an "opportunity to study the variation of indicated bearing value with length of piles and spacing (or compaction) in sand foundations." Although inadequate by modern standards, these tests were a pioneering effort in scientific analysis of pile-founded structures. These tests provided enough information for the engineers to remedy the situation at all the locks still under construction on piles—that is, at Lock and Dam Nos. 3, 6, 7, 8, 10, 11, 12, 15, 17, 18, 21, 22, 25, and 26. They added a series of reinforced concrete struts to the foundations of the lock chambers. The top of these struts was level with the floor of the lock. Thus, a portion of the horizontal thrust imposed on the land wall by the esplanade fill carried to the riverward wall of the lock upstream from the upper miter sill and downstream from the lower miter sill.

Similarly, the Corps engineers redesigned the foundations of the guide walls at several locks resting on pilings. These walls had the same weakness as the land walls. To solve this problem, the Corps held an interdistrict conference. Struts could not be used since no river walls existed to absorb horizontal stress. Therefore, the conferees decided that battered piles with a wider crib and some additional vertical piles would give the necessary support. Feagin, again, was a leader in finding this solution. He conducted load tests upon groups of battered piles similar to those he conducted on the full piles.

As soon as they opened for navigation, the Corps learned that navigation in and out of the upstream ends of Lock and Dam No. 20, completed in 1935; Lock and Dam Nos. 11, 16, and 18, completed in 1937; Lock and Dam Nos. 21 and 22, completed in 1938; and Lock and Dam Nos. 13 and 14, completed in 1939; was very difficult. All had outdraft problems. By 1940, Rock Island District engineers had devised a common solution to these problems at Locks Nos. 11, 16, 18, 20, 21, and 22. The Corps added a 500-foot, cell-foundation, guard wall (see PHOTO 14) to the riverward wall of the auxiliary lock at each of these complexes.
But this solution was not enough at several complexes where the outdraft problem was especially strong, including at Lock and Dam Nos. 11, 22, and 24. In 1941, the Corps built upper-approach flow deflecting dikes at these complexes.

However, this still did not solve the problem at several sites. In 1942, the engineers decided to try a new strategy at the four locks which still had the worst outdrafts: Lock and Dam Nos. 11, 13, 15, and 22. They built 400- to 600-foot-long extensions to the upstream guide wall (see PHOTO 15) of each of these locks in the hope that the additional length would allow the boats and lock staff, working together, to counteract the problem by physically holding the boats against the guide wall. At Lock and Dam Nos. 15 and 22, founded on bedrock, these guide wall extensions could be built in what had long been the traditional way. However, at Lock and Dam Nos. 11 and 13, which were founded on sand, the Corps had to build the guide walls on timber cribbing partially filled with riprap. The concrete wall was supported by battered timber pilings driven to refusal. This design eliminated the necessity of building an expensive cofferdam for this addition. Satisfied with the results at all four locations, the Corps applied this solution to all the other locks in the system in 1951.

In 1978, traveling mooring keels (also known as rail-mounted traveling check posts—essentially large cleats on rails, see PHOTO 22) were devised to help with the task of physically holding the boats against the guide walls. Each upstream keel’s rail runs the full length of both the guide wall extension and the guide wall itself, that is, right up to the lock gate. At first they were installed only at the upstream end of the lock, but after 1980 the Corps began having them installed the full length of both the upstream and downstream guide walls wherever possible.

The top-down nature of change in the Corps District is evident in the machine pit covers which site staff began installing at the locks in the St. Louis District in 1946. Despite being very practical and useful additions from the point of view of the lock staff, they did not spread to the locks in the Rock Island District until the 1980s. Most site staff indicated in 1988 that the structures had only been built and installed by site staff in 1983. By 1998, they were being routinely removed from Rock Island District locks (only Lock and Dam Nos. 11 and 12 still had them) but remained in place at the St. Louis District locks. Even at Lock and Dam No. 24 which was undergoing extensive rehabilitation in 1998, there were no plans to remove the machine pit covers.

Comprehensive change has been considered for the system, beginning in 1945. That year, Congress authorized the Corps to study the economic and environmental feasibility of deepening the Upper Mississippi channel to 12 feet. The Corps completed this study in 1949, but no action was taken on it because of the Korean War. By 1968, when the deepening of the Lower Mississippi channel to 12 feet was already underway, Congress authorized the Corps to study deepening the Upper Mississippi channel to this depth again. The Corps considered two basic methods for increasing the depth: raising the height of the dams, dredging the river bottom, and various combinations of the two. The controversy reached its height in 1972. However, the Corps’ Phase I report on the study, released in draft form in 1972 and in final form in 1973, determined that it would not be economically feasible to build a 12-foot channel from the mouth of the Illinois to Minneapolis.
Meanwhile, in about 1970, just after the oldest bank-to-bank structure in the Upper Mississippi River 9-Foot Navigation System (Lock and Dam No. 15) had turned 25, the Corps began the rehabilitation process at individual lock and dam complexes. Some of the changes were site specific and made by the site staff. Others were system-wide within a given Corps district. For example, in 1970 the Rock Island District bought over 40 identical boat davits (see below Section F) and had anywhere from two to four of them installed at each complex under their charge.

Similarly in 1971, the Corps districts began replacing equipment. The Rock Island District began by purchasing a group of identical new haulage engines (see below Section F) and replaced all the haulage engines at the locks under their command with these new units. This happened again in the 1990s when these 1970s vintage haulage engines were replaced with new ones at every complex.

It was in this same period that site staff at virtually all the lock and dam complexes up and down the river began building things to make their job more comfortable. It may have all begun in 1958 at Lock and Dam No. 24 in Clarksville, Missouri. Site staff there “designed” and built crude metal and glass shelters to stand in when operating the gate and valve operating controls on the land wall side of the lock—the place where most of the control work is done, especially in inclement weather. St. Louis District staff allowed them to keep the buildings in place and encouraged the staff at the other two complexes in their district to build similar shelters. In less than a decade, the Rock Island District was also encouraging its lock staffs to build them. By about 1970, staff at virtually all the lock and dam complexes under the supervision of the St. Louis and Rock Island Districts had built similar control stand shelters. Although all were clearly based on the same model, there was a certain amount of individuality in the structures from site to site. However, in both Corps districts during the 1990s, these site-built structures were replaced with new standardized units. Those in the Rock Island District were replaced with rectangular, brick, and glass units, and those in the St. Louis District were replaced with sleek, aerodynamic-looking, oval buildings (see Section F).

Similarly, starting with a site-initiated innovation at Lock and Dam No. 12 in 1960, air-lock vestibules to shelter the central control station office doors became a “home-made” but standard feature of all the complexes by about 1972. In the major rehabilitations of the central control stations, planned in 1984 with work beginning in the Rock Island District in 1985 and in the St. Louis District in 1987, the insulation, face brick (in the Rock Island District), and stucco (in the St. Louis District) which were placed over the original concrete finish of the styles 1a, 1b, and 3 central control stations (see Section F) were continued over these air-lock vestibules. In style 2a and 2b control stations (see Section F), the face brick put on the vestibules was tied into the existing face brick of the central control stations. It is now virtually impossible to tell that the vestibules were not part of the original massing or any of the central control stations. However, neither this nor the covering of the original surface finish was seen as an adverse impact to structures of National Register significance by the State Historic Preservation Officers (SHPOs) with jurisdiction over these sites. The Illinois, Iowa, and Missouri SHPOs signed off on the central control station rehabilitation work in the Rock Island and St. Louis Districts before it was begun. These same projects also
included new windows or at least storms windows over the old ones at all the central control stations. After the rehabilitations were complete, all the central control stations retained integrity of location, setting, feeling, and association, and the style 2a and 2b central control stations retained integrity of location, setting, materials, workmanship, feeling, and association.\(\text{139}\)

Although the central control station rehabilitations were planned and approved as a block, they were not done as a block. The work at Lock and Dam Nos. 11, 12, 13, 16, and 17 began in 1985, while the central control station at Lock and Dam No. 22 did not get its new brick facade until 1997. The central control station at Lock and Dam Nos. 14 and 17 have never been rehabilitated; rather their exteriors have been left as built. However, the lock staff no longer works out of either building. They have been abandoned. The staff works out of a new, separate building designed as an operations center which was erected in those historic districts.\(\text{140}\)

In 1975, well before these exterior changes were made, the Corps had contractors pull the old standby generators, which dominated the machinery rooms of the central control stations, and build new emergency generator buildings (see below Section F). Without the standby generator, neither the size nor shape of the machinery rooms of the central control stations make sense to the visitor. By 1976, in the St. Louis District, contractors were framing in the balconies along the edges of the machinery rooms and insulating and suspending new ceilings over the main expanse of the machinery rooms.

The Rock Island district-wide construction of the emergency generator buildings and removal of the standardized Colonial Revival lockmaster’s and assistant lockmaster’s residences from the esplanades at all the locks and dams under its stewardship in the mid-1970s dramatically altered the appearance of the lockward portion of the each of those complexes. Although similar district-wide generator building additions and residence removals were conducted by both the St. Paul and St. Louis Districts, dates of those actions are not available. Regardless, the effect was similar at all the lock and dam complexes in the system.

The visible change was also significant at Lock and Dam No. 19 in 1978-1979, when the Corps permanently dewatered the 1910-1913 lock and dry dock at the Lock and Dam No. 19 complex. Contractors built a substantial sea wall extending from the 1952-1957 lock to the never-completed commercial power plant extension wall to provide protection in case the upper gates of either older structure ever failed and a rock-retaining dike at the downstream end of the old lock and placed excavated silt in the old lock chamber. Similarly, sometime before 1978 the St. Louis District erected a closure dike above the auxiliary lock gates at Lock and Dam No. 25, presumably to provide protection in case these gates ever failed. The closure dike above the auxiliary gates at Lock and Dam No. 24 was not built until 1981.\(\text{141}\)

Meanwhile, in 1972, at the request of the governors of the states within the Upper Mississippi River drainage basin, President Richard Nixon created the Upper Mississippi River Basin Commission (UMRBC). Its purpose was to develop a region-wide river management plan, covering both land and water resources. In 1974, the UMRBC created the first of its “Great River Environmental Action Teams” (GREAT) to plan development between Minneapolis and Lock and Dam No. 10 in Guttenberg, Iowa.
1976, the UMRBC created “GREAT II” to study the area from Lock and Dam No. 10 to Lock and Dam No. 22. “GREAT III” was established in 1977 to study the reach of the river from Lock and Dam No. 22 to the mouth of the Ohio.

Although empowered to develop comprehensive resource management plans, the teams became focused on channel maintenance issues in less than 5 years. Nevertheless, their work was incorporated into the UMRBC Comprehensive Master Plan authorized in 1978.142

In 1983-1984, the Corps replaced all the 30-ton, vertical-lift, electric cranes with 70-foot booms (see PHOTO 24) that sat on the service bridge decks on the tops of the moveable sections of all the dams. The lock staffs use the cranes to move parts and equipment. The new cranes sit on the original crane trolleys which also support additional bridge cranes used for lifting emergency bulkheads and other various tasks (see below Section F). The trolleys ride on 15-gauge track systems running the entire length of the service deck bridges.

That same year, Corps contractors removed the original light standards around all the locks and installed new high mast, free-standing single- and double-headed lighting standards.

Also, in 1984 plans were completed for major 50-year rehabilitations at all the locks and dams. In June 1985, before any of this work was begun, consensus was reached among representatives of the Rock Island and St. Paul Districts of the Corps; the SHPOs of Illinois, Iowa, and Missouri; and the Advisory Council on Historic Preservation that documentation could stand as appropriate preservation/mitigation for most actions to be undertaken in the generic lock and dam rehabilitations. The Minnesota and Wisconsin SHPOs concurrence is recorded in a 1987 Programmatic Agreement for Lock and Dam Nos. 22 which formalized the 1985 agreement. It was signed by the Illinois, Iowa, Minnesota, Missouri, and Wisconsin SHPOs; the Corps Rock Island and St. Paul Districts; and the Advisory Council. The massive Historic American Engineering Record (HAER) documentations conducted in 1987, 1988, and 1989 were the implementation of this part of the agreement and reflect the St. Louis District’s concurrence. The St. Louis District not only allowed the Upper Mississippi River locks and dams under its stewardship to be documented, but provided the funding to produce Gateways To Commerce, The U.S. Army Corps of Engineers 9-Foot Channel Project on the Upper Mississippi River, the National Park Service’s one-volume summary of the three documentations.143

The 1985 conferees also reached a tentative agreement that most of the proposed rehabilitation actions would not adversely affect those characteristics that contribute to the significance of individual structures/complexes or the system as a whole. As defined by Michael C. Quinn of the Advisory Council on Historic Preservation in June 1985, those characteristics were “general overall configuration and appearance-buff concrete, miter gated [sic] locks, and the dam structure with its combined tainter and roller gates—and its continued existence as a system which is capable of functioning.”144

The first 50-year rehabilitations began in 1986. They were not all complete by 1998. Typically, a 50-year rehabilitation included replacement of all the electrical...
wiring, switching gear, and control panels at both the lock and the dam; scour protection, refurbishing and repainting the dam's roller gates; replacing the Tainter gate chains in the dams; resurfacing the lock; repairing and restoring the existing lock gates on both the main lock and the auxiliary lock; replacing almost all the machinery and small buildings associated with the main lock; and installing a bubbler system in the lock chamber.

The electrical work generally has no visible effect on the structures, and most of that which does is at such a small scale compared to the focal points of the districts as to have no noticeable effect (compare PHOTOS 36 and 37). The exception relates to the provision of emergency power. As noted above, the c. 1975 system-wide removal of the original standby generators from the machine rooms of the central control stations and the installation of emergency generators in specially built buildings had a significant effect on the interiors of the central control stations and the outward appearance of the esplanades. In this project these replacement generators were themselves replaced. The new generators (see PHOTOS 32) have integral weatherproof housings. Therefore, they are installed on concrete pads outside. At these sites where these new generators were installed or reinstalled after the 1993 flood, these pads were enlarged to substantial pedestals intended to keep the new generators high and dry. Even where these pedestals exist, the visual impact of this change is less than the 1970s work. The 1970s emergency generator buildings have been converted to different uses at the different locks and dams.

Scour protection is all underwater and, therefore, invisible.

Resurfacing has a visible effect, but it has been minimized by matching the color of the new concrete with the old. However, the T-bar armor in the portion of the lock walls within the lock chamber is new. But, since there was always some steel on the walls and similar armor had already been added to the guide walls and the portion of the lock walls outside the chambers, it is only noticeable to the trained eye specifically looking for differences from the original.

Outside of the St. Paul District, the impact of the 50-year rehabilitations is most visible in the replacement of almost all the machinery and small buildings associated with the locks. In a typical rehabilitation, all four sets of lock valve operating machinery and all four sets of lock gate operating machinery are replaced with new equipment. The new operating machinery (see PHOTOS 16 and 17) sits on top of the lock walls rather than in the machine pits in the walls (see Section F). Weatherproof housings are an integral part of the new units themselves, so the eight machine pit covers have been demolished at each lock which has had its 50 year rehabilitation. The new shelters around the replaced control panels operating these sets of machinery (discussed above) are, as often as possible, built as part of the 50-year rehabilitation.

The most visible impact of the 50 year rehabilitations in the St. Paul District is the demolition of the historic central control stations and their replacement with new operations buildings. The St. Paul District used the June 1985 conference (discussed above) on the significance of the navigation system and the essential physical features, without which the lock and dam installations could no longer be identified as 1930s Upper Mississippi River 9-Foot Navigation Project lock and dam
historic districts, as the starting point for independent negotiations with the Minnesota and Wisconsin SHPOs and the Advisory Council on Historic Preservation. Under the resulting agreement, the St. Paul District was authorized to remove all the central control stations at Upper Mississippi River 9-Foot Navigation Project complexes under its stewardship, except for the central control station at Lock and Dam No. 7, in return for funding substantial documentation efforts. Christine Whitacre's 1992 editing and integration of the 1987, 1988, and 1989 HAER documentation into a book, Gateways to Commerce: The U.S. Army Corps of Engineers 9-Foot Channel Project on the Upper Mississippi River, published by the Rocky Mountain Region of the National Park Service, was the implementation of this agreement.145

Just as in the Rock Island and St. Louis Districts, where the central control station rehabilitations were planned and approved as a block but not done as a block, the St. Paul District began its central control station rehabilitation from the north and worked south. By 1998, the district had replaced the central control stations at Lock and Dam Nos. 3, 4, and 5 and was working on the replacement at Lock and Dam No. 5A. The work at Lock and Dam No. 6 is slated to begin in 1999. Removal of the central control stations at Lock and Dam Nos. 8 and 9 will follow. The St. Paul District is currently negotiating the details of an agreement to turn the central control station at Lock and Dam No. 7 near La Crosse, Wisconsin, into a visitors center.

At most of the complexes in all three Corps districts, the rehabilitation also included the installation or renovation of a bubbler system run by a large external compressor (see PHOTO 32). In most cases the compressor is placed on a concrete pad or pedestal near the new generator. Bubbler systems are used to keep ice away from the lock gates. Thus, they extend the length of the navigation season on the river.

The change to the resources involved in these rehabilitations was, however, nothing compared to the change to the system when, in 1990, Lock and Dam No. 26 was demolished. It was replaced by Lock and Dam No. 26R (also known as the Melvin Price Lock and Dam). This new lock and dam, built between 1979 and 1990, is located 2 miles downstream from the old one.

The massive flood of 1993 led both the St. Louis and Rock Island districts to make further changes at the locks and dams. For example, new incoming power transformers were installed in the esplanades of almost all the lock and dam historic districts. In many cases, the 1993 experience accounted for the fact that it, as well as the new emergency generators, were placed up on concrete pedestals which would keep them accessible in times of high water.

Changes in attitudes toward secondhand smoke motivated the construction of one or more smoking shelters (see PHOTO 30) adjacent to the lock and in the esplanade at each lock and dam complex during the 1990s.

Tapping the Power of the Upper Mississippi River: 1844-1940

The 100-year effort to improve the Upper Mississippi River for navigation reveals the depth and breadth of the nineteenth- and early twentieth-century American belief that improved waterborne transportation was the key to prosperity. However,
by the 1890s, railroad competition with waterways, among other things, had so altered economic conditions throughout the country that improvement of waterways for the single purpose of transportation could no longer be justified in cost-effective terms, even in the undeveloped portions of the west. In increasing numbers, local and regional waterway boosters supported multiple-use projects, thinking they could get the navigation improvements they wanted if they added the benefits that could be achieved from compatible second and third uses to the cost benefits accruing from improved navigation. Local residents who did not concern themselves with transportation needs joined the navigation boosters in promoting multiple-use resource development because they had other water-related concerns (such as flood damage, sewage disposal, or a need for electric power).

By the turn of the century, flood control, storage of water for crop irrigation, hydroelectric power generation, and provision of water for municipal and industrial use had all joined navigation as commonly considered multiple-uses to which American waterways could and should be put. Leaders of the Progressive Conservation movement, which championed multiple-use waterway development, were beginning to influence national politics.

Plans, actions, and events for the Upper Mississippi River's Des Moines Rapids were significant precursors to this shift in zeitgeist. As early as 1844, the Mormon residents of Nauvoo, Illinois, were planning what appears to be the first multiple-use waterway improvement project on the Upper Mississippi River. They wanted to construct a large dam nearly all the way across the river to Montrose, Iowa. The dam was intended to both provide power and back up the river enough to produce a deep harbor at Nauvoo. When the Mormon's leader, Joseph Smith, was assassinated in June 1844, they dropped the plan.146

However, the multiple-use idea did not go away. Within 5 years, residents of Keokuk, Iowa, had formed a multiple-use waterway improvement corporation, the Navigation and Hydraulic Company of the Mississippi Rapids. On January 15, 1849, Iowa Governor Ansel Briggs signed the law authorizing the company to raise $500,000 for its improvement. As noted above,147 the company hired Samuel R. Curtis as its chief engineer later that same year. Curtis recommended that the Navigation and Hydraulic Company of the Mississippi River build an embankment out in the river from Montrose to Keokuk and then excavate the space between the embankment and the shore as a canal with one lock with a 24-foot lift at the foot of the canal. Curtis recommended that the canal be used not only for navigation but also as an enormous mill race to generate enough power to operate "all the machinery that human invention can locate within reach of its influence." When the company could not raise enough money to execute Curtis' plan, it was abandoned until 1856 when Curtis returned to Keokuk, was elected mayor, and refined his plan by increasing the width of the canal to 200 feet. This added a third use to the canal. Not only would it create a dependable depth for navigation between Montrose and Keokuk and generate power, but it would also serve as a "great steamboat harbor sufficient to safely moor all the steamboats of the Upper Mississippi."148

Although, between 1867 and 1870 the Corps did build a canal based on a lateral dam 200 or more feet from the shore extending from Montrose to Keokuk, it had a single purpose: improving navigation. From 1824 to 1902, the only legal water
resource development goal any federal agency could work towards was aiding navigation. Prior to the Supreme Court’s 1824 Gibbons v. Ogden decision, no part of any federal agency could even do that. Consequently, Brevet Major General James H. Wilson, the officer in charge of designing and building the Corps Des Moines Rapids Canal, and D.C. Jenne, his assistant who did the actual plans, had no need to maintain as much difference as possible in the elevation of the water above and below the lock at Keokuk. In other words, they did not need to maximize the head of water at Keokuk. Instead, they divided the 24-foot lift needed between Montrose and Keokuk into two parts, one part provided by a lock 2.5 miles upstream from Keokuk and the other part provided one at Keokuk. Among other things, this allowed Wilson and Jenne to use miter gates on the locks. Miter gates cannot operate against a head of water greater than 16 feet.149

Despite the Corps refusal to maintain enough head at Keokuk to generate commercially viable power in conjunction with the navigation canal, local residents refused to give up the idea of generating power with all that falling water. After the first hydroelectric power station in the United States went into operation at the Falls of St. Anthony on the Upper Mississippi River in Minneapolis on September 5, 1882, interest in a hydroelectric plant at Keokuk mushroomed.150 The existence of the Des Moines Rapids Canal precluded building any kind of power plant on the Iowa side of the river, so discussions focused on the other side of the river. In 1899, 25 residents of Keokuk, Iowa, and Hamilton, Illinois, the small town directly across the river, met to discuss developing the water power available at the foot of the Des Moines Rapids. In 1900, this group incorporated under Illinois law as the Keokuk and Hamilton Water Power Company. In 1901, the federal government authorized the company to build a wing dam on the Illinois side of the river.

The company now had to find an engineer to design the dam. This was not as easy a task as it might seem. Samuel Curtis had been dead since 1866, but the company needed an engineer with his audacity, vision, and technical expertise. Common American engineering wisdom at the turn of the century still held that the only cost-effective techniques for generating hydroelectric power required a difference in elevation of 150 feet or more between the upper and lower pools. A few bold hydraulic engineers in Chicago thought otherwise and set out to prove their ideas in concrete and steel. Lyman Edgar Cooley was one of those men. In 1901, the Keokuk and Hamilton Water Power Company hired him to make a survey and develop specifications for its power generation project.

Cooley pronounced the wing dam impractical and informed the company it would need to erect a dam all the way across the river if it was to effectively generate enough hydroelectric power to be a commercial success. Cooley recommended building this dam at the foot of the Des Moines Rapids, right where the last lock of the Des Moines Canal was located. The water would be 40-feet-deep right behind the dam and would gradually taper off until it reached its natural depth about 54 miles upstream. Thus, the whole 11.25 miles of the Des Moines Rapids would be submerged in deep water and made navigable for all ice-free seasons of the year. Cooley’s dam included a navigation lift lock, completing its role as an improvement for navigation. It would serve the company’s primary purpose of generating power by including a hydroelectric facility to utilize the 40-foot difference in elevation between the surface of the water behind the dam and the tail waters of the dam at low water. This low-head
(i.e., small difference in elevation between upper and lower pools) hydroelectric power generation potential was the force driving the project to construction.

The Keokuk and Hamilton Water Power Company informed the Corps of Cooley’s recommendations, and the Corps agreed to study the issue further if so authorized by Congress. In the Rivers and Harbors Act of June 13, 1902, Congress authorized the Corps to determine if such a structure would be a benefit or an impediment to the navigation of the Upper Mississippi River.

It is probably not coincidental that in 1902, the year Congress authorized the Corps to study this most “progressive” Keokuk waterway project, the leaders of the Progressive Conservation movement achieved two other major victories in Congress. Representative Theodore R. Burton, chairman of the House Rivers and Harbors Committee, and President Theodore Roosevelt moved decisively to end the pork-barrel era of the Gilded Age as it affected the Corps. They led Congress to create the Corps National Board of Engineers for Rivers and Harbors (BERH) to review all prospective Corps projects independent of any local political influence. In theory, BERH only recommends projects which the standing board members from throughout the country, acting as professional engineers not administrators, judge meritorious of construction. This attempt to remove water resource management decisions from the traditional political process was an attempt to realize the Progressive Conservation movement principle that decisions about water resource development should be made by technicians not politicians.151

Again pushed by President Roosevelt, Congress also passed the Reclamation Act in 1902. By providing for federal planning, construction, and development of irrigation works, this act significantly enlarged the area in which federal water resource development could be legally pursued. As noted above, prior to 1902 the only legal water resource development goal any federal agency could work toward was aid to navigation, and only the Corps could do it. Congress did not make the Reclamation Service a part of the Corps. Congress made the Reclamation Service part of the Geological Survey of the Department of the Interior; thus setting up a rivalry which exists to this day, although it is now focused on other issues. The Geological Survey had been building a staff geared for producing comprehensive, multiple-use plans for the development of both land and water resources since its creation in 1879. Almost from its beginning, the Reclamation Service staff succeeded in pushing a broader goal than just irrigation for developing western water resources. As early as 1903, while the Corps was still studying the Keokuk proposal, the Reclamation Service began designing and building high dams which stored massive amounts of water and had the potential for generating hydroelectric power.152

Later in 1903, Montgomery Meigs, a civilian employee with the Corps whose father had helped Robert P. Lee survey the Des Moines Rapids before the Civil War, endorsed the Keokuk and Hamilton Water Power Company’s plan to build a bank to bank structure as discussed above under “The 4.5-Foot Channel Era: 1878-1907.”

Although the commercial exploitation of falling water is pivotal to the development of Minneapolis from 1820 on and St. Paul’s location as the northern terminus of navigation on the Upper Mississippi River is basic to its development, multiple-use development of water resources did not come to the Twin Cities as early as it came
to Keokuk. True, the reservoir system which the Corps began building upstream from Minneapolis in 1881 was justified on the grounds that it was an improvement to
navigation. But, since there was virtually no navigation above St. Paul, the
pronouncements that these structures were "intended" to increase the navigability of
the river below St. Paul during summer low water periods were relatively transparent
ruses to cover improvement of the hydroelectric generating capacity of the river at
Minneapolis. It is hard to accept as a coincidence that Minnesota Senator William
Washburn, the political power behind the reservoir construction bills, was one of
the principal owners of the Minneapolis Mill Company. When Minneapolis Brush
Electric Company began operating the Nation's first hydroelectric central power
station in 1882 using water these reservoirs regulated, the Minneapolis Mill Company
was a primary beneficiary. By 1883, the Minneapolis Milling Company was leasing
13,000 horsepower of that water. William de la Barre, the Austrian immigrant
waterway engineer who was largely responsible for the development of hydroelectric
power in Minneapolis, became an employee of the Minneapolis Mill Company that same
year. In 1909, by which time de la Barre was managing the now combined Washburn and
Pillsbury organizations, they were utilizing 55,068 horsepower. As Raymond Merritt
understated the case, "The effect of the reservoirs on navigation below St. Paul is
not as easy to document as the direct benefits to the water power interests at the
Falls of St. Anthony."\textsuperscript{153}

Obviously, Congress' 1909 authorization for the Corps to examine the Upper
Mississippi River as a potential source of hydroelectric power was not premature. It
was already generating significant power but all beyond the navigable range of the
Upper Mississippi-at the Falls of St. Anthony. The special board of engineers that
decided to conduct this study reported in 1910 that the work already underway between Minneapolis
and St. Paul should be modified to allow for hydroelectric power generation. The
River and Harbors Act of August 18, 1894, had authorized the Corps to build two locks
and dams, one with a lift of 13.8 feet and the other with a lift of 13.3, to provide a
5-foot navigation channel between St. Paul and the bottom of the Falls of St.
Anthony in Minneapolis. The first illogically named Lock and Dam No. 2-not only was
it built first, but it was also upstream of the other-was completed 12 years later
and put into operation on May 19, 1907. The second lock and dam, Lock and Dam No.
1, had not even been started by then. Its design had to be changed because in the
interval between its authorization and construction Congress had ordered that the
channel depth had to be 6 feet deep rather than 5 feet deep. However, construction
did begin later that year. As is customary in lock and dam projects, construction of
the lock began first. This lock, however, was still only designed to have a lift of
13.3 feet, and thus, the dam provided nowhere near enough head to generate
power.\textsuperscript{154}

The modification that the special board of engineers recommended in 1910 and
that Congress authorized later that year increased the lift on that lock from 13.3
to 35.9 feet so that it could serve a hydroelectric power generation purpose as well
as a navigation purpose. This not only opened the possibility of a low-head
hydroelectric generation station as part of the complex, but it also increased the
depth of water above the dam to 9 feet and the depth of water below the dam to 6 feet.
Unfortunately, it also submerged Lock and Dam No. 2-a 3-year-old structure at the
time the decision was made. Given this, it is hard to argue that this multiple-use
waterway improvement completed in 1917 (4 years after the Progressive project at Keokuk) but not actually producing power until 1924 was truly cost-effective.\textsuperscript{155}

Hydropower was not generated at Lock and Dam No. 1 until 1924 because, although the bank-to-bank structure completed in 1917 included the foundation of a power house capable of holding either horizontal or vertical turbines, the Corps did not build a power house on this foundation. The federal government's position was that whoever made the money from the power also needed to make the capital investment in the power house. After turning down applications from the city of Minneapolis, the city of St. Paul, Northern States Power Company, and the University of Minnesota, the Federal Power Commission finally licensed the Ford Motor Company to develop the power at the site. Ford was building a new assembly plant in St. Paul on the east bank of the Mississippi which could use all the power it could get. The hydroelectric plant Ford placed in operation in July 1924 consisted of four water wheels connected to four generators, each capable of producing 4,500 horsepower.\textsuperscript{156}

Even once the Ford hydroelectric plant was producing power, Lock and Dam No. 1 still hard-pressed to lay a solid claim to multiple-use status. There was not consistent 6-foot channel from St. Paul to Lock and Dam No. 1. Another lock and dam at Hastings, Minnesota, was necessary to make Lock and Dam No. 1 truly useful to navigation.\textsuperscript{157}

That structure, Lock and Dam No. 2, also had hydroelectric power generation capabilities. However, the power generated from the 12.2 head at this site only served the normal operation of the lock and dam complex itself.

Although both the Keokuk and Lock and Dam No. 1 installations included low-head power generation, the approximate 40-foot head at each was not nearly so low as that used to generate power in the structures the Corps built on the Upper Mississippi River between 1931 and 1940 as part of the 9-Foot Navigation Project. These power plants had more in common with Lock and Dam No. 2 than the Keokuk installation or the High Dam in Minneapolis.

In 1929, the special board of engineers that developed the first fullscale 9-foot channel plan examined three scenarios for locks and dams on the river. The second scheme included three high dams with heads from 17 to 23 feet and one low dam between Rock Island, Illinois, and Hastings, Minnesota. The justification for this plan was that it provided for economically feasible generation of hydropower. Unfortunately, unless these high dams were constructed at very high cost with extra long spillways, they would have increased flood stages appreciably. Given the extent of improvements along the shores of the Upper Mississippi that were just a few feet above natural high water levels, the cost of increasing the flood stage was very high. Moreover, the high dams would have precluded open-river navigation at three more places on the river. Therefore, the board concluded that not enough hydropower could be generated at the new dams to offset the various costs which would be incurred by generating it. The board recommended a system of low dams at which the potential for generating hydropower was much less.\textsuperscript{158}

The board repeated this conclusion in its final report the next year. "All possible power is purely secondary due to low heads and the rapid cutting down of
head as the flow increases from the low-water discharge." The report did include calculations on the amount of energy which could be generated at each of the dam sites between Rock Island and Hastings. They ranged from 20 million to 370 million kilowatt-hours annually, with the highest being at what became Lock and Dam Nos. 14 and 15. The board concluded that cost of developing such relatively small amounts of power and the difficulty of finding buyers for it within possible reach of the dams made the commercial production of power at any of the navigation dams "a possibility only for the remote future."\(^{159}\)

This accounts for the power generation station included in Lock and Dam No. 14 but never equipped with turbines and the power plant at Lock and Dam No. 15 which provided power only to the complex at which it was located.

**Another Multiple-Use, the Upper Mississippi River Produces Jobs: 1930-1940**

The events which foreshadowed the actual beginning of the Upper Mississippi River 9-Foot Navigation Project and the Great Depression occurred within days of each other in October 1929. On October 1, 1929, Major General Lytle Brown was appointed Chief of Engineers, replacing Major General Edwin Jacob. Nine days after that, on October 10, 1929, the Corps created the Upper Mississippi Valley Division (UMVD) to supervise 12 districts including the St. Louis, Rock Island, and St. Paul Districts. Lieutenant Colonel George R. Spaulding was named Division Engineer with William H. McAlpine, who had been his principal civilian assistant in Louisville, becoming his head engineer in St. Louis. On October 15, 1929, Colonel Spaulding removed Major Charles L. Hall from the six-member Special Board of Engineers creating the first full-scale plan for a 9-foot channel in the Upper Mississippi River.

Hall was the Rock Island District engineer who, in August 1928, had recommended that the Upper Mississippi River not be canalized (the only way to achieve a dependable 9-foot depth for the whole distance between Minneapolis and Alton) and then, in February 1929, reported that there was not enough commercial traffic on the river to convince him that a viable barge industry would develop even if a 9-foot channel were created. In short, Hall believed the project was economically inadvisable. Moreover, he concluded that the project would have disastrous environmental impacts.\(^{160}\)

Echoing the concerns of Midwestern conservationists, Hall feared that the slackwater pools would create vast swamps of stagnant and polluted water. He was also concerned about the effect of slackwater navigation on indigenous wildlife. In an address to the School of Wildlife Protection in McGregor, Iowa, Major Hall said that the project would "radically change" the wildlife of the region. The outcry was immediate and furious. An editorial in the Minneapolis Journal berated Hall, saying that the Major's duties were "neither floral nor faunal, but engineering," and suggested that his time might be better spent in areas in which he had been specifically trained.\(^{161}\)

Hall's comments, though, reflected a growing national environmental awareness. Fostered by the work of Upper Mississippi Valley native Aldo Leopold and other conservationists, several environmental groups were reevaluating lock and dam projects and their effects on river valley environments. Controversy over projects such as the Hatch Hetchy Dam near San Francisco (1907-1913) and the Keokuk Power Plant Dam
(1910-1913) prompted those concerned with the Upper Mississippi Valley environment such as Will Dilg, founder of the Izaak Walton League of America, to actively oppose the canalization project.

Previous environmental concerns on the Upper Mississippi had surfaced in 1923 when a proposal was made to drain approximately 30,000 acres of the Winnesheik Bottoms, a 30-mile area on the Wisconsin side of the river between Prairie du Chien and La Crosse. The ensuing battle between conservationists and developers resulted in a victory for the conservationists and the establishment of the Upper Mississippi Wildlife Refuge. The proposed 9-foot channel’s lock and dam system would create permanent, large-scale flooding of formerly noninundated and seasonally inundated lands along the Upper Mississippi, appreciably affecting the ecology of the area.152

Hall’s report also drew angry criticism from politicians who saw the project in an entirely different light. They believed that the limited navigation on the Upper Mississippi River was a justification for the 9-Foot Channel Project not grounds on which to oppose it. The 9-foot channel would increase navigation, the politicians argued, thus providing its own economic justification. Although Congress had directed the Corps to evaluate the economic benefits of the 9-foot channel, some politicians felt that Hall had overstepped his bounds. They believed it was up to the Corps to build the 9-foot channel, not justify it on economic and environmental grounds.

Key members of the Corps were also unhappy with Hall’s report. Therefore, it is not surprising that in February 1929, although not “convinced of the advisability of the improvement,” Hall recommended an additional survey to determine the cost of providing a dependable 9-foot-deep channel, 200 feet wide in the straight reaches, and at least 300 feet wide at bends between the mouth of the Illinois River and Minneapolis. When the six-member team was organized to conduct this “more thorough” survey in May 1929, Hall was one of the members. It was from this committee that he was pulled on October 15, 1929, just 15 days after Major General Lytle Brown became the new Chief of Engineers, replacing Major General Edwin Jadwin.

Chief of Engineers Jadwin, like his predecessor Major General Harry Taylor, opposed the project. Jadwin shared Hall’s environmental concerns and was concerned about the project’s flood control implications. In addition, Jadwin, like Taylor and other Progressive Era thinkers, believed that projects should stand on their own merit and not be the product of special interest politics. Unlike military bureaucracy survivors such as Lieutenant (later Major) G. K. Warren in the 1850s, proponents of such views after World War I were refusing to recognize the political realities of the 9-Foot Channel Project. Many politicians felt the progressive line of thought was arrogant. Taylor’s, Hall’s, and Jadwin’s acknowledgments that moveable dam systems constituted the only logical way to assure a 9-foot channel—and their concurrent refusal to endorse the project—looked to some as being not only contradictory, but downright haughty. On August 7, 1929, Jadwin was removed from his position. Ten major officers were passed over to assure Brown, who supported the 9-Foot Channel Project, of his appointment.153

Not only did General Brown support the Upper Mississippi River 9-Foot Channel Project, he had also expressed a willingness to placate President Hoover’s general
animosity towards the Corps. By 1921, when Herbert Hoover became Warren Harding’s Secretary of Commerce, the private, civilian engineering industry had matured. It began lobbying against the continued retention of engineering responsibilities by the two major construction units of the American military: the Corps of Engineers and the Quartermaster Corps.164 The nonmilitary federal engineers in the Department of the Interior’s Reclamation Service and the Department of Agriculture’s Forest Service supported these moves. Hoover, whose first professional engineering jobs were with the Department of the Interior’s Geological Survey, spearheaded the drive for a civilian-dominated national public works department. Hoover’s allegiance to the Geological Survey was reflected in its and the Bureau of Mines transfer from the Department of the Interior to the Department of Commerce while Hoover was Secretary of Commerce. When Hoover was elected President in November 1928, there was a renewed impetus for the creation of a new, civilian-engineer dominated national public works department. To heal the breach with the private sector engineering community, General Brown almost immediately announced that all further Corps of Engineer rivers and harbors work would be done by contract, except where it was manifestly impractical or a waste of government money. Following this action, private engineering groups eased their pressure to remove military engineering responsibilities from both the Corps and the Quartermaster Corps.165

Spaulding’s and McAlpine’s creation of the UMVD design team are discussed above in “Building a Slackwater Navigation System on the Upper Mississippi River.”

Just as the collapse of the stock market in October 1929 was not the beginning of the Great Depression, this reorganization was not the actual commencement of design of the 9-Foot Project. That had begun in February 1925 when, as discussed above, the then new U.S. Army Corps Chief of Engineers, Major General Harry Taylor, asked the Senate’s Rivers and Harbors Committee to authorize a reexamination and survey of the stretch of the Upper Mississippi between what is now known as Lock and Dam No. 1 in the extreme southern portion of Minneapolis (which had been completed in 1917) and the mouth of the Chippewa River with a view toward the construction of a slackwater navigation system.

Once the Corps had admitted the need for a slackwater navigation system to achieve a 6-foot channel between Lake Pepin and Minneapolis, the engineers were forced to admit the necessity of slackwater navigation systems at other places on the river. For example, at times there was as little as 4.3 feet of water in the final 2.5 mile section of channel through the Rock Island Rapids (the section between the Moline Lock and the foot of Arsenal Island). To solve this problem, the Corps either had to create a slackwater navigation system by building a lock and dam at the foot of Arsenal Island or blast a very wide, deep, expensive channel through 2.5 miles of rock. The prospect of several new bank-to-bank lock and dam structures at various intervals along the river encouraged consideration of a 9-foot channel. If a series of locks and dams were to be constructed, why not make them a little bigger in order to create a significantly more useful waterway?166

On April 26, 1926, in a hearing before the House Committee on Rivers and Harbors, Chairman S. Wallace Dempsey, together with Congressman William W. Chalmers of Ohio, pressed Chief of Engineers Taylor hard on the implications of a lock and dam at Hastings, Minnesota. They forced the General to admit that it would be possible
to build enough locks and dams to give the Upper Mississippi a 9-foot-deep channel. General Taylor refused, however, to say if this could be done at a cost commensurate with the resultant increase in freight. Nevertheless, in January 1927, Congress authorized the Corps to build a lock and dam at Hastings and to ‘examine the Upper Mississippi River with a view to securing a channel depth of 9 feet at low water with suitable widths.’

Colonel Hall’s August 1928 and February 1929 reports, discussed above, were the result of the authorization.

Similarly, the stock market crash of October 1929 reflected wild overspeculation and excessive gains that had begun in 1925. Both the crash and the Depression were the result of deep problems in the modern economy that were building up through the 1920s. The prosperity of the 1920s could only continue if demand grew as rapidly as supply. During the 1920s, people had to be persuaded to abandon such traditional values as saving, postponing pleasures and purchases, and buying only what they needed. Between 1923 and 1929, manufacturing output per person increased by 32 percent, but workers’ wages only grew by 8 percent.

Following the crash, stocks rallied late in the year, and business activity did not begin to decline until the spring of 1930. Then, underconsumption began a downward spiral. As more and more people lost their jobs, fewer and fewer consumers could buy the goods produced which caused more and more people to lose their jobs. Fewer and fewer people were needed to produce less and less. Unable to rid themselves of mounting inventories, manufacturers closed down plants and laid off workers, thus causing demand to shrink still further.

President Herbert Hoover’s response to the Great Depression evolved gradually between 1929 and 1932. As Secretary of Commerce from 1921 to 1928 under both Warren G. Harding and Calvin Coolidge, one of the few forms of relief that Herbert Hoover supported was indirect aid to agriculture through systematic waterway improvement. He was uncritical of American capitalism.

In December 1929, in keeping with the idea he still held that the stock market crash was just another speculative panic in an otherwise sound economy, Hoover did not want to fund the Upper Mississippi River 9-Foot Navigation Project until things leveled out again. When they did not, Hoover’s April and May 1930 support of the project’s authorization was one of the first signs of his awareness of the real depth of the problem. As late as March 1930, Hoover had been saying the crisis would be over in 60 days.

The Upper Mississippi River 9-Foot Channel Project is one of the best indicators of the evolution of Hoover’s response to the Great Depression. It constituted one of Hoover’s first anti-Depression measures and was typical of those he relied on early in the Depression. Despite the popular perception, Hoover, not Roosevelt, was the first President to use the federal government to fight the depression.

As early as March 1931, Congress authorized Secretary of War Patrick J. Hurley to spend more than $52 million on river improvement projects that were justified as unemployment relief. In March 1932, President Hoover personally appealed to Congress
to pass a bill appropriating $60 million for rivers and harbors projects intended to ameliorate unemployment. 169

In September of 1932, Emergency Relief Appropriation gave the project a new infusion of funds.

Despite this support of the project as a relief work effort, Hoover had not dropped his animosity towards the Corps. In a final presidential effort in January 1933, Hoover issued an Executive Order transferring the civil works functions of the Corps, including this project, to the Department of the Interior. Congress saved the Corps civil functions by disapproving this Order in 1933. 170

The Great Depression reached its nadir during the winter of 1932-1933. The national political mood was clear: all civil works projects that could not be modified to serve a major relief work purpose would be abandoned. The Upper Mississippi River 9-Foot Navigation Project came under cancellation consideration during the special session of Congress that President Franklin D. Roosevelt called as part of his "First 100 Days." Iowa Representative Edward C. Eicher introduced a bill calling for the abandonment of the 9-Foot Channel Project during a 4-day congressional hearing in May 1933.

The National Industrial Recovery Act of 1933 allotted $33.5 million to the project. This money was scheduled for disbursement at specific times and targeted to specific locks and dams in high unemployment areas. For example, it included up to $1,420,000 for the construction of Lock and Dam No. 7, the closest structure to La Crosse, Wisconsin, and the same amount for Lock and Dam No. 8, about 24 miles downstream, in federal fiscal year 1934. Nolan Brothers of Minneapolis began construction of Lock and Dam No. 7 on February 7, 1934, under a $1,319,989 contract. The Sutton-Kelly Company of Milwaukee began construction of an office, camp buildings, etc., (necessary before construction of the actual lock at Lock and Dam No. 8 could commence) on December 19, 1933, under a $1,421,762.90 contract.171

On October 5, 1933, the Public Works Administration allotted $22 million to the Chief of Engineers to build 14 locks, including Lock No. 14. The Rock Island District's chief civilian engineer, Edwin E. Abbot, and his staff completed the design for Lock No. 14 in January 1934. By January 11, 1934, there were no longer sufficient funds available from this allotment to build Lock No. 14 so the Corps postponed beginning its construction indefinitely. With at least 9 million people still without work, the midterm elections of 1934 were, in large part, a referendum on Franklin Roosevelt's unemployment policies.

In July 1934, the Public Works Administration allotted an additional $17 million to the project.172

In 1935, at the height of its involvement with emergency relief monies, the Rock Island District alone had 11 National Industrial Recovery Act, Public Works Act, Emergency Relief Appropriation Act, and/or WPA funded projects underway. The contractors at these sites employed 10,000 men. More were employed at comparable projects in the other two Corps districts.
By appropriating the final $146,117,000 needed to finish the project in the Rivers and Harbors Act of August 30, 1935, Congress shifted the project back to regular funds. Although the project was only about 33 percent completed by this time, the mark its relief work status had on it was indelible.\(^\text{173}\)

As early as 1936, American leaders, seeing the potential for American involvement in a major European war, began a major rewriting of the Nation's military preparedness plan.\(^\text{174}\) In 1938, Harry Hopkins developed a plan for the WPA to do construction associated with preparedness and rearmament. In an attempt to keep the work from going to the WPA, the Army Quartermaster Corps made an issue of who controlled emergency construction. By late 1938, President Roosevelt had come to favor transfer of all military construction to the Corps, if the transfer of responsibilities could be accomplished without a fight with Congress which might jeopardize his other programs. As part of these negotiations, the Corps agreed to have the WPA actually do, under the Corps supervision, some of the construction associated with preparedness and rearmament. Since the May 1933 redefinition of the Upper Mississippi River 9-Foot Channel Project, tens of thousands of relief workers employed by private contractors had been building waterway improvement structures under Corps supervision. Since the Flood Control Act of 1936, the WPA had also been doing and funding flood control construction work under the supervision of the Corps. These precedents paved the way for the President's late 1938 decision to support the addition of the supervision of all WPA construction projects to the Corps work load. The 1938 addition of two responsibilities, supervision of all WPA construction and supervision of preparedness and rearmament construction, ushered in the twentieth-century zenith of Corps power and responsibility which culminated in its World War II roles.\(^\text{175}\)

However, pressure continued under President Roosevelt's administration to remove the Corps civil works functions. As late as May 1939, Secretary of the Interior Harold L. Ickes was still lobbying the President to let Interior's Bureau of Reclamation take over the Corps civil works. Hoover had not given up his crusade; it lasted into the Eisenhower administration.\(^\text{176}\)

SECTION B NOTES


2. John O. Anfinson, "Upper Mississippi River, Nine-Foot Channel History, Part 1: Why Congress Authorized the Project" (St. Paul: U.S. Army Engineer District, draft,

3. It would be unrealistic to consider this full area as being served by the project today. This figure corresponds to the full drainage area of the Upper Mississippi. Before World War II, the long-haul trucking industry was not a real competitor to waterborne or rail-based freight services in this region of the country. Therefore, streams that would no longer be seen as navigable did, then, funnel goods to the river just as roads which we would see as inadequate served as feeders to the railroads.


5. Anfinson, "History," Chapter 5, pp. 29-30 and 37; and Gateway to Commerce, p. 30; Arkansas Gazette, March 31, 1931; and Martin Reuss, "The Army Corps of Engineers and Flood Control Politics on the Lower Mississippi," Louisiana History 23 (Spring 1982), pp. 140-144.

6. Long argued that locks and dams across the Upper Mississippi River would obstruct natural navigation, slow the current, and increase the rate of sediment deposition. U.S. Congress, Senate, Message from the President to the Two Houses of Congress, S. Ex. Doc. 1, 34th Cong., 1st sess., 1856. Hall feared that the dams would create swamps of stagnant, polluted water (many cities along the river used the river for their sewage disposal as late as 1929). He was also concerned about what inundating the backwaters and edges of the river would do to the native wildlife. Minneapolis Journal, August 14, 1929.


8. Richard White, The Middle Ground: Indians, Empires, and Republics in the Great Lakes Region, 1650-1815 (New York: Cambridge University Press, 1991), p. 5; and Gateways to Commerce, p. 18. From here on out in this background section of this historic context, descriptions of types of watercrafts used on the Upper Mississippi are, unless otherwise specifically noted, drawn from W. Wallace Carson, "Transportation and Traffic on the Ohio and Mississippi before the Steamboat," Mississippi Valley Historical Review 7 (June 1920): 33-35; Dale Van Every, Ark of Empire: The American
9. Between Radisson's and Groseilliers' arrival on the Upper Mississippi and the establishment of the first fur trading posts there, the French built the Languedoc Canal connecting the Bay of Bisque with the Mediterranean. The Languedoc, completed in 1681, was France's greatest canal and one of the most important ever built in Europe.

10. Although first explored by Radisson and Groseilliers in 1658 and its importance as a link in the main water passage from the St. Lawrence River to the Gulf of Mexico identified by Louis Jolliet and Father Jacques Marquette in 1673, it was not until May 8, 1683, that Nicolas Perrot ceremoniously claimed the Upper Mississippi in the name of Louis XIV of France. Using that date as a starting point and the Treaty of Paris as the ending point, the Upper Mississippi was only part of New France for 74 years. If Radisson's and Groseilliers' trip made it part of New France (as legitimate a claim as dating its inclusion in New France from Jolliet's and Marquette's arrival on it), then the Upper Mississippi was part of New France for 105 years. There is also a question about the appropriate ending date. Although General Thomas Gage took possession of the French territory east of the Mississippi for the British relatively quickly, the Spanish delayed in sending their first governor to Louisiana until 1766. Rather than decide any of that here, the approximate 100-year figure is used for the French tenure throughout.

11. Although the Spanish technically followed the Canadians west of the Upper Mississippi from 1763 until 1802, the area was still primarily French or British in these years.

12. The Canadians had three advantages in this struggle. First, the best beaver were always found north of the Wisconsin River. In other words, the Canadians controlled the best fur lands. Second, it was relatively easy, much of the year, to provide the kind of cold storage which keeps furs in good condition in Montreal. Warm, humid New Orleans was not well suited for the role of a major fur trade center. Fur storage was difficult most of the year in that climate. Third, the Canadians had a long history as allies, protectors, suppliers, and mediators of the disputes between the Algonquin groups living in the drainage. The Louisianians were an unknown quantity.

During the Fox Wars (1710-1738), the Mesquawkie attacked fur traders from Louisiana and the Native Americans who traded with them; this helped the Canadians solidify their hold on the fur trade. This is not to say, as the Louisianians accused, that the Canadians encouraged the Mesquawkie and other Algonquians to attack New Orleans-oriented traders or their trading partners in order to monopolize the fur trade. After the peace was made, the Canadians and the Mesquawkie created a new alliance.
The Sauk's and Mesquawkie's rise to dominance in the area between the mouths of the Wisconsin and Des Moines Rivers (that is, from present-day Prairie du Chien, Wisconsin to Keokuk, Iowa) helped secure the Canadians' domination of the fur trade. The Sauk established Saukenuk, their village on the point of land between the Upper Mississippi and Rock Rivers at present-day Rock Island, Illinois, in 1731. Few villages in what Richard White calls the "middle ground" and the French 300 years before him had called the pays d'en haut were inhabited by members of only one tribe. The linking of any particular tribe and a village or territory here only refers to the most easily identified ethnic group within that cluster of people.

It is legitimate to talk of a Canadian fur trade monopoly at this point because the Missouri River-based trade which funneled into Louisiana at St. Louis did not even begin to develop until after 1764.


13. In 1699, Louis XIV divided New France into three colonies: Louisiana, Canada, and Acadia. Although the designation did not mean anything until after 1720, and the Upper Mississippi all the way up past present-day La Crosse, Wisconsin, appeared on a 1763 map of Louisiana (as printed in Frederick J. Dobney, River Engineers of the Middle Mississippi (St. Louis: U.S. Army Corps of Engineers, St. Louis District, 1978), p. 5), the Upper Mississippi north of the Missouri was always an economic dependency of Montreal and thus also part of the colony of Canada.


16. They were formerly referred to as the Fox. Fox is an English translation of a not entirely flattering French nickname for the tribe. Its use is offensive to many Native Americans.

18. White, p. 137.


21. Formerly known as the Winnebago. Winnebago is a nonsense word invented by the French who were too lazy to learn the Ho-chunk language.


About 1780, the Mesquakie abandoned virtually all of their Wisconsin River villages for villages along the Upper Mississippi. These villages stretched from mouth of the Wisconsin to the mouth of the Rock River in what is now Illinois. As late as 1787 many Mesquakie and Sauk "summered" along the Mississippi near Prairie du Chien. Kay, p.164; and David B. Stout, Erminie Wheeler-Voegelin and Emily J. Blasingham, Sac, Fox, and Iowa Indians II: Indians of East Missouri, West


26. In 1700, the French had discovered lead 30 miles west of what is now Ste. Genevieve, Missouri. Samples were sent to Paris and Louis XIV gave Antoine Crozat, a wealthy French merchant, a 15-year monopoly on the lead trade. The trade was so small, however, that Crozat gave up his monopoly in 3 years. It was not until Phillipe Renault, the French director of mines, arrived in 1720 that the Missouri mines were really developed. Their production did not peak, however, until the first half of the nineteenth century. From 1720 to 1735, the lead was taken from these mines to Kaskaskia, on the east bank of the river, for shipment south on the Upper Mississippi. Once Ste. Genevieve, on the west bank of the Upper Mississippi, was established in 1735, the shipments to New Orleans originated there.

27. Smith, pp. 182–183; Howard, p. 166; History of Iowa County, p. 395.


29. Howard, p. 166.

30. Leland D. Baldwin, The Keelboat Age on Western Waters (Pittsburgh: University of Pittsburgh, 1941), pp. 4–5; History of Iowa County, p. 400; and Tweet, Rock Island District, p. 70

31. See above, endnotes 11 and 21. The Sauk and Mesquawkie had been coming into conflict with the Osage about the land west of the Upper Mississippi and below the Des Moines River for many years. The Spanish had favored the Sauk and Mesquawkie in these disputes. Wilkinson began favoring the Osage over the Sauk. This may have had something to do with his own involvement in the plans that were already being formulated for Aaron Burr's attempt to liberate the Spanish provinces of the Southwest and perhaps separate the western states from the Union. Regardless of that, Wilkinson's position played a useful role in getting the Sauk and Mesquawkie to cede a large section of land to the United States. [For further information on this see James Ripley Jacobs, The Tarnished Warrior (New York: Macmillan Co., 1938); Royal Ornan Shreve, The Finished Scoundrel (Indianapolis: Bobbs-Merrill Co., 1933); and Walter Flavius McCalib, The Aaron Burr Conspiracy (New York: Wilson-Enkson, Inc. 1936)].

Soon Wilkinson's forces turned back a 300-man Sauk and Mesquawkie war party going after the Osage. This, coupled with the presence of a small group of American pioneers squatting on prime Sauk lands along the Quiver River just north of St. Louis, made the Sauk and Mesquawkie suspicious that the Americans were going to join the Osage and cut the Sauk and Mesquawkie off from their southern hunting territory.
Sauk leaders protested U.S. actions and asked for a government trading post on their lands, but refused to surrender an Osage prisoner they had. When Wilkinson did nothing about these complaints and requests, in the fall of 1804, Sauk warriors raided the pioneer settlement on the Quiver River, killing several Americans. Realizing the Americans would retaliate, the Sauk and Mesquawkie moved their small villages south of the Des Moines River to the north side of that river and sent two Sauk chiefs and a trusted fur trader to St. Louis to try to defuse things.

The Sauk shared a common Algonquin cultural formula for dealing with murder, whether in battle or as the result of individual actions. When someone was killed, the dead person’s kin held the group to which the murderer belonged (family, kin, village, or nation)—not the specific individual who did the killing—responsible for the act. The victim’s kin expected to be compensated for their loss by the other group. Compensation could take the form of “raising the dead” (providing a slave to take the victim’s place), “covering the blood” (giving the relatives goods that they saw as the equivalent of a person) or, failing these, by the killing of a member of the offending group (not necessarily the killer—the choice of the person to be executed belonged to the offending group). The decision about which of these three forms of compensations should be extracted belonged to the victim’s kin, but social pressure urged accepting something less than the killing of a person of the offending group, because that only invited further retaliation. (For further information on this cultural formula see White, passim, but especially, pp. 76-77; and Nichols, pp. 10-11.)

The two Sauk chiefs admitted their warriors had killed the Americans on the Quiver River and offered to cover the blood with gifts. Wilkinson would accept no payment and demanded the specific warriors who had done the killing. The chiefs explained they could not do this. Wilkinson, who was not yet governor, let them leave but requested they return when Harrison came to St. Louis later in the fall. The Sauk tribal council sent a small delegation of minor village chiefs and one of the warriors who had participated in the Quiver River raid back to settle matters with the Americans. Once they arrived in St. Louis, Wilkinson immediately jailed the warrior. The chiefs thought that they were, in effect, covering the murder done by the warrior by signing the treaty—accepting general American sovereignty (much as they had recognized earlier French, British, or Spanish claims) in exchange for the release of their tribesmen. Unfortunately, much to the confusion of the chiefs, Wilkinson did not release his prisoner and they had sold their land. Nichols, pp. 21-28.

32. Formerly referred to as Chippewa or Ojibwa. Anishinabe means “the people.”
33. In 1807, Wilkinson sent Captain James B. Many back to Prairie du Chien to reaffirm Pike’s recommendation to station troops there. It is not clear whether it was Pike or Many who selected the exact site for the fort on the top of a large Native American mound on St. Feriole Island at Prairie du Chien. Nichols, pp. 28-34.

In 1817, Brevet Major Stephen H. Long, one of the Nation’s preeminent engineers, set out from Ft. Crawford in a six-oared skiff. Unlike Pike and Many, who were officers in the regular Army of the West, Long was at that time a member of the U.S. Army Corps of Topographical Engineers. He and his party of 15 worked their way

Much has been written about the colorful Pike and his expeditions. Some of the most easily accessible are John Upton Terrell, Zebulon Pike: The Life and Times of an Adventurer (New York: Weybright & Talley, 1969); W. Eugene Holton, The Lost Pathfinder: Zebulon Montgomery Pike (Norman: The University of Oklahoma Press, 1949); Elliot Coues, The Expeditions of Zebulon Montgomery Pike, To Headwaters of the Mississippi River, Through Louisiana Territory, and in New Spain, During the Years 1805-6-7 (Reprinted ed. Minneapolis: Minnesota State Historical Society, 1965) and Donald Jackson, The Journals of Zebulon Montgomery Pike (Norman: The University of Oklahoma Press, 1966).

Long was even more famous in his day than Pike, and much has been written about him. Two of the most easily accessible biographies are: Roger L. Nichols and Patrick L. Hallett, Stephen Long and American Frontier Exploration (Newark: University of Delaware Press, 1980), and Richard G. Wood, Stephen Harriman Long, 1784-1864, Army Engineer, Explorer, Inventor (Glendale, Cal.: A. H. Clark Co., 1966). He is also covered extensively in studies of the U.S. Army's role in the settlement and development of the frontier, including: Louis B. Wright and Elaine W. Fowler, eds., The Moving Frontier (New York: Delacorte Press, 1972), 252-253; Francis Paul Prucha's path-breaking studies, Broadax and Bayonet: The Role of the U.S. Army in the Development of the Northwest, 1815-1860 (Madison: University of Wisconsin Press, 1953) and The Sword of the Republic: The United States Army on the Frontier, 1783-1846 (London: Macmillan & Co., 1969); as well as in William H. Goetzmann's excellent simultaneous works, Army Exploration in the American West, 1803-1860 (New Haven, Conn.: Yale University Press, 1959) and Exploration and Empire: The Explorer and Scientist in the Winning of the American West (New York: Alfred A. Knopf, 1966).

34. Nichols, p. 34.
35. Wilson, "Over the Rapids," p. 363; and Tweet, Rock Island District, p. 87.
37. Nichols, p. 34.
38. Tweet, Rock Island District, p. 21; and Schafer, p. 28.
40. Nichols, pp. 42-45 and 54-56; and Howard, p. 93.

41. Nichols, pp. 54-56; Howard, p. 92.

42. History of Iowa County, p. 396.

43. For further information on Long, see endnote 33 above. When Chief of Engineers Colonel Joseph Gardner Swift persuaded Long to join the Corps in 1814, he was commissioned a Second Lieutenant, however he was brevetted to Major which means he had the authority of a Major but not the pay. When Long undertook the 1817 explorations discussed in endnote 33 he was a member of the Topographical Corps, not the Corps of Engineers as he was in 1819 and 1820. The difference and relationship between the Corps of Topographical Engineers and the Corps of Engineers are complex. The Corps of Engineers has existed continuously since 1775. The Topographical Corps only existed as a separate part of the army intermittently between 1813 and 1863. When not a separate part of the army, the topographical engineers were under the supervision of the Chief of the Corps of Engineers; that is, they were part of the Corps of Engineers. The best and most easily accessible studies of the two organizations and their interrelationships are: Brigadier General Henry L. Abbot, "The Corps of Engineers," Journal of the Military Service Institution 15 (March 1894): 414-425; Edward Burr, "Historical Sketch of the Corps of Engineers, U.S. Army," Occasional Paper No. 71, Army School of Engineering, 1939; C. H. Chorpening, "Waterway Growth in the United States," Transactions of the American Society of Civil Engineers, Centennial Transactions, vol. CT (1953): 985-1010; Walter P. Craighill, "Corps of Engineers, United States Army," American Society of Civil Engineers 8 (1897): 429435; A. A. Humphreys, "Historical Sketch of the Corps of Engineers," in U.S. Congress, House, Reorganization of the Army, 45th Cong., 3rd sess., H. R. 555, 327-349; Henry C. Jewett, "History of the Corps of Engineers to 1915," Military Engineer 38 (1946): 340-346; Ellis L. Armstrong et al, eds., History of Public Works in the United States 1776-1976 (Chicago: American Public Works Association, 1976), 585-643; Henry P. Beers, "A History of the U.S. Topographical Engineers, 1813-1863," Military Engineer 34 (1942): 287-291, 348-352; and William M. Robinson, "The Corps of Topographical Engineers," Military Engineer 23 (July-Aug. 1931): 303-307.


44. History of Iowa County, pp. 399-400.


46. Cronon, p. 308.

These projects came to the Corps as the result of two seminal pieces of legislation: the General Survey Act of April 30, 1824, and the Rivers and Harbors Act of May 24, 1824. The General Survey Act was unusual in that it constituted a continuing general congressional authorization for the Corps to survey roads and canals important for national commerce and defense and for the transportation of the
mail. It gave the executive branch the right to decide which roads and canals to study and in which order. The act was repealed in 1838, returning to the Congress the right to decide which roads and canals to study and in which order.

The Rivers and Harbor Acts continue to be the basic legislation authorizing Corps of Engineers (or for intermittent periods between 1838 and 1865, the Corps of Topographical Engineers) waterway improvement activities. Since 1824 almost every Congress has passed one or more Rivers and Harbors Acts. The most noteworthy exceptions are the 26th Congress (1839-1841), the 29th through 31st Congresses (1845-1851), the 33rd through the 38th Congresses (1853-1865), the 92nd Congress (1971-1973), and the 94th through the 97th Congresses (1975-1983). Each act has two principal parts. One section authorizes the Corps to conduct preliminary examinations and surveys at designated locations. The other major section authorizes specific rivers and harbors projects in accordance with reports previously submitted by the Chief of Engineers.

Because the legislation that relates to the Corps of Engineers can be found in several collections (including the very convenient U.S. Army, Office of the Chief of Engineers, Laws of the United States Relating to the Improvement of Rivers and Harbors, from August 11, 1790, to January 2, 1939 [3 vols. and 2 indices; Washington: Government Printing Office, 1913 and 1940]) as well as the Statutes at Large, no page numbers will be given herein for legislation. Generally, Rivers and Harbors Acts will be cited by year only, unless the specific date is necessary to find one of several Rivers and Harbors Acts passed within the same calendar year.

48. Nesbit, p. 110; Smith, p. 183; Schafer, p. 37.

49. See above, endnote 30.

50. Tweet, Rock Island District, pp. 28 and 39.

51. Buford's work was funded under the General Survey Act rather than a Rivers and Harbors Act, so all he could do was study, not implement any recommendations. Buford's entire report is contained in U.S. Congress, House, Message from the President of the United States, Transmitting Copies of Surveys Made in Pursuance of Acts of Congress, of 30th April, 1824, and 2nd March, 1829, H. Ex. Doc. 7, 21st Cong., 1st sess., 1829, p. 7.

52. Nesbit, p. 111; Smith, p. 529; Schafer, p. 11; Fay, Garfield, and Neville, pp. 3-4 to 3-6; and William J. Petersen, "A Century of River Traffic," The Palimpsest 27 (10), p. 293.


54. U.S. Congress, Senate, Report from the Secretary of War, in Compliance with a Resolution of the Senate of the 25th Instant, in Relation to the Rock River and Des Moines Rapids of the Mississippi River, S. Doc. 139, 25th Cong., 2nd sess., 1837, passim.
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57. Howard, pp. 241-245.


64. Rivers and Harbors Act of 1852, also known as the Western Rivers Improvement Act of 1852.

65. Congress appropriated funds for this survey in 1850. Captain Andrew A. Humphreys and Lieutenant Henry L. Abbot supervised its conduct and prepared its report Report on the Physics and Hydraulics of the Mississippi River (Washington, D.C.: Government Printing Office, 1861) which laid out the theoretical basis for Corps flood control recommendations and planning until 1936. Not only Warren, but Long also was associated with this survey. Long's and Humphreys' names are linked in a critique of Charles Ellet's flood control ideas which is contained in the survey report. Warren's work on this survey is referenced by Tweet, Rock Island District, pp. 54-55. If, however, Warren did not graduate from West Point until 1854 as Merrit claims in St. Paul District, p. 37, this may not be true. But, given that Merritt did not seem to be aware of Warren's pre-Civil War work on the Des Moines Rapids, Tweet (who initially wrote 5 years before Merrit, but produced a revised version 4 years after Merritt-apparently read Merritt's work in the interval) seems more believable. Checking original documents to verify this point was beyond the scope of this project.

66. Leland R. Johnson, The Davis Island Lock and Dam, 1870-1922 (Pittsburgh: U. S. Army Engineer District, 1985) (hereinafter cited as Johnson, Davis Island), pp. 34-36 gives a full discussion of these French innovations.


69. U.S. Congress, Senate, Report of the Secretary of War in Answer to a Resolution of the Senate Relative to the Improvement of the Des Moines and Rock Island Rapids, S. Ex. Doc. 12, 33rd Cong., 2nd sess., 1854, p. 3.


71. Tweet, Rock Island District, p. 61. This appropriation was not included in a River and Harbors Act because no Rivers and Harbors Acts were passed by the 33rd through 38th Congresses, that is, from 1853 to 1865.


73. Ibid; Dobney, pp. 39-40; and Hunter, pp. 566-584.

74. See above endnote 64.

75. Both the Corps of Topographical Engineers and the Corps of Engineers were tiny organizations by modern terms. There were only 16 officers and four cadets in the Corps of Engineers that Thomas Jefferson constituted as a military academy at West Point in 1802. That is not many more than the half a dozen topographical engineers who were pulled out of the Corps of Engineers and constituted as a separate unit in 1816. For much of the pre-Civil War era both Corps combined consisted of a single battalion of regular engineer troops and about 90 officers. Montgomery Meigs, who had worked with Robert E. Lee on the Des Moines and Rock Island Rapids problems in 1837, became well known because of the wider range of projects that Congress assigned the Corps in the post war era. He directed some of the most highly visible of these projects. For example, he supervised construction of the Capital Dome, the Washington Aqueduct, and the Pension Building in Washington, D.C.


77. These assignments may not have been entirely based on a desire by General Humphreys to ensure that a canal was built at the Des Moines Rapids. They may also have been affected by the fact that Warren, a hero of Gettysburg, had been relieved
of his command after the Battle of Five Forks on April 1, 1865. Although eventually cleared of any inappropriate actions in an 1879-1882 court of inquiry (where it came out that Warren was relieved because Ulysses S. Grant had a personal dislike for him and Phil Sheridan resented the battle being won by Warren's infantry rather than the Calvary), in 1866 it would have been a mighty deterrent to appointing Warren to as publicly prominent a position as that at the Des Moines Rapids. A decision made by Warren might not have been as readily accepted as one made by Wilson, who, on the other hand, remained a Civil War hero. Wilson fought in the battles of Vicksburg, Missionary Ridge, and Chattanooga before a detachment of his forces captured Jefferson Davis on May 10, 1865. Humphreys' personal confidence in Warren's engineering abilities is reflected in the role he assigned Warren in relation to overall strategy on the river (see below). Or Humphreys may simply have seen Warren as better at formulating the big picture than a detailed plan. This interpretation is supported by the fact that Humphreys successor, General Richard Delafield, sent Warren out West in 1868 to examine the construction of the Pacific Railroads, another strategic level rather than tactical level assignment. U.S. Congress, House, Letter from the Secretary of War, in Answer to a Resolution of the House, of December 20, 1866, Transmitting a Report of the Chief of Engineers with General Warren's Report of the Surveys of Upper Mississippi River and Its Tributaries, H. Ex. Doc. 58, 39th Cong., 2nd sess., 1867, p. 2; Merritt, St. Paul District, pp. 150-151; and Tweet, Rock Island District, pp. 361-362, 67 and 108. The meaning of brevet rank is discussed above in endnote 43. It is a very common practice during wartime.


79. H. Ex. Doc. 58; and Johnson, Louisville District, p. 46.


81. U.S. Congress, Senate, Examination of Sites for Reservoirs at Headwaters of Mississippi River, S. Ex. Doc. 198, 43rd Cong., 2nd sess., 1870; Merritt, St. Paul District, pp. 71-75. Also see below, "Tapping the Power of the Upper Mississippi."


83. Although Jenne was simply a civilian employee of the army in 1866, his status was elevated in 1867 when Congress established the rank of United States Engineer in
order to supplement the number of military engineers working on western rivers improvement. According to Tweet, Rock Island District, p. 357, only five men were ever given this rank. Jenne was the first.

84. Delafield had been working on the Mississippi system since 1829 when he had been a Captain working with Captain Henry M. Shreve at snagging. Delafield's interest in snagging began before his assignment to Shreve. In 1824, Captain Delafield had been one of the people to submit snag boat designs to General Alexander McComb in response to his June 1824 ad offering $1,000 for the best plan for removing snags from western rivers. From 1831 to 1834, Delafield was the Corps officer Congress demanded inspect Shreve's dike construction work on the Ohio and Mississippi Rivers. During that same period he was in charge of the construction of the National Road across Ohio and Indiana. Delafield later served twice as Superintendent of West Point and designed the castle insignia that has become the symbol of the Corps of Engineers. Although Delafield was the Chief of Engineers who submitted the Corps Annual Report for 1866, that appointment had to have come very late in the year. Humphreys was still Chief of Engineers on Dec. 21, 1866. Dobney, pp. 23 and 24; Leland R. Johnson, The Falls City Engineers: A History of the Louisville District Corps of Engineers United States Army (Louisville: U.S. Army Engineers District, 1974) (hereinafter cited as Johnson, Louisville District), pp. 48 and 80; U.S. Congress, House, Report of the Chief of Engineers for 1866, H. Ex. Doc. 18. 39th Cong., 2nd sess., 1866; and Merritt, St. Paul District, p. 64.

85. This assignment may have had a great deal to do with Wilson's decision to resign from the service. Wilson's claims to fame rested on a trestle bridge he built over the Little Tennessee River in 32 hours from dismantled houses. He was an acknowledged expert on bridges. Macomb was not. He was an administrator who could get contractors to invent the things he needed, which was what he had done in his 3-year stint as Superintendent of Western River Improvements—he had the floating plant for use on the western rivers built. Even though Macomb had the unusual distinction of having developed methods of inflating reconnaissance balloons in the field, he was no one's idea of a designer. Macomb's assignment to superintend this bridge must have raked the much younger (Wilson was 33 at the time and Macomb 69), higher-ranking Wilson. Wilson was a Lieutenant Colonel brevetted to Major General while Macomb was only a Colonel. Warren had taken the job in June 1869 when Congress assigned the Corps responsibility for building the bridge that Brevet Brigadier General Thomas Jefferson Rodman, then Commandant of the Rock Island Arsenal, had designed. Warren, however, almost totally redesigned the structure before turning construction supervision over to Macomb. Tweet, Rock Island District, pp. 362-363.

86. This may have been a replacement for the assignment Warren had intended to give Stickley, supervision of the construction of the Rock Island Bridge. Tweet, Rock Island District, p. 110.

87. It was so bad that that Rivers and Harbors Act of 1900 made it illegal to float loose timber or logs or stack rafts of timber and logs in streams or channels actually navigated by steamboats, if doing so endangered that other traffic. Tweet, Rock Island District, p. 240.

89. Although the Moline Lock, stripped of its lock gates, and the remainder of the concrete dams which funneled water to it are still extent, they are not covered by this context and are not part of the Lock and Dam No. 15 Historic District being nominated to the National Register of Historic Places as part of this Multiple Property Submission. For a discussion of why they are not included, see Section 10 of that individual National Register Registration Form.

90. The Meigs report behind this decision was not published until 1916 as "Report of Mr. Montgomery Meigs, U.S. Civil Engineer," in U.S. Army Corps of Engineers, Annual Report of the Chief of Engineers United States Army to the Secretary of War for the year 1916 (The government has printed the Annual Report of the Chief of Engineers and bound it as a separate volume every year since 1867. Published at the end of the fiscal year, the exact title and format have varied slightly from time to time. Hereinafter, all reports from this series will be referred to as Annual Report followed by the fiscal year which the report covers.), Vol. II, p. 1509. For information on the origin of the request for this approval, see below "Tapping the Water of the Upper Mississippi." The actual buildings, structures, and objects associated with this complex are discussed in the Lock and Dam No. 19 Historic District National Register Registration Form submitted with this Multiple Property Nomination Form.


92. U.S. Congress, House, Survey of the Upper Mississippi, H, Doc. 341, 59th Cong., 2nd sess., 1907. Tweet, Rock Island Rapids, pp. 1-2; and District engineer officer to Chief of Engineers, August 27, 1913, RG77, Entry 81, Box 798, NACB.

93. Rivers and Harbors Act of March 5, 1914; Richard Monroe to H. Burgess, June 9, 1920, and H. Burgess to Div. Engineer July 24, 1920, RG77, Entry 81, Box 798, National Archives and Records Administration-Great Lakes Region (Chicago), Chicago, IL (hereinafter cited as NACB); and Annual Report 1924, p.1090.


A group of Minneapolis businessmen founded the Upper Mississippi Barge Line Co. the summer of 1925 in order to get the Inland Waterways Corporation to extend its service to the Upper Mississippi. During World War I, the railroads inability to handle intra-continental freight was so great that the federal government began operating barge and towboat fleets in order to reestablish waterway commerce. After
the war, much of this fleet was transferred to the War Department which continued to offer barge service through its Inland and Coastwise Waterway Service. On June 3, 1924, Congress mandated the creation of the Inland Waterways Corporation, which took over from the Inland and Coastwise Waterway Service. Upon application of the water carrier, the Interstate Commerce Commission (ICC) could order all connecting common carriers to set up joint rates. A viable water carrier with government subsidized low rates could ask the ICC to order the railroads to set up joint rates. The Upper Mississippi Barge Line Co. built boats and barges, put them on the river, and forced the Inland Waterway Corporation (through a combination of lobbying and law suits) to lease the fleet from them and begin operating on the Upper Mississippi in 1926. In 1926, even before the boats began operating for the season, the Upper Mississippi Barge Line Co., the Inland Waterways Corporation, and the Illinois Central Railroad had established joint rates. For more information see Marshall E. Dimrock's Developing America's Waterways: Administration of the Inland Waterways Corporation (Chicago: The University of Chicago Press, 1935) or for a more up to date, though shorter treatment see Michael C. Robinson's "The Federal Barge Fleet: an Analysis of the Inland Waterways Corporation, 1924-1939," National Waterways Roundtable Proceedings (Washington, D.C.: U.S. Government Printing House, 1980).

95. Col. C.W. Kuntz, Central Division Engineer, Cincinnati, OH, to Chief of Engineers, 2 Nov. 1927 and Col. Harley B. Ferguson, Central Division Engineer, to Chief of Engineers, 11 Dec. 1928, RG77, District Files, 1923-1940, Box 62, File 2294, NA; S. G. Roberts, "Roller Gate Dams for the Kanawha River," Engineering News Record 111(Sept. 21, 1933), pp. 337; and "U.S. Engineer Office, Improvement of Mississippi River, Development Near Rock Island, Illinois, Hearing on December 22, 1930," typescript, (hereinafter cited as Rock Island Hearing Dec. 1930), RG77, Entry 81, Box 798, NACP, p. 67. Grimm's plans for the Hastings structure were submitted to Congress on April 19, 1928. It was built in the later half of 1929 and 1930. Although Grimm was never a member of the Upper Mississippi River design team, he knew many of its members well from his work on the Ohio River. He remained with the Ohio River Division into 1930 by which time he had completed his plans for the Kanawha River dam. He then transferred to the Pacific Engineer Division at San Francisco. He died there in 1942. For further biographic information on Grimm see Leland R. Johnson to W. Patrick O'Brien, February 6, 1988 (2nd letter of that date), copy in the files of the National Park Service, Rocky Mountain Regional Office. The Corps distributed plans of its Lock and Dam No. 15 on the Upper Mississippi River to the public in December 1930.


97. Gjerde, p. 100.


102. Transfer approvals for Ylvisaker and Abbott are contained in Chief of Engineers Lytle Brown to Colonel George R. Spaulding, Nov. 30, 1929, RG77, Box 825, File 2294, NA. Information on Ylvisaker's education and his role in Louisville comes from interviews by Leland R. Johnson and Charles E. Parrish with Oren Bellis, Louisville, KY, June 6, 1986, as cited in Leland R. Johnson to William Patrick O'Brien, Feb. 6, 1988 (first letter of that date), copy in files of the National Park Service, Rocky Mountain Regional Office.


104. H. Doc. 290, passim.

105. Roberts, pp. 338 and 340; and George R. Spaulding to Chief of Engineers, Feb. 7, 1930, RG77, Box 825, File 2294, NA.

106. Roberts, p. 339; and P. S. Reinecke, "The Rhine and the Upper Mississippi," The Military Engineer 30 (May-June 1938), pp. 167-171. The Main River is the tributary of the Rhine that passes through Frankfort to Nuremberg. The Neckar is the next major tributary south of the Main, meeting the Rhine at Mannheim. The Neckar flows through Wurzburg and Stuttgart before curling back east toward the Black Forest.


108. Scour is a condition that results from a concentrated flow of water passing over a structure and rolling along the riverbed below the structure. The force of the water can excavate large holes in the riverbed, ultimately undermining the structure. Downstream aprons, derrick stone protection, and baffles reduce the force of the water in pier dams with gates operated from fixed bridges. Hydraulic jump is a phenomena associated with the tendency for water flowing over a structure to fall in a determinable curve. If the curve of the water falls well beyond the face of the structure, a vacuum can form that literally sucks the concrete or other building
material from the structure. Careful design and the provision of baffles and settling basins serve to reduce and control hydraulic jump.

109. Roberts, p. 339. Vertical lift gates' name explains their technology. The Keokuk Dam gates are vertical lift gates. See Lock and Dam No. 19 Historic District Nomination Registration Form submitted as part of this Multiple Property submission. Tainter gates are discussed below at length. Sector gates are roller gates in which the roller is a sector of a circle instead of a cylinder (see below, discussion of roller gate). John S. Scott, A Dictionary of Civil Engineering 2nd ed. (Baltimore: Penguin Books, 1965). p. 260.

110. In 1902, a Krupp roller dam was built on the Main River near Schweinfurt, Germany. Soon roller gates predominated on the dams on both the Main and Neckar Rivers. The roller dam at Kibling, Germany, which was built before 1915, involved a particularly remarkable use of the technology. This dam had one 28-foot high roller gate providing a 46-foot clear span. Another interesting pre-1915 example is a dam near Stuttgart, Germany, which had two spans, 92 feet by 12 feet. McAlpine, p. 420; Roberts, p. 338; "Building the Rolling-Crest Dam Across Grand River," Engineering News 76, No. 2 (July 13, 1916), p. 60; Johnson, Davis Island, p. 162; and Frank Teichman, "Large Roller-Crest Dam, Grand Valley Project, Colorado," Engineering News 76, No. 1 (July 6, 1916), p. 4.

111. McAlpine, pp. 420-421; and Roberts, pp. 338 and 340-342.


114. Teichman, pp. 2-4; and "Building Rolling-Crest Dam Grand River," pp. 60-61.


Throughout this form, dam gate sizes are cited in round numbers. Sizes, such as 88 feet 10.5 inches, are given exactly in some of the sources. That level of exactitude is not necessary for the purposes of this narrative. These measurements should be taken as approximations for use in categorizing the various sizes and styles of installations and not as exact measures per se.

118. In the Rivers and Harbors Act of 1930 Congress had authorized the Corps to build the system described in H. Doc. 290. The contract drawings for Lock and Dam No. 4 in Alma, Wisconsin, reflected H. Doc. 137. The drawings called for a nonnavigable rather than navigable dam. The CB&Q's attorneys argued and the U.S. District Court for the Western District of Wisconsin agreed that this constituted a radical difference in nature and kind from the structure proposed in H. Doc. 290 and authorized in 1930. In early 1932, the Corps was enjoined from building Lock and Dam No. 4. U.S. Congress, House, Committee on Rivers and Harbors, Mississippi River to Minneapolis-Decree of Injunction Restraining the Government from Construction of a Lock and Dam at Alma, Wis., H. Doc. 7. 72nd Cong., 1st sess., 1932.

119. U.S. Congress, House, Public Resolution No. 10, H. J. Resolution 271, 72nd Cong., 1st sess., 1932. Once the CB&Q had won its injunction on Lock and Dam No. 4, it was clear that if the survey report and plans published in H. Doc. 137 were followed, the railroads could get similar injunctions issued at most, if not all, of the other proposed lock and dam complexes. Even the structures at Lock and Dam 15, the first of which was already under construction, were open to injunction. Therefore, almost at once the Corps used the publication of H. Doc. 137 to get the House Rivers and Harbors Committee to open wide ranging hearings on the entire project. The implications of this judgement were discussed at the beginning of these hearings. Jan. 1932, Hearings, pp. 6-10. The joint resolution was the result of these initiatives. The Corps wasted no time in using its new authority. By March 4, the Corps had officially modified the plans for Lock and Dam No. 4, including a change in upper pool depth that met conservationists' concerns, and by March 8, its lawyers had moved for dismissal of the injunction. Judge F. A. Geiger of the U.S. District Court for the Western District of Wisconsin dismissed the injunction. The information on the completion of the main lock at Lock and Dam No. 15 is drawn from Annual Report, 1932, p. 1114.

120. Although the specific date that the Corps eliminated Lock and Dam No. 23 was not discovered in this project, it had to be after January 1932 because Lock and Dam No. 23 was still listed as a project element in H. Doc. 137, which was published that month. As noted above, H. Doc. 137 was a much more refined plan than that presented in H. Doc. 290.

121. H. Doc 137 included Lock and Dam No. 5A which, as its number reflects, was a late (that is, post H. Doc 290) insertion into the system. The Corps added Lock and Dam No. 5A after it discovered that the pool Lock and Dam No. 6 would create (without this additional lock and dam) would have flooded significant portions of the city of Waconia, Minnesota. "Lock & Dam No. 5A, HAER No. MN-23," in Locks & Dams 3-10 HAER, 6.


124. "Lock & Dam No. 4 HAER No. WI-47," p. 8 in Locks & Dams 3-10 HAER.

125. Locks and Dams 3-10 HAER.


128. Johnson, Davis Island, pp. 135 and 162; Mary Yeater "Hennepin Canal Historic District, " National Register of Historic Places Inventory-Nomination Form, Section 7, pp. 2-3; and Gjerde, pp. 125-128.

129. Daley, p. 106; and Elliot, p. 9.


133. The final construction reports mention these being added at Locks 16, 18, 11, 21, 22, and 12—that is, all those in the Rock Island District built on piles except Lock 17. It is not clear if the struts were not used at Lock 17 or were simply not added in. Lock 17 was the last lock constructed in the district. By then, struts may have been a standard feature drawn in at the initial design date and not meriting special mention. For a good description of the struts and their function see "Mississippi River Lock and Dam 21 Final Report-Construction," Vol. I: "Introduction and Lock" (Rock Island: U.S. Army Corps of Engineers, Rock Island District, August 1939) (hereinafter cited as "Final Report Lock 21"), pp. 8-9, RG77, NACB. Feagin's tests are described in Thomas J. Mudd, "Locks and Dam No. 26, Mississippi River, Alton, Illinois," typescript (St. Louis: U.S. Army Corps of Engineers, St. Louis District, 1975), pp. 3-4 and U.S. Army Corps of Engineers, St. Louis District, "Final report—Lock and Dam No. 26, Part I—Locks," (St. Louis: U.S. Army Corps of Engineers, St. Louis District), pp. 16, 32, and 34. Lidicker described his own tests in William Z. Lidicker, "Unusual Timber and Steel Bearing Pile Load Tests as Mississippi River Lock and Dam No. 3" (July 26, 1939), p.1-13, RG77, Entry 1629, Box 22, File 54.7, NACB.
134. R. A. Wheeler to Chief of Engineers, May 3, 1934, RG77, Entry 111, Box 997, File 3424, Washington National Records Center, Ft. Belvoir, VA (hereinafter cited as WNRC); and Mudd, p. 3.


136. Patrick O’Bannon, "Upper Mississippi River 9-Foot Channel Project Locks and Dams 24-27, An Inventory for the U.S. Army Corps of Engineers, St. Louis District" (Historic American Engineering Record Documentation, Lakewood, CO: Rocky Mountain Regional Office, National Park Service, 1989), (hereinafter cited as Locks & Dams 24-27 HAER); 1988 interviews (list); Chris Morgan, Lockmaster of Lock and Dam No. 24, and Bob Deien, Locktender at Lock and Dam No. 24, interviewed by Mary Rathbun, February 25, 1998, notes archived at American Resources Group, Ltd., Carbondale, IL.


138. In 1998, the old control stand shelters were still in use on the land wall at Lock and Dam No. 12. They had been replaced at all the other complexes in the two districts. However, in several cases the lock staff had recycled the old control stand shelters. Some staffs moved one to each end of the land wall where they serve as locktender’s shelters. At other complexes, the staff relocated them to the intermediate wall and put them back into use as shelters for use when operating the lock from the control stands on that side of the lock.


140. Wayne Currier, Lockmaster of Lock and Dam No. 11, interviewed by Mary Rathbun, Jan. 25, 27, and Feb. 2, 1988, notes from these interviews in long term storage at Rathbun associates, Hollandale WI; Tom Picket, Lockmaster of Lock and Dam No. 22, interviewed by Mary Rathbun, Feb. 19, 1998. Notes archived at American Resources Group, Ltd., Carbondale, IL.

U.S. Army Corps of Engineers, Rock Island District, "Mississippi River, River a. Harbor Project, Lock 19, Major Rehabilitation," site map, September 30, 1978, and "Mississippi River, Lock and Dam No. 19, Old Lock and Dry Dock, Sheet Pile and Closure," as built drawings 1977. The date the work was done at Lock and Dam No. 25
is much less clear. The list of alterations and additions to the complex on page 5 of Lock & Dam 25, HAER No. MO-37, Locks & Dams 24-27 HAER does not say when the dike was built. It simply reports a repair to it in 1978. It may have been that the dike was put in then. Often when things are done in one Corps district they are often done at another at about the same time. The alterations and additions list on page 5 of Lock & Dam No. 24, HAER No. MO-36, Locks & Dams 24-27 HAER is much more specific. It reports the actual construction in 1981.


145. John Anfinson, Historian, St. Paul District, interviewed by Mary Rathbun, Dec. 8, 1998, (notes archived at American Resources Group, Ltd., Carbondale, IL.) is the source of the information in this and the following paragraph.


147. see above, "Improvement Work Begins," pp. 18-19.


149. Annual Report, 1867, p. 265; and Tweet, Rock Island District, pp. 91-103.


151. Johnson, Louisville District, p. 170; Hays, pp. 93-94; and Rathbun, Little Rock District, pp. 120-122.

Collins, CO; Department of Economics, Colorado State University, 1970) offer a more modern, although still dated, treatment.


155. Ibid; and Annual Report, 1929, p. 1139.


158. H. Doc. 290, pp. 5, 37, and 40.

159. H. Doc. 137, pp. 6 and 24.


164. The Corps of Engineers and the Quartermaster Corps have existed almost as long as the American military has existed. The Corps of Engineers has traditionally had responsibility for building bridges, roads, and fortifications, while the Cantonment Division of the Quartermaster Corps built and provided shelter for troops. As the twentieth century began, the enormous increase in construction needs of the Army caused by rapid, mass mobilization, and systematic training involved in technologically modern war demonstrated that military construction was the key to military preparedness. See Lenore Fine and Jessie A. Remington, The Corps of Engineers: Construction in the United States, United States Army in World War II (Washington, D.C.: Office of the chief of Military History, 1972), pp. 18-40.

Even before America's entry into World War I, the Corps of Engineers and the Construction Division (the renamed and expanded Cantonment Division) of the
Quartermasters Corps had begun to struggle for control of military construction. During World War I and for most of the interwar years, the Quartermaster Corps retained responsibility for behind-the-lines construction; its Construction Division built stateside camps and cantonments, ports of embarkation, training centers, posts, stations, airfields, schools, hospitals, bases and depots, and munitions plants and depots. Congress limited the Corps of Engineers military construction function to building actual fortifications. Throughout the 1920s and into the 1930s, the Corps of Engineers was in danger of losing all its military construction functions to the Quartermaster Corps. Fine and Remington, pp. 25-90.


167. U.S. Congress, House, Hearings Before the Committee on Rivers and Harbors, House of Representatives, 69th Congress, 1st Session on the following subjects: Report on Unqua Harbor and River, Oreg.; Report on Islais Creek, San Francisco Harbor, Calif.; Raising the levels of the headwaters of the Mississippi River; Control of floods on the Illinois River, Illinois; Allowing credit and disbursing officers for reimbursement of certain subsistence expenses; Acceptance and approval of bids for furnishing materials and labor; Collection of commercial statistics, 26 April 1926, p. 188; Rivers and Harbors Act of Jan. 21, 1927, 69th Cong., 2nd sess., Chapter 47.


169. Arkansas Gazette, March 31, 1931; and Reuss, pp. 140-144.


171. Annual Report, 1933, pp. 675 and 683; and Gjerde, p. 149.


175. Roosevelt to Senate, Aug. 13, 1937, in Edgar B. Nixon, ed., Franklin D. Roosevelt and Conservation, 1911-1945 (Hyde Park, NY: General Services Administration, National Archives and Resources Service, Franklin D. Roosevelt Library, 1957), p. 102. Roosevelt was reluctant to give the Corps all water resource development responsibilities. This reluctance revolved around the concern that the Corps of Engineers’ background was not sufficient for the planning of a comprehensive program for the water and related resources of the nation.

176. Harold L. Ickes to Franklin D. Roosevelt 20 May 1939 in Nixon, p. 336. When this effort failed, Ickes shifted his attention to the Department of Agriculture in his ongoing crusade to enlarge the scope of the Reclamation Service’s authority.
in 1939, because the Department of Agriculture's Forest Service and Soil Conservation Service had water resource management responsibilities, Ickes tried to get the whole Department of Agriculture transferred to the Bureau of Reclamation.

In 1947, President Truman appointed Hoover chairman of a commission for reorganization of the executive branch. Hoover's 1949 report called for the transfer of control of harbor and flood work from the Corps to the Interior Department. At first the staff of the Corps were confident that the President would not give the Hoover recommendations to Congress, but in the early 1950s Truman did just that. Conference Report, May 4, 1950, Record Group 338, Box p-52647, File 337, WNRC.

As a result, criticism of the Corps and its management of water resource projects became more public than at any time since the 1930s. In 1951, the House Public Works Committee created a special subcommittee to examine federal water project policies and procedures. The subcommittee found Congress had authorized more than 900 projects that the Corps had not yet begun. The Public Works Committee insisted that the Corps systematically work through this backlog. The committee ordered the Corps to review all civil works projects and classify each as active, deferred, or deferred. In 1952, the Corps began this review and categorization. Asess. U.S. Congress, House, Committee on Public Works, Subcommittee to Study Civil Works, Hearings, Study of Civil Works, Part I, Corps of Engineers, U.S. Army, 82nd Cong., 2nd sess., March 30 and April 2, 3, and 29, 1952.

Meanwhile, the Corps began to counterattack the Truman reorganization plan and the Hoover report. It called its offensive Operation Pork Barrel, which proved successful although it lasted into the Eisenhower era. Armed Service and Department Memo, April 17, 1952; and Circular letter Lewis A. Pike, Office of the Chief of Engineers, May 5, 1952, both in RG 77, Fort Worth; J. G. Burke to Francis Cherry, Feb. 17, 1953; and Francis Cherry to President Eisenhower, Feb. 25, 1953, both in Francis Cherry Official Papers, 1952-1954, Arkansas Historical Commission, Little Rock, AR.
F. Associated Property Types

Name of property type: LOCK AND DAM HISTORIC DISTRICTS

Description

A lock and dam historic district on the Upper Mississippi River 9-Foot Navigation Project includes bank-to-bank structures which turn the free-flowing river into a slackwater navigation system (see above "Building a Slackwater Navigation System on the Upper Mississippi River," Section E), plus various esplanades, green spaces, buildings, structures, and objects associated with that bank-to-bank structure. The bank-to-bank lock and dam structure is the key component in any slackwater navigation system. It is also the most significant human-made feature of such a system.

Because of the collective nature of a lock and dam district, including numerous discrete as well as numerous interrelated resources, it is a broadly defined property type. This broad definition encompasses the full range of structures, buildings, and objects that comprise the districts.

No two districts are exactly the same. Each was shaped by its place in the technological development of the project and the navigational needs and hydrological characteristics of the stretch of the river in which it is located. However, each Upper Mississippi River 9-Foot Navigation Project Lock and Dam Historic District includes at least one navigation lift lock and one dam. The lock(s) and the dam(s) are the most important structures within each district. In addition to the locks and dams, there are individual resources that are common to most of the districts. These will be identified below.

The bold italic words below correspond to buildings, structures, and objects itemized as individual resources on the lists of contributing and noncontributing structures in the National Register Registration Forms being submitted with this Multiple Property Nomination Form. Some districts include unique resources, such as the boat harbor and seawall in the Lock and Dam No. 15 Historic District. Those unique features are not described here. Rather, they are described in the individual nomination form covering the district that includes them.

Navigation lift locks are described in general terms above (see Section E). Their primary purpose is to allow boats to pass between two bodies of water which have markedly different elevations. There are several distinct kinds of navigation lift locks in the Upper Mississippi River 9-Foot Navigation Project today. However, one style of lift lock reoccurs frequently enough to have systemic significance and to merit description here with its standard appurtenances. Locks that differ from this standard, but still contribute to the historic character of a district, are described in the individual nomination form for the specific historic district of which they are a part. Locks which were built after the end of the Period of Significance for the historic context described in this Multiple Property Documentation Form, that is, locks built after 1948, are not described.
Within the context of the Upper Mississippi River 9-Foot Navigation Project 1870-1948, a canal lock which has been converted for use in a slackwater navigation system is not the same thing as a lock built as a river lock.

The main lock is almost always located at one end of the bank-to-bank structure. The four exceptions are Lock and Dam Nos. 2, 5A, 13, and 14 where alternate lock placement was determined by unusual site specifics. Appurtenances are generally located on the shore nearest the lock portion of each bank to bank structure.

The Corps designed 23 standard Upper Mississippi River style locks between 1929 and 1936 as a part of the Upper Mississippi River 9-Foot Channel Project. Five were founded on bedrock. The other 18, 17 of which still exist, rested on concrete foundations set on 14,000-15,000 timber piles, placed in the same configuration that the final lock structures were going to have, driven to refusal in riverbed sand, and then sealed in that shape by steel sheet piling "walls" driven along the outside edge of the pattern.

The lock chambers of all standard Upper Mississippi River style locks are 110 feet wide by 600 feet long. These chambers are formed by two massive, fixed sides of standard, monolithic, reinforced concrete masonry, a 24-inch-thick concrete floor, and two pairs of traditional, flat-leaf style miter gates. The lock wall closest to one of the river's banks is known as the land wall. The riverward wall of each standard Upper Mississippi River style lock is referred to as the intermediate wall, rather than the river wall, because it is simultaneously the riverward wall of the main lock and the landward wall of the auxiliary lock (discussed separately below because they are not standard Upper Mississippi River style locks). A very noticeable feature of the lock walls are ceramic tile river depth gauges found in the wall in strategic spots.

The miter gates on standard Upper Mississippi River style locks are steel-skin plates surrounding an interior, metal, vertical bracing frame. The two leaves in each set of gates are hinged panels balanced on steel pintels embedded in the lock floor and attached at their quoin ends to the lock walls. Rubber seals on the quoin end of the gates sit on a stainless steel plate embedded in the masonry. When closed, the miter cut ends of the two leaves toe together in the center of the lock chamber forming a "V" configuration pointing upstream. Steel beams, embedded in reinforced concrete gate sills on the floor of the lock, support the parallel "Vs", one at each end of the lock chamber.

The lock staff operates each pair of gates independently by remote control switches located in free-standing, weatherproof cabinets that sit on the top of the lock walls. These cabinets are known as control stands (see accompanying material, PHOTOS 18 & 38). There are four control stands at each standard Upper Mississippi River style lock, one beside each leaf of each pair of lock gates. Both leaves of each pair of gates can be operated from either control stand adjacent to that pair. The lock staffs generally operate the gates from the control stand on the land wall of the lock.

As noted above (see Section E), since the 1970s, the two, formerly free-standing control stands on the land wall of each lock have been incorporated into one
of the four walls of the two **control stand shelters** at each lock. The bulk of the control stand is outside the building at some shelters (see PHOTO 10, Lock & Dam 25 Historic District Form and PHOTO 4, Lock & Dam 22 Historic District Form). Only the control dials and knobs are inside the shelter. The buildings are obviously intended to shelter the operators, not the equipment. In most shelters, however, the control stands are totally enclosed. Nevertheless these control stand shelters are still buildings rather than structures in National Register terminology. They were built to shelter human activity.

As also noted in Section E, by 1998 the Corps had all the 1970s and older control stand shelters in the Rock Island and St. Louis Districts replaced, except for those at Lock and Dam No. 12. Those will not remain there indefinitely. They are only still there because that complex has not yet had its 50 year major rehabilitation (see Section E). Although all the 1970s and earlier shelters were clearly based on the same model, there was a certain amount of individuality in the structures from site to site. Most can be divided between two types: larger (see PHOTO 5, Lock and Dam No. 12 Historic District Form) and smaller (such as the ones at Lock and Dam No. 25). In most cases the lock staff relocated the old control stand shelters when their new ones were installed. Generally, if the old control stand shelters were large, the staff moved them to the intermediate wall and reused them as control stand shelters there (see PHOTO 5, Lock and Dam No. 16 Historic District Form). If they were small, the lock staff relocated them to the far ends of the land walls or land wall extensions to use as locktender's shelters (see PHOTO 5, Lock and Dam No. 22 Historic District Form).

There are at least three types of 1990s control stand shelters. Those in the Rock Island District are brick and glass rectangles. But those built first, referred to here as 1990s Rock Island District Style 1 control stand shelters (see accompanying material, PHOTO 34), have slightly different roofs and are made of a brick distinguishable from that used in those built later, 1990s Rock Island District Style 2 control stand shelters (see accompanying material, PHOTO 35). There are also two pairs of new control stand shelters in the Rock Island District (those at Lock and Dam Nos. 11 and 22) which, although they are also brick and glass rectangles, differ more from the two identified types than the two types differ from each other. The new control stand shelters in the St. Louis District are distinctly different from those in the Rock Island District. Those in the St. Louis District are sleek, aerodynamic-looking ovals (see accompanying material, PHOTO 36).

The switches in both the free-standing control stands and those in control stand shelters govern electrically operated motor assemblies, originally housed in machine pits in the lock walls but now sitting atop the walls in weatherproof housings which are considered part of the assemblies (see accompanying material, PHOTO 16). These assemblies, both the original ones and the replacements, are referred to as the **gate operating machinery**. One set of gate operating machinery is located adjacent to each gate leaf. Each set of machinery powers arms and gears which open and shut the gate it is situated beside. The motors can be operated at speeds. The high speed winding develops 25 horse power (hp) at 1,200 revolutions per minute (rpm) for a closing time of one minute. The low speed winding develops 5 hp at 300 rpm for a closing time of four minutes.
A few locks have gate operating machinery shelters. These protect machinery with either a low gabled or flat metal roofed structure that rests on a low concrete wall. The object of these shelters is to protect the machinery that does not have its own weatherproof housing.

Unlike early locks, the chamber is not filled through the gates. Water flows into each lock chamber through 14-inch-diameter longitudinal culverts, one in the base of each lock wall. The flow of water in each culvert is controlled by two Tainter valves, one just inside the lock gates at each end of the lock chamber. Each valve is located toward the bottom end of a shaft within the lock wall. This shaft runs straight down from the top of the wall to the top of the longitudinal culvert. When the Tainter gate is open, it is contained in the vertical shaft. When it is closed, it moves down and blocks off the longitudinal culvert. A series of small ports branch off the longitudinal culverts. They open directly into the lock chamber.

When the Tainter valves at the upstream end of the lock chamber are open and the ones toward the lower end closed, gravity forces water to enter each large culvert through an intake opening in its lock wall, just above the upper lock gates. The water flows from the large culverts through the ports to flood the lock chamber. If the Tainter valves at the upstream end of the lock chamber are closed and the ones toward the lower end open, then the water drains from the chamber through these same ports and flows into the lower pool through discharge openings in the lock walls, just below the lower gates.

The valves are opened and closed by valve operating machinery. These electrically operated motor assemblies were originally housed in machine pits in the lock walls but are now sitting atop the walls in weatherproof housings which are considered part of the assemblies (see accompanying material, PHOTO 17). Both the original and the replacement assemblies are referred to as the valve operating machinery. One set of valve operating machinery is located above each valve close to the ends of the lock chamber.

Some locks do not have the machinery in weatherproof housing, but the equipment is housed in a valve operating machinery shelter. The machinery at these locks is protected with either a low gabled or flat metal roofed structure that rests on a low concrete wall.

At most of the locks is a Central Control Station which houses the lock offices as well as a number of other functions. Almost all central control stations are located on the landward lock wall, toward the middle of the lock chamber. There are five styles of central control stations. Style 1a (see accompanying material, PHOTOS 1, 2, & 3) were rectangular poured concrete walled buildings with hipped tile roofs and hidden gutters. The side walls terminated above with rounded parapets. The long side parallels the long side of the lock chamber. Three sets of paired tall arched windows pierced the river side of the building with the center set replaced on the landward side by an entry. One of the shorter sides had two of the same style windows and the other had a substantial chimney mass. Shallow pilastered buttresses were found on the corners, between the window sets and in the center of the shorter walls. A second variant of this style, 1b (see accompanying material, PHOTOS 4 & 5),
was similar to the 1a except that the building was not as high, the length was less, and the space between the windows was less. The windows were therefore squatter presenting a different aspect.

The 2a Style central control station (see accompanying material, PHOTOS 6 & 7) has only one example, at Lock and Dam No. 14. This style served as both a central control station and as a powerhouse. It therefore housed water channels, turbines, and generators in addition to the lock operation elements. It was brick rectangular in plan with a shorter concrete wing offset to the left rear. The roof was flat. The windows and door opening extend up almost the full height of the building, ignoring the stories within. The window and door openings have recessed brick moldings and were basket arched. Shallow brick pilasters are at the corners and between each bay. The main door bay is much larger than the window bays. The 2b Style (see accompanying material, PHOTOS 8, 9, & 10) central control stations shared some elements with the 1a and 1b buildings but were clearly distinctive. The hipped roof was replaced by a flat roof, the outer wall material was brick, and the windows were arched but were no longer paired, and were wider. The casing was recessed one layer into the brick walls. The pilastered buttresses separated all window and door openings. This style the central bay on the long sides devoted to a door opening with an arched transom window above matching the other windows in height.

The Style 3 (see accompanying material, PHOTO 11) central control station is only found at the lock and dam complexes administered by the St. Louis District, that is, at Lock and Dam Nos. 24 and 25 historic districts. It is masonry and has a narrow rectangular plan with a flat roof. A 1988 enlargement and remodelling has altered this style significantly.

An incomplete auxiliary lock is to the seaward of each lock except at Lock and Dam No. 15 where there is a complete auxiliary lock and Lock and Dam No. 14 where the old LeClaire Lock was retained. These auxiliary locks were intended to allow for an increase of traffic to be adjusted within the as-built design of the 9 foot channel. This resource consists of the upstream section of a lock. The Corps constructed about 200 feet of a lock including functioning miter gate repairs. The lock head is offset about 50 feet downstream from the complete lock sections included all the features of the completed lock except that the intermediate wall terminated with a bulk nose, but not the seaward lock wall as was the case for the completed locks.

A number of buildings, structures, and objects, which must be listed as individual resources within a lock and dam historic district, but are actually ancillary to the lock, are described above. There are other similar items not included there. They are described below.

At the time of their construction, each lock chamber was equipped with upstream and downstream guide wall extensions (see accompanying material, PHOTO 15), one attached to each end of the land wall of the lock. The Corps departed radically from standard practice in designing guide wall foundations. Traditionally, guide walls were located on rock foundations, where such foundations existed. During the 9-Foot Channel Project, however, the Corps constructed guide walls on timber cribbing partially filled with riprap. The concrete was supported on timber stub pilings.
either placed directly on rock or driven to refusal. The substitution eliminated the necessity of expensive cofferdams for this portion of the work.¹

**Stage recorders** consist of small concrete housings located at the extreme far ends of the guide walls.

Many of the locks have **mooring keels**. These recent innovations (see accompanying material, PHOTO 22) are large mooring cleats on rails on the edge of the lock walls outside the lock chamber. They are streamlined metal with an upper cross piece held by two posts rising from a base which rides the rails on rollers. The rails are close to the edge of the guide walls and are part of the mooring keels. The barges are tied to these and can be moved along the guide walls without slipping the barge lines.

**Haulage units** (see accompanying material, PHOTO 20) are found on the lock walls near the miter gates. They are composed of a large cable spool and the engine that turns that spool. The haulage unit cable is attached to the barge and can pull the barge along the wall.

Some of the haulage units (see accompanying material, PHOTO 21) have **haulage unit shelters**. These essentially consist of a wooden framework with a sloped roof intended to protect the machinery but also the operator.

**Scooter sheds** house the small vehicle the site staff uses to travel around the lock. Although it can drive across the top of the closed lock gates so that it gives access to both sides of the lock, it does not provide access to the top of the dam or the dam storage yard at the far end of the moveable section of the dam.

**Boat davits** are single-armed derricks of metal construction. In this context, starting about 1970, the Corps had them mounted on lock walls. Lock staff used them to load and unload materials as well as launch emergency lifeboats when necessary.

**Jib cranes** (see accompanying material, PHOTO 23) are boat davits by another name. However, in this navigation system the term jib crane is reserved for the new units, put in during the 1990s to replace the lighter-weight units, the boat davits, installed in the 1970s.

**Locktender's shelters** are metal framed and flat metal roofed buildings that are found on the extremities of the lock walls. The upper walls are of glass. They serve as a place for the locktenders to stand out of the weather when not actively involved in doing something. Most, if not all of them, were control panel shelters which were moved when replaced.

Continuing upriver from the river wall of the auxiliary locks are the **guard walls** (see accompanying material, PHOTOS 13 & 14). These concrete walls are solid above the normal water level but are open below except for supporting piers. Their porous nature prevents boats and barges from going into the dam but allow water and ice to flow through the wall.
Mooring cells are polygonal piers of metal sheetpiling with concrete interiors out in the river which stand off on the approach to the lock. They assist bargemen in negotiating their approach to the lock entrance.

Deflecting dikes are found at some of the lock and dam historic districts. These are earthen structures anchored to the river bottom which deflect the river's current. Dikes or levees are, when put to different uses, given different names. For example, the districts nominated with this form include deflecting dikes, mooring levees, access road dikes, and protection levees. Yet, all of them are essentially the same thing.

Dams are walls which hold back water. There are two basic types of dams: stationary dams and moveable dams. A stationary dam is simply a solid wall of earth, concrete, or even steel which holds back water. It is probably what most people imagine when they think of a dam. River engineers seldom build stationary dams in slackwater navigation systems that are not part of a large structure which includes at least one moveable dam. The only exceptions in the Upper Mississippi River navigation system are generally built as part of flood control or power generation items. The dam forms a pool in the river above it, but the release of water from behind that dam only occur when the water behind the dam gets so high that it threatens to flood adjacent development. When such dams are used in conjunction with hydroelectric power generation facilities (as is the case at Lock and Dam No. 1 on the Upper Mississippi River), some water is released from behind the dam whenever the power station is in operation. That water flows through the turbines of the power house from above the dam to the lower pool.

Most of the dams in these bank-to-bank lock and dam structures include both moveable and stationary sections. The three exceptions are Lock and Dam Nos. 1, 15, and 20. Lock and Dam No. 1 does not include a moveable section. Neither Lock and Dam Nos. 15 nor 20 include a stationary section. Some of the dams incorporate islands and/or bridge abutments. Some include hydroelectric power generation facilities.

The stationary sections of these dams are earthen dikes. There are three types of these. They are an overflow dam, ogee spillway, and a non-overflow dam. The visible earthen dike has a much wider earth and stone or rock base which was placed on the river bottom. A non-overflow dike often has a gravel, grass, or even in some cases, a wooden above-water surface. An ogee spillway is topped with a concrete surface with an inverted reversing curved surface. In profile the curve is 's'. An overflow dam often is topped with concrete or covered with riprap or large rocks.

Two basic types of moveable dams are used in navigation systems: navigable dams and nonnavigable dams. Both can be used in slackwater navigation systems. Sometimes, slackwater navigation system dams include navigable and nonnavigable sections in the same structure. Navigable dams are exactly what their name suggests—dams which ships can sail over.

The moveable dams in the Upper Mississippi River navigation system are nonnavigable. In a nonnavigable dam, all river traffic must pass through the lock regardless of how high the river's flow.
A moveable dam allows water to flow through the use of a gate. There are three gate types in the Upper Mississippi River navigation system. These are slide gates, Tainter gates, and roller gates.

Slide gates are found only at the Keokuk Dam and represent an earlier form of moveable dam. They have relatively small gate openings. The metal skinned truss supported gates slide up and down in slots on either side of the gate openings. Cranes and winches on railway cars that ran along the top of the dam pulled them up.

The moveable dams built by the Corps as part of the 9-Foot Project, were quite different. They had two general gate types, the Tainter gate and the roller gate.

Tainter gates function by closing the flow of water with a curved surface which moves into the gate opening from above or below. Two arms at either end of the gate end at pivot points. These pivots support the gates against the water and allow them to move against the flow. In the 9-Foot Channel Project there are four main kinds of Tainter gates. These are Types 1a, 1b, 2a, and 2b. Several factors differentiate from one gate to another. The 1a and 1b differ from the 2a and 2b in that they are about 40 feet long rather than 60 feet as are the 2a and 2b. In addition, they have solid skins only on the water side of the gate. The 1a is a nonsubmersible gate, it does not go down far enough into the gate to allow water over its top. The 1b is a submersible gate. It has a plate curving off its top surface back to prevent excessive turbulence when it is lower below the surface of the water. The face of the 1a, 1b, and 2a types of gates also differs from the 2b (see accompanying material, PHOTO 41). This surface is an arc segment of a cylinder. On the 2b (see accompanying material, PHOTO 42) gates the face of the gate is elliptical (as is a plate attached behind to the truss that supported the face). The 2b is a nonsubmersible 60-foot gate with an arched face, but it does have a plate on the nonwater side behind the water face. A Tainter gate is operated either by locomotive hoist cars or by line shafts and motors located below the dam deck.

The other kind of moveable dams on the Upper Mississippi River are those with roller gates (see accompanying material, PHOTO 44). Roller gates are 100-foot-long cylindrical metal gates which have gear teeth at both ends. These fit into gears in the downstream side of slots at the ends of the gate openings. The gates are operated by large geared chains that are pulled up by engines in pierhouses above the dam bridge deck. There are two types of roller gates, submersible and nonsubmersible (see accompanying material, PHOTO 44). Submersible gates have two sills at the bottom of the gate opening to allow the gate to be submerged. Most of the gates have a metal apron to form a seal with the sill at the bottom of the gate opening.

Roller gate dams can also be divided into several groups on the basis of their architectural style (see above Section E). This style is most obvious in the pier houses of the dams. Style 1 pier houses are found in dams built before 1936. Pier houses—there are only 4 of these, with 3 subtypes, 1a (see accompanying material, PHOTO 45 & 46), 1b, and 1c (see accompanying material, PHOTO 43 & 47). The pier houses perch atop the roller gate piers. They have engaged buttress detailing, large multi-pane industrial sash windows, rubbed concrete finishes, and hipped steel truss metal tiled roofs. In the 1a style the windows are slightly smaller than those in the 1c and there is a center area of roof that can be lifted out to gain access.
In dams built after 1936 and before 1948, the pier houses are quite different (see accompanying material, PHOTO 48). They have been termed Art Moderne styling, although in many ways they seem to evoke a more industrial feel. The streamlined nature of these pier houses with their slit windows emphasize their machine-like nature. Although they shelter humans, they clearly are focused on their function as part of the machine that is the dam. These pier houses are incorporated into the overall pier design of the dam structure. They have flat roofs, three pane slit windows, and recessed cornices. There are two variants of these pier houses. In Style 2b, the shape and detailing of the pier house is the same as Style 2a. However, the inner surface of the upper half of the oval roller gate track is filled with a steel diaphragm. This relatively thin piece of metal extends vertically from the downstream end of the pier to the upstream end from immediately below the pier house to a point about half way down the roller gate track. The web detail on the steel diaphragm section of the 2b roller gate piers varies slightly from site to site. All 2b roller gate piers are equipped with a door through the metal diaphragm and ladders on both sides of the pier. A ladder and a set of stairs along the inner wall of the downstream side of the upper portion of the oval roller gate track gives access from pier houses to these lower ladders.

The four dams built before 1936 are relatively more architectural, although simple in design. Clearly, houses remain at the root of their design. The pier houses perch atop the roller gate piers. William McAlpine and Lenvick Ylvisaker designed these dams. They completed the plans for all four dams between July 1931 and June 1934. The designs reflect pre-World War I German engineering architecture. These four dams clearly illustrate a design. At Lock and Dam No. 20, they had the shape refined with piers not as tall as the first three sets of roller gate piers, those at Lock and Dam Nos. 4, 5, and 15. Unlike their predecessors, the roller gate piers at Lock and Dam No. 20 have a clear break between their larger below-water sections and their trimmer above-water portions. Moreover, the piers project downstream immediately below the pier house, creating a slight overhang.

The pier houses, however, still reflected the humanity of their builders. The ultimate homage to the machine came in the first four of the 19 dams built after 1936 but before 1948. All 19 of these dams reflect sophisticated, streamlined, Art Moderne styling. These pier houses are incorporated into the overall pier design of the dam structure. They have flat roofs, three pane slit windows, and recessed cornices. These dams were designed by Edwin Abbott. He completed the drawings for all 19 between August 1934 and September 1936. The designs were cheaper to construct and just a bit easier for the untrained workers the contractors had to use in order to build.

An individual resource which is ancillary to moveable dams and large enough to be recognized are the moveable cranes (see accompanying material, PHOTO 24). These pieces of equipment can move all along the walkway of the operable section of the dam. They provide a variety of services, such as cleaning out debris and placing concrete. These cranes (see accompanying material, PHOTO 39 & 40). They consist of a crane on a moveable carriage.

An esplanade is a standard park/lawn, service area and access road component of a lock and dam complex. Almost all esplanades will be located on the landward side.
of the main navigation lock. It generally contains a variety of support buildings, grassy open areas, parking, trees, and much of it is usually enclosed by a chain link fence.

**Emergency generator buildings** are two standardized buildings that the Rock Island District had added to several lock and dam complexes at or about the same time for this same purpose. Style 1 (see accompanying material, PHOTO 26) emergency generator buildings, constructed at 8 lock and dam complexes, are simple metal buildings with a rectangular plan and a low gabled roof. Generally, they have a standard door and a window as well as a large drive-in door.

The Style 2 emergency generator building (see accompanying material, PHOTO 27) serves the same function as the other building but is quite different in appearance. This is a smaller brick building with an almost square plan. The walls have a base of thin brick below a water table. Above is a standard face brick. A widely overhanging flat roof tops the brick wall. A standard door and an overhead large door are both glazed to eliminate the need for windows.

The most recent approach to **generators** is to have an integral metal casing generator which is free-standing outside on its own platform (see accompanying material, PHOTO 32).

This approach is also used for the **air compressors**. These have an integral metal casing generator which is free-standing outside on its own platform (see accompanying material, PHOTO 32). These supply compressed air for bubblers which can counteract freezing of the water in the lock chamber and parts.

There are two styles of **workshops**. These buildings have been added to the sites to provide safe, accessible workspace for the staff to maintain the equipment of the lock and dam. The main area in both styles is the central work area accessed through a large overhead door in the center of the main facade. The Style 1 workshop (see accompanying material, PHOTO 28) is of long narrow rectangular plan, has one story, and a flat roof. It has small windows and a smaller door flanking the large overhead door. It is quite utilitarian in appearance. The Style 2 workshop (see accompanying material, PHOTO 29) is brick and is also rectangular in plan. It has small windows and a hipped asphalt shingle roof. It is only one story.

**Bridges** comprise individual resources at many lock and dam districts. Many are access bridges to the lock and dam; they represent a wide range of types.

**Visitor centers** are a common resource at lock and dam districts. There are a variety of different kind of visitor centers. They are made of different materials. They have one common element, a second story viewing area. These are protected by open roofs supporting a framework. Some have shelter up to 50 percent of the viewing stand. Where there are no walls the viewing area has rails. A railed stair or stairs provide access to the public from the esplanade. Some have restroom facilities below the viewing stand.
Incoming power transformers provide the usual electric power for the site. These are generally ground units. They are generally green or gray rectangular metal cases. They supply power to the various buildings and locations through underground wires.

Other buildings that are individual resources at the lock and dam historic districts are garages. These buildings are of simple square or rectangular plan, with perhaps a small wing. They are frame and have a gable or shed roof. A necessary feature is an overhead garage door. They have small rectangular windows.

Similar to these are the utility buildings. These buildings are of rectangular plan with low sloping roofs and generally metal walls. They often have large overhead doors. They serve as workshops and material storage.

A response to changing cultural pressures are the smoking shelters (see accompanying material, PHOTO 30). Smoking is not allowed close to or in the buildings at the lock and dam sites. These wooden shelters consist of a framework with no walls supporting a roof.

**Significance**

Within the context of the Upper Mississippi River 9-Foot Navigation Project, examples of this historic district have national significance in transportation and maritime history under National Register Criterion A because they are part of the Upper Mississippi River 9-Foot Navigation Project. Some districts eligible for listing as members of this historic district also have national significance under Criterion A in the area of social history because their specific histories exemplify particularly clearly the role the Upper Mississippi River 9-Foot Channel Project had in the 1933-1940 national relief work effort and the effect that status had on their construction. Some districts eligible for listing as members of this historic district also have national significance under Criterion C in the area of engineering because they include rare, intact examples of a nationally significant, historic, engineering technology because they include resources which are the first application of a of technological breakthroughs in navigation engineering; or because resources within them illustrate particularly well the evolutionary nature of American engineering.

**Registration Requirements**

In order to qualify for listing, examples of this historic district must include, at least, intact examples of one navigation lift lock, one dam, and one other associated resource. The essential physical features that must be present in each district for it to be eligible for listing as a member of the Lock and Dam Historic District property type under this context are 1) that the structural components of the bank-to-bank structure remain visually evident in their mature 9-foot channel navigation system configuration with water flowing between, around, and through them, 2) that the lock(s) continues to have buff-colored concrete walls and employ miter gates, and 3) that, if the dam includes a pier dam as one of its components, that section continues to include only Tainter gates and roller gates no
higher than 30 feet and no wider than 100 feet and that the piers remain buff-colored concrete.

Moreover, the majority of individual resources within an eligible district must have been used for navigation or in support of navigation on the Upper Mississippi River. These resources must also be visually evident.

For a district as a whole to retain integrity and thus be eligible for listing, the majority of the components contributing to the district's historic character must possess integrity of location, design, materials, feeling, and association, and bear essentially the same relationship to each other as they did during that district's Period(s) of Significance. Each eligible district must contain both individually undistinguished features and distinctive features as focal points. The distinctive focal points must include, at least, one lock and one dam.

To contribute to the historic character of a district, a resource must have been present during the district's Period(s) of Significance, relate to the documented significance of the district, and possess historic integrity or independently meet the National Register criteria.

The Upper Mississippi River 9-Foot Navigation Project is still in use by the Corps, thus significant features associated with the operation of the navigation system have, by necessity, been subject to continuing maintenance, upkeep, or replacement as necessary. In 1985, following a Programmatic Memorandum of agreement between the five State Historic Preservation Officers involved, the three Corps Districts managing part of the system, and the Advisory Council on Historic Preservation, the Corps began conducting a series of rehabilitation projects which significantly altered the exterior of or, in the St. Paul District completely eliminated, the historic central control stations.

Name of property type: HYDROELECTRIC FACILITIES AND THEIR ASSOCIATED RESOURCES

Description

Within this context, Hydroelectric Facilities and Their Associated Resources have national significance in maritime history under National Register Criterion A and national significance in engineering under National Register Criterion C.

Registration Requirements

Subtype: Power House

Description

A power house is a building designed to house the electric current generators which are activated by moving water channeled from an impounded pool. No specific
engineering or architectural style is associated with power houses. It contains water channels, turbines, electric generators, transmission machinery, and working space for operating the power generation. It can also contain power plant and lock and dam operation offices, workspace, storage space, and transformers. It can be a relatively large building or a small building.

**Significance**

A power house is a power production facility. They are important as part of the transformation of America into a society and culture dependent on electrical energy for much of its domestic energy needs. The power houses should be evaluated under Criterion A for their importance relative to importance of electric power in the development and shaping of early and mid-century America and under Criterion C as engineering structures.

**Registration Requirements**

In order to qualify for listing, examples of this property type must include enough intact examples of the intact exterior structure to convey the concept of carrying power from the power house to the community. The essential physical features that must be present in each power house for it to be eligible for listing as a member of the Transmission Tower property type under this context are 1) the exterior form essentially intact, 2) some of the turbines, and 3) at least one generator.

**Subtype: Transmission Towers**

**Description**

These metal skeleton truss structures hold the wires that carry the current generated in the power house.

**Significance**

Each transmission tower is significant because it strongly signifies and represents the power created by the power house. The transmission tower should be evaluated under Criterion A for the importance relative to importance of power transmission in the development of early and mid-century America and under Criterion C as engineering structures.

**Registration Requirements**

In order to qualify for listing, examples of this property type must include enough intact examples of towers and associated power lines to convey the concept of carrying power from the powerhouse to the community. The essential physical features that must be present in each set of transmission towers for it to be eligible for listing as a member of the Transmission Tower property type under this context are 1) that at least three towers exist and associated and wires 2) that the wires connect to the powerhouse and 3) that the towers be essentially intact.
Subtype: Fender Walls

Description

Each fender wall (sometimes called fender dam) is a porous wall which extends upriver. This concrete wall is solid above the normal water level but is open below except for supporting piers. Their nature regulates the amount of water entering the forebay which supplies the generating turbines with water. The restriction of the flow also retards the formation of ice while the upper wall deflects ice and debris from the forebay. An opening at the upper end of the wall allows river traffic access to the lock.

Significance

The fender walls is significant because it is an important part of the technology that allowed hydroelectric power to develop on the low head rivers of the Midwest. Fender walls should be evaluated under Criterion A for their importance relative to importance of hydroelectric power generation on the rivers of the American Midwest and under Criterion C as engineering structures.

Registration Requirements

In order to qualify for listing, examples of this property type must include the almost intact fender wall to convey the concept of filtering the water that reaches the power house water turbine intakes. The essential physical features that must be present in each fender wall for it to be eligible for listing as a member of the fender wall property type under this context are 1) that almost all of the wall exists, 2) that the water be present most of the time in the river and forebay 3) that the power house be extant and recognizable.

SECTION F NOTES


2. Ibid; Locks & Dams 11-22 HAER, pp. 82-83; Locks & Dams 3-10 HAER, pp. 37-40; St. Paul Drawings M-L 4 41/1 and M/L 5 41/1; Rock Island Drawings M-L 15 41/1 and M-L 20 41/1; Teichman, pp. 1-2.

3. Gateways to Commerce, p. 83; Locks & Dams 11-22 HAER, pp. 84-85; Locks & Dams 3-10 HAER, 37-40; St. Paul Drawings, M/L 5A 41/1, M/L 6 41/1, M/L 7 41/1, M/L 8 41/1, M/L 9 41/1 and M/L 10 41/1; Rock Island Drawings, M/L 11 41/1, M/L 12 41/1, M/L 13 41/1, M/L 14 41/1, M/L 16 41/1, M/L 17 41/1, M/L 18 41/1, M/L 21 41/1 and M/L 22 41/1; St. Louis Drawings M/L 24 41/1 and 25 41/1; and E. E. Gesler to Chief of Engineers, 27 Nov. 1936, RG77, Entry 111, Box 955, File 3524-Part 3, WNRC.
4. As early as June 20, 1985, Michael C. Quinn of the Advisory Council on Historic Preservation in Washington, D.C., on page 3 of his June 20, 1985, "Comments on Historical-Architectural and Engineering Study Lock and Dam Nos. 11-22, 9-Foot Navigation Project Mississippi River" which were written as a follow up to a June 4, 1985, meeting of staff from the Rock Island and St. Paul Districts of the Corps of Engineers, the State Historic Preservation Officers of Illinois, Iowa, and Missouri, and the Advisory Council on Historic Preservation had identified "buff concrete, miter gated locks, and the dam structure with its combined Tainter and roller gates" as the attributes that define these properties' significance. Copies of his entire statement and a 60-page transcript of the June 4 meeting are contained in Rathbun Associates, "Historical-Architectural and Engineering Study: Lock and Dam Nos. 11-22, 9-Foot Navigation Project, Mississippi River," Vol. 2, Appendix IV: Related Correspondence. The maximum width and length of the dam gates were added in this study after the author had seen the difference modern gates of the same type but different scale made on the Upper Mississippi in the St. Louis District and on the Peoria and La Grange Dams on the Illinois River. The figures cited here represent the largest size in each dimension built as part of the system. The system included gates of the maximum dimension in both directions.
G. Geographical Data

All the resources associated with this Multiple Property Documentation Form are found at lock and dam complexes spanning the Upper Mississippi River between Minneapolis, Minnesota, and Winfield, Missouri. There was a lock and dam complex associated with the historic context described in this Multiple Property Documentation Form spanning the Upper Mississippi River near Alton, Illinois. The Corps demolished it and replaced it with a new lock and dam in 1990. That is why the geographic area of the historic context is 19.3 miles longer than the geographic area in which the historic resources associated with it are located.

Because the Upper Mississippi River forms the border between the states of Minnesota and Wisconsin, Iowa and Wisconsin, Iowa and Illinois, and Missouri and Illinois, portions of districts are found in all five of these states. In each case, the state in which the portion of the district which includes the central control station is located determines the state in which the Corps and the State Historic Preservation Officers (SHPOs) consider that district.

Another way of identifying the location of a lock and dam complex is by its distance in river miles from the mouth of the Ohio River. In these terms the locks and dams associated with this Multiple Property Documentation Form can be found from 847.6 miles upstream from the confluence of the Ohio and Upper Mississippi Rivers to 241.5 miles above the mouth of the Ohio River. The now demolished lock and dam complex was located 212.2 miles above the head of the Lower Mississippi River.

The location of all of the extant bank-to-bank structures in the Upper Mississippi River 9-Foot Navigation Project as it existed in 1948 are listed below, from north to south. The list also includes the structure's number or name, the community in or near which the central control station for the structure is located, the river mile from the confluence of the Ohio and Mississippi River at which the structure is situated, and the date that the earliest still extant part of each structure went into operation.

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>LOCATION</th>
<th>RIVER MILE</th>
<th>PLACED IN OPER.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock and Dam No. 1</td>
<td>Minneapolis, Hennepin Co., MN.</td>
<td>847.6</td>
<td>19171</td>
</tr>
<tr>
<td></td>
<td>[high dam, Twin Cities Lock and Dam, the Ford Dam]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lock and Dam No. 2</td>
<td>Hastings, Dakota Co., MN.</td>
<td>815.2</td>
<td>19302</td>
</tr>
<tr>
<td>Lock and Dam No. 3</td>
<td>Red Wing, Goodhue Co., MN.</td>
<td>808.5</td>
<td>1938</td>
</tr>
<tr>
<td>Lock and Dam No. 4</td>
<td>Alma, Buffalo Co., WI.</td>
<td>752.8</td>
<td>1935</td>
</tr>
<tr>
<td>Lock and Dam No. 5</td>
<td>Minnieska, Winona Co., MN.</td>
<td>737.25</td>
<td>1935</td>
</tr>
<tr>
<td>Lock and Dam No. 5A</td>
<td>Winona, Winona Co., MN.</td>
<td>728.0</td>
<td>1936</td>
</tr>
<tr>
<td>Lock and Dam No. 6</td>
<td>Trempealeau, Trempealeau Co., WI.</td>
<td>713.5</td>
<td>1936</td>
</tr>
<tr>
<td>Lock and Dam No. 7</td>
<td>Dresbach, Winona Co., MN.</td>
<td>701.8</td>
<td>1937</td>
</tr>
<tr>
<td>Lock and Dam No. 8</td>
<td>Genoa, Vernon Co., WI.</td>
<td>679.1</td>
<td>1937</td>
</tr>
<tr>
<td>Lock and Dam No. 9</td>
<td>Lynxville, Crawford Co., WI.</td>
<td>647.4</td>
<td>1938</td>
</tr>
<tr>
<td>Lock and Dam No. 10</td>
<td>Guttenberg, Clayton Co., IA.</td>
<td>615.1</td>
<td>1936</td>
</tr>
<tr>
<td>Lock and Dam No. 11</td>
<td>Dubuque, Dubuque Co., IA.</td>
<td>583.0</td>
<td>1937</td>
</tr>
<tr>
<td>Lock and Dam No. 12</td>
<td>Bellevue, Jackson Co., IA.</td>
<td>556.7</td>
<td>1939</td>
</tr>
<tr>
<td>Lock and Dam No. 13</td>
<td>Fulton, Whiteside Co., IL.</td>
<td>522.5</td>
<td>1939</td>
</tr>
<tr>
<td>Lock and Dam No.</td>
<td>Location</td>
<td>Mileage</td>
<td>Year</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------------------------------</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>14</td>
<td>Pleasant Valley, Scott Co., IA.</td>
<td>493.3</td>
<td>1924</td>
</tr>
<tr>
<td>15</td>
<td>Rock Island, Rock Island Co., IL.</td>
<td>482.9</td>
<td>1934</td>
</tr>
<tr>
<td>16</td>
<td>Muscatine, Muscatine Co., IA.</td>
<td>457.2</td>
<td>1937</td>
</tr>
<tr>
<td>17</td>
<td>New Boston, Mercer Co., IL.</td>
<td>437.1</td>
<td>1939</td>
</tr>
<tr>
<td>18</td>
<td>Oquawka, Henderson Co., IL.</td>
<td>410.5</td>
<td>1937</td>
</tr>
<tr>
<td>19</td>
<td>Keokuk, Lee Co., IA.</td>
<td>364.2</td>
<td>1870</td>
</tr>
<tr>
<td>20</td>
<td>Canton, Lewis Co., MO.</td>
<td>343.2</td>
<td>1935</td>
</tr>
<tr>
<td>21</td>
<td>Quincy, Adams Co., IL.</td>
<td>324.9</td>
<td>1938</td>
</tr>
<tr>
<td>22</td>
<td>Saverton, Ralls Co., MO.</td>
<td>301.2</td>
<td>1938</td>
</tr>
<tr>
<td>24</td>
<td>Clarksville, Pike Co., MO.</td>
<td>283.7</td>
<td>1940</td>
</tr>
<tr>
<td>25</td>
<td>Winfield, Lincoln Co., MO.</td>
<td>241.5</td>
<td>1939</td>
</tr>
</tbody>
</table>

**SECTION G NOTES**

1. The 1930 authorizing act for the 9-foot channel construction project called for the incorporation of two existing bank-to-bank structures into the system: Lock and Dam Nos. 1 and 2.

2. Ibid.

3. This complex incorporates a lift lock and remanents of a canal built as part of the 1907-1930 6-Foot Channel navigation system.

4. The Des Moines Rapids Canal bullnose, an element of the 1866-1878 4-Foot Channel Project, is still part of this complex. The bank-to-bank structure also includes major elements (the dam, power house, old lock and dry dock power plant, old lock, and dry dock) from 1913, as well as a new lock from 1957.
H. Summary of Identification and Evaluation Methods

Surveys Conducted and Data Collected

This Multiple Property Nomination is the culmination of a series of six United States Army Corps of Engineers funded historical and architectural/engineering surveys of the Upper Mississippi River 9-Foot Navigation Project conducted between 1982 and 1998.

Jon Gjerde conducted the first survey, which covered the Upper and Lower St. Anthony's Falls Locks and Dams as well as Lock and Dam Nos. 1-10, in 1982 and 1983 under a contract with the St. Paul District of the Corps of Engineers. Although this survey concentrated on documentary research at state historical societies, major libraries, and the archives at the St. Paul District, it also included site visits. It resulted in a 195 page, plus appendices, report, 13 Historic American Buildings Survey/ Historic American Engineering Record (HABS/HAER) Inventory Cards, and a four-page National Register nomination for "Locks and Dams 3 through 10 on the Upper Mississippi." 

Dr. Gjerde recommended that the National Register form he wrote not be submitted as a nomination until it had been amended to include any of the locks and dams under the stewardship of the Rock Island and St. Louis Districts which were significant as part of the same thematic resource. Although all reviewers found that Dr. Gjerde's survey included sufficient information on the social, political, and economic events leading up to the construction of the structures, as well as detail on the actual construction, neither the Wisconsin nor the Minnesota SHPOs thought the report had sufficient information on the significance and integrity of the structures for them to determine the eligibility of either the group of installations or any of the individual complexes or component buildings, structures, or objects. The Iowa SHPO, however, felt the survey provided enough information for his staff to determine that Lock and Dam No. 10 might be eligible for listing in a nomination prepared after the Upper Mississippi River locks and dams south of Guttenburg, Iowa, had been evaluated for significance.

Rathbun Associates, with Mary Yeater Rathbun acting as the principal investigator, conducted the second survey in 1984 and 1985. It convened Lock and Dam Nos. 11-22 and was funded and supervised by the Rock Island District of the Corps of Engineers. This study included documentary research at major libraries and the Rock Island District's archives and library, state archives, state historical societies, state libraries, the Chicago Historical Society library, and the Newberry library, at each of the 12 installations and at the local libraries and historical societies near each of these complexes. As experienced waterway improvement historians, Rathbun Associates extracted significant information from the approximately 10,000 separate drawings in the Rock Island District's files. They also examined virtually all the approximately 21,000 still photographs of the construction of these facilities stored at the district office and at the individual installations. This study incorporated oral history research that resulted in 15 formal tape recorded interviews with site level personnel. In addition, it entailed intensive level surveys of the 12 installations conducted in June and July 1984. This study resulted
in a 233 data page and 283 figure (including both photographs and copies of original contract drawings), plus appendices, report and 54 HABS/HAER Inventory Cards.

In October 1984, well before the study was completed, its preliminary conclusions, and recommendations were used by the Illinois, Iowa, and Missouri SHPOs and the Rock Island District as the basis for evaluations of the properties to select appropriate preservation treatments. The result was a Memorandum of Agreement concerning remodeling undertakings and protection, preservation and rehabilitation treatments for nine buildings, one at each of nine lock and dam complexes under the Rock Island District's stewardship.2

In June 1985, the draft report served as the platform from which the Illinois, Wisconsin, Iowa, and Missouri SHPOs, the St. Paul and Rock Island Districts of the Corps of Engineers, and the Advisory Council on Historic Preservation determined that the Upper Mississippi River 9-Foot Channel Project Lock and Dam Nos. 3 through 22, 24, and 25 were eligible for listing on the National Register of Historic Places. This determination was reflected in the 1987 Programmatic Agreement for Lock and Dam 3-22 signed by the Minnesota, Wisconsin, Iowa, Illinois, and Missouri SHPOs, the St. Paul and Rock Island Districts, and the Advisory Council that refers to impacts on resources determined eligible for the National Register of Historic Places. However, the Keeper of the National Register of Historic Places never signed a Determination of Eligibility.3

In 1986, the Corps and cultural resource management professionals attached to the U.S. Department of the Interior, National Park Service, determined the Upper Mississippi River 9-Foot Channel Project was eligible for listing on the National Register of Historic Places. On February 25, 1986, the Keeper of the National Register signed a Determination of Eligibility for Lock and Dam Nos. 3-10 on the Upper Mississippi River. To ensure their adequate documentation as important resources on the history of technological development in the United States, the St. Paul District of the Corps of Engineers and the Historic American Engineering Record of the National Park Service's Rocky Mountain Regional Office began a cooperative project in August 1986.4

William Patrick O'Brien, historian, of the Rocky Mountain Regional Office of the National Park Service and Clayton B. Frazer, photographer, of "Frazerdesign" conducted the third survey in 1986 and 1987 as the first phase of this cooperative project. This survey covered Lock and Dam Systems 3-10. Mr. O'Brien's documentary research expanded upon Dr. Gjerde's in terms of both collections examined and subjects explored. Due to the thousands of linear feet of records on the Upper Mississippi River 9-Foot Channel Project in the National Archives repositories in Chicago, Kansas City, and St. Louis, Mr. O'Brien inspected selected holdings at each of these facilities. He based his selections on his own research in the archives of the St. Paul District and at engineering libraries. As an experienced architectural historian, he was able to extract significant, new information from the approximately 10,000 separate drawings and hundreds of historic photographs in both the archival and active 9-Foot Channel Project files of the St. Paul District. Mr. O'Brien broadened the scope of inquiry to include administrative and technological history. He also visited Lock and Dam Nos. 3-10, conducting intensive level surveys of the nine installations and identifying the photographs Mr. Frazer should take. O'Brien
and Frazer produced a HAER Documentation consisting of 173 data pages, 482 exterior photographs, 81 interior photographs, 60 photographic copies of historic photographs, and 258 photographic copies of drawings.

Rathbun Associates, again with Mary Yeater Rathbun as historian and with Peter Rathbun as photographer, conducted the fourth survey in 1987 and 1988 under a contract with the Rocky Mountain Regional Office of the National Park Service. It covered Lock and Dam Systems 11-22. Mrs. Rathbun's documentary research expanded upon that done in 1984-1985. She physically searched through the attics and storage rooms at Lock and Dam Nos. 11-22, looking for documentary material that she had not examined in 1984 or 1985. The massive proportions of the surviving documentation of the Upper Mississippi 9-Foot Navigation Project in National Archives repositories in Chicago, Illinois; Suitland, Maryland; and Washington, D.C. and at the Rock Island District headquarters which pertain to Lock and Dam Nos. 11-22 forced her to use selective inspection methods also. The relevant section of Entry 81 of Record Group 77 at the Chicago depository contains about 700 boxes, that in the relevant sections of Entry 111 and 112 of Record Group 77 at Suitland includes another 73 boxes. Entries 608, 609, and 610 (collectively totalling 5 linear feet) at the National Archives in Washington and Entry 107 (132 linear feet) in Suitland, as well as the holdings in Kansas City and St. Louis, had to be skipped as a result of time and budgetary constraints. In modeling this study on Mr. O'Brien's, Mrs. Rathbun's research focused on the administrative and technological significance of the 12 installations. The technical resource holdings of the Curt F. Wendorf Engineering Education Library at the University of Wisconsin-Madison were particularly useful in this regard as were Rock Island District personnel. This survey also included an intensive level resurvey of each of the 12 installations as well as the large format photography of them. Rathbun Associates produced a HAER Documentation consisting of 424 data pages, 178 exterior photographs, 63 interior photographs, 12 photographic copies of aerial photographs, 31 photographic copies of historic photographs, and 185 photographic copies of drawings.

Patrick W. O'Bannon, historian, of John Milner Associates, Inc. and John P. Herr, photographer, of John Herr Photography conducted the fifth survey in 1988 and 1989 under a contract with the Rocky Mountain Regional Office of the National Park Service. It covered Lock and Dam Systems 24-27, including Lock and Dam No. 26R that was then under construction. Much of this study focused on in-depth documentation of the Lock and Dam No. 26 installation. It was slated for demolition in 1990. Dr. O'Bannon's documentary research drew on the St. Louis District's archives and the National Archives repositories in St. Louis and Kansas City. Much of the National Archives material was unprocessed. Building upon the two previous studies, which turned up information on personnel involved in the project, Dr. O'Bannon was particularly successful in finding periodical literature. He also visited each complex separately from Mr. Herr's visits. Their HAER Documentation included 149 data pages, 58 exterior photographs, two photographic copies of aerial photographs, 24 photographic copies of historic photographs, and 49 photographic copies of drawings related to Lock and Dam Nos. 1-25.

Between 1989 and 1992, Christine Whitacre, historian, of the Rocky Mountain Regional Office edited the three HAER documentations into a single volume, Gateways to Commerce: The U.S. Army Corps of Engineers' 9-Foot Channel Project on the Upper
Mississippi. Published as the second in a series of National Park Service monographs about cultural resources in the 16-state Rocky Mountain Region, the St. Louis District of the Corps of Engineers provided the funding to produce it.

Mary Yeater Rathbun, working as a subcontractor to American Resources Group, Ltd., wrote this form under a 1988 delivery order for the Rock Island District of the Corps of Engineers in support of a feasibility study of navigation improvements which might be undertaken in the years 2000-2050 on the Upper Mississippi River and the Illinois Waterway. She used both documentary research and physical investigation.

Mrs. Rathbun reviewed the products and, where possible, the working records of the five previous research efforts and the synthesis of the three HAER documentations and analyzed the data they contained. She evaluated the value of the data to the tasks at hand. She integrated and synthesized the pertinent data from all five studies as well as the synthesis of the three HAER documentations. Gateways to Commerce could not be simply repeated in this Multiple Property Documentation. The goals of that effort were different than the goals of this project. Moreover, Ms. Whitacre's relative lack of knowledge of the details of waterway engineering required reanalysis of some of her integrations for this project. For example, without extensive experience in waterways engineering history, it was very logical for her to have thought that the discussions of foundation testing and redesigns covered in the three documentations were references to three different things, rather than responses to the foundation difficulties that revealed themselves when Lock and Dam Nos. 4 and 5 were completed in 1934. In addition, in several cases—most notably in relation to the 1930-1940 national relief work effort—the interpretation offered here differs substantially from that offered in the previous synthesis.

Mrs. Rathbun also identified the sources from which the data in the five studies and one synthesis was drawn, the theoretical and methodological biases of those who developed the literature, the failures of observation or description, and the data gaps. She then conducted original documentary research to fill these gaps. The staff at the various installations were also particularly helpful in this regard.

During February 1998, Mrs. Rathbun visited Lock and Dam Nos. 11-22, 24-25, and 27. During these visits she conducted reconnaissance level resurveys of each property, noting all changes since the 1987 or 1988 site visits made in association with its HAER documentation. She photographed each still extant resource at Lock and Dam Nos. 11-22 and 24-25 which had changed since that documentation. Mrs. Rathbun also created lists of all the buildings, structures, and large-scale objects on each property, noting if they would be contributing or non-contributing resources to a historic district. She developed tentative historic district boundaries, based on visual barriers and visual changes in the character of the property.

Upon completion of her documentary research and physical investigation, Mrs. Rathbun synthesized the information to determine salient themes and areas of significance. She then described the impact these themes had on the resources she had examined, in other words she prepared a written narrative of the historic context related to this multiple property submission. Although the historic context had to cover the entire 635.4 miles of the Upper Mississippi River in which extent resources
built between 1931 and 1948 as part of the Upper Mississippi River 9-Foot Channel Project are located, the focus of the project was the 14 lock and dam complexes under the jurisdiction of the Rock Island and St. Louis Districts of the Corps of Engineers.

Mrs. Rathbun also identified two property types associated with that context, cataloged the 34 most common buildings, structures, and objects in the lock and dam historic district property type, subdivided the hydroelectric facilities and their associated resources, divided property type into three subtypes, described the associative and physical characteristics that define the 34 most common elements in the lock and dam historic districts and each of the three subtypes of hydropower facilities and their associated resources, and determined the significance of each property type to the historic context. Mrs. Rathbun developed registration requirements for each property type and, where appropriate, each subtype.

Then, Mrs. Rathbun organized and synthesized the above information into this Multiple Property Documentation Form.

She also described the 14 historic districts being submitted with this form, delineated the boundaries of those 14 districts, categorized the collective 158 contributing and 409 non-contributing resources within those districts, evaluated the significance of each of these districts, and organized and compiled this information into 14 National Register Registration Forms.

**Historic Context Prepared**

In the National Register program, historic contexts "describe the impact of various historic themes" on a specific geographic area during a specific time period. This Multiple Property Documentation Form describes the impact of patterns of transportation, maritime history, engineering, commerce, conservation, military, politics, economics, labor, and social history on the 635.4 miles of the Upper Mississippi River from Lock and Dam No. 1 (also known as the Twin Cities or Ford Lock and Dam or, simply, the High Dam) in the extreme southern portion of Minneapolis, Minnesota through the place adjacent to Alton, Illinois where, until 1990, Lock and Dam No. 26 was located during the period from 1931 to 1948.

The Upper Mississippi River is nearly double this length. From its headwaters in north-central Minnesota, the Upper Mississippi River flows south about 1,215 miles. It ceases to exist at the southern tip of Illinois where it joins with the Ohio River to form the Lower Mississippi River. The Upper Mississippi begins this journey as a stream near Lake Itasca. From there it winds through fields and forests for over 500 miles before becoming a large river when the waters of the Minnesota River join it near the Minneapolis/St. Paul International Airport. Just 34 miles south of there, when the St. Croix River adds its waters to the enlarged stream, the Upper Mississippi begins its role as an interstate boundary. From that point south, the Upper Mississippi River forms all or part of the boundary of five states: Minnesota, Wisconsin, Iowa, Illinois, and Missouri. Just above St. Louis, the Missouri River empties its waters into the Upper Mississippi. Finally, approximately 1.5 miles south of St. Louis at Cairo, Illinois, the Upper Mississippi River meets the Ohio River, which more than doubles its volume. The combined streams form the "mile-wide tide, shining in the sun" made famous by Mark Twain.
This form only deals with half of this full course because all the buildings, structures, and objects that the Corps built to be part of the Upper Mississippi River 9-Foot Navigation Project between 1931 and 1948 are located in this 635.4-mile reach of the river. The geographic area covered by this historic context actually extends 39 miles farther north than the area needed to simply encompass the resources built between 1931 and 1948 because the congressional authorization for the project, which President Herbert Hoover signed into law on July 3, 1930, officially included in the project three existing locks and dams as well as 23 locks and dams to be constructed. Two of these three existing locks and dams, Lock and Dam No. 1 and Lock and Dam No. 2, were upstream from the northernmost lock and dam to be built, that is, north of Lock and Dam No. 3. The third existing lock and dam incorporated in the Upper Mississippi River 9-Foot Navigation Project in 1930, Lock and Dam No. 19, was two thirds of the way down the system: south of 17 and north of six of the locks and dams that the Corps built between 1931 and 1948.9

Interestingly enough, although the geographic area of this context was based exclusively on the location of extent resources related to its twentieth century theme, the area also has eighteenth- and nineteenth-century patterns of historical development which are clearly differentiated from those of the reaches of the river upstream and downstream from it. Patterns of settlement, commerce, transportation, social history, industry, and agriculture were dramatically different along the Upper Mississippi River above and below Alton from 1699 to 1815. In those years, the Upper Mississippi below Alton flowed through an agricultural frontier, which was relatively heavily settled by Europeans, while that above Alton traversed a fur-rich wilderness, which Europeans were just beginning to exploit for its mineral wealth. Collectively farmed fields adjoined seasonally occupied Native American villages scattered along this reach of the river.10

Although there was very little difference in the areas above and below Minneapolis in those years, in the period from 1840 to 1930 these two areas’ historical developments were almost as radically different from each other as those above and below Alton had been in the eighteenth century. A steady sequence of industrial manufacturing cities grew along the Upper Mississippi River between Minneapolis and Alton in the second half the nineteenth century, while the area upstream from Minneapolis remained a sparsely settled, semi-wilderness dominated by extractive industries and marginal agriculture. Still today, the headwaters’ reach of the river is dominated by state and national forests and Native American reservations and adjoins one of the largest wilderness areas left in the United States.

The time period covered by this historic context begins on April 23, 1931, when Merritt-Chapman-Whitney Corporation of Duluth, Minnesota (a subsidiary of Merritt-Whitney-Scott Corporation of New York City), signed the contract to build the first structures specifically designed for this project—the two parallel locks at Locks and Dam No. 15 in Rock Island, Illinois.11 The period of this context begins then because every plan for the Upper Mississippi River 9-Foot Navigation Project, including the one laid out in the authorizing legislation, was significantly altered. In contrast, the first construction contract was binding and Merritt-Chapman-Whitney and its subcontractors began work on the first of the structures covered by it very shortly after it was signed. The signing of this contract is a specific activity which was not changed after the fact. The National Register program encourages
basing the time periods covered by historic contexts on definite, documented events—often the date of the beginning of construction of the oldest resource associated with the context.\textsuperscript{12}

The time period for this context ends in 1948 because 50 years ago is the recommended "closing date for periods of significance where activities begun historically continued to have importance and no more specific date can be defined to end the historic period."\textsuperscript{13} The post-1948 significance of the Upper Mississippi River 9-Foot Navigation Project does not meet Criteria Consideration G.

This does not mean that there are no man-made river improvements that are part of today's Upper Mississippi River 9-Foot Navigation Project in other reaches of the river. In 1990, the Corps demolished Lock and Dam No. 26 (built between 1934 and 1938 as part of the original project) and replaced it with Lock and Dam No. 26R (also known as the Melvin Price Lock and Dam). This new lock and dam, built between 1979 and 1990, is located two miles downstream from the old one. The Upper Mississippi River 9-Foot Navigation Project extends even farther downstream than that today. In 1953 the Corps opened the 8.4-mile Chain of Rocks Canal and the twin locks located further downstream than Lock and Dam No. 26R. In between these two, the Corps completed Dam No. 27, also known as the Chain of Rocks Dam, in 1964.\textsuperscript{14}

Two other locks and dams extend today's Upper Mississippi River Navigation Project 4.9 miles further upstream from Lock and Dam No. 1 to "an area of placid river flats untroubled by flood waters where three miles of wide shoreline on either side of the river make an ideal harbor."\textsuperscript{15} However, neither the Lower St. Anthony's Falls Lock and Dam (built between 1950 and 1956), the Upper St. Anthony's Falls Lock (built between 1959 and 1963) and Dam (built in 1951), nor any of their appurtenant structures were present during the period covered by this historic context.

It also does not mean that some of the National Register Nomination Forms submitted under this Multiple Property Documentation Form will not have Periods of Significance which begin before 1931. Several of the lock and dam complexes have included, since the very first construction on them as components of the Upper Mississippi River 9-Foot Navigation Project, historic resources which pre-date the project. After all, the 9-Foot Channel Project was the culmination, not the beginning, of a 100-year effort to improve the navigability of the Upper Mississippi. Inevitably, some of the places where structures had been built to improve the river in the past were bound to be places where improvements were called for in this project. Likewise, narrow spots in the river are ideal places for bridges as well as for locks and dams. When pre-1931 resources are elements of an Upper Mississippi River 9-Foot Navigation Project lock and dam historic district, they contribute to the historic character of that district as much as they have their own significance as remnants of a previous, historically significant project or as features of another historically significant entity.

For example, the Le Claire Lock, Le Claire Canal Closing Dam, and the non-submerged portions of the Le Claire Canal Lateral Dam are some of the few remnants of the Upper Mississippi River 6-Foot Channel Project (1907-1930) still extant. Because they have been integral parts of the Lock and Dam No. 14 Historic District
since February 12, 1935, when the Rock Island District let a contract to Central Engineering of Davenport, Iowa, to build the first structure specifically designed for the 9-Foot Navigation Project within this district, these 6-foot channel remnants also contribute to the historic significance of the 9-foot channel historic district.16

The Rock Island Arsenal Bridge is an example of a pre-1931 resource that contributes to the historic character of a 1931-1948 Upper Mississippi River 9-Foot Navigation Project Lock and Dam Historic District, but is essentially a feature of another historically significant entity. The Rock Island Arsenal Bridge was already in place when work began on the first 9-Foot Channel Project structures in the Lock and Dam No. 15 Historic District in 1931. Phoenix Bridge Company of Phoenixville, Pennsylvania, acting as general contractor, with Soosmith & Company of New York and George P. Nicolas & Bro. of Chicago as sub-contractors built the bridge in 1895-1896 on the substructure of a preceding bridge. The Corps designers incorporated the bridge in the plans for the Lock and Dam No. 15 installation from the beginning. In fact, some of the most serious opposition to the Corps plans for Lock and Dam No. 15 at the December 22, 1930, pre-construction public hearing came from U.S. Army Ordnance Colonel D. M. King, who expressed official concern that the proximity of the locks and dam to the Rock Island Arsenal Bridge would significantly impact access to the Arsenal, as the swing span would have to be open much of the time. The Corps took this national defense concern seriously. Thus, the bridge affected the final design and subsequent operation of the locks. As an original element of Locks and Dam No. 15, the Rock Island Arsenal Bridge contributes to the historic character of the district. However, the bridge is already listed on the National Register of Historic Places as part of the U.S. Army's Rock Island Arsenal. It is resource 320 in the 1969 Arsenal Island listing. Jeffrey A. Hess and David Arboogast also documented it for the Historic American Engineering Record in February 1985 as one of the 38 most historically significant buildings and structures in the Rock Island Arsenal.17

Therefore, both the Lock and Dam No. 14 Historic District and the Lock and Dam No. 15 Historic District National Register Nomination Forms submitted with this Multiple Property Documentation Form have Periods of Significance which begin before 1931. Lock and Dam No. 14's begins in 1921 and Lock and Dam No. 15's in 1895. Similarly, the Periods of Significance for the historic districts encompassing the three existing locks and dams which were grandfathered into the system in 1930, Lock and Dam Nos. 1, 2, and 19, begin before 1931. The Lock and Dam No. 1 Historic District's Periods of Significance could begin as early as 1894, if any elements from its initial construction remain visible. The Lock and Dam No. 2 Historic District's Periods of Significance begins in 1928, while the Lock and Dam No. 19 Historic District's Periods of Significance begins in 1870 when the Des Moines Rapids Canal Bullnose that remains, tied to the downstream wall of the dry dock, was built.

Organization of the Context

Because this is a geographically based as well as thematically based historic context, the first five sections of the context following the brief introduction narrate the engineering trends, commercial, military, political, social, and maritime history of and transportation patterns on the reach of the river covered in this context prior to the beginning of construction of the 9-Foot Navigation Project. Emphasis is given to this background information because the five very detailed
The next section deals with the pivotal events, political decisions, military actions, and commercial and transportation patterns, navigation aspects of maritime history, and engineering trends that affected the physical form of the Upper Mississippi River 9-Foot Navigation Project and gave it its distinctive character separate from that of other inland waters improved for navigation. In order to avoid repeating readily available information in the HABS collection in the Library of Congress and the National Park Service book, less emphasis has been given to administrative history and technological developments than otherwise would have been the case.

The seventh section traces the alterations to the system when those alterations affected structures in more than one historic district at the same time or in a parallel manner. They are reflections of patterns of maritime history and engineering trends. Alterations specific to one historic district are discussed in the nomination form for that district.

The multiple-use components of these waterway improvements are discussed separately in the eighth section of the context. The National Register program includes in its definition of maritime history "the history of the ... navigation, and use of inland ... waters,"18 (emphasis added) so this section of this context deals with the hydroelectric facilities and their associated resources that were part of the Upper Mississippi River 9-Foot Navigation Project between 1931 and 1948. This section, of course, also contains some discussion of the engineering trends which shaped the physical form of the hydroelectric facilities from earlier periods which were incorporated into the 9-Foot Project from its inception.

The final section of this context addresses the Upper Mississippi River 9-Foot Navigation Project's role in the 1930-1940 national relief work effort and the affect that role had on the construction process. In so doing, it addresses the project's areas of economics, politics, military, and social history significance. This section also deals with the conservation significance of the post-1930 work on this river.

**Property Types Identified**

Upper Mississippi River navigation system Lock and Dam Nos. 11-25 were investigated and evaluated for this nomination. The 567 individual resources examined in this study were grouped into property types based on common form, function, and physical characteristics. The typology was based on these characteristics. Because each lock and dam complex includes many diverse types of buildings, structures, and sites, all of which are part of a singular operation, the broadest encompassing property type for such complexes was utilized.
Registration Requirements Established

The registration requirements were based on direct observation of Upper Mississippi River navigation system Lock and Dam Nos. 11-25. In addition, the preparers utilized historic analysis of the photographic and documentary evidence of the Upper Mississippi River navigation system Lock and Dam Nos. 1-10. The standards of integrity were based on the National Register standards interpreted in light of extensive personal knowledge of the Upper Mississippi River navigation system.

National Registration suggestions in literature condition of existing resources

SECTION H NOTES


As noted in the next paragraph, between the two actions described in this paragraph, in 1986, the Keeper of the National Register signed a Determination of Eligibility (DOE) for nine of these structures. This step may have resolved any lingering uncertainty about whether all the structures were eligible or not. Knowing that the Keeper would probably sign DOEs for other groups as they were sent in, the Corps and the SHPOs may have decided to skip that paperwork and simply agree to act as if the Keeper had signed DOEs on the rest.

4. Locks & Dams 3-10 HAER, p. 4; Paul Lusignan, Historian, Office of the Keeper of the National Register, National Park Service, Washington, D. C., interviewed by Mary Rathbun, March 17, 1999 (hereinafter cited as Lusignan 3/17/99). Notes archived at American Resources Group, Ltd., Carbondale, IL.
5. Gateways to Commerce, pp. 91-96.

6. See above, "Alterations Begin Before System Completed," Section E.


It is noteworthy that the River and Harbors Act of 1930 authorized this specific project in accord with a report which had not yet been completely written, let alone submitted to Congress by the Chief of Engineers. The Special Board of Engineers that developed the initial full-scale 9-foot channel plan began work on May 29, 1929. On Dec. 29, 1929, Major General Lyle Brown, Chief of Engineers, released an advance report on the plan. Although dated Dec. 16, 1929, it was not published until Feb. 15, 1930, as H. Doc. 290. The full report of the Special Board of Engineers studying this project was not delivered to the Chief of Engineers until Dec. 1930, not submitted to Congress until Dec. 1931, and not published until Jan. 1932 as H. Doc. 137.

10. In 1699, settlements, populated by immigrants directly from France, began to develop on the fertile alluvial plain, which stretches nearly 100 miles along the east bank of the Upper Mississippi, downstream from where the Missouri empties its saturation of sediment into the Upper Mississippi. There was no need to improve the Upper Mississippi for these clergers, habitants, miners, and soldiers. The infusion of water from the Missouri increased the flow of the Upper Mississippi enough between the mouth of the Missouri and the mouth of the Ohio so that this reach of the Upper Mississippi was easily navigable most of the year. In 1699, three Seminarian priests founded the Mission of the Holy Family to convert the Native Americans living at the north end of the American Bottom, as this fertile plain has been known since the 1780s. Traders gathered, the priests encouraged agriculture, and the village of Cahokia formed. Similarly, the Jesuit Mission of the Immaculate Conception, which Father Gabriel Marest moved to the southern end of the American Bottom in 1703, became the nucleus of the village of Kaskaskia. The French established Fort de Chartres, 15 miles upstream from Kaskaskia, as a seat of military and civil power in 1720. By 1729, Prairies du Rocher, a farming village, developed not too far south of Fort de Chartres, while a small village (Ste. Anne) developed right outside the fort
and a third, St. Phillip, grew north of the fort. The 1699-1763 population of the American Bottom and Ste. Genevieve, the French village established on the west side of the Upper Mississippi in 1735, probably peaked at 1,500-2,000 French people and 500-600 African-American slaves. These French colonists had very little reason to travel into the reach of the river north of the Missouri because, in 1780, the Mesquawkie effectively closed the Chicago Portage, the link between the Illinois River drainage and the Great Lakes, to the French. At first, the French on the part of the Upper Mississippi south of the Missouri continued to travel to Montreal by going downriver to the Ohio and then upriver (a process that took three times as long as a downriver trip in these pre-steamboat days) to the mouth of the Wabash, fighting the current of the Wabash to the portages to the Maumee River and from there entering Lake Erie at today's Toledo, Ohio. After Antoine Laumet de La Mothe, sieur de Cadillac, founded Detroit in 1701, travelers from the Illinois Country did not need to travel far on Lake Erie, but their goods still had to traverse the full length of Lakes Erie and Ontario to reach the St. Lawrence valley for transhipment to France. The French on the lower part of the Upper Mississippi had no reason to do any of this once Jean Baptiste Le Moyne, sieur de Bienville, founded New Orleans in 1718 as a strategic trading post with direct sea connections to France. The portion of the Upper Mississippi south of the Missouri became an economic dependency of New Orleans and the primary axis of transportation in that portion of the river changed from east-west to north-south. Howard, pp. 36-40.


13. Ibid.

14. Although Dam No. 27 does not relate to the overall engineering significance of the Upper Mississippi River 9-foot navigation system, if Dobney on p. 116 [apparently quoting Alfred J. D'Arezzo, "Chain of rocks Across the Mississippi," The Military Engineer 54 (May-June 19620: 185-187] is correct that this was "the first dam undertaken on a major waterway without use of cofferdams, without dewatering, and without river diversions" and that it involved theoretical engineering innovations to place rocks "so that they would resist the current and remain stationary", then perhaps it meets Consideration G under Criterion C as an individual structure. Patrick O'Bannon, who used Dobney's work extensively in compiling his Locks & Dams 24-27, does not verify any of this significance. The question was not pursued in
this project because the dam was outside the time period of this context and does not relate to the significance of the historic 9-foot navigation system.


I. Major Bibliographical References

Those sources which are entirely specific to a particular property nominated as part of this multiple property submission and, thus, contained on the individual registration form for that property are not repeated here. Only sources which provide information on more than one property are listed here. General reference works are not cited unless they provided specific information on more than one related property or assisted in evaluating and documenting more than one related property.

Drawings

U.S. Army Corps of Engineers, Rock Island District, District Library vault, Rock Island IL. "Drawings: Upper Mississippi River Lock and Dam 9-Foot Channel Project." The original contract drawings are organized into structural groups and assigned an operations folio number relative to that structure.

U.S. Army Corps of Engineers, St. Paul District, District Library, St. Paul, MN. "Drawings: Upper Mississippi River Lock and Dam 9-Foot Channel Project."

U.S. Army Corps of Engineers, St. Louis District, District Library, St. Louis, MO. "Drawings: Upper Mississippi River Lock and Dam 9-Foot Channel Project."

Photographs


Manuscript Collections


National Archives, Civilian Records Center, St. Louis, MO. U.S. Army Corps of Engineers, District Files, Civilian Employment Records. Record Group 146 (unaccessioned).

National Archives, National Personnel Records Center, St. Louis, MO.


United States Department of the Interior
National Park Service

NATIONAL REGISTER OF HISTORIC PLACES
CONTINUATION SHEET

Section I Page 121  Upper Mississippi River 9-Foot Navigation Project, 1931-1940
Name of Multiple Property Listing

U.S. Army Corps of Engineers, St. Louis District Office, St. Louis, MO. St. Louis District Office Records.


Reports


Government Documents

U.S. Congress, House of Representatives. Hearings before the Committee on Rivers and Harbors, House of Representatives, 72nd Congress, 1st session, on the subject of "The Improvement of the Mississippi River between the Mouth of the Missouri River and Minneapolis," Jan. 25, 26, 27, 1932.

—. Mississippi River Between Mouth of Missouri River and Minneapolis, Minnesota (Interim Report), H. Doc. 290, 71st Cong., 2nd sess., 1930.


—. Survey of Mississippi River Between the Mouth of the Missouri River and Minneapolis, H. Doc. 137, 72nd Cong., 1 sess., 1932.

—. Congress, House of Representatives, Committee on Rivers and Harbors. Mississippi River to Minneapolis—Decree of Injunction Restraining the Government from Construction of Lock and Dam at Alma, Wis., H.Doc. 7, 72nd Cong., 1st sess., 1932.


—. Report of the Secretary of War in Answer to a Resolution of the Senate Relative to the Improvement of the Des Moines and Rock River Rapids, E. Doc. 12, 33rd Cong., 2nd sess., 1854.

Books


**Articles**


Theses and Papers


Exterior View of a Style 1a Central Control Station.
Lock and Dam No. 20 Historic District
1/2 mi. n. of Henderson St.
CANTON, Lewis County, MO
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: MO-34-20, HAER, MO, 56-CANT.1- HAER Collection, Prints and Photographs Division, Library of Congress, Washington, D.C.
View: Lockward facade, east and south sides, looking northwest
PHOTO 2. Interior of a Style 1a Central Control Station.
Lock and Dam No. 20 Historic District.
1/2 mi. n. of Henderson St.
CANTON, Lewis County, MO.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
View: Main floor, looking south (note: new central power control panel along east wall, original removed 1984)
PHOTO 3. Interior of a Style 1a Central Control Station.
Lock and Dam No. 20 Historic District.
1/2 mi. n. of Henderson St.
CANTON, Lewis County, MO.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
View: Basement, looking north
PHOTO 4. Exterior View of a Style 1b Central Control Station.  
Lock and Dam No. 11 Historic District.  
11 Lime St.  
DUBUQUE, Dubuque County, IA.  

Photographer:  
Date of Photograph:  
Location of Original Negative:  

Peter A. Rathbun  
September 1987  

Front (landward) facade, north and west sides, looking southeast (note: A frame air-lock addition, built force account by site staff, to shelter the office door on the north end of the building was replaced by a brick structure incorporated into the main building when insulation and face brick were placed over the original concrete exterior finish in 1985. It is not part of the original massing or design.)
PHOTO 5. Interior of a Style 1b Central Control Station.
Lock and Dam No. 11 Historic District.
11 Lime St.
DUBUQUE, Dubuque County, IA.
Photographer:
Date of Photograph:
Location of Original Negative:

View:

Peter A. Rathbun
September 1987
IA-23-25, HAER, IOWA, 31-DUBU,11- HAER
Collection, Prints and Photograph
Division, Library of Congress,
Washington, D.C.
Main floor machinery room, looking north
(note: drop ceiling visually reduces the
vertical space in this room. Its full
height is obvious from the fenestration
shown in PHOTO 4).
PHOTO 6. Exterior View of a Style 2a Central Control Station.
Lock and Dam No. 14 Historic District.
25549 182nd St.
PLEASANT VALLEY, Scott County, IA.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IA-25-7, HAER, IOWA, 82-LECLA.V,1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: Front (lockward) facade, north and east sides, looking southwest

Upper Mississippi River 9-Foot Navigation Project, 1931-1948
Name of Multiple Property Listing
Interior of a Style 2a Central Control Station.
Lock and Dam No. 14 Historic District.
25549 182nd St.
PLEASANT VALLEY, Scott County, IA.

Photographer:

Date of Photograph:

Location of Original Negative:

View:

Peter A. Rathbun
September 1987

Main floor machinery room, looking west
(note: tile drop ceiling visually reduces
the vertical space in this room. It is
actually much taller. Stairway leads
not to a second floor immediately above
the drop ceiling, but to a mezzanine
above the west room [visible through
the doorway just north of the foot of
the stairs] only. This reversible
interior modification is reflected in
the fenestration shown in PHOTO 6. Also
note: original central power control
panel along south wall.)
PHOTO 8. Exterior View of a Style 2b Central Control Station. 
Lock and Dam No. 13 Historic District. 
4999 Lock Rd. 
FULTON, Whiteside County, IL.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #2, frame 6, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: Front (landward) facade, south and east sides, looking northeast
PHOTO 9. Interior of a Style 2b Central Control Station.
Lock and Dam No. 17 Historic District.
173 Lock and Dam Road
NEW BOSTON, Mercer County, IL.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
View: Main floor machinery room, looking north (note: original central power control panel along north wall)
PHOTO 10. Interior of a Style 2b Central Control Station.
Lock and Dam No. 17 Historic District.
173 Lock and Dam Road
NEW BOSTON, Mercer County, IL.
Photographer:
Date of Photograph:
Location of Original Negative:

View:

Peter A. Rathbun
September 1987
IL-28-10, HAER, ILL, 66-NEBO,1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
Main floor machinery room, looking south (note: full vertical dimension of the room and location of mezzanine visible. Compare to PHOTO 7 to see what that room would look like if the drop ceiling were removed.)
PHOTO 11. Exterior View of a Style 3 Central Control Station.
Lock and Dam No. 24 Historic District.
350 First St.
CLARKSVILLE, Pike County, MO.
Photographer: John P. Herr
Date of Photograph: October 1988
Location of Original Negative: MO-36-17, HAER, MO, 82-CLAVI, 2-HAER

View: Lockward facade, north and west sides, looking south (note: office added to west end when fenestration altered and insulation and stucco exterior finish were placed over the original buff brick walls in 1987. The office addition is not part of the original massing or design.)
Lock and Dam No. 25 Historic District.  
10 Sandy Slough Rd.  
WINFIELD, Lincoln County, MO.  
Photographer: John P. Herr  
Date of Photograph: October 1988  
View: Downstream side, looking northwest (note: closure dike immediately upstream from these gates [top visible in this photograph] is not an original feature. When this auxiliary lock was built, the intention was that it [as well as all the other incomplete auxiliary locks in the system] could be eventually completed and used. This is not possible after a closure dike has been installed. The Corps has only installed closure dikes at auxiliary locks 24 and 25.)
PHOTO 13. Guard Wall.
Lock and Dam No. 11 Historic District.
11 Lime St.
DUBUQUE, Dubuque County, IA.
Photographer:
Date of Photograph:
Location of Original Negative:

View:

Peter A. Rathbun
September 1987
IA-23-20, HAER, IOWA, 31-DUBU,11- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
Riverward side, looking northwest
PHOTO 14. Guard Wall.
Lock and Dam No. 13 Historic District.
4999 Lock Road
FULTON, Whiteside County, IL.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IA-26-6, HAER, ILL, 98-FULT.V,1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: From intermediate wall of lock, north and west sides, looking southeast
Lock and Dam No. 13 Historic District. 
4999 Lock Rd. 
FULTON, Whiteside County, IL. 
Photographer: 
Mary Yeater Rathbun 
February 1998 
UMR-NATIONAL REGISTER, roll #1, frame 
33, Environmental Impact Section, 
Planning Division, Rock Island District, 
U.S. Army Corps of Engineers, Rock 
Island, IL. 
From upstream end of land wall of main 
lock, looking northeast.
PHOTO 16. New Lock Gate Operating Machinery.
Lock and Dam No. 16 Historic District.
33109 102nd Ave. W.
MUSCATINE, Muscatine County, IA.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #3 frame 18,
Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: From land wall of main lock, just downstream from downstream side of downstream control stand shelter, looking southwest.
PHOTO 17. New Valve Gate Operating Machinery, Lock and Dam No. 20 Historic District.
1/2 mi. n. of Henderson St.
CANTON, Lewis County, MO.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #4, frame 16, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.

View: From land wall of main lock, just upstream from downstream lock gate operating machinery, looking south
PHOTO 18. Control Stand.
Lock and Dam No. 12 Historic District.
401 N. Riverview St.
BELLEVUE, Jackson County, IA.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #1, frame 12, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL
View: From upstream end of land wall of main lock, looking southeast
Golden Gate Bridge, San Francisco, CA.

Location of Original Negative: Mary Yeater Rathbun
February 1998
UMR-NATIONAL REGISTER, roll #3, frame 2, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.

From land wall of main lock just downstream from operations and visitors center, looking southwest.
PHOTO 21. Haulage Unit Shelter.  
Lock and Dam No. 13 Historic District.  
4999 Lock Rd.  
FULTON, Whiteside County, IL.  
Photographer:  
Date of Photograph:  
Location of Original Negative:  

Mary Yeater Rathbun  
February 1998  
UMR-NATIONAL REGISTER, roll #1, frame 27, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.  
From access road, looking northwest
PHOTO 22. Traveling Mooring Kevel.
Lock and Dam No. 13 Historic District.
4999 Lock Rd.
FULTON, Whiteside County, IL.
Photographer:
Date of Photograph:
Location of Original Negative:
View: Mary Yeater Rathbun
February 1998
UMR-NATIONAL REGISTER, roll #1, frame 31, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
From upstream end of land wall of main lock, looking southeast
PHOTO 23. New Jib Crane.
Lock and Dam No. 21 Historic District.
1 mi. W. of SR 57
QUINCY, Adams County, IL.
Photographer:
Date of Photograph:
Location of Original Negative:

Mary Yeater Rathbun
February 1998
UMR-NATIONAL REGISTER, roll #4, frame 25, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
From access road, looking southwest

View:
PHOTO 24. Moveable Crane on Dam.
Lock and Dam No. 20 Historic District.
1/2 mi. n. of Henderson St.
CANTON, Lewis County, MO.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: MO-34-17, HAER, MO, 56-CANT,1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: From upstream guard wall, looking south
PHOTO 25. Exterior View of a Style 1 Emergency Generator Building.
Lock and Dam No. 17 Historic District.
173 Lock and Dam Road
NEW BOSTON, Mercer County, IL.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #3, frame 20, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: From driveway, north and west sides, looking southeast
Lock and Dam No. 21 Historic District.
1 mi. w. of SR 57
QUINCY, Adams County, IL.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #4, frame 26, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: From driveway, east and south sides, looking west
### PHOTO 27. Exterior View of a Style 2 Emergency Generator Building.

**Lock and Dam No. 24 Historic District.**
350 N. First St.
CLARKSVILLE, Pike County, MO.

**Photographer:** John P. Herr  
**Date of Photograph:** October 1988  
**Location of Original Negative:** MO-36-20, HAER, MO, 82-CLAVID, 2 HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.

View: Front facade, south and east sides, looking northwest.
PHOTO 28. Exterior View of Style 1 Workshop.
Lock and Dam No. 12 Historic District.
401 N. Riverview St.
BELLEVUE, Jackson County, IA.
Photographer:
Date of Photograph:
Location of Original Negative:

View: Peter A. Rathbun
September 1987
IA-24-4, HAER, IOWA, 49-BEL,1, HAER
Collection, Prints and Photograph
Division, Library of Congress,
Washington, D.C.
Front facade, south and east sides,
looking northwest
PHOTO 29. Exterior View of Style 2 Workshop.
Lock and Dam No. 14 Historic District.
25549 182nd St.
PLEASANT VALLEY, Scott County, IA.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IA-25-15, HAER, IOWA, 82-LECLA.V.1- HAER
Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: Landward facade, north and west sides, looking east
PHOTO 30. Smoking Shelter.  
Lock and Dam No. 22 Historic District.  
at end of SSR E  
SAVERTON, Ralls County, MO.  
Photographer:  
Date of Photograph:  
Location of Original Negative:  

View:  

Mary Yeater Rathbun  
February 1998  
UMR—NATIONAL REGISTER, roll #5, frame  
8, Environmental Impact Section, Planning  
Division, Rock Island District, U.S.  
Army Corps of Engineers, Rock Island,  
IL.  
From driveway, looking northeast
Lock and Dam No. 22 Historic District.
at end of SSR E
SAVERTON, Ralls County, MO.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
View: From upstream guide wall extension of lock, looking northeast
PHOTO 32. New Generator and Compressor.
Lock and Dam No. 16 Historic District.
33109 102nd Ave. W.
MUSCATINE, Muscatine County, IA.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #3, frame 11, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.

View: From access road, looking south
PHOTO 33. 1990s Rock Island District Style 1 Control Stand Shelter.
Lock and Dam No. 13 Historic District.
4999 Lock Rd.
FULTON, Whiteside County, IL.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #1, frame 25, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: From access road, looking north
PHOTO 34. 1990s Rock Island District Style 2 Control Stand Shelter. Lock and Dam No. 17 Historic District.
173 Lock and Dam Rd.
NEW BOSTON, Mercer County, IL.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #3, frame 19, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: From access road, looking northwest
PHOTO 36. Original Controls for Operating Dam Gate.
Lock and Dam No. 24 Historic District.
350 N. First St.
CLARKSVILLE, Pike County, MO.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative: UMR-NATIONAL REGISTER, roll #6, frame 6, Environmental Impact Section, Planning Division, Rock Island District, U.S. Army Corps of Engineers, Rock Island, IL.
View: From dam service bridge, looking south
PHOTO 37. New Controls for Operating Dam Gate, Installed 1998.
Lock and Dam No. 24 Historic District.
350 N. First St.
CLARKSVILLE, Pike County, MO.
Photographer: Mary Yeater Rathbun
Date of Photograph: February 1998
Location of Original Negative:

View: From dam service bridge, looking south
PHOTO 38. Control Stand, Back, Open.
Lock and Dam No. 11 Historic District.
11 Lime St.
DUBUQUE, Dubuque County, IA.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IA-23-17, HAER, IOWA, 31-DUBU, 11-HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: Landward side, looking northwest
PHOTO 39. Tainter Gate Bulkheads.
Lock and Dam No. 11 Historic District,
11 Lime St.
DUBUQUE, Dubuque County, IA.
Photographer:
Date of Photograph:
Location of Original Negative:

View:

Peter A. Rathbun
September 1987
IA-23-5, HAER, IOWA, 31-DUBU.11- HAER
Collection, Prints and Photograph
Division, Library of Congress,
Washington, D.C.
East end of moveable dam, looking
northeast
PHOTO 40. Roller Gate Bulkheads.
Lock and Dam No. 11 Historic District.
11 Lime St.
DUBUQUE, Dubuque County, IA.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IA-23-6, HAER, IOWA, 31-DUBU,11- HAER
Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: East end of moveable dam, looking southeast
PHOTO 41. View of a Style 2a Tainter Gate.
Lock and Dam No. 14 Historic District.
25549 182nd St.
PLEASANT VALLEY, Scott County, IA.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IA-25-5, HAER, IOWA, 82-LECLA.V.1-HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: From river wall, looking southeast
PHOTO 42. View of a Style 2b Tainter Gate.
Lock and Dam No. 18 Historic District.
Henderson County, IL.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IL-29-1, HAER, IL, 36-GLAST-1, HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: From toe of dike, looking southeast

Upper Mississippi River 9-Foot Navigation Project, 1931-1948
Name of Multiple Property Listing
PHOTO 43. View of a Style 1b Roller Gate Pier House.  
Lock and Dam No. 20 Historic District.  
1/2 mi. n. of Henderson St.  
CANTON, Lewis County, MO.  
Photographer: Peter A. Rathbun  
Date of Photograph: September 1987  
Location of Original Negative: MO-34-7, HAER, MO, 56-CANT,1- HAER  
Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.  
View: From dam bridge deck, looking west
PHOTO 44. View of a Roller Gate.  
Lock and Dam No. 15 Historic District.  
Arsenal Island, Rock Island, IL.  
Rock Island County, IL.  
Photographer: Peter A. Rathbun  
Date of Photograph: September 1987  
Location of Original Negative: IL-27-8, HAER, IL, 81-ROCIL 1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.  
View: Looking south
PHOTO 45. View of a Roller Gate 1a Pier House.
Lock and Dam No. 15 Historic District.
Arsenal Island, Rock Island, IL.
Rock Island County, IL.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IL-27-10, HAER, IL, 81-ROCIL 1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: Looking north
Upper Mississippi River 9-Foot Navigation Project, 1931-1948
Name of Multiple Property Listing

PHOTO 46. View of a Roller Gate 1a Pier House Interior.
Lock and Dam No. 15 Historic District.
Arsenal Island, Rock Island, IL.
Rock Island County, IL.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: IL-27-11, HAER, IL, 81-ROCIL,1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.

View: Looking west
PHOTO 47. View of Roller Gate 1c Pier House Interior.
Lock and Dam No. 20 Historic District.
1/2 mi. n. of Henderson St.
CANTON, Lewis County, MO.
Photographer: Peter A. Rathbun
Date of Photograph: September 1987
Location of Original Negative: MO-34-9, HAER, MO, 56-CANT,1- HAER
Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
View: From dam bridge deck, looking west
PHOTO 48. View of a 2a Roller Gate.
Lock and Dam No. 18 Historic District.
Henderson County, IL.
Photographer:
Date of Photograph:
Location of Original Negative: 

View:

Peter A. Rathbun
September 1987
IL-29-6, HAER, IL, 36-GLAST ,1- HAER Collection, Prints and Photograph Division, Library of Congress, Washington, D.C.
From dam bridge deck, looking southeast
PHOTO 49. Pier House, Type 2a, Interior.
Lock and Dam No. 11 Historic District.
11 Lime St.
DUBUQUE, Dubuque County, IA.
Photographer:
Peter A. Rathbun
September 1987
Location of Original Negative:
IA-23-11. HAER, IOWA, 31-DUBU,11- HAER
Collection, Prints and Photograph
Division, Library of Congress,
Washington, D.C.
Date of Photograph:
View: View to south